CHINESE-STYLE MEAT PRODUCTS PROCESSING SCIENCE AND TECHNOLOGY

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Chapter 1. Introduction

Pork cooking in China is an ancient art, with a recorded history dating back to approximately 5000 years ago. It is widely accepted that Chinese sausages were made and eaten 2000 years ago, Processed Chinese-style pork based small goods are consumed in all parts of China but with significant differences in consumption volumes from one province to another . The volume of pork consumption per capita is, of course, also very different between these provinces.

Although the main classes of Chinese-style pork based small goods give the impression of similar appearance and texture to other countries varieties of pork based small goods, the ingredient formulation and processing technologies are vastly different. The variety of Chinese-style pork based small goods is large, but like European varieties, the basic technology is similar for many of the products. Similar to development of European small goods, Chinese-style pork based meat products have been developed in different geographical areas producing similar style products, but with different appearance, texture and flavor profile. There are in excess of one hundred different Chinese-style pork based small goods. Examples of Chinese-style pork based small goods include Majestic ham such as Jianghua dry cured ham and Yunnan dry cured ham, Chinese bacon, dried sausage and Zoukei (fermented), meat snacks such as pork jerky (Zougan), pork floss. Additionally, marinade, stewed, spiced meat products and roasted meat products also occupy the most parts of the meat products.

The main Chinese meat processing characteristic is the uses of drying and high salt and sugar contents as a function of preservation. The main meat processing technologies include drying, marinating, roasting, stewing and curing. Besides, the early immigrants of Chinese to other countries especially in Asian countries, nearly recent years, as China has opened the door to permit their citizens immigrate to other countries over the world. Totally, Chinese population are accounted for one fourth of the world population. Despite of the hosts or immigrants they may be interested in the foods with their home country taste. Chinese are very conservative in eating habits, they are very difficult to change to accept other country foods. Although most of Chinese children like to eat hamburger or fried chicken, but they will change when they are grown up. Therefore, in order to provide the formulation for the immigrants from China and the meat industry in the host countries to make the Chinese-style meat products the author has collected many formulas of different meat small goods from

different areas.

This book is divided into two parts. The first part introduce basic science which contains introduction, history of Chinese-style meat products, categories of Chinese-style meat products, meat resources, raw materials and food additives, chemistry and histology of meat tissue, meat quality, and microbiology of meat products. Second part introduce manufacturing of meat products which includes techniques for processing, ham and bacon, sausage, dried meat products, meat balls and lion head, meat jellies, fermented meat, canned meat spread and spicy ground pork and marinated and spiced meat.

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Ming Tsao Chen wrote at Da Yeh University
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Chapter 2. Histories of Chinese-style meat products

The history of Chinese roasting

Luo(1990) in his book "Roasted and Spiced Food in Hong Kong" said：Roasting is an earliest cooking technique found by Chinese, thus it plays a very important role in ancient cooking history.

"The Imperial Century" recorded: "Among 9 markets of Zhou palace, carts carry wine while horses carry broiled food", showing that all kinds of roasted meat were taken as the main foodstuffs in the palace of Shang Dynasty. In the Zhou Dynasty, the broiled and minced meat had become valuable foodstuffs in memorial ceremonies, and several kinds of roasted foods were included in the famous" Eight Treasures".

After Qin and Han Dynasties, the technique of roasting had been much more popular. Miscellaneous Records of the Western Capital recorded that after Han Gaozu Liubang had mounted the throne, he took roasted deer livers and beef livers as snacks for wine daily. The royal eating culture had been so unconventional and special, the rich and the officials tended even to take roasted foods as daily meals.

Although cooking means varied in the Tang Dynasty, roasted foods still played an important role. Taking the "Roasted Banquet" which Wei Chenyuan prepared to feast Tang Zhongzong as example, there were as many as 5 to 6 items in the roasted food column. It was reported in Special Records of Qing Dynasty that when official Duan Chengshi, a gastronomist, went hunting at the countryside one day, he found a native pork thick soup most delicious and named it "Careless Broils". The story reflected that roasted food was a synonym for delicious food.

Up till the Song Dynasty, the food marketing was developed in big cities and roasted foods played the main role in the food outlets. The Dream of Millet recorded that more than 10 kinds of roasted foods were available in the food outlets, namely roasted green shrimps, roasted backbones with honey, roasted river deer meat, roasted eel etc. That might be the most prosperous period for the roasted foods in ancient times.

An important Notes on Foods and Drink by Hu Sihui in the Yuan Dynasty, items like roasted lamb hearts and kidneys etc. were found under "Precious and Extraordinary Recipes" which were specially designed for the emperors. In the Ming and Qing Dynasties, no matter banquets were held in the royal palace or common market, the roasted foods were often taken as appetizers.

Reference:

Y. Z. Luo(1990)：Roasted and Spiced Food in Hong Kong, 1st ed., pp.10, Wanli Publishing Co., HK.

The history and use of nitrate and nitrite in the cured meats

The origin of the use of nitrate in the curing of meat is meat is lost in the history, but it is certain that the preservation of meat with salt preceded the intentional use of nitrate by many centuries.

Binkerd and Kolari(1975) reported the history and use of nitrate and nitrite in the curing of meat. In their review they found the technology of sea-salt production was known by at least 1200BC by the ancient Chinese who early made salt from drilled wells. It appears that meat preservation was first practiced in the saline deserts of Hither Asia and in coastal areas. Desert salts contained nitrates and borax as impurities. However, the reddening effect of nitrates was not mentioned until late Roman times.

Thus, saltpeter or nitre' was gathered in ancient China and India long before the Christian era. Wall saltpeter ($Ca(NO_3)_2$), found as an efflorescence on the walls of caves and stables, was used by the ancient peoples in the curing of meat. This form of nitrate is formed by nitrifying bacteria. It is reasonable to suggest that desert and wall salts, because of their nitrate contaminants, yielded cured meats that were distinctive not only in color but also in flavor. If the cure without nitrate the cured meat does not have cured meat flavor. The preservative effect of salt is due to its power of attracting water from meat tissue, and by thus extracting fluid to harden the tissues. Therefore, the peoples not only recognize the effects of salt and saltpeter used in meat curing on meat color and preservation, but also know to use sugar or sweet pickle in the cure to buffer the convergence of salt.

Reference:

Binkerd, E. F. and Kolari, O. E. 1975. The history and use of nitrate and nitrite in the curing of meat. Fd Cosmet. Toxicol. 13:655-661

History of sausage manufacture in China

Although the origin of sausages in China is very difficult to trace due to the lack of documentary proof, it is often accepted the statement as of probable veracity, that were made and eaten by the ancient Chinese about 2000 years ago. In full accordance with it is the fact that an eminent Chinese scholar estimates that pigs were domesticate in Eastern Asia as early as 2900B. C. Savic et al.(1988) said there are evidences that throughout the continuance of the 300 years long separation of north and south China (317-589 A. D.), sausage were already well known, it is likely that coincidentally with Mahayan Buddism promoted by Liang Wu-Ti (502-550), the consumption of sausages for New Year and other celebrations spread over China. Chinese people enjoy this delicacy especially during festivals and likely various forms of sausages were known.

At any rate we may definitely state that the recorded history of sausage making in China had begun in the period from 5th to 6th century and that this history continued in Unbroken line through the great ages of the Tang (618-907), Sung (960-1279) and Ming dynasties (1368-1644), especially noted for their accumulation of scientific knowledge, productivity of its crafts knowledge, productivity of its crafts and small-scale industry and gastronomy to the present time. Thus, the modern Chinese-style sausages have their roots deeply embedded in the history as many types of different Chinese meat products, including hams, do.

Reference:
Savic, Z., Sheng, Z. K. and Savic, I. 1988. Chinese- style sausages, a special class of meat products. Fleischwirtsch, 68(5):612-616.

Dongpo pork

Dongpo pork is a famous dish in Hangzhou. It is said that there was an anecdote during his second exile to Hangzhou. As the West Lake was full with weeds, Su Dongpo who was the famed poet and statesman of the Song Dynasty. He held office in Hangzhou and was respected and loved by his constituency, thanks to his successful efforts to clear West Lake and to build a dike that bears his name" Suti. In gratitude, people brought Su gilts of pork, since it was rumored that he especially loved this meat. Su developed a special recipe and forever immortalized the dish by writing a poem that also served as a recipe:

Over a slow fire, with a little water, simmer till soft, a very good taste. The same recipe is used today. The pork is braised in a covered clay pot for hours with soy sauce and seasonings. The finished meat is shaded a dark, brownish red and is tender as soft bean curd.

Nina Simonds. 1990. Dongpo pork. China Food., Harper perennial. Pp. 220.

Dongpo pork

Hammered meat ball

Hammered meat balls (Gong wong)

The hammered meat balls originated in the Shing-Chu area many years ago. It was reported that there was a young man who showed filial piety for his mother who preferred eating pork but was difficult to chew it. The young man bought pork and hammered it to pulverize the meat tissue, and made the fragile meatballs for his mother.

Because the taste and texture of the meatballs were palatable to many people, thus, this meat item became a commercial product sold on the market. The process has changed from the original commercial product to the meatballs produced today. There was another history that meatballs were introduced by a man named as "Cheng" who sold noodle soup at the Square of Temple for Cheng-Hunag in Shing-Chu several years ago. He mixed pork with dried green onion, fried dried pork skin and fat which were crushed into an emulsion (meat paste); molded into balls; and boiled in water. At first, the soup of this product became so turbid that the customers would not accept it. Later there was a man from Fu-Chow, Fu-Jiang, who improved this product consequently. The man prepared the balls by mixing crushed pork with sugar, salt and mono-sodium glutamate to make a good product. These meatballs were also called water balls.

Traditionally, the producers placed the pork in a mortar and used a hammer to crush the park prior to making meatballs. Due to the increase in consumption and demand the manufacturing procedure of hand-making was replaced of a crushing machine. Since the meatballs used raw meat obtained immediately from warm carcass after slaughter this required processing soon after slaughter (pre-rigor state). These limitations of the meat ingredient and, manufacturing time influenced the production and curtailed distribution to the neighbors surrounding the processing plant. However, the original process did not lead itself to industrialization. The processing method have to be developed and improved and new procedures were provided for commercial application. Thus, there have been new methods developed such as crushing machines, massaging and paddling machine (a mixer and blender with paddles) and the use of frozen or chilled pork as meat ingredient.

Reference:

M.T. Chen and H. W. Ockerman. 1980. Studies on the improved methods for meatballs processing. Recent Advances in Food Science and Technology. Vol. II, pp. 304.

Lion's head

Lion's head is famous dish in Yangzhou. It is made of ground pork ,sugar, salt,

crushed water chestnut, starch, cooking wine and seasonings and then mixed well to mold into the balls. The meat balls are cooked with cabbage leaves slowly in a covered earthenware pot so that the flavors mingle, resulting in a rich stock. It is a very popularly dish found in restaurants all over China. The large meatballs are thought to look like a lion's head, and the cabbage leaves, which become wilted and slightly browned in the cooking process, suggest a lion's name. (Simonds, 1991)

Peking roasted duck

Roasted duck is very famous Chinese food in the world. It is preferred to the most people both Chinese and foreigners. One of the author's friends-an American who can eat up one whole roasted duck when he visits China. From this story, we can know how delicious the roasted duck is?

It is said that Peking duck dates back to 1,000 years ago. The earliest roasted duck is called Tsu duck (tsu means roasting, 炙). As early as Southern and Northern dynasties around AD 400, tsu duck appeared in book of Shi Zhen Lu. During the Song Dynasty, the roasted duck had become a delicacy in Lin-an(currently Hangzhou), the capital of Song Dynasty. After Song Dynasty was conquered by Yuan Dynasty, the Emperor of the Yuan Dynasty took the roasted duck to Beijing. By the Ming Dynasty, the roasted duck was one of the indispensable dishes on imperial court menus during the Lantern Festival. It is said that roasted duck was Emperor Qian Long and Empress Dowager CiXi's favorite. Therefore, the roasted duck was officially called Beijing Roasted Duck.

In Qin Dynasty (AD1636-1911), there were several stores of roasting ducks found in Beijing. The preparing methods were roasting duck by closed stove, chao-souw roasting duck and roasting duck hang on stove. The most famous restaurant of roasted duck—Quan Ju De roasting duck hang on stove which was called as "hang-roasted duck". Hang-roasted duck method is different from the other methods, in this method the dressed duck hang on iron hook and spread the coating syrup and roasted in stove. The roasting room Quan Ju De uses is built with burnt tiles and bricks, inside wall is round-shape and closed, leaving only a small hole, and place iron poles on the wall both sides for hanging ducks. The fruit trees are used as fuel to roast ducks. So the flavor of products are differ from the products from other methods.

Reference:

Cai Yusi. 2010. Beijing roast duck and Quan Ju De. In Stories befind Chinese dishes. Rediscovering China. Pp. 59.

Lion head

Peiking roasted duck

Nanjing pressed salt duck

With a history of at least three hundred years, Nanjing ducks were called tribute ducks during the Qing Dynasty, since each year local officials would cull the finest specimens from the first batch of ducks preserved to present as a tribute to the imperial household.

For traditional Nanjing pressed duck, birds raised between early winter and mid-spring are used exclusively. They are then salted, pressed, and dried completely. In this form the duck will keep almost indefinitely. The traditional method for preparing the duckling for eating calls for duck first to be the soaked in cold water for four to six hours to remove the salt. The duck is then placed in a pot of cold water with seasonings such as scallion, ginger root, and star anise and simmered for at least 1.5 hours, with the water and seasonings discarded and replenished two or three times during this period. Finally, once cooled, the duck is cut and served cold or at room temperature as an appetizer (Simonds, 1991).

Chapter 3. Pig Production and Meat Industry Development in Taiwan

Pig Industry Development

The pig production in Taiwan is an important enterprise for the farm village. The total value of pig production has overtaken rice to become the largest item of agricultural production since 1986. In 1994, the total production value of hogs amounted to NT$ 75,279,420,000, representing 26.43% of the total agriculture production value. This indicates the importance of pig enterprises.

During the early postwar period, hog farmers in Taiwan raised the native species with leftovers or by-products of crops as a household sideline. With simple pig sites and poor sanitary condition, hogs grew slowly and were lower in productivity. To promote superior hog breeds and productivity, the government began to introduce new hybrids of foreign and native breeds with nourishing feed in 1963. These measures created a new stage in the history of hog farming in Taiwan. And from 1973 to 1979, the government, selected 56,000 households in 102 villages, to rear hogs of a three way hybrid and implemented the composite farming system of crops, fishes, and hogs. Such measures laid to a foundation for the specialization of hog enterprise in Taiwan.

Since 1979, the government had carried out demonstrations of modernization of hog farming, including elevated farrowing pens, piglets nursing pens, and heat lamps for piglet warmth. This led to increased survival rate for piglets and the better production of hogs. In 1979, two core herd farms were set up at two locations: Taiwan Livestock Research Institute and Taiwan Sugar Company (TSC) Animal Industry Research Institute. These two hog-breeding farms set up 126 household herd farms in 1983 to develop excellent hog breeds for supplying hog farmers all over the island with two-way hybrid gilts and three-way hybrid piglets, thereby establishing a supply system of breeding hogs from the nation's core herd farms to hog farmers. Also, to extend the superior breeding hog, the government practiced a display auction of breeding hogs. Currently, the two nation core herd farms hold the display auction of breeding hogs once every month; the Hog-farming Association, R. O. C. conducts the auction of breeding hogs and gilts once every three months. By this auction, the superior breeding hog was introduced directly to hog farmers all over the island to promote hog quality.

As living standard rise, people are conscious of environmental problems. The problems of hog feces have noticed with the increase in the hog farming scale. The government has actively assisted and guided hog farmers in separating organic fertilizer and gas from hog feces. In addition, NT$1.2 billion was appropriated from the fund of Sino-American and agriculture development and approved for low interest

loans to facilitate the disposal of hog feces. The government has granted NT$ 0.8 billion loans up to 1990 and with NT$ 0.4 billion set aside for the next loan cycle.

As a result of multiple efforts, such as improving breeding stock and management skill, hog farming has progressed in efficiency. The current feed period per head is 195 days, feed conversion rate is 3.34, the average dressing percentage is 82.4%, backfat thickness is 1.83cm, and the average lean cut percentage is 56.14%. Also, 265 head of breeding hogs were exported in 1986. The continuous export of breeding hogs in recent years shows the hog m Taiwan is by no means inferior to that in other developed countries.

To strengthen and to make more orderly the concept of market orientation for the marketing of hogs, the government established several marketing channels to aid in regulating production and marketing effectively. Recently Taiwan produced 11 millions hogs. sufficient to supply domestic needs as well as foreign markets. The current consumption of pork per capita is 34.26kg. In recent years, Taiwan exported 3 to 4 millions heads of hogs to Japan every year and earned a great deal of foreign exchange. This greatly contributed to the rural economics. Unfortunately, the pig industry in Taiwan was seriously effected by foot and mouth disease in 1996. The population of hogs decreased to 8 million and exportation of pork to Japan was also stopped. (Source: Dept. of Agriculture and Forestry. Taiwan Provincial Government: A New Look for Agriculture in Taiwan, 1991).

Breeds of Pig

Pig breeds in Taiwan for production are classified into two major groups . One group consists of worldwide famous breeds such as Landrace. Yorkshire, Duroc and Hampshire. The other group consists of native breeds such as Taoyuan and miniature Lanyu. Taiwan Yorkshire, Landrace and Duroc Pigs originated from Europe and the U.S.A., but now have become special lines with their own characteristics. Taiwan Yorkshire shows a strong body structure and good reproductive performance. Taiwan Landrance exhibits higher growth rate with higher lean content, and Duroc has better muscularity and meat quality. In addition, these breeds of Taiwan line are subtropical-heat adapted, showing good appetite and consistent growth rate throughout their entire growth period, and most importantly, are affected little by subtropical heat. The crossbred of Landrace, Yorkshire, and Duroc is the result of the best production system of crossbreeding and is being used for market hog production. Taiwan pork has built its well-deserved reputation of superior quality and is appreciated by local as well as overseas consumers. In Taiwan, a three-way crossing with breeds of Landrace, Yorkshire and Duroc is used for pork production . In general, the Landrance breed serves as the dam line to mate with Yorkshire boars for the production of hybrid LY

gilt, Also, there are some farmers using the Yorkshire breed to serve as the dam line to mate with Landrace boars for the production of YL hybrid gilts. Sometimes, the upgraded lines of LYL, YLL, YLY or LYY are produced when gilts are mated by Duroc boars to produce three-way cross (LYD) pigs. In recent years, the numbers of Yorkshire stocks has decreased, farmers are useing Landrace sows directly mated to Duroc boars to produce LD pigs for marketing. There are 900 million pigs produced in the world. Taiwan's production number is 10 million and represents 2%. But, an average of 380 pigs produced per farm is ranked in the Top 20 pork producing countries. Numbers of breeding stocks in Taiwan in the last decade are list in Table 1.

Table 3.1. Number of Hogs on Farms at the Years End.

Year	Number of Hog Farm	Total	Number of Hogs on Farms, at the Years End		
			Breeding Hog		Piglets
			Male	Female	
1990	47221	8565250	52226	1100457	1295360
1991	39662	10089137	60017	1193914	1457084
1992	33247	9754460	57767	1130274	1401337
1993	29771	9844920	60082	1181590	1417758
1994	27324	10065552	63565	1270667	1440495
1995	26153	10508502	65434	1355529	1521698
1996	25357	10698366	69086	1448767	1600377
1997	20454	7966887	51808	998371	1283020
1998	17072	6538596	40830	799220	956142
1999	16016	7243194	43351	891644	1082890

Source : Agricultural Statistics Yearbook, 1999.

In the survey of pig production in May of 1998, the number of pig farmers were 18,739. There are 9565 farms with a production of less than 99 hogs and this represented 51.0% of the hog farms. There are 7608 farms producing 100 to 1000 hogs. and this represents 40.6% of the hog farms. There are 1450 farms producing 1000 to 5000 hogs, and this represents 7.8% of the hog farms. For a production scale of greater than 5000 hogs, 116 farms were recorded and represented 0.6% of the hog farms. In May of 1998, the number of female breeding stocks was 820,000 head and there were 740,000 sows and 80,000 gilts.

At present, there are two major AI centers in Taiwan for supplying semen to pig farmers around the island. One is located at Chang-hua Animal Propagation Station of Taiwan Live-stock Research Institute (CAPS-TLRI) and the other one is located at the Pig Research Institute at Taiwan (PRIT). AI boars are auctioned from two boar test

stations: Boar Performance Test Station in the North and in the South. Based upon the sale market of semen extenders, the estimated usage of AI in Taiwan is 45% of sows inseminated artificially and most of the large-scale farms practiced AI on a regular basis.

Table 3.2. Dosage of semen supplied by Taiwan Livestock Research Institute.

Year	Number of Boars in Taiwan	Number of sows in Taiwan	Ratio of boar to sow	Semen dosage supplied by the Institute
1984	33800	763500	22.6	45392
1985	35137	728405	20.7	34501
1986	35361	744664	21.1	28897
1987	36893	762047	20.7	27581
1988	39465	830358	21.0	28843
1989	46891	1005979	21.5	25331
1990	52226	1100457	21.1	16184
1991	60017	1193914	19.9	6682
1992	57767	1130274	19.6	2907
1993	60082	1181590	19.7	4871
1994	63565	1270667	20.0	9659
1995	65434	1355529	20.7	11520
1996	69086	1448767	21.0	13014
1997	51808	99837	19.3	3581

Source: Wu Ming-Che, Private communication, 2000

Hog production

There were 540,538 pig farms raising 3,078,546 pigs in 1971. Each farms raised 5.69 pigs on the average. The number of pig farms decreased to 140,452 in 1981, while the total head increased to 4,825,862 hogs which averaged 34.35 pigs per farm. To the end of October in 1994, the number of pig farms had decreased to 27,324, while the total number of hogs has increased to 10,056,552, averaging 386 pigs per farm. The structure of pig production in Taiwan has progressed toward an economic scale with industrial management.

To decrease pig production cost, the government selected and assisted 191 demonstration farms in the Taiwan area. and established 4 technical service groups to decrease production cost. To promote pig raising techniques and management efficiency, the government assisted and guided pig farmers to establish automatic feeding and computer information equipments. To improve production structure and decrease production cost each year and increase pig farmer's profit, the government

assisted and guided pig farmers in purchasing of farm materials and hired veterinarian together with the model of "improving pig raising technique and management efficiency" and "pig cooperative management of farmers group". The changes in the number of pigs on farms at year's end, in the last decade are shown in Table 3.

Table 3.3. Pork Production in Taiwan (From 1990 to 2008)

Year	Supply for Slaughtered		
	Head	Live Weight (m.t.)	Carcass Weight (m.t.)
1990	12121873	1224193	1008729
1991	13525987	1366664	1126132
1992	13310000	1365340	1126406
1993	13225000	1376193	1135361
1994	13860000	1458904	1203596
1995	14180000	1494572	1233022
1996	14310000	1538611	1269354
1997	11400000	1248300	1029848
1998	9800000	1080940	891776
1999	8980000	996780	822344
2000	9,990,000	1,115,883	920,603
2001	10,420,000	1,165,998	961,948
2002	10,060,000	1,125,721	935,354
2003	9,460,000	1,082,224	892,835
2004	9,410,000	1,088,737	898,208
2005	9,499,457	1,104,787	911,449
2006	9,624,662	1,128,010	930,609
2007	9,418,921	1,107,665	913,824
2008	8,727,229	1,044,649	861,836

Source: Agricultural Statistics Yearbook, 2009.

Pork Production

Pork in Taiwan supplies the domestic needs, and also the exports to Japan. Exports of Frozen or chilled pork to Japan have increased each year. from 38,275 tons in 1973 to 234,754 tons in 1994, earning over 1.3 billion US dollars of foreign exchange for Taiwan. Pork has been one of the international competitive items in the agricultural sector.

Related to hog slaughtering hygiene, all the livestock (meat) markets in the Taiwan area, receive a health inspection by veterinarian before each auction, to assure

that all the auction hogs are healthy. Also, anti-mortem and postmortem inspection are performed by veterinarian at the slaughterhouse. To assist the production and marketing, 30,700 MT of Frozen storage were established in meat markets and packing plants under government subsidy.

Table 3.4. Per capita consumption of red meat and poultry.

Year	Pork	Beef	Mutton	Poultry	Others	Total
1984	32.49	1.70	0.38	18.18	0.02	52.77
1989	35.82	2.37	0.76	22.38	0.01	61.34
1994	40.36	2.97	1.23	27.81	0.02	72.39
1995	39.76	3.16	1.04	28.78	0.02	72.76
1996	40.62	2.81	1.10	30.49	0.02	75.04
1997	39.05	3.44	1.30	33.49	0.03	77.31

Source: Food Balance Sheet of Taiwan. 1997.
Council of Agriculture, Executive Yuan,

As one of the chief agriculture activities in Taiwan, the hog industry has a solid relation to the stability and prosperity of the rural economy. To stabilize hog production and to supply sufficient meat for the public, the government has advocated, establishing a foundation which was initiated by the Ministry of Economy, (former) Joint Commission on Rural Reconstruction. Taiwan Provincial Government, Taipei Municipal Government. Taiwan Provincial Association of Farmers, Taiwan Sugar Corp., and export meat processing factories. On Nov. 16th , 1972, the "Taiwan Meat Development Foundation" (TMDF) was established with a fund of NT $ 1,000,000 (one million NT dollars), under the incorporation regulations of the Civil Code.

Since establishment the Foundation has positively engaged in guiding export of frozen (chilling) pork to Japan. This helped to adjust the supply and demand for pigs in Taiwan. Through more than ten years of effort, the amount of pork exported to Japan increased each year, and Taiwan has taken first or second place in the recent five years as the exporter of frozen (chilled) pork.

Whenever there was an over production of pigs, the Foundation, in line with the government's policy, encouraged purchasers to buy more and conducted sales promotion programs to alleviate the pressure. Once in 1988 the pork exported to Japan was found to have residue of sulfa drugs and immediate actions were taken by the Foundation to make the refused pork into powder for feeds, and to subsidize freight cost etc, so as to minimize loss suffered by exporters. In such ways the Foundation has been able to maintain a smooth channel of pig marketing, to stabilize

pig supply and to keep the pig industry's development normal.

The promotion of carcass grading has benefited to the pig breeding program, upgrading of pork quality and contributed to a better marketing system. Between 1980 and 1990, there were more than 14,740,000 pig carcass graded and this has greatly helped the stabilize the pork export market.

A "Handbook on Pig Carcass Grading System in Taiwan" was published on 1988 to introduce carcass grading. Grading is based on carcass weight, back fat thickness. lean meat percentage and appearance judged by firmness and quality of the meat.

Based on the carcass grading technique for the improvement of hog breeding, the Foundation has often sponsored in-service training on carcass grading and cutting tests. In December 1988. two sets of Danish FOM lean meat rating machines were introduced to be used in the carcass grading process. If these machines could be integrated into our grading system, all the carcass grading practice would be done with grading machine for a more scientific operation and better grading results.

To meet with demands of the meat processors, the Foundation conducted training classes on: "Slaughter sanitation and quality control of livestock and poultry", "Testing of serum and urine by the ELISA method", "Seminar for meat market managers", etc. Educational material for the improvement of technology and quality control was published such as：hand books on "Carcass cuts specification", "Quality control of meat", "Management of meat shops", and also the Foundation produced video tapes and slides on the meat quality process.

In order to introduce local consumers to better understanding of good quality of meat and meat hygiene, this Foundation sponsored tasting fairs on frozen (chilling) pork, poultry meat and processed meat, published educational material on "To know meat sanitation", "How to buy meat and its preservation and cooking" for free distribution. They also produced TV advertisement periodically on "frozen (chilling) pork's for better sanitation", and the "establishment of frozen (chilling) pork and poultry meat market system".

As a way of expanding the pork products promotion, the Foundation began in 1983 publishing "Meat Today", a bi-annual magazine, which provides the latest information on high quality meat products. "Meat Today" is issued free of charge. The Foundation aims to upgrade the standard of pork processors and to boost the development of the domestic processed pork industry.

Table 3.5. Countries ranked according to pork consumption per person per year.

Country	Uptake/person/year	1995 Production (x 1000ton	1995 Imports (x 1000ton
Denmark	66.7	1610	10
Spain	54.0	2120	66
Belgium-Lux'g	52.9	986	51
Austria	51.3	407	1
Germany	48.6	2960	1100
Netherlands	46.6	1755	50
Taiwan	39.9	1150	-
France	38.9	2300	370
Singapore	38.8	88	30
Switzerland	38.8	260	9
Ireland	38.3	224	18
Poland	36.8	1430	20
Italy	35.9	1320	830
Sweden	35.8	311	16
Hungry	35.2	395	8
Hong Kong	34.6	8	202
Canada	33.4	1280	25
USA	32.3	8350	352
Portugal	31.2	306	30
China	26.0	32000	-
UK	23.4	1015	462
Greece	22.6	147	75
Australia	18.8	351	2
Korea	18.7	830	30
Ukraine	17.4	900	-
Bulgaria	17.1	146	-
Japan	16.4	1400	664
Russia	15.7	2100	250
Romania	14.6	390	1
Mexico	10.8	940	80
Philippines	10.5	745	10
Brazil	7.9	1360	2
Kazkhstan	7.2	170	-

Source: Pig International 25(6): 29, 1995.

A list of Taiwan's pork desirability would include:

Why Taiwan's Pork Tastes so Good

1. Almost 90% of Taiwan's pork is produced from the three-way crossbreds LYD and two-way crossbreds, LD. That is, all these pigs have 50% Duroc blood. Usually the intramuscular fat of lean meat produced by the Duroc breed is much higher than the other breeds. The meat that has higher intramuscular fat tastes juicer.
2. The pigs are usually sent to market at a weight of 100-110 kg. The pork from this weight of pigs usually has higher intramuscular fat and meat flavor and is much better than the pork from light weight hogs.
3. Almost all of the pork from the male pigs is from castrated pigs. They have no boar taint.
4. Clean and open pig house produces low or no skatol in pork; consequently the meat has no undesirable odor.
5. Pigs production in Taiwan are very lean. The result is that the meat from the flank has less fat in it. The meat has good taste but less fat.
6. Pigs farms have eliminated the gene of porcine stress syndrome (PSS) from our herd so that our pigs are less likely to produce the low quality pale soft exudative (PSE) meat. PSE pork has low water binding capacity; the meat tastes tough and dry.
7. Local pork, warm or chilled, is always fresh.

Reference:

Council of Agriculture, Executive Yuan, R.O.C. (1999): Agricultural Statistics Yearbook.

Taiwan Provincial Government Department of Agriculture and Forestry (1991): A New Look for Agriculture in Taiwan.

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Wu, M. C. (2000): Pig Production in Taiwan, Private communication.

The development of meat industry in Taiwan---present status and future

Over the years, the developed industries of pig, chicken and duck in Taiwan have provided sufficiently raw materials required by the domestic meat industry. Meat industry is an extend industry of animal production industry. Meat industry needs animals and poultry as raw materials. On the other hand, animal industry also depends

on the development of meat industry to expand its market, so the two industries are complementary each other and closely related.

Meat industry can be divided into the primary processing industry and the secondary processing industry. The primary processing industry is the industry to use the products obtained from animals and poultry after slaughtering and cutting operations to produce all kinds of fresh meat (including hot boned meat, frozen meat and chilled meat). Therefore, the primary industry is totally dependent on the local animal production. Fresh meat is main raw materials used for curing, reforming, drying and cooking to manufacture a variety of meat products including semi-finished and cooked products. The sources of fresh raw materials, whether are obtained domestically or imported , which depend upon their quality and price.

For decades, the meat industry in Taiwan always stay at the stage the traditional stage of selling hog and hot deboned meat. exporting frozen meat and small-scale meat product processing. However, in recent years, the meat industry has been changed with economic growth and resulting in living standard and consuming knowledge increase, the consumers pay much more attention to require the food hygiene and safety. Therefore, meat industry has been developed gradually towards the direction of modernization to meet the requirement of the market.

Status and the facing problems

1. Pork is main source of meats consumed in Taiwan

Pork has always been the main meat. The past two years, the consumption of pork in Taiwan, is about 35kg per person per year on average, it occupies 60% of 58kg total meat consumption.

According to the Pork Consumption Research Report reported by the Institute of Agricultural Economics in 1978 and 1986, it indicated that pork consumption in Taiwan mainly was raw meat which occupied about 85% . The raw meat is obtained from the front and back leg, sparerib, belly popularly.

In terms of grades, the consumption of fresh pork is high grade up to 65%, the intermediate grade is accounted as 24% and the low grade, the least is accounted as 14%.

The consumption of processed meat, in 1978 and 1986, were 2.2kg and 5.7kg, which occupied 8% and 14%.of pork consumption, respectively. It is simply said, from the above information can be seen that 1.8 kg the consumption of Chinese-style meat products was at 1.8 kg per person in the past 10 years, of which the sausages and fried pork floss are the highest up to 75%. The consumption of western-style products also increased 1 kg, including ham and hot dog.

2. The slaughter sanitary inspection needs to be implemented.

According to agriculture annual report, in 1987 the slaughtered pigs about 11,000,000 heads, totally about 940,000 metric tones of carcass weight. In 1966 the first mechanical (electrical) slaughterhouse was found in Kaohsiung city. Taiwan. Promoting electrical slaughter and sanitary inspection for animal slaughter have been more than 20 years since that time. There were 43 electrical slaughterhouses established for domestic market and export until 1988. The investment was estimated worth more than 5 billion. Annual slaughtered hogs had 20,000,000 heads. The capacity of slaughtered hogs in 6 hours daily was much more than the hog production annually.

There were 17 electrical (mechanical) slaughterhouses for supplying domestic market, includes 17 public slaughterhouses and NLD slaughterhouse (As known as new slaughterhouse in northern part of Taiwan, which was sold to Yasheng Meat Industrial Company).

The sanitary inspection of livestock slaughter including before and after slaughtering to ensure meat's hygiene and safety , and to block the transmission of communicable diseases common to humans and animals also, tracking source of the disease to prevent animal diseases.

It was found from the statistics of livestock slaughter sanitary inspection that the sanitary inspected number of pigs slaughtered from 18 electrical slaughterhouse for domestic market by veterinarian in 1987 totally was about 216,000 heads, of which 1902 heads were unfit for human consumption (occupies 0.08%), 16,000 heads were partially discarded (occupies 7.4%).

Additionally, there were about 2/3 of pigs, more than 5,000,000 heads slaughtered artificially at traditional slaughterhouse for domestic market. There were 77 traditional slaughterhouses were approved by the local government to carry on the animal slaughtering operation. However, their slaughter sanitary inspection needs to be strengthened.

Another tough problem was that a illegal slaughtering without permission from the meat business, the butchers try to avoid paying income tax and sanitary inspection. Although the tax paid for slaughtering had been cancelled on 26. April.1987, the illegal slaughtering still occurred and prevailed. Thus, the safety and sanitation of meat consumption could not be protected.

3. The consumption pattern of meats

Since the traditional consumption custom of people in Taiwan, the warm carcass pork was still the main consumption pattern. Domestic market, under the marketing system of hog and pork, that still kept the auction of live pigs, the shipping of pig carcasses, meat retailing and wholesale, all the processes were carried out at room

temperature, resulting in rapid multiplication of bacteria and the freshness of pork was poor also.

According to a study of pork consumption habits (Department of Agricultural Economics, National Taiwan University in l984), all meat consumption 89% was from the meat stalls in traditional market, 11% was from supermarket or meat store, the above information showed that the traditional meat stalls were no longer exclusively in meat consumption market. The supermarket and a variety of chain stores, followed later, that selling chilled meat or frozen meat, had occupied a majority place in the market.

Also, according to estimates in 1985, the sale of small packed frozen meat had reached 2,000 tons on the domestic market. Particularly, in 1984-1985 many supermarkets in Taipei, purchased chilled and frozen meat from exporting meat packing plants to process : cutting, dicing and sold convenient, high quality and sanitary meat products that met the modern cold chain.

4. Qualification and problems of meat products

During that period, there were almost 10 modem factories to produce fresh pork for supplying the domestic market., although the quality of their products was fairly good, but the quantity was not enough to supply the demands. They could not compete to the products produced by the family-style small-scale processing plants that poor equipment, lower production and poor sanitation.

The number and meat product annual production of the domestic factories were very difficult to know. It was understood that there were about 100 registered meat processing factories in Taiwan, mostly in the central and southern parts of the island, it's products can be divided into two categories namely Chinese-style and Western-style products.

At that time, the varieties of western-style products increased in Taiwan, it's mostly sold in cold storage including cooked ham, western-style sausage (hot dog, frankfurt, wiener sausage, and salami etc.), bacon and hamburger etc.

Popular processed meats on the market of Chinese-style products were sausage, fried pork flosses, pork jerky, dried meat dices, canned meat paste, canned braised pork. In recent years, Hsinchu meatball has a special mouth feeling, easy to preserve and prepare. The consumption is caught up with other products. It is conservatively estimated that the production is above 2,000 tons at least per year.

The traditional Chinese-style meat products need to use higher concentration of salt or sugar to obtain the long-term preservation at room temperature. However, these products have negative effect on the health of consumers, so the market is gradually replaced by the healthy products with low salt, low calorie, and low cholesterol.

5. Exportation of frozen pork to Japan

In l987, 3,260,000 heads were slaughtered for exporting, there were 134,000 tons frozen pork exported to Japan, occupying the imported pork 48% of 280,000 tons of Japan, an unprecedented expansion creating a 20 years record, captured the market share over Canada and the United States. Since 1987 the factory of frozen pork had increased up to 26 companies exporting frozen pork to Japan.

However, the fast growth was facing the competition to other importing countries that wanted to seize and replace of Taiwan on the market, and Japan might impose on non-tariff barrier to Taiwan. For example, April, 1989, the frozen pork exported to Japan, the incidence of sulfonamide residue in pork and Japanese government declared that from April, 1989 strictly enforced to inspect antibiotics, sulfa, and pesticide residues in the imported meat.

So far, exporting pork was still a primary processing : frozen and chilled meat. over 20 years, the type of the products was only stopped from half-carcasses to parts of deboned meat to surface fat-free meat.

This type of processed products was still had profits under abundant labor and low wages in the past years, but today, economic prosperity, lack of labor and wages gradually rising. Thus, the meat industry faced challenges.

At that time, the challenges facing meat factory were hard to find operator and then difficult to maintain a certain level of work quality. The issues above mentioned and unfavorable factor appreciated NT dollar weaken the competition of meat exported to Japan. Unfortunately, Taiwan occurred Foot & Mouth Disease in 1997 hit meat industry and pig production. Since that time, the heads of pig production declined rapidly and the exportation of frozen pork was shortly stopped. As a result, the pig production was decreased in 8,000,000 heads, most of meat companies were bankrupted, and related businesses were also damaged, such as feed manufacturing factories, transportation etc. Until now, it is still sagging.

Ⅱ. Future prospects

At present, admittedly, exporting frozen pork and poultry meat can bring large sum of foreign exchange, however our country's meat industry in terms of future prospects in the market, the domestic market should be the dominate. In order to maintain and improve people's health, The primary goal is to improve the quality and quantity of domestic meat consumption. For consumers, "quality meat" only means no more the general mentioned cleaning, they also required the meat that is from healthy livestock and poultry and does not contain residual drug that is harmful to human health, all totally depend on the consensus from domestic livestock production enterprise and for the sanitary inspection system of slaughter livestock government

can full implement it. In order to safeguard consumers' health, primary meat processing industry for livestock slaughter in a qualified slaughter house and be supervised by a professional trained inspector are required. Followed the slaughtering the carcasses and fresh meat with safety and health quality, distribution and sale in cold chain system are also required. It is so-called modernization of meat supply maintaining meat in good quality of sanitary and freshness. Although, at present, the meat consumption pattern, hot deboned meat is dominate, however, small package, convenient type (stripped, sliced and other processes) of chilled and frozen raw meat consumption will increase with the change of social pattern, busy life increasing and modern supermarkets generally are available.

On the other hand, the secondary meat processing, patterns of processed meat products should be moving towards the era of diversified, convenient, quick and easy high-level processing products. On meat marketing, the manufacturers who have a quality mark, a trusted brand (ensuring safety, sanitary and nutrition) will be the dominants. In other words, "the quality "of fresh meat product will be the most consideration that if consumers accept it. To carry out a logo, with credibility, system that will be a bridge between the manufacturers and consumers, leading the consumers easy to identify the quality meat, as a guideline for purchasing products, The promotional education for consumption, a complete monitoring system for manufactory and for product sampling test, all of these depend on the government and relevant units to implement it.

According to a survey, the consumption and national income, indicated that generally, meat consumption is almost representative of the national income.

The national income and meat consumption in 1961 and 1974 were 150 dollars, 13 kg, and 900 dollars, 20kg, respectively which were under the standard levels of the world shown in the survey. Nearly 2 years, the national income was more than 3,000 dollars and meat consumption was 38 kg (35kg of pork, 3 kg of beef or lamb) , which were still under the standard level that the national income was more than 3,000 dollars and meat consumption is 76 kg in 1974. From the above, knowing the meat consumption of Chinese was far below the standard level of world, in low proportion, especially, the processed meat products (China 14%, Japan 30%, the United States 50%), therefore, there should be a great space for meat industry to develop. In conclusion, if the meat processing industry can improve and overcome the facing problems that sanitary management of slaughtering and processing, the ensured quality of meat and processed products, modern marketing system, to meet consumers' demand for product diversification, for convenient food, the meat industry development will be inevitable towards "prosperity" and become the shining star of industries.

Exploration of the Original of Frozen Pork Export of Taiwan

Taiwanese private meat industry produced frozen pork for exporting began in 1968. At that time, Mr. Feng-Shu Chang was mayor of Pingtung County, who went to Japan along with Dr. Tom Yu (China Joint Commission on Rural Reconstruction-the predecessor of the Council of Agriculture) and Mr. Zheng-Jie Su (Chief of Animal Husbandry division, Bureau of Agriculture, Taiwan Provincial Government) to seek the business opportunity for exporting frozen pork to Japan. Finally, they decided to choice Takasaki Meat Company as cooperative partner.

The rural society of Taiwan, most of farmers raised pigs as their subsidiary jobs for their family for a long time since early1960s. Whenever, every new year, festivals, thanksgiving blessing, happy wedding, students registration and so on, the farmers just sale or slaughter one head of home-raising pig, they could be afford to pay all expenses. Thus, the pig industry became an important measure of savings of farmers. So, there was an old saying " the rich can not give up reading, and the poor can not give up feeding pigs."

In order to improve the farmers' incomes and prosper rural economy in 1961s, the government promoted vigorously " the pig comprehensive plan " to help the pig farmers to improve pig housing, feeds and feeding and technique. The animal husbandry experts and scholars also made an effort to educate the farmers " how to improve pig breeding, disease prevention and feed formulation " and acquired an outstanding contribution. To the comprehensive plan of pigs, Dr. Robert Lee(head of Animal Husbandry Division), Dr. Tom Yu and Ming-Cheng Zhuang (experts of animal husbandry) devoted themselves to development, implementation, promotion of Taiwan's pig industry from tradition towards modern.

Pingtung was an area of raising big population of pigs, because of oversupply, falling prices, pig farmers often lost money. Thus, the mayor Mr. Chang was eager to solve these problems, he proposed a plan to establish a modern meat processing plant to help the farmers to take precaution to regulate production and marketing purposes. After mayor Chang and other administrators returned to Taiwan he encouraged farmers' association of county and township of Pingtung to invest together to build a meat processing plant to self-slaughter, cut, process and freeze to produce frozen pork for exporting to Japan. Later , the directors of farmers' associations all worried about to invest quite a lot of capital about this plan and profit returned, consequently it was difficult to get in agreement and the plan was stranded.

In order to solve the difficult circumstance of oversupply problems completely to protect pig farmers' profits, mayor Chang try to ensure the relatives and friends such as Mr. Tien-Miau Chen (the former ex-chair of council of Kaohsiung city), Loo

Chan, Rei-Cheong Lee, Kuen-Rong Liu (the famous MD in Pingtung county) and so on to invest and surmounted all difficulties to build up the first modern meat packing plant in Taiwan. Meanwhile, public offering to the farmers of Pingtung county to invest NT $ 1000 per share together with Japanese investment 37 million yuan joint venture to establish Taiwan-Japan Agricultural Livestock Industry Co., Ltd. (Taiwan Farm Industry Co., Ltd) in Pingtung city in1967.

The following year, the construction and facilities of plant were completed and started to operate. Because of the first such system factory was found in Taiwan, neither the related laws and regulation can be followed, nor practical experience can be referred. Mayor Chang based on the law" the government official was prohibited to operate commercial business ", its board of directors elected his wife Mrs. Chang Chen Chiu-Chan as president, Takasaki Ham Company appointed Mr. Takahashi mission first as general manager, and employed the former director of Pingtung County Government Secretary, the Provincial Civil Affairs Department as a committee member Mr. Yang Zeng-Chun as deputy general manager. From that time, they began to step on a hard and bleak operation road.

Frozen pork exported to Japan, had its specifications, procurement covered six main parts including fore leg, shoulder, loin, tenderloin, belly and ham(hind leg), which must be followed the requirement by Japanese customers. The primal cuts for exporting must be skinned, de-boned, cut, trimmed and packaged.... based on the specifications. At that time, slaughtered pigs sold in Taiwan, every head would need to pay butcher tax NT $ 500 in advance that was not assessed to the cost and harassed the Japanese investors. Thus, to solve this problem the company was imperative to apply for export tax rebates. At that time, Taiwan government did not have the standard of tax rebates for pork export. So, under supervision of Commission of Rural Reconstruction, in particular, TF company slaughtered about 2000 heads of pigs for cutting test of 6 parts of the primal cuts for exporting and took a detail records. It was found the cuttability of 6 parts of the primal cuts was 42.5% by weight. The processors of frozen meat for exporting could use these data to bargain with Ministry of Finance about tax rebate ratio for frozen pork export. Then, the butcher tax issue was solved. However, another issue followed up since the butcher tax had to pay before slaughter, the processors had to encounter the backlog of large sums of money, increased operational difficulties. Thus, the processors asked theCommodities Bureau of Taiwan Provincial Government to help to establish a butcher tax accounting system to allow the processors to pay soon after exporting.

This policy was very helpful to the future operation for the new processors exporting business.

After TF company founded for three years, its business was turnaround, so many

investors (approximate 28 plants) began to establish the processing plants for exporting frozen pork to Japan. Therefore, this trend of exporting frozen pork promoted the related industries such as the pig, feed, vegetable oil refining, animal drugs, freight transportation, banking, customs and so on were all booming. At that time the annual slaughtered pigs reached more than 6 million heads and produced more than 0.2 million metric tons of frozen pork for export, and earned 1.5 billion USD for the country.

In 1974, the Ministry of Interior required all frozen pork export production plants had to organize " Industrial Association " based on the laws. Thus,Taiwan Frozen Meat Industry Association (TFMIA) was established under the guidance of Rural Reconstruction and required the members of the association to donate NT $ 80 per head of pig. Meanwhile, Taiwan Meat Development Foundation (TMDF, now merged into the National Animal Industry Foundation) was established. For decades TMDF made a great contribution to Taiwan's meat industry including meat processing, transportation, storage, inspection, carcass evaluation and so on. TFMIA would also make an effort to open up exporting market for frozen pork.

More than hundred of Japanese companies (customers and related industries) were invited to Taiwan to visit the meat packing plants for exchange experiences and freindship every year. Our processors also organized delegation group to visit Japan frequently. These could be seen feeling of harmony and consequent market share 50% or higher in Japan.

Unfortuately, in 1997, Foot and Mouth Disease was prevailing in pigs of Taiwan, thus frozen pork exports suddenly stopped. This epidemic occurrence damaged the frozen pork industry and other related industries severly. Although, government had some remedial policy to help the industries, but little benefit to them. According to estimation of Ministry of Economic Affairs this incident caught about 150 species of the related industries lost approximate 2700 billion, and the economic growth rate fell 1.4% points. After F&MD occurrrence only remaining seven plants continue operation that caused us lamented. At present, there were 22 plants of TFMIA members still made an effort to operate domestic market and also try to open up the mainlandchina market. We wish they can introduce advanced technology and equipment to improve their meat quality level to enter the international market.

Taiwan Meat Development Foundation(TMDF)

1. Origin and objectives of the foundation

1.1. Origin

As one of the chief agricultural activities in Taiwan. Hog industry had a solid relation to the stability and prosperity of the rural economy. To stabilize the hog production and supply sufficient meat for the public, the government had advocated, therefore, establishing a foundation which was initiated by the Ministry of Economy, joint Commission on Rural Reconstruction. Taiwan Provincial Government, Taipei Municipal Government, Taiwan Provincial Association of Farmers, Taiwan Sugar Corp., and export meat processing factories. And on Nov. 16th, 1972. "Taiwan Meat Development Foundation" was established with a fund of NT$ 1,000,000 under the incorporation regulation of Civil Code.

1.2. Objectives

The "Taiwan Meat Development Foundation" was set up to adjust the supply and demand of meats, develop technology of preservation, shipping and processing of meats in order to stabilize the domestic supply of pork, and promote livestock production in Taiwan.

2. Organization

The Board of Directors of the TMDF has 15 to 17 members, and five of them were elected as standing directors. And among the five standing directors should the president be elected by themselves to stand for the foundation on external affairs. There were 3 supervisors, a Fund Managing Committee and a Technical Consulting Committee. An executive general was appointed to direct the operation of TMDF following the decisions made by the board, to supervise all the subordinate staff, they were: Secretarial Division, Finance Division and Operation Division.

Besides, for the purpose of offering better services, a Technical Service Center was set up in Pingtung City to provide services such as carcass grading, analysis of drug residues in meat and quality control. TMDF also invited relevant scholars and experts to join Meat Grading Unit, Meat Quality Control Unit, Good Quality Meat Mark Committee and Editorial Board for "Meat Today" a biannual magazine.

3. Programming of operation

3.1. Major operational

3.1.1. Adjustment of the pigs supply and demand

3.1.2. Improvements on productivity and management of hog production.
3.1.3. Carcass grading
3.1.4. Quality assay of feeds and meats.
3.1.5. Modernization of meat marketing. Assistance on the improvement of meat marketing facilities.
3.1.6. Market survey and promotion.
3.1.7. Promotion of meat science and technology and extension of quality meat.

4. Chief Achievements
4.1. Regulation of hog production and marketing.
4.2. Hog production and management improvement.
4.3. Carcass grading.
4.3.1. Promotion of export carcass grading.
4.3.2. Establishment of carcass grading system.
4.3.3. Training of grading technique and its improvement.
4.3.4. Quality assay of meats and feeds.
4.3.5. Modernization of meat marketing
4.3.6. Market survey and promotion.
4.3.7. Promotion of Meat Science and Technology and Extension of Quality Meat.

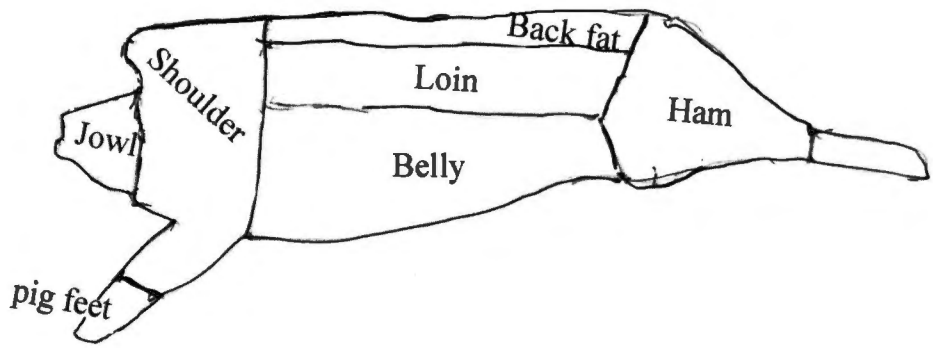
5. Ending of TMDF

Council of Agriculture reorganized the Foundation and unify other animal production related associations to establish an organization which was called as National Animal Industry Foundation in 2000. The objectives of this organization were almost same as those of TMDF. The author would like to show the readers an unforgettable mark-Good Quality Meat Mark or CAS quality meat mark as the follow:

Chapter 4. Source and Selection of Pork

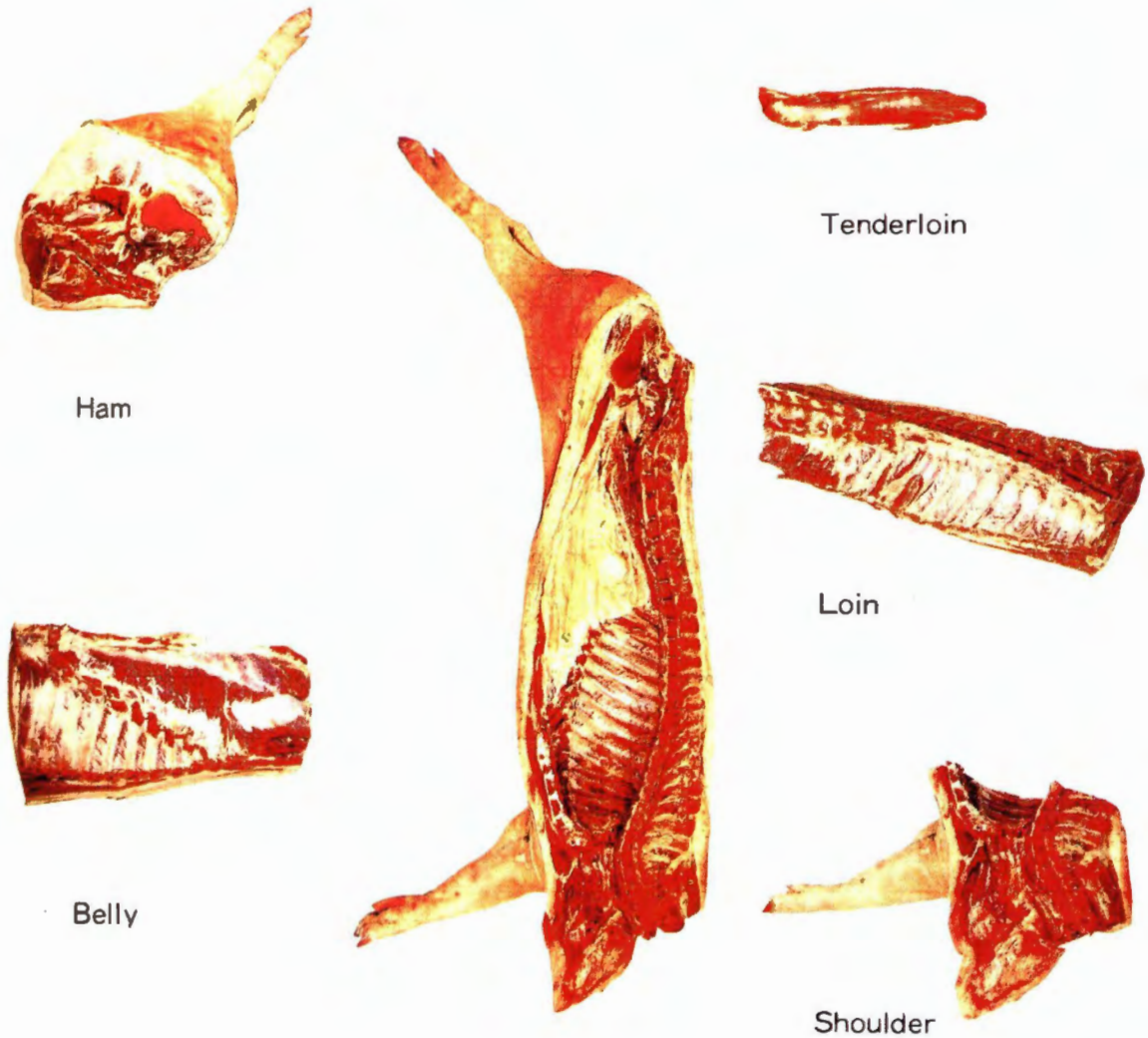
Raw meat is used for Chinese-style small goods processing

PORK CHART



Shoulder: Bacon, roasted pork, sausage, meat balls.
Ham: Ham, roasted ham, bacon, sausage, dry pork, fry shredded pork, meat balls.
Loin: Roasted ham, bacon.
Belly: Bacon, salted pork, roasted pork
Jowl: Spiced jowl smoked jowl, jelly jowl.
Pig feet: Spiced pig feet.
Back fat: Sausage, meat balls.

Pork primal cuts for domestic market

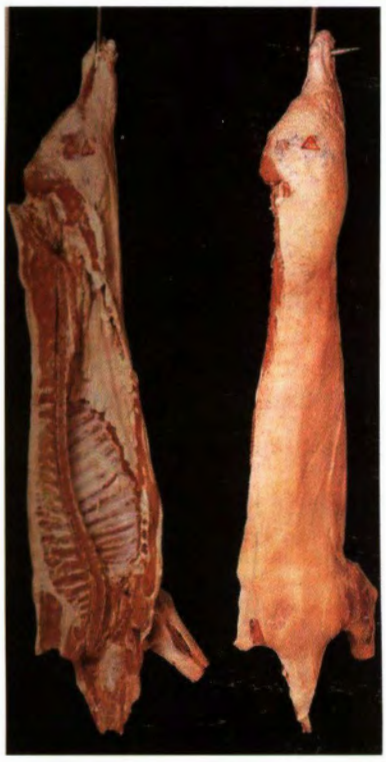
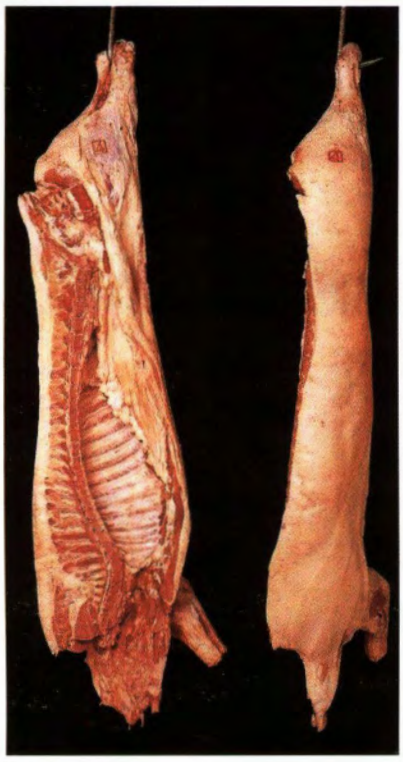
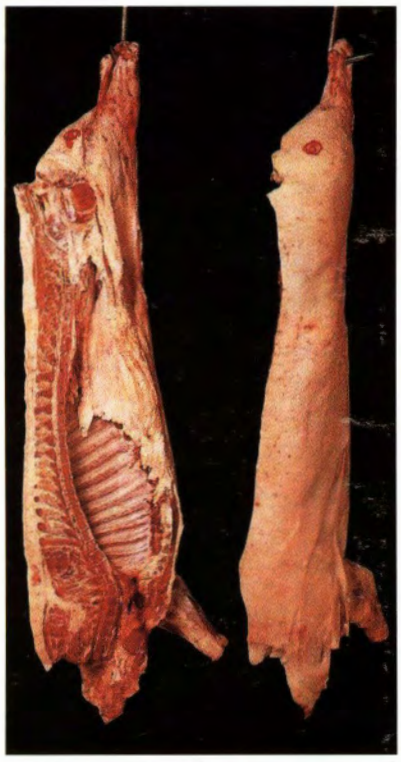


Carcass & Cuts of Hog

PORK CARCASS GRADE

Grade No.1
Carcass weight : 85.5 kg
Carcass Length : 89 cm
Thickness of Backfat at
11 th Rib : 1.8 cm
Cutability of Lean : Above 54%

Grade No.2
Carcass weight : 84.7 kg
Carcass Length : 87 cm
Thickness of Backfat at
11 th Rib : 1.5 cm
Cutability of Lean : 50~53%

Grade No.3	Grade No.4	Grade No.5
Carcass weight : 87 kg	Carcass weight : 86.6 kg	Carcass weight : 83kg
Carcass Length : 81.5 cm	Carcass Length : 83 cm	Carcass Length : 80 cm
Thickness of Backfat at	Thickness of Backfat at	Thickness of Backfat at
11 th Rib : 1.8 cm	11 th Rib : 2.5 cm	11 th Rib : 2.9 cm
Cutability of Lean : 46~49%	Cutability of Lean : 42~45%	Cutability of Lean : 38~41%
		

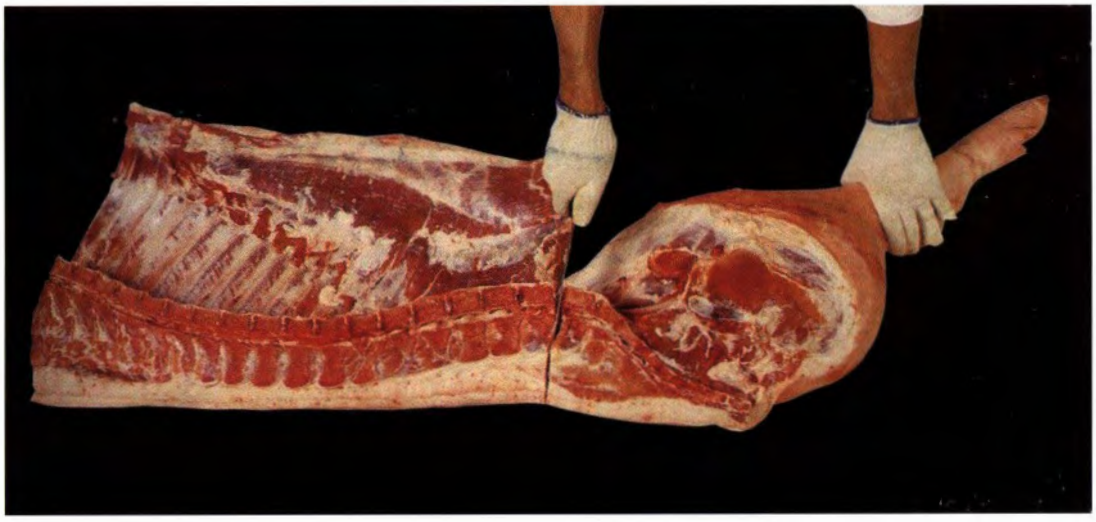
Fabricated cutting method

Shoulder

Cutting Method: Cut from the point between 4 th and 5 th ribs, at right angle with midline of back

Ham

Cutting Method: Cut from the point between last Lumbar and Last 2 nd Lumbar, at right angle with midline of back



Tenderloin

Cutting Method: Cut off from the anterior point of the aitch bone, and extend to after the end of the tenderloin.

Loin and Belly

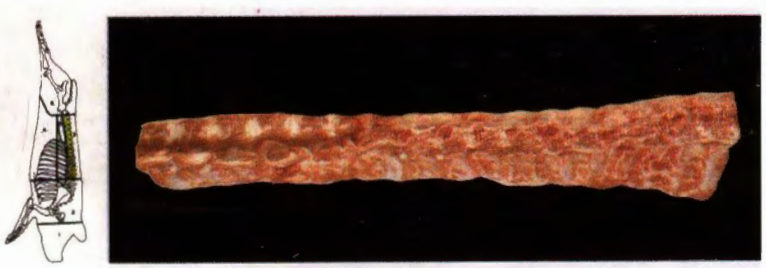
Cutting Method : Curvature from the deepest wide point inside of ribs to the point at 1/3 width of outside edge of flank parallel with midline of back.

Shoulder

Shank and Forefeet

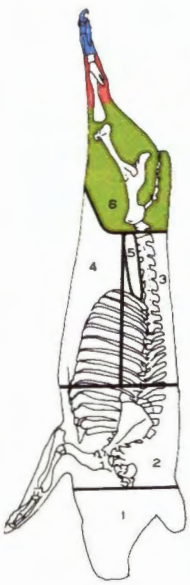
Shoulder Ribs

Boston Butt and
Picnic Shoulder

Loin	
Center Cut Loin	
Back Bones	
Back Ribs	
Boneless loin	

Belly	
Belly	 
Spareribs	 

Ham



Rearfeet

Fresh Ham
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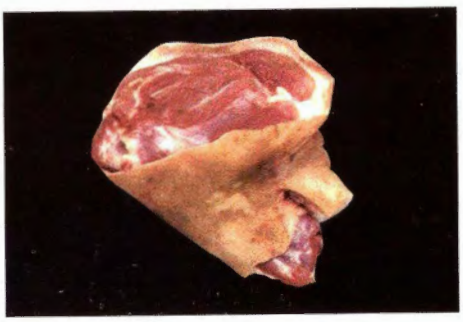
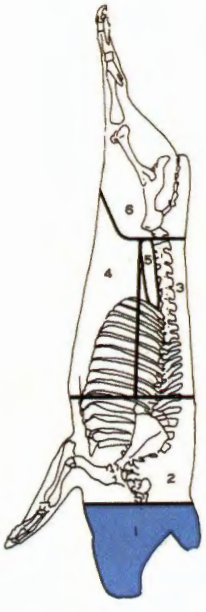
Pork Hock



Tenderloin

Side products

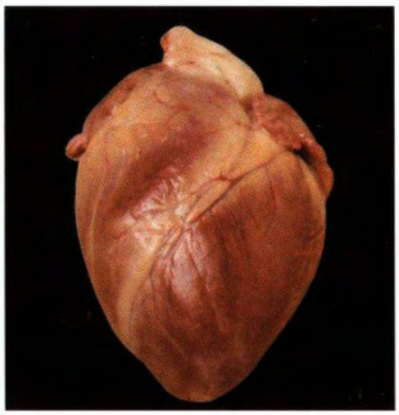
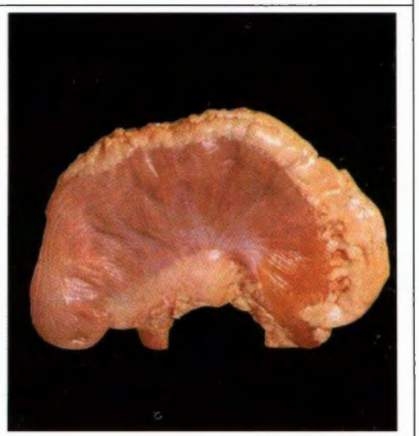
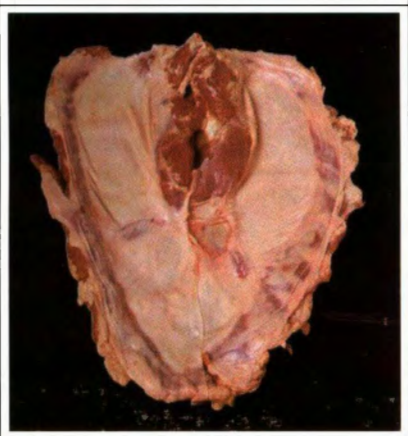


Head Skin

Ear

Tongue and Cheek

Side products

Liver		Heart	
Kidney		Stomach	
Diaphragm		Spleen	

Side products

Small Intestine		Brain	
Uteru & Bladder		Trachea Oesophagus	
Tail		Large Intestine & Rectum	

Chapter 5. Histology and Chemistry of Muscle Tissue

EFFECT OF CHEMICAL CHANGES IN MUSCLE PROTEINS DURING POSTMORTEM PROCESSING ON THE TEXTURE OF TRADITIONAL CHINESE MEAT PRODUCTS

INTRODUCTION

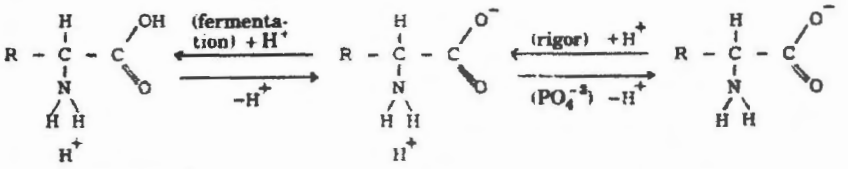
Meat processing is one of the traditional Chinese food industries .The unsanitary practices of a few meat packing companies rocked the entire industry when they were given nationwide publicity at the turn of the century. The government and some meat scientists in Taiwan have made efforts to educate consumers and processors about the advantages of chilled or frozen meat for human consumption. However, consumers and processors refrain from using chilled or frozen pork is that some of their products can only be made from warm pre-rigor meat. It is well-known that the pre-rigor meat has some advantages over post-rigor meat for making traditional Chinese meat products. However, it is difficult commercially to handle and remove the meat from the warm carcass in the first few critical hours following slaughter. In order to explain the reasons why the warm and pre-rigor meat is better than the post-rigor meat, this chapter will stress the chemical and histological changes in muscle during postmortem processing. This chapter will also compare the quality of traditional Chinese meat products manufactured from meat at different stages of rigor.

After an animal is slaughtered, a number of chemical and physiological events begin to occur. After bleeding, oxygen is no longer brought to the muscle cell. Initiation of anaerobic glycolysis and the decrease in muscle pH result in inhibition of enzyme reactions necessary for the synthesis of ATP and creatine phosphate. Since there is not enough ATP present to allow the muscle tissue to relax, the muscle enters rigor mortis and loss of extensibility. The process of rigor mortis occurs in skeletal striated muscles of all vertebrates and follows a remarkably consistent pattern of chemical change. The process is affected by temperature and exceptional physiological circumstances. In general, the change in the pH value of the muscle during the rigor process is shown in Fig. 19.1, 19.2, and 19.3. Muscle proteins are zwitterions and amphoteric compounds. Their isoelectric points are around pH 5.5. In this condition, the functional properties of muscle protein are impaired. Hence, meat in rigor functions poorly in many Chinese processed meats. The structural changes in the protein molecule which occur with changes in pH are diagrammatically illustrated below with an amino acid:

Acidic pH (example : pH 4.5). Increased water retention.

Isoelectric point. Minimum solubility, Minimum water retention. (Example:pH5.5).

Basic pH (example pH 7), Increased water retention.



Positive Charge **Neutral Charge** **Negative Charge**

Myofibrillar proteins play a major role in defining the qualities and attributes of postmortem muscle tissue. Myrofibrillar proteins are largely responsible for rigor mortis, tenderness or toughness, water holding capacity, emulsification properties, and fibroid binding. Our knowledge about muscle proteins has greatly expanded in the last 5 to 10 years because of the innovative approaches taken in studying the fundamental properties of myofibrillar proteins in postmortem muscle tissue.

The recent discovery of a calcium activated protease(CAF) endogenous to the muscle fiber and capable of degrading the z-disks of myofibrils has increased our understanding of the proteolytic changes in muscle proteins and the primary mechanisms of meat tenderization. The primary contributors to this research are workers in the Muscle Biology Laboratory at Iowa State University. They have found that postmortem Z-disk degradation and myofibril fragmentation are closely associated with sensory tenderness and shear values. Olson et al. (1977) demonstrated that CAF was responsible for the loss of Z-disk integrity, myofibril fragmentation, and the degradation of troponin -T to a 30,000 dalton component during postmortem aging. These changes by CAF parallel those that occur during the natural aging process of postmortem muscle tissue. Goll *et al.* (1984) summarized the effects of CAF on contractile proteins of skeletal muscle (Tables 19.1 and 19.2). Proteolysis of muscle proteins was proposed early as the principal mechanism of tenderization and has since been acknowledged by many others. However, there is little information about why the functional properties of pre-rigor meat are better than those of post-rigor meat. The authors wonder whether the molecules resulting from proteolysis of muscle proteins have more or less non-polar groups. This is worthy of investigation.

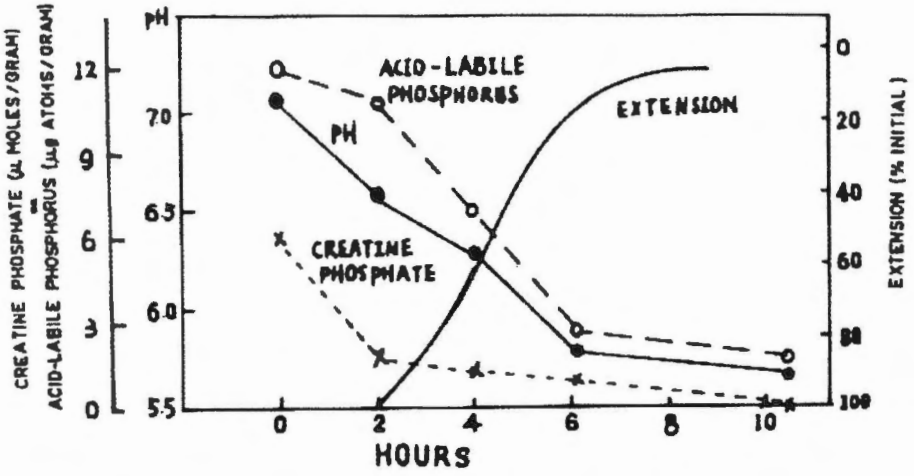


Fig. 5.1. Chemical and physical changes in beef sternomandibularis muscle held at 37℃ .

Zero time:1 h and 45 min postmortem (Newbold 1966).

Some of the advantages of pre-rigor meat, such as good water holding capacity, are maximal in meat obtained as soon after slaughter as possible. Meat with a high water holding capacity will be higher yielding, more tender , firmer, and better in forming emulsions than meat with low water holding capacity. Pre-rigor meat is excellent for emulsion products such as meatballs. The emulsion forming characteristics of pre-rigor meat are superior to those of post-rigor meat. Essentially, if pre-rigor meat is available, there are few disadvantages in using it other than the necessity of altering some of the techniques used in removing the meat from the carcass. The objective of this study was to determine the importance of state of rigor on the quality of fried shredded pork.

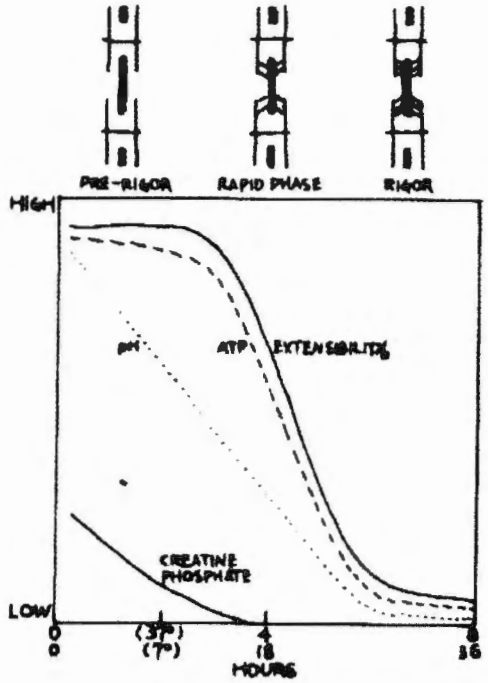


Fig. 5.2. Rigor onset in beef at 37℃ and 7℃ and crossbridge formation between thick and thin filaments as rigor develops (Marsh 1981).

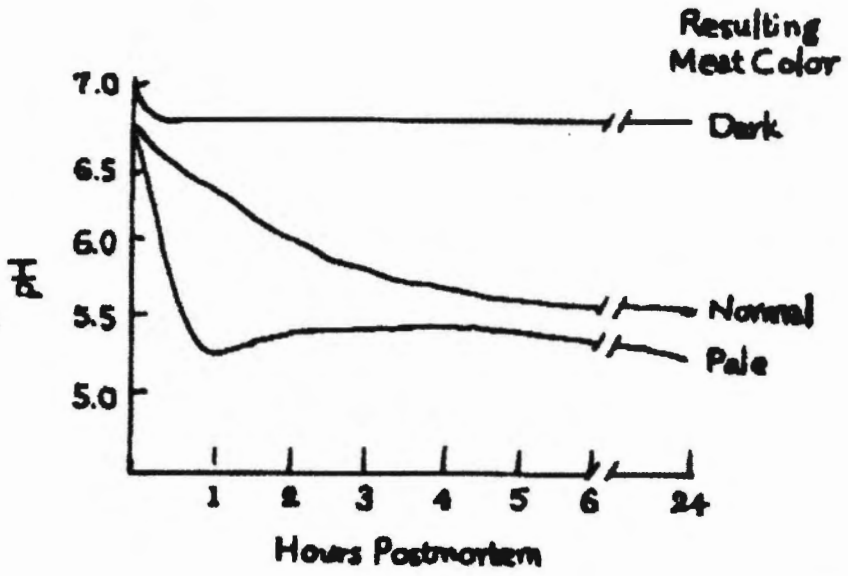


Fig. 5.3. Postmortem pH decline curves for porcine muscles (Modified from Briskey, 1984).

Table 5.1. Summary of the effects of CAF, The Ca^{2+} Dependent protease, on contractile proteins from skeletal muscle.

Contractile Protein	Location in Muscle Cell	Effect of CAF
Myosin	Thick filaments	No effect; may degrade heavy chain of myosin to 190K daltons if LC_2 light chain is unphosphorylated
Actin	Thin filaments	No effect
a-Actinin	Z-disk	No effect
Troponin-C	38.5 nm intervals along the thin filament	No effect
Tropomyosin	All along the thin filament; possibly in the Z-disk	Degrades to peptide-s of approximately 17K and 15K daltons
Troponin-T	38.5 nm intervals along the thin filament	Degrades rapidly to several different peptides of approximately 30K daltons that are then degraded to 14K daltons
Troponin-I	38.5 nm intervals along the thin filament	Degrades fairly rapidly to peptides of approximately 14K daltons
C-protein	43 nm intervals along the thin filament	Degrades from a 130K dalton peptide to approximately 120K dalton peptide
Filamin	Z-disks	Degrades to two fragments 240K and 9.5K daltons
Desmin	Z-disks	Degrades to peptides of 32K and 18K daltons
Gelsolin	I-band	Degrades to peptides of 43K and 38K daltons; these are then degraded slowly to peptides of 42K and 36K daltons

Goll et al. (1984)

Raw ham was trimmed, cut into 650 pieces and the pH values determined. The meat cuts were divided into four groups: pre-rigor, rigor, pre- rigor plus EDTA, and post-rigor. The pre-rigor plus EDTA and post-rigor samples were stored in a refrigerator at 2-4℃ for 24 h. The warm meat cuts were stored at room temperature for 6-8 h. The pH values of all the samples were measured again, and then the samples were used for preparing pork jerky and fried shredded pork. Following trimming, the warm, chilled, and frozen cuts were also used for preparing meatballs and their emulsifying capacities were determined. The binding ability (tensile strength

of the pork jerky product was determined using a Warner-Brazler Shear device. One end of the jerky strip was fixed on the stand and the other end was set against the knife blade. The force in kilograms required to tear the strip was recorded. The length of the muscle fiber in the fried shredded pork was also measured.

Table 5.2. Evidence that CAFis causally involved in postmortem meat tenderization

A. CAF and postmortem storage have very similar effects on muscle ultrastructure. Ancillary: Both Z-disk degradation and loss of M-line integrity would be expected to greatly increase tenderness
B. CAF and postmortem aging have very similar effects on contractile proteins. Ancillary: Amount of 30,000 dalton material in myofibrils is related to the increase in tenderness that occurs during postmortem storage.
C. Muscles with higher levels of CAF increase more in tenderness during postmortem storage than muscles with leas CAF.
   1. Myofibrils in muscles with higher levels of CAF have greater degradation of Z-disks. Ancillary: Degree of Z-disk degradation, amount of myofibril fragmentation, and amount of 30,000 dalton material are all related to tenderness.
D. Both CAF treatment and postmortem storage increase the Mg^{2+} - modified and Ca^{2+} - modified ATPase activities of myofibrils.
E. Both CAF treatment and postmortem storage result in degradation of the intermediate filament protein, desmin.
F. Postmortem loss of connectin (titin), which may be related to gap filaments, depends on the presence of Ca^{2+} suggesting that the Ca^{2+} is needed to activate CAF.
G. Lyophilized muscle reconstituted with saline solutions containing CAF is more tender than muscle reconstituted with saline solution alone.

Goll et al (1984)

As is shown in Table 19.3, the pH values of the muscle samples were 6.01, 6.07, 5.82, and 6.78, respectively, for the pre-rigor, pre-rigor plus EDTA, rigor, and post-rigor samples. The reason one sample was treated with EDTA was to chelate calcium ions and inactivate CAF action in the myofibrils. The binding ability of all the pork samples except for the product made from meat in rigor was very good. These products were also tender and glossy. These results indicate that pork jerky can be made from both pre- and post-rigor meat, but not from meat in rigor. This is true because salt soluble proteins in the pre- and post-rigor meat are more easily extracted than those from meat in rigor.

Table 5.3. pH values of pre-rigor plus EDTA, rigor and post-rigor meat

Sample	Pre-rigor	Pre-rigor Plus EDTA	Rigor	Post-rigor
pH values	6.01	6.07	5.82	6.78

The lengths of fried shredded pork made by the various treatments are shown in Table 5.4. It was found that the post-rigor sample had the shortest muscle fiber bundles and the in-rigor samples had the next shortest bundles. The post-rigor sample was mealy and weak. This apparently was due to proteolysis of myofibrils. However, if the meat is stored at room temperature as it is in the markets in Taiwan, fragmentation of myofibrils must be serious, and the product made from this kind of meat must be even mealier and weaker than the post-rigor sample studied here. The work done by Chen (1977) helps explain this phenomenon. He studied the effects of enzymes on the biochemical changes and ultrastructure of muscle during postmortem aging. He found that the extractability of myofibrillar proteins, for all samples stored at 2℃, showed a slight increase with storage time, and that the extractability of sarcoplasmic proteins remained nearly constant at the same temperature. However, the extractability of muscle proteins increased at higher temperatures, the results tending to indicate that the optimal condition for the activity of natural muscle enzymes is between 25℃ and 37℃. Micrographs obtained from his study showed no major changes in the structure of those samples stored at 2℃. Degradation gradually occurred in the Z-disks, sarcosomes, and sarcoplasmic reticulum of the muscle cells in all samples. However, at 25℃ and 37℃ observable alterations occurred in the myofibrils of samples handled aseptically.

Table 5.4. The length of fried shredded pork prepared from meat in various stages of rigor.

Sample	Pre-rigor	Pre-rigor Plus EDTA	Rigor	Post-rigor
Before cooking	10cm	10 cm	10 cm	10 cm
After cooking	7.8 cm	7.6 cm	6.9 cm	4.5 cm
After frying	4.92 cm	4.93 cm	4.2 cm	3.4 cm

Traditionally, meatball processors have used raw meat obtained immediately from the slaughtered warm carcass. Although warm meat has superior properties of water-holding capacity, emulsifying capacity, and protein solubility, as mentioned before, the degree of these functional properties is dependent on the particular stage of

rigor. Since rigor onset and the accompanying pH decline may be precipitously rapid in porcine muscle (see Fig. 19.2), and since the postmortem muscle temperature strongly influences the rigor pattern (Marsh 1981), it was found that processors of traditional meatballs occasionally experienced some troubles with the quality of their products.

Chen (1979) studied the emulsifying capacity of warm, chilled, and frozen meat. He discovered that warm meat was sometimes not as suitable as chilled meat, due to the fact that the warm meat occasionally entered the rigor stage. Therefore, new procedures and methods were developed - so-called "innovative" or "improved" methods - which use pre-rigor frozen meat and employ grinding, blending, or chopping techniques. The texture of meatballs produced by these new methods is different. The products made by the traditional hammering techniques have a layered quality not displayed in the new products, but products produced by both methods have the same degree of brittleness.

In conclusion, according to processors, pre-rigor meat is favored for producing traditional Chinese meat products. Meat in rigor is unsuitable for traditional products and other common meat products as well. It is evident that the hot-boning technique has to be improved. Carcass and deboned meat in a pre-rigor state require proper handling, and the processors must learn these handling techniques. These recommendations are based on both practical experience and scientific research.

References:

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CHEN, M.T. 1977. Effects of enzymes on the ultra-structural and biochemical changes of muscle during postmortem storage. Ph. D. Dissertation. Ohio State University, Columbus, Ohio, USA.

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Biochemical and histological changes of muscle during postmortem rigor mortis and resolution of rigor:

Changes in biochemical, histological and microbiological properties of meat postmortem during storage are very important to quality of muscle foods. Meat is directly obtained from muscle tissues of meat animals. However, muscle tissues are very complicate biological system. The knowledge of chemical composition and

biological properties and their changes of muscle tissues of life animals are necessary basis to understand that the muscle conversion from physiological function to its use as foods.

One of the most remarkable postmortem changes of meat after slaughtering of animals is rigor mortis---a stiffening. In this section I would like to refer the book written by Dr. Judge et al.(1989). They elucidate rigor mortis and resolution of rigor simply and easy to understand. Especially, the chart of the curve of rigor mortis changes is very important to the meat processors.

Rigor mortis stiffening is due to formation of permanent cross-bridge in muscle between actin and myosin filaments. The chemical reaction that forms actomyosin is the same as muscle contraction in life animal. The difference between the living muscle and dead animal in rigor states is that relaxation is impossible in the latter state, because no energy is available for breaking rigor complex (actomyosin) bonds. During normal contraction, cross-bridge form at only about 20% of the possible binding sites, but in rigor postmortem, nearly all binding sites in the area of overlap between actin and myosin filaments containing cross-bridges.

Energy source for muscle contraction is mainly ATP which is biosynthesized under aerobic condition in life animals (it is so called oxidative rephosphorylation). ATP is depleted as muscle contraction , but it is resynthesized immediately in living muscle However, ATP can not be synthesized in the meat after slaughtering because blood circulation ceases, local metabolism continues anaerobically, thus the rigor complex can be broken down. At this time the muscle begins to loss extensibility which is defined as rigor onset and this phase lasts until the completion of rigor. The period of time before rigor onset is called the delay phase(pre-rigor state), the muscle is relatively extensible and elastic.

After rigor completion phase, the muscle becomes soften and ultrastructure of myofilaments become weaken. These changes are caused by the action of neutral protease enzymes such as calpains and cathepsins. These structural alterations may relate to tenderization accompanying meat aging. As the author's opinion the meat processors must learn these changes which are very important to raw meat quality.

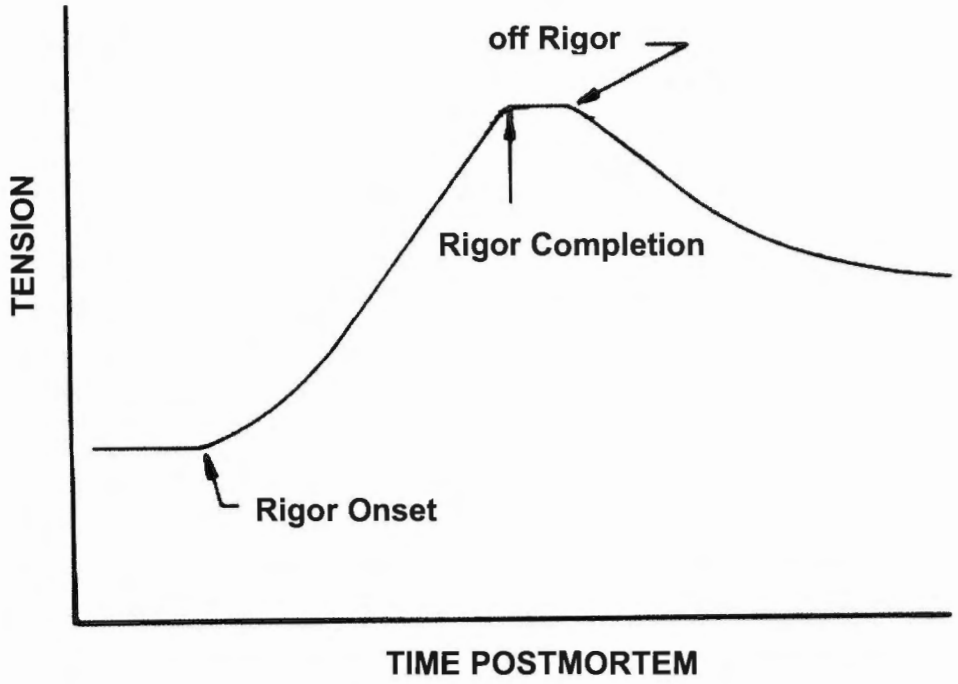


Fig. 5.4. The curve of changes in muscle of rigor mortis.

Table 5.5. Delay time before onset of rigor mortis of different animals.

Species	Time(hours)
Beef	6-12
Lamb	6-12
Pork	1/4-3
Turkey	< 1
Chicken	< 1/2
Duck	1/2-2
Fish	< 1

Source: Judge et al. (1989): Principles of Meat Science, 2nd ed.

Hot boned meat

Meat is obtained from the processing or cutting of carcass meat starts within a few hours of death while the meat is still in its pre-rigor state. It is not obtained from any warm carcass meat, it is only from the pre-rigor meat. Most of traditional meat products processors in Taiwan are misunderstanding to regard the warm meat as a hot boned meat which has good functional properties for manufacturing their products

such as sausages, meat balls, fried shredded pork and pork jerky etc. Actually they often face some troublesome to process their products such as Shing-chu meat balls. The meat balls processors often can not get good emulsifying capacity and water holding capacity of the products. Although Dr. Robert Rust(1977), professor of meat science at Iowa State University has proposed that products made from hot boned meat are generally more palatable than those made from meat chilled before boning. Hot boned meat also has the advantages of increase water binding capacity and emulsifying capacity over meat which is allowed to pass through rigor. Unfortunately, usually the traditional meat processors can not get the hot boned meat within pre-rigor state, most time the meat they purchased are in rigor state, and resulting in worse emulsion of the products.

Pre-rigor effect

We have learned that the hot boned meat produced from the meat is still in its pre-rigor state which has good functional properties than meat obtained from chilled before boning. This is so called pre-rigor effect. The pre-rigor state is difficult to be controlled by the processors who do not have the slaughterhouse. The raw meat is not obtained from their own slaughterhouse. The meat they purchased is usually in rigor state of passing through rigor. Thus, the author suggests that when the processors want to utilize the hot boned meat as raw meat they have to measure pH of meat. If the pH value of meat is between 5 and 5.5 it is better to hold the meat until the pH value passes through this range.

I always claim it is very important to learn the changes in physicochemical properties of muscle post-mortem which have been discussed in the previous chapter. Especially the curve of rigor which is divided into four phases including delay phase(pre-rigor), rigor onset, completion of rigor and resolution of rigor. The length of change depends upon the energy in the blood and muscle of animal at slaughtering. The pre-rigor state is delayed until ATP dropped out. The detail please refer to the previous chapter.

Advantages of hot processing

1. Improve meat yield.
2. Reduce drip in vacuum pack and less unsightly staining of fat.
3. More uniform meat color.
4. Opportunity to mould meat.
5. Saving in refrigeration (capital and running costs).
6. Superior water holding capacity.
7. Saving in labor.

Disadvantages of hot processing

1. Greater hygiene and temperature control required.
2. Boning on rail desirable.
3. Less easy to cut, trim and vacuum pack hot meat.
4. Unconventional shapes of cuts.
5. Problems in synchronizing slaughter, boning and manufacturing lines.
6. Difficult to introduce into conventional plants.
7. Hot boned meat without attaching on bone may shorten more than meat attaching on bone and becomes tough.

Flow chart of operation of hot processing plant for pork production

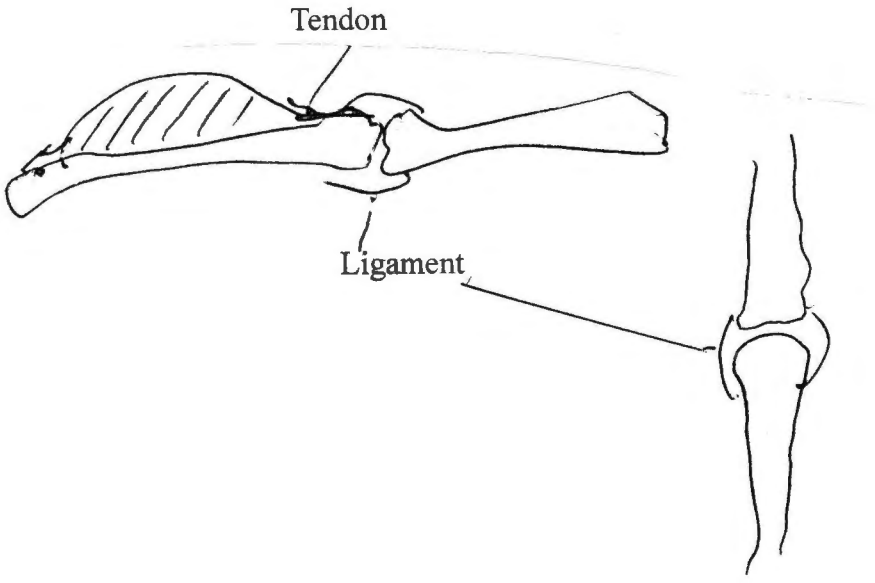
The structure of meat, distribution of connective tissues and adipose tissue in a muscle

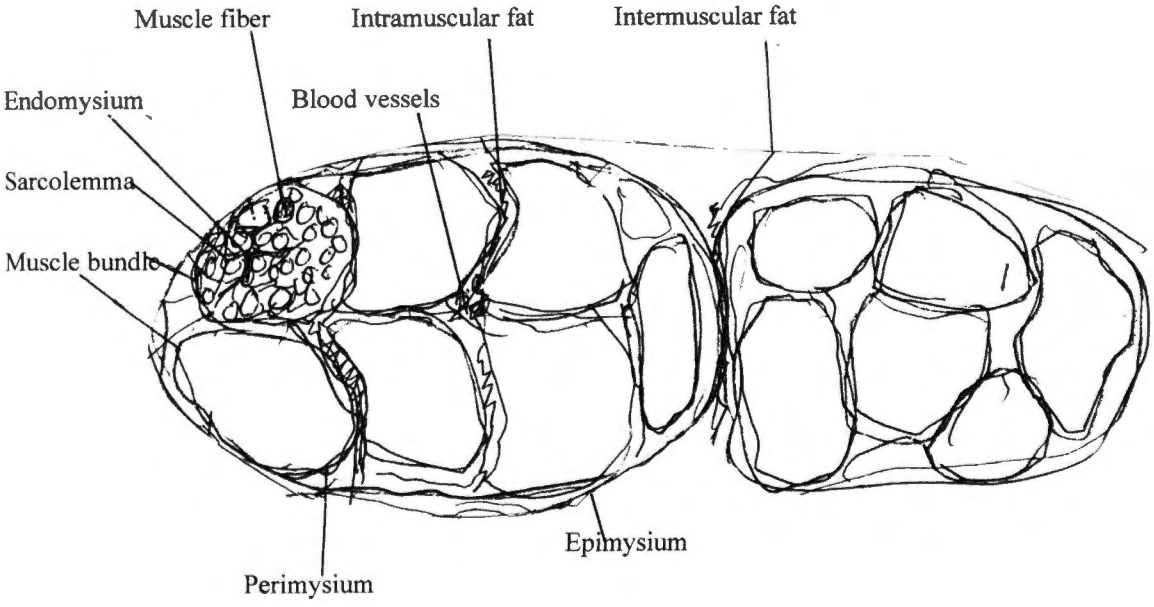
Most meat we eat are skeletal muscle, cardiac muscle which constitute of heart is also consumed by human. However, since a carcass meat consist of lean, fat and bone, together with connective tissue which distribute surrounding the muscle cells(fibers), muscle bundles and muscle cuts. Fats are located between muscle bundles, lying between individual muscles or intramuscular located in the muscle which is referred to as marbling fat, because when animals are fattening. It gives a marbled appearance I to lean meat. This phenomenon is very important to the flavor, juiciness and I tenderness of meat.

Connective tissue distribution

1. Sarcolemma is a membrane bounding the cell which folds in to give a system of tubules that form a network through the fiber.
2. Endomysium is a membrane surrounding individual muscle fibers to form a fine network.
3. Perimysium is a membrane surrounding muscle bundles.
4. Epimysium is a membrane surrounding a whole muscle.

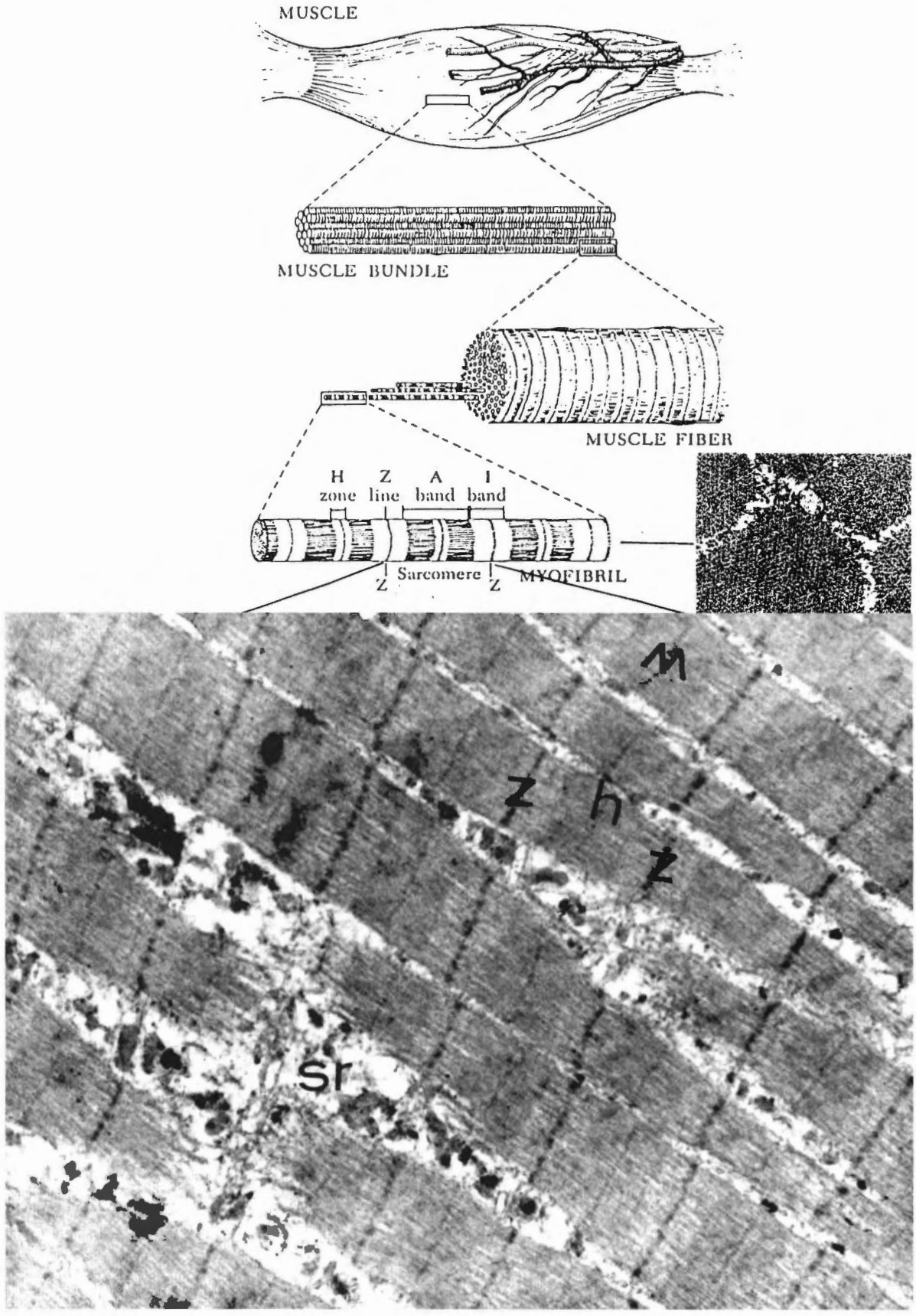
The main component of the connective tissue is collagen and elastin.





The concentration and complexity of chemical composition of connective tissue is increased with increasing age of animals. These changes will affect tenderness of meat. The concentration of connective tissue is different in different location, and results in different tenderness of meat.

Structure of muscle



Chapter 6. Meat Quality

Quality is defined as the sum of all the characteristics and properties of a product. Important quality factors of meat are color, odour, flavor-sensory factors, shelf-life, freedom from residues-hygiene factors, protein, fat, vitamin and mineral contents-nutritional factors, and also water binding and pH of meat-tectnological factors or functional properties. Among these four category of quality factors of the meat, the hygiene and technological factors are most important to quality of the products. Apart from the good processing practices. the quality of the meat products begins with good quality of raw materials, especially good microbial and functional properties of me raw meal. The quality of the raw meat begins with good slaughtering practices. In this paper the microbial and functional properties will be discussed.

The overall quality of meat by means of quality characteristics showing mutual dependencies and relationships as follows:

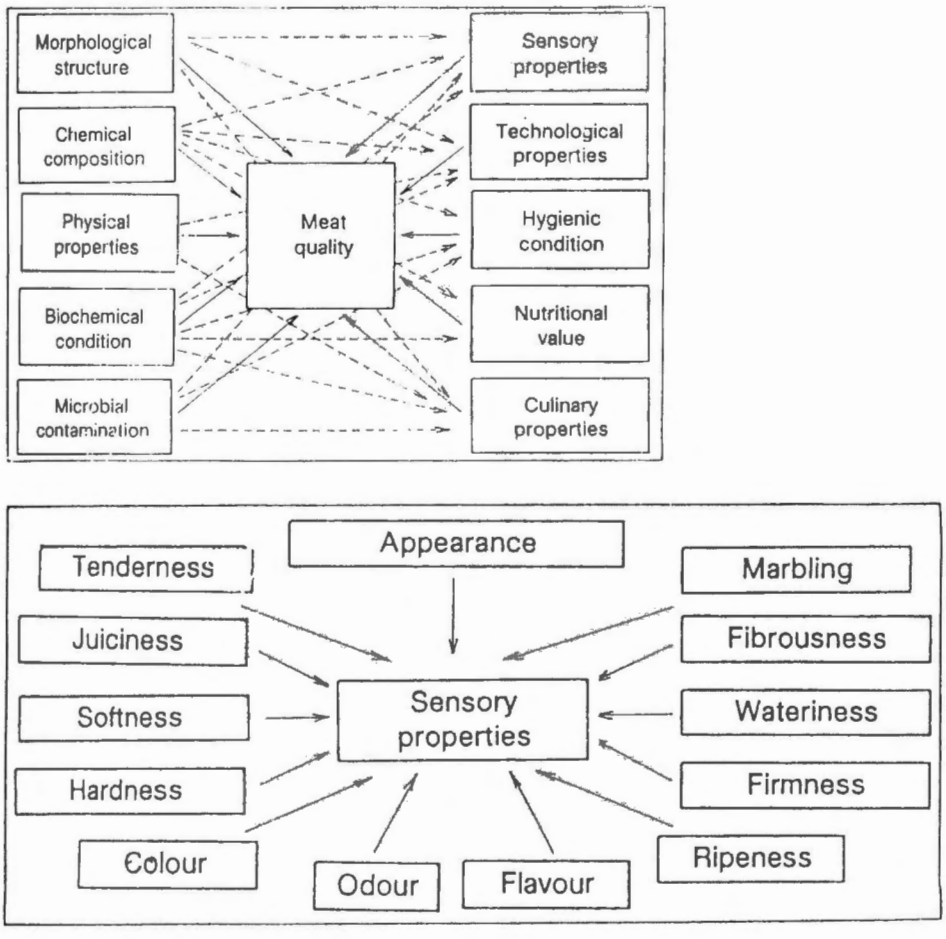


Fig. 6.1 The qualitative characteristic" sensory properties" and how to itemize it by means of quality features.

Production factors which influence pork quality characteristics

Table 6.1. Production factors which influence pork quality characteristics

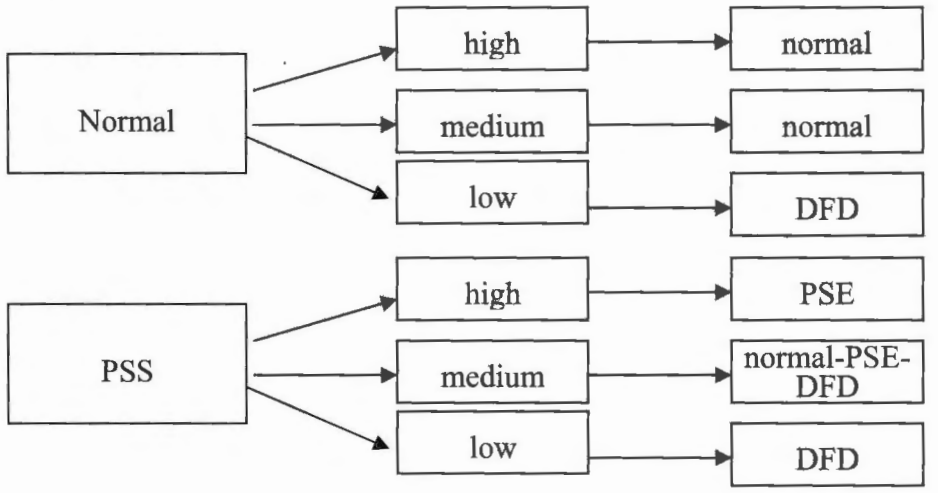
Production factor	Quality characteristic	Specific topics discussed in review
Genetics	Muscle color Muscle water holding capacity Carcass composition	PSE - Halothane gene
Nutrition	Carcass composition Meat flavor	Dietary protein Dietary fats Vitamin E
Growth promotants	Carcass composition Meat palatability	Porcine somatotropin Ractopamine
Pre-slaughter handling and transportation	Muscle color Muscle water holding capacity Hog death during-transit	Transportation Fasting Resting
Immobilization	Muscle color Muscle water holding capacity Blood splash Broken bones	Electrical-stunning,CO_2 -stunning ,Captive bolt stunning
Dehairing	Meat shelf-life Muscle color Muscle water holding capacity	PSE Bacterial contamination
Post slaughter handling	Muscle color Muscle water holding capacity Shelf-life	Chilling Electrical stimulation
Packaging and storage	Shelf-life Meat safety	Packaging environment Storage temperature

' The specific factors affecting pork quality characteristics are discussed and referenced in the body of this review .

Meat quality begins with slaughtering

1. Pre-slaughter handling and transportation.
2. Stunning methods
3. Relation between genotype, energy reserves and meat quality

Genetic disposition	Energy content in the muscles at sticking	Meat quality



Relationship between genotype, energy reserves and meat quality (Nielsen, 1981).

Table. 6.2. Summary of events leading to PSE and DFD meat.

PSE	DFD
◎ Acute stress	◎ Chronic stress
◎ Rapid initial acidification	◎ Reduced glycogen
◎ Low initial pH at high carcass temperature	◎ High ultimate pH
◎ Proteins denature	◎ Proteins do not denature
◎ Low water-holding capacity	◎ High water-holding capacity
◎ "Bound" water lost	◎ Water held by proteins
◎ Muscle fibres separate	◎ Fibres tightly packed
◎ Large extracellular space	◎ Small extracellular space
◎ Light scattering high	◎ Light scattering low
◎ Surface appears pale	◎ Surface dark
◎ Low pH promotes Mb oxidation	◎ O_2 diffusion inhibited by closed structure
◎ Reduction in absorption of green light by Mb	◎ O_2 used up by high cytochrome activity
◎ Meat looks less red	◎ Mb O_2 layer thin and underlying Mb (purple) shows through

Table. 6.3. Characteristics of soluble muscle proteins

Property	Sarcoplasmic proteins	Myofibrillar proteins
Conformation	Globular	Fibrous
Molecular weight (range/average)	Low mol. wt. (80,000)	High mol. wt.[a] (400,000 to 800,000)
Primary solubility characteristics	H_2O or low concentration of salt solutions	Insoluble in H_2O; soluble in salt solutions
Water-binding capacity	Very low	Very high
Viscous behavior in solution	Low viscosity	High viscosity
Emulsification-type interaction with lipids	Slight	Extensive
Gel-forming ability from protein-protein interaction	None, forms coagulum	Extensive, forms protein matrix

[a] Normal subunit proteins and relative quantities arc as follows: myosin (50-55%); actin(15-20%); tropomyosin (4-6%); troponins (4-6%); C-protein (2.5-3%); α-actinin (2.0-2.5%); β-actinin (1%); M-proteins (3-5%).

Eating Quality(palatability)

1. Color：myoglobin chemistry
2. Tenderness：breed, sex, age, location, nutrition, biochemical and physiological conditions of muscle, cooking methods, ageing, and tenderization.
3. Juiciness：water holding capacity, fat content(marbling).
4. Texture：breeds, sex, age, location
5. Flavour：maturity, marbling, sex odour, ageing

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A System for Assuring Pork Quality from Farm to Table

1. Factors affecting meat quality
   1) 0n farm
   2) In transportation
   3) In-plant
   4) Post-plant handling

2. Control points

2.1. Genetic input

1) Choice of breeds

(a) Breeds of good meat quality

Berkshire：Overall meat quality is good but slightly poor carcass and proliferation.

Duroc：higher marbling level but greater react to stress during slaughter.

(b) Average for pork quality breeds

Spots, Poland china, Yorkshire, Hampshire(m+m+)

(c) Bad pork quality breeds

Landrace, Hampshine (RN-)

Recommendation：All commercial market hogs should have at least some percentage of Durocs (+/or Berkshires), or other hybrids or synthetic lines, with commercially proven pork quality performance to help enhance the opportunity to produce higher quality pork products.

2) Choice of sires within breed

Recommendation : Request pork quality information and/or quality EPD(expected progeny differences) status on all sire purchases from individuals or companies. Furthermore, the breeding stock companies and breed associations should begin to provide this type of pork quality information to their customers. Traits of interest are loin color, loin intramuscular fat, and drip loss. Ultimate loin pH (24-hour) is a predictor of quality that is also of interest.

3) RYR1 or Halothane(Stress)gene RYR1 or Halothane (stress) gene

Recommendation : Require that all breeding stock purchases be certified stress gene free. All commercial producers should certify that they do not or will not knowingly market hogs with the halothane gene.

4) Napole (RN) Gene Napole(RN-) Gene.

Recommendation : Work should proceed to isolate the RN (Napole) gene and further clarify its positive and negative impacts.

5) Loin intramuscular (IM) FAT

Recommendation : Continue to utilize breeds and sires that will contribute positively to marbling without increasing fat in other depots (subcutaneous, abdominal, and inter-muscular).

6) Fiber type

Recommendation : Encourage consideration of the use of fiber typing of genetic seed stock for improvements in leanness and pork quality.

7) DNA Technology

Recommendation : Utilize the new valuable genetic tools in traditional selection programs. As these DNA tests become more readily available, commercial producers need to ask for assurance that their breeding stock suppliers are utilizing all the pork quality tools at their disposal.

2.2. Nutritional inputs

1) Vitamin & Mineral supplementation

Recommendation : Vitamin E is proven beneficial to pork quality but may be economically prohibitive. More information is needed.

Recommendation : Adding magnesium to the diets of finishing hogs for five days prior to slaughter has been shown to be beneficial to quality and should be considered.

2) Amino acid levels Pre-market

Recommendation : Restricting amino acids in the diet in late finishing can double IM fat levels, but is not recommended due to other negative consequences : poorer performance and lower meat quality.

3) Dietary fat sources and levels

Recommendation: Moderate the use of fat in the diet controlling the amount of unsaturated fat added. Also, consideration should be given to the use of CLA for its effects on belly hardness.

4) Ad Lib Feeding

Recommendation: Continue the U.S. practice of full feeding finishing hogs maximize quality of the product.

5) Dietary starch

Recommendation : Further studies are necessary to support or refute the value or costs of starch feeding with typical U.S. rations. No producer recommendation apparent at this time.

6) Metabolic modifiers

Recommendation: Because PST is not yet approved for use in the U.S. no recommendation is evident. However, with demonstration of economic return from the performance and carcass benefits, positive consideration should be given to using betaine and chromium for the potential pork quality benefits. Use of ractopamine is dependent on its value for performance and carcass traits with little value to pork quality. Its use should be predicated on adapting handing systems for minimum stress and gentle handing on the farm, in transport and at the plant.

7) Feed withdrawal

Recommendation : Ensure that total withdrawal time from last consumption until slaughter is between 12 and 18 hours, with access to water.

2.3. On-farm hog handling

1) Health/Stress management

Recommendation : View the NPB " Handling" videos; eliminate or significantly curtail the use of electric prods; accustom pigs to human activity during the finishing period; separate health stressed pigs from healthy pigs; empower stockpersons by teaching them handing affects the welfare of the animals in their care and the resulting meat quality. 2).Slaughter weight

2.4. Transporting hogs

1) Trucker quality assurance (TQA)

Recommendation : Producers are responsible for the proper handling of their hogs in transport to market even if the hauling is hired. Require all truckers to become certified in the National Pork Board' s Trucker Quality Assurance program.

2) Electric prods

Recommendation : Eliminate (or significantly curtail) all use of electric prods for

loading and unloading hogs.

3) Truck//Trailer type
4) Weather extremes
5) Transport times

2.5. Pre-Slaughter handling

1) Facility construction
2) Water sprays
3) Electric prods
4) Rest (Lairage) times
5) Pre-stun handling

Recommendation : The two greatest stressors on pigs just prior to slaughter are isolation and restraint. Implement a dual system for moving pigs to the restrainer for electrical stunning or into the chamber for C02 stunning to reduce isolation. Systems that can alleviate the stress of restraint should be investigated. All workers in this area need to be thoroughly trained on the effects of stress on subsequent pork quality.

2.6. Stum & Early postmortem

1) Stunning system a. electrical stunning b. $C0_2$-stunning
2) Stun to stick interval

Recommendation : Make a adjustments to reduce the stun to stick interval to less than ten seconds.

3) Horizontal vs. vertical sticking / bleeding
4) Bleed time

Recommendation : Allow sufficient time for adequate bleeding of carcasses but reduce this time to no more than five minutes.

5) Scald temp/time or skin time

Recommendation : Document the process for addressing the scald time and temperature and the impact on carcass temperature. Scalding conditions are temperature is at 62℃ in Winter and 60℃ in Summer , time is 5.5-7.5 min.

6) Time on buffer rails

2.7. Evisceration

1) Evisceration time

Recommendation : Reduce the time from stick to chill to no more than 30 minutes.

2) Splitting accuracy

Recommendation : Implement a procedure for monitoring and reducing the incidence of off-split carcasses and the effects on product quality.

3) Fecal contamination

Recommendation '?Encourage a system of feed withdrawal with hog suppliers and implement a procedure for training of employees for these critical areas of opening and gutting.

4) Trimming

Recommendation : Consider a system that captures veterinary data on-line for transfer to producers.

5) Measuring carcass composition

Recommendation : Strive for more accuracy measuring and reporting composition of carcasses. Use the FFLI equations as the standard for the industry.

6) Measuring pork quality

Recommendation : Continue to develop devices and procedures for accurate measurement or prediction of pork quality on line. Develop systems to communicate quality estimates. Have pork producer suppliers make information available about any changes they make in genetics, handling or nutrition that may affect their running average quality.

2.8. Carcass chilling

1) Chilling system

Time Postmortem	Temperature (℃)	Temperature (°F)
At Death	39	39
1 hour postmortem	35-37	35-37
2 hour postmortem	30-32	30-32
3 hour postmortem	26-28	26-28
5 hour postmortem	22-24	22-24
6 hour postmortem	20	20
10 hour postmortem	12	12
16 hour postmortem	8	8
20 hour postmortem	5-7	5-7

Recommendation: Develop and utilize systems with the goal of removing the heat from the carcass as quickly as possible without compromising tenderness. Also, support work should be on the interactions of completed chilling systems with pork quality, handling, and genetics (leanness) of the carcasses.

2) Chill time/temperature

Recommendation : Space carcasses to allow adequate air movement during chilling. Achieve a temperature in the thickest part of the ham of below 30℃ as quickly

post mortem as possible > 10℃ within 12 hours post mortem. Assuming a 24-hour chill, deep ham temperatures should be less than 4.4℃ as the carcass enters fabrication.

3) Carcass suspension

Recommendation : Consider the aitchbone method of carcass suspension to achieve an extra level of tenderness in the loin and ham.

2.9. Fabrication

2.10. Further processing of fresh pork

1) Enhancement of fresh pork

Recommendation : Support research work to evaluate different levels, ingredient, and various quality levels of raw materials to use in the enhancement of fresh pork.

2) Irradiation of fresh pork: It is better not to use irradiation on pork.

3) Freezing & thawing of fresh pork

2.11. Packaging

1) Aging of pork

Recommendation : Because pork products continue the aging process during packaged storage, shipment, and display, all pork should be allowed this normal aging process for periods of up to ten days after slaughter.

2) Packaging:: MAP system can be used to extend the storage life of pork.

2.12. Cooking effects on pork quality

1) Cooking method may affect sensory quality of pork

2) End point temperature

3) Cooking loss & Juiciness

References:

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cases of processing,

Chapter 7. Functional properties of raw meat

Since all processed meat products arise from raw meat materials, one must understand the importance of the functional properties as a carry-over from the fresh meat state into any further processing operation. So called functional property is defined as the physical and chemical characteristics which influence the behavior of muscle proteins in food system and during processing such as water finding capacity, fat emulsification, gelation, color, and solubility.

Processed meat products can be divided into two categories-comminuted and non-comminuted products. In all cases of processing, whether it is in fresh/frozen restructured, or cooked restructured products, or in the emulsified meat items, functional properties are simply measures of descriptive actions which result from behavoir of the muscle tissue's proteins, fat and water components.

There are three fractions of animal muscle proteins : myofibrillar, the contractile proteins or structural proteins which make up about 50 to 55% of the total protein, sarcoplasmic, the metabolic functioning proteins that make up about 30 to 34% of total protein; and stromal, the connective tissue proteins of approximately 10 to 15% of total protein. The composition of the muscle proteins are shown in Table l And the properties of these three fraction proteins are shown in Table 2 and 3. In the sarcoplasmic protein: myoglobin- pigment of muscle which predominates the meat color. The change of myoglobin can affect the color of fresh meat and processed meat, consequently, influencing the consumer's decision to purchase the products. It also affect the development of cured meat color. The myofibrillar fraction must be considered the most important group which influences the quantitative ability of raw meat to bind water, emulsify fat and form a gel structure upon heating. The another property will influence the above mentioned properties-the solubility of muscle proteins. All of these properties will be discussed as follows:

Table 7.1. The fractions and composition of animal muscle proteins

Fractions	Mammal muscle	Poultry muscle	Fish muscle
Myofibrillar	49-55%	60-65%	65-75%
Sarcoplasrmic	30-34	30-34	20-30
Stroma	10-17	5-10	1-3

Table 7. 2. The characteristics of muscle proteins

Sarcoplasmic	Water soluble	Enzymes, myoglobin
Myofibrillar	Salt soluble	Actin, myosin. troponin, tropomyosin, a. and actinin
Stroma	Mainly insoluble	Collagen, reticulin and elastin

Table 7.3. Major properties of soluble muscle proteins[1]

Property	Sarcoplasmic	Myofibrillar
Conformation	Globular	"fibrous"
Molecular Weight (average/range) Solubility	low (60.000 to 120,000) soluble In water or dilute salt solution	high (400,000 to 800.000) water insoluble; swells, hydrates water in low salt (0.25 to 0.3 molar); solubilizes in high salt (>0.4 molar)
Solution	low viscosity	high viscosity
Viscosity (at comparable concentrations)	Solutions	solutions
Water Binding Ability	very low	very high in the presence of salt
Emulsification (Fat Interaction)	thin films on dispersed fat/oil particles	thick, aggregated film coatings on dispersed fat/oil particles
Gelation Ability (Heat-Induced)	none (forms coagulum)	extensive (forms a protein matrix)

1 From Acton, J. C. and R. L. Kick (1985): Functional properties of raw materials. Meat International/ February, pp. 32.

1. Color

The red color of meat comes chiefly from muscle pigment and to some slight extent from blood pigment. The red muscle pigment, myoglobin, is to be found in the muscle cell. When a lot of oxygen is taken up by the myoglobin the color becomes bright red, like that of a freshly cut slice of fresh meat. The less oxygen is taken up the darker does the red color become. This marked willingness of the muscle color to react to oxygen also plays an important part in the production of meat products, especially frankfurter-type sausages. A central iron atom is a characteristic of the chemical structure of the myoglobin molecule. Myoglobin production in the animal body is therefore dependent, amongst other things, on adequate supplies of iron. As the muscle pigment is found in the muscle tissue the value determining constituent of any cured meat product becomes a determining factor in color formation. A strong cured color can always be obtained more easily in sausages that contain a lot of meat than in those with higher fat, connective tissue, or moisture contents. Generally speaking we can say: Insufficient muscle pigment means a poor cured color. Although this may seem obvious it is not always realized in the practice of frankfurter-type sausage manufacture and is often the simple explanation of inadequate color formation and color retention. The pigment content is dependent largely on animal species, feeding and age and on the part of the body from which It comes. The bovine muscle has myoglobin content about 300 to 400mg/100g meat. porcine muscle has

100 to 200mg/100g meat, and veal contains only 50 to 100mg/100g meat. PSE pork often contains more myoglobin than one would expect in this often very light meat. The accumulation of liquid on the surface and the open structure of the meat cause great absorption and scatter of light and this makes the meat appear very light.

Development of cured meat color: the simplified reaction mechanism of cured color development in frankfurter-type sausage shown in Pig. 1. The reaction is affected by heat treatment, curing time, pH of meat and salts. All meat products therefore have a mixed color made up of attractive red pigment compounds (myoglobin,oxymyoglobin and nitric oxide myoglobin) and unattractive met-myoglobin. However, one important aim in meat product manufacture must be to keep the met-myoglobin content as low as possible:

% Met Mb in total pigment	Color of the product
<30%	=deep red
30 to 50%	=red
50 to 60%	=brownish
60 to 70%	=reddish brown
>70%	=grey, brown

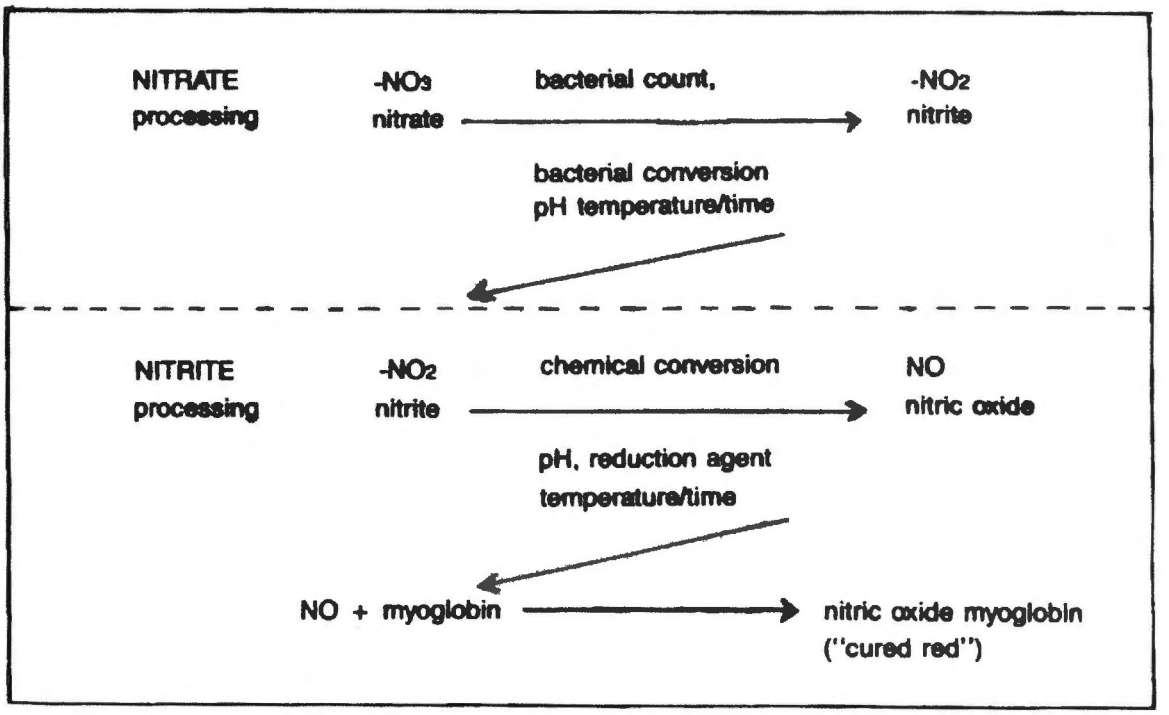

Fig. 7.1. Simplified reaction mechanism of cured colour development in frankfurter-type sausage.

2. Water binding:

Generally speaking water binding capacity can be defined as the ability of meat to hold fully or in part its own water while it is being processed. As the amount of water held in the meat depends on the Internal condition of the meat and its external treatment, the condition, treatment and method of measurement must be accurately known or described before anything can be said about the water binding capacity of the particular meat. Water of muscle tissue exists in three forms: bound water; immobilized water; and free water. Of the total water, only about four to five percent is tightly bound to protein molecules and is actually about one molecular layer in surface thickness relative to its intimate association with the protein's structure. We do not have to worry about this quantity in meat processes, as it is bound to protein very tightly; we can neither increase this amount nor decrease it.

There are many proteins closely associated with one another in the filament structure of muscle tissue, for instance, thick filament consists of many myosin molecules lying close to one another. Between the molecules of the filament there are more or less large numbers of water molecules, depending on the pH of the muscle or meat. This water is also bound, but not as firmly as the protein-bound water. It can be described as immobilized water and we call it filament-bound water. Actually, the bound water is described as the water molecules are bound to proteins so firmly that no ice crystals form even when frozen to -50℃. This type of binding water we call as protein-bound water. The water between the filaments of fibrils is similarly immobilized. This fibril-bound water is also regarded as being immobilized as a function of its pH. In contrast there is the water in the sarcoplasmic area, which moves about relatively freely and can be described as free water. But even this free water it is shut into the cell by the cell membrane. Finally, there is extracellular water which amounts to less than 10% of the total water in living muscle, but In meat can rise to more than 15%, depending on the postmortem changes. This water located outside the cells in long. narrow passages called capillaries in which it to fixed by what is known as capillary force. It appears only slowly on the surface of meat where it evaporates or drips off.

The factors influencing the WBC of muscle tissue are tissue pH. salt addition, and how extensively the tissue disrupted. Effect of muscle tissue pH on its water binding capacity has been described by Wismer-Pedersen (1971) (Fig. 2). Net protein charges are negative at pH values greater than 5.0 and positive of pH values lower than 5.0. The minimum of water binding capacity occurs at pH 5.0 where the net protein charge is zero. When salt is added to meat, as in most processing operations, there is a shift of the net zero protein charge to pH near 4.0 (see Fig.3). In effect, by addition of salt, we obtain a greater net negative charge at whatever the existing pH is

(normally pH 5.6 to 5.8), and the protein attracts more water, thus increasing its water binding capacity. Capillarity is not something we can control very well in fresh meats. Evidence that size of muscle fibers plays a role does exist, in that fine-grained fresh meat cuts do not exude as much drip loss as coarse-grained meat cuts. It is obvious from a textural view that there is more capillarity in numerous fine fibers than in fewer coarse fibers and as stated earlier, free water is held primarily by capillary action. In summary, we want as much water in the immobilized. restricted state as possible. for if retained, other than the higher yield resulted, a final cooked product will have greater juiciness. How much water will be retained is dependent initially on fresh meat factors related to the myofibrillar protein's behavior. and its carryover from fresh meat through heating to a final cooked product.

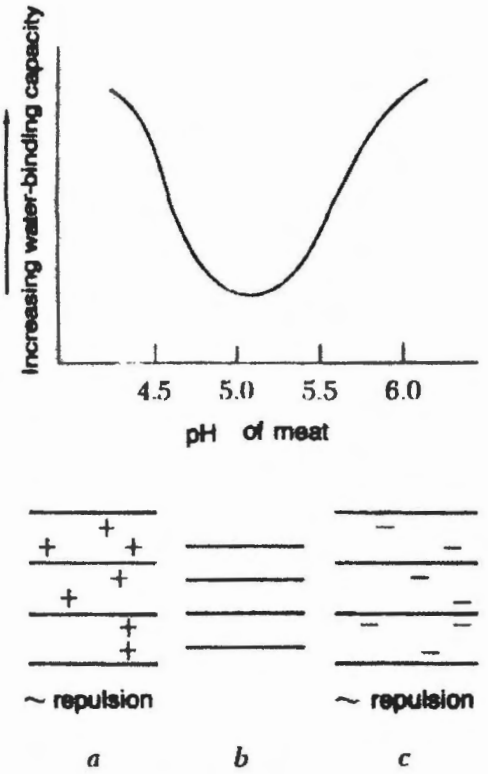

Fig. 7.2. Effect of pH on amount of immobilized water in meat through its impact on the distribution of charged groups on the myofilaments and size of space between them.

(a) Excess positive charges on the filaments

(b) Balance of positive and negative charges

(c) Excess negative charges on the filaments.

From: J. F. Price and B. S. Schweigert (1971): The Meat Sci. and Meat Products, 2nd ed. pp. 184.

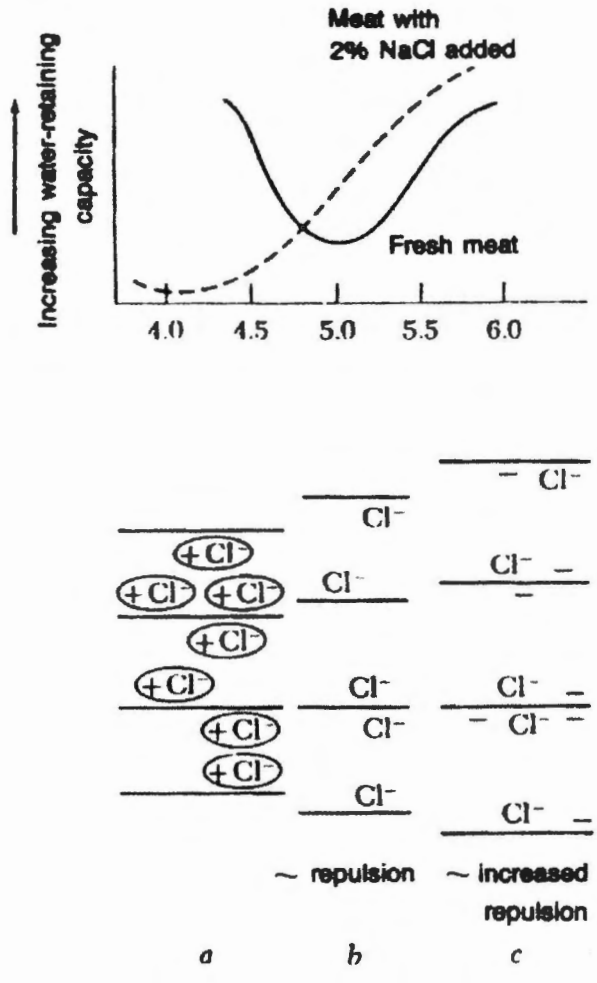

Fig 7.3. Modified distribution of charged groups on the myofilaments through addition of Nac1 and its effect on the amount of immobilized water in meat at various pH values, (a) Balance of positive and negative charges through C1- annihilating excess positive charges. (b) Excess negative charges through binding of C1-(c) Increased excess of negative charges through binding of C1-

From: J. F. Price and B. S. Schweigert (1971): The Meat Sci. and Meat Products, 2nd ed. pp. 185.

3. Fat emulsification:

An emulsion is defined as a dispersion of one liquid in a second immiscible liquid. A stable emulsion consisting of two pure liquids cannot be prepared. In order to obtain an emulsion, a third component, an emulsifying agent, must be introduced.

Generally, the introduction of an emulsifying agent will lower the interfacial tension of the two phases thus stabilizing the two phases (Becher, 1965). Meat emulsions are considered to be oil in water emulsion system, consisting of a fairly coarse dispersion of solid fats (disperse phase) in water (continuous phase) with protein being the emulsifying agent (Safne, 1968). In emulsion-type meat products such as frankfurter, bologna sausages and related items. the component phases are solids or semisolids and. therefore, possess somewhat different characteristics from a typical or classical liquid-liquid emulsion system such as salad dressings.

The processes in comminuted emulsion-type meat product processing have been summarized into three steps (see table 10) by Schutt (1976). The emulsifying capacity of raw meat materials is dependent upon the handling of meat. It has been stablished that pre-rigor meats are superior to post-rigor meats in water binding capacity, emulsifying capacity, emulsion stability and developing the desired texture of the finished product. Also. as the pH is increased, within limits, above the isoelectric point of muscle proteins an improvement in these functional properties is obtained. Fresh meats are superior to frozen meats and pre-blending of post-rigor meats with salt and water improves the functional properties of the muscle proteins over that of either prost-rigor fresh or frozen meats. Salt or selected phosphates assist in retaining the functional properties of pre-rigor meat even during the freezing process (Saffle. 1968; Tadic, 1971). The myofibrillar proteins are the muscle proteins primarily responsible for obtaining good functional properties in emulsion-type meat products (Schut and Brouwer, 1971). However, sarcoplasmic and connective tissue proteins play a role in emulsion stability and finished product texture but their roles have not been as clearly defined as that of the myofibrillar proteins. Myosin has been identified as the primary emulsifying agent in meat emulsion. The sequence of adding ingredients in the preparation of the emulsion influences the stability by the orientation of the muscle proteins to that of the water and fat (Waldman, 1973). Factors affecting emulsion stability are meat batter temperature in the cutter, or in emulsion-mill, salt, protein amount and type, particle size and heating process. These problems are not discussed here.

4. Gel-forming:

Protein gelation is another functional property of muscle proteins. This property is very important to meat processing both comminuted and non-comminuted meat products. The gel structure or protein matrix retains water and stabilizes fat in emulsion meat products and acts as a binder in restructured meat during heat process. The protein gelation involves changes which the myofibrillar proteins undergo in the temperature zone of heat processing after comminution for emulsion meat products or

blending-tumbling for non-comminuted products (from initial batter or blending temperature to final product temperature 65.6-71.1℃). The gel forming of muscle proteins has a two-step process shown as follows:

Native protein (as in raw meat)
↓ intermediately heating
Denatured protein
↓ heated up near 60℃
Protein aggregation to gel structure

Very simply, the protein changes are directly the result of heat energy but the order in which events occur are very important. The rate of heat input is very critical for protein gel formation. Since gelation is a two-step process, too rapid a heat input will result in driving denatured protein to aggregate before it is conformationally ready to form a suitable gel matrix. If this occurs, protein stabilized fat globules rupture the protein coating due to thermal expansion upon heating, and rendering of fat from a poorly formed protein gel matrix results. Additionally, less water is entrapped because the matrix is not properly form with enough capillarity to bind water. The best example is the busted or fatted out sausages. As was seen In Table 9, sarcoplasmic proteins do not form gel structures-they coagulate into a large particulate mass upon heating. However, the myoflbrillar proteins can form gel structures when heated. Gelation of the myofibrillar proteins is defined as the formation of a protein matrix capable of retaining water and dispersed fat particles.

Myoflbrillar proteins will form gel structures at salt concentrations as low as approximately 05% but its structures are weak. Optimum gel or protein matrix formation is at the salt concentration between 15 to 25% under considering salt self-limiting. And optimum pH conditions for gelation of myofibrillar proteins are found in the pH range of approximately 55 to 65. and pH 6.0 is best. Fortunately, most processed products fall within this pH range (pH 5.9 to 6.2).

What to the best rate of temperature increase for gel formation? Acton and Dick (1965) has pointed out that myofibrlliar proteins sols heated at a rate between 0.84 to 1.0℃ per minute will develop a good get structure. However, this rate is not suitable for all processed meat, it Is dependent on size and raw material compositions.

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Chapter 8. Microbiology of meat and meat products

Microbial changes in meat products

Fresh meat begins to undergo change from the moment of slaughter of the animal. These changes may be brought about by the meat tissue enzymes, by microbial enzyme action. and by oxidation of the lipids. The enzyme action in autolysis may include some proteolysis of the muscle and the connective tissues and slight fat hydrolysis. Excessive autolysis may produce "souring" which is very difficult to distinguish from microbial proteolysis. Preliminary autolysis may also make the meat product an even better substrate for microbial growth. A freshly slaughtered meat animal harbors very few bacteria inside the muscle tissues, and most of these are confined to the lymph nodes. Most of the bacteria isolated from the lymph nodes appear to be the types that would be intestinal origin. However, the surface of the meat is exposed to varying degrees of contamination during slaughter, evisceration, and other operations after slaughter. The microorganisms isolated from the surface of the meat and their action on meat are shown in Table 1.

Proper sanitation with respect to these operations can do much to control the level of this contamination. In any event, the carcass must be promptly and rapidly chilled to prevent extensive growth of contaminating microorganisms. Many genera and species of bacteria are included in this surface contamination. However, we are concerned only with those that may be pathogenic or cause food poisonings and those that may be able to multiply during subsequent storage and cause spoilage. Those organisms that grow most rapidly during the usual storage and handling conditions rapidly become the dominant flora. The microbiological flora associated with the spoilage of fresh meats have been isolated and shown in Table 2. Wholesale and retail cuts of fresh meat contain a mixed microbial flora limited chiefly to the surface. Meat held under proper refrigeration will generally develop a predominant flora of psychrophilic microorganisms. The most commonly encountered are Pseudomonas. *Achromobacter*, and *Flavobacterium*. These bacteria are aerobic and require a high aw for optimum growth. Other bacteria involved are *Lactobacillus*, *Microbacterium,* and *Micrococcus*. The mesophilic organisms would become important as the storage temperature increased to 15℃ to 20℃. Packaging the meat in oxygen-impermeable films favors the growth of lactobacilli, microbacterium, and micrococci, and lack of objectionable by-pro-ducts results in a longer shelf life. If the surface of unpackaged meat becomes relatively dry and temperature is 10℃ or greater, micrococci are favored. Yeasts and molds grow slowly on all unpackaged fresh meats and are favored when the surface dries somewhat. None of pathogenic or food poisoning bacteria grow at less than 5℃--- with the exception of type E *Clostridium botulinum*, which as

not been found on any meat products, and those capable of growth at 10℃ or less grow very slowly. The microorganisms most commonly associated with the spoilage of fresh meats are presented in Table 2.

The processed meat products differ from other fresh meats in that they contain ground pork or other meats and ingredients. Particularly, pork sausage has a somewhat short refrigerated shelf life because of the relatively large microbial population it contains. These phenomena resulted from the addition of large part of pork trimmings. The most common spoilage found is souring as a result of the growth and acid production by *Lactobacilli* and *Leuconostocs* between 0℃ to 10℃. *Microbacteria* and *Micrococci* may cause spoilage at higher temperatures. Pork sausage in natural casings may also develop slime on the casing or variously colored spots because of the growth of *Alternaria*.

The initial number of microorganisms present will change the quality of the processed meats. Undesirable changes in the meat pigment will produce a discolored cured product,. and high initial bacterial load may produce off-flavors and inferior appearance and texture.

The most common spoilage of cured meat products such as ham and bacon is souring and proteolysis. The microorganisms involved with spoilage of ham and bacon are summarized in Table 3. Since cured-type sausages are very popular meat product in Taiwan and also have some microbial problem with them, thus, in this paper. I would like to point out some changes caused by microorganisms.

Microorganisms will grow on the surfaces of sausages as the presence of sufficient moisture. This problem takes place when the cooked product is cooled the moisture in the air will condensed on the meat surface or the chilled meat remove to the warm circumstance, the moisture will condensed on the surface of the product too. Unpackaged moist frankfurters will develop a surface slime of micrococci and yeasts. Mold growth will occur upon longer storage as the surface dries somewhat. On the contrary, the vacuum packaging of frankfurters removes the available oxygen and stimulates the growth of facultatively anaerobic yeasts and hetero-fermentative lactic acid bacteria. They yeasts produce a surface slime while the lactobacilli may produce swells because of the formation of CO_2.

Bacteria can also grow within the sausages upon long-term refrigeration or during shorter periods at temperatures greater than 10℃ Some of genera encountered in spoilage of bologna-type sausages are *Bacilli, Micrococci. Lactobacilli*, and *Leuconostocs.* The latter three are acid producers and cause an undesirable souring. The pink color may fade at outer surfaces of the sausage product, producing a chill ring that may be caused by production of organic acids and reducing substances by bacteria, oxidation, or undercooking. Greening discolorations can occur in several

forms such as green ring, green cores, or a general surface greening in the sausage products. Greening can be the result of inadequate heat treatment or recontamination after processing. The microorganisms involved in greening are *Lactobacillus viridescens*. Greening is caused bacterial growth without apparent surface slime. Microbial formation of heat-stable peroxides occurs prior to heating with oxidation of the cured meat pigments by the peroxides after heating.

Table 8.1. The microorganisms isolated from the surface of the meat and thier action on meat

Class of Food Products	Genera Dominating When Spoilage Occurs During Standard Conditions of Storage
Fresh Meat	Gram-negative rods*, *Acinetobacter, Aerobacter, Aeromonas, Alcaligenes, Arthrobacter, Bacillus, Bacteroides, Citrobacter, Clostridium,* Corynebacterium, Enterobacter, Escherichia, Kurthia, *Lactobacillus, Leuconostoc, Microbacterium, Micrococcus, Moraxella, Neisseria, Pediococcus, Salmonella, Serratia, Staphylococcus, Streptococcus, Streptomyces* and *Thamnidium*.
Poultry	Gram-negative rods*, *Aerobacter, Aeromonas, Alcaligenes, Bacillus, Cryptococcus, Dospora, Eberthella, Escherichia, Lactobaciltus, Micrococcus, Penicillium, Proteus, Rhodotorula, Salmonella, Sareina, Steptomyces*, and *Streptococcus*.
Sausage. Bacon. Ham. Etc.	*Acinetobacter, Aeromonas, Alcaligenes, Arthrobacter, Bacillus, Corynebacterium, Debaryomyces, Lactobacillus, Leuconostoc, Microbacterium, Micrococcus, Moraxella, Neisseria, Pediococcus, Penicillium,* and *Staphylococcus, Streptococcus, Vibrio*, Yeast.
Vacuum Packaged Cooked Meat	*Achromobacter, Acinetobacter, Aerococcus, Arthrobacter, Corynebacterium, Coryneforms, Enterobacteriaceae, Kurthia, Laclobacillus, Leuconostoc, Microbacterium, Micrococcus, Pediococcus, Pseudomonas, Staphylococcus, Streptococcus, Vibrio*, Yeast.

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Table 8.2. The microflora associated with the spoilage of fresh meats

Product	Microorganism	Type of spoilage produced
Fresh meat	*Pseudomonas* *Achromobacter* *Flavobacterium*	Production of slime, greenish Discolorations, fluorescent pigments, white to colored spots (bacterial colonies)
	Lactobacillus *Microbacterium* *Micrococcus*	Sliminess or stickiness, souring *Micrococcusor putrefaction*

From : Price, J. F. and B. S. Schweigert(1971): The Meat Sci. and Meat Products, 2nd ed. pp. 255, W. H. Freeman and Co., San Franscisco.

Table 8.3. The microorganisms involved with spoilage of ham and Bacon

Processed meats Ham, cured	*Achromobacter* *Pseudomonas* *Bacillus* *Lactobacillus*	Various bone and meat "sours"
	Streptococcus *Clostridia*	Gas pockets in muscle, "gassy or puffers," greenish discolorations
	Micrococcus *Microbacterium* Yeasts	Surface slime

	Streptococcus Molds	Slime formation, white to colored spots or discolorations
	Lactobacillus *Micrococcus* *Streptococcus*	Slight souring in vacuum-packaged bacon
"Cured" sausages	*Micrococcus* Yeasts	Surface slime
	Lactobacillus	Gas production in vacuum-packaged frankfurters
	Leuconostoc *Micrococcus*	Chill rings (fading of cured color at outer surfaces)
	Lactobacillus	Greenish discolorations

From : Price, J. F and B. S. Schweigert (1971): The Meat Sci. and Meat Products, 2nd ed. pp. 255, W. H. Freeman and Co., San Franscisco.

In Taiwan area, we have done much work on the investigation of the sources of microbial contamination in meat and meat products. The results are shown in Table 4,5 and 6. As we know, the efficiencies of pasteurization and sterilization of food products are not absolutely hundred percent or completely, especially for meat products, thus. the initial microbial load is very important to the quality of final products, both of wholesome and safety. However, slaughterhouse and packing plant have to be concerned with raw meat quality to protect your products and consumers.

Table 8.4. The isolation and identification of the contaminated microorganisms of pork from different areas in Taiwan

地區 Local area / 菌名 Genus	台北 Taipei	台中 Taichung	嘉義 Chiayi	台南 Tainan	高雄 Kaohsiung	旗山 Chishan	鳳山 Fengshan	屏東 Pingtung	合計 Total	%
埃希氏菌 Escherichia	1	-	-	2	2	1	1	16	23	3.80
志賀氏菌 Shigella	7	7	2	-	-	2	2	29	49	8.09
沙門氏桿菌 Salmonellae	5	7	4	1	3	5	2	26	53	8.79
亞利桑那菌 Arizona	3	-	-	-	-	-	-	4	7	1.16
產檸檬酸菌 Citrobacter	3	-	-	-	-	-	-	5	8	1.32
克萊勃士桿菌 Klsbsiella	3	-	-	-	3	2	3	12	23	3.80
鉅桿菌屬 Serrateia	3	4	-	3	4	-	5	21	40	6.60
大腸桿菌屬 Enterobacter	4	2	-	-	3	-	-	9	18	2.97
金黑佛尼亞菌 E. Hafniae	12	7	3	-	6	-	4	19	51	8.42
變型桿菌 Proteus	2	2	2	4	2	1	3	29	45	7.13
普羅維典西菌 Providencia	4	-	3	4	4	-	2	7	24	3.96
金葡萄球菌 Staphylococcus	-	-	-	-	-	-	-	-	0	-
格蘭氏陽性球菌 G(+) coccus	5	1	4	-	6	-	13	20	49	8.09
產氣莢膜桿菌 Clostridium Perfringens	-	-	-	-	-	-	-	-	0	-
非腸內菌 Non-Enterobacter	15	20	7	17	18	29	11	99	216	35.64

Table 8.5. The isolation and identification of the contaminated microorganisms of meat -products

廠別 Brand / 分佈 Genus	A	B	C	D	E	F	G	H	I	合計 Total	%
埃希氏菌 Escherichia	-	-	-	1	-	-	2	-	2	5	6.33
志賀氏菌 Shigella	-	1	-	1	-	-	2	-	2	6	7.59
沙門氏桿菌 Salmonellae	-	4	3	-	-	-	-	-	-	7	8.86
亞利桑那菌 Arizona	-	1	-	-	-	-	-	-	-	1	1.27
產檸檬酸菌 Citrobacter	-	3	-	-	-	-	-	-	-	3	3.80
克萊勃士桿菌 Klsbsiella	-	-	-	-	-	-	-	-	2	2	2.53
鉅桿菌屬 Serrateia	-	-	2	-	-	1	-	-	3	-	3.80
大腸桿菌屬 Enterobacter	-	-	-	-	1	3	-	-	-	4	5.07
變型桿菌 Proteus	-	-	1	-	-	-	-	-	-	1	1.27
普羅維典西菌 Providencia	-	-	-	-	-	-	-	-	-	0	-
金葡萄球菌 Staphylococcus	2	2	-	1	-	2	3	1	-	12	15.19
格蘭氏陽性球菌 G(+) coccus	-	2	3	-	-	3	-	-	-	8	8.89
產氣莢膜桿菌 Clostridium Perfringens	-	-	-	-	-	-	-	-	-	0	-
非腸內菌 Non-Enterobacter	4	1	5	5	5	-	5	-	2	27	31.18
合計	6	15	14	8	6	9	12	1	8	79	

Table 8.6. Species and frequency of occurrence of contaminated bacteria isolated from meat and meat products in Taiwan

	Traditional slaughter house	Modern Sloughter house 1	Processing plant	Market	Total	Frequency
Escherichia	18	2	2	15	37	5.20
Shigella	15	6	9	23	53	7.44
Salmonellae	9	5	11	21	46	6.47
Arizona	0	0	1	11	12	1.69
Citrobacter	0	3	1	5	9	1.26
Klsbsiella	17	3	17	49	86	12.08
Enterobacter	44	8	27	77	156	21.91
Serrateia	20	3	15	35	73	10.25
Proteus	16	4	14	27	61	8.57
Staphylococcus	14	9	20	41	84	11.80
Clostridium Perfringens	7	0	2	23	32	4.49
streptococcus	10	5	6	42	63	8.85

Hurdle Technology and HACCP

1. Factors affecting microbial growth
   1) Nutrition
   2) Water activity-below 0.85 can inhibit most of microorganisms
   3) Temperature-<5℃ or above 60℃
   4) pH value:<4.6
   5) Oxygen or redox potential
   6) Competitors
   7) Inhibitors

2. Potential hurdle for food preservation
   1) Temperature (high or low)
   2) pH (low or high)
   3) aw (low or high)
   4) Eh (low or high)
   5) Modified atmosphere (CO_2, O_2, N_2, etc.)
   6) Packaging (vacuum packaging, active packaging, aseptic packaging, new edible coatings, etc.) Pressure (high or low)
   7) Radiation (UV, microwaves, irradiation, etc.)
   8) Other physical processes (ohmic heating, high electric field pulses, radiofrequency energy, oscillating magnetic field, ultrasonication etc.)
   9) Microstructure (emulsions, solid-state-fermentation, etc.)
   10) Competitive flora (lactic acid bacteria)
   11) Preservatives (organic acids, GDL etc.)

Chapter 9. Chinese-style processed meat products

Chinese-style processed meat products can be divided into the following categories. Sausages and roasted and spiced meat products occupied the most parts of production and consumption in these products. Thus, the author have collected and provided much information of manufacturing techniques in this book.

Table 9.1. Categories of Chinese-style Processed Meat Products

Category	product	characteristics	major technology
Non-comminuted meats			
Ham and bacon	Dried cured hams	dry cure, low Aw	dry curing, greening, fermented, maturation
	Jinghua cured ham Yunnan cured ham (Shangwei hotwe)		
	Bacon	dry curing or wet curing	curing, injection, drying
	Hunan lup-zou	pungent, salty	
	Guangdon lup-zou	smoked or non-Smoked	
	Salty pork	cured without nitrite	
Sausages			
	Lup-cheong	Reddish-brown, Small diameter Dried sausage Lower Aw.	Diced fat, course grinding, minced meat, fat speckled, curing, stuffing, dried at 50-60℃ for 2-4 days or 5-6 hr.
	En-cheong	fat speckled, Small diameter Dried sausage Lower Aw.	
	Harbin sausage	Salty	
	Wuhan sausage	salty and pungent	
	Guangdon sausage	sweet and dried	
	Taiwan sausage	a mingle taste	
	Liver sausage		
Dried meat products	Dried sliced pork	Dried sliced meat Aw0.65-0.75	meat is frozen, sliced, boiled, cubed, dried by air, oven, wood coal dried
	Zou-gan, Zou-jaw Zou-tyao Zou-shu		
	Neu-zou gan(dried beef) strip and slice		

	Zou-soon	Dried fibrous	Cooked, shredded, dried at high temperature with surface-scraping machine, fried with lard
Meatballs	Gong wong Fish balls Lion's head	fragile Elastic	grinding, emulsifying ,molding, cooking, cooling course ground pork
Meat loaf	Zou-gun	fragile	Grinding, emulsifying Baking, cooling
Fermented meat	Zou-kei	salty, sour	curing with high salt and steamed rice, fermented
Roasted meat products	Roasted pork Roasted duck Roastd goose	Crispy · crusty Simmered meat	Seasoning, curing and Roasting Meat and seasoning boiled for 30 to l50 min with seasonings and Chinese herbs and spices
Xiangdo		Heat processed, smoked ball-shaped sausage	Bladder casings, closed into a ball with string, sticks, balls are cooked in boiling water, smoked by burning low grade sugar.

Manufacturing Techniques For Chinese –Style Meat Products in Taiwan

In Chinese sausage processing, the procedure consists of grinding and blending the meat, seasoning and curing the batter, stuffing and cooking the product, and sometimes smoking the sausage. Careful selection of meat for sausage formulation is important in obtaining high quality products.

Regular pork trimming, which are used for most of Taiwan's sausage production, are trimmed from primal cuts and must be free of bone, skin, clots and bruises.

The fat content of the sausage usually does not exceed 25%. The small intestines of the hog are used for casings for most of the Chinese style sausages.

During the cooking and smoking process, the smoke house temperature is maintained at 74℃ and held there until the sausages internal temperature reaches 61.7℃ to 68℃. The humidity should be maintained at 78 to 80% to avoid excess drying.

The procedure for producing homemade type sausages is as follows:

1. Trim skin and connective tissue from pork.
2. Cut lean pork into strips (2cm x 1cm x 1cm) and dice chilled back fat into 0.6cm cubes.
3. Mix 7.5 kgs lean pork and 2.5 kgs of back fat with 90gms of salt (NaCl), 0.2gms of

Sodium Nitrate, 150gms sugar, 24gms of MSG, 7.5gms of white pepper and 60mls of wine.

4. Stuff into a small intestine hog casing.
5. Link at 10cm intervals and tie with string.
6. The sausages are then placed outside for sun drying for 2-3 days.
7. Final product is about 70% original weight.
8. Products stored at refrigerated temperatures.

The most famous and popular Hay-Chao (sausage factory) brand sausage procedure is described as follows：

1. Grind 34.1kgs of pork trimmings (85% lean) through a 1.3 cm plate. Dice 11.4kg chilled back fat into 0.6cm cubes.
2. Mix meat with 10% ice, 2% salt (NaCl), 1% MSG, 0.1% polyphosphate, and 0.012% sodium nitrite.

* Percentages of all ingredients are based on the weight of the meat.

3. Keep mixed meat in chiller (5-7℃) overnight.
4. Stuff into a hog or sheep casing.
5. Link at 12cm intervals.
6. Heat in smoke house (50-60℃) with smoking.
7. Hold at 15.5-18℃ for 24-48 hours prior to vacuum packaging.

* Finished products are very perishable and have not been, in all cases, cooked sufficiently to destroy *Trichinella spiralis* (a nematode worm that may be in an encysted larvae state in raw or partially cooked pork).

Chinese-style sausage basic formulations

Chinese-style sausages contain, apart from pork and fat, a considerable amount of nonmeat ingredients. According to the quality and quantity of pork used and ratio of lean meat to fat. Chinese sausages can be classified as:

special quality (70% lean pork, 30% fat)
average quality (60% lean pork, 40% fat)
commercial quality (35% lean pork, 65% fat)

An average basic formulation for Chinese liver sausages may be as follows: 50kgs of lean pork, 30 kgs of pork back fat, and 20 kgs pork liver.

To 100 kgs of meat and fat, the following non-meat ingredients are commonly added:

Water - up to 20 L; water is not included in sausage formulations in China's meat industry plants.

Sugar - about 6-12 kgs; in Singapore, sugar addition is often higher.

Salt (or nitrite salt)- 1.5-3.5kgs; the amount of salt added decreases with the increased quantity of soy sauce (which usually contains no less than 15% salt).

Light soy sauce (soy sauce without caramel) - about 1.7 kgs; in the PR of China the amounts added are 1-6 kgs, but may also be substituted by a mixture of monosodium glutamate, sodium chloride and water.

Chinese wines - "Mei Kuei Lo Chiew" in Singapore, Malaysia, Hong Kong. "Rose wine" in Singapore. "Anisado wine" in the Philippines; about 1.3 to 3.5 L.

Colouring agents - according to the country; in the PR of China they are rarely used.

Spices - cinnamon, and ginger among others.

Choice of meat

With Chinese-style sausages the whole secret of success is in the formulation with pork quality the single most variable factor. Although the methods of slaughtering and carcass dressing used in China and Southeast Asia are basically the same as those applied in Europe, there are some notable differences that influence the quality of the meat. Major differences encompass the frequent practice of skinning pigs and cutting up carcasses immediately after the slaughtering operation has been completed. The quality of the slaughtering operation, dressing , cutting and processing operations is often somewhat low due to improper and outdated tools along with a lack of specialized training.

The meat industries in China and Southeast Asia have never implemented chilling carcasses after slaughter on a large scale. Cutting of the pre-rigmarole carcasses is predominantely done in the horizontal position, with hot meat often used in sausage production. Frozen meat, if available, is also considered an appropriate raw material. In general, meat cuts from hams (leg), shoulders and loins are used for sausage production. Trimming are also used, but very little attention is paid to the grade of trimmings.

Non-meat Ingredients

There is a wide group of non-meat ingredients, which are of great importance in the production of Chinese style sausage manufacture. All ingredients mentioned are essential. Omissions from the recipe will lead to the decrease in product quality.

Added sugar is mainly in the form of commercial saccharose with mono-saccharides exceptionally used. Sugar, soy sauce (light) and wine are integral ingredients in Chinese style sausages. These ingredients contribute heavily to the organoleptic and keeping quality of the finished product.

Cinnamon (traditional Chinese cinnamon - Cinnamon Cassia) is a major spice ingredient of Chinese style sausages, used especially in Mainland Southeast Asia and Taiwan. Leaving aside ginger and galingale, the popularity of other spices is dependant upon the region or locality. Other commonly added spices include clover, Chinese anis (badian, Illicum Verum) fennel, garlic, pepper (white), roseleaf and five spice powder (Ng heding Fun).Commercial ready spice mix's are also readily available.

Imported spice mixtures are being increasing utilized in Southeast Asia. Monosodium glutamate ("AJINOMOTO") is occasionally used in Southeast Asia.

Nitrite (if used) is often added in the form of a commercial "Nitrite salt mixture". Colouring agents may also be used to enhance the attractiveness of Chinese sausage products. The colouring agent are usually natural in origin . For example; the red colour of cochineal - carmine red 4 - is used in Malaysia for colouring casings; achuete (annato), a red dye, is a carotenoid preparation obtained from the seeds of the tree Bixa orellana in the Philippines; angkhhak, an orange pigment traditionally produced rice in the Orient by Monascus purpureues and Monascus anka, is used in China as a general heat-stable food colourant for wine, bean curd, pork, duck and sausages.

Synthetic colours such as Amaranth (a red acid azo dye). Ponceau 4R (strong red to reddish orange), Erythrosine (brick red xanthane dye), among others are also common.

Jing-Hua dry cured ham

"Jing-hua" is a city in china which produces the most popular hams in the country. The Jing-Hua ham has an excellent flavour and is often used as a garnish as well as a main ingredient for such items as Honey Dew Ham, Jing-Hua Chicken with Ham, and stuffed Winter Melon with ham.

The production of "Jing-Hua" hams is similar to the production of country cured (dried cured) hams in the U.S and can generally be divided into three phases. The first is the curing period, during which the curing ingredients (a mixture 3.63 kgs salt, 1.36 kgs of sugar, and 85gms of sodium nitrate) are rubbed on all ham surfaces. Approximately 35.5gms of the curing mix is used per 454 gms (or 1 lb) of ham. The total amount of the curing mix should be applied at 3 intervals, with this allowing a more uniform salt penetration. During this time , generally about 30 to 40 days depending on the size of the hams, the products should be maintained at refrigerated temperatures.

During the second phase, hams are hung in the smokehouse and are subjected to a cool smoke but are not cooked. The smokehouse temperature is kept between

21-32.2℃ with the internal temperature of the hams usually ranging approximately 5.5℃ lower than the smokehouse temperature. The smoke is applied continuously for 2-3 days until the hams obtain a desirable amber or mahogany colour.

The third phase includes a long aging process. Hams are aged for 6 to 9 months (not generally accomplished under refrigerated temperatures) during which time the full flavour profile of the product is developed.

Dried Pork

Since the taste and texture of oriental dried pork is palatable to many people, this meat product has become a popular commercial product. The production process has changed drastically from the original homemade product to the commercially produced dried pork produced today.

Homemade dried pork product is produced from partially frozen ham or pork which is sliced paper thin, soaked in a curing mixture (25% sugar, 2.5% salt, 10% soy sauce, and 0.012% sodium nitrite. Percentages of these ingredients are based on the weight of meat used) for 24 hours. The pork is then placed (slightly overlapping) on a lightly oiled bamboo basket. The meat slices are then placed outside for air drying (Weather permitting) until the reach approximately 50% of there original weight. The meat slices are then cooked at approximately 150℃ on a grill until browned. This conventional manufacturing method requires a great deal of labour and time in addition to being unsanitary (or microbiologically unsound)depending upon the natural environmental conditions.

A new technique has been developed to produce a high quality, uniform, attractive, thin sliced, cured, dried, oriental pork product. This method utilizes chunks of pork which are injected with brine under high pressure. Following curing, a tumbling technique is used to aid in the even distribution of curing ingredients throughout the muscle tissue and increase the extraction of salt soluble proteins (helping "glue" muscle tissue back together).

Once the tumbling operation is completed the meat mass is placed into moulds and frozen. The frozen tissue is then sliced (0.2cm) and placed in an oven at 204.4℃ for drying and cooking. When the product reaches 55% of their cured weight, cooking is ceased and the product processing is complete. Advantages of the commercial process over the traditional process include saving in labor and time and superior colour and attractive appearance of the dried pork.

Meatballs

Comminuted, emulsion-type meatballs which are usually served in a soup are also a very popular meat product in Taiwan. A strong cohesiveness, elasticity and

fragileness are the usual desired characteristics of this type of product.

In the history of comminuted Chinese meatballs it was reported that a young man, showing pity for his mother who liked eating pork but had difficulty chewing traditional pork products, hammered pork to pulverize the meat tissue and make fragile meatball for her.

Traditionally, the processors placed the pork in a mortar and used a hammer to crush the meat. Due to a increase in the products popularity, manufacturing via a press machine has replace the hand-hamming process. Since the manufacturing of the traditional meatballs required pre-rigor raw meat obtained immediately after the carcass had been slaughtered, limitations on the meat ingredients and manufacturing time occurred, it also curtailed the distribution of the meatballs to neighbouring areas surrounding the processing plant.

The traditional method of production of meatballs has been described as follows：

1. Warm, pre-rigor pork is used as the meat ingredient.
2. Pork is placed in a mortar with salt (2%) and ice (10%).
3. Meat tissue is crushed with a hammer or press machine until the meat becomes sticky.
4. The smashed meat is mixed with other seasonings such as sugar (5.2%) and MSG (1%) in a blender.
5. The batter is placed in a freezer until it becomes firm.
6. The firm meat mixture is moulded into a ball shape and boiled in water.

* The percentages of salt, ice, sugar, and MSG are based on the weight of the raw pork.

The original meatball process did not lead itself to industrialization, with improved processing methods being developed by M.T. Chen (1980) and is as follows:

1. Chilled or frozen pork is used.
2. Meat and frozen fat are ground separately with the aid of a meat grinder.
3. 34.1 kgs (75 lbs) of lean ground pork (5% fat) is placed in the bowl of a blender or a mixing machine and blended (or mixed) for 5 minutes with salt (2%), sugar (5.2%) and polyphosphate (0.1%). This results in the extraction a some salt soluble proteins which acts as an emulsifier.
4. 11.4 kg (or 25 lbs) of ground fat is added and blended continuously for 2-3 minutes or until the mixture becomes very sticky.
5. The mixture is then placed in a freezer for 30 minutes to firm the tissue.
6. Balls (3cm in diameter) are made and cooked in a 80℃ water bath for 20 minutes.

Roast Pork

Roast pork is another type of Chinese cuisine which is popular in Taiwan. Traditionally, there are some basic techniques related to the success of preparing a good roast pork including the method of cutting, the seasoning, and the length of cooking. Systematic methods to achieve the best results for a roast pork for commercial application have been described by Chen (1983) with the procedures for smaller quantities described by Fu (1969) as follows:

1. Cut pork into strips which are 15.2cm (6 inches) long, 2.5 cm (1.7 inch)wide and 1.5 cm (1 inch) thick. Score each side with at least 4 slashes approximately 1.1 cm (0.25 inches) deep. Soak with marinade (5% green onion powder, 5% ginger powder, 4% sugar, 3% soy sauce, 1% seafood sauce, and 0.01% red food colour)

* Percentages of all marinade ingredients are based on the on the weight of pork used)

2. Hang pork strips on hooks and place in a charcoal oven at 204.4℃. Cover and roast for 8 minutes, place hooks on opposite ends (ie. turn meat upside down) and roast for an additional 7 minutes.
3. Remove from oven and cut into slices for serving

Chapter 10. Food additives commonly used in meat products

Food additives are very important to food processing, which play a vital functional role in food safety, nutrition, sensory quality, technological properties. However, the applications of food additives must be followed food regulation and instruction. When they are used over dosage it will cause trouble with food safety. This chapter the author would like provide some special food additives often used in meat processing. The other additives beyond this category the readers can refer the related books.

1. Common salt :

Salt is a staple in meat industry. It is used extensively in the preparation of cured meats and sausages processing. It is an essential ingredient in the preparation and processing of meat products. The basis of objective of salt applied in meat products can be classified as flavor enhancer, preservative, and conditioner.

Besides, it is very important for reconstituted meat and emulsion-type products to extract the myofibrillar proteins as a binder or emulsifier.

1) Salt is used in cured meat :

a. Primary functions : It imparts flavor and acts as a preservative by lowering water activity. An insufficient amount of salt will result in off-odors and flavors and, because of increased water activity, in color and shelf-life problems. In the formed and chunked hams processing, if salt is added insufficiently, it may result in low yield, poor binding and visual unacceptability. In hams and bacons, water holding capacity and cooking yield can be adversely affected by low salt dosage.

b. Important properties of salt for cured meats : a) Purity improves flavor, b) Rapid solubility reduces the time it takes to make curing solutions, c) adherence provides cling for dried cured, and d) Cleanliness prevents undesirable insoluble/extraneous matter that may plug injection needles.

2) Salt is used in sausages :

a. Primary functions : It imparts flavor, solubilizes and extracts myofibrillar proteins(salt soluble proteins) to form emulsions, and acts as a preservative. An insufficient usage of salt in cooked ,dry cured sausage and Taiwanese meat balls my cause a smeary surface of the products, or surface greening. The former is caused by insufficient amounts of salt-soluble proteins extracted to emulsify the fat. The latter is shortage of salt to retard bacterial growth.

b. Important properties of salt for sausages :

a) Purity improves flavor and keeping quality.

b) Cleanliness prevents undesirable, insoluble /extraneous matters.

c) Rapid solubility ensures optional protein extraction and emulsion formation.

d) Low metal contamination improves stability and protect from oxidative rancidity.

e) Uniform particle sizing ensures good mixing and dispersion.

2.Nitrate and nitrite

Many consumers are very concerned with the safety of addition of nitrate and nitrite in cured meat products and sausages to form nitrosamines which are a carcinogen. As the author remembered the food chemists tried to search for other chemicals which can replace of nitrate or nitrite added in meat products. Unfortunately, they failed to find any chemical being able to replace them. The functions of nitrate and nitrite are 1) to develop cured meat color-nitrosyl myoglobin and inhibit microbial growth especially *Clostridium botulinum* which may causes a mortal intoxication-botulism. Therefore, so far, there are not anything being able to play a role on both functions.

Nitrite usage level and its effects:

1. Meat products	level
Frankfurter-type sausage	60-80ppm
Sausage made from precooked ingredients	70-80ppm
Cooked cured products	80-120ppm
Dry sausage	100-120ppm
Raw ham	50-150ppm
2.Nitrite effects	
1)Color development(cured red)	30-50ppm
2)Aroma development(cured aroma)	20-40ppm
3)Preservation effect(microbiological inhibition)	80-150ppm

Inhibit *Clostridium botulinum*, *Salmonella* spp. and *Staphylococcus aureus* etc.

4)antioxidant effect

3.Cured meat color development

Potassium Nitrate(KNO_3) ----------→ KNO_2

$KNO_2 + CH_3CHOHCOOH$ ----------→ $HNO_2 + CH_3CHOHCOOK$

$2\ HNO_2$ ----------→ $NO + NO_2 + H_2O$

Myoglobin(Mb) + NO(nitric oxide)----------→ MbNO

(Nitrosyl myoglobin---cured meat color)

MbNO + heat ----------→Nitrosyl hemochrome(cooked cured meat color, pink)

4.Regulation of residue level :No more than 70ppm

3. Phosphate

Function of appropriate phosphates:

Acidulant : Monosodium phosphate, sodium acid pyrophosphate, phosphoric acid.

Buffering agent : Sodium tripolyphosphate, tetrasodium pyrophosphate, trisodium phosphate.

Dispersing agent : Sodium hexametaphosphate, sodium tripolyphosphate, sodium acid pyrophosphate, tetrasodium pyrophosphate.

Emulsifier : Trisodium phosphate.

Protein modifier : Disodium phosphate, sodium acid pyrophosphate, sodium hexametaphosphate, sodium tripolyphosphate, tetrasodium pyrophosphate, trisodiumphosphate.

Sequestrant : Sodium acid pyrophosphate, sodium hexametaphosphate, sodium tripolyphosphate, tetrasodium pyrophosphate.

To select an appropriate phosphate used in meat processing and dosage is very important to quality of the product. The regulation of level added in meat products is below 0.5%. It is used at the level above 0.3% which will cause the product tasted astringent.

4. Glycerin, sorbitol, manitol

They are used as a softener in meat products, especially in pork jerky.

5. Potassium sorbate

It is used as antifungal agent. The sausage can be dipped in a solution containing 2.5% potassium sorbate to prevent mold growth.

6. Organic acids

The function of organic acid is used to inhibit microbial growth. They are citric acid, malic acid, tartaric acid, acetic acid, and lactic acid. They can be used by individual or combination. Here is a formula of organic acids used to dipping or spray the surface of the products to reduce the microbial contamination.

2.0% acetic acid, 1.0% lactic acid, 0.25% citric acid, 0.1% ascorbic acid which are added water to make up to 100%.

7. Ank rice or ank red

A colorant produced from steamed rice fermented by *Monascus anka* or *Monascus purpureus.*

8. Herbs and spices often used in Chinese-style meat products.

In general, the level of dosage is at 0.1 to 0.2% on the basis of raw meat weight.

They are:

Star anise, clove, cinnamon, bay leaf, nutmeg, cadamon, cumin, fennel, basil, licorice, cassia bark, tangerine peel, wild pepper, black pepper, white pepper, paprika, chili, ginger, garlic, Chinese angelica, kaempferol, coriander, sesame,

galangal, onion, amomun, tumeric, purple perilla, caraway, fagara, five spice powder and so on. These herbs and spices not only impart the special flavor to meat products, but also possess some functions such as antioxidant, antimicrobial and health effects. The author also suggest the processors can try to use the western herbs and spices to develop new formula of sausage or processed meats. Five spice powder is a very popular spice used in Chinese-style meat products.

It has different compositions which are showed as follows:

Formula 1. Clove, cinnamon, nutmeg, amomun, and kaempferol

Formula 2. Cinnamon, star anise, fagara, fennel and dried ginger.

Formula 3. Fagara, cinnamon, star anise, pepper and tangerine peel.

Formula 4. Cinnamon, star anise, kaempferol, amomun, licorice, ginger powder, fennel.

9. Rock sugar is used to replace of can sugar in some products.
10. Meat-based proteins used in processed meats.

◆Protein ingredients play a vital role as a functional and essential component in meat products
-Cost effective ingredients that add value -Functional benefits - improve product texture, increase processing yield, enhance product flavor, improve emulsifying capacity, reduce syneresis - Nutritional benefits - source of energy required for growth, good amino acid profile, protein digestibility and bio-availability
◆Collagen Proteins
-Is the main component of tendons, bone, cartilage, skin, vascular tissues of mammalian and avian species -Improves water retention, sliceability , texture and succulence of meat products (whiting, 1989) -Collagen (in the form of hydrolyzed gelatin) - promoter of human well being -Maintain joint and bone health -Collagen proteins can be modified to improve functionality through the immobilization of free water (Prabhu and Doerscher, 2000) - Collagen proteins work synergistically with meat proteins to bind fat, water and other components (Prabhu et. al., 2000)
◆Plasma Proteins
-Plasma is a colloidal suspension of 90% water and 10% protein -Plasma proteins have excellent solubility, low viscosity and the ability to form strong, elastic, irreversible gels hence it is an ideal protein to used in retorted products -Plasma can emulsify fat similar to meat proteins - Two distinct regions: one hydrophilic (water loving) and one hydrophobic (fat loving)

◆Meat Stocks
-Meat stocks are obtained derived from the cooking of animal bones and adhering meat - Meat stocks can be used to enhance meat flavor that lost during processing or due to high level of extension of meat products - Increases protein content

Glucono delta lactone.

Glucono delta lactone (GDL) is a natural constituent of many foods. It can be found in honey, fruit juices, wine and many fermented products. As a natural food acid it contributes to the tangy flavor of various foods and since it lowers the pH it also helps preserve the food from deterioration by enzymes and microorganisms.

Glucono delta lactone is regarded as a GRAS (Generally Recognized as Safe) food additive. In processed foods, GDL functions as a curing and pickling agent; leavening agent; pH control agent; and sequestrant. From a nutritional standpoint, GDL is a carbohydrate.

Glucono delta lactone is unique among food acidulants because of its lactone formation (see Figure 1). In an aqueous solution there is an equilibrium between gluconic acid and the delta and gamma lactones.

This change in molecular form contributes to its flavor and unique chemical function. GDL when mixed in an aqueous solution initially tastes sweet and then slowly hydrolyzes to an acidic flavor. The final flavor of an aqueous solution is much less tart than other common food acids.

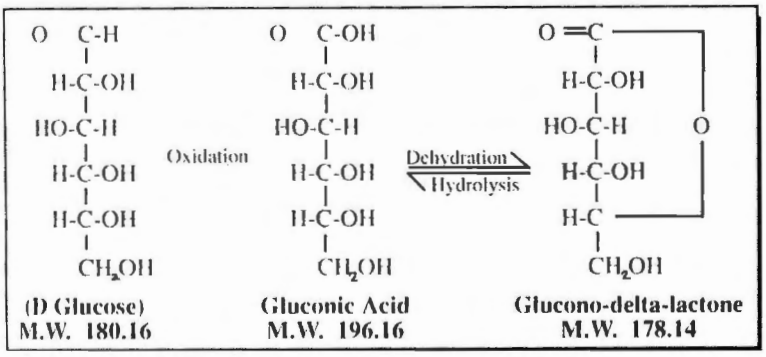


Figure 10.1

In addition, this slow hydrolysis or chemical change from the lactone to the acid allows GDL to function in food.

In a comparison of nine organic acids (Table 1) Furukawa et al.$_3$ reported that sour taste is mainly associated with pH and to a lesser extent with the degree of acid dissociation. Sourness was more intense in fumaric > tartaric > malic > acetic >

succinic > citric > lactic > ascorbic and > gluconic acid (GDL). Rubico and McDaniel[4] using free choice profiling of acids indicated the relationship between astringency and pH was more evident than was the relationship between pH and sourness. Other comparisons of food acidulants have further substantiated the mild flavor of GDL in solution.

The rate of hydrolysis from GDL to gluconic acid in an aqueous solution is influenced by both temperature and pH. The final pH of the solution is directly related to the concentration of the acid in the solution. Graph A depicts these relationships.

Table 10.1 Acid Taste Comparison

Organic Acids	Relative Sourness	*Acid Equivalent
Citric	100	100
Tartaric	140-147	68-71
Lactic	91-96	104-110
Fumaric	178-185	54-56
Malic	128-137	73-78
Succinic	112-116	86-89
Ascorbic	46-48	208-217
Acetic	115-139	72-87
Gluconic (Glucono delta lactane)	29-35	282-341

*Amount Of Organic Acid Needed To Taste Like 100 grms Citric

Reference: The Taste Tests Of Organic Acids, Furukawa et. al.

Meat products have historically been preserved using fermentation, curing and smoking. GDL is used to enhance modern meat preservation techniques by reducing the level of nitrite required, accelerating the curing process and producing a more shelf stable product. The use of GDL in meats has flourished in Europe where it has been found to be a valuable adjunct to "old world" processing techniques.[12] The latest trend in meat processing using "HACCP Hurdle Technology" includes using strict pH control among its critical control parameters to achieve product safety. Glucono delta lactone is a preferred acidulant because of its slow hydrolysis and mild flavor. The flavor of the other common organic acids can often overwhelm delicate meat and spice flavors.

The amount of GDL which may be added to sausage is often regulated by government authorities. In the United States, GDL is allowed to be used in sausages at a level of 8 oz per hundred pounds (5g/kg) of meat. Except Genoa sausage where a 1% level (10g/kg) is permitted. GDL use is balanced with other ingredients such as

salt, nitrite, sorbic acid, etc. to control water activity and achieve optimum shelf-life.

GDL can also be used in restructured meat products. A dry binder is mixed with raw meat to form restructured patties, roasts and other meat products. Based on the weight of the raw meat, the binder contains 1% sodium alginate, 0.2% calcium carbonate and 0.3% GDL. The binder mixture must not exceed 1.5% of the products content and must be added in dry form. The ingredients used in the binder must be shown on the product's label.

When used at a level of 0.5%, GDL can markedly reduce the growth of lactic acid bacteria and extend the shelf life of vacuum packaged pork liver pate.

Chapter 11. Cured meats-ham and bacon

Manufacturing and Characteristics of Chinese-Style Dry-Cured Ham

Introduction

Chinese began to manufacture dry-cured ham from Sung Dynasty. There have been 800 to 1000 years of history. It can be divided into three categories by locality of production. The cured ham produced in northern part of Yangze River is called Pei-Twe (north ham), southern part is called Nan-Twe (south ham), and the cured ham produced in Yunnan, Szechwan, and Kweichow areas is called as Yung-Twe. The producing areas are located in Chekiang, Yunnan, Kiangsi, Szechwan, Kiangsu provinces. The famous dry-cured ham is produced in Jinghua, Chekiang and Shangwei, Yunnan. However, the processing is still followed the traditional method. The masters even regard the processing procedures as the national secret. Therefore, the quality and market are limited and technique has not been improved without experience exchanged. In order to improve the quality the method or modern technology have been introduced. The paper will discuss about the manufacturing of dry-cured ham in China.

Quality of fresh ham

Jin-Hua ham is one of the famous products in China. This is due to the ham is made of fresh ham from "Liang-Tou Wu" a breed of pig with black head and tail. Liang-Tou Wu pig has thin skin, slender bone, but now it may be not only source of fresh ham. The fresh hams are supplied by local butchers. The problem is that the fresh hams are not cooled and resulted in bone sour at aitch bone, the thickest site of ham. The processing area is dirty, the hygiene is poor and the process is so climate-dependent. These problems may retard the industry progress if they are not solved.

Table 11.1. Fresh ham quality evaluation

Desirable	Undesirable
1.Weight is at 5 to 6.5 Kg	1.Too big or too small
2.Leg and feet are slender	2.Toe is too big, leg is too fatty
3.Skin is thin and clean	3.Skin is thick, pores of skin are coarse and big
4.Meat is bright red and tender	4.Meat is dark red and too soft or red
5.Subcutaneous fat is clean and white	5. Subcutaneous fat is dark or yellow

Classification of hams

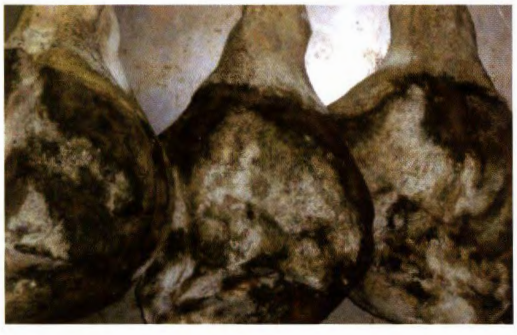
Chinese dry-cured hams are classified by locality (Table 2) and shape or appearance. It can be classified by shape into bamboo-leaf ham, loquat ham, round ham and square plate ham.

Table 11.2. Requirements of different famous dry-cured ham manufacturing

Name	Season	Curing Method	Methods of salting	Shape of ham	Salt usage(%)	Market season
Jinhua, Chekiang	Beginning of winter to spring	Dry-curing and piling-up	Sprinkling salt on the ham surface	Bamboo-leaf	7-8	m.a.
Ru-Nieh,Kiangsu	Same as the above(SAA)	Same as the above(SAA)	Same as the above(SAA)	Bamboo-leaf or loquat	10-12	m.a.
Eng-Su.Hu-Peh	SAA	SAA	SAA	Bamboo-leaf	8	m.a.
Da-Hsien, Szechwan	SAA	SAA	SAA	Bamboo-leaf	8.1	m.a.
An-Fu,Kiangsi	SAA	SAA	SAA	Bamboo-leaf	6-7	m.a.
Shang-Wei, Yunnan	From Oct. 23 to beginning of spring	Dry-rubbing	Sprinkle salt on ham skin and feet	Loquat	7	m.a.
Her-Chin,Yunnan	SAA	Pickling by soaking	Meat and skin surface by injection, sprinkled salt, spread wine, and rubbing salt. Place cured ham in crock and sealed	Disc-shape	8-15	Lunar calendar June
Man-Hsien, Szechwan	SAA	Pickling by soaking	Rubbing salt and soaking in crock	Rhombic	8-10	Lunar calendar October

1.SAA: same as the above

2.m.a.: midautumn



Curing methods

In Principle, dry-curing and piling-up, dry-cured by rubbing and piling-up, and wet-curing (pickling) are the most popular methods which are used in the mainland China for manufacturing of hams. However, the purpose of all methods is to remove the water from the hams.

1. Dry-curing and piling-up method : generally, total amount of salt used is divided into several portions and sprinkled on the surface of fresh hams (lean meat) every 4-5 days, separately, and let salt penetrate into meat gradually, then placed the cured hams on the ham bed for dehydration.
2. Dry-salt rubbing : grinding salt fine and rubbed on fresh ham surface vigorously, then piled-up on the ham bed.
3. Wet-curing : place fresh hams in vat and pressed with stones or bricks.

Improved procedure

1. Pre-chilling of fresh ham : selected fresh hams are chilled at 0-5℃ to internal temperature down to 7-8℃.
2. Trimming fresh hams into bamboo leaf shape.
3. Curing in cooler at 6-10℃ (average at 8℃) and 75-85% (average 80%). The usage of salt is 3.25-3.5% by weight of ham in winter, 3.5-4% in spring and autumn, while 4.0-4.25% in summer. The salt is sprinkled on the ham by 4-6 times separately. Totally, it is cured for 20 days.
4. Washing and brushing of salted ham in warm water at 20-25℃ and remodeled into bamboo leaf shape and hanging on and dried in the air at 15-25℃ (average at 22℃) and RH 70% . Meanwhile, correcting the shape of hams like bamboo-leaf. Then changing position of hams every four or five days. Finally correcting the shape of hams. Totally the cured hams are dried in the air for 20 days.
5. Accelerating conditioning at high temperature : The hams are hanged on the rack and accelerated to ferment at 25-30℃ (average 28℃), then elevated the temperature to 30-35℃ (average 33℃), RH 60% . During conditioning the position of hams must be changed every 3 or 5 days. The total time of conditioning is taken 35-40 days.
6. Piling up in the great height for aging : pile the cured hams by 8 to 10 layers. The room temperature is controlled at 25-30℃, RH 60% . The cured hams are turned upside down every 3 to 5 days and oiling (tea oil, vegetable oil and ham fat) to make meat tender, more concentrate aromatic. Total aging time is taken 10 days, then the final products are obtained.

Table 11.3. Sensory quality of dry-cured ham

Grade / Items	Good	Fair	Worse(inedible)
Color	Cutting surface of meat appears deep rose red or peach-red color, fat tissue shows white or slightly red and glossy	Same as good grade but only fat shows light yellow and less glossy	Cutting surface of meat shows dark red and spots with different color, fat shows yellow and non-glossy
Texture	Firm and flat surface of cut	Slightly soft	Loose, soft and sticky bone and bone marrow, remarkably
Flavour	Special aromatic or flat aromatic flavour	The product shows moldy or slightly sour	Off-flavour and off-odor, seriously sour

Table 11.4. Maximum level of quality for Chinese dry-cured ham

Trimethylamine (mg/kg)	=13	13-20	>20
Peroxide value (meg/kg)	<20	20-32	>32
Sodium nitrite (ppm)	<20	20	>20

Source: Zhu, Shangwu (1988): Dry-cured: Technology and analysis of composition. Symposium In 44th ICoMST, Spain.

Consumer acceptance

Good quality dry-cured hams should have a standard shape and clean appearance. The lean: fat ratio should be higher than 65:35. The skin is bright yellow. The color of lean meat is dark rose or pink and fat is white or reddish with glossy (Table3).

Ham quality is mainly determined by its aroma. Three special positions are chosen as check points. The first at the seam between leg bone and tibia, the second is at the seam between leg bone and ilium and third is at the hollow place between sacrum and ilium. Insert bamboo sticks into these three positions, sticking depth being 1/3 to 1/2 of ham thickness. To smell them as soon as they are pulled out. If three sticks smell aromatic, the ham is graded as A. If two sticks smell aromatic, the ham is graded as B. If only one stick smell aromatic, the ham is graded as C. No stick should smell stink. Trimethylamine content, nitrite content and peroxide value of ham should be determined (Table4). Table 5 shows the maximum levels of different levels of different grades as permitted by the Chinese Ham Standard.

Because Chinese dry-cured hams are rather salty, the consumers usually cook it with pork, beef, chicken, duck, fish and vegetables etc. Ham imparts its excellent flavour to other foods and blends well with other foods.

Table 11.5. Quality Standard of Jin-Hua Ham

Grade	Flavor Test	Meat Quality	Weight (kg)	Appearance
AA	3 testing sites are desirable	Higher lean meat but less fat; plump M. bicept	2.5-5	Bamboo leaf shape, thinner skin, straight leg, flat skin surface, yellow and shinning, no hair residue and blood spots, no hurt, and insect and rodent bite, Clean and perfect shape, branded clearly
A	Aroma of two sites are good but 3rd one is fair	Less lean but center of ham is plump	2.0	No knife scar, no blood spots, other conditions are same as Grade AA.
B	One site is good but other two sites are j ust fair	Center of ham is slightly flat and thin but ends of ham are slightly salty	2.0	Coarse skin surface, no insect and rodents bite, cutting edge carefully, no hair residue, toe bent, leg straight, bamboo leaf shape, and branded clearly.
C	One of three sites is off-flavor but not putrid	Tested saltier	2.0	No rodent bite, cutting skill slightly worse, branded clearly.

Reference

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2. Huang, D. C. and S. S. Chang (1998). New Technology and Formulations of Meat products, pp.2289-310. Chinese Light Industrial Publishing Co., Peking.
3. Zhu, S. W.(1998). Dry-Cured Ham in China. Proceedings for Symposium on Dry-Cured Ham Technology, pp. 185-188. In 44th ICOMST. Spain.

Table 11. 6. Chemical Composition of Dry-Cured Ham(lean meat part)

Processing method	Moisture, %	Crude protein,%	Salt content,%	Ash, %	Iron, mg%	Phosphorus, ppm	Calcium, ppm	Na-nitrite, ppm	TMA-N, ppm	TVA-N, ppm
Improved Method	49.6	35.8	8.1	9.4	3.5	29.0	N.D.	24.1	6.72	73.8
Traditional method	40.6	34.1	9.8	12.0	4.9	21.2	0.2	-	8.12	84.0

TMA-N: Trimethylamine-N

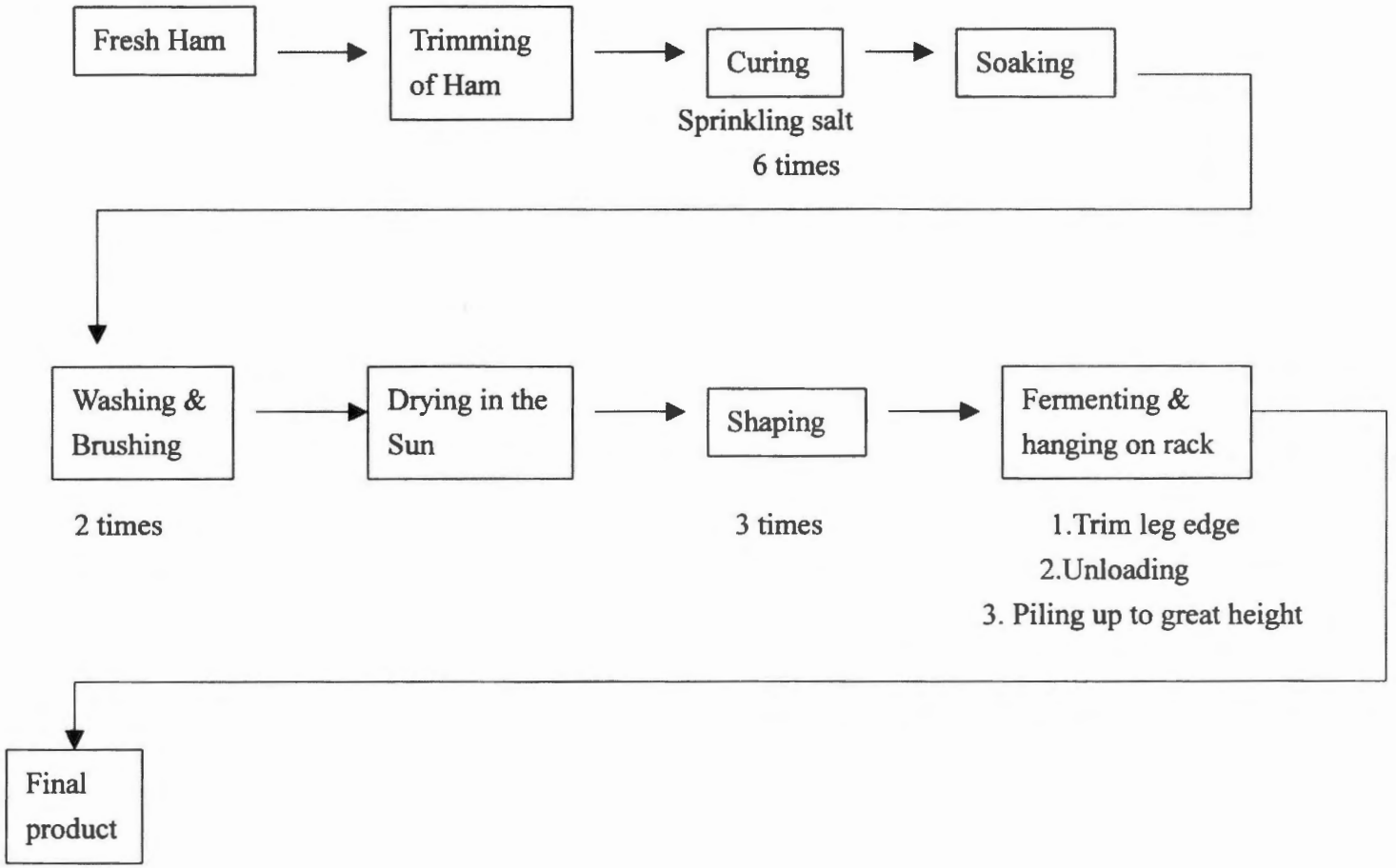
TVA-N: Total Volatile Ammonium-N

Table 11. 7. Properties of Fat part of Dry-Cured Ham

Method	Acid value	Peroxide value, %	TEP, ppm	Sodium chloride%
Improved method	14.5	0.75	14.6	0.44
Traditional method	29.1	0.88	24.4	1.22

TEP:

Procedures for Dry-Cured Ham Manufacture



Rubo dry Cured ham

Raw meat: pig hind leg(ham), 100kg

Ingredients: salt 12 kg

Processing procedures:

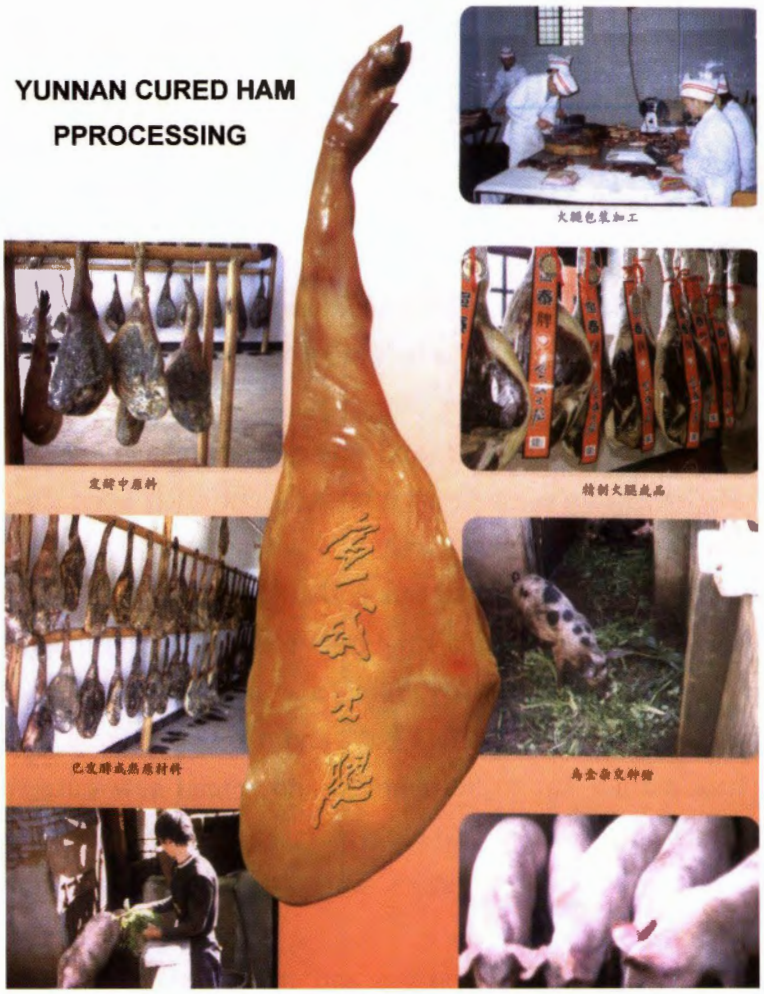
Dry cured ham in Rubo is processed from winter to the beginning of spring when it is snowing and temperature cold down. It is better to control the temperature at 2-l0℃. The product is processed at beginning of winter which is called as early winter ham; and the product is made in middle of winter season which is called as real winter ham; while the product made at the beginning of spring is called as early spring ham, and the product made in the late spring is called as late spring ham.

1) Selection of leg (ham): To select the pig with small head and fine leg, thin skin and meat tender at the life weight of 60-80 kg. After slaughtering chill carcass at -l-4℃ for 12 h. It is required that back fat thickness is below 3 cm, and hind leg weight is 4-7 kg.
2) Trimming of leg: Burn the ham surface hair, and brush to clean, remove blood residue, then trim the leg(ham) into a shape of lute. And cut aitch bone do not appear and trim off visible fat and connective tissue.
3) Curing: In general, salting is divided into five times, the first salting followed by second salting at second day, the third salting time is at fourth day, fourth salting time is at 9^{th} day, fifth salting time is at 16^{th} day. Salt is also divided into five parts, 2kg, 5 kg, 3kg, 1.5 kg and 0.5 kg for 1^{st}, 2^{nd}, 3^{rd}, 4^{th} and 5^{th}, respectively. When salting the salt on the ham surface has to be removed and spread new salt every time. After salting the hams are piled on the racks carefully, don't make salt to escape. The height of piling is not over 20 layers, for homemaking is not over 5 layers.
4) Washing and sun-drying: After salting the salted and maturated ham must be washed and dried by sun(generally, salting time 30 days in winter, and 25 days in spring). Dip the salted ham in the clean water for 12 -18 h, then brush and wash smear and dirt from the surface of the ham, and drain.

   After washing, place on the racks for sun-drying. During drying the ham must be remodeled., and make tiptoe into right angle and meat firm, surface clean. Drying time 7-9 days in the clear winter and 6-7 days in the spring, which depending the climate and the skin surface becomes golden yellow. Then remove to fermenting room and pile on the rack for fermentation.
5) Holding fermentation: Holding and fermenting are the key processing for assuring a special quality. During fermentation, holding room must be inspected often, and aeration. Generally, the windows of holding room are opened in clear day and closed m raining day. In high temperature days, the windows are closed daytime,

and opened at night to maintain the molds growth normal. Fermentation time is about 5-6 months.

Before the raining season the legs must be taken to spread vegetable oil or lard to prevent insects and oxidation of fat, water loss to keep cured ham flavor traits.



Yunnan cured ham processing

Jinhua cured ham and Xuanwei cured ham are the famous cured ham in China. Xuanwei cured ham is one of the traditional meat products in Yunnan province, the southwest part of China. It is famous for its rose-red color, intense flavor, desirable taste and typical shape like Chinese instrument-pipa, very preferable to consumers. The production of cured ham is more than 15,000 metri tons per year currently, and most of the products are exported to Asian countries.

Some studies on ingredients and processing conditions of dry cured ham have been reported. Leak et al.(1984) studied the effect of tumbling and tumbling time on quality and microflora of dry-cured hams. Careri et al.(1993) studied that sensory property related to chemical data of Italian-type dry-cured ham. Gou et al.(2004) worked on the brine diffusability in muscle tissue of dry-cured ham at different processing time.To improve the cured ham quality to meet the new industrial procedures of manufacturing and consumers' demands, the number of researchers have increased in the study of the processing techniques of Xuanwei cured ham( ). For increasing the lean content of ham, legs from different genotype of pigs(local Wujin breed and Wujin x Duroc cross breed) were processed to study the cored ham quality(Hongsheng, 1987). Consumers need less salty meat products because of health recommendation to reduce hypertension(Morgan et al., 2001), in order to reach this aim, it becomes very common to decrease the salt content of Xuanwei dry-cured ham(Zhaofen, 1988). There are so many molds growing on the surface of the traditional Xuanwei cured ham, but, as Dongfu(1990) studied the relationship between microorganisms and cured ham quality and found that yeasts were important to the development of cured ham quality traits. Some special species of microorganisms were isolated from the traditional Xuanwei cured ham and the selected strains were cultivated in ham to study the function of microorganism on the cured ham quality, then to process a new type of cured ham(Huang, 2003). The physical and chemical properties of dry-cured ham affecting many quality traits such as color, flavor, taste and rancidity development(Bailey,19 ; Cutting,19..; Enser and Rhodes, 19..), and volatile compounds in Xuanwei cured ham have been studied(Ping, 2004; Fadong, 2004). Changing the traditional cured ham processimg procedure such as longer processing time and seasonal processing method to adapt to the new industrial procedures of manufacture and marketing of Xuanwei cured ham is necessary. The purpose of this study was to evaluate the influence of different ingredients and processing conditions on the chemical composition and quality of the Xuanwei dry-cured ham.

Processing procedure

Green legs: The legs are obtained from the carcass and held in a cold room at 4-8℃ and 65% RH, 24 hours for ripening.

Method 1:

The legs are salted with 5% common salt and massaged by hand for 5 min (traditional method). The legs are salted with curing mixture of 5% NaCl, 1.2% sucrose, 0.2% polyphosphate, 100 ppm sodium nitrite and 400 ppm sodium ascorbate and massaged for 25 min to increase the ingredient diffusing rate.

Method 2:

The legs are salted with the same ingredients as method 1 except without sodium ascorbate and massaged by hand for 10min.

Method 3:

The legs are injected to increase their weight by 10% of curing solution consisting of 24% NaCl, 2.5% sucrose, 0.5% phosphate and 100 ppm Na-nitrite by using a high pressure multi-needle injector.

All hams are salted and stacked on pallets in a cold room at 4-8℃ and 75-85% RH for salting 21 days. Thereafter, the hams are moved to another room at 10-15℃ and 50-60% RH and holding for drying 40days. Temperature is then increased gradually from 15 to 25℃ and RH% also is increased progressively to 65% for ripening 120 days. The process takes 180 days totally, the chemical and sensory properties of the cured hams are determined during different processing stages.

Physicochemical and sensory analyses

Diffusing rate of ingredients into ham: After 7 days and 15 days salting, one ham is taken from each group. From each ham two adjacent samples (S1 and S2) are cut in perpendicular to the surface from the central part of the lean surface by about 5 x 5cm to the opposite surface covered with rind. According to the changes in the color and texture of the samples, the depth is measured from the lean surface to the color changing point with a ruler, and the moisture, NaCl and Na-nitrite contents are also determined. All analyses are carried out in triplicates.

The chemical composition and hygienic quality of the cured ham: Four hams are selected from each method, the samples are taken from Biceps femoral muscle used for determination of the chemical composition such as moisture, protein and fat, NaCl and Na-nitrite contents, TBV-N and Acid value. Sodium chloride is determined by

potentiometric titration with $AgNO_3$ in an autotitrator, and the content was expressed as percent by weight (w/w). Nitrite concentration is measured spectrophotometrically at 546nm using a spectrophotometer. The moisture content is determined by drying 3g of homogenized sample in a oven at 105℃ until stable weight.

Protein content and TVB-N value are determined using Kjeldhal method, fat content is determined using Soxhlet ether extraction and AV is determined by acidity titratometry with NaOH. All analyses are carried out in triplicates.

Sensory testing: Two hams are selected for the sensory test of each method. Two hundred grams of the sample is taken from Biceps femoral muscle of each ham for sensory evaluation by 12 trained panelists. The sample is sliced in 1 mm thick by a commercial slicer and steamed in a cooker for 30 min, thereafter, 4 slices (about 10 g) of each group are served immediately on a white porcelain plate to the panelists. A glass of about 100ml of distilled water is provided for each assessor between two samples. Thirteen sensory traits including appearance (redness, rose-red, reddish), odor (intensity, rancidity and cured), taste (saltiness, cured, rancid and undesirable) and texture (firmness, dryness and softness) are assessed and given the scores ranging from the most dislike (0 point) to the highest like (10 points) by Hedonic scoring system.

Quality of products from different methods

The diffusing rate is found the highest in method 3, then followed by method 2, and the traditional in the descent order. The differences in NaCl and NaNO2 contents of the samples among the treatment are the same order as diffusing rate. However, the differences in the moisture content of the samples are found the highest in method 3, then followed by the traditional and method 2 . These results show that the ingredients diffusing rates for the test groups are higher than the traditional and suggesting that massaging can improve the curing ingredients penetrating into the meat tissue. The curing ingredients diffused through the tissue of ham of the test improved methods after 15 days salting. The new curing methods can shorten the salting time from 21 days of the traditional method to 15 days. The results of determination in moisture, protein, fat and NaCl contents in the lean tissue of ham reveal that no significant difference existing in the chemical composition of the cured hams among the treatments except for the moisture content in method 3. As compared with the traditional Xuanwei style cured ham, NaCl and fat contents in the samples from the improved methods are significant lower than the traditional cured ham ($p<0.05$). Low NaCl and fat contents in the cured ham are beneficial to consumers because of health recommendation to lower hypertension (Morgan and Brunner, 2001), but low fat content in the lean meat tissue of the ham is harmful to the cured ham flavor. The

levels of $NaNO_2$, TBV-N in the lean meat tissue and AV in fat tissue of the cured ham. The $NaNO_2$ content in the improved methods is about 1.97-2.55 ppm which is lower than Chinese dry-cured meat standard below 20 ppm ($p<0.05$) and Chinese standard of Xuanwei cured ham below 4ppm ($p<0.05$). It is found there was no problem with the addition of 100ppm of $NaNO_2$ in the cured ham processing. TVB-N values in the products obtained from the new methods are higher than the traditional Xuanwei style cured ham (70mg%) ($p<0.05$). The higher TVB-N value is harmful to the cured ham flavor, this problem needs to be further studied.

The scores of sensory evaluation for appearance (color), odor, taste and texture of the dry cured ham with different ingredients and processing techniques. The scores of color for the samples from method 1 and 2 are significantly higher than the traditional ($p<0.05$), and indicating that the addition of 100ppm $NaNO_2$ could improve the color of the cured ham. However, other traits (odor, taste and texture) are not significantly affected by ingredients and processing technique.

In conclusion, modified cured ham processing conditions selected in this study are summarized as follows: The raw hams are salted and stacked at 4-8℃, 75-85%RH for 15-20days, after salting they are hung in the room at 10-15℃, 50-60%RH for drying 40days. During the ripening period the hams are hung in the room at 20-25℃, 65-75%RH for 120days. The curing ingredients used in the samples of test groups are found that the addition of 100ppm $NaNO_2$ can improve cured color of hams and the residue of nitrite is below the Chinese cured ham standard. Whereas the hygienic indicators of the cured ham and the results of sensory evaluation are not significantly affected by the addition of sodium ascorbate and polyphosphate and processing technique as expected. New processing technique reduced the ham salting time, for an example, hind legs at weight of 10Kg (middle size), salting with special ingredients and massaging for 10-20min can increase the diffusing rate and reduce salting time from the traditional 21 days to 15 days.

Xuanwei cured ham

Xuanwei cured ham like Jinhua cured ham is one of the famous cured ham in China. It is also one of the traditional meat products in Yunnan province., the south west part of China. It is famous for its rose-red color, intense flavor, desirable taste and typical shape like Chinese instrument-pipa (lute), very- preferable to the consumers. The production of me cured ham is more than 15,000metri tons per year currently, and most of the products are exported to Asian countries.

Raw materials : hind leg (ham) 100 kg

Ingredients : salt 9 kg, Nitrate 250 g

Procedures:

1) Trimming of leg: Trim off hairs, visible fat and dirt. Trim the leg into lute shape.
2) Salting: Mix salt and nitrate evenly and rub and spread the curing salt on the surface of ham until brine come out. Then turn the side and allow the meat surface face down, the press out blood residue. Sprinkle salt on the surface again and rub. After salting the hams are piled up to 20 layers (home made, pile in vat). During salting the hams are salted every 5-8 days. The salt dosage is 3, 4.5, 1.5 kg, for ist, 2^{nd} and 3^{rd} times, respectively. Turn both sides every salting time up and down. It is better for total salting time not over 25days.
3) Hanging and fermenting : After salting, tie every cured leg on joint with hemp rope, then hang in greening room for fermentation and maturation. The fermentation time need 6 months. During fermentation it must be aeration and often open windows to allow surface of ham easy to dry. The climate of Yunnan is dry which is optimal condition for making cured ham.

Spanish-Cured Ham Processing

1. Materials

   The green hams from an E.U. authorized slaughter house were obtained from 6 months old pigs [Large White x Landrace (female) and White Belgian (male)], each weighing approximately 10 kg.

2. Procedures

   1) The hams were selected according to their pH (5.6-5.8) which was measured in the Semimembranosus muscles after tumbling (Tumbler- Bleeder MSV-800, FRC, La Cellera de Ter, Girona, Spain) to eliminate the residual blood in the green hams.
   2) After selection of the hams, the surface of each ham was immediately nitrified

with a dry salt mixture of 9.0g of NaCl, 0.6g $NaNO_2$ and 0.4g $NaNO_3$ per kg of ham. Then, the hams were piled in stainless tubs in a cold storage room (T: 2 ±1℃) for one day before they were completely covered with salt (the traditional method) and left for 11 days at 2 5 ±1℃ and 90 ±5% RH.

3) At the end of the salting stage, the excess salt was brushed off, and the hams were washed with cool water (< 10℃). The salted hams were then hung in another cold storage room (2.5±1℃; 85±5%) for 3 weeks (post-salting stage).

4) The dry-maturation stage lasted 9 months with the hams hung in a controlled cellar (16±6℃; 75±5%) for the first 8 months and then at ambient temperature (28±6℃; 65±10%) for the last month ("estufado" step).

3. Spanish dry-cured ham properties

Table 11.8. Mean values of chemical variables in Semimembranosus (SM), Semitendinosus (ST) and Biceps femoris (BF) Muscles in dry-cured ham.

Muscle	pH	% Moisture (wet basis)	Aw	Nitrite (ppm)	% Chloride (dry basis)
SM	5.92[a]	29.72[a]	0.780[a]	5.93[a]	4.89[a]
ST	6.03[a]	46.03[b]	0.834[b]	6.94[a]	7.11[b]
BF	6.12[a]	50.72[c]	0.848[c]	12.36[a]	8.01[c]

[a-c] For each variable means within the same column with unlike superscripts differ ($P<0.05$)

Table 11.9. Mean values of color coordinates, psycophysical magnitudes and a^*/b rations in Semimembranosus (SM), Semitendinosus (ST) and Biceps femoris (BF) Muscles in dry-cured ham.

Muscle	L^*	a^*	b^*	c^*	h^*	a^*/b^*
SM	25.98[a]	8.85[a]	5.49[a]	10.41[a]	31.81[a]	1.61[a]
ST	32.59[b]	12.58[b]	8.82[b]	15.36[b]	35.03[b]	1.42[b]
BF	34.80[c]	15.55[b]	10.50[b]	18.77[c]	34.02[b]	1.48[c]

[a-c] For each variable, means within the same column with unlike superscripts differ ($P<0.05$)

L^*(lightness); a^*(redness); b^*(yellowness); C^*(chroma); h^*(hue)

Reference: PEREZ-ALVZREZ et al. Journal of Muscle Foods 10 (1999) 195-201.

Parma ham processing procedures

Parma ham processing secrets are considered as good information to Chinese-style dried cured ham processing. The procedures are proposed by USDA in order to establish the standard for the kind of ham that the U.S. will allow to be imported. These procedures specify times, temperatures and relative humidity for each stage of curing these delicately flavored dry hams that are aged for more than a year. The standards for processing are as follows:

The ham must be processed for a period of not less than 400 days in accordance with the following conditions:

1. After slaughter, the ham is held at a temperature of 0-1.5℃ for a minimum of 72 h during which time the aitch bone is removed and blood vessels at the end of the femur are massaged to remove any remaining blood. Thereafter, the ham is covered with an amount of salt equal to 4-6% of the weight of the ham, with sufficient water added to ensure that the salt adheres to the ham.
2. The ham is then placed for 5-7 days on racks in a chamber maintained a temperature of 0-4℃ and at a relative humidity of 70-85%. Then it is covered with

salt equal to 4-6% of the weight of the ham with sufficient water added to ensure the salt adheres to the ham.

3. The ham is then placed for 21 days in a chamber maintained at a temperature of 0-4℃and at a relative humidity of 70-85%; thereafter the salt is brushed off the ham and the ham is placed in a chamber maintained at a temperature of 1-6℃ and at a relative humidity of 65-80% for between 52 and 72 days.
4. The ham is then brushed and rinsed with water and then placed in a chamber at a temperature of 15-23℃ and a relative humidity of 55-85% for 5-7 days.
5. Then the ham is placed for curing in a chamber maintained at a temperature of 15-20℃ and at a relative humidity of 65-80% for a minimum of 314 days at the beginning and increased by 5% every 2.5 months until a relative humidity of 85% is reached.

Caution:

1) During all of the procedures the ham has no contact with any meat or animal product other than pork fat that is heat-treated to at least 74.33℃ that may have been placed over the ham during curing.
2) The raw hams are obtained from disease-free hogs.

Chinese-style bacon processing

Chinese-Style Bacon

Formula 1 (Dry curing method)

Nonmeat ingredients are based on the wt of meat.	percentage
Belly/ loin /ham	100
Salt	4
$NaNO_2$	0.02
Sugar	1
MSG	1
White pepper powder	0.3
Star aniseed	0.5

Processing procedure

1. Trim and shaping pork and cut into 5x20-25 long strip.
2. Salt is toasted with star anise and then chilled, and mixed with other nonmeat ingredients thoroughly.
3. The pork is rubbed with the cure mixture and placed in a container face to face(lean side to lean side), then cured in the cooler at 2-4℃.
4. Next day, turn the meat over. The meat on top is changed to the bottom layer by layer.

5. After 3-7 days curing, take out to soak in the cool boiled water to remove the extra salt, and hang on the rack for drying and smoking.
6. Drying and smoking：drying in smokehouse at 50-55℃ for 2 hr, then change to 60℃ for drying and smoking for 4-6 hrs until the meat surface become dry and firm, and the color becomes brown color.
7. Chilling and packaging with vacuum.

Formula 2 (Wet curing method)

Pickling solution composition	Percentage
Water(10-15℃)	87.1-89.2
Salt	10-20
Sugar	5
MSG	2
Sodium nitrite	0.1-0.15
Polyphosphate	0.5
Sodium erythorbate	0.2-0.25
Pepper	2

Processing procedure

1. Preparing the pickling solution
   Solve polyphosphate in the water thoroughly, then add other ingredients thoroughly.
2. Curing：
   Place the raw meat in the pickling solution by Meat：pickle 1：2.5 (W/V) and cured at 5-8℃, and turn over once a day, totally 2 times.
3. Drying and smoking：
   After 2 days curing, take out the cured meat soaked in the cool boiled water to remove the extra, salt, then hang on the rack and placed in the smokehouse, and drying and smoking at 60℃ for 2 hrs, then changed to 65℃ for one hr until internal temperature to 53-55℃.
4. Slicing and packaging.
5. Stored at the refrigerator.

Formula 3.

Chinese style bacon

Formula	%
Raw meat	100
Salt	4.2

Sugar	1
MSG	0.5
Sodium nitrite	0.02
Sodium erythorbate	0-02
White pepper powder	0.2
Hot pepper seeds (花椒)	0.3
Chinese star anise (broken)	0.3
Shao Hsing wine	0.5

Processing procedure:

1. Raw meat shaping and trimming
2. Salt, star anise and hot pepper seed roasted to color becoming brown and cooled.
3. Salt added with nitrite by the ratio of 1 : 1 (pre-blending), then mixed with other ingredients throughout.
4. Curing-Spreading the curing agents on the surface of meat, then place the meat into container by face to face.
5. Second day, turning the position of the cured meat, the cured meat at the bottom exchanged with the meat at top.
6. The meat is cured for 7 days and then desalting in the warm boiled water for 20-30 min.
7. Drying : Hooked and hang on the rail and drying in smoking house at 55-60℃ for 3-4 hours, then smoking (temperature is at 55-60℃, RH% 55-60%) until the color become desirable.
8. Chill and packaging.

Comment : Drying and smoking time totally 5-7 hours.

Hunan-style bacon

Raw materials : pork belly, ham or shoulder (100%)

Curing agents (dosage based on the weight of pork)

Star aniseed 0.3%, wild pepper 0.5%, salt 4%, sugar 1%, MSG 0.5% and potassium nitrate 0.15%.

Procedures:

1) Cut pork into a right rectangular shape with 300 g, wash and drain.
2) Fry star aniseed and wild pepper with salt and cool, then mix with nitrate well. If want to get a good shape and desirable color, press with bricks or stone to remove blood residue and add 1 tbsp of ank red in the curing agents.

3) Sprinkle the curing agents on the surface of meat and rub strongly, then pile up layer by layer in the container, and cure for 7 days. During curing, turn both sides of the meat every two or three days.
4) After curing take out to dip the product in the warm water to remove the smear and dirt, drain and perforate a hole for tying a hemp rope.
5) Hang on bamboo sticks and dry by sun heat to almost dried, then change to dry by oven heat with wood coals, sometimes add peanut shells or wood chips, or pineal and pine branch to dry and smoke. When drying or smoking in the oven, cover the opening with hemp bag to keep heat but not burn. Total drying and smoking time is 12 h. Occasionally ,some people only cure pork with wild pepper, star aniseed and salt without nitrate for 7 days, and dry in the cold air, smoke for 3 days, then dry by sun for 2-3 weeks in winter.

Guangdong-style bacon (l)

Raw meat : pork belly, belly with spareribs 100 kg.

Curing agents：

Sugar 4 kg, salt 2 kg, soy sauce 1.5 kg, sauce colorant 1.5 kg, Dachi wine 1.5 kg, and nitrate 50 g.

Procedures:

1) Trim meat and cut meat into long rectangular strips about 43x5cm, about 250g. Wash with warm water to remove smear and dirt, drain.
2) Mix the curing agents well and rub on the surface of meat, then pile in the vat layer by layer. Turn both sides of meat every 4 h during curing. After 8 h curing take out and perforate a hole to tie with a cotton string and hang on bamboo stick and dry at 50℃ roasting room for 35 h or dry by sun heat for 3 days.

Guangdong-style bacon (2)

Raw materials：pork 600g (belly, ham or shoulder).

Curing agents：

Salt 300g, sugar 600 g, soy sauce 300 g, wine 300g and nitrate 6 g.

Procedures:

1) Cut belly into long rectangular shape, 300 g.
2) Mix the curing agents well and rub on the surface of meat and cure for 24 h.
3) Perforate the meat at end to tie with hemp rope and hang on bamboo stick to dry by sun heat for 3 days, and shift to dry in oven for a while.

Haga salted pork

Ingredients：

Pork belly 600g, garlic 10 bulbs, black pepper grains 110g, chicken essence, Powder 75g, salt 1 tsp and wine 1 tsp and wild pepper powder, white pepper, sugar, five spices and cinnamon powder 1/2 tsp for each.

Procedures:

1) Wash pork and drain, cut pork into strips, chop garlic for use.
2) Fry black pepper grains to be aromatic.
3) Mix pork with all ingredients and cure in refrigerator for 3 days.
4) After curing take out to dip in clean water to remove salt slightly, and then roast in oven until both sides become golden brown.

Cantonese bacon

Cantonese-style sausage

Chapter 12. Sausages

Sausage manufacture

Principles for sausage manufacturing

1. Operation conditions (environment)
   a) Facilities---refrigeration systems.
   b) Equipment---grinder, chopper knives, stuffer and smokehouse, etc.
   c) Employees---level of training.

2. Sanitation
   a) Facilities
   b) Equipment
   c) People
   d) Cleaning procedures---must have 85℃ of water bath. The complete procedures for cleaning are rinsing, detergent, rinsing, sanitizer, rinsing and heat drying.

3. Raw meat treatments
   a) Temperature : raw meat must be kept at -1 to 2 ℃.
   b) Desinew and trim connective tissue and visible fat.
   c) Condition-microbial, chemical
   d) Compositional (formulation)

4. Non-meat ingredients
   a) proper use levels.
   b) Salt purity.
   c) Handling of curing salt.
   d) Spice handling/ storage.
   e) Weighing of ingredients.

5. Grinding

   Grind lean meat with a sharp knife and blade to prevent the meat tissue becoming smeary. Grinding meat can be carried out two times: first time using big diameter of plate, the second time using fine plate to prevent smearing. Before grinding the grinder must be cooled in freezer.

6. Blending and mixing

   First step blend ground lean meat with salt, polyphosphate and ice to extract salt soluble proteins as a binder or an emulsifier, then mix or emulsify fat and other

ingredients. It is better to use vacuum blender and mixer. During blending or mixing you can add dry ice to lower temperature and prevent fat oxidation.

7. Stuffing
   a) Stuffer must be cooled in the freezer and it is better to use vacuum stuffer.
   b) After stuffing it is better to puncture the casings to allow the entrapped air to escape.
   c) Proper casing/storage/preparation.
   d) Proper sizing of horn to casing
   e) Proper tightness

8. Thermal processing/smoking
   a) Control house conditions as much as possible (temperature, humidity, air movement).
   b) Develop suitable schedules (record).
   c) Assure proper internal temperatures.
   d) Check thermometer accuracy.

   *Drying : Sun-drying is energy saving and resulting in a good color and flavor development, but it is not easy to control the climate changes and fly contamination. In Chinese meat processing some home-made products are dried by sun heat. The large scale meat processing plants the products are dried by oven or roasting room. When the products are dried in the advanced stage the temperature can not rise too high to cause the meat protein denatured on the outside of the product to prevent the water escaping. It must be increased gradually.

9. Packaging
   a) Advantages of vacuum packaging
      (1) Barrier to contamination
      (2) Prevent moisture loss
      (3) Maintain cured color
      (4) Retard rancidity
      (5) Prevent aerobic microbial growth, but can not affect anaerobic bacteria, so the sanitation is very critical.
   b) Packaging temperature
   c) Select correct film
   d) Draw proper level of vacuum
   e) Handle product properly before and after packaging

10. Finished product evaluation
    a) Appearance
    b) Flavor, aroma, taste
    c) Yield %
    d) Cost
    e) Labeling

Chinese-style sausage manufacture

Xiang cheong (spiced sausage), shangdo are prepared with ground or diced pork, mixed with other ingredients such as cure salt, seasonings, spices and stuffed into animal intestines (casings) or bladder, then dried by sun heat or oven. In general, sausages are made in winter season, thus it is called as " Lupcheong "(Lup month means December in Lunar calendar). It is also called as " Yencheong " in south China such as Taiwan, Fuken.

There are many famous brands of sausage products in Taiwan and Guangdong such as Xiangdongyang , Black-Bridge Sausage and Huang-Song-Huang sausage. A common formula is as follows:

Raw meat

Lean pork 35 kg, back fat 15 kg

Ingredients

Chinese white wine (rose wine, Shangxia Fun Jao, Dachia, Wuliangyi, and Shao Shing wine) 2.5kg, Sugar 5kg, white soy sauce 0.25 kg, salt 1.5-1.7 kg, sodium nitrite 5g,corn syrup 1 kg, ice water 3.5-5 kg, casing 0.6-0.7 kg, string 0.65-0.75 kg and straw 0.2-0.25 kg.

Procedures :

1. Raw meat trimming : Selection of pork must check its thickness of back fat and size of pigs. Don't use the meat from the spent sow and bore, while choice the matured pigs, usually hams are used.
    1) Cut lean meat and trim off tendon, membrane, visible fat and bones etc. and then slice into 1.2 cm thick a piece.
    2) Cut back fat into 0.6-.0.8 cm dices.
2. Preparation of fillings (batter) :
    1) The lean meat is soaked in cold water by the ratio of 20-30 : 17.5 (water : meat), but in 20℃ warm water during cold weather, and stirred by hand, repeated this operation several times, about 5 min. then decant the water and change clean water and repeat.

Finally, take out the meat and drain out of the water.

2) Grind the meat with 1.2 cm diameter plate. At the same time remove broken bone debris and connective tissue. If find dark red meat slices which must take out for rinsing again.

3) Dice back fat and rinse in running water to remove smeary fat. If the surface. fat is not rinsed off, when the sausage is dried, the product surface will become smeary. This may retard water evaporating.

Usually, diced back fat is rinsed in warm water at 30-50 ℃ for fresh diced back fat, while 50 ℃ for frozen back fat. After soaking, the fat is rinsed using cold water, cold day using warm water. Thereafter, drain off the water.

4) Blending and mixing:

a) Blend ground lean meat with salt, sugar, nitrite, soy sauce and cold water to extract salt soluble proteins.

b) Mix protein matrix with diced fat, add remaining water, spices, extenders and white wine thoroughly.

3. Stuffing :

1) Soak casings in 40℃warm water to soften for use.

2) Stuff the meat mixtures (fillings) into the casings of proper diameter, tie into a proper length of a section with string. It is better using vacuum stuffer to remove the air off, otherwise, puncture the casings to allow entrapped air to escape.

3) Wash the fresh sausage with 30 ℃ warm water or dip in 2. 5% potassium sorbate solution to prevent mold growth.

4) Hang the sausage on bamboo sticks on the rack of drying car.

4. Dry in the oven at 55 ℃ for 3 h, then change the site (exchange up and down of position), then reheat at 40-50℃ for 4-5 h. During drying the aeration vent of the dryer or oven must be opened.

Note: Some Chinese-style sausage drying schedule:

1) Hang the moist sausage on bamboo sticks and place on the rack at bottom layer in drying room by proper distance for air circulation.

2) Isolate the drying room around, the wall with lining cloth, then close the door and window of the room to keep heat. The room temperature rise up to 55 ℃ and dry for 3 h, then take out sausage and replace on the wooden rack out of the room for water evaporating. Afterward, exchange the position of up and down for heating evenly, then replace into the drying room. The temperature is lowered down to 40-50 ℃, and dry for 4-5 h. Then take out and change the position and replace into the drying room at 35-40 ℃ and dry for 4-5 h.

3) Elevate layer drying: First layer (lower layer) : dry for 4-5 h and exchange 2

times, second layer (middle layer) : dry for 2-4 h and 3rd layer (up layer) : dry for 12-18 hr.

5. Cool the product to room temperature in the air.
6. Finished product treatment: take out the product and cut into 2 sections for one bundle and weave the dust with a clean cloth and then package.
7. Store the product in the cool aeration condition or refrigerator.

Formulation and Processing of Chinese-style Sausages

Tien-Jing sausage

Ingredients: Based on meat weight

Pork (lean : fat =7:3) 100%

Salt 3%

Soy sauce 3%

Chinese wine 3%

Sugar 8%

MSG 0.2%

White pepper powder 0.1%

Nutmeg powder 0.05%

Sodium nitrite 0.006%

Procedures:

1) Grind lean meat and back fat into 1 cm^2 granules, separately.
2) Blend ground lean meat with salt, nitrite until sticky, then add ground fat and other ingredients and mix well.
3) Stuff the meat batter into cleaned presoaked goat casings, and link every 14-15 cm long for a section with cotton string, and puncture the casings to allow entrapped air to escape.
4) Hang sausage on bamboo stick of rack and dry by sun- heat or oven at 50-60℃ for 4-5 h.
5) Cool and dry in the air for 3-5 days.

Tien-jing laurel sausage (Great wall sausage)

Ingredients:

Lean pork 10 kg, starch 300 g, laurel flower 300 g , salt 300 g, sodium nitrite 1 g, sugar 100 g, MSG 20 g, white pepper powder 10 g, wine 100 g.

Procedures:

1) Trim meat to remove fat and connective tissue. Cut pork into slate and cured with salt and nitrite at -1 to 5 ℃ for 20-24 h.
2) Grind the cured meat into 1 cm^2 particles and mix with other ingredients well.
3) Stuff the mixture into the casings and puncture the casings to allow the entrapped air to escape. Hang the fresh sausage on the bamboo stick for drying.
4) Dry the fresh sausage in the drying room at 50-70 ℃ the drying room temperature raise from the lower layer to upper layer gradually. Dry the sausage surface become dry and slightly red.
5) Cook the dried sausage in hot water at 85℃ to internal temperature to 80℃.
6) Smoke the cooked product at 70℃ to become a desirable appearance.
7) Cool and package.

Tienjing date sausage

Ingredients:

Pork lean meat 50 kg, salt 1.5 kg, wine (Dachi) 1.5 kg, sugar 3.5 kg, MSG 100 g, sazen 15 g , nutmeg 15 g, soy sauce 1 kg, garlic 500 g, and sodium nitrite 3 g.

Procedures:

1) Desinew lean meat, cut into slate, then grind into 0.5 cm particles.
2) Blend ground pork with salt, nitrite, MSG, sugar and soy sauce thoroughly, then mix with other ingredients well.
3) Stuff the mixture into the casings and tie it into every 3 cm long for a node, then cut every 40 nodes long and tie two end to become a loop.
4) Dry in roasting room at 70℃ for 3 h until the casings become dry.
5) Cool and. dry in the aerating room for 5-7 days.
6) Cook in 100℃ boiling water for 15-20 min.
7) Cool and package.

Beijing garlic sausage

Ingredients:

Lean meat 30 kg, back fat 20 kg, starch 15 kg, white pepper 100 g, fennel 100 g, MSG 50g, garlic 1 kg, salt 2.75 kg, and potassium nitrate 25 g.

Procedures:

1) Grind lean meat and back fat by 1 cm diameter plate, and chop garlic separately.
2) Cure ground lean meat with salt, nitrate at 9-13℃ for 2-3 days.
3) Blend the cured ground meat with chopped garlic, seasonings, starch slurry (mix with 20 kg water) well, then add ground fat and mix thoroughly.
4) Stuff the mixture into the casings and tie every 10 cm long for a node, and puncture the casing to allow the entrapped air to escape.
5) Dry wet sausage at 50-60℃ in oven for 45 min, then cook in the water at 75-80℃ for 40 min to allow the product to become firm and elastic.
6) Smoke for 40 min at low temperature.

Beijing (Puwuhuang) sausage

Ingredients: Based on meat weight

Pork ham or shoulder (lean : fat =7:3) 100%
Chinese wine 0.5%
Salt 2.0%
MSG 0.5%
Sugar 1%
Casings (goat intestine)

Procedures:

1) Trim off connective tissue and remove skin.
2) Grind pork.
3) Mix ground pork with wine, MSG, salt and sugar thoroughly.
4) Stuff the meat mixture into the goat casings, and clip every 10 cm long for a node.
5) Dry in the air or by sun heat.
6) Cook fresh sausage in the stewed soup for 10-15 min as cooked sausage.
7) Store fresh sausage in the aeration condition, in the Winter it can be stored for 3-5 months, in the Summer only stored for about one month, while cooked sausage can be stored in the cool aeration place for 2 days in the Summer, and 3-5 days in the winter, 10 days in the refrigerator.

Kaifong (Henan) sausage

Ingredients:

Lean meat 35 kg, back fat 15 kg, salt 1.5 kg, sugar 750 g, wild pepper powder 300 g, anise 200 g, cassia bark 100 g, galangal 100 g, sodium nitrite 3g, MSG 200 g.

Procedures:

1) Grind lean meat, and dice back fat, separately.
2) Mix all ingredients in water, and add ground lean meat and blend, then mix ground back fat thoroughly.
3) Stuff the mixture into the casings, and puncture the casing to allow the entrapped air to escape.
4) Hang the fresh sausage on the bamboo stick and dry in the air for 2 h, then dry in the roasting room (preheated) at 50℃ for 10 h, then the temperature shift to 45℃ for 14 h.
5) Cool and package

Shangdong sausage

Ingredients:

Pork (lean meat 70 kg, back fat 30 kg), soy sauce 12 kg, vegetable oil 1 kg, ginger 1 kg, wild pepper powder 70 g, clove 50 g, Sazen 50 g, and fennel 50 g.

Procedures

1) Grind or cut lean meat and back fat into 1 cm^2 pieces, separately.
2) Mix soy sauce, oil, chopped ginger and onion, wild pepper, clove, fennel and

sazen thoroughly, then add ground meat and blend well.

3) Soak goat casings in warm water (cool water in the Summer) to soften it.
4) Stuff and tie the sausage every 12 cm long for a node, and puncture the casings to allow the entrapped air to escape.
5) Hang the fresh product on bamboo stick and dry by sun heat, or by oven-drying at 60-70 ℃ for 3 h.
6) Take out the dried sausage and cool in the air for 2-3 days until the products become firm.

Shangxia sausage

Ingredients:

Pork lean meat 35 kg, back fat 15 kg, salt 800g, sugar 1.25 kg, soy sauce 2.5 kg, white wine 300 g, wild pepper 60 g, sazen 50 g, nutmeg 40 g, and MSG 40 g.

Procedures: the procedures are the same as those of Shangdong sausage processing.

Liu-Wei-Zei sausage (Taiyuan, Shangxia)

Ingredients:

Pork 100 kg (30% fat content), salt 1.9 kg, wild pepper 300 g, MSG 200 g, white soy sauce 2.5 kg, nutmeg 100 g, potassium nitrate 100 g, sazen 120 g, dill 120 g, white wine 600g, sugar 2.5 kg.

Procedures:

1) Trim pork to remove skin and bone, wash.and drain. Cut into 1-1.5 cm thick slices, then cut into dices.
2) Blend and mix the meat with other ingredients thoroughly.
3) Stuff the mixture into casings and tie into 10 cm long for a node, and hang the fresh sausage on the bamboo stick for drying.
4) Dry the products by sun-heat for 5-6 days, then dry in the air for aging 15 days.
5) Cool and package.

Harbin sausage

Ingredients:

Lean pork 75 kg, back fat 25 kg, salt 2.5 kg, sugar 1.5 kg, soy saucee 1.5 kg, Chinese white wine 500 g, potassium nitrate 100 g, sodium bicarbonate 18 g, angelica (Beichu) 18 g, anise 10 g, fennel 10 g, cassia bark 12 g, nutmeg 17 g.

Procedures:

1) Selection of meat: Fresh ham or shoulder. Casings are made of pig intestine by 2.6-2.8 cm diameter.
2) Trim off skin, fat and remove bones, then cut meat into 1 cm^3 dices, and wash smear with warm water.
3) Dump the casings in warm water to soften and drain for stuffing.
4) Blend ground meat with salt, sugar and nitrate, then mix with ground fat and other ingredients.
5) Stuff the mixture into the casings and tie the sausage every 15-20 cm long for each node. And puncture the casing to allow the entrapped air to escape.
6) Rinsing the surface of the casings, dry by sun heat for 2-3 days and oven at 50℃ for 1-2 days and nights.
7) Cool and package.
8) Store the finished products below 10℃, its storage life is about 1-3 months.

Liaoning sausage

Ingredients :

Lean meat 25 kg, back fat 25 kg, salt 1.75 kg, sugar 2.5 kg, shaoshing wine 5 kg, sesame oil 2 kg, five spices* 250 g, clove 250 g, sazen 250 g, and nitrite 3g.

* Five spices are a mixture of angelica 500g, nutmeg 500 g, dried tangerine peel 500 g, cassia bark 500 g, kaempferol 500 g, wild pepper 500 g, and aniseed 500 g.

Procedures:

1) Grind lean meat into 1 cm^2 pieces and cut fat into1 cm^2 dices.
2) Blend the ground lean meat with salt, sugar, nitrite and then mix with diced fat, sesame oil, five spices, sazen as fillings.
3) Stuff the fillings into goat casings which are dumped in the warm water and soften, and tie the product every 10 cm long for a node. And puncture the casings to allow the entrapped air to escape.
4) Hang on bamboo sticks of rack and dry by sun heat or roast by oven at 60-70℃ for 3 h, then take out and cool in the air for 3-5 days.
5) Package.

Golden brand Harbin dried sausage

Ingredients:

Pork 50 kg(frozen lean meat 42.5 kg, back fat 7.5 kg), sugar 2.5 kg, Shaoshing wine 1.5 kg, salt 1.5 kg, ginger 500 g, Gouchize 250 g, Huangchi 250 g, cassia bark 50 g, clove 15 g, Jenseng 25 g, wild pepper 30 g.

Procedures:

1) Grind lean meat and back fat, separately.
2) Cook Jenseng, Huangchi and Gouchize with water as herb extracts.
3) Blend ground lean meat with herb extracts and other ingredients thoroughly to become viscous.
4) Mix (3) with diced fat well as fillings.
5) Stuff the fillings into the casings and puncture the casing to allow the entrapped air to escape.
6) Dry the fresh product in oven for 4 h and. dry by sun heat for 2 h in Spring, Summer or Autumn until the casings dried, then cool in the air for 3-4 days.
7) Then tie into bundle and store in dry, aeration room to dry about 10 days for aging.

Shanghai liver sausage

Ingredients:

Lean pork 15 kg, back fat 15 kg, fresh pork liver 20 kg, salt 1 kg, soy sauce 3 kg, sugar 3 kg, white wine 1.75 kg and nitrite 3 g.

Procedures:

1) Preparation of batter
   a. Grind lean meat and back fat into 1 cm^2 dices, separately. Cut liver into 1 cm^2 pieces.
   b. Blend ground lean meat with salt, soy sauce, sugar, wine and nitrite well, then mix with ground fat and pork liver thoroughly as fillings.
2) Stuffing:
   a. Soak goat casings in the warm water to soften and clean it.
   b. Stuff the fillings into the casings, and tie the sausage every 24 cm long for a node, then link with string. Puncture the casings to allow entrapped air to escape.
3) Dry by sun heat or by oven-drying at 60-70 ℃ for 3 h.
4) Cool the product in the air for drying 2 days.

Nanjing sausage

Ingredients:

Pork lean meat 40 kg, back fat 10 kg, salt 2.25 kg, five spices 50 g, and nitrite 3 g.

Procedures are the same as those of Shanghai liver sausage.

Shanghai crystal Lupcheong

Ingredients:

Lean meat 35 kg, back fat 15 kg, salt 1.25 kg, white soy sauce 2.5 kg, sugar 3 kg, Shaoshing wine 1 kg and nitrite 5 g.

Procedures:

1) Grind lean meat into 1 cm^2 pieces, and cut back fat into 1 cm^2 granules by hand, then rinse fat granules with warm water to remove the surface smear, and cool.
2) Blend ground lean meat with salt, sugar, soy sauce, wine and nitrite to be viscous, then mix with fat granules well.
3) Stuff the mixtures into goat casings, and tie the sausage every 24 cm long for each node, and puncture the casings to allow the entrapped air to escape. Hang on the bamboo sticks on the rack for drying.
4) Dry the wet sausage by sun heat or oven heat at 60-70 ℃ for 3 h, then remove out and hang in the cool, aerating room. for drying 2 days and nights.

Zejiang sausage

Ingredients:

Lean meat 35 kg, back fat 15 kg, salt 1.25 kg, light soy sauce 2.5 kg, white wine 1.75 kg, sugar 1 kg, five spices 60 g, and nitrite 3 g

Procedures:

1) Grind lean meat and back fat into 1 cm^2 granules, separately.
2) Blend ground lean meat with salt, sugar, nitrite and soy sauce to be viscous, then mix the mixture with ground fat and other ingredients thoroughly.
3) Stuff the batter into the goat casings and tie every 15 cm long for each node, then link y string. Puncture the casings to allow entrapped air to escape.
4) Dry the fresh sausage on the bamboo sticks of the rack by sun heat or oven at 60-70 ℃ for 3 h.
5) Cool and dry in the air for 3-5 days.
6) Pack and store.

Wuhan sausage

Ingredients:

Lean meat 70 kg, back fat 30 kg, funju (wine) 2.5 kg, sugar 4-5 kg, nitrite 50g, white pepper 200g, salt 3 kg, MSG 300 g, and ginger juice 300g.

Procedures:

1) Lean meat is desinewed and cut into dices. The casings are cleaned and soaked in the warm water for softening and drained.
2) Mix the lean meat with salt and nitrite and cure at 5 ℃ for 1-2 days. Wash the cured meat by 30 ℃ water and drain, then grind lean meat and fat into 1 cm^3 dices, separately.
3) Blend ground lean meat with salt, sugar, nitrite, MSG and wine to be viscous, then add ground fat and other ingredients and mix thoroughly.
4) Stuff the mixture into the casings and tie every 12-15 cm long for each node, then link by strings. Meanwhile puncture the casing to allow the entrapped air to escape.
5) Rinse the wet sausage in warm water to remove smear and contaminants, then hang on bamboo sticks of rack for drying.
6) Dry the product by sun heat for 2-3 days until the surface becomes dry, then shift to dry in the air, or dry at about 50 ℃ by fire in the roasting room for 1-2 days and nights.
7) Store the product at below 10℃ for 1-3 months.

Hunan sausage

Ingredients:

Pork 100 kg(lean 80%, fat 20%), sugar 4 kg, salt 2.5 kg, wine 2 kg, wild pepper 50 g, hot red pepper 100g, and nitrate 100g.

Procedures:

1) Cut lean meat and fat into 1 cm^2 dices, separately. Rinse the diced lean meat and fat in the warm water to remove blood residue and smear, drain.
2) Blend lean meat with salt, sugar, wine and nitrate to be viscous, and then mix diced fat well.
3) Stuff the mixture into the casing and place on the table to puncture to allow the entrapped air to escape. Tie the sausage every 33 cm long for each node and soak in the warm water to remove the surface smear and hang on the bamboo stick for drying.
4) Dry the sausage by oven at 50-60℃ roasting room, then shift the temperature to 70 ℃ , gradually. After 3-4 h drying, change the position up and down, then reheat for 9-10 h.
5) Packaging: Cut 33 cm long product into two sections, and every 8 sections tied into one bundle for sale.

Bejing sausage

Formula 1:

Ingredients(Based on meat weight)

Pork: Back fat	30%,	Lean pork	70%
Soy sauce	11		
Sugar	4		
Salt	3		
Nutmeg	0.05		
Amomum	0.01		
Sodium nitrite	0.01		

Procedures:

1. Grind or cut back fat and lean meat into 1 cm^2 pieces, separately.
2. Mix all ingredients and spray on the ground meat and then blend for 2 to 3 min as batter.
3. Soak casing (goat intestine) in warm water and clean and drain it for use.
4. Stuff the mixture or batter into casing. As stuffing as far as possible to squeeze out the air or needle punching for releasing the air.
5. Tie the stuffed sausage into a proper length (about 12 cm) of nodes and then hung on a bamboo pole.
6. Dry the sausage by sun-drying or oven -drying at 70℃ for 3-4hours.
7. Cool and package.

   Coment:Yield:65%

Formula 2:

Ingredients(Based on meat weight)

Lean pork(85% lean)		pork ham(skinless)	100%
Salt	3		
Sugar	2.5%		
Soy sauce	3		
Nutmeg	3		
Amomum	0.12		
Wild pepper	0.12		
Ginger juice	0.7		
Sodium nitrite	0.01		

Procedures:

1. Desinew ham and remove some membrane of tissue and cut into 1cm^2 pieces.

2. Add salt and nitrite to meat and blend it for 7 times until the mixture become sticky, and then place in tank for curing 10 hours.
3. Mix all ingredients with the cured meat throughout for stuffing.
4. Stuff the batter into soaked and clean casings, and tie into a knot of 20cm long, and squeeze the air out as far as possible or by needle punching to releasing the air. And hung on the bamboo pole.
5. Dry the stuffed sausage in the air for about 25 days or dry by oven-drying at 60℃ for 5-6 hours.
6. Cool and package.

Ground pork with garlic and pickle cucumber

Materials:

Ground belly or shoulder	600 g
Garlic	10 valves
Pickle cucumber	150 g
Soy sauce	100 cc
Rice wine	8 cc
Pickle cucumber brine	150 cc
White pepper	1/4 spoon
Cube sugar	1 spoon
Water	300 cc

Procedure:

1. Grinding pork, chopping pickle cucumber and garlic for use.
2. Preheating the wok and place the ground pork and frying with medium fire until the meat becomes white, then scooping the fried pork.
3. Place chopped garlic is fried until flavor produced, then add the fried pork and soy sauce, pickle cucumber brine, rice wine and pepper and fry the mixture until the fragrant come out.
4. Add water and cook with big fire until boiling, then add chopped pickle cucumber, cube sugar and cook to the sugar dissolved.
5. Then place into sand wok and simmered with small fire.

Chinese style bacon

Formula	%
Raw meat	100
Salt	4.2
Sugar	1

MSG	0.5
Sodium nitrite	0.02
Sodium erythorbate	0.02
White pepper powder	0.2
Hot pepper seeds (花椒)	0.3
Chinese star anise (broken)	0.3
Shao Hsing wine	0.5

Processing procedure:

1. Raw meat shapping and trimming
2. Salt, star anise and hot pepper seed roasted to color becoming brown and cooled.
3. Salt added with nitrite by the ratio of 1:1 (pre-blending), then mixed with other ingredients throughout.
4. Curing-Spreading the curing agents on the surface of meat, then place the meat into container by face to face.
5. Second day, turning the position of the cured meat, the cured meat at the buttom exchanged with the meat at top.
6. The meat is cured for 7 days and then desalting in the warm boiled water for 20-30 min.
7. Drying :Hooked and hang on the rail and drying in smoking house at 55-60℃ for 3-4 hours, then smoking (temperature is at 55-60℃, RH% 55-60%) until the color become desirable.
8. Chill and packaging.

Comment: Drying and smoking time totally 5-7 hours.

Nancheong hash sausage

Ingredients:

Lean pork 50 kg, back fat 21 kg, sugar 4.28 kg, salt 2.1 kg, Chinese white wine 2.1 kg, potassium nitrate 35.7 g, white pepper 143 g, red pepper(hot) 1.43 kg.

Procedures:

1) Cut lean meat and fat into 0.8-1 cm^3 cubes, and mix with ingredients and 1.78 L water well and stand for 2-4 h.
2) Stuff the mixture into the casings and tie every 25-30 cm long for each node, and clip the center. After stuffing puncture the casing to allow the entrapped air to escape.
3) Rinse the surface of the wet sausage with warm water, then hang on the bamboo stick for drying.

4) Dry the product by sun heat or oven for 2-3 days, then cool and dry in the air for 20-30 days. If dry by oven at 50℃ it will take 24-36 h.
5) Cool and store.

Guangdong sausage (1)

Ingredients:

Lean meat 70 kg, back fat 30 kg, salt 2.5-3.0 kg, sugar 6-8 kg, Chinese white wine 2-3.5 kg, white soy sauce 2.5 kg, potassium nitrate 50 g, MSG 250 g.

Procedures:

1) Cut lean meat into 10-12 cm x 2.5-3 cm, then rinse in water to remove blood residues and drain. Use 8-10 mm d plate of grinder to grind the lean meat.
2) Cut back fat into 1 cm^3 cubes, and rinse in warm water at 35℃ to remove smear and dust, drain.
3) Blend ground lean meat with salt, nitrate, sugar, MSG, soy sauce and wine to be viscous, then mix with ground fat thoroughly.
4) Stuff mixture into the casings, and puncture the casing to allow the entrapped air to escape. Tie the sausage every 20-26 cm long for each node, then link at middle to two parts by 12-13 cm long.
5) Rinse the product in the warm water to remove the surface smear.
6) Dry by sun heat or oven at 45-50℃.
   a. Hang the product on the bamboo sticks of rack and dry by sun heat. During sun-drying every 3-5 h change the position once, totally dry for 1- 2 days, then cool and dry in the aeration room.
   b. Dry by oven heat at 45-50℃ for 1-2 days and nights. During drying exchange the position of upper and lower layers.
7) Package and storage.

Huang-Song-Huang Brand sausage (Lupcheong)

Ingredients:

Pork 100kg (lean 70%, fat 30%), salt 2.8-3 kg, sugar. 9-10 kg, 50^0funju (wine) 3-4 kg, light soy sauce 2-3 kg, nitrate 50 g, water 15-20 kg.

Procedures:

1) Trim ham or shoulder to remove connective tissue, bones and separate lean meat and fat.
2) Grind lean meat through 10-12 mm d. plate, and fat through 9-10 mm d. plate. Rinse the ground lean meat and ground fat to remove the surface smear and dirts with 35℃ water.
3) Blend ground lean meat with salt, sugar, wine, nitrate, soy sauce and water until become viscous. Then mix with ground fat well.
4) Stuff the mixture into casings and tie every 23 cm long for each node and link at middle site into 2 sections. Puncture the casings to allow the entrapped air to escape.
5) Rinse the product to remove the smear and dirts with warm water or dip in sorbic acid solution (5%) to prevent microbial growth on the surface.
6) Dry the product by sun heat for half day, and turn. sides once every 3 h, then change to dry by oven at 50-52℃ for 24 h.
7) Cool and store.

Shisong sausage (Guangdong lupcheong)

Ingredients:

Pork 5 kg, sugar 500 g, water 500 g, Dachi wine 250 g, salt 190g.

Procedures are the same as those of Guangdong sausage (1) processing.

Suchurn sausage

Ingredients:

Lean meat 45kg, back fat 15 kg, salt 2 kg, sugar 1 kg, Chinese white wine 500g, vegetable oil 1 kg, sodium nitrite 3 g, wild pepper powder 50 g and MSG 200 g.

Procedures:

1) Grind lean meat and back fat into 1 cm^3 cubes, respectively.
2) Blend ground lean meat with salt, sugar, wine and nitrite thoroughly to be viscous, then mix ground fat and oil and wild pepper well.
3) Stuff the mixture into casings and tie 15 cm long for each node, then link by string and puncture the casings to allow the entrapped air to escape.

4) Hang the wet sausage on the bamboo sticks of the rack for drying. Dry by sun heat or oven at 60-70℃ for 3 h.
5) Cool in air for drying 3-5 days.

Nanling sausage (Guangxia)

Ingredients:

Lean meat 35 kg, back fat 15 kg, sugar 4 kg, salt 700 g, soy sauce 2 kg, Chiju (wine) 1.2 kg, nitrite 5 g, spices 50 g, polyphosphate 150g, and MSG 150g.

Procedures:

1) Grind lean meat and fat into 1 cm^3 cubes, separately.
2) Blend the ground lean meat with salt, sugar, nitrite, polyphosphate, soy sauce, wine and MSG well to be viscous. Then mix the ground fat and spices thoroughly.
3) Stuff the mixture into the casings and tie every 10 cm long for a node, and link by string. Puncture the casings to allow the entrapped air to escape.
4) Dip the wet sausage in the warm water to remove smear and dirts and drain.
5) Hang the product on the bamboo sticks of rack, and dry by sun heat in day time, and dry by oven in the night. This process takes 3 days.

Kweizhou sausage

Ingredients:

Lean meat 80 kg, back fat 20 kg, salt 3.1 kg, sugar 1.1 kg, wine (Moutaiju) 1.1 kg, white soy sauce 1.1 kg, K-nitrate 200 g.

Procedures:

1) Grind lean meat and fat into 1 cm^2 pieces, separately.
2) Rinse the ground meat with warm water to remove the smear.
3) Dry salt to evaporate the moisture, cool and mix nitrate, add sugar, wine, soy sauce, then blend with ground lean meat and fat to cure for 50 min.
4) Stuff the mixture into the casings and place on table to puncture the casing to allow the entrapped air to escape. Tie the sausage every 23 cm long for each node, and link at middle to become two sections of 11.5 cm long.
5) Rinse the surface smear of the product and hang on the bamboo sticks for drying.
6) Dry by wood coal in the roasting room, the temperature can not rise too high to prevent resulting in dry outside but wet inside of the sausage. After dry for 12 h, exchange both positions of up and down. Then keep drying another 12 h.
7) Cool the product in the aeration condition.

Lanzhou sausage (Ganshu)

Ingredients:

Pork meat (ham and shoulder) 50 kg, salt 1 kg, chopped onion 1 kg, cooking wine 1 kg, sesame oil 1 kg, soy sauce 2 kg, sugar 3.25 kg, chopped ginger 500 g, five spices 100g,MSG l00g and Na-nitrite 3 g.

Procedures:

1) Grind meat into 1 cm^2 pieces.
2) Blend ground meat with salt, soy sauce, sugar, cooking wine, nitrite, MSG until becomes viscous. Mix batter with other ingredients well.
3) Stuff the mixture into casing, and tie every 40 cm long for each node, then tie two end to become a loop. Puncture the casing to allow the entrapped air to escape.
4) Hang an hook and dry at 60℃ in the roasting room for 30 min, then rise the temperature to 140℃ for cooking 1.5 h. During roasting exchange both positions of lower and upper layers 2-3 times.
5) Brush syrup on the roasted sausage before take out of the roasting room.

Crystal sausage

Ingredients:

Pork skin 3 kg, lean pork 2 kg, salt 100 g, MSG l0g, nitrite 0.15g

Procedures:

1) Trim connective tissue out of lean meat and cut it into 2 cm x 1 cm pieces.
2) Remove fat from skin and cut into 1 cm^2 particles.
3) Cure lean pork slates with 40 g salt and nitrite for 24-48 h at 0-5℃ in cooling room.
4) Cook lean meat for 30-40 min, and boil pork skin in three times of water added with the rest of salt for 3-4 h, and remove skin residues and add cooked lean meat, and other ingredients and cook until boiling.
5) Stuff the mixture into the casing and tie every 15 cm long for each section, and Cool for 12 h. Occasionally, turn the sausage up and down to prevent meat particles moving to one end.

Pepper sausage

Ingredients:

Pork shoulder 50 kg, beef jowl 30 kg, pork jowl 20 kg, salt 750 g, sugar 1 kg,

K-nitrate 50 g, hot red pepper 50 g, allspices 2 kg, pepper 750 g, garlic 30 g, glucose 250 g.

Procedures:

1) Grind pork shoulder, pork jowl and beef jowl into coarse particles initial phase, then fine particles, separately.
2) Blend the ground meat with salt, nitrate, sucrose, glucose to become sticky, then mix with other ingredients well.
3) Stuff the mixture in the casings and cure in chilling room at 3℃ for 10 days, then ferment at 22-24℃, 80% RH for 48 h.
4) Smoke at 32-34℃ for 2-3 days, and dry at 14℃ for several days.

Blood sausage

Ingredients:

Pig blood 25 kg, pork cheek 40 kg, belly 25 kg, pork skin 10 kg, salt 2.2 kg, white pepper 340 g, allspices 60 g, onion 500 g.

Procedures:

1) Chop precooked pork skin, ground pork and onion for a while, then add blood and chop again, thereafter, add diced fat (0.5-1.5 cm^3 cubes) and seasonings and mix thoroughly.
2) Stuff the mixture into the casings and cook at 83-85℃ for about 1 h.
3) Cool quickly.

Guangdong mushroom sausage

Ingredients:

Lean meat 20 kg, back fat 20 kg, mushroom 10 kg, salt 1.25 kg, soy sauce 2.5kg, sugar 5 kg, sodium nitrite 3 g, and white wine 1 kg.

Procedures:

1) Cut lean pork into strips and grind into 1 cm^2 particles, cut fat into 1 cm^2 dices.
2) Soak dry mushroom, clean and cut into 1 cm^2 dices.
3) Blend ground pork with salt, sugar, wine, soy sauce and nitrite well, and mix ground fat thoroughly.
4) Stuff the mixture into the casings and tie every 21 cm long for a section, and puncture the casing to allow the entrapped air to escape.
5) Dry by sun heat or by oven at 50-60℃ to be dried, then hang on bamboo sticks in the cool air for 3-5 days.

Beef sausage

Ingredients:

Beef 83 kg, hen eggs 5-7 kg, vegetable oil 2.5-3.5 kg, potato starch 4-7 kg, sugar 0.8-3.5 kg, salt 2.5-3 kg, glucose 80 g, sodium nitrite 8.5 g.

Procedures:

1) Cut beef into cubes and drain blood residues.
2) Blend beef cubes with salt, sugar, glucose, and nitrite well and cure for 10-36 h
3) Grind cured beef cubes and store for 10-36 h. Mix the ground beef with other ingredients thoroughly.
4) Stuff the mixture into casings.
5) Cook green sausage, and roast, then smoke (optional).

Goat meat sausage (Henan)

Ingredients:

Goat meat 50 kg, goat fat 1 kg, salt 1.5 kg, sugar 1 kg, shaoshing wine 100 g, galangal 50 g, ginger juice 50 g, wild pepper 50 g, sesame oil 500 g, goat casings.

Procedures:

1) Cut goat meat into 1cm x 3 cm strips. Grind goat fat through 3/8 in d, plate.
2) Blend meat strips with salt, wine, vegetable oil, sugar and ginger juice well.
3) Fry wild pepper with sesame oil in the preheated wok.
4) Mix the goat meat mixture with sesame oil fried wild pepper and ground fat thoroughly.
5) Stuff the mixture into casings and make a node every 15 cm long.
6) Dry in aeration room.

Duck or chicken sausage (Guangdong)

Ingredients:

Lean pork 30 kg, back fat 15 kg, chicken meat or duck meat 5 kg, sugar 5 kg, salt 1.25 kg, soy sauce 2.5 kg, white wine 1 kg, and sodium nitrite 3 g.

Procedures:

1) cut lean meat into strips , then grind into 1 cm^2 dices, cut back fat into 1 cm^2 cubes, then dip in 100℃ hot water to be transparent. And cut chicken meat or duck meat into 1 cm^2 dices.
2) Blend ground pork and diced chicken meat with salt, soy sauce and nitrite, then mix with diced fat and the rest of ingredients thoroughly.

3) Stuff the mixture into casings, and make a node every 21 cm long, and puncture the casings to allow the entrapped air to escape.
4) Dry green sausage by sun heat or oven, and hang on bamboo sticks in the cool and aeration room for 3-5 days.

Fish sausage

Ingredients:

Formula 1：

Fish meat 80 kg, lean pork 8 kg, back fat 6 kg, starch 4.5 kg, salt 1.8 kg, Shaoshing wine 5 kg, MSG 160 g, white pepper 50 g, ginger juice 1.5kg.

Formula 2：

Fish meat 80 kg, pork 8 kg, leaf fat 6 kg, starch 4.5 kg, salt 1.8 kg, curry 400 g, pepper 350 g, MSG 10 g, corn starch 50 g and tomato juice 20g.

Procedures are the same as those of sausage making.

Nanjing Xiang do

Formula 1：

Lean pork 70 kg, back fat 30 kg, salt 5 kg, sugar 5 kg, potassium nitrate 50 g, five spices 50g, and pig bladder.

Formula 2：

Lean pork 80 kg, back fat 20 kg, salt 1 kg, sugar 1 kg, sodium nitrite 10 g, polyphosphate 50 g, white pepper 100 g, sodium ascorbate 50g.

Procedures：

1) Trim the bladder fat off and wash and clean, then cure with salt.
2) Grind lean meat and fat through 3/8 in d. plate, separately.
3) Blend ground lean meat with salt, nitrite or nitrate and sugar thoroughly, and mix with ground fat and other ingredients well.
4) Stuff the mixture into the cleaned and cured bladder with 250 g batter, and clip or tie by cotton strings.
5) Cure at 4℃ for 24 h.
6) Dry by oven at 50℃ for 8 h.
7) Place the green xiangdo at 13-22℃, 59-89% RH condition for 2 weeks, then shift to 15℃, 60-83% RH for 2 months fermentation.

Chinese-Style Sausage

Formula 1

Raw meat	Percentage（%）
Pork picnic	30
Pork trim(80-85/15-20)	30
Fat meat (15-20/80-85)	40
Ingredients(are based on the weight of the meat)	**Percentage（%）**
Cane sugar	8-12
Sodium glutamate	1
Sodium tripolyphosphate	0.2-0.3
Chinese rice wine	1-2
Salt	1.5-2.0
Sodium nitrite	0.01-0.02
Sodium erythorbate	0.05
Potassium sorbate	0.25
Cinnamon powder	0.05-0.1
Five spices*	0.1-0.2
pepper	0.1-0.2

*Five spices：the composition is the same as that shown in the dried pork.

Formula 2

Lean；fat＝3-4:1	100%
Nonmeat ingredients are based on the weight of meat.	
Salt	1.8
Sugar	1
MSG	0.5
$NaNO_2$	0.015
polyphosphate	0.2
potassium sorbate	0.2%
pepper powder	0.2
Cinnamon	0.17
Garlic powder	0.2
Chinese rice wine	1-2

*Salty taste

Formula 3

Lean ; fat=3-4:1	100%

Nonmeat ingredients are based on the weight of meat.

Salt	1.6-1.8
Sugar	6-12
MSG	1
$NaNO_2$	0.015
polyphosphate	0.3
Chinese rice wine	1-2
potassium sorbate	0.2
White pepper powder	0.2
Garlic powder	0.2
Cinnamon	0.17
Ice water	10

*Sweet taste

Processing procedure

1. Grind meat through a 7mm plate.
2. To meat, add sodium phosphate, salt, $NaNO_2$ with half the formula water, mix until tacky.
3. Add seasonings and spices to the mixture.
4. While mixing add sugar with remaining water, mix thoroughly.
5. Add fat meat and mix completely.
6. Stuff in pork casings and link at 10-12 cm intervals.
7. Dry in a smoking house at 50-55℃ for 10 to 12 hours.
8. Chilling and packaging.

Taiwanese-Style Sausage

1. Shao-hsing Sausage

Formula :

Raw meat : Lean pork Back fat=80-70:20-30

Ingredients	%
Salt	1.4
Polyphosphate	0.25
Sodium Nitrite	0.02
Sodium Erythorbate	0.05
Licorice extracts	2.8*
Shao-Hsing wine	2.8

Sugar	12
Monosodium Glutamate	0.5
Mushroom(Shitake) Concentrate	0.1
Bay Leaf Powder	0.1
Cinnamon Powder	0.2
Garlic Powder	0.17
Coriander Powder	0.1
Nutmeg Powder	0.1
Celery Seed Powder	0.2
White Pepper powder	0.2
Ice water	5

*Licorice extract: licorice is extracted with water by 1:10 ratio

Procedure:

1. Raw meat treatment: Desinewing and to remove connective membrane outside of lean meat.
2. Grinding
   Chilled lean pork is ground by grinder with 6/8 inch plate and chilled back fat is diced with dicer or cut by hand into small cubes(pieces).
3. Blending and mixing
   Ground lean meat is blended with salt, polyphosphate, sodium nitrite and ice water by mixer for 3-5 minutes, then added with ground fat and continue blending for 3-5 minutes, then mixed with other ingredients such as sugar, MSG and spices for 5-8 minutes.
4. Curing
   The mixture is placed in cold room(4-5℃) for 12-18 hours for cured color development.
5. Stuffing and linking
   The cured mixture is stuffed into natural casings with vacuum staffer and linked into desired lengths.
6. Drying
   The sausage is dried at48-55℃ in smoking home for 5-12 hours, depending on the products.
7. Cooling and packaging.

Taiwanese-style sausage

Formula 2：

Ingredients：

Raw meat：lean : fat ratio=3.5-4:1

Salt	1.6%
Sugar	5-12
Monosodium glutamate	0.25
Polyphosphate	0.25
Sodium nitrite	0.02
Cinnamon powder	0.15
White pepper powder	0.2
Five spices powder	0,1
Sodium erythorbate	0.05
Paprika powder	0.14
Garlic powder	0,2
Shao-hsing wine	1.8
Ice water	5
Pork extract	option

Note：You can mustard or Monascus anka powder or black pepper powder or curry powder to prepare the sausages with the ingredient name such as Mustard sausage.

Sausage formulation

Salt	1.4%	Mushroom concentrate	0.1%
Polyphosphate	0.25	Bay leaf powder	0.1
Sodium nitrite	0.02	Cinnamon powder	0.2
Sodium erythorbate	0.05	Coriander powder	0.2
Licorice extract	2,8*	Garlic powder	0.17
Shao hsing wine	2.8	Nutmeg powder	0.1
Sugar	12	Celery seed powder	0.2
Sodium glutamate	0.5	White pepper powder	0.2
Dried winter vegetable powder	0.2	Ginger powder	0.15
Mustard powder	0.2	Acetyl mannitol	0.5
Ice water	5-8		

*Licorice : water=l : 10

Cantonese sausage formulation

Lean : fat = 3 : 1

Sugar	7.5%	Soy sauce	3.5%
Rice wine	2	Salt	1.5
MSG	1	Ginger juice	0.35
Five spice powder	0.3	Polyphosphate	0.2
Sodium nitrite	0.01		

Pungency sausage (辣味香腸)

Lean: fat =3:1

Salt	2.5%	Sugar	2.5%
Sorghum liquor	2.5	Red pepper powder	0.5
MSG	0.5	Nitrite	0.01

Ma la sausage (麻辣香腸)

Lean: fat =1:3

Red pepper powder	0.5%	Hot pepper powder(roasted)	0.25%
Orange skin(slightly roasted)	0.1	Star anise, cinnamon, white nitrite	0.02
Ginger juice	0.3	large onion	0.03
Soy sauce	3	Salt	2-3
Sugar	2	White wine	0.5
MSG	0.5	Sodium nitrite	0.01

Taiwanese-Style Ham

Formula	Percentage
Raw meats : Fresh ham or shoulder	100%
Nonmeat ingredients are based on the wt of meat.	10
Starch	2
Sugar	2
Salt	0.5
polyphosphate	0.3
Sodium erythorbate	0.05
Potassium sorbate	0.2
Sodium nitrite	0.015
Ice water	10.0

Processing procedure

1. Trim off fat and tendon or other connective tissue, then slice at 3-5mm thick or cut into cubes of 4x4x4cm and chilled to 5℃.
2. Place the trimmed meat slices or cubes into tumbler, add salt, polyphosphate, ice water, nitrite, sugar, MSG, then tumbler at 11 rpm for 4hr at -1 to 2℃ chilling room continuously.
3. Add starch and spices after 2hr tumbling.
4. Stuff the tumbled mixture and meat into cellophane casings.
5. Cook in 80-90℃ smokehouse with dry heat for 3-4 hr until internal temperature to 60-65℃, then remove the cellophane casings and stuff in saran casings and put in a metal mold, then steam for 1 hr until the internal temperature to 90℃.
6. Chilling by electric fan.

Chapter 13. Dried meat products

Meat snacks

1. Spicy beef cubes

Raw materials : Frozen beef round 1200g

Marinade ingredients :

Salt 1 tsp, sugar 3 tsp, MSG 1/2 tsp, dark soy sauce 5 tsp, light soy sauce 1tsp, ginger juice 1 tsp, rose wine 2 tsp, red pepper powder 1tsp, licorice powder 1/4 tsp, star anise powder 1/4 tsp, pepper powder 1/8 tsp, chicken essence powder 1/8 tsp, sodium nitrite 0.12 g, water 600g.

Procedures :

1) Defrost frozen beef round and cut it into 15cmxl0cmx6mm chunks according to muscle fiber direction, then wash and drain.
2) Mix marinade ingredients with beef chunks and cured for 1 hr, during curing turn over once every 20 min to allow the seasonings to distribute thoroughly.
3) Cut the marinated beef chunk into proper size cubes and cook with the residue sauce for 1 hr until the sauce becomes sticky, place cooked beef cubes on the stainless net frame and dry in oven at low temperature until dry and cool.

2. Curry beef slices

Raw materials : Frozen beef round 1200g
Bamboo frame 1
Curry powder 3 tsp

Marinade ingredients :

Salt1/2 tsp, sugar 3 tsp, MSG 1/2 tsp, dark soy sauce 1 tsp, light soy sauce 1 tsp, ginger juice 1 tsp, fried curry powder 1 tsp, licorice powder 1/4 tsp, star anise powder 1/4 tsp, pepper powder 1/8 tsp, Sodium nitrite 0.12g, rose wine 2 tsp, water 600g.

Procedures :

1) Cut beef round into 4 chunks, wash and drain. Mix marinade ingredients with beef chunks and cure for 1 hr.
2) Cook marinated beef chunks with the residue sauce for 30 min. Take out to cut into 6 mm thick beef slices and cook again by mild fire to absorb the sauce until

becoming sticky, then spray curry powder on the beef slices.

3) Place the cooked beef slices on the frame and dry in oven at low temperature and cool.

3. Satay beef jerky

Raw materials : Beef round 1200g
Satay sauce * 150g
Vegetable oil 150g

Equipment : small mesh stainless steel net frame 1

Marinade ingredients :

Salt1/2tsp, sugar 3 tsp, MSG 1/2 tsp, dark soy sauce 1 tsp, light soy sauce 1 tsp, ginger juice 1 tsp, salty sauce 1tsp, licorice powder 1/4 tsp, star anise powder 1/4 tsp, pepper powder 1/8 tsp, Na-nitrite 0.12g, rose wine 2 tsp.

Procedures :

1) Wash beef and cut into 4 mm thick slices.
2) Mix beef slices with the marinade ingredients and cure for 1 hr, during curing Turn over once every 20 min to allow seasonings to distribute thoroughly.
3) Place the marinated beef slices on the frame, and roast in dryer or oven at low temperature for 15 min.
4) Take out to spread vegetable oil on both sides of the beef slices, and reheat in oven for another 15 min.
5) Take out again to spread satay sauce on both sides of beef slices, then roast again for 10 min, and then spread satay sauce one more time.
6) Cool and dry in the air.

* Satay sauce formula :

Ingredients : Satay sauce3/4tsp, Satay powder 3/4 tsp, light soy sauce 1 tsp, dark soy sauce 1 tsp, salt 1/6 tsp, sesame oil 1/4 tsp, rose wine 1/4 tsp, sour bean extract 1 tsp(10 grains soaked in 4 tsp water for 2 days).

4. Satay spicy beef cubes

Raw materials: Beef round 1200g
Satay sauce 190g

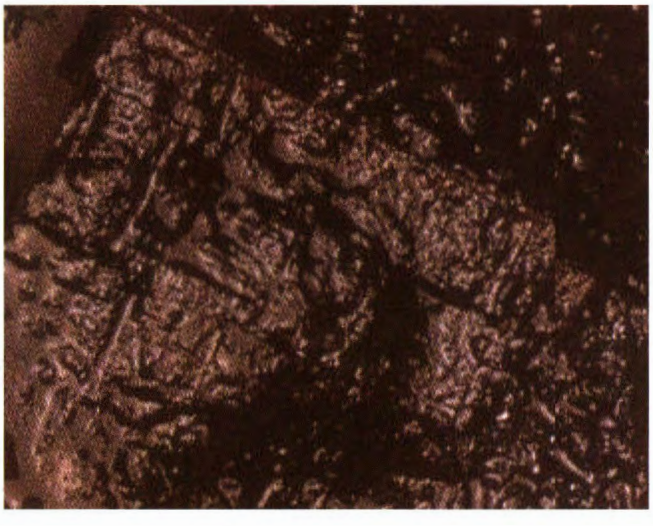
Ingredients :

Salt 1/2 tsp, sugar 3 tsp, satay sauce 1 tsp, licorice 1/4 tsp, MSG 1/2 tsp, dark soy

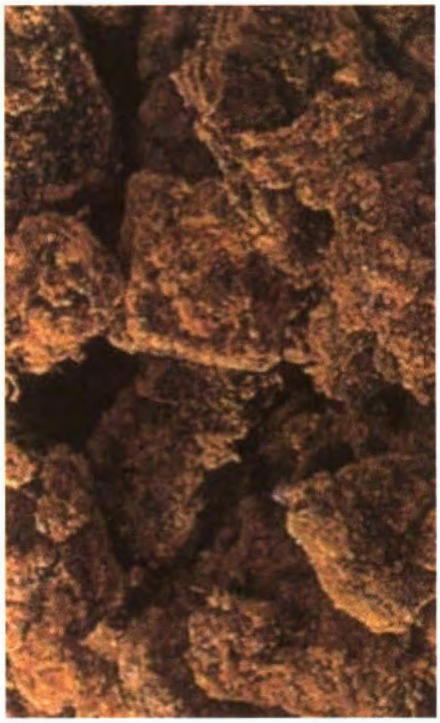
sauce 1 tsp, light soy sauce 1 tsp, ginger juice 1 tsp, star anise powder 1/4 tsp, pepper powder 1/8 tsp, chicken essence powder 1/8 tsp, Na-nitrite 0.12 g, rose wine 2 tsp, water 600g.

Procedures：

1) Cut beef into 5 cm cubes, wash and drain.
2) Mix beef cubes with marinade ingredients and cure for 1 hr, during curing stir once every 20 min to allow the seasonings to distribute thoroughly.
3) Cook beef cubes with seasonings juice in cooker by mild fire for 50 min, stir during cooking.
4) Cook until the seasonings juice becomes sticky, then take out and drain.
5) Mix the cooked beef cubes with satay sauce and dry for 30 min in preheated oven or dryer at low temperature, then take out and cool.



Honey beef jerky



Beef chunk

Curry beef jerky

5. Honey taste beef jerky

Raw materials：Beef round 1200g
Honey syrup* 150g
Vegetable oil 150g

Tools：Small mesh stainless steel net frame

Marinade ingredients：

Salt1/2 tsp, sugar 3 tsp, MSG1/2 tsp, dark soy sauce 2 tsp, light soy sauce 1 tsp, ginger juice 1 tsp, licorice powder 1/4 tsp, star anise powder 1/4 tsp, pepper powder 1/8 tsp, chicken essence powder 1/8 tsp, Na-nitrite 0.12 g, rose wine 2 tsp.

Procedures：

1) Cut beef into 4 mm thick slices.
2) Mix beef cubes with marinade ingredients and cure for 1 hr, and stir once every 20 min to allow the ingredients to distribute thoroughly.
3) Roast the marinated beef slices on pre-spreaded vegetable oil stainless steel frame by mild fire for 15 min in preheated oven.
4) Then take out to spread the oil on both sides of beef slices, and reheat for 15 min, and take out to spread honey syrup, and reheat for another 10 min.
5) Take out to spread honey syrup again, and cool and dry in the air.

Honey syrup preparation

Ingredients：Maltose 450g, water 4 tsp, rock sugar 75g, ginger 2 slices, salt 1 tsp.

Procedures：Cook water, rock sugar, ginger slices and salt until rock sugar dissolve, then add maltose and cook by mild fire until boiling.

6. Oyster oil beef cubes

Raw materials：Beef round 1200g

Marinade ingredients：

Oyster oil 5 tsp, salt1/4 tsp, sugar 5 tsp, MSG 1/2 tsp, soy sauce 2 tsp, ginger juice 1 tsp, pepper powder1/4 tsp, chicken essence powder 1/8 tsp, Na-nitrite 0.12 g, rose wine 5 tsp, water 600g.

Procedures：

1) Cut beef into 5 cm cubes, wash and drain.
2) Mix beef cubes with marinade ingredients well and cure for 1 hr, and stir once every 20 min during curing for distributing the ingredients thoroughly.
3) Boil the marinated beef cubes with marinade juice in the cooker by mild fire for 50 min, stir during boiling.
4) When the marinade juice is coked to become sticky, and cool in the air.

7. Beef jerky with fruit juice

Beef round	1200g
Syrup	150g*
Vegetable	150g

Tools：Small mesh stainless steel net frame

Marinade ingredients：

Gya in tsu (denutted, chopped) 75g, salt 1/2 tsp, sugar 3 tsp, MSG 1/2 tsp, dark soy sauce 1.5 tsp, light soy sauce 1 tsp, ginger juice 1 tsp, licorice powder 1/4 tsp, pepper powder 1/8 tsp, chicken essence powder 1/8 tsp, Na-nitrite 0.12g, rose wine 2 tsp.

Procedures：

1) Cut beef into 4 mm thick slices and mix with marinade ingredients, then cure for 1 hr, during curing stir once every 20 min to allow the seasonings to distribute thoroughly.
2) Roast the marinated beef slices on the pre-spreaded oil stainless steel net frame in the preheated oven at low temperature for 15 min. Then take out to spread oil on both sides of beef slices and roast another 15 mm.
3) Take out the beef slices to spread ginger juice and reheat for 10 min, then take out to spread honey syrup on both sides of beef slices, and cool and dry in the air.

Pork jerky

Ingredients(Based on meat weight)：

Ham	100%
Sugar	18
Soy sauce	8
Salt	1
MSG	1
Potassium sorbate	0.2
Sodium ascorbate	0.05
Anka pigment	0.1
Sorbitol or glycerol	

Procedures：

1) Remove connective tissue, fat, skin from ham.
2) Freeze ham to -10 ℃, and slice ham into 3-5 mm thick.
3) Mix the sliced meat with the all ingredients and cure at 0℃ for 24-48 h.
4) Place the cured sliced pork flatly on the stainless steel frame which pre-spreaded oil, and dry at 55-60 ℃ for 1 h, then change the position of both side and dry again at 60-70 ℃ for 1-2 h.
5) Finally, roast the dried pork slices at 180 ℃ for 3-5 min depending upon the thickness of the meat slices.
6) Cool and package.

Dried Pork

Formula：

Raw meat：Fresh ham(trim off surface fat)

Ingredients (are based on the weight of raw meat)

	Percentage (%)
Cane sugar	15-20
Salt	0,8-1
MSG	0.5-0,8
Soy sauce	8-12
Chinese rice wine	1-2
Cinnamon powder	0.05-0.6
Five spices*	0.1-0.15
Sodium nitrite	0.02
Sodium ascorbate	0.05
Potassium sorbate	0.25

*Five spices:25% star anise, 25% fagara, 12.5% cassia or cinnamon, 12,5% cloves and 25% fennel seeds

Processing procedure：

1. Trim ham off the connective tissue and surface fat, and freeze to solidify the meat.
2. Slice the partially frozen pork into a 3-5mm thick meat, then marinated in the mixture of the nonmeat ingredients and blend thoroughly and store at 2-4 ℃ for 2-3days.
3. Place the cured pork slices on the bamboo rack flatly which is pre oiled.
4. Dry the sliced pork at 55℃ for 1 hr, then turn over and dry at 65℃ for 1-2 hrs.
5. Roasted at 180℃ for 3-5 min.

Fried pork floss (shredded pork)

1. Ingredients(all ingredients are based on weight of meat)

Lean pork from hot boned sow ham	100%
Sugar	11
Salt	1.2
Sodium glutamate	1
Soy sauce	7
Fried onion	0.6
Garlic	0.6

2. Equipment

Cooking vat
Spinning roasting dryer
Shredder of tearing machine

3. Processing procedure

3.1. Cooking：Place raw meat in cooking vat and cook meat until it is ease to tear, thereafter, tear the cooked meat into floss for drying.

3.2. Drying：After cooking transfer the floss into spinning roasting dryer, and add all ingredients and 10% broth, then dry by strong heat.

3.3. Chilling and finishing: Dryness test-grasp by hand and then open, if the floss is dispersed, the dryness will be finished.

Note: after cooking meat, don't throw away the broth of meat, which has to be added back to floss.

Devro snack sticks (sweet)

Materials

	%
Pork Belly (40% Fat, 60% Lean)	60.00
Beef VL90	20.00
Ice	9.65
Salt	1.50
Nitrate	0.1
Onion Powder	0.3
M.S.G.	0.3
Dextrose	0.3
Pepper (White Ground)	0.5
Garlic powder	0.3
Phosphate	0.2
Erythorbate	0.1
Sugar	3.59
Potato starch	3.16
	100.00

Production

（1） Put Lean Beef VL90 through 3mm mincer plate.

（2） Put minced beef into Bowl Chopper. After a few rotations. Add whole quantity of salt, nitrite and phosphate and continue chopping.

（3） Add ice gradually and continue chopping.

（4） When ice has absorbed, the meat mixture must be well bound.

（5） Add Pork Belly, mix well and add all spices.

（6） Chop to the required size 4-5 mm.

（7） Straight fill into snack casings 13-16-17mm. Hang on smoke sticks about 60 cm long.

（8） Smoke and Steam Cook Cycle.

Time	Smoke	Steam	Temp.℃	Damper
15 mins	No	No	60	Open
20 mins	Yes	75%	68	Closed
15 mins	No	Yes	78	Closed

（9） Do not shower keep in room temperature this product should have a weight loss of 30-35% for shelf life.

（10）If weight loss is not reached, a drying cycle in Smoke House is necessary. Dry Heat at 80℃.

This information is a guide for your experimental use only, no responsibility is accepted.

Fried pork floss (shredded, zou-song) (l)

Raw materials : pork ham, shoulder, 600 g.
Fried flour 2 tbsp (L)
Red tofu zu 1/2 cube

Seasonings : Sugar 1.5 tbsp, soy sauce 3 tbsp, MSG 1 tsp, wine 1 tbsp, water 6 cups.

Procedures：

1) Cut pork into 4x4 cm cubes, cook pork cubes with onion and ginger in quick cooker added with 10 cups water for 23 min or 1 h.
2) Take out to shred.
3) Add seasonings, shredded pork, bone broth 4 cups in wok to fry by low heat for 40 min until dry, then add hot lard and fried flour and mix well.
4) Cool in the air and pack.

Formula 2

Raw meat : 18kg
Seasonings :
Sugar 600g, MSG 375 g, salt 300 g, soy sauce 1 bottle.
Procedures are the same as formula 1.

Formula 3

Raw meat : ham, shoulder or loin.
Seasonings (based on the weight of meat):
Sugar 10-15%, lard 2-3%, salt 2%, soy sauce 2% and MSG 1%.

Fried oily pork floss (shredded, zou-shu)
Raw meat : ham, shoulder or loin
Seasonings : sugar, soy sauce, MSG, ank mash, and five spices.

Procedures：

1) Trim meat to remove visible fat and connective tissue, and cut into 5x5cm cubes.
2) Cook pork cubes until the meat can be shredded by high heat.
3) Shred pork by shredder machine or by wooden hammer, to separate the muscle fibers.
4) Mix pork shredder with seasonings and cook to be dry by high heat in advance, then change to mild heat. Stir during drying occasionally to prevent pork shredder burning.
5) Sprinkle hot lard on the shredded pork when it is fried to be almost dry, keep frying to be dry.
6) Cool in the air.

Formula 2

Raw meat : ham, shoulder or loin 100%

Seasonings (based on the weight of meat)：

Sugar 10-15%, lard 8-10 %, salt 2%, soy sauce 2%, and MSG 1%.

The procedures are the same as the above.

Restructured Chinese-style pork, jerky and cubes

Recently here, the consumer trends were such that market growth for meat snacks and specialty items was stimulated. We all know about the large numbers of working women who no longer spend the day in the kitchen, and we've heard about the increased disposable income that allows consumers to pay more for what they want. Then there's that search for new and unusual flavors and the national desire for good health, which includes weight control. Here there are many school children who go to school without eating breakfast. This is harmful to children's health , therefore, I consider to develop a kind of meat snack for school children which is good for their health. Meat jerky and cubes are considered to be nutritious snack foods. They are very popular and preferable traditional Chinese-style meat products. Unlike other snack foods, they are not distributed and sold well in the market due to their costs, packaging , and specifications. They are made of pork ham with high value raw meat, without proper packaging and lacking proper specifications. Therefore, it is very important to processors of these items to make the products uniform, packaged well, and to cut costs to compete with other snack foods.

Recently, new technologies such as restructured meat manufacturing and massaging or tumbling technology have been applied by processors. Thus, in this

study, they are also used to make pork jerky and cubes with the original products' defects such as hardness and moldiness. These new products are also classified as intermediate-moisture foods with low water activity. However, they are also very hard in texture if they are made under undesirable conditions. Thus, the humectant, sorbitol, was used to improve the texture of the products and inhibit mold growth.

Definition of restructured meat

Today there is an ever-increasing demand for fast food, meals away from home, convenience, individual entrees, and smaller-size portions. With less time available for food preparation, the demand for items such as boneless steak meat cannot be met by existing high quality supplies at prices perceived as reasonable by consumers. If restructured meat and poultry products are developed, it will not only increase the value of specific primal cuts, use lean trimmings, and produce a steak with specific seasonings to create new products but also will be able to compete with the intact muscle products with low-cost, uniform, completely edible steak products. The word restructuring, as it is used with respect to red meat and poultry products, refers to taking the raw material---the soft tissue, including lean, fat, and connective tissue, and changing its form. Restructuring adds value and can upgrade raw materials which would not normally be part of a steak-like product. Typically, these raw materials are used for ground meat systems or manufactured into sausage products.

Many different types of products have been restructured, including roasts, steaks, chops, cutlets, strips, and cubes. A wide variety of cured and smoked products have also been developed, many using some of the same technologies, but this article will discuss Chinese-style pork jerky and cubes in particular (Mandigo, 1986).

Functional properties of raw materials

Since all processed products arise from raw meat materials and added ingredients, each of which has a specific or contributing function, one must view the importance of functional properties as a carry-over from the fresh meat state into any further processing operation. This discussion will concentrate on three major functional properties of raw meat materials, and on the tissue characteristics which influence these properties: water and oil binding abilities, solubility, and gelation of muscle proteins during heating.

Restructured pork jerky and cubes are processed by using lean pork trimmings and mixed with salt and polyphosphate to extract the salt soluble proteins as a binder. The salt soluble proteins have gel forming ability during heating and bind the meat particles together to form a uniform product. The following table notes major properties of the myofibrillar and sarcoplasmic proteins of muscle tissue.

PROPERTY	SARCOPLASMIC	MYOFIBRILLAR
Conformation	globular	"fibrous"
(average/range)	low (60,000 to 120,000 daltons)	High (400,000 to 800,000 daltons)
Solubility	soluble in water or dilute salt solution	water insoluble; swells hydrates water in low salt (0.25 to 0.30 molar); solubilizes in high salt (> 0.4 molar)
Solution Viscosity (at comparable concentrations)	low viscosity solutions	high viscosity solutions
Water Binding Ability	very low	very high in the presence of salt
Emulsification (Fat Interaction)	thin films on dispersed fat/oil particles	think, aggregated film coatings on dispersed fat/oil particles
Gelation Ability (Heat-Induced)	none (forms coagulum)	extensive (forms a protein matrix)

Gelation of myofibrillar proteins is defined as the formation of a protein matrix capable of retaining water and dispersing fat particles. Myofibrillar proteins will form gel structures at salt concentrations as low as approximately 0.5%. These structures are weak at low salt concentrations. Optimum gel or protein matrix formation is found when the salt concentration is between 1.5% and 2.5%. and the best gel or protein matrix formation is found in the pH range of 5.5 - 6.5, with 6.0 being the optimum. Gelation is a chemical reaction that follows a certain order of steps as outlined below(Acton and Dick, 1985):

Native proteins (as in raw tissue)

↓

Denatured protein (intermediate heating)

↓

Protein aggregation to gel structure

(occurs near 140°F in heating)

Processing procedures of pork jerky and cubes

Formulation	
Raw meat : shoulder : ham =80:20	100%
Salt	1.5%
Polyphosphate	0.3%
Cane sugar	8.0%
Sodium glutamate	0.5%
Sodium nitrite	0.01%
Sorbitol	2%(with or without)

Processing procedure

1. Grinding: Raw meat is ground through a plate with 3/8 inch diameter holes.
2. Mixing: All ingredients are added to the ground meat and mixed together for 15 minutes.
3. Curing: The mix is stored in the cooler at 4℃ for 12 hours.
4. Stuffing and molding: Stuff the cooled mixes into casing or molds and freeze at -28℃.
5. Tempering: Remove the frozen mixes to a 4℃ cooler for 5 - 8 hours to raise temperature to between -5℃ and -10℃.
6. Slicing: Pork jerky by 8 x 7 x 0.5cm, and pork cubes by 2.5 x 2.5 x 1.5cm.
7. Drying: Dry the sliced and diced jerky and cubes at 35℃ to 40℃ in an oven for 8 or 12 hours.
8. Roasting: After drying, roast the products at 250℃ for 3 minutes.
9. Cooling: Cool the products to room temperature.
10. Packaging: Pack the products in LDPE bags or vacuum packed in PVDC bags under 1000 mbar.

Effect of drying time on product quality

Water activity(Aw) is one of the important factors influencing the stability of intermediate-moisture food. In this experiment, Aw of the products is shown in Table 1 which shows that the Aw the products is depressed as the drying time increases. When pork jerky is dehydrated for 8 hours, its Aw levels are poised at 0.827, and Aw levels of pork cubes are poised at 0.879. When the products dry for 12 hours, their Aw levels are depressed to 0.640 and 0.760 for pork jerky and cubes, respectively. The pH values of the products are also affected by the drying time; the longer drying time, the higher pH (Fig. 1).

Table 13.1. Effect of drying time on the water activity of the products

Item	Drying time (hours)	
	8	12
Pork jerky	0.827	0.640
Pork cube	0.879	0.760

Tables 5 and 6 show that the bacterial counts of products dried for 12 hours are higher than those of the products dried for 8 hours. This may be caused by the contamination or growth of microorganisms during the drying period at 35℃ to 40℃, since the drying temperature is not sufficient to destroy the organisms.

Except for moisture, all other chemical compositions increase as the drying time increases (Table 2). Table 4 shows that shear values are affected remarkably by the drying time. The shear values are parallel with the drying time increased, but increase as the moisture content decreases. The drier the meat products, the harder or tougher the texture.

Table 13.2. Effect of drying time on the composition of products.

Item	Drying time (hours)							
	8				12			
	C.P	C.Fat	Moisture	Ash	C.P	C.Fat	Moisture	Ash
Pork-jerky	41.07	13.20	33.49*	4.95	46.19	15.50	14.81	6.43
Pork cub	37.71	9.55	43.19*	4.20	40.64	13.44	25.08	5.71

Note: *indicates significant difference ($P<0.05$) in the same row same composition.
C.P. = crude protein .Fat = crude fat

Volatile basic nitrogen (VBN) for the products of both drying times increased as storage time increased, but the products dried for 12 hours were more stable than the products dried for 8 hours. Figs.4 and 5 reveal that the VBN of the pork cubes changed sharply, perhaps because it has higher Aw value which enhances microbial growth and proteolyzes the muscle proteins. TBA value of the products dried for 12 hours is lower than the products dried for 8 hours, but TBA value of the former becomes higher than the latter at the end. of the storage time. This result agrees with the work done By Lin (1987). The color change of the products shown in Fig.2 and 3 reveals that L-value of the products dried for 12 hours is lower than that of the products dried for 8 hours, but a-value of the former is higher than that of the latter. This result also agrees with the results of sensory tests of the products. The color of the former is shown in darker red than the latter. However, changes of L-value of the products dried for 12 hours are more stable than the products dried for 8 hours.

Table 13.3. Effect of Dying Time on the Shear Value (kg) of the products.

Item	Drying time (hours)	
	8	12
Pork jerky	6.89	10.21 *
Pork cube	8.54	10.47*

Note : *indicates significant difference (P<0.05)in the same row.

Table 13.4. Effect of drying time on the panel test scores of the products.

Drying	Time (hours)	Color	Mouth	Texture	Flavor	Acceptability
Pork jerky	8	3.80	3.20	3.45	3.45	3.50
	12	3.85	3.40	3.45	3.85	3.60
Pork cube	8	3.75	3.70	3.60	4.05	3.60
	12	4.25	4.00	3.80	3.90	4.00

Table 13.5. Effect of packaging and sorbitol addition on the microbial counts (No.of cells/g) of pork jerky during storage

Storage time(days)	Drying time (hours)					
	8		12 (without sorbitol)		12 (with sorbitol)	
	Conventional	Vacuum	Conventional	Vacuum	Conventional	Vacuum
0	$1.17x10^3$	$1.17x\ x10^3$	$6.67x10^4$	$6.67x10^4$	$3.21x10^4$	$3.21x10^4$
5	$3.83x10^5$	$6,00x10^2$	$2.23x10^4$	$4.00x10^3$	$4.90x10^4$	$2.88x10^3$
10	$2.18x10^6$	$1.23x10^3$	$1.56x10^5$	$1.00x10^3$	$1.03x10^5$	$5.30x10^3$
20		$7.10x10^3$		$2.00x10^3$		$5.95x10^3$
30		$8.71x10^3$		1.00x10		$6.85x10^3$

Table 13.6. Effect of packaging and sorbitol addition on the microbial counts (NO.of cells/g) of pork cube during storage

Storage time(days)	Drying time (hours)					
	8		12 (without sorbitol)		12 (with sorbitol)	
	Conventional	Vacuum	Conventional	Vacuum	Conventional	Vacuum
0	$1.13x10^3$	$1.13x10^3$	$3.97x10^4$	$3.97x10^4$	$1.60x10^4$	$1.60x10^3$
5	$2.37x10^5$	$1.20x10^3$	$1.33x10^5$	$2.67x10^3$	$6.64x10^4$	$1.29x10^3$
10	$3.48x10^6$	$1.07x10^3$	$9.49x10^5$	$1.00x10^3$	$1.22x10^5$	$8.41x10^3$
20		$1.00x10^4$		$2.10x10^3$		$7.21x10^3$

Table 13.7. The appearance change in pork jerky and pork cubes during storage.

Drying time(hours)		Storage time (days)			
		0	10	20	30
Pork Jerky	8	-	+	†	‡
	12	-	-	-	-
Pork Cub	8	-	+	†	‡
	12	-	-	-	-

Note 1 :

- : No mold growth and slime detectable
+ : Mold grows slightly
† : More mold growth
‡ : Mold grows seriously

Note 2 :

NO slime detectable on pork jerky

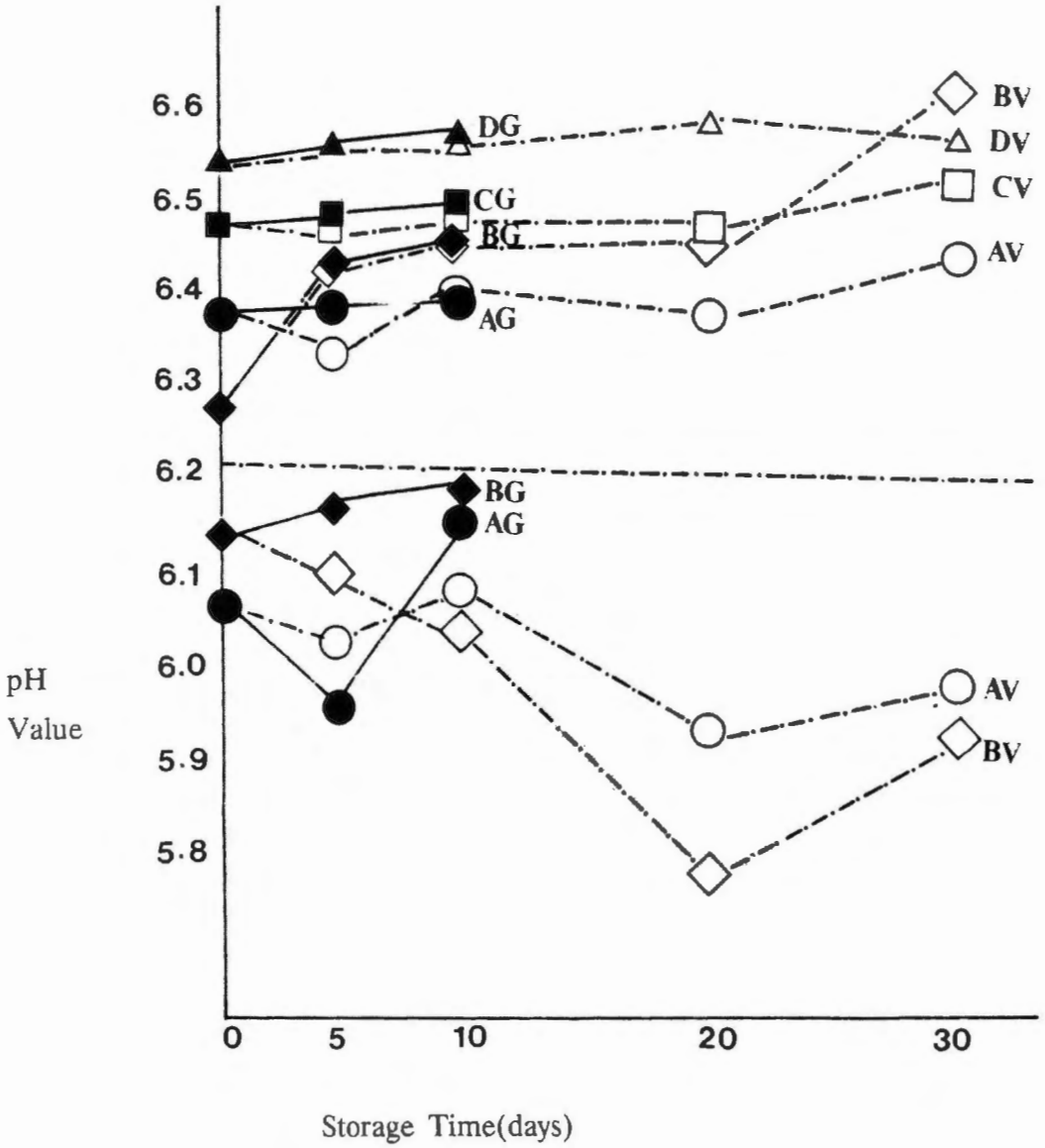
Troller and Christian (1987), in the book "Water Activity and Food", have explained that the very nature of IMF products is based on increasing their shelf life, and thus microbiological stability has been emphasized, sometimes to the exclusion of other potentially deleterious effects such as color changes, lipid oxidation and nutritional losses. Thus, though the lower Aw value can prolong the shelf life of the products, the other quality factors must be considered. The results of the panel test show that the scores for test of mouth, feel, color, texture, flavor, and overall, acceptability of the pork jerky dried for 12 hours are higher than those of the pork jerky dried for 8 hours, and pork cubes have the same results as for pork jerky except for flavor (Table 4). From the results of this study, Desrosier et al. (1977), and Lin (1983), it is very clear that the Aw value of food below 0.8 can prevent the microbial growth, and below 0.6 can inhibit mold growth. However, if the Aw is too low, the product will lose its flavor and acceptability. In this study, it was found that molds grow on the products-pork jerky and cubes, after 5 days of storage (Table 7). This result agrees with the work done by Desrosier et al. (1977). From the above noted manufacture of the restructured pork jerky and pork cubes it is suitable to dry the products for 12 hours.

Effects of packaging on the product quality

It is well-known that packaging can extend the shelf-life of foods, especially evacuation of the atmosphere from inside a package made of impermeable film. This

effect has been attributed to retarding bacterial growth, Preventing lipid oxidation, and reducing weight and shipping cost (Elliott and Michener, 1965; Mossel, 1967; Potter, 1980; and Lynch et al. 1986) .

From the data supplied in Figure 1, it can be seen that pH changes of the vacuum packaged products are more stable than those of the aerobic packaged products. The changes of the vacuum packaged products dried for 12 hours are more stable than the same products dried for 8 hours, the former rises slowly, and the latter is unstable and lower during subsequent storage. There are large variations in the numbers of the total bacterial counts for the products in aerobic packaging, but small variation in the vacuum packaged products. The changes of color (Fig. 2 and 3) in spite of drying time, are more stable in vacuum packaged products than the aerobic packaged products, particularly their L-values. These results are the same as the findings of Lynch et al. (1986a), Seman et al. (1986) and Lin (1987). They found that the color of the vacuum packaged meat products was more stable than that of the aerobic packaged products in bags, and more acceptable and preferable to consumers. VBN values of the products are presented in Fig. 4 and 5. It can be seen that the vacuum packaged products dried for 12 hours are more stable in VBN values than the products dried for 8 hours, but there are no differences between the aerobic packaged products stored for 10 days and the vacuum packaged products. The changes of TBA values presented in Fig. 6 and 7 show small variations in TBA values in the vacuum packaged products, and a rancid flavor is detected in the aerobic packaged products stored for 10 days. Similar variations are reported by Lin (1987). These results show that vacuum packaging extends shelf-life of the products.



Note: A = Pork jerky B= Pork Cubes C=Pork Jerky + Sorbitol
D=Pork cubes + Sorbitol G = Conventional Packaging
V= Vacuum packaging

Figure 1. Effects of packaging and sorbitol addition on pH value of the products during storage.

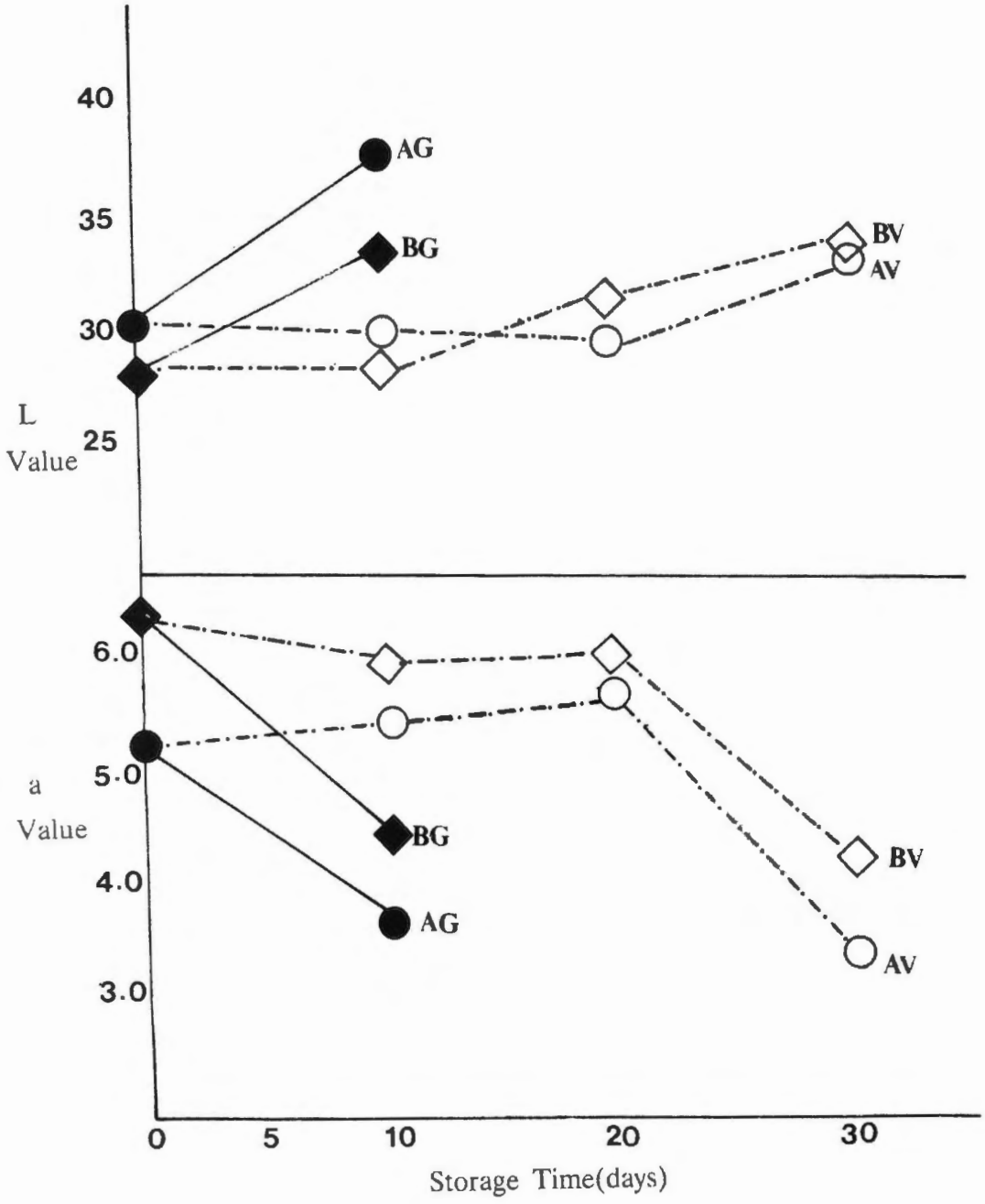


Figure 2. The color changes (L value and a value) of the products dried for 8 hours during storage.

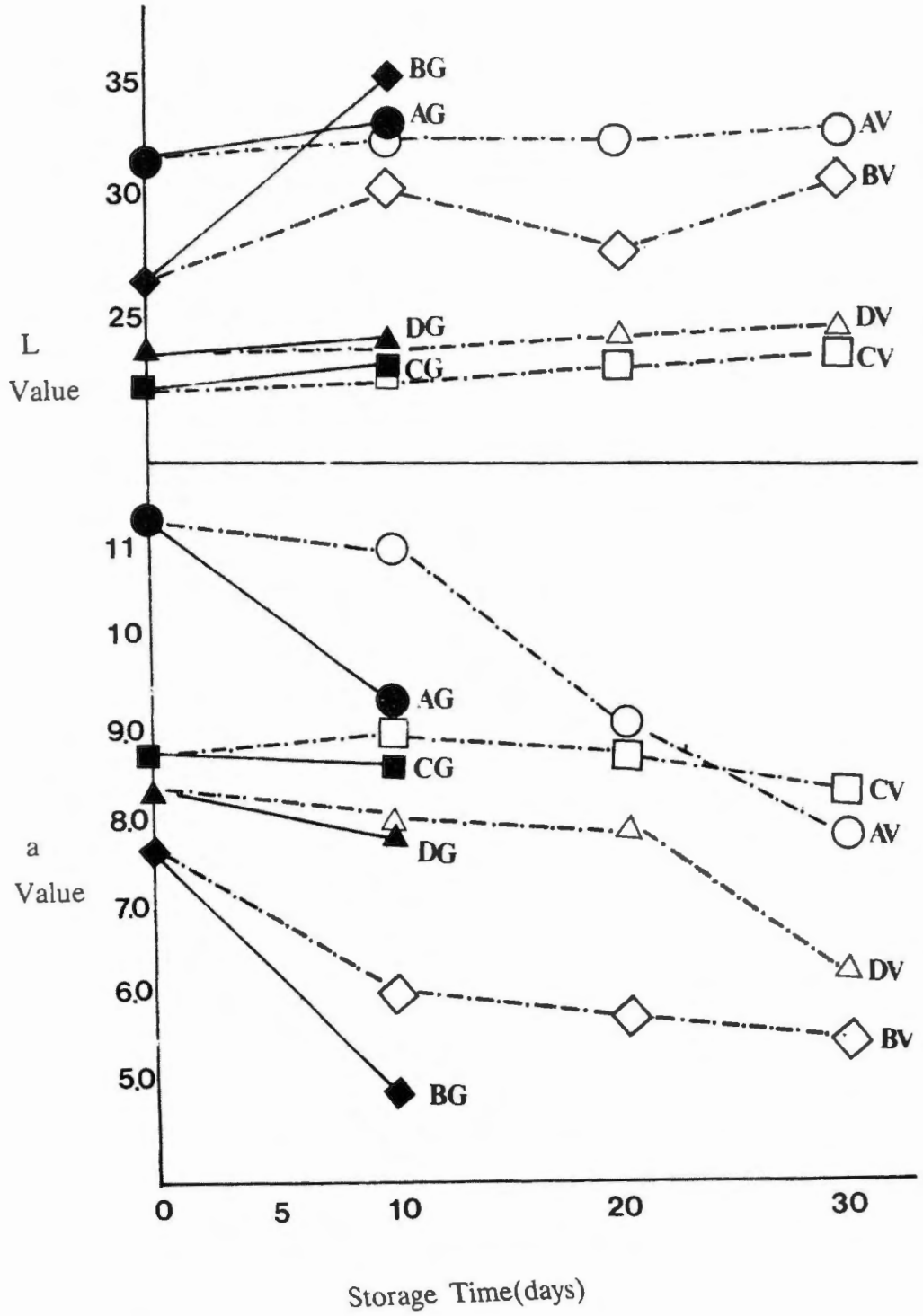


Figure3. Effect of packaging and sorbitol addition on the color (L value and a value) of the products dried for 12 hours during storage.

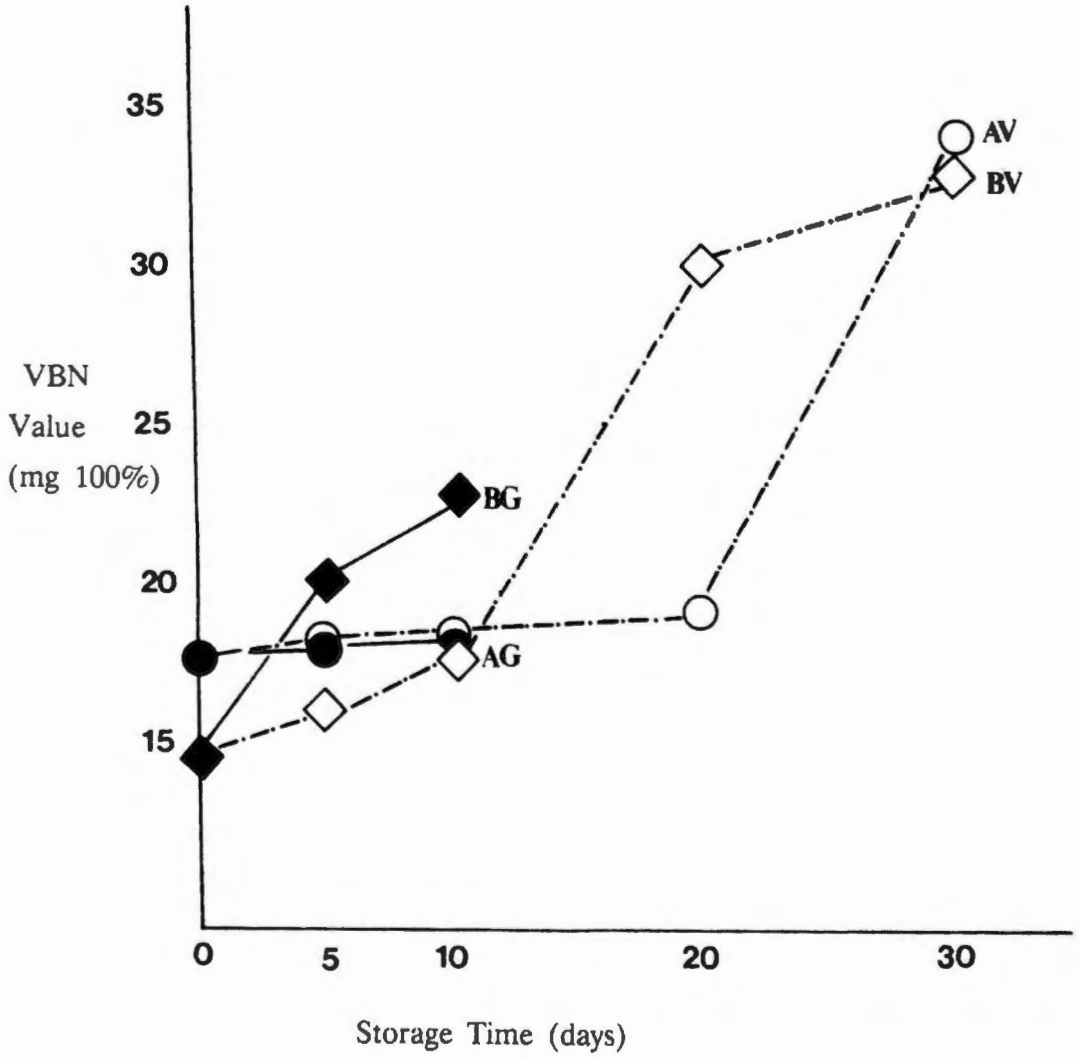


Figure 4. Effect of packaging on VBN value of the products for 8 hour during storage.

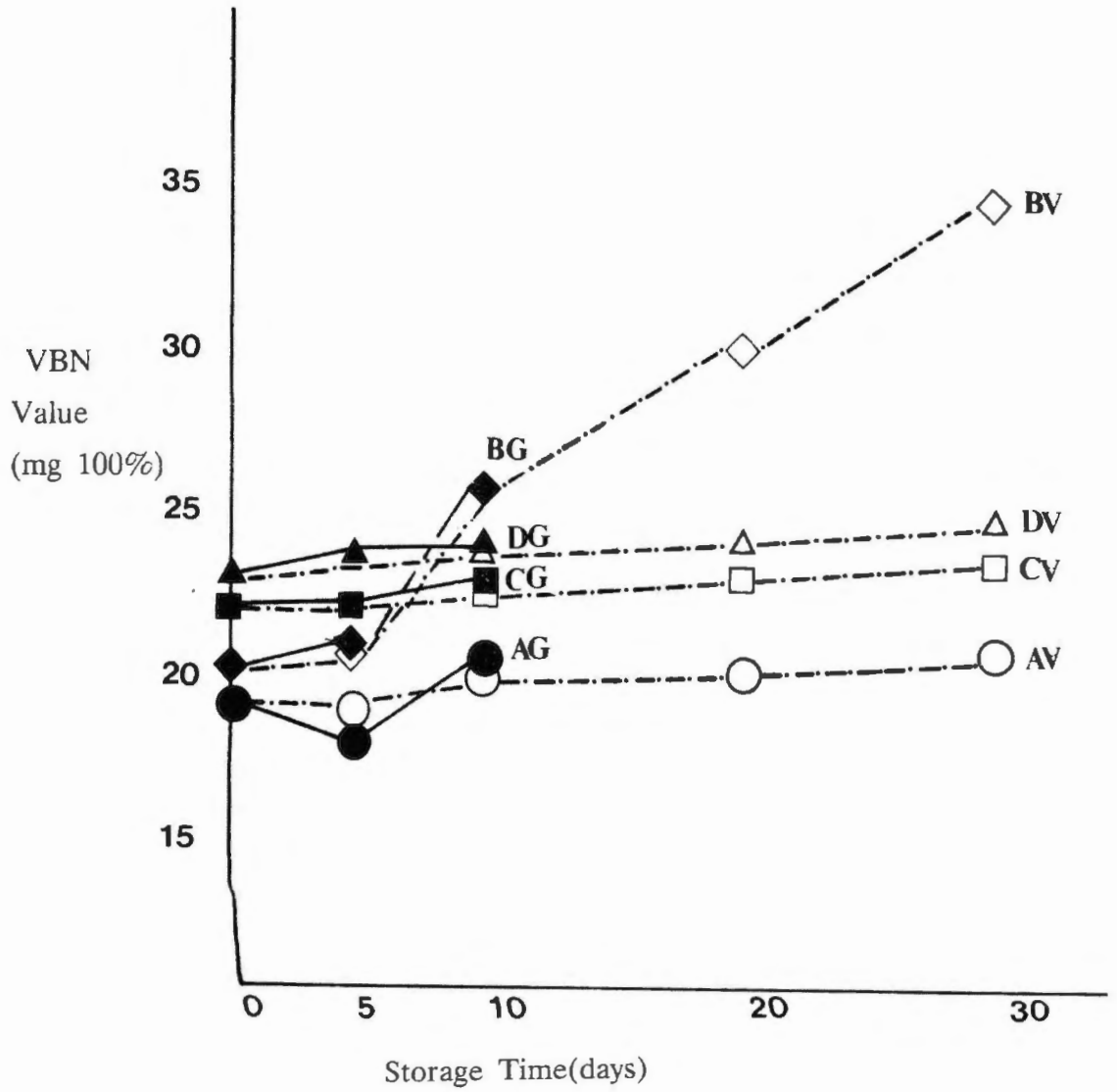


Figure 5. Effect of packaging and sorbitol addition on VBN of the products dried for 12 hours during storage.

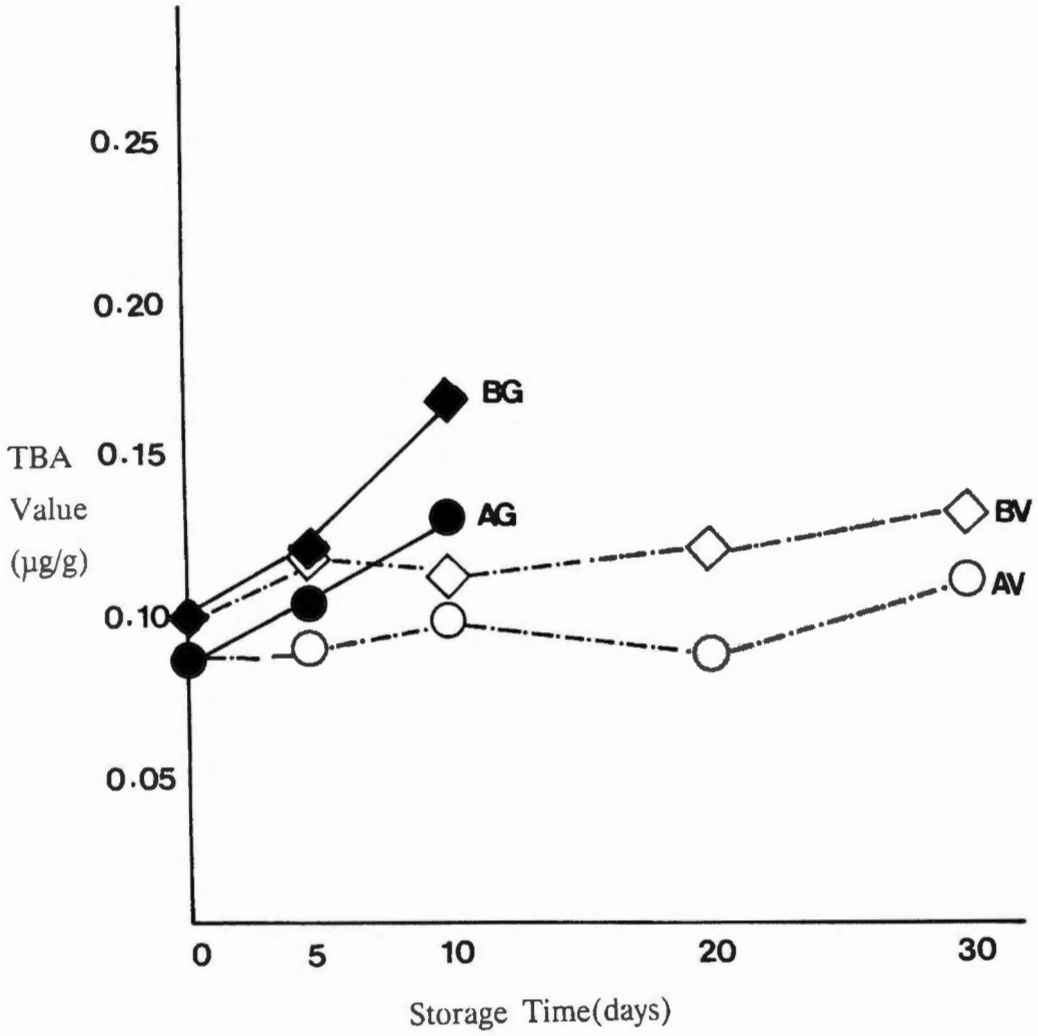


Figure 6. Effect of packaging on TBA value of the products dried for 8 hours during storage.

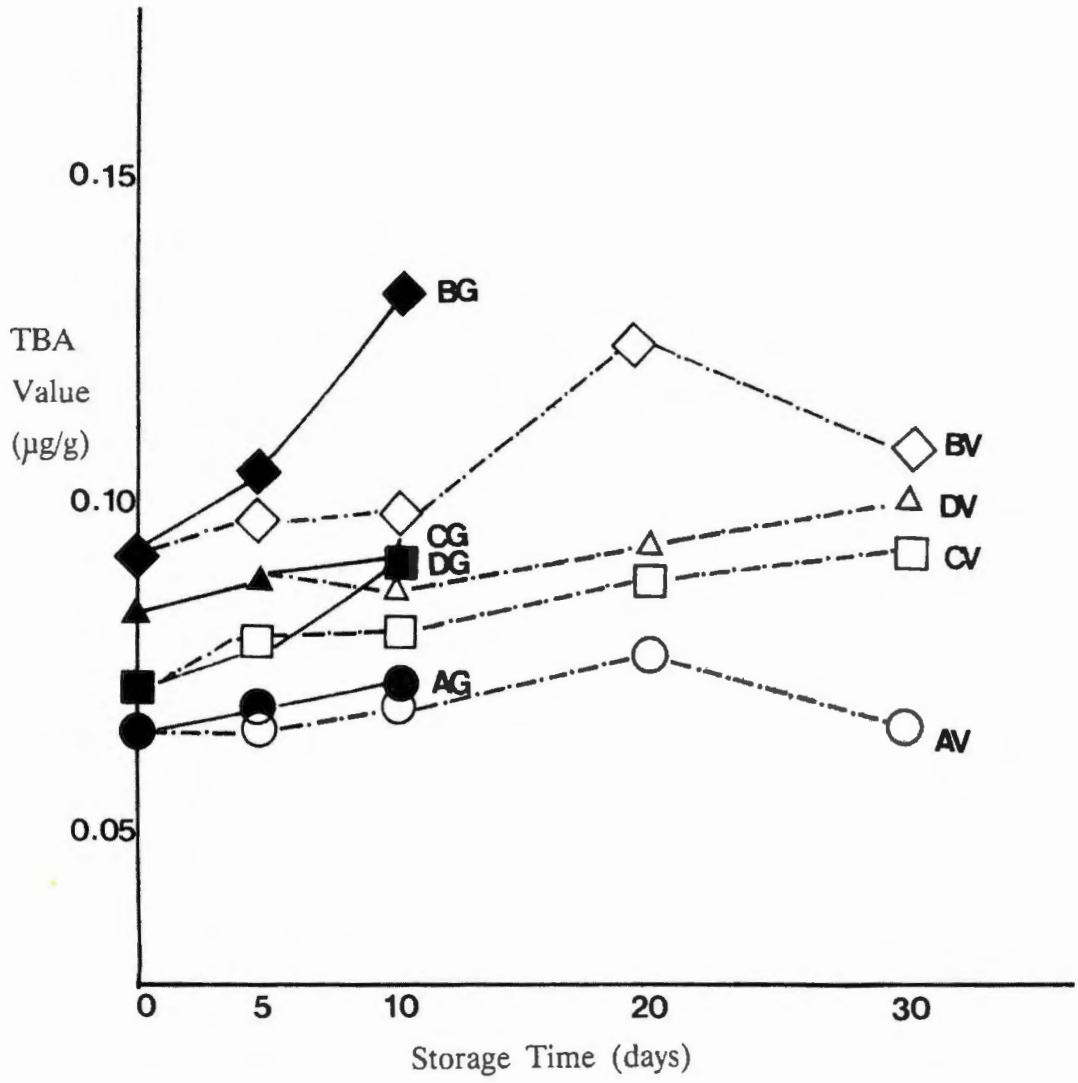


Figure 7. Effect of packaging and sorbitol addition on TBA value of the products dried for 12 hours during storage.

Effects of sorbitol addition on product quality

Addition of sorbitol to intermediate-moisture food can not only reduce their Aw value, but also improve their tenderness. As noted above, the longer the drying time, the harder the products become, thus sorbitol is employed in this experiment to improve the texture of the pork jerky and pork cubes The Aw values of pork jerky and pork cubes with sorbitol and dried for 12 hours are poised at 0.715 and 0.742, respectively. There are no remarkable changes in pH value for the sorbitol modified products during subsequent storage. They are more stable than the products without the addition of sorbitol (the control)

In color changes, L-values of the products with sorbitol is lower than the control. This means the color of the products with sorbitol is darker red and more stable than the control. There are no significant changes in TBA, VBN, and total bacterial counts between the products with sorbitol and the control. However, it does not affect the quality of pork cubes which have higher Aw value than the pork jerky. These results can be seen in Fig. 5 and 7, and Table 4, and suggest that sorbitol does affect the quality of the restructured pork cubes with the high Aw value, but does not affect the quality of the pork jerky with the low Aw value. These results may correspond with the statement by Troller and Christian (1978). Many polyhydric alcohols produce a significant depression of food Aw only at concentrations above their flavor threshold, a condition that restricts their usefulness in many foods. To overcome this difficulty, combinations of solute may be employed. The flavor threshold threshold for sorbitol concentration used in this style of Chinese meat snack foods needs studying.

In conclusion, drying time, Aw, packaging, and sorbitol addition do affect the quality of intermediate-moisture foods. Longer drying time can depress Aw value of the products and extend their shelf-life, but may make them harder in texture. Vacuum packaging also can enhance the stability of the quality of the products. Sorbitol can improve the texture and lower the Aw value at a higher level of the intermediate-moisture meat products. However, sorbitol addition cannot improve the color of the products.

Summary

Restructured meat manufacturing technology is employed to make the Chinese-style snack meat products such as pork jerky and pork cubes which are classified as intermediate-moisture foods. Raw meat obtained from shoulder and ham by the ratio 4 : 1 is ground and mixed with other ingredients and restructured. Chemical composition, total bacteria counts, pH value, color, shear value, VBN and TBN value are determined to study the effects of drying time, packaging, and sorbitol

addition on the quality of the products during storage.

The results show that the longer drying time can lower moisture content and Aw value, and inhibit microbial growth of the products which results in extending their shelf-life. However, the longer drying time may cause the products to become harder. TBA and VBN values in the products dried for 12 hours are more stable than the same products dried for 8 hours. The changes of color for the former are more stable but darker in red than the latter. And the same products with vacuum packaging have similar variations. These factors will enhance the quality of products with lower Aw and vacuum packaging.

Sorbitol is used to lower Aw value and improve the texture of the products. The result indicates that it does affect the products with higher level of-Aw value, but does not affect the products with the lower level of Aw value.

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Jerky conveyor dryer

Chapter 14. Meat balls and fish balls

Hammered meatballs are one of the comminuted emulsion-type meat products. Meat emulsions are very important economically to the meat and food processing industry. Emulsion technology, as applied to sausages or comminuted meat products has been studied extensively .during the past 25 years. Currently there are few research reports in this area in Taiwan, although there are some comminuted emulsion-type products such as fish balls, meat balls, and meat loaves produced. The producers manufacture these products using techniques learned by experience but the principles and theories of emulsions are not well understood.

The major reason for the application of emulsion principles to meat processing is based upon trends of utilization of more diversified protein sources such as soy protein, peanut protein, and homogeneous protein blends, for the preparation of comminuted meat products, especially during times of shortage of protein sources in the world. During this time, it is very important to utilize deboned meat or trimmings or other protein sources as a substitute for red meat. It is also very important to apply the principles of emulsion technology to the meat industry for development of new meat products in Taiwan.

This paper will discuss the processing methods, theory and factors affecting the quality of meatballs.

HISTORY OF THE HAMMERED MEATBALLS

The hammered meatball originated in the Shing-Chu area many years ago. It was reported that there was a young man who showed filial piety for his mother who preferred eating pork but who has difficulty in chewing it. The son bought pork, hammered it to pulverize the meat tissue, and made fragile meatballs for his mother.

Since the taste and texture of the meatball were palatable to many people, this meat item became a commercial product. The production process has changed from the original commercial product to the meatballs produced today.

There was another theory that meatballs were introduced by a man named "Cheng" who sold noodle soup at the Square of the Temple for Cheng-Huang in Ching-Chu several years ago He used pork mixed with dried green onions, fried dried pork skin and fat which were crushed into an emulsion (meat paste); molded into balls; and boiled in water. At first, the soup of this product became so turbid that the customers would not accept it. Later there was a man from Fu-Chow who improved this product by consequently, manufactured the ingredients and adding sugar, salt, and sodium glutamate and, a good product. These meatballs were also called water balls.

Traditionally, the producers placed the pork in a mortar and used a hammer to crush the meat prior 'to making meatballs. Due to the increase in consumption manufacturing by a press machine replaced the hand hammering process. Since the meatballs used raw meat obtained immediately from warm carcass after slaughter this required processing soon after slaughter. These limitations of the meat ingredient and, manufacturing time influenced the production and curtailed distribution to the neighbors surrounding the processing plant. However, the original process did not lend itself to industrialization. The processing method had to be developed and improved and new procedures incorporated for commercial application. Thus, there have been new methods developed such as crushing machines, massaging and paddling machines (a mixer or blender containing a paddle) and the use of frozen or chilled pork as meat ingredients.

To compare the traditional (original) method with the current (improved) method of meatball processing the following steps may be used as a guide.

TRADITIONAL

1. Warm meat was used as a meat ingredient.
2. Chilled pork was placed in a mortar with salt, ice, and binding agents.
3. Meat tissue was crushed with a hammer or press machine until the meat became sticky.
4. The smashed meat was mixed with the other seasonings and frozen ground fat in a blender.
5. The mixture was placed in a freezer until it became firm.
6. The meat mixture was molded into a ball and boiled in water.

IMPROVED

1. Chilled or frozen meat is used.
2. Meat and frozen fat are ground with the aid of a meat grinder.
3. The lean ground pork is placed in the bowl of a blender or a peddling machine and blended 5 min, with salt, sugar, and .binding agents to extract the salt-soluble protein which is used as an emulsifier..
4. Ground fat is added and blending is continued for 2 or 3 minutes or until the mixture becomes very sticky or a good binding capacity is obtained.
5. The mixture is then placed in a freezer for 30 minutes.
6. Balls are made and boiled in 80°C water for 20minutes .

Theory of meat emulsion

An emulsion is defined as a dispersion of one liquid in a second immiscible liquid. The presence of a third component residing at the interface between the droplet and medium also must be considered in explaining the stability of such a system. This third component is called arc emulsifier. Most emulsions involve water and oil or fat as the two immiscible phases. There are two types of emulsions in food systems-Oil in Water (O/W) such as milk and mayonnaise, and Water in Oil (W /O) such as butter and margarine. The type is determined by the： composition o： the phases. Meat emulsions are considered to be an oil in water emulsion, consisting of a fairly, coarse (larger than classical emulsions) dispersion of solid fat (disperse phase) in water (continuous phase) with salt soluble proteins being the major emulsifying agent. In sausage emulsions the component phases are solids or semisolids and, therefore, possess somewhat different characteristics from emulsions as classically defined. The meatball mixture is also considered to be an emulsion which is similar to the sausage-type emulsion, except that particle size and method of preparation of the emulsion are different between both the products.

The meatball emulsion is prepared from pork with added salt used to extract the salt-soluble proteins such as myosin and actin which are used as emulsifiers to coat or stabilize the emulsion. The first process consists of cutting the meat, adding the salt and ice, and placing this mixture in a mortar to be crushed by a hammer or the ground frozen pork and added salt are placed in a blender to be chopped until the product is sticky and has good binding capacity. This is then mixed with ground pork fat to make an emulsion. The particle size of the meat ball emulsion is coarser than that of the sausage-type emulsion. The salt soluble proteins, actin and myosin apparently concentrate on the fat globule surface by charge orientation to form a membrane. The salt-soluble proteins (myofibrillar) are the muscle proteins primarily responsible for the good functional properties in a meat emulsion. However, sarcoplasmic and connective tissue proteins play a role in emulsion stability and finished product texture but their role has not been as clearly defined as that of the myofibrillar proteins.

The proteins of interest as stabilizers of emulsions in food systems are derived from three major sources： dairy, meat, and vegetable proteins behave in a manner similar to that of active surfactant agents. They tend to form mechanically strong monolayer films at the interface. As proteins, their structure, and hence their behavior, is more affected by such variables as salt concentration, pH, and temperature, than would be found for the normal emulsifiers.

The purpose of this research was to investigate the manufacturing process and such variables as refrigeration and additives on' the emulsifying capacity of pork

when used to make meatballs. The result revealed that the difference in emulsifying capacity between warm meat and chilled or frozen meat was not significant. This may be due to warm meat being in rigor when the samples were being measured. A significant difference was noted between additives added to meat samples resulted in the following order： Polyphosphate Isolated soy protein Sodium caseinate. Control. It has been demonstrated that frozen pork can be used as a meat ingredient for meatballs and, in spite of the fact that no demonstrable difference was found for the emulsifying capacity of warm and frozen meat, an emulsifying agent improved the product made with frozen tissue.

The composition, cooking loss, shear value and sensory properties (fragileness, elasticity, juiciness, and taste) of meatballs were determined. The results indicated that frozen pork combined with fish paste and isolated soy protein and polyphosphate can lower the cooking loss, increase the water binding capacity, and increase the emulsifying capacity of the product.

THE FACTORS AFFECTING THE QUALITY OF THE MEATBALLS

In relation to processing, it has been determined that there are some factors affecting the quality of the meatballs and these include such things as temperature, the ratio of lean meat to fat, the processing machine, and additives. These will be discussed individually.

1. *Meat ingredient*：

One of the major considerations in selecting the various meat ingredients for a meat emulsion is the ability of the meat to bind or emulsify fat and retain moisture. The hammered meatball is commonly made with lean meat from warm carcass (pre-rigor meat) which has a higher water binding capacity and emulsifying capacity than chilled or meat in rigor. In pre-rigor meat the salt-soluble proteins are easily extracted and used as an emulsifier. Warm meat also has a higher moisture binding ability. The degree of water binding capacity associated with each rigor stage or with the rate of postmortem change is observable because of the large scale effects it has on firmness, structure, and texture of the meat product. Those muscles with an extremely high proportion of bound water are firm, have a tight structure, and a dry or sticky texture. Conversely, tissues with poor water binding ability are soft, have a loose structure, and a wet or grainy texture.

2.*Temperature during emulsification is very critical to the meatball manufacturing process.*

Meatball manufacturing emulsification requires maintaining a lower temperature than other emulsion-type products. During blending or hammering, the temperature of the meat mixture has to be kept at 10-12° C. Excessive temperature above 12°C would denature the protein and cause breakdown of the emulsion. An emulsion temperature of approximately 10°C approaches the critical point. The instability of the hammered or pressed emulsion, or ground and blended emulsion when taken to a higher temperature was due to a decrease in viscosity and surface tension and the mechanical action of the hammer or the press forced the fat particles into contact with each other. Thus, in spite of the method used, the temperature of the emulsion is critical.

3.Ratio of lean to fat： The lean to fat. ratio is very important for producing a stable emulsion.

As the fat content (added fat or fat contained in tissue) of the emulsion increases, additional protein is required to emulsify this fat if a stable emulsion is to be maintained Fat is low in cost ,L1d also regulates the juiciness of the product. Both fat and water must be added as raw materials for an acceptable meat emulsion. It has been found that increasing the moisture and fat level in t h products resulted in corresponding increases in juiciness. Juiciness varied more noticeably with changes in moisture content than in fat content. It appeared that additional moisture had a greater effect on juiciness than a corresponding increase in the fat content. A 30% fat level will crop the stability of an emulsion when less than 16% added water is used for fresh beef. An equivalent drop in stability was found when less than 21 % water was added to the frozen meat. T his would indicate a change in the protein hydration when meat is frozen. It was suggested that the pretreatment of meat with water and salt was more important in frozen than in fresh meat, but this can not be applied to the meatball emulsion prepared with frozen pork. If the fat is added over the level which can be emulsified by the salt-soluble protein, it will result in a significantly higher cooking loss, and the product becomes too greasy.

4. In the traditional processing, a mortar or press machine is employed to make meat balls, and warm *meat is used as the meat ingredient.*

The temperature rise of an emulsion is found to be due to the energy supplied by the hammer as a result of overcoming frictional resistance and pressing. If the temperature is not controlled below the critical point, the emulsion will break. In order to keep the temperature at a desirable point, ice is usually added to the emulsion during emulsification. However, ice must be kept at a certain level or the product will become too juicy, or the emulsion will break. In the new, or improved methods,

frozen meat is used as a meat ingredient and a blender is employed. Heat produced in this process is lower than that of the former processing techniques. It is unnecessary to add ice to an emulsion, but care must be taken to avoid too great a temperature increase. For this reason, a wood bowl blender is often used to carry out blending and mixing. Both manufacturing methods can produce a good product if desirable conditions are maintained. The texture (mouth feel) of meatballs produced from these two methods is different. The product made by pressing or hammering has a layer by layer feeling, but the good products produced by both methods have the same degree of fragileness.

5. Food additives :

In order to improve the processing method of hammered meatballs, -polyphosphate, isolated soy protein, fish paste and sodium caseinate are added to the meat mixture containing frozen lean meat, fat, salt and other ingredients, respectively. Meatballs were manufactured to compare the effects of these emulsifying agents on the cooking loss, composition, texture, taste, juiciness and fragileness of the products.

The results appeared to suggest that the method used in this experiment was suitable for meatball processing and that frozen pork could be used as the raw meat material. Although these emulsifying agents added to the meatball ingredients could improve the water-holding capacity, emulsifying capacity and texture of the product, the lean to fat ratio must be considered otherwise, the cooking loss would be increased and fragileness and juiciness would be decreased.

In conclusion, the improved method can be used to make good meatballs if proper conditions are maintained.

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Fish balls processing

Formulation			
Table salt	3%	Sugar	4.5-6%
Monosodium Glutamate(MSG)	0.5%	Polyphosphate	0.1-0.3 %
Fresh garlic slurry	0.2%	White pepper	0.17%
Starch(sweet potato starch)	10%		

Procedures :

1. Trimming and cutting of fish.
2. Grinding with fine mesh plate for times.
3. Blending(beating) for 10 minutes to extract muscle proteins.
4. Adding salt and polyphosphate and blending for three minutes, during blending add crushed ice.
5. Adding MSG(or Garlic slurry).

6. Sweet potato starch prepared into slurry(added with small amount of water).
7. Blending into a good batter.
8. Boiling with cold water and cooked to 70-80°C.

Option: fat added will make product juicy.

Fish ball processing technology

Fish balls are a kind of fish products differing from surimi based products such as kamaboko, chikuwa, satsumage, shellfish analogues in Japan. It is made offish flesh (without washing) through mincing, smashing with salt, seasonings and binders to become a sticky fish paste, then forming and heating to produce a elastic and firm products.

Mechanism of forming elasticity of fishballs

It is generally to understand that to produce gel products with the required elasticity and firmness, two basic requirements must be met. To meet these requirements Mackie (1992) proposed two principles as follows：

1.The myofibrillar proteins must initially be dissolved in a salt solution.

2.On heating to form a gel the proteins must be denatured in such a way that they form a regular network structure capable of immobilizing the water present in the uncooked surimi.

Fish ball manufacturing process

A general flow diagram of fish ball manufacturing process：

	Dressing Rinsing		washing		Smashing with salt		Forming		
Whole raw fish	------->	minced fish flesh	-------->	washed flesh	------>	Sticky paste	------>	Final product	
	Separating Flesh		Straining Dewatering		Mixing seasonings		Gelling Heating		

1) Resources of fish available：Shark, cutlass fish, sharp toothed eel, mackerel, blue whiting, cod, herring, and milk fish etc.
2) Raw fish selection：fresh and rich in white muscle, less fat and bones.
3) Storage of raw fish：stored at -15 to - 20℃.
4) Heading, gutting, cleaning, deboning and mechanically separated flesh from bones and skin, washing, then dewatering.

5) Desinewing：to remove the connective tissue.
6) Smashing：smash minced fish flesh with salt, then starch and seasonings by smashing machine which is equipped with jacket cooling system to keep the temperature below 5℃
7) Forming or molding：by forming machine, sometime, the product can be filled fillings.
8) Heating at 90℃ for 15 to 20 min to fix protein.
9) Cooling and packaging.

Fish ball manufacturing

1. Milk fish balls

Raw fish：dressed and gutted milk fish.

Ingredients (based on the weight of fish flesh)：

Salt 1.8-2.5%, cassava starch 5-10%, sugar 1 %, white pepper 0.2%, chopped garlic 3%, phosphate 0.3%, ice water 5-10% and egg white proper amount.

Procedures：

soluble protein.

1) Flesh (skinned deboned, gutted, cut off abdomen).
2) Mincing two times with small hole plate.
3) Smashing or chopping with salt, ice water, polyphosphate to extract salt soluble protein.
4) Blend the fish paste with sugar, starch and seasonings.
5)Stir and forming(heat at 80-90℃ for cook for 20 min.

Fuzhou fish balls

Formula：

Fish paste	100%
Fried ground pork with oily onion	25%
Egg with	2%

Procedures：

1) Make frozen fried ground pork with oily onion into small balls.
2) Form the fish paste into balls and fill the fried pork balls inside of balls, then flat the hole of balls and flat the hole with fish paste.
3) Cook water to boiling by medium heat, then place the balls in boiling water and keep cooking for 3 min to cook well.

Dansui fish balls

Fish paste 100%

Frozen fried ground pork 25%

Salt 1.5%, white pepper 0.2%, starch 5% and sugar 0.5%

Egg white 1%

Procedures are the same as milk fish balls.

Shrimp balls

Formula

Shrimp meat

100%

Salt 1%, sugar 0.5%, white pepper 0.2%, Starch 5%, polyphosphate 0.3% and ice water 5%

Procedures：

1) Deshell, wash, clean and drain.
2) Smash shrimp meat with salt, sugar, polyphosphate and ice water into paste.
3) Mix the shrimp paste with remaining ingredients well.
4) Form into balls and cook in boiling water by medium heat.
5) Cool.

Squid balls

Formula：

Squid (gutted) 100%

Salt 1.5%, sugar 0.5%, white pepper 0.2%, starch 3.3%, polyphosphate 0.3%, ice water 2%, palm oil 5% (optional)

Procedures：

1) Wash squid, gutted and remove skin and cut into cubes.
2) Grind squid cubes two times with fine hole plate.
3) Smash or chop ground squid with salt, polyphosphate and ice water into protein matrix.
4) Blend the matrix with palm oil to emulsion well.
5) Form into balls and cook in boiling water by medium heat for 10-20 min, then take out and cool.
6) Drain and fry in oil at 170℃ to become golden color.

Squid balls Formula 2.

Squid 1200g

Lard 75g, egg white 2 eggs, cassava starch 1 tbsp, rice wine 1 tsp, salt trace, MSG trace, white pepper trace and garlic oil trace.

Salt 3%, MSG 0.5%, white pepper 0.17%, back fat 6.25%, polyphosphate 0.3%, egg white 4%,and starch 2-5%

The procedures are the same as formula 1.

Crab meatballs

Formula：			
Crab meat 50%,	cod paste 50%		
Salt 1.5%			
White pepper 0.25,	starch 2-5%,	polyphosphate(ppt) 0.2%,	ice water 2%,
Palm oil 5%,	sesame oil 1 %,	sugar 0.5% and MSG 0.5%.	

Procedures：

1) Smash or chop crab meat and cod meat with salt, ppt, ice water to extract muscle proteins as emulsifier.
2) Blend the meat paste with palm oil and sesame oil until it be shinning.
3) Mix the remaining ingredients well and stored in freezer for 20 min.
4) Form into balls and cook in precook water(80℃) for 20 min.
5) Cool.

Sea cucumber balls

Formula：

Salt 1.5%, white pepper 0.2%, ppt 0.3%, sesame oil 1%, sugar 1 %, MSG 0.5%, chicken broth 0.1 %, ginger and green onion suitable amount.

Procedures：

1) Dress sea cucumber and wash.
2) Cook sea cucumber with ginger and green onion in boiling water for 3-5 min.
3) Take out and drain.
4) Grind, smash or chop with salt, ppt and ice water into matrix.
5) Blend with remaining ingredients well into batter.
6) Form into balls and cook in boiling water by medium heat for 5 min to cook well, then take out, drain and cool.

Chapter 15. Roasted and spiced meats

Cooking of meat

Principle of cooking of meat

1. Dry-heat and short time for cooking tender meat such as more tender steak from beef, pork, lamb chops. The cooking methods of a dry heat procedure involve broiling, roasting, frying.
2. Moist-heat and long time for cooking less-tender cuts such as shank meat, heel of round, breast of lamb, and chuck roast of beef. The cooking methods of a moist-heat procedure involve braising, stewing, swissing, simmering or pressure-cooking and pot roasting.
3. Combination methods of cooking：The cooking methods are accomplished by combination of moist-heat and dry-heat procedures such as pan fried beef, tabayaki beef is fried beef on pan which covered during cooking, the chef frequently sprayed the water for keeping moisture and gelatinizing collagen.

Caution：The internal temperature of meat has to reach above 60 ℃ to destroy the pathogenic organisms and *Trichinela sporalis* to prevent food borne diseases.

The cooked foods have to be consumed in two hours after cooking, otherwise, it has been kept above.60℃ or below 5 ℃(beyond the temperature of danger zone). Thus, most Chinese foods are eaten in full cooked condition, so this custom prevent the occurrence of food poisoning, however, principles and rules of food sanitation must be followed by the cookers.

Types of roasting

Roasting can be classified into four types depending on stove models and operation methods as follows：

1. Open stove roasting

An iron rack is placed on top of a wide-open-mouthed stove or basin, while the ingredients are skewered or placed in baking pan and then roasted repeatedly above the rack. The advantages of open stove roasting are simple equipment, easy-to-handle heating and convenient to operate, while the disadvantages are dispersed fire, uneven heating and taking a long time for roasting. However, the palatability of the products made of small ingredients is much better than that produced by the closed stove roasting or the product made of big items is roasted partially.

2. Closed stove roasting

The raw materials are skewered with hooks or roasting pins, or placed in baking pan, then transferred to an air-tight oven where the door is being closed to keep the temperature and the items are roasted done through radiation heat. The traditional closed roasting stoves are made up of bricks, however, most of them are made up of iron steel today. The characteristics of this method are that a high temperature is being maintained, roasting time is shorter than open roasting stove. Cooking rate is fast, heating is even and raw materials can be cooked easily.

3. Oven roasting

Roasting oven is smaller in size than roasting stove, which can be driven by coal gas or electricity. Ovens are always preheated before placing any ingredients in the baking pan. The cooking temperature and roasting time should be adjusted according to the capacity of the ovens as well as the textures and sizes of the ingredients. A high temperature should be used at the very beginning until the ingredients are properly colored. Then a medium to low heat to desired. ovens can be taken to prepare other dishes, bread or snacks as well.

4. Microwave oven roasting

Microwave oven is not suitably used to roast Chinese-style meat products. It is unable to roast the product becoming golden brown surface at earlier stage, however, nowadays, new model have already overcome this problem. It also can not be used to roast big amount of the products.

Reference： Luo, Y. Z. (1990)：Roasted and Spiced Food in Hong Kong, Food Paradise Publishing Co., HK.

Spiced meats (Lu wei)

The processing of spiced foods is a uniquely Chinese cooking technique. Spiced foods are very popular cooked products in traditional Chinese flavor. The spiced meats and roasted meats occupy most part of production and consumption of meat products in Chinese communities-Taiwan, Mainland China, Hong Kong, Asian countries, even in other world. Thus, this section the author pay more attention to collect the formulary and recipes in this book.

Definition of" Lu " is mix all marinade ingredients well and cook to be aromatic as brine. Then dump raw materials such as meats, animal by-products such as pig feet, jowl, heart, livers, poultry leg, claws, feet, neck, head, wings etc. in the brine and boil it over high heat, then reduce to medium to low heat, and keep simmering until the

brine thoroughly penetrated into the foods. Therefore, all the spiced foods are coated with a thick juice and their appearances are attractive and flavors are desirable.

Spices and herbs commonly used in spiced foods are as follows： Star anise, licorice, cumin, clove, bay leaf, white (black) pepper, nutmeg, amomum, cinnamon, ginger, wild pepper, tangerine peel, fennel, kaempferia, and lesser galangal.

Seasonings： can sugar, rock sugar, maltose, table salt, sodium glutamate, sesame oil, oyster oil, yellow colorant, ank red, Shaoshing wine, white vinegar, Hot pepper sauce, fermented bean curd, fish sauce, condensed milk, hot pepper oil, sweet bean sauce, sesame sauce, light soy sauce, dark soy sauce.

Raw materials： pig jowl, pig shank, belly, sparerib, pig ear, pig large intestine, pig stomach, pig forefeet, chicken wings, duck, gizzard, duck claw etc.

Whether a stock is good or not depends on if it has a harmonious taste. The preference of consumers in the taste of spiced foods varies from different localities.

The marinade stock is divided into two kinds of brine broths which are the common ones.

1. Red marinade stock (Red-Lu) which is prepared on the base of soy sauce.
   Ingredients：
   1) Fresh spices：4-5 bulbs garlic (crushed), 2 sections green onion, 3-4 slices ginger 2 red chili pepper.
   2) Spices bag：2 tar anise, 1 tbsp wild pepper, 1-2 pieces cinnamon, 4-5 cloves, 2-3 pieces dried ginger, 112 tbsp cumin, 1-2 grains nutmeg, 1 tangerine peel, 1-2 slices licorice, 2-3 bay leaves, and white pepper.
   3) Seasonings：1 cup cooking wine, 112 cup Shao-shing wine, 2 cups soy sauce, 8 cups water, 1 tbsp rock sugar and *1/2* tbsp salt.

Preparation of stock：

Sauté garlic, ginger and green onion with 2 tbsp oil in wok, add soy sauce and cooking wine, and the remaining ingredients and cook by high heat until boiled, adjust to low heat to cook for 20 min as a stock for use.

2. White marinade stock (White-Lu) which is prepared on the base of salt.
   Ingredients and preparation are basically the same as those of red marinade stock, just remove soy sauce, sugar and sautéing the fresh spices.

Common rules of preparation of the spiced meat

1. Wash and clean raw materials such as pig feet, or shank, poultry wings, feet and whole dressed carcass, blanch it until blood residue disappears (it means

churn-tong), then rinse in running tap water to cool and firm the meat (it means pyao-sui).

2. Select Lu stock such as Red-Lu or White-Lu depends on the raw materials which you want to produce.
3. Preparing methods are divided into method for producing cold spiced foods which is called as cold-lu and the method for producing spiced foods with red-lu stock, it is called as hot-lu.
   1) For hot-lu, the raw meat materials are dressed, blanched and rinsed, then place in hot stock and keep cooking and turn off fire to soak until suitable time.
   2) For cold-In, the raw meat materials are dressed, blanched and rinsed, then soak in precooked and cooled stock for suitable time.

Examples：

1.Spiced foods prepared by Red-Lu

1) Red-Lu stock

A. Spices：star anise 10g, amomum 15g, cinnamon twig 2 g, dried ginger 15g, cumin 5g, licorice 5g, wild peppercorn 109, tangerine peel 5 g, cassia bark 2 g, dried red pepper 5 g, clove 2 g, bay leaf 1 g, nutmeg 2 g.

B. Old ginger 300g, green onion 600g.

C. Seasonings：Salt 300g, MSG 100g, rock sugar 600g, soy sauce 2 liters, rose wine 300ml, Shao-shing wine 300ml, water 20 liters, yellow colorant 2 tsp.

Preparation of stock：

a) Wash ingredients "B", crush ginger and cut onion into 3 sections.
b) Place ingredient "A" and "B" into cotton bag and tight.
c) Cook Spice cotton bag and seasonings by big fire and cover the kettle to boil, then shift to medium fire to cook for 30 min to fragrant appearing which is used as red-lu stock.

2) Spiced chicken, goose wings, goose claw, goose gizzard, chicken leg, goose liver and heart.

A. Wash the raw materials, blanch chicken or other ingredients in boiling water, dip chicken in boiling water 3-4 times and then place in boiled stock and cook for 50 min, during cooking the kettle is uncovered. The soaking time depends on the raw materials as follows：

Items	temperature	covered or uncovered	cooking time	soaking time
Rose oily				
Chicken	low heat	x	50 min	10 min
Goose wings	low	x	40 min	1 hour
Goose claw	low	x	40 min	1 hour
Goose gizzard	low	x	40 min	1 hour
Chicken leg	low	x	20min	1 hour
Goose liver	low	x	20 min	1 hour
Goose heart	low	x	20 min	1 hour

*Source：Yeo tse(2008)：The Selected Delicious Spiced Foods Examples 298, Chinese Fabricating Factory Publishing Co., Beijing.

2.White -Lu(Spiced rice duck)

A. Raw material： duck 2 birds

a. Dress duck carcass and wash.

b. Cook in boiling water with low heat for 60 min, during cooking lift once every 5 min until no blood coming out as insert stainless steel needle.

c. Rinse in the running water for 1-2 h, set aside.

B. Stock ingredients：

Seasonings ：MSG 100g, salt 150g, water 2000g, rock sugar 600g.

Spices: bay leaf 5 g, amomum 5 g, dried ginger 5 g, cassia bark 5g, star anise 5g, licorice 10g.

Green onion 15 g, ginger 10g, dark soy sauce 35 g, Shao-shing wine 100g.

a. Boil seasonings, then add spices and cook until fragrant appearing.

b. Cook "a" with green onion, ginger and soy sauce to boiling.

c. Cool

C. Preparation of spiced rice duck

a. Soak the treated duck in cold stock for 4-5 hour.

Spicy and hot soup concentrate

Ingredients

Cassia bark	37.5g
Citrus peel	18.8g
Wild pepper	37.5g
Star anise	10g
Clove	37.5g

Cinnamon stick	18.8g
Cardamom	15g
Licorice	56.3g
Luo han guo	50g
Nutmeg	37.5g
Red pepper, dried	37.5g
Kaempferol	37.5g

Spices	
Chopped ginger	
Chopped garlic	
Seasonings	
Hot pepper powder(upward to sky)	300g
Ground hot chili	600g
Suchurn pepper powder	200g
Hot soybean sauce concentrate	600g
Rice wine	300cc
Soybean sauce concentrate	600g
Black soybean sauce concentrate	100g
Rock sugar	300g
Bone concentrated soup	1600cc
Chicken flavorings	300g
Sugar	300g

Procedures：

1. Add trace oil in the cooker (fryer wok) to fry star anise and wild pepper to sauté then take out for use.
2. Add the spices in to wok and fry to sauté and take out for use.
3. Add hot pepper powder(upward to sky), ground hot chili powder to fry, then add hot soybean sauce concentrate and black soybean sauce concentrate and fry, there after add bone concentrated soup, seasonings, and materials of (1, 2) and other ingredients and cook with small fire(low heat) for 3 to 4 hour.
4. Cool and store for use.

Taiwanese-style marinade bag

Ingredients

Star anise	10g
Wild pepper	3g
Cassia bark	3g
Cloves	2g
Pepper grains	3g
Cardamom	5 grains
Citrus peel	3g

Spices

Onion slices	1 bulb
Green onion	4 sections
Ginger 80g	
Garlic	10Ovalves
Red pepper	3fruits

Other ingredients

Coriander stems	20g
Bone concentrated soup	300cc
Sugar cane	200g

Seasonings

Star anise	10g
Soy sauce	300cc
Rock sugar	100g
Sugar	50g
Hot soybean sauce	50g
Salt	30g
Concentrated soy bean sauce	30cc
Rice wine	600cc
Caramel colorant	50cc
Sadei sauce	100g

Procedures：

1. Add trace oil, star anise and wild pepper in wok and fry to sauté, the pack them into the marinade bag and tied and store for use.
2. Add spices in wok and fry them to sauté and take out for use.
3. Add sugar in wok and fry evenly, add other seasonings, marinade bag, and spices(1, 2) and cook with big fire(high heat) until boiling, and turn to small fire(low heat) and continuously cook for 3-4 hours.
4. Cool and store for use.

Guangdong -style marinade bag

Ingredients

Star anise	4 grains
Wild pepper	3g
Coriander	3g
Bean curd skin	2g
Licorice	3g
Cardamom	5 grains
Lo han guo	half fruit
Huang Qi	2g
Cinnamon	2g
Cinnamon stick	3g
Kaempherol	3g

Spices

Onion bulb slices	1 bulb
Green onion	2 sections
Ginger	50g
Garlic	10 valves
Hot pepper	3 fruits
Red onion	10 bulbs

Seasonings

Soy sauce	300cc
Rock sugar	100g
Caramel colorant	30cc
Dark soy sauce	50cc
Rice wine	600cc
Sadei sauce	100g
Bone concentrated soup	300cc

Procedures

1. Add spices into wok and fry to sauté and cool for use.
2. Pack the marinade ingredients in bag and place into wok.
3. Add all seasonings into wok (2) and cook with big fire until boiling, then turn to small fire to cook for 2-3 hours.
4. Cool and store for uses.

Traditional marinade bag

Ingredients	
Star anise	3 grains
Wild pepper	3g
Cloves	3g
Cardamom	3 grains
Licorice	3g
Cassia bark	3g
Cumin	3g

Spices	
Green onion sections	1 piece
Ginger slice	50g
Garlic	80g
Red pepper	50g

Seasonings	
Soy sauce	300cc
Rock sugar	100g
Rice wine	600cc
Salt	20g
Water	3000cc

Procedures

1. Add spices into wok and fry to sauté and store for use.
2. Pack all marinade ingredients in bag and tie, then place in wok.
3. Add (1), all seasonings into (2) and cook with big fire until boiling, then turn to small fire and cook for 2-3 hours.
4. Cool and store for uses.

Suchurn-style **marinade bag**

Ingredients	3g
Citrus peel	6g
Licorice	3g
White pepper grains	4 grains
Star anise Cardamom	5 grains
Wild pepper	3g
Cloves	3g
Cumin	3g
Sand ginger	3g

Spices

Onion slices	1 bulb
Green onion	2 sections
Ginger	80g
Garlic	10 valves
Red pepper	8 fruits
Coriander	30g

Seasonings

Bone concentrated soup	5000cc
Soy sauce	400cc
Hot soybean sauce	100g
Rock sugar	50g
Salt	30g
Caramel colorant	50cc

Procedures

1. Place spices into wok and fry to sauté and cool for use.
2. Pack the marinade ingredients into the bag and tie
3. Add seasonings and bone concentrated soup and spices (1) to the wok (2), and cook
4. With big fire until boiling, then turn to small fire and cook for 2-3 hours.
5. Cool and store for uses.

Hunan marinade bag

Ingredients	8 grains
Star anise	75g
Wild pepper	37.5g
Licorice	37.5g
Cinnamon stick	37.5g
Citrus peel	37.5g
Cloves	37.5g
Cumin	37.5g
Bay leaf	37.5g

Spices

Green onion	4 sections
Ginger	100g
Garlic	15 valves
Hot pepper	5 pieces

Seasonings

Salt	100g
Chicken flavorings	50g
Sugar	100g
Soy sauce	900cc
Rice wine	120cc
Dark soy sauce	100cc
Bone concentrated soup	3000cc

Procedures

1. Add trace oil and spices and fry to sauté and cool for use.
2. Add star anise and wild pepper and fry to sauté, then pack them with other marinade ingredients into bag and tie.
3. Add seasonings and the materials of (l, 2) into wok and cook with big fire until boiling and then turn to small fire to cook for 4 hours.
4. Cool and store for uses.

Yunnan marinade bag

Ingredients

Cassia bark	37.5g
Licorice	18.8g
Cumin	37.5g
Star anise	6grains
Chum-Gong	37.5g
Bay leaf	18.8g
White pepper grains	75g
Cardamom	5grains
Nutmeg	37.5g
Other ingredients	4sections
Green onion	
Ginger 100g	
Carrot	100g
Radish	200g
Bone concentrated soup	1000cc

Seasonings

1. Add trace oil and green onion and ginger into wok and fry them until sauté and cool for use.
2. Pack all marinade ingredients into bag and tie for use.
3. Add all seasonings and the ingredients of (1, 2) into the wok and cook with big fire until boiling, and then turn to small fire to cook for 1.5 hours.
4. Cool and store for uses.

Chao-Chow-style marinade bag

Ingredients(for marinade bag)

Cardamom	2 grains
Star anise	10 g
Cassia bark	8 g
Sand ginger	15 g
Cloves	5g
Wild pepper	5g
Cumin	3g
Coriander stems	20g
Bay leaf	3g
Citrus peel	8g
Lo han guo	*1/4* fruit
Marinade sauce	
Green onion	3 sections
Ginger	20g
Water	1600cc
Soy sauce	400cc
Oyster oil	100cc
Cooking wine	100cc
Fine sugar	**129g**
Coriander stem	**20g**
Garlic	**20g**
Salt	**5g**

Procedures

1. Pack all marinade ingredients into cotton bag and tie tightly .
2. Add crushed green onion and ginger into the cooker and add water to cook until boiling, then add soy sauce, oyster oil and cooking wine into the cooker and keep cooking until boiling.
3. Then add sugar, coriander stems, garlic, salt, and marinade bag and turn to small fire to boil about 5 minutes and allow the fragrance to come out.

Five spices marinade bag

Marinade **ingredients**

Wild pepper	3g
Cloves	2g
Cumin	2g
Star anise	6g

Cassia bark	4g
Licorice	4g

Marinade juice

Soy sauce	150cc
Salt	8g
Water	1000cc
Ooloong tea leaf	15g

Procedures：

1. Pack the five spices into the bag ..
2. Cook soy sauce, salt and water in cooker with medium fire until boiling.
3. Add Ooloong tea leaf into step 2 and cook again until boiling, then add marinade bag (l) and turn to small fire to cook until boiling, about S minutes.
4. Cool and store for use.

Chinese-style meat sauce

Spicy meat sauce

Ingredients

Pork belly with skin	600g
Red onion	5 grains
Garlic	10 valves
Five spices	6g
Oyster oil	200cc
Shaoshing wine	50cc
Water	800cc
Rock sugar	10g

Procedures

1. Wash pork and cut into 5cm cubes.
2. Rinse the pork cubes (l) to remove fat and oil on the surface.
3. Hammer the pork cubes (2) for use.
4. Wash and chop red onion and garlic for use.
5. Heat oil wok then add chopped red onion and fry with small fire until sauté.
6. Add hammered pork (3) into step (5) and turn up to medium fire and fry until discoloration.
7. Add chopped garlic, five spices, oyster oil, soy sauce and wine and boil, then add water and cook with big fire. After boiling add sugar and turn to small fire to cook for 60 minutes.
8. Add rock sugar before finishing and cook until the sugar is dissolved.

Red onion meat sauce

Ingredients	
Pork skin	200g
Red onion	50g
Lard	50g
Ground pork shoulder	800g
Bone concentrated soup	1200cc
Seasonings	
Soy sauce	100cc
Rice wine	10cc
Pepper powder	trace

Procedures

1. Wash and clean pork skin and cut into big pieces, boil 5 min then take out to rinse for use.
2. Clean red onion and trim two ends and chop it for use .
3. Head wok, add lard and chopped red onion to fry to become golden brown color and fragrant with small fire, then take out 20g for use. And add ground pork to fry to discoloration and water reduction, then add all seasonings and fry to become fragrant, and turn out the fire.
4. Place the mixture of (3) into a clay cooker except fried red onion, and add bone concentrated soup to boil.
5. After boiling add pork skin (1) and turn to small fire and covered to cook for 1 hour, then add 20g fried red onion and keep cooking for 10 min, and remove pork skin.
6. Cool and store for use.

Mushroom meat sauce

Ingredients	
Pork shoulder	600g
Back fat	150g
Mushroom(dried)	50g
Red onion	5 bulbs
Green onion	5 pieces
Sliced ginger	5pieces
Soy sauce	200cc
Shaoshing wine	300cc
Rock sugar	l2g
Water	800cc

Procedures

1. Wash pork and back fat and dip in boiling water, then take out to cool in tap water to remove the surface oil, then grind it.
2. Clean mushrooms and soak in warm water to soften, then chop it; and wash red onion, green onion and ginger and chop them for use.
3. Heat wok and add ground back fat (l) and press oil out, and fry and dry the residue of fat, then separate the lard and dried residue for use.
4. Place the chopped mushroom and chopped red onion in the hot wok and fry them to become fragrant.
5. Add ground pork and fry to discoloration, then add the fried and dried fat residues (step 3) and stir and fry.
6. Add chopped green onion and ginger and fry it.
7. Add soy sauce and fry, then add Shaoshing wine, rock sugar and boil with big fire, finally remove the mixture into clay cooker and cook for 1 hour with small fire.
8. Cool and store for use.

Pickled cucumber meat sauce

Ingredients

Ground pork	500g
Pickled cucumber	250g
Chopped garlic	15g
Chopped ginger	5g
Bone concentrated soup	800cc
Seasonings	
Salt	trace
Chicken flavorings	5g
Rock sugar	trace
Rice wine	10cc
Soy sauce	10cc

Procedures

1. Chop pickled cucumber for use.
2. Heat wok, add 15cc vegetable oil and fry chopped garlic, chopped ginger, then add in ground pork and fry to discolor, and add all seasonings and chopped pickled cucumber and fry it.
3. Finally add bone concentrated soup to cook until boiling, then turn to small fire and cook 40 min.

Flavor fried onion chicken sauce

Ingredients

Deboned color chicken thigh	400g
Onion	100g
Ginger	10g
Green onion	50g
Red onion	30g
Soy sauce	100cc
Fine sugar	8g
Water	700cc

Procedures

1. Wash chicken thigh and grind it for use.
2. Clean onion, ginger(peeled), and green onion and chop them.
3. Add 100cc oil into wok and heat, then add the ingredients of (2) and fry them with small fire, then add ground chicken meat and fry to discoloration.
4. Add all other ingredients in step (3) and cook until boiling then add fried red onion and cook for 15 min with small fire.
5. Cool and store for use.

Sweet Roasted Pork

Formula

Raw meat： Pork shoulder or loin	100%
Seasoning blend	
MSG	0.1%
Salt	1.8-2
Sugar	10-12
Sesame oil	1
Soy sauce	5
Water	3.5
Seasoning sauce*	2
Red onion	1
Mei-Kuei Lo wine	1.5
Monascus pigment or Red No. 6	0.6

*Seasoning sauce

Soybean cheese	8%
Sugar	17.5
Sesame paste	17.5

Sea Food Sauce	17
Fermented bean paste	40
Mix all ingredients together and thoroughly.	
Coating ingredients(Maltosyrup)	
Maltose	800g
Cubic sugar	100g
Water	150g
Ginger	10g
Salt	5g
Rose liquor	40g

Procedure for coating maltosyrup preparation：

1. Add cubic sugar with water and boiled.
2. Maltose (malt sugar) is cooked to be solved and added to the cubic sugar syrup.
3. Add salt and ginger and blend thoroughly.
4. Add rose liqueur and chilled for use.

Sweet roasted pork preparation

1. Cut pork into 3x4x20 cm strip.
2. Marinade the pork in seasoning blend and mix thoroughly, then cure for 12-24 hrs.
3. After marinating, the pork is poured with the seasoning blend again. 4.Hang on hook surround the bomb oven which has been preheated at 200℃.
5. Take out to coat or smear the malt sugar or coating ingredients, then reheated or roasted again for 10-20 min.
6. Chilling to the room temperature.

Roasted pork belly

Ingredients：

Boneless pork belly (based on the weight of meat) 100%.

Coating ingredients：white vinegar 0.7%, malt sugar 0.1 %, anka red pigment 0.01 %, white wine 0.5 %.

Marinade ingredients(based on the weight of sugar：salt mixture)：

Sugar：salt= 1.5：1, five spices 0.17% and ginger powder 0.17%.

Procedures：

1) Cook pork belly in boiling water for a while, and shift to low heat and cook until well done.
2) Cut up a few gashes on the lean pork and marinated with marinade.

3) Mix the coating ingredients well, spread on the surface of the belly, hang up with a hook, and roast boiled pork belly in an oven over low heat.
4) Shift to high heat and roast for 30 min and take out to spread with malt sugar.

Roasted piglet

Raw material：

Piglet 1 head (10 kg)

Coating ingredients：

White vinegar 160 g, brown vinegar 40 g, shaoshing wine 40 g, malt sugar 12 g and Baking soda trace.

Marinade ingredients：

Sugar 3tbsp, salt 2 tbsp, five spices and ginger powder trace.

Procedures：

1) Open the belly or abdomen of piglet.
2) Cut of the first 3 row spareribs.
3) Remove the trotter's bones and foot tendons.
4) Wash, clean and drain.
5) Brush the marinade onto the abdominal cavity.
6) Insert the roasting pin and penetrate evenly through the head.
7) Flat the carcass with wooden board.
8) Tie up the trotters and feet with iron wires.
9) Pour boiling water onto the carcass and dry.
10)Spread the coating syrup. .
11) Baste with oil and turn the sides occasionally during roasting.
12) Roast the skin become golden color and aromatic.

Roasted pork (Chashau pork)

Formula	600g
Pork (loin or shoulder)	2 sections
Green onion	3 slices
Ginger	75 g
Soy sauce (light)	Wine 30 g
Seafood sauce	15 g
Ank red	1.6g
Sugar syrup	7.5 g
Oil	15 g

Procedures:

1) Cut pork into 3 .3cm x 16 cm, and place in a big bowl, add the mixture of crushed green onion, ginger slices and wine, soy sauce, sea food sauce, sugar, red colorant

(ank red) and blend well to marinate for 1 h.

2) Hang the marinated pork on the roasting stove by s-shape stainless steel hook and roast by wood coal fire for 8 min, take out to spread marinade then replace in the another stove and reheat for 7 min, totally 15 min.
3) Remove the roasted pork from hook and brush syrup and oil as final product.

Hot and spiced chicken(duck) feet and wings

Raw materials

Chicken feet 20 pieces, duck feet 12 pieces, chicken or duck wings 5 pieces

Spiced and hot soup concentrate 600 mL

Procedures:

1) Wash and clean chicken feet or wings, duck feet or wings and dip in the boiling water several times.
2) Remove and cool in running water to remove smear and get firm.
3) Cook poultry feet or wings in the cooker with spiced and hot soup until boiling, then turn to low heat and keep cooking about 10 min for chicken or 15 min for duck.
4) Cut it into small pieces and add some soup for serving.

Spiced pig feet or pig jowl

Pig feet (or pig jowl) 600 g

Taiwanese-style spice concentrate 1200 g

Procedures:

1) Singe feet or jowl by natural gas to burn hairs on the surface, brush and clean.
2) Dip the cleaned feet of jowl in boiling water and rinse in running water to remove the smear on surface.
3) Cook the soup concentrate until boiling, then add the feet or jowl, then turn to low heat to cook for 35 min, then turn out the heat and marinate for more 20 min and take out.
4) Slice it when serving.

Spiced duck claws

Duck claws 300 g

Guangdong spiced and hot soup concentrate

Procedures:

1) Wash and clean the duck claws and cut the tip of claw. 1000mL
2) Add soup into the cooker and cook until boiling, then add the cleaned claws, and turn to low heat to cook for 5 min, then turn out the heat and marinate more 10 min.

Jellied sauced pig feet

Raw material: pig feet 100%

Ingredients (based on the weight of pig feet, knuckle)

Meat 100%, sweet soybean sauce 10%, soy sauce 4%, soy bean sauce 2 %, wine 2%., rock sugar 4%, star aniseed 0.15%, cinnamon cassia bark 0.2%, garlic 0.6 %, water 35-40% and spices 0.1 %.

Procedures:

1) Select knuckle, wash, clean hair and remove extra skin and fat.
2) Mix knuckle with sweet soybean sauce, wine, soy sauce thoroughly and marinate at 3-5℃ for 12-24 h.
3) Cook knuckle with all remaining ingredients in jacket vat by high heat, then turn to mild heat about 1.5 h, during cooking stir occasionally.
4) Place the cooked knuckle in mold and press to shape, then cool at 2-3℃ to solidify.
5) Cut into cubes and pack by vacuum.
6) Store at 2-3℃.

Ground pork with garlic and pickle cucumber

Materials:

Ground belly or shoulder	600g
Garlic	10 valves
Pickle cucumber	150g
Soy sauce	100cc
Rice wine	8cc
Pickle cucumber brine	150cc
White pepper	1/4spoon
Cube sugar	1 spoon
Water	300cc

Procedure:

1. Grinding pork, chopping pickle cucumber and garlic for use.
2. Preheating the wok and place the ground pork and frying with medium fire until the meat becomes white, then scooping the fried pork.
3. Place chopped garlic is fried until flavor produced, then add the fried pork and soy Sauce, pickle cucumber brine, rice wine and pepper and fry the mixture until the fragrant come out.
4. Add water and cook with big fire until boiling, then add chopped pickle cucumber, cube sugar and cook to the sugar dissolved.
5. Then place into sand wok and simmered with small fire.

Wann roang pork feet-a famous country-style marinated food

Raw materials: pig feet, knuckles, green onion and ginger

Seasonings (based on the weight of pig feet):

Star anise 0.5 %, red pepper 0.5%, wild pepper 0.6%, nutmeg 0.3%, cloves 0.5%,bay leaf 0.3%, cassia bark 0.6%, soy sauce 1 %,rock sugar 1 % and wine 0.5%.

Procedures:

1) Trim pig feet and bum hair on the surface with gas and brush, clean.
2) Mix the seasonings well and put in the cotton bag for use.
3) Dip pig feet in boiling water for 20 min to remove the blood residue and deodorize.
4) Dip the pig feet in cold water which is added with papain tenderizer for 30 min to tenderize pig feet.
5) Quick freeze the cold pig feet in -25 to -30℃ freezer for one week.
6) Cook the frozen pig feet with wine, spring water and seasonings bag by medium heat, then take out to cook in another spices bag and soy sauce and spring water by low heat for 1h. Then take out to cool in the air.

Sauce for serving:

Soy sauce 3 tbsp, rock sugar 1 cube, black vinegar 1 tbsp, cassava starch *1/2* tbsp, water 2 tbsp, garlic 1 bulb.

Preparation: Crush rock sugar and cook to be dissolved, then add chopped garlic, soy sauce, black vinegar and add starch to thicken the sauce and cook to become sticky.

Hot dried beef slices

Raw materials:

Hot marinated beef 600g

salt 10 g, sugar 50 g, maltose 20 g.

Procedures:

1) Slice the marinated beef into 0.5 thick slices.
2) Add the seasonings in wok and cook until boiling, then add the beef slices to work and cook by medium heat until the soup absorbed up.
3) Place the beef slices on the frame and roast to dry.

Hot marinade soup preparation:

Ingredients:

Green onion pieces, matured ginger 30 g, red pepper 1, red pepper powder 5 g.

Seasonings:

Soy sauce 100g. rice wine 20 mL and water 500 mL.

Procedures:

1) Wash green onion, ginger and red pepper, then slice.
2) Mix all ingredients except wine and cook until boiling, then add wine and cool for use.

Roasted material: 1 goose3.0~3.5kg

Coating syrup: White vinegar 160 g, brown vinegar 40g, malt syrup 40 g.

Marinade:

Sugar 3tsp, star anise 4 stars, proper amount of ginger and garlic and a dash of five spices

Procedures:

1) Open the anus and clean the goose carcass, discard feet, remove lungs and air-pipe out from the tail(dressing).
2) Sprinkle the marinade into the abdominal cavity from the tail and sew up with .a needle, mix the coating syrup the carcass inside and outside thoroughly for use.
3) Pour boiling water on the carcass, dry and spread the coating syrup evenly.
4) Hang the goose carcass on the rack with a hook, and dry in the air, then roast in the oven by high heat for about 40min, change the position of carcass occasionally to ensure evenly heating.

Spiced goose

Raw material: Goose 1 about 3-3.5 kg

Spices:

Star aniseed 13 g, wild pepper 13 g, allspice 13 g, clove 13 g, cassia bark 13 g, amomum 13g and licorice 2g.

Seasonings:

Water 2.56 kg, light soy sauce 2.56 kg, rock sugar 640 g, salt 160 g and white wine 80 g.

Procedures:

1) Wash the dressed goose carcass and drain for use.
2) Add the spices in a cloth bag and tie up the opening, and cook with seasonings in a pot for 20 min by high heat.
3) Add the onion and dressed goose in the pot, then turn to low heat and keep simmering for more 30 min. Afterward, take the goose out and cut up for serving.

Spiced chicken

Raw material:

1 dressed chicken .1.2 -1.5 kg

1green onion

Spices:
Star aniseed, cassia bark, wild pepper, allspice, cloves and diced resurrection lily 12 g for each.
Seasonings:
Dark soy sauce 320g, light soy sauce 3.2 kg, rock sugar 1.28 kg, salt 80 g, Shaoshing wine 160 g and water 100 g.
Procedures:
1) Wash the dressed chicken and drain off for use.
2) Add spices in a cloth bag and tie up the opening and cook with seasonings in a pot for 20 min.
3) Add onion and chicken in the pot, then turn to low heat and keep simmerimg for more 20 min, then take out the cooked chicken and cut for serving.

Comments:
I provide various marinade formula, the processors can use to produce different spiced foods according to the consumers' preference. Here just give some examples and don't want to repeat all the manufacturing procedures. The formulas provided here can be use to marinate meat products and animal by-products such as beef shank, pig feet, poultry feet and claw, heart, wings etc. The procedures for most marinated foods are same, only cooking times are different. So you can try it.

Dongpo zou (pork)
Ingredients:
Pork belly with skin 600 g, green onion 3 pieces, ginger slices 4 pieces, garlic 4 bulbs and cotton strings.
Spice bag:
Star aniseed 2 grains, licorice 3 g, cassia bark 3 g, bay leaves 3 leaves, allspice 2 granules, Loo-han-gou 3 g.
Seasonings:
Soy sauce 2 tbsp, rock sugar 100 g, Shaoshing wine 100mL.
Procedures:
1) Cook pork in boiling water for 20 min, then cut into 4 cm2, and tie with cotton strings.
2) Wash green onion and cut, slice ginger for use.
3) Preheat wok with vegetable oil until about 120℃, then add garlic and fry to become golden brown color.
4) Put marinade bay in wok, add seasonings, and green onion, sliced ginger and pork and cook by high heat until boiling, then shift to low heat and simmer about 90 min.

Hot marinated and spiced beef shank

Ingredients:

Beef shank 600 g, hot spiced soup 1000mL

Procedures:

1) Clean and remove membrane and visible fat of shank, the cook in boiling water until without blood residue when insert the stainless steel needle into the meat.
2) Take out the boiled pork and cool in the running water to remove the surface smeary fat and cause meat firm.
3) Cook cooled shank in hot spiced soup and cover the wok to cook for 30 min with medium heat. When the shank become soft then turn off the heat and soak in marinade soup* for 1 h, then remove to slice for serving.

Comment:

The author does not recommend or suggest the cookers to use old Lu stock repeatedly.

Because the fat or oil and proteins left in the stock, if it is cooked repeatedly, the fat is oxidized and protein is denatured and produce free radical compounds and carcinogenic compounds such as lysinoalanine. Therefore, the author suggest the cookers do not apply reused stock solution.

Chapter 16. Miscellaneous meat products

Ank mash

Ingredients:

Long glutenous rice 600 g, Monasucs ank 150 g, Asp.orazye (white mold) 3 g, Cold boiled water 600 mL, rice wine 100 mL, salt 3 tbsp,sugar *1/2* tbsp.

Procedures:

1) Wash glutenous rice and add 450 mL cook in electrical cooker, and 1 cup water in outside layer of cooker and begin cooking.
2) Take out the steamed rice and stir, then place in a pan to cool.
3) Add ank and 3 g ground white mold in a stainless steel container and add 600 mL cold boiled water then mix mix thoroughly.
4) Add cooled, steamed glutenous rice and mix evenly, then add rice wine and keep stirring and soak for 10 min until the steamed rice showing red color, then fill in glass bottle and cap it.
5) Store the bottles and cans in the cool and dark room.
6) At 7^{th} day, open cap and stir evenly, then cap again. At 15^{th} day, take out and filtrate to get liquid (ank wine). The residues is added with salt and sugar then blend thoroughly to become ank sauce.

Anka mash pork

Ingredients:

Pork belly 600 g, chopped fresh ginger 5 g, chopped fresh garlic 5 g, anka sauce 100g, egg yolk 1, sweet potato starch 20 g, sliced cucumber 20 g.

Seasonings:

Soy sauce 1 tbsp, salt trace, rice wine 1 tbsp, sugar 1 tbsp, pepper powder trace, five spices powder trace.

Procedures:

1) Wash pork and drain, mix with chopped ginger and garlic and all seasonings thoroughly. Then spread anka sauce on the surface of pork as anka pork.
2) Cover the film and place in the refrigerator for 24 h.
3) Remove the film and spread the extra anka sauce on the pork surface, then mix with egg yolk, and coat sweet potato starch, then stand for 5 min to allow absorb the liquid.
4) Heat the oil to 150℃ and place pork and fry with medium heat gently until near cook well, then shift to high heat to fry out of the oil and take out to drain out the oil.
5) Cool and cut into slices, and add cucumber slices for serving.

Anka meat balls

Ingredients:

Rice (amylase rice) 200 g, sweet potato starch 500 g, water 800mL, pork shoulder 300 g, chopped green onion 30 g, coriander 10 g, flavoring sauce 10 g.

Marinade:

Chopped garlic 10 g, soy sauce 1 tbsp, anka sauce 3 tbsp, sugar 1 tbsp, rice wine 1 tbsp, pepper powder trace and cassava starch trace.

Procedures:

1) Mix rice starch with 300 mL water for use.
2) Cook 500 mL water to boiling, and add (1) and cook to become sticky, and cool.
3) After cooling, add sweet potato starch and blend into batter thoroughly for use.
4) Cut pork into small pieces, and mix with the chopped green onion and remaining ingredients well, and cure for 30 min as fillings.
5) Take one mold and spread trace vegetable oil on the bottom of the mold to prevent stick on, then add start batter (2), then fill in a suitable fillings (3), finally add suitable amount of batter to cover the fillings as meatballs.
6) Place meatballs on the steamer and steam for 30 min, then remove the meatballs from the mold. Then fry the balls in oil cooker by low heat to become cruspy.
7) Drain oil out.

Anka fried ground pork(zou chao)

Ingredients:

Ground pork 300 g, chopped garlic 50 g, anka sauce 4 tbsp, bone broth 600 mL, salt trace, sugar *1/2* tbsp and rice wine 2 tbsp.

Procedures:

1) Preheat cooker, add 2tbsp vegetable oil, chopped garlic and fry, then add ground pork and fry until whitening, then add anka sauce and fry again.
2) Add remaining ingredients(except broth) and keep frying until become tasty and aromatic, then add bone broth and cook for 20 min and cool.

Anka lion head(meat balls)

Ingredients:

Chinese cabbage 600 g, water chestnuts 3 bulbs, ground pork 250 g, anka sauce 2 tbsp, chopped green onion 109, chopped onion 10 g, chopped garlic 10 g, cassava starch trace, bone broth 800mL and coriander trace.

Marinade:

Soy sauce *1/2* tsp, sugar 112 tsp, pepper powder trace and sesame oil trace.

Seasonings:

Chicken flavorings 1 tsp, salt 112 tsp and sugar 114 tsp.

Procedures:

1) Cut cleaned cabbage and chop waterchestnuts for use.
2) Mix ground pork and marinades, and marinate for 10 min, then add anka sauce and blend until the mixture become elastic.
3) Mix chopped waterchestnuts, chopped green onion, onion, garlic, starch thoroughly until the mixture become sticky, then form into big balls.
4) Fry the big balls to become golden brown.
5) Preheat the cooker, add 2 tbsp oil, and onion cuts and fry, then add cabbage and fry to be soft.
6) Cook lion head with bone broth with seasonings and add coriander for serving.

Anka Dongpo pork

Ingredients:

Pork belly 600 g, cotton string 5, green onion 3pieces, ginger 1 piece, hot pepper 1 piece, star anise 2 pieces, anka sauce 5 tbsp and water 1000mL.

Seasonings:

Salt trace, soy sauce *1/2* tbsp, rock sugar 1 tbsp and rice wine 3 tbsp

Procedures:

1) Wash pork and cut into big cuts and tie with cotton strings, and cook in boiling water for 5 min until no blood residue appearing, and take out to cool in running water.
2) Cut green onion, red pepper for use.
3) Preheat cooker, add 2 tbsp vegetable oil, bay leaf to fry until fragrantly, then remove the bay leaf.
4) Add (3) material on the batter of a sand cooker, then place pork cuts (1).
5) Preheat (3) and fry anka sauce, then add water and remaining ingredients to cook until boiling.
6) Add (5) soup to (4) sand cooker and cook with high heat until boiling then shift to low heat for 1 h.

Dongpo zou(pork)

Ingredients:

Pork belly with skin 600 g, green onion 3 pieces, ginger slices 4 pieces, garlic 4 bulbs and cotton strings.

Spice bag:

Star aniseed 2 grains, licorice 3 g, cassia bark 3 g, bay leaves 3 leaves, allspice 2 granules, Loo-han-gou 3 g.

Seasonings:

Soy sauce 2 tbsp, rock sugar 100 g, Shaoshing wine 100mL.

Procedures:

1) Cook pork in boiling water for 20 min, then cut into 4 cm 2, and tie with cotton strings.
2) Wash green onion and cut, slice ginger for use.
3) Preheat wok with vegetable oil until about 120℃, then add garlic and fry to become golden brown color.
4) Put marinade bay in wok, add seasonings, and green onion, sliced ginger and pork and cook by high heat until boiling, then shift to low heat and simmer about 90 min.

Hot marinated and spiced beef shank

Ingredients:

Beef shank 600 g, hot spiced soup 1000mL

Procedures:

1) Clean and remove membrane and visible fat of shank, the cook in boiling water until without blood residue when insert the stainless steel needle into the meat.
2) Take out the boiled pork and cool in the running water to remove the surface smeary fat and cause meat firm.
3) Cook cooled shank in hot spiced soup and cover the wok to cook for 30 min with medium heat. When the shank become soft then turn off the heat and soak in marinade soup* for 1 h, then remove to slice for serving.

Hot dried beef slices

Raw materials:

Hot marinated beef 600g

Seasonings:

Salt 10 g, sugar 50 g, maltose 20 g.

Procedures:

1) Slice the marinated beef into 0.5 thick slices.
2) Add the seasonings in wok and cook until boiling, then add the beef slices to wok and cook by medium heat until the soup absorbed up.
3) Place the beef slices on the frame and roast to dry.

***Hot marinade soup preparation:**

Ingredients:

Green onion 2 pieces, matured ginger 30 g, red pepper 1, red pepper powder 5 g.

Seasonings:

Soy sauce 100 g, rice wine 20 mL and water 500 mL.

Procedures:

1) Wash green onion, ginger and red pepper, then slice.
2) Mix all ingredients except wine and cook until boiling, then add wine and cool for use.

Roasted goose

Raw material:

1 goose 3.0-3.5 kg

Coating syrup:

White vinegar 160 g, brown vinegar 40g, malt syrup 40 g.

Marinade:

Sugar 3 tsp, salt 2 tsp, star anise 4 stars, proper amount of ginger and garlic and a dash of five spices

Procedures:

1) Open the anus and clean the goose carcass, discard feet, remove lungs and air-pipe out from the tail (dressing).
2) Sprinkle the marinade into the abdominal cavity from the tail and sew up with a needle, mix the coating syrup the carcass inside and outside thoroughly for use.
3) Pour boiling water on the carcass, dry and spread the coating syrup evenly.
4) Hang the goose carcass on the rack with a hook, and dry in the air, then roast in the oven by high heat for about 40min, change the position of carcass occasionally to ensure evenly heating.

Spiced goose

Raw material: Goose 1 about 3-3.5 kg

Spices:

Star aniseed 13 g, wild pepper 13 g, allspice 13 g, clove 13 g, cassia bark 13 g, amomum 13g and licorice 2g.

Seasonings:

Water 2.56 kg, light soy sauce 2.56 kg, rock sugar 640 g, salt 160 g and white wine 80g.

Procedures:

1) Wash the dressed goose carcass and drain for use.
2) Add the spices in a cloth bag and tie up the opening, and cook with seasonings in a pot for 20 min by high heat.
3) Add the onion and dressed goose in the pot, then turn to low heat and keep simmering for more 30 min. Afterward, take the goose out and cut up for serving.

Spiced chicken

Raw material:

1 dressed chicken .1.2 -1.5 kg

1 green onion

Spices:

Star aniseed, cassia bark, wild pepper, allspice, cloves and diced resurrection lily 12 g for each.

Seasonings:

Dark soy sauce 320g, light soy sauce 3.2 kg, rock sugar 1.28 kg, salt 80 g,

Shaoshing wine 160 g and water 100 g.

Procedures:

1) Wash the dressed chicken and drain off for use.
2) Add spices in a cloth bag and tie up the opening and cook with seasonings in a pot for 20 min.
3) Add onion and chicken in the pot, then turn to low heat and keep simmering for more 20 min, then take out the cooked chicken and cut for serving.

Chapter 17. Fermented Meat

Sour meat(a fermented meat product)

1. Sour meat produced by aboriginals in Taiwan

1) Names of sour meats

Name	fermentation time	container
Siraw	30 days	glass bottle
Gimosiyan	7-10 days	glass jar
Sagularwa	15-30 days	-
Senpohun	15-30 days	-
Shilau	15-30 days	Jar
Dungmen	7-12 days	earthen jar
Dermomen	15 days	glass vat
	1-2 days	
	1-2 years	earthen jar

2) Major critical characteristics of sour meat in Taiwan

Critical characteristics	traditional method	improved method
Raw meat	pork, beef, offals, fish etc.	pork
Fermentation	natural fermentation	starter culture
Starter culture	complicate, we isolated and identified four groups as *Lactobacilli, Streptococcus, Enterococcus and Lactococcus.*	*Lactobacillus plantarum*
Salt	high salt level above 10%	6%
Fermentation temperature	room temperature	low temperature 2~4℃
Water activity		0.92
pH value		4.1
Nitrite added	none	none
Carbon source	steamed rice	steamed rice Sugar

Source: Chen et al., 1992, 1993.

Procedures:

1. Traditional method
   1) Wash pork, drain and cut into strips(about 3x5xO.5-1.5 cm).
   2) Spread suitable amount of salt(about 10%) on the pork strips and cure in the refrigerator for 2-3 days, and discard drips.
   3) Steam rice or millet and cool it.
   4) Then place cured pork on the steamed rice layer by layer in bottle or jar, then Seal closely.
   5) Store in cool place for 30 days.
2. Improved method is same as the traditional method, it only before bottling add starter culture *L. plantarum* at the level of 3000,000cfu/g, then seal. And adjust pH below 5 with citric acid.

Rham manufacture

Ingredients

Lean pork (chopped)	600g	60%
Cooked pork skin (shredded)	400g	40%
Salt	25g	2.5%
Cooked rice	60g	6.0%
Crushed garlic	50g	5.0%
Sugar	5g	0.5%
Sodium tripolyphosphate	3g	0.3%
Ascorbic acid	0.5g	0.05%
Sodium nitrite	0.1g	0.01%
Starter culture (optional)		1~3%

Procedures

1. Chop lean pork and cooked pork skin, and crush garlic, separately.
2. Mix the chopped pork and pork skin with crushed garlic, and other ingredients well.
3. Inoculate starter culture if needed.
4. Wrap the mixture with clean banana leaf and tie closely ..
5. Place the wrapped pork mixture in the fermenting room at 90-110F for 6-8 hours, then move to chilling room.

Formula 2	
Pork (lean)	56.8%
Cooked pork skin	32.5%
Garlic	5%
Cooked rice	25%
Sodium nitrite	0.015%
Salt	2.5%
MSG	0.185%
Sugar	0.5%

Chapter 18. Functionality and utilization of soy protein in meat products.

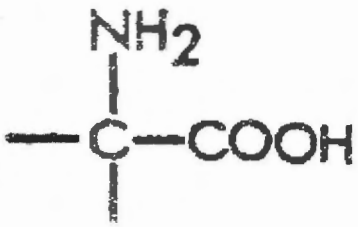
I FUNCTIONALITY OF PROTEINS

Functional properties can be defined as those physicochemical properties which affect the processing and behavior of proteins in food systems as judged by the quality of the final product. The main functional properties have been11Sted in Table 1. These properties are seen to be inter-related.

The main functional properties that I shall be dealing with will be solubility and water binding. viscous thickening and gelation, emulsification, foaming and texture-forming (Table 2).

Before I go on to discuss the functional properties of these proteins I would like to briefly describe the basic structure and chemical properties of proteins in order to understand their behavior and to give and insight as to how this behavior may be manipulated.

The structural units of all proteins are amino acids -



Amino acids

The primary structure is simply a linear sequence of amino acids connected by peptide bonds (-CO-NH-), formed by the condensation of the amino group of one amino acid and the carboxyl group of another. The covalent linkages can also be formed by disulphide bonds. The organization of the amino acid chain in a three dimensional configuration is known as the secondary structure. Examples of this structure are the *a*-helix, β pleated sheet and the collagen triple helix. The structure is stabilized by H bonds between the hydrogen of the NH-groups and oxygen of the CO-groups. In the tertiary structure the helices are bent in short segments which are packed in a definite way to give globular or fibrous proteins. This configuration (Fig.l) is held by hydrogen bonds, salt linkages, hydrophobic interactions and covalent disulphide linkages. In any denaturation process which is the basis of many functional properties, the secondary and tertiary structures are destroyed (Fig.2).

The three structures described consist of only one polypeptide chain. When

several chains interact to form a native protein molecule, a quaternary structure is formed, e.g., haemoglobin. The stabilizing bonds are similar to those of the tertiary structure.

Table 18.1. Functional properties of proteins[1]

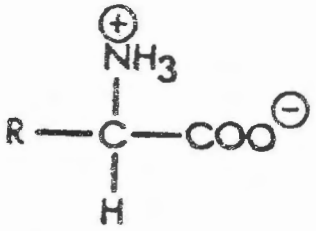
General property	Specific functional term
Organoleptic	Colour, odour, flavour, texture, mouthfeel
Kinaesthetic	Smoothness, grittiness, turbidity
Hydration	Solubility, water absorption, swelling, water holding capacity, viscosity, gelling
Surface	Emulsification, foaming
Textural	Viscosity, network cross-binding
Rheological	Aggregation, elasticity, gelation

Table 18.2. Functional properties of animal proteins in food

Property	Protein	Food system
Solubility and water binding	Meat	Sausage
	Blood	Sausage
Viscous thickening and gelation	Meat	Sausage
	Blood	Sausage
	Egg white	Cake
	Gelatin	Desserts
Emulsification	Meat	Sausage
	Blood	Sausage
	Egg yolk	Cake
Foaming	Egg white	Cake
	Egg yolk	Cake
Fibre forming	Blood	Meat products
	Offal	Meat products

Naglin Howell: IFFA MAY/June, 1978, P.119-120

The nature of these bonds is due to the structure and specific properties of the amino acid. Proteins like amino acids are amphoteric, that is they possess both a positive and negative charge depending on the pH and ionic strength. This net charge can contribute to the interaction of the proteins with other substances.



Amino acid zwitterion

The R groups or side chains also exert an important influence on protein behaviour. The properties of the side chains can be divided into four groups, as shown in Table 3.

Table 18.3. Properties of amino acid side chains.

Polar uncharged (hydrophilic) R groups which can hydrogen bond with water and are soluble in aqueous solution, e.g., hydroxyl group of serine, threonine and tyrosine; the sulphydryl group of cysteine and the amide group of asparagine and glutamine. Nonpolar (hydrophobic) R groups which are less soluble in aqueous solutions, e.g., the amino acids tryptophan leucine and proline. Net positively charged R groups, e.g., the amino group of lysine and the guanidine group of arginine at pH 6-7. The negatively charged R group e.g., the dicarboxylic amino acids, aspartic and glutamic acids at neutral pH.

The types of bonds, reactive groups, and charge of the proteins determines their behaviour, and the functional properties in a product.

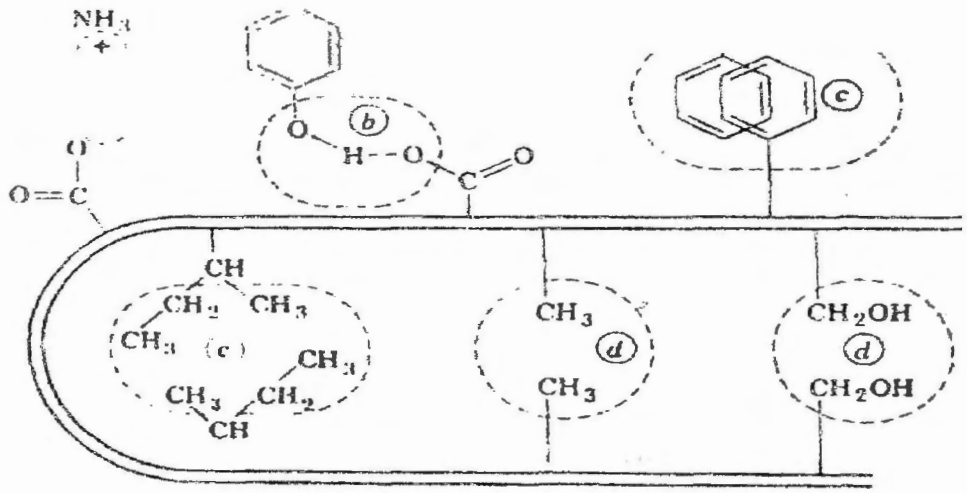


Fig.1 *Some types of non-covalent bonds which stabilize protein structure: (a) Electrostatic interaction,' (b} hydrogen bonding between tyrosine residues and carboxylate groups on side chains; (c) interaction of non-polar side chains caused by the* mutual repulsion of solvent; (d) Van del' Waals interactions. From C.E. Anfinsen, ref .4.

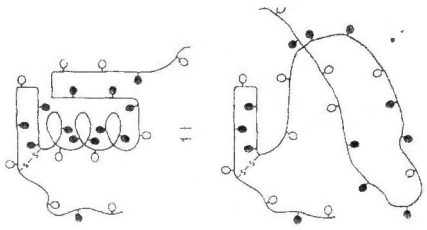


Fig.2 *A diagrammatic representation of the denaturation of a protein molecule .Hydrophobic side-chains (filled circles) are mostly buried in the molecule in the native state but are exposed to the solvent in the denatured state, while the polar and ionic side-chains (open circles) are largely solvated in both the native and denatured states. With permission from J F Brandts, in Thermobiology, A. H. Rose, ed., p.25* (1967). *Copyright/Academic Press Inc., (London) Ltd.*

Except for their nutritional uses, soy protein products are used primarily for their functional characteristics. The presence of both lipophilic and hydrophilic groups in the same polymer chain facilitates association of the protein with both fat and water. This promotes formation of stable oil and water emulsions when a protein dispersion is mixed with oil. The protein's polymer chain contains lipophilic, polar, nonpolar, and negatively and positively charged groups, which enable soy protein to associate with many different types of compounds. It may adhere to solid particles and act as a binder or, in solution as a dispersing and suspending agent. Protein films may adhere to surfaces, and solids may be distributed and cemented together within the protein film. Such properties usually require a protein with a relatively high degree of water dispersability. Soluble proteins are easier to incorporate into moist foods.

In a relatively insoluble protein product, these properties are present to a limited degree. Although such products remain highly valuable nutritionally, they may contribute only slightly to viscosity, gel formation, emulsification, binding, adhesion, or to the stabilization of emulsions and suspensions.

An insolubilized protein contains essentially the same functional groups as the native protein. The only difference is a change in the .accessibility of these reactive groups. Interactions and association with food ingredients, such as water and oil, are still possible through unfolding, rearranging, and crosslinking of the polymer chains. Although the accessibility of hydrophilic sites has been reduced, the protein can still hydrate. The degree of hydration is sufficient only to get the product into a swollen state, but not into solution. Therefore, instead of forming an aqueous solution, a relatively insoluble soy protein absorbs water and, when the maximum amount is absorbed, forms a suspension in the excess water. For similar reasons, such a product is also capable of absorbing oil or fat; however, the maximum amount of absorbed oil is less than that of water.

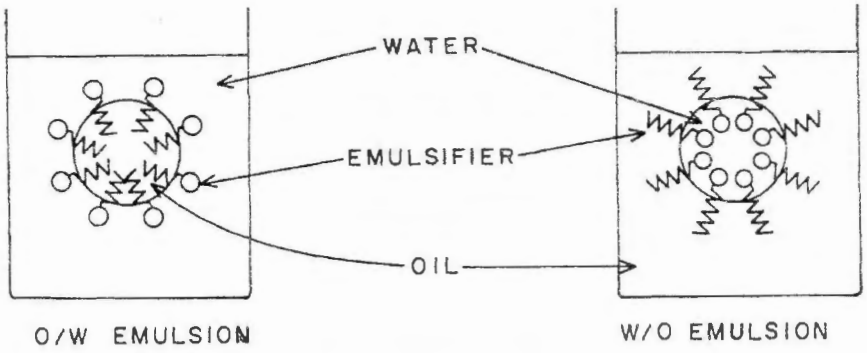


Figure3 Stabilized emulsion droplets.

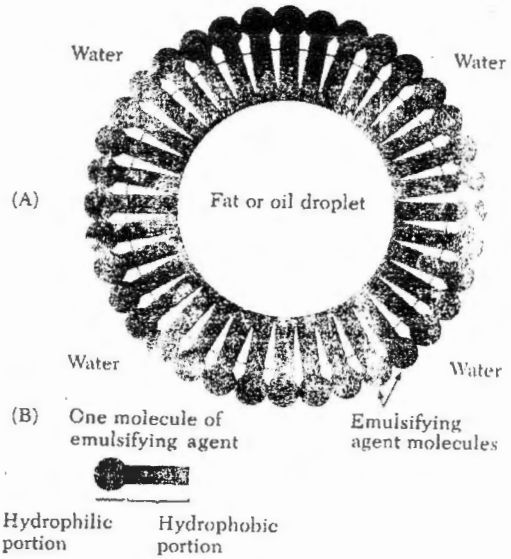


Figure 4 . *(A)* The emulsifying agent is located at the interface between the lipid and water phases. These molecules are oriented so that their hydrophilic portions are in contact with the water phase while their hydrophobic portions are in contact with the lipid phase. The emulsifying agent forms a monomolecular layer surrounding the lipid droplet. (B) A molecule of emulsifying agent with its hydrophilic and hydrophobic portions indicated. Courtesy of W. H. Freeman and Company.

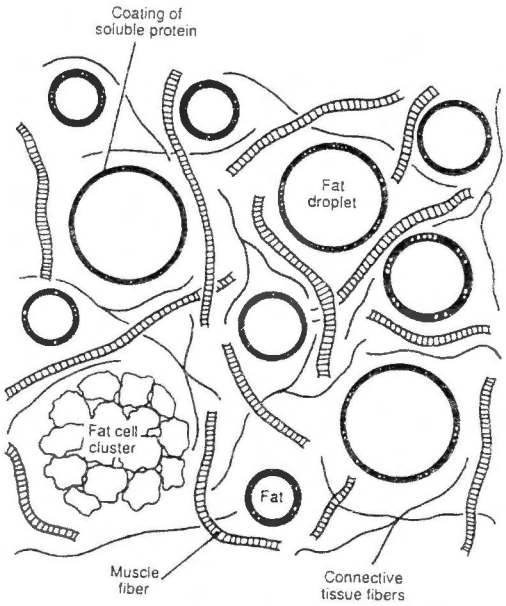


Figure 5 A diagrammatic illustration of a raw meat batter. Fat droplets are dispersed in an aqueous medium that contains soluble proteins, other soluble muscle constituents, gelled proteins and segments of muscle fibers and connective tissue fibers. Note that the fat droplets are coated with a thin layer of soluble protein (emulsifying agent) which has been released into the aqueous medium from the muscle fibers. Courtesy of W. H. Freeman and Company.

Ⅱ、FUNCTIONALITY OF SOY PROTEIN INGREDIENTS

The functional properties of soy protein products are summarized in Table 4. Flours, concentrates and isolates bind I to 6 grams of water per gram of protein. Normally, isolates and concentrates are desired for fat absorption, although soy flour can reduce fat absorption in doughnuts and other deep-fat fried products.

The physical properties of meat, poultry, seafood, eggs, and dairy products are closely related to their protein composition. To successfully incorporate soy proteins into these traditional food products usually requires that the protein ingredient exhibit properties in the food product similar to those of the protein being supplemented or replaced. Mixing energy input. In general, both the process and the equipment used in making food emulsions, particularly very viscous emulsions, exert a major influence on the emulsion's properties. Functional properties are not only important in determining the quality of the final product, but also in facilitating processing; for example, improved physical properties of cookie dough or processed meat slicing.

Various processing treatments can alter the characteristics of soy protein products. These treatments can involve the use of enzymes, solvents, heat, fractionation, and pH adjustment, or a combination of these treatments.

Table 18.4. Functional Properties Performed by Soy Protein Preparations in Actual Food Systems[a]

Functional property	Functional property	Food system	Preparation used
Solubility	Protein solvation, pH dependent	Beverages	F,C,I,H
Water absorption and binding	Hydrogen-bonding of HOH, entrapment of HOH, no drip	Meats, sausages, Breads, cakes	F,C
Viscosity	Thickening, HOH binding	Soups, gravies	F,C,I
Gelation	Protein matrix formation and setting	Meats, curds, cheese	C,I
Cohesion-adhesion	Protein acts as adhesive material	Meats, sausages, Baked goods, pasta products	F,C,I
Elasticity	Disulfide links in gels deformable	Meats, bakery	I
Emulsification	Formation and stabilization of fat emulsions	Sausages, bologna, soup, cakes	E,C,I
Fat adsorption	Binding of free fat	Meats, sausages, donuts	E,C,I
Flavor-binding	Adsorption, entrapment, release	Simulated meats, bakery	C,I,H
Foaming	Forms stable films to entrap gas	Whipped toppings, chiffon desserts, angel cakes	I,W,H
Color control	Bleaching of lipoxygenase	Breads	F

a. F, C, I, H, W denote soy flour, concentrate, isolate, hydrolyzate and soy whey, respectively .

Ⅲ、Comparison of Functional Properties of Food Proteins Used in Meat **Products**

Water-binding ability: Surimi ranked second, behind soy.

Ability **to reduce cost:** Surimi ranked third, behind soy and whey.

Fat-binding ability: Surimi ranked second, behind *caseinate.*

Texture improvement: Surimi ranked highest.

Gel formation: Surimi ranked highest.

Gel formation at suitable temperature: All ingredients ranked similarly, but type products. Next in popularity are the loaf-type products, many of which are the canned type. In the U.S, Japan and Taiwan the coarse-ground meat products such as hamburgers, patties, and Chinese-style sausage are more popular than the loaf products.

In most of the developed countries, meat is the chief item of almost every meal, but especially in the main meal of the day. Since meat is such an important part of our diet, meat processing is competitive.

Although the processor is in the business of selling a protein, he must include fat in his product for both economic and organoleptic reasons. With a relative protein shortage and a fat surplus in today's market, it is necessary to use protein to carry the fat.

Soy proteins are considered a natural addition to processed meats for several reasons. (A.) Soy proteins are functional; many have emulsification and binding properties. Soy proteins have an affinity for the meat juices. This not only helps reduce cooking losses, but the resulting product is more juicy and flavorful. (B.) Soy protein properties are economical. On the basis of protein they are among the lowest cost products available. (C.) Soy protein products are high in nutritious protein that will complement the meat protein.

Soy flour, the finely ground soy protein product, has been used in cooked sausage and nonspecific loaves for several years. Its primary purpose has been to extend meat, and it was used because it was an inexpensive product high in nutritious protein. It was recognized early that soy flour has the advantage of holding both the meat juices and the fat. Its main disadvantage has been its taste and feel in the mouth. These factors tended to limit its use.

Of the various types of soy flours available, the toasted products are preferred in meat applications. White soy flours have high lipoxidase, urease, and trypsin inhibitor activities that can cause problems in emulsion systems. This is especially so in sausages cooked in smokehouses where temperatures are insufficient to destroy these activities. As far as I am aware, lecithinated or fatted soy flours have never been shown to offer any advantage in meat systems.

In the U.S. soy flours currently are permitted alone or in combination with other permitted additives not to exceed 3 *112%* total. In chili the upper limit for additives is 8%. In meatballs and Salisbury steaks it is 12%.

Soy grits are identical in composition to soy flours. The only difference is particle size. Soy grits also are available in various degrees of cook. Like soy flour the toasted product is preferred in meat applications. Soy grits also are used in sausage products but to a lesser degree than soy flour. Soy grits have greater utility in coarse ground meat products such as hamburger-type products. In the U.S. additives such as soy grits are not permitted in hamburgers. Hamburger by definition is only meat, it may or may not contain seasoning.

At present the only name permitted for an extended ground neat hamburger-like product is "patty." Thus far patties are considered nonspecific. However, our regulation are in a state of flux and this may change in the near future.

Present usage of soy grit products in coarse ground meat products is ca. 6%.When hydrated with twice its weight in water, an 18% extension of the meat may be realized. In federally inspected plants soy grits are restricted alone or in combination to 3 *1/2%* in sausage, and to 12% in meatballs.

It is interesting to note that the disadvantage of mouth feel in products containing soy flour is not noticed in similar products containing soy grits. This may be due to expectancy on the part of the taster, i.e. if it can be seen it is expected.

Soy protein concentrate which has a protein content on a moisture free basis of 70% is used to an even greater extent in coarse ground meat products. Its advantages over soy grits are that it is blander and has a higher protein content. Because of this the product can be hydrated to a greater degree and used at higher levels. If too little water is used to hydrate the product, the supplemented meat product will tend to be dry. Usual hydration levels are ca. 2. 5 : 1. A good guide in hydrating soy products is to achieve a protein level in the hydrated product of ca. 18%.

In supplementing ground meat in a patty-type product, extensions can be made to ca. 20% without flavor adjustment. Above this level it will be necessary to use additional seasoning to offset the dilution effect the bland product has on the taste of the meat being reduced. Obviously in applications of this type, the coarse ground soy protein concentrate product usually is used rather than the flour-like product. For classification purposes this type of product is referred to as granular soy protein concentrate (GSPC).

The advantage in using GSPC in patties is that shrink is reduced 10%, i.e. if 25% shrink is noted in the all-meat product, the additive type will shrink 22.5%. Good dimensional stability, as well as a better tasting, juicier product, is an added benefit.

For optimum results from the use of GSPC, it is recommended that the product be presoaked with water for a short time before it is added to the meat. After mixing the combination should be reground through a 3/16-in. plate.

The flour-like soy protein concentrate is used primarily in emulsion systems in the same manner as soy flour. Because of its higher protein content and blander flavor, it is preferred over soy flour in sausage-type products.

In federal plants soy protein concentrate is permitted alone or in combination to 3 1/2% in sausage, 8% in chili, and 12% in meatballs and salisbury steak.

Isolated soy protein (ISP) is available in either the isoelectric form or as a proteinate. Although it can be made as the salt of various cations, its usual form is the sodium proteinate .

ISP is a globulin-like fraction selectively extracted from defatted flakes. It is both an emulsifier and a binder.

One available type possesses the property of gelation. This can be seen if 12-17% dispersions are made in water and the material is heated. The gel will form at elevated temperatures. As might be expected, there is a concentration-time--relationship. temperature ISP also is used advantageously in canned meat items because it is not affected adversely by the high processing temperatures. In this application, there appears to be a protective action for the meat protein against the effects of heat. Because of this property, it should play an important part in items to be processed at higher temperatures and shorter processing times. It is entirely possible to make a dispersion of ISP in water in which an emulsion of fat will be locked in upon heating.

This is similar to the way the lean meat proteins of sausage or loaf items lock in the fat when the emulsion is cooked. If one wishes to demonstrate this, an emulsion can be made of 15% ISP, 50% water, and 35% lard. It will be found that the emulsion is extremely stable. After heating, it will withstand boiling, frying, or commercial canning temperatures without breakdown. This cannot be done with any other known binder with the possible exception of high viscosity caseinate.

Although this binding property is readily demonstrated, the author does not wish to imply that even the best binder in a comminuted meat item (sausage or nonspecific loaf) will replace the myosin found in lean skeletal muscle in every respect. On a unit protein basis, myosin exhibits a somewhat higher overall functional performance; it possesses a meat flavor, and from the nutritional standpoint, closely approaches the amino acid balance of the protein needed by man. Present U.S. regulations restricting fat to 30% and water addition to 10% have changed the picture somewhat in the utilization of soy proteins. This is especially so since only 2% ISP is permitted in frankfurters, bologna, and similar products.

In a No.1 type frank where the red meat portion is good red meat, there is little need for a myosin extender. Therefore, in this type of frankfurter the limited use of ISP at 270 offers little more than an insurance ingredient. In this case, soy protein concentrate at 3*112%* offers more of an economic advantage to the processor. In a formulation where the animal protein additions have little binding index, where there is greater stress, ISP has more utility. By using 2% ISP in a formulation, it has the functional effect of adding an extra 10% of meat to the formulation. Lean meat is ca. 20% protein.

ISP has greatest utility in those systems, such as a nonspecific loaf, where there is no restriction on the amount of water used. To be most effective, ISP must have additional water apart from the system in which it is functioning. Depending on what is used in the meat system, ISP will need ca. 3-4 times its weight in water.

ISP also functions to an advantage in stress situations where too great a quantity or poor binding meats are used.

Firmness in a sausage product is dependent on the amount of lean meat in the formulation, while fat tends to soften the product and make it more tender. This tendering effect also is noted if excessive amounts of ISP are used. Hence, this limiting factor can be used as an advantage in the production of a high protein-low fat sausage product. In this case the combination of ISP and water (l:3 by wt) can be used in place of fat.

The Central Soya Research Laboratory was able to formulate an acceptable fish frankfurter that consisted of 19% protein and 3% fat. Meat items were also produced that had fat contents ranging from 6-15%. In a commercial demonstration a frankfurter was produced that analyzed as follows: moisture, 69.4%; fat, 6.6%; protein, 17.8%; ash, 3.0%.

When compared with a frankfurter with a fat content of 30%, not only is the amount of saturated fat greatly reduced but also the caloric content is significantly lower.

A summary of basic soy protein products used in various meat systems and a reflection of actual usage by various processors are shown in Table 6 Soy protein inclusion in the meat system has been classified into major (A.) and minor (B.) categories. The major category means that the product is used at relatively high levels; the minor category indicates the product is used at low levels.

Soy proteins are available in many different sizes and shapes. Some of the more common forms are: powdered, granular, flake, chunk, fibrous and hydrated. There is a suitable soy protein for virtually any processed meat. Table 711Sts suggested applications for different forms of soy proteins. Powdered soy proteins work best in products where no visible soy protein is desired in the finished product. Examples are

frankfurters and luncheon loaves. Soy proteins also perform excellently in coarse ground fresh products and have the ability to impart texture to the finished product. In the United States, a lot of low cost hamburger patties are manufactured containing either textured flours or concentrates. Isolated soy protein can be used to replace 25% of the meat in a beef patty without adversely affecting the eating quality of the product. Soy protein large chunks work nicely in soups or stews.

Table 18.6. Basic Soy Protein Products Used in Various Meat Systems [a]

			70% Protein dry basis		90% Protein
	50% Protein		Soy protein concentrate		Dry basis
Meat system	Soy flour	Soy grits	Coarse	fine	Isolated soy protein
Ground(coarse)					
Patties	B	A	A	B	B
Meat balls	B	A	A	B	B
Meat loaves	B	A	A	B	B
Chili	A	A	A	B	B
Sloppy joe	B	A	A	B	B
Tacos	A	A	A	B	B
Salisbury steak	A	A	A	B	B
Sausage	AB	A	A	A	A
Emulsion					
Sausage	A			A	A
Bologna	A			A	A
Loaves	A			A	A
Canned	A			A	A
Other					
Baby foods	A	A	A	A	A
Soups					
Canned	A	A	A	A	A
Dry					
Sauces and gravies	A	A	A	A	A
Pet foods	A	A	A	A	A
Poultry rolls	B			B	B

[a] A=major additive, B=minor additive.

Table 18.7. *SUGGESTED USAGE FOR VARIOUS SOY PROTEINS*

Physical Characteristic	Suggested Use
Powder	Emulsions, Loaves, Poultry Rolls, Red Meat Rolls, Beef and Pork Patties, Chicken Patties, Chili, Meatballs, etc.
Granular	Semi-Dry Sausages, Meatballs, Coarse Ground Processed Sausages, etc.
Flake	Pizza Toppings, Beef and Pork Patties, Chicken Patties, etc.
Chunk	Soups, Stews, etc.

Soy proteins are available either colored or uncolored. Uncolored products are either white or light tan in appearance. Uncolored, textured products are used in fresh meat products like beef or pork patties. The most common colored soy protein products have a light caramel appearance. These caramel colored products function effectively in cooked products such as pizza toppings, chili and burritos. Specialty soy proteins can be manufactured in several different colors.

Soy Protein Products used in Chinese Meat Products

The purposes of use of soy protein products in various Chinese meat products are to improve the nutritive value, to diminish the cost of production, and to investigate the acceptability of these soy meat products and their proper usage. In this study, soy flour, soy grits, textured soy protein and soy protein isolate as portion added in Chinese sausage, shredded pork, pastry fillings, pickled cucumber pork and meat balls, and the results were obtained as follows:

Sausages added with soy flour *(200/88* Dawsoy) were lowest in cooking loss and the protein content of the products increased with the usage of the soy flour, but it was better to limit the usage below 1070. If the excessive use would result in undesirable color, texture and beany flavor of the products. 5% soy flour added in the fried shredded pork could improve the texture and flavor of the product, and 10% added would increase the nutritive value remarkably. 10% soy grits *(l0/20* Dawsoy) added in fillings pastry could improve the flavor and juiciness of pastry, and to reduce the fat content of the product significantly (P<O.OI) .15% of Textured Soy Protein added in

pickled cucumber pork was still acceptable to the test panelists and the protein content of the product also was increased. Its acceptability was due to the particle size of the textured soy protein being similar to that of the coarse ground pork used in pickled cucumber pork and its function. Small amount of soy protein isolate was used in hammered meat balls (usage bellow 2.5%) could improve elasticity and flavor of the product.

How do soy proteins function?

Soy proteins are primarily hydrophilic in nature. This means they have the ability to bind water. They also have the ability to absorb some fat and consequently reduce cook-out during processing. Some soy products achieve this primarily by entrapping the fat, while some of the more sophisticated soy proteins are capable of emulsifying fat. The higher the protein content of a soy product, the greater will be its ability to absorb water and control fat. In this regard, soy protein concentrates will function more efficiently than soy flours, and isolated soy protein will function more effectively than soy concentrates. In emulsion type products where bind is very important, isolated soy protein works extremely well.) Table 8 lists typical average hydration ratios for various soy proteins. The hydration ratio represents how many parts of water each part of soy protein will bind.

Table 18.8. SOY PROTEIN HYDRATION RATIOS

Item	Item Hydration ration
-	(Parts Water: Parts Soy Protein)
Soy Flour	2-2.5:1
Soy Protein Concentrate	3-3.5:1
Soy Protein Isolate	5:1

When evaluating the price/kg of various soy proteins, it is very important to consider the cost/kg of hydrated product. The product with the lowest cost/kg dry does not always have the lowest cost/kg hydrated. It is also important to consider the functionality of the soy protein rather than just the cost/kg of the soy product.

When using soy proteins, it is very important that the formulation contain sufficient moisture for complete hydration of the soy protein. Under hydration can result in loss of texture and emulsion breakdown and in wasting some of the binding capacity of the soy protein. Over hydration will lessen the gel strength of the finished product. It is important to note that soy proteins have the ability to gel upon heating in

much the same manner as meat proteins. Often, when adding soy protein to a formulation, it is calculated that one fourth of the water needed for hydration will come from the normal formulation itself Table 911Sts typical hydration times for different types of soy proteins. Naturally, the hydration time may be different for specific products. This table is intended to serve only as a guideline. If warm water is used to hydrate textured soy products, hydration time will be less than when using cold water.

Table 18.9. *TYPICAL HYDRATION TIMES* FOR DIFFERENT SOY PROTEINS

Item	Hydration Time
Powdered Products*	5 minutes
Flake Products	5 minutes
Granular Products	10-15 minutes
Chunk Products	20 minutes

* Some powdered products, such as isolated soy protein, hydrate best with high shear energy, for example, a bowl chopper. Under these conditions the soy protein can usually be hydrated in 30-60 seconds.

V、MANUFACTURING PROCEDURES WHEN USING SOY PROTEINS

In order to achieve maximum benefit from the incorporation of soy proteins in a formulation, it is important that they be handled correctly. Following are some guidelines that can be used under different manufacturing conditions.

1. USE OF TEXTURED SOY FLOUR OR TEXTURED SOY PROTEIN CONCENTRATE IN PORK OR BEEF PATTIES:
   GRINDERIBLENTIER PROCESSING SYSTEIVI
   A. Put textured soy protein in blender.
   B. Add sufficient water for hydration. Mix until soy protein is hydrated.
   C. Add ground meat and flavorings and mix until thoroughly blended.
   D. Regrind through final plate.
   E. Form into patties.

2. USE OF SOY PROTEIN CONCENTRATE IN COARSE GROUND COOKED SAUSAGES:

GRINDER/BLENDER/GRINDER PROCESSING SYSTEM

A. Coarse grind meats.

B. Transfer to blender. Add soy protein concentrate (grits or powder) and mix until thoroughly blended.

C. Add hydration water and continue mixing until it is absorbed.

D. Add cure, salt, seasonings and the remaining water and continue mixing until the meat block is very tacky.

E. Regrind through fine plate.

F. Proceed as usual.

3. USE OF ISOLATED SOY PROTEIN IN BEEF OR PORK PATTIES
GRINDER/GRINDER PROCESSING SYSTEM

A. Grind meat.

B. Add dry isolated soy protein and hydration water and mix for 2 minutes.

C. Add other nonmeat ingredients and mix two additional minutes.

D. Regrind meat and proceed as usual.

4. USE OF ISOLATED SOY PROTEIN IN EMULSION PRODUCTS:
CHOPPER/EMULSION MILL PROCESSING SYSTEM

A .Place 4 parts water and 1 part isolated soy protein in chopper. Chop 30 seconds on low speed then 30 seconds on high speed.

B. Add meat and remaining nonmeat ingredients and chop for 2 minutes.

C. Add remaining water and continue chopping until desired temperature is reached.

D. Run through emulsifier.

E. Proceed as usual.

5. AUGMENTATION OF CHUNKS OF MEAT WITH ISOLATED SOY PROTEIN:
BLENDER PROCESSING SYSTEM

A. Prepare brine using isolated soy protein (see section on preparation of a brine from isolated soy protein).

B. Place chunks of meat in blender. Add prepared brine and mix until it is Absorbed (this usually takes 2-6 minutes). NOTE: The longer you mix, the tighter the texture will become.

6. PREPARATION OF A BRINE USING ISOLATED SOY PROTEIN

Since some isolated soy proteins are dispersible, they can be used as a

component of brines for whole muscle products. This provides tremendous opportunities to produce products such as ham, roast beef, corned beef and roast pork of good quality that have exceptional yield. Brines containing isolated soy protein can be used to increase typical pumping levels from 120% to 180%, possibly even higher. Following is the procedure that should be used when preparing a brine containing isolated soy protein.

(1) Weigh or meter water into brine tank.

(2) Add isolated soy protein to tank and mix with water using high shear mixing (propeller mixer or equivalent). In order to achieve full benefit from the isolated soy protein, it is very important that it be fully hydrated before the addition of the other brine ingredients. If salt is added too soon to the brine, it can hinder hydration.

(3) After the isolated soy protein has been mixed with the water and hydrated, add the sodium phosphates and dissolve.

(4) After the sodium phosphates are thoroughly dissolved, add the sodium erythorbate and dissolve.

(5) Now add the cure, salt and flavorings and dissolve.

(6) After all ingredients have been added and dissolved, the brine is ready For pumping.

Most types of commercial stitch pumping equipment can be used to inject this brine. However, it is not advisable to artery pump this brine. The colloidal particles of protein in suspension are larger than the inside diameters of some capillaries, consequently, even distribution of the brine throughout the muscle cannot be accomplished. If artery pumping is used, the result is frequently low yields and1uncured or under cured areas in the finish product. The recommended procedure is to bone the hams prior to pumping. After stitch pumping, the hams should be either massaged or tumbled in order to assure distribution and equilibration of the brine in the ham. If possible, the product should be vacuum mixed for 1-2 minutes after massaging or tumbling prior to stuffing.

CHECK WITH SUPPLIERS

Most producers of soy protein products have conducted extensive research on optimum procedures for incorporation of their soy proteins into processed meat products and are an excellent source of technical information. Do not hesitate to call on them and ask for their assistance. They will be most happy to help you with your specific problem and to help you take advantage of the many opportunities possible with today's high quality soy proteins.

VI. Furmulations using soy proteins

BEEF PATTIES WITH SOY PROTEIN CONCENTRATE

Ingredients

Ingredients

71 %	Beef Trim (30% fat)
7 %	Soy Protein Concentrate (grits)
21 %	Water
1 %	Salt
	Appropriate seasonings

Manufacturing Procedure

1. Hydrate soy protein concentrate with water.
2. Grind beef through 10 mm plate.
3. Transfer beef and hydrated soy protein concentrate to blender. Add salt and seasonings and 2-3 minutes.
4. Regrind through 4 mm plate.
5. Form into patties.

SEASONED PORK PATTIES WITH TEXTURED SOY FLOUR

Ingredients

55.25% Pork Trimmings (50/50)

23.0% Pork Trimmings (80/20)

6.5% Textured Soy Flour

13.5% Water

1.75% Salt

Appropriate Seasonings

Manufacturing Procedure

1. Hydrate textured soy flour.
2. Grind pork through 10 rum plate.
3. Transfer pork and hydrated textured soy flour to blender. Add salt and seasonings and mix for 2-3 minutes.
4. Regrind through 5 mm plate.
5. Form into patties.

SEASONED PORK PATTIES WITH TEXTURED SOY FLOUR AND ISOLATED SOY PROTEIN

Ingredients

65.5%	Pork Trimmings (50/50)
20.0%	Water
9.0%	Textured Soy Flour
1.75%	Isolated Soy Protein

Ingredients (continued)

1.75%	Salt
	Appropriate Seasonings

Manufacturing Procedure

1. Hydrate textured soy flour with *1/2* of water.
2. Grind pork trimmings through 10 mm plate.
3. Transfer ground pork and hydrated textured soy flour to blender.
4. Add isolated soy protein and remaining water and mix I minute.
5. Add salt and seasonings and mix 2-3 minutes.
6. Regrind through 5 mm plate.
7. Form into patties.

MANUFACTURE OF FRANKFURTERS USING ISOLATED SOY PROTEIN

Ingredients

35%	Boneless Beef (80/20)
30%	Boneless Pork *(50/50)*
26%	Water
3%	Nonfat Dry Milk
2%	Isolated Soy Protein
2%	Salt
2%	Seasonings and Cure

Manufacturing Procedure

1. Put isolated soy protein and hydration water in chopper (4 parts hydration water to 1 part soy protein isolate). Chop on low speed for 30 seconds. Chop on high speed for 30 seconds.
2. Add meat, salt, nonfat dry milk, seasonings and cure and chop for 1 minute.
3. Add remaining water and chop until desired temperature is reached.

4. Run meat batter through an emulsifier.
5. Continue processing using usual manufacturing procedures.

HAM PRODUCT MADE WITH ISOLATED SOY PROTEIN

Brine Ingredients

82.04%	Water
10.00%	Isolated Soy Protein
6.90%	Salt
1.06%	Sodium Phosphates
	Appropriate amount of Sodium Erythorbate and Sodium Nitrite
	Optional Flavorings and Sweeteners can be added if so desired

Manufacturing Procedure

1. Skinned and defatted hams.
2. Bone hams.
3. Pump hams 60%
4. Massage or tumble hams for 10-15 hours. (Note: Add 2 lbs. of isolated soy protein to each 160 lbs. of pumped ham in massager or tumbler.)
5. Stuff into fibrous casings and put into oval ham presses.
6. Process through smokehouse to an internal temperature of 69℃

COOKED BEEF ROLL MANUFACTURED WITH ISOLATED SOY PROTEIN

Ingredients for Meat Block

80%	Boneless chuck (90-95% lean)
20%	Beef Trimmings (70 lean)

Ingredients for Brine*

78.25%	Water
11%	Isolated Soy Protein
5.0%	Salt
2.0%	Dextrose
2.0%	Hydrolyzed Vegetable Protein
1.25%	Sodium Tripolyphosphate
.50%	Flavorings

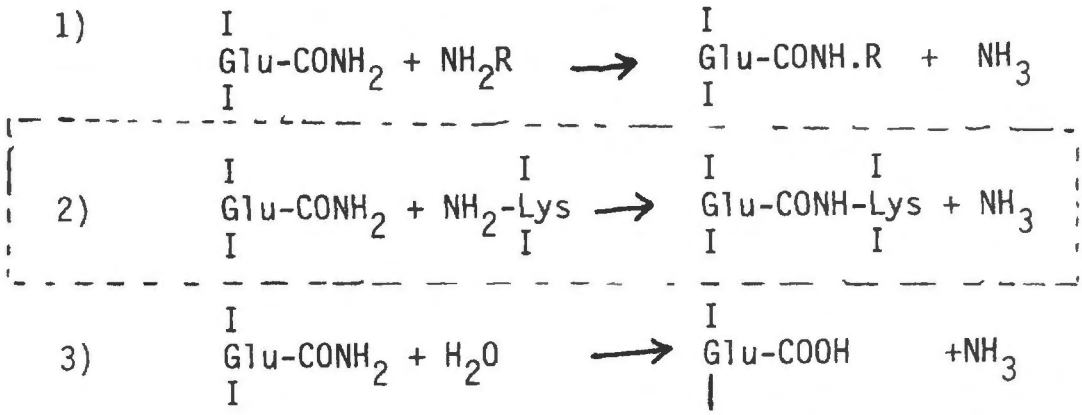
*Prepare brine according to directions in section on "Preparation of a brine using isolated soy protein."

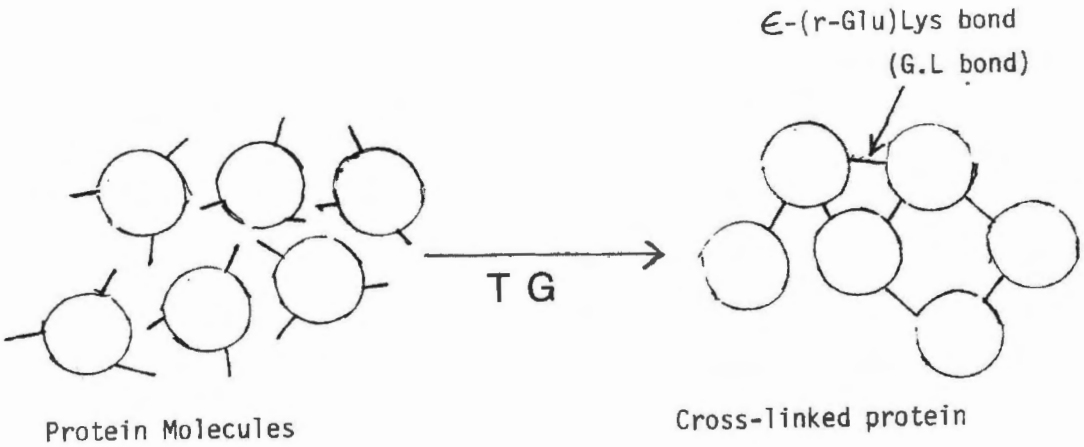
Manufacturing Procedure

1. Grind boneless chuck through kidney plate.
2. Grind beef trimmings through 4 mm plate.
3. Place all meat in mixer.
4. Add 40%~ brine to meat by weight.
5. Mix until all brine is absorbed (mix under vacuum if possible). Mixing time is usually around *30-45* minutes.
6. Stuff into large diameter casings.
7. Heat process.

Ⅶ、New trends in research of soy proteins

1. Transglutaminase can be a tool to polymerize different proteins through the formation of intermolecular crosslinks to produce a new protein to improve the functional properties and nutritional values of currently available food proteins. TGase reaction mechanisms is as the follows:





(1) Crosslinking of Soybean 7S and 11 S Proteins by Transglutaminase IKURA et al (1980) reported that:

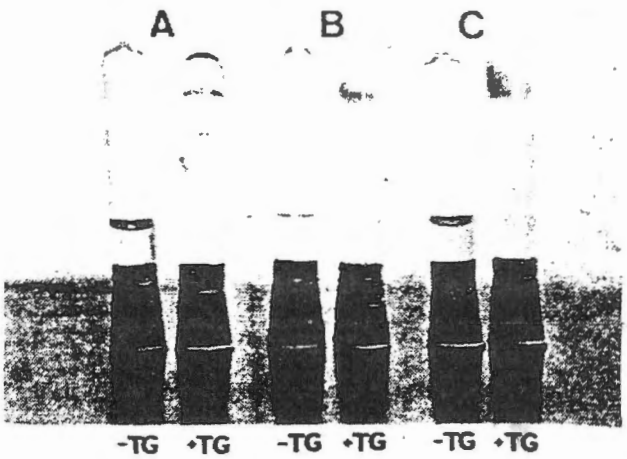
Transglutaminase catalyzes the formation of intermolecular and intramolecular ε-(γ-glutamyl)lysyl crosslinks in proteins. The study here examined the substrate effectiveness of soybean 7S and 11S proteins in the intermolecular-crosslinking reaction catalyzed by guinea pig liver transglutaminase.

Both 7S and 11 S proteins could act as the substrate for the transglutaminase reaction. The reaction with 11 S protein was faster than that of 7S protein. Analyses of the reaction products by sodium dodecyl sulfate-polyacrylamide gel electrophoresis indicated that three main subunit groups of 7S protein and two acidic subunit groups of 11 S protein were polymerized through the formation of intermolecular crosslinks by transglutaminase. Interestingly enough, no intermolecular crosslink was formed between the basic subunits of 11 S protein. The possible significance of the intermolecular crosslinking catalyzed by transglutaminase is discussed, including the use of this enzyme reaction to improve the properties of food protein. (Agric. Biol. Chem.,[44 (12), 2979~2984, 1980]

(2) Gelation of Casein and Soybean Globulins by Transglutaminase

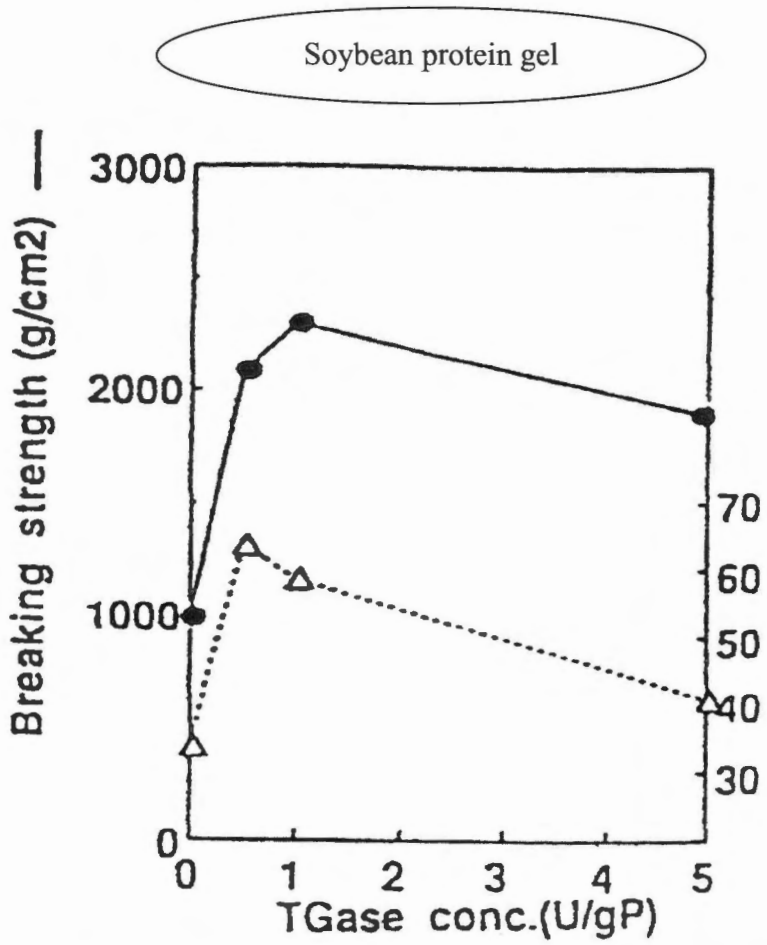
Which catalyzes the formation of inter- and intramolecular ε-(γ-glutamyl)lysyl cross-links between protein molecules. We have found that solutions of several proteins (α sl casein, and soybean l1S and 7S globulins) were gelatinized firmly by transglutaminase. The gel formation depended on the protein concentration. In the case of α s1I-casein. a reaction mixture containing below 2% was incapable of gelation. However, above 3%, a firm gel was formed

by transglutaminase. As to soybean 11 S and 7S globulins, reaction mixtures containing below 5%, did not form gels, while, above 8% firm gels were formed. Thus, trans glutaminase and a higher concentration of a substrate protein are indispensable for firm gel formation. It is supposed that the protein gels are formed through covalent bonds with transglutaminase. [Agric. Biol. Chem., 49(8), 2283~2286, 1985]



Gelation of Protein Solutions by Transglutaminase.

The proteins studied were: A. *a* sl -casein (5% w/v); B 11S globulin (10% w/v): C. 7S globulin (10% w/v). - TG transglutaminase was not added to the protein solution which was incubated at 37 C for 4hr: +TG. transglutaminase was added to it at the ratio 0.03 units/mg substrate protein which was incubated at 37°C for 1 hr. The pH of the reaction mixtures was 7.5.



Effect of Tgase concentration on gel strength of soy protein

(3) Transglutaminase Catalyzed Cross-Linking of Myosin to Soya Protein, Casein and Gluten

Hamm (1966) has postulated denatured myosin may be stabilized by hydrogen bonding and hydrophobic interactions while Peng et al. (1982), has proposed that hydrophobic bond formation is the preferred type of interaction between soya 11S and myosin heated to 85℃ or higher Although these non-covalent interactions may have a considerable cumulative effect on the structure of a meat product, inter- and intra-chain covalent cross-links have been shown to contribute significantly to the tensile strength of some protein

structures e.g. collagen (Tanzer, 1973). The possibilities for incorporating inter- and intra-chain covalent cross-links into meat based products were therefore examined, with the ultimate aim of improving and binding strength in these products. The approaches that can be adopted to introduce covalent cross-links into proteins fall into two categories, namely, chemical and enzymic. Feeney (1977) and Zadow (1979) suggest that enzymic rather than chemical modification of foods will be more readily accepted by regulatory authorities and the consumer.

One enzyme of potential use in the food industry is transglutaminase (see Folk and Chung (1973) and Folk and Finlayson (1977) for reviews). Transglutaminases catalyse a Ca2+ dependent acyl-transfer reaction in which the γ-carboxamide groups of peptide bound glutaminyl residues are the acyl donors. Water, a variety of amines and the lysyl residues of proteins can act as acyl acceptors. With the lattere-(γ-glutamyl) lysine cross-links are generated. There are several forms of trans glutaminase but the bulk of the literature concerns the enzymes from human blood plasma and guinea pig liver.

Derrick and Laki (19661) produced the first evidence of myofibrillar protein cross-linking by transglutaminas using enzyme purified from guinea pig liver. A considerable literature now exists on the reactions and biological role of trans-glutaminase enzymes, but the only references to the cross-linking of myofibrillar proteins refer to their role is stabilizing the haemostatic plug (Mui and Ganguly, 1977 Cohen et al. 1979; Kahn and Cohen, 1981). Cohen et al (1979) and Kahn and Cohen (1981), have shown the plasma transglutaminase can catalyse the formation glutamyl-lysine bonds in myosin and also between myosin and actin, myosin and fibronectin, and fibrin and actin. These results cannot be directly related to myosin in meat systems because the proteins were treated with enzyme for up to 3 hr at 37°C and pH 7.5. Therefore the present study was undertaken to determine if transglutaminase can catalyse covalent bond formation under conditions more relevant to meat systems.

The covalent linkage of nonmeat proteins to myosin at temperatures and pH's common in meat product processing was investigated. Iodinated proteins were crosslinked to immobilized myosin and then quantitated by gamma counting after non-crosslinked material was removed by washing with 6M guanidine hydrochloride. Bovine plasma transglutaminase catalyzed the formation of -(γ-glutamyl) lysine crosslinks between myosin and soya protein, casein or gluten at 4-5℃ for 16 hr and at pH's from 5.5-7.0. Casein was the best substrate with approximately 0.4g of casein cross-linked to 1.0g myosin.[J. of Food Sci. 49: 57C (1984)]

(4) Properties of Biopolymers from Crosslinking Whey Protein Isolate and Soybean llS Golbulin. (Journal of Food Science volume 61, No.6, 1996, p.1129~ll31)

(5) Improvement in rheological and functional properties by heating

IT is well known that there are remarkable differences between the heat induced gelling properties of meat and soybean protein. For example, meat protein forms maximum stable gels at temperatures between 60°C and 7℃ , while soybean protein forms only weak and unstable gels at similar temperatures. Soybean protein forms stable and firm gels at temperatures between 90-100℃ ,Since most meat products are heated at about 70°C , added soybean protein should not promote gel formation of meat products. Accordingly, it is necessary to improve soybean protein to from the gel at lower temperature when soybean protein is used in meat process.

There are many studies concerning the heat-denaturation of soybean proteins but few concerning the improvement of functional properties of this protein. Heat treatment has been considered one of the preferred methods to improve the functional properties of this protein. Aoki and Sakurai (1969) showed that when soybean protein extracts were heated during the processing of soybean protein ingredients, the resulting products formed more firm and stable gels than those of the non-treated products. However, they studied rheological properties and water-holding capacity of gels formed at 95°C for 50 min but not those formed at lower temperature (i.e., 17℃). Bianchi et al.(1985) showed that modification of rheological properties of meat homogenates occurred by addition of soybean protein of varying degrees of heat denaturation. However, they examined the gel properties of only raw meat homogenates. In a previous report, it was suggested that rheological properties and water holding capacity of gels formed from ground meat were improved by the addition of heat treated soybean protein (Shiga et al., 1985). It is of interest to know the types of soybean protein denaturation induced by heat treatment and also the reasons they cause improvement in functional properties.

(1) Influence of Heating Temperature on Conformational Changes of Soybean Proteins Changes of ultra-centrifugal patterns of soybean proteins by heating up to 100 ℃ were almost completed at 80°C at lower ionic strength and at 90°C at higher ionic strength. However, changes in DTNB reactive sulfhydryl groups, sulfite reducible disulfide, ultraviolet difference spectra and turbidity of the protein solutions were still observed at temperatures higher than 80 or 90°C. These results suggest that 11 S protein dissociates into subunits at a temperature

below 80 or 90°C, and that the conformations of these subunits can change at a temperature above 80 or 90°C. When heated at high ionic strength, the protein solution became turbid because of aggregation of proteins. SDS-polyacrylamide gel electrophoresis showed that aggregated proteins separated by centrifugation as precipitates were formed from low molecular weight subunits of 11S protein and non-aggregated proteins remaining in the supernatant were from 7S protein and high-molecular-weight subunits of 11S protein. (Agric. Biol. chem., 43(4),683~690, 1979)

(2) Mechanism of Heat-Induced Gelation and Gel Properties of Soybean 7S Globulin

The gelation of 7S globulin when heated at 100°C and 0.5 ionic strength was investigated. The minimum protein concentration required for gel formation was 7.5%. The minimum heating times with protein concentrations of 7.5% and above 10% were 20min and 15sec, respectively. The hardness of gel formed above 12% protein concentration became maximum after 15 sec heating and then remained constant on subsequent heating. The gels were transparent. The gelation mechanism was presumed to be as follows. Soluble aggregates with molecular weights of around 1 million the shapes of which are not uniform, are formed at first which then associate with each other randomly to form a cluster. Finally a gel, the structure of which seems to comprise aggregates of clusters, is formed No *SH/S-S* exchange reaction participates in this process. These results show that the gel properties and gelation mechanism for 7S globulin are different from those for llS globulin. (Agric. Biol. chem., 50(5), 1287~1297, 1986)

(3) Relation Between Denaturation and Some Functional Properties of Soybean Protein

Selected functional properties of soybean protein heat denatured to different degrees were studied. rheological properties (total breaking energy. Young's modulus) and water-holding capacity of soybean protein gel were improved by the preheat treatment applied during preparation of soybean protein. When soybean proteins were preheated in the presence of N-ethylmaleimide (NEM) or 2- mercaptoethanol (ME), the improvement in rheological properties was largely inhibited. But in the presence of potassium bromate ($KBr0_3$), improvement in rheological properties occurred. The rheological properties and water-holding capacity of gel formed from ground meat containing NEM-treated protein were similar to that of ground meat containing soybean protein preheated without NEM.

Table 10 Effects of Temperature on Some Functional Properties of Soy Isolate[a]

Temperature (℃)	Solubility (%)	Swelling (ml/g)	Viscosity 15S-1
25	53	10	
70	67	17	3620
80	68	20	7490
90	71	17	5280
100	81	14	1410

[a] Measurements were made at 25℃ after heat treatment.

Table 11 *Effect of Heat on Some Physical Properties of Soy Protein*

	Heating temperature(℃)				
Property	80	100	120	140	160
Subunit structure	dissociation-unfolding			degradation	
Solubility	decrease-		increase in solubility	precipitation	
Viscosity	increase - decrease			decrease	
Hydration	increase.			decrease	
Gelation (following heating)	regular		hard-fragil	soft elastic	sol

Ⅷ、References

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Chapter 19. Vegetarian meat analogues

1. Vegetarian Ham

Ingredients:

Vetex-l000 (a chunk TVP)	1 kg	
Whey Protein	0.615 kg	100 %
Water	4.6 kg	61.5 %
Vegetable Oil	0.46 g	460 %
Sugar	66.8 g	46 %
Salt	66.8 g	0.668 %
Polyphosphate	13.6 g	0.668 %
MSG	33.4 g	0.136 %

Method

a) Soak and rehydrate TVP with water in 1:4 ratio.

b) Dehydrate and blend to shred the TVP into fiber.

c) Rehydrate whey protein with the rest of the water, and add the oil to the emulsion.

d) Mix the fibrous TVP with the emulsion with vacuum blender.

e) Stuff with vacuum stuffer.

f) Form and steam cook at 95℃ for 60 minutes.

g) Cool with tap water and freeze for S days.

h) Package as desired.

2. Meat Paste Analogue

Ingredients:

TVP	15 %
Water	16 %
ISP	5 %
Wheat Gluten	2 %
Starch	5 %
Oil	10 %
Sugar	1 %
Salt	1 %
Whey Protein	2 %
MSG	0.5 %
Polyphosphate	0.3 %
HVP	0.5 %

Method:

a) Soak and rehydrate TVP, then dehydrate and chop.

b) Emulsify ISP by adding to water and oil.

c) Mix 1 and 2, plus wheat gluten and whey protein, then add polyphosphate, sugar, salt, MSG and HVP.

d) Place the mixture at 2°C for stuffing.

e) Stuff.

f) Steam and Chill the stuffed product.

3. Vegetarian Hot Dog

Ingredients:

Soy Protein Isolate (ISP)	11 %
Water	44%
Vegetable Oil	13 %
Egg White (liquid)	24.5 %
Red Colorant	trace
Flavorings	0.5 %
TVP	7%

Methods:

a) Soak TVP for one hour, then dehydrate and shred

b) Add ISP to water and oil, then add egg white to the emulsion.

c) Add the shredded TVP to the emulsion and mix well.

d) Add other ingredients to the mixture and blend well.

e) Fill casing and cook to 85°C internal temperature.

f) Chill with tap water and freeze.

4. Simulated Chicken Meat

Ingredients:

TVP (Chunk #10)	16.5 %
Water	55.53 %
Vegetable Oil	13%
ISP	8%
Egg White Powder	4%
Flavorings	2.5%
Salt	0.25%
White Pepper Powder	0.12%
Polyphosphate	0.1 %

Method:

a) Add ISP to water and oil to emulsify. Add egg white powder and mix well.

b)Soak and rehydrate TVP with eater, then dehydrate and shred.

c) Add the shredded TVP to the emulsion (a) and mix well.

Vegetarian Meatballs Formula

Ingredients	Percentage%
Texturized soy protein	7.0
Soy protein isolate	11.0
Water (water:crushed ice)	44.0
Egg white(liquid)	14.0
Whey protein concentrate	10.0
Wheat gluten	10.5
Plant protein hydrolysate (Soybean cheese)	0.5
Sodium Chloride	0.5
Polyphosphate	0.2
Sodium glutamate (MSG)	0.5
Cane sugar	2.0
Vegetable oil (you may try to use coconut oil or palm oil)	13.0

Procedures:

1. Rehydration of TVP (TVP:water= 1:4) and shred it , then place in refrigerator(2-4°C).

2. Prepare emulsion:
   1). Place rest of water and ice into chopper and blending slowly with low speed and Add ISP slowly in the chopper for one minute.
   2). Add vegetable oil slowly and blending quickly with high speed to make emulsion become glossy (about chopping for two minutes).
   3). Add the rehydrated TVP into the emulsion.

3. Add other ingredients except wheat gluten to the emulsion and blending until the emulsion become stable and glossy batter.
4. Then add wheat gluten slowly and continue blending until the batter become glossy.
5. Molding into balls and boiling in water (95℃)for 30minutes, then remove to chill,

Chapter 20. Machines and Equipment

The type and extent of machinery and equipment required for Chinese-style meat products manufacturing depend upon the variety and volume of the production. Besides, some of machines and equipment for processing Chinese-style meat products such as marinated, roasted, and spiced meat products and meat balls are different from sausage making. In this chapter, the author will introduce not only sausage and ham making machines, but also the traditional product processing machines.

1. Grinders are used to cut the meats into small pieces for intimately mixing with each other and with curing materials and spices. In general, plates with round holes ranging in diameter from 1/8 inch to *1-1/4* inches are used for sausage. In order to produce the best product and to avoid a smeary texture, the meat grinder should have sharp blades and be in good working condition (sharp knives and grinder blades). Before operation the grinder should be cooled in freezer. Operation of grinder:
   a. Keep cylinder of grinder full of meat. Never let a grinder run idle. It ruins the knives and plate.
   b. Do not operate grinder if meat does not flow freely.
   c. Remove small bones and gristle from grinder at frequent intervals to keep holes of plate free of bones and gristle.
   d. Do not allow meat to back up against outlet of plate and create pressure on the meat coming through the plate from the cylinder.
   e. Do not overload or force a grinder. Grind frozen meat or exceptionally tough meat twice, first through a coarse plate and then through a fine plate. This will minimize maintenance and replacements.

2. Cutters or chopper

   In the cutter, comminution and mixing are accomplished by revolving the meat in a bowl past a series of knives mounted on a high speed rotating arbor which is in a fixed position so that the knives pass through the meat as the bowl turns. The meat is guided to the knives by a plow arrangement which is in a fixed position inside the bowl. The cutter is better to be equipped with a vacuum pump to prevent fat oxidation during operation. The raw materials are filled to 112 volume of bowl, do not overload. In order to prevent temperature of batter increases, dry ice can be added in the bowl to reduce heat and retard fat oxidation. Meat can not be overchopped, otherwise, the muscle cell membrane may be damaged and causing fat oxidation. The cutter has to be equipped with safety devices to prevent

3. Mixers are round vessels equipped with two sets of parallel, wing-shaped paddles revolving in opposite directions and designed to work the meat back and forth and intimately mix it. End paddles scrape the meat off the mixer should be so designed as to discharge the contents completely either through a bottom opening or by tilting the mixer on its side. Some mixers are fitted with tight covers and are connected to vacuum pumps to allow the entrapped air to escape from the meat during the mixing process.
4. Stuffer or filling machine

   Stuffers are used to force the meat mixture into casings or other containers. They are vertical cylinders ranging from 50 to 500 pounds capacity equipped with a cover which quickly and easily can be removed or tightened and which contain a piston operated by means of steam, water, or air pressure. Tubes or stuffing horns should be made of stainless metal. Stuffers are equipped with safety devices to shut off the pressure below the piston when the meat has been discharged from the cylinder. When stuffing process, the stuffer should be filled full of meat mixture to remove the air from the chamber.
5. Drying oven or smokehouse

   Oven or smokehouse should equipped with an air-condition, in which air is circulated over heating coil and distributed by fans through ducts to the products. The installations provide for regulation of temperature, humidity and volume of circulated air and of density of smoke(if needed).
6. Other equipment
   a. Frozen meat slicer, steak slicer, dicer, tumbler, clipper, bone saw, knife sharpener, fish meat and bone separator, blender, smasher, injector and meat ball forming machine.
   b. Rack for tray cart, sausage rack, meat tanker, working table, basket cart, knife sand steel.
   c. Deck oven, convection oven, broiler, deep-fat fryer, close stove, open stove, roasting utensils, kettle.
   d. Packaging machine.

Tumbling and massaging of meat tissue

First published work on tumbling in the USA was by Mr. Russell Maas for Oscar Meyer's and it was published under the US patent No. 3,076,713(Feb. 5,1963). Principle of tumbling : To extract protein as a binder agent which is primarily composed of myosin and alpha actinin(Ockerman, 1992) and it will impact energy to cause a transfer of kinetic energy into the muscle tissue and slightly increases the

temperature. Massaging is less vigorous than tumbling and the energy is usually generated as frictional effect.

Effects of tumbling and massaging: It can increase the yield of meat products from 4 to 8% and it is usually accomplished in from 3 to 24 hours(often intermittently). It is usually performed on boneless cuts and bone-in products, but not used for mixing ground meats.

The advantages of tumbling:

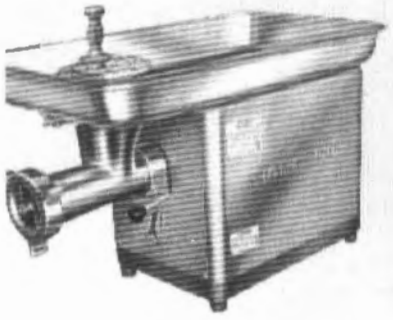
1. To maximize yield and to obtain a uniform yield.
2. To improve color and increase color uniformity.
3. To improve binding ability.
4. To reduce cooking loss.
5. To reduce cooking time.
6. To control the quantity of added substance.
7. To reduce meat product inventory.
8. To increase brine penetration and uniformity.
9. To improve slicing characteristics.
10. To salvage protein that would be lost in brine exuding from the tissue.
11. To accelerate the curing process.
12. To produce a uniform composition of the final product.
13. To transform trimmings into a product that resembles intact cuts of meat.
14. To save curing pickle.

The disadvantages of tumbling:

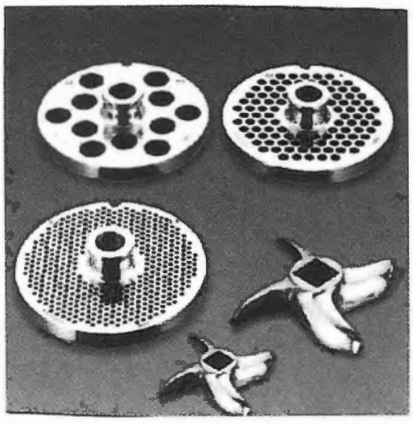
1. Cost of equipment.
2. Connective tissue remain relatively undistributed.
3. Fat removal is necessary for sliced product or for good cohesion in most products.
4. Salt and/or phosphate are usually required.
5. Excessive tumbling lower the integrity of the tissue and
6. A slight rise in product temperature.

Reference:

Ockerman, H. W. 1992 Review of tumbling and massaging muscle tissue research. Proceedings of 1st Academic Seminar on Animal Products Processing of Two sides of Taiwan and China. Pp.55-58.



Grinder



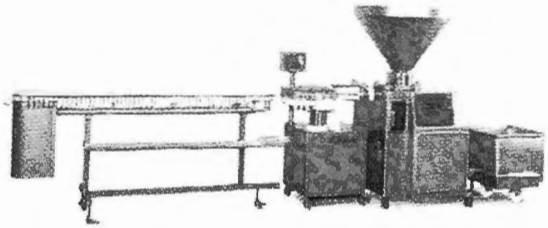
Plates and knife

Cutter or chopper

Mixers

Air pressure filler

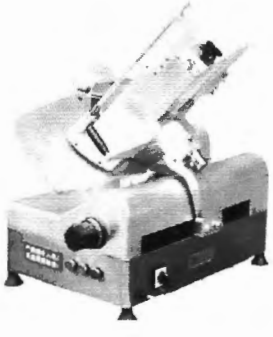
Electrical stuffer



Sausage filler with linker

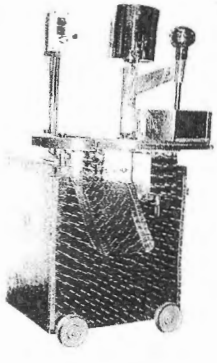
Sausage dryer

Vacuum packaging machine

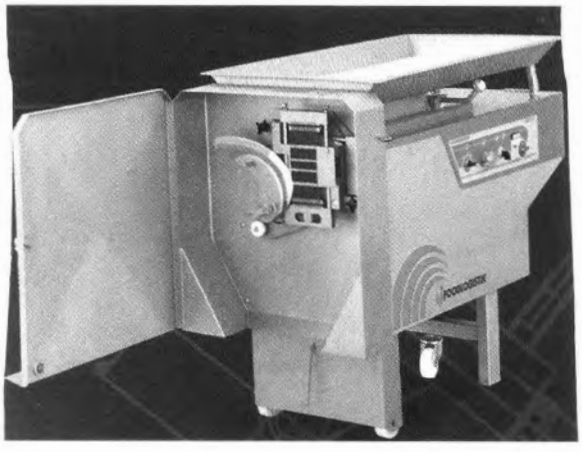


Frozen meat slicer

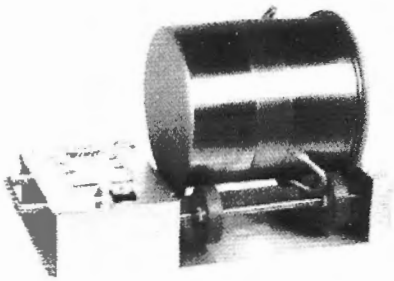
Steak slicer



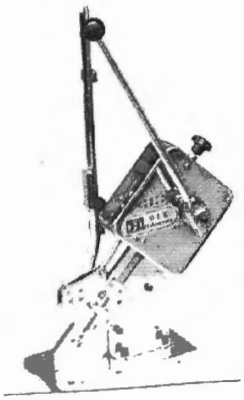
Slicer for pork Jerky



Multi-purpose dicer for cubes, strips& slices



Tumbler

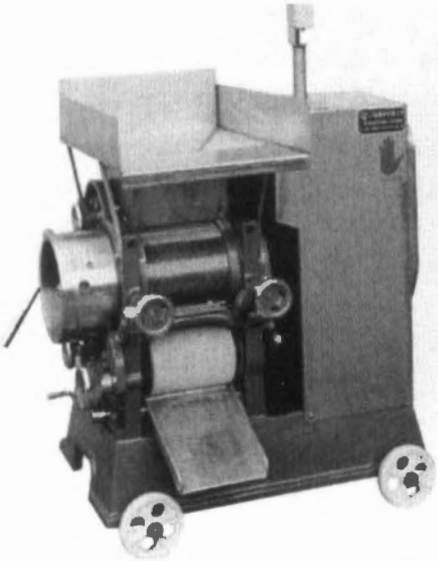


Clipper

Knife sharpener

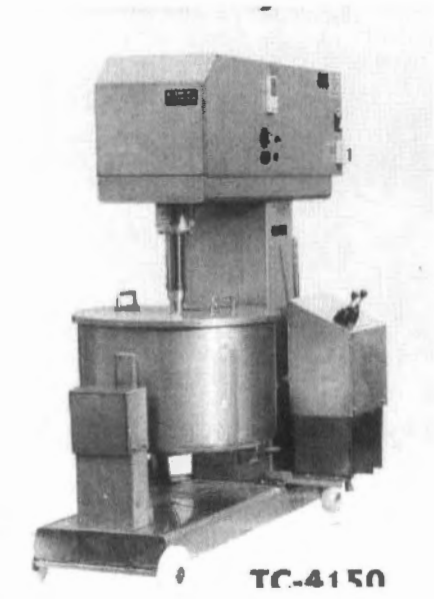
Frozen meat auto slicer

High speed meat mincer (grinder)

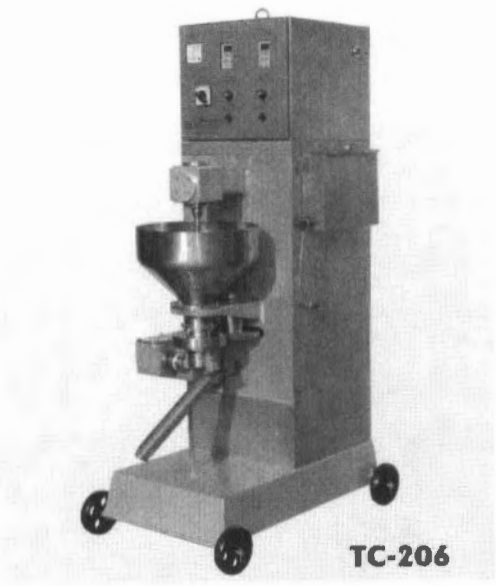


Fish meat & bone separator

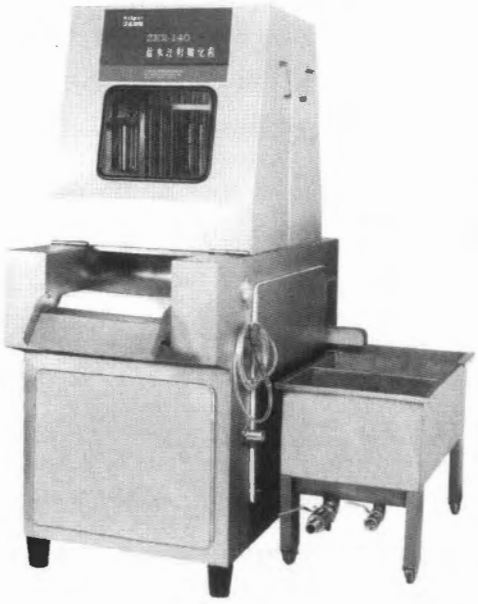
Meat smasher



Hydraulic auto tilting blender



Meat ball forming machine



Brine injector

Smoking house

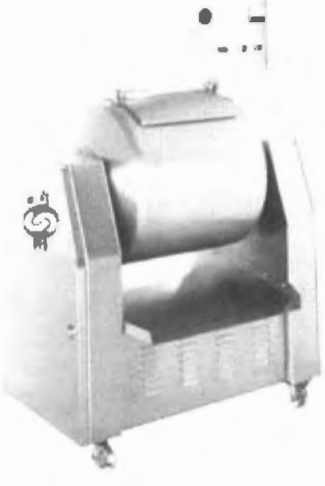
Pork shredler

Stirring apparatus beater

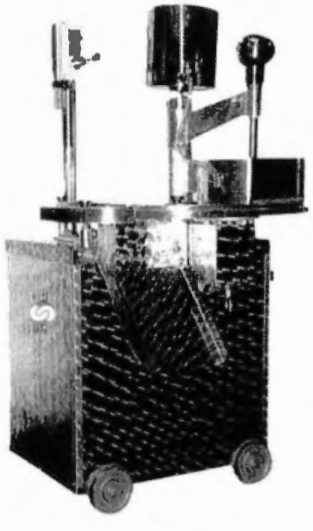
Meat rolling machine

Thermal processor

Vacuum mixer



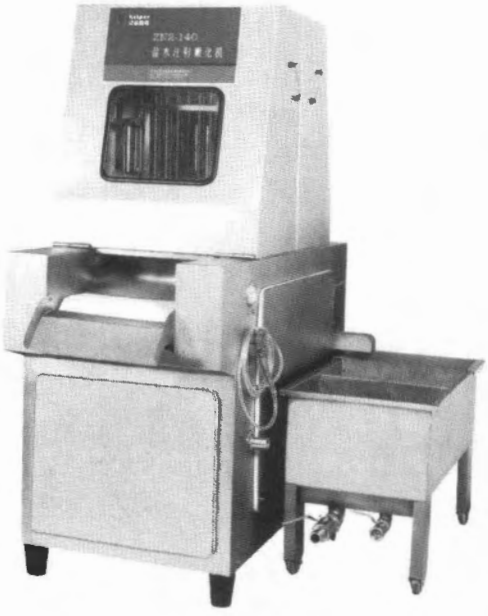
Vacuum processor



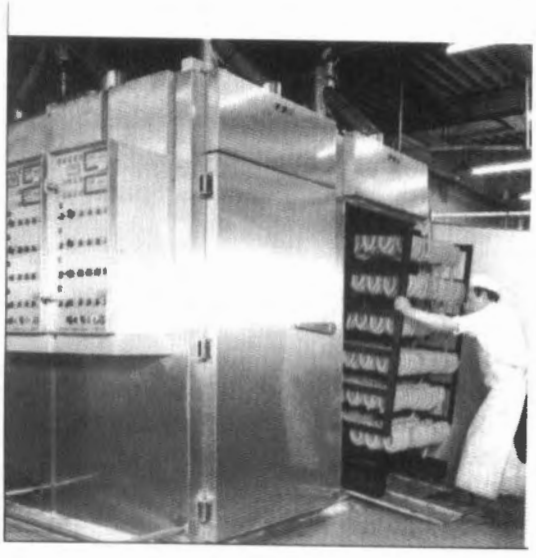
Automatic slicer

Hydraulic auto tilting blender

Meat ball forming machine



Brine injector



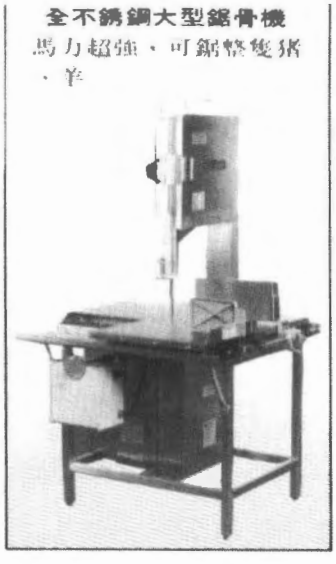
Smoking house

Pressure cooker

Pork floss fryer

Auto skinner

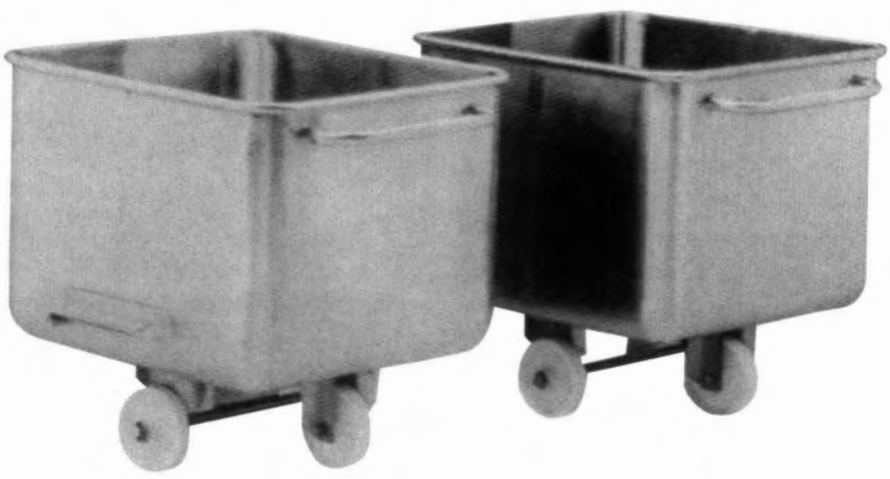
Meat dicer



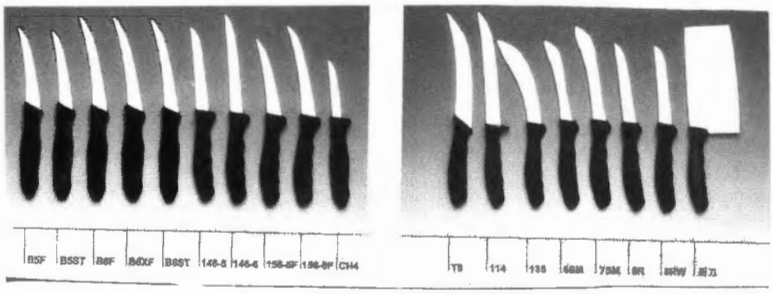
Bone saw

Rack for tray cart

Sausage rack

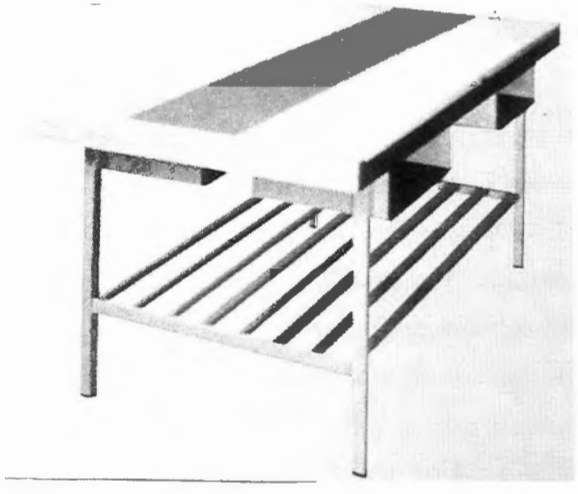


Meat tank



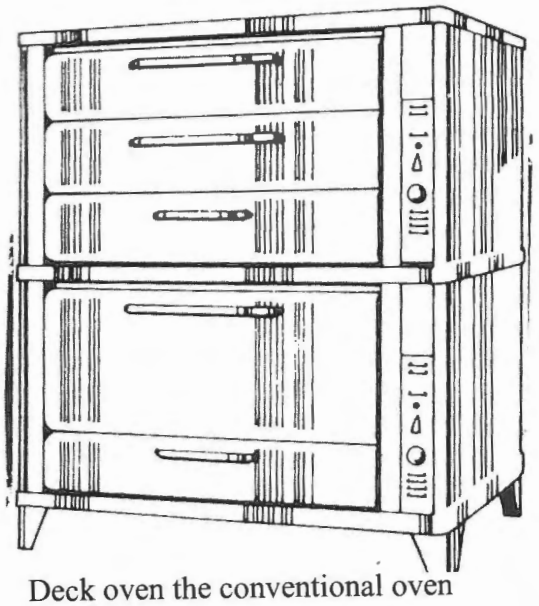
A set of knives

Sharpening steel



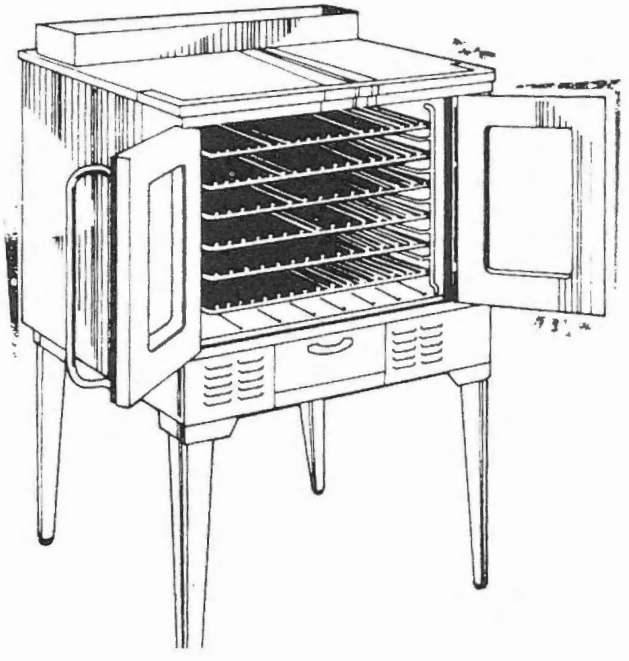
Working table

Basket cart

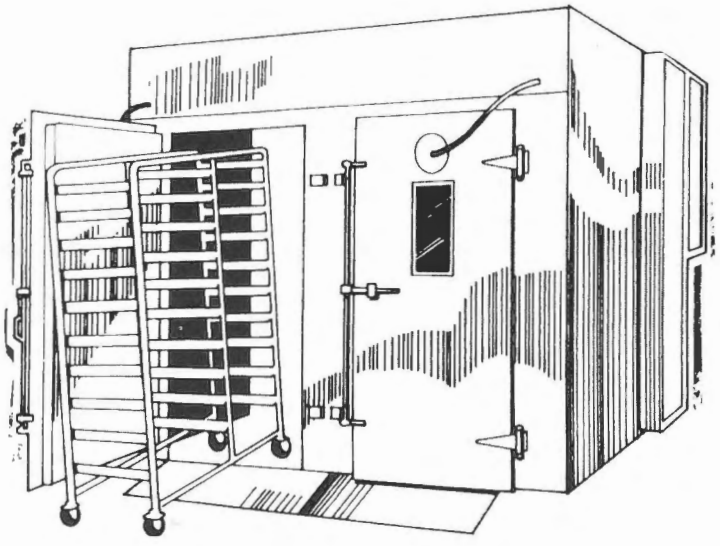


Deck oven the conventional oven

A conventional oven heats air In a closed chamber, and the heat is transferred by conduction to the food being cooked. Roasting is the meat cookery method achieved in this manner. A thermostat maintains oven temperature at the desired level through an automatic control which maintains a pre-set temperature.



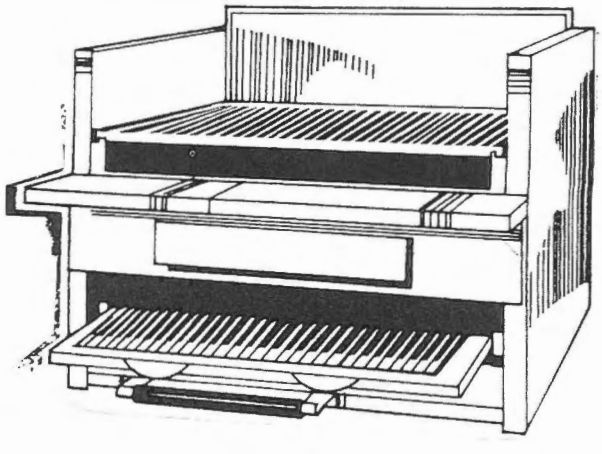
Convection oven



Convection Oven, Roll-In Type

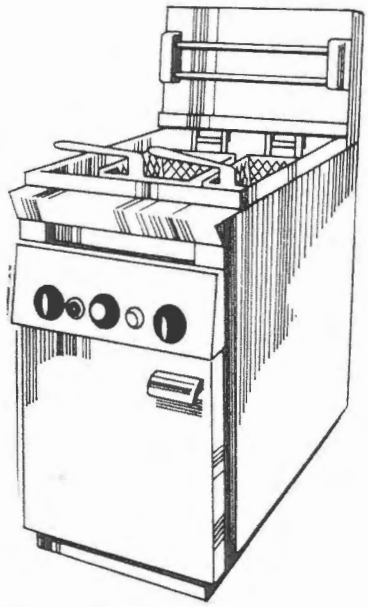
A major improvement in cookery equipment has been the addition of forced air, resulting in the second category of ovens, the convention oven. A compact unit-which provides better utilization of oven space than does the conventional oven, It will handle a variety of foods quickly and efficiently.

But convection ovens have disadvantages, too. Moving air removes the moisture in the air around the product being cooked, so a convection oven would tend to dry out the surface of a cut of meat. Because of this drying effect and the quicker heat penetration, lower cooking temperatures are frequently advisable for a convection oven. Temperatures for roasting meat should be reduced 50°F.



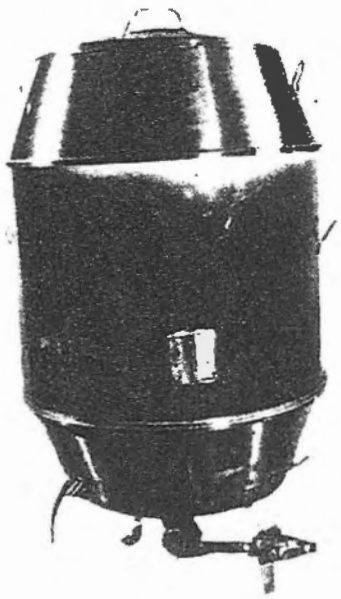
Broiler

Common types of conventional equipment include the heat-from-above gas or electric broiler, the gas-fired open hearth broiler, and other forms of broilers which are heated from below. There are numerous designs within each type because of variations in size, style and shape.



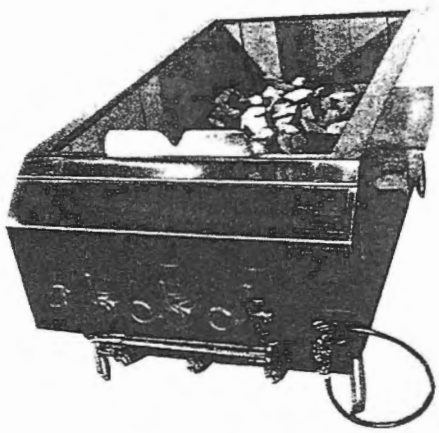
Deep-Fat Fryer

Technically, frying is any type of cooking done in fat, but in describing equipment the word "fryers" generally refers only to deep-fat fryers. The most common type of fryer is a self-contained floor or counter model with one or two wire mesh baskets that can be lowered into a vat of heated tat or oil.



Close stove

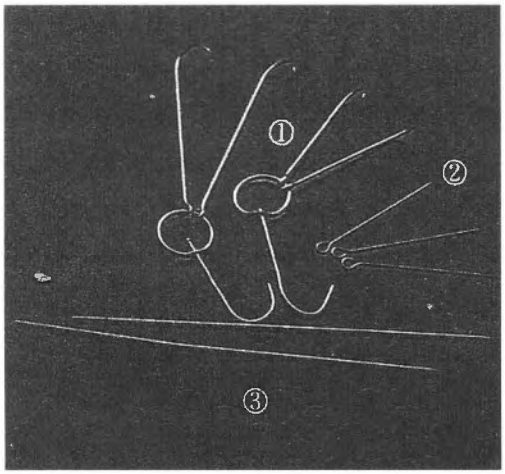
Medium-scale built-in oven in restaurants taking coal gas as fuel.



Open stove

Up-to-date model which takes coal gas as fuel.

Roasting Utensils Frequently Used



1.Hooks

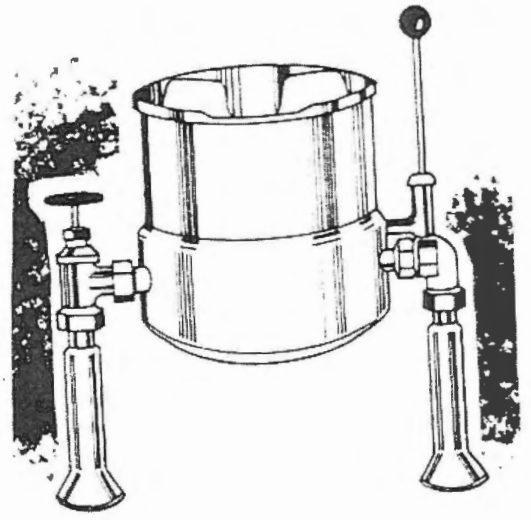
to hang up the food onto the iron bar within the oven.

2.Needles

to sew up the openings of the poultry so as to prevent the marinade from spilling out.

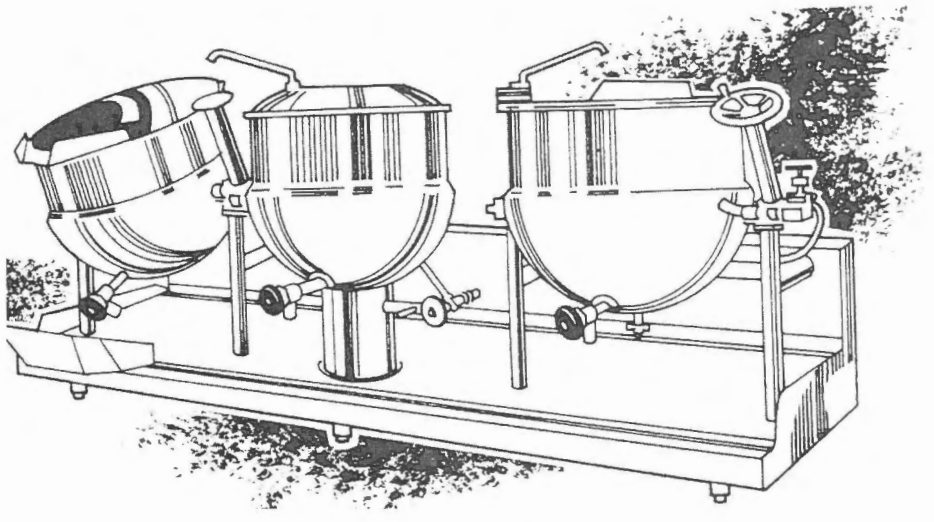
3.Roasting pins

to skewer up the food which are small or unable to be hanged up by the hooks.



Trunion Kettle

The smaller counter-mounted models are often called trunion kettles because they have trunions, or stationary pivots on their sides which allow the kettles to be tilted. Because of this tilting feature which makes it easier to handle foods, the trunion kettle is often used instead of a double boiler or a pot on top of the range. Another advantage of the trunion kettle is that it cooks foods quickly.



Free-Standing Steam-Jacketed Kettles

Steam-jacketed kettles cook with heat transferred from steam, rather than by the steam itself. The steam is enclosed in a jacket surrounding a kettle. The steam heats the kettle, thereby indirectly heating the food inside.

Size is the most important variable in steam-jacketed kettles, and it deserves consideration by the buyer because one of the main advantages of this equipment is the large amount of cooked food it can produce.

g)

WEIGHT CONVERSION TABLE		
Kilogram	Metric ton	Pound
1	0.001	2.20462
1,000	1	2,204.62
0.453592	0.000454	1
907.184	0.907185	2,000
1,016.046	1.01605	2,240

WEIGHT-UNIT CONVERSION FACTORS		
Units Given	Units Wanted	For Conversion Multiply by
lb	g	453.6
lb	kg	0.4536
oz	g	28.35
kg	lb	2.2046
kg	mg	1000000
kg	g	1000
g	mg	1000
g	ug	1000000
mg	ug	1000
mg/g	mg/lb	153.6
mg/kg	mg/1g	0.4536
ug/kg	ug/lb	0.4536
Mcal	kcal	1000
kcal/kg	kcal/lb	0.4536
kcal/lb	kcal/1g	2.2046
ppm	ug/g	1.
ppm	mg/kg	1.
ppm	mg/1g	0.4536
mg/kg	%	0.0001
ppm	%	0.0001
mg/ g	%	0.1
g/kg	%	0.1

TEMPERATURE CONVERSION TABLE											
℃	℃or℉	℉	℃	℃ or ℉	℉	℃	℃ or ℉	℉	℃	℃ or ℉	℉
15.0	59	138.2	23.9	75	167.0	32.8	91	195.8	77	170	338
15.6	60	140.0	24.4	76	168.8	33.3	92	197.6	82	180	356
16.1	61	141.8	25.0	77	170.6	33.9	93	199.4	88	190	374
16.7	62	143.6	25.6	78	172.4	34.4	94	201.2	93	200	392
17.2	63	145.4	26.1	79	174.2	35.0	95	203.0	99	210	410
17.8	64	147.2	26.7	80	176.0	35.6	96	204.8	100	212	413
18.3	65	149.0	27.2	81	177.8	36.1	97	206.6	104	220	428
18.9	66	150.8	27.8	82	179.6	36.7	98	208.4	110	230	446
19.4	67	152.6	28.3	83	181.4	37.2	99	210.2	116	240	464
20.0	68	154.4	28.9	84	183.2	37.8	100	212	121	250	482
20.6	69	156.2	29.4	85	185.0	43	110	230			
21.1	70	158.0	30.0	86	186.8	49	120	248			
21.7	71	159.8	30.6	87	188.6	54	130	266			
22.2	72	161.6	31.3	88	190.4	60	140	284			
22.8	73	163.4	31.7	89	192.2	66	150	302			
23.3	74	165.2	32.2	90	194.0	71	160	320			

$$℃=(℉-32)\times\frac{5}{9} \qquad ℉=℃\times\frac{5}{9}+32$$

MEASURE CONVERSION TABLE						
(Liter)	(Kiloliter)	(U.S. Gallon)	(1mb Gallon)	(Barrel)	(Cubic feet)	(Cubic Inch)
1	0.001	0.264178	0.219975	0.00629	0.035316	61.026
1.000	1	164.178	219.975	6.28995	35.316	61.026
3.78533	0.003785	1	0.83268	0.0238	0.133681	231*
4.54596	0.004546	1.20094	1	0.028594	0.160544	277.42
158.984	0.158984	42*	34.9726	1	5.6146	9.702*
28.316	0.028316	7.4805	6.2288	0.17811	1	1.728
0.016387	0.000016	0.004329	0.003605	0.00103	0.000579	1

VOLUME- WEIGHT CONVERSION TABLE

Raw materials	1 tea spoon	1 table spoon	1 cup
Water	5g	15g	236g
Milk	5g	15g	150g
Sugar	3g	9g	100g
Flour	2g	7g	90g
Butter	4g	14g	225g
Baking soda	3.5g	12g	
Yeast powder	3g		
Yolk	4g	12g	10eggs

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Appendix Ⅰ: The best meat processing plants in Taiwan

台灣農畜產工業股份有限公司
負責人：張陳秋蟾　　連絡人：廖勝河
工　廠：屏東市建國路480號　　ＴＥＬ：(08)7520525-7
台畜香腸・台畜羊腸香腸・台畜特製香腸・台畜燻里肌肉・台畜燻腿肉・台畜蘿萊火腿・台畜醬肘子・台畜福壽火腿・台畜胡椒里肌肉・台畜洋式赤肉火腿・台畜百壽火腿・台畜三明治火腿・台畜熱狗・台畜法蘭克福火腿・台畜法蘭克香腸・台畜蒜味香腸・冷凍猪肉

The Taiwan Farm Industry Co., Ltd

History of company:

Taiwan Farm (TF) embarked upon the meat-processing industry with modern electric slaughter during the mid 1960s. TF was the first modern meat packing plant, successfully exported frozen pork to Japan and launched the meat processing enterprise in Taiwan.

Most of Pingtung farmers raised pigs as their subsidiary jobs during the early 1960s. In an attempted to help the farmers increase income and prosper rural economy. Pingtung County mayor, Mr. Feng-Hsiu Chang along with other administrators went to Japan to seek the business opportunities. They initiated the food processing industry on agricultural and livestock products for export. With Taiwan and Japan's joint venture, Mr. Tien-Miau Chen, the ex-chair of Kaohsiung City Council, worked with some other influential locals, surmounted all difficulties to build up the first modern meat packing plant in July of 1967-Taiwan Farm Industry Corporation. TF exported frozen pork to Japan starting in July of 1968 and became the forerunner of domestic modern meat-processing enterprise to enter Japan market. The successful export of frozen pork of frozen pork to Japan solved the plight of the slow sale and over-production of pigs, not only increased the farmers income but helped the breed improvement. Further, it laid the foundation for exporting frozen pork products, conducive to the Taiwan-Japan trade on agricultural and livestock products, and reduced the Taiwan trade deficit with Japan.

Corporate milestones (Important evens) :

1967 The Taiwan Farm Industry Co., Ltd. was found in Pingtung county. It was a Taiwan-Japan joint venture meat processing plant. The invest capital value was NTD 30,000,000 (approximate 1,000,000USD.

1968 Started to produce frozen pork to export to Japan. It also begun to produce cooked pressed ham, bacon, western-style sausages.

1976 It begun to use cellulose casings for processing pressed ham, hot dog and Chinese-style sausages.

1977 It won " Class A award of QC grading of factory. "

1978 The headquarter of company was moved from Pingtung to Taipei City.

1979 It was awarded Good Food Health and Sanitation Practice Factory by Department of Health.

1986 It has been awarded CAS certification.

1987 Developed chicken nugget, pork hamburger etc. prepared foods.

1989 Sales exceeded one hundred million NTD.

1990 Capital increased to NT $ 8.7 million two hundred million.

1992 Products awarded for the 1992 Chinese Olympic team to Basalona, Spain, that specifies the use of nutritional meat products.

1994 Products awarded the Hiroshima Asian Games in 1994 the Chinese Taipei team specified the use of nutritional meat products.

1995 It was awarded with "Good food Sanitation and Safety Factory" from Taiwanese Government.

1997 International Livestock Japanese companies to sell equity to 5.18% last to British colony-Virgin Islands Inc., than officially quit the company operation right.

1998 President Mrs. Chang , Chen Chiou-cham was retired and back as honorary president. And Mr. Chris Y. P. Chang took over as president and general manager of the company.

Won the New meat Product Development Award of CAS.

Acquired U.S. BQR ISO 9002 international quality assurance certification.

2002 Acquired SGS ISO 9001 International quality assurance certification.

2003 Acquired SGS HACCP food safety control system validation.

2004 Won the third of slaughterhouse and out of vehicles and lariage disinfections assessment from BAPHIQ, COA.

2005 Won the second of slaughterhouse and out of vehicles and lariage disinfections assessment from BAPHIQ, COA.

2006 Won the third of slaughterhouse and out of vehicles and lariage disinfections assessment from BAPHIQ, COA.

Acquired SGS ISO 2200 food safety control system validation.

Taiwan Farm produces three major products,including frozen pork, processed meat products and regular food products. The processed meat products cover western style ham,hot dog,Chinese sausage, bacon and Chinese salted meat,frozen instant dish,frozen instant meat,shredded meat and dried meat chip,more than 500 kinds of products.

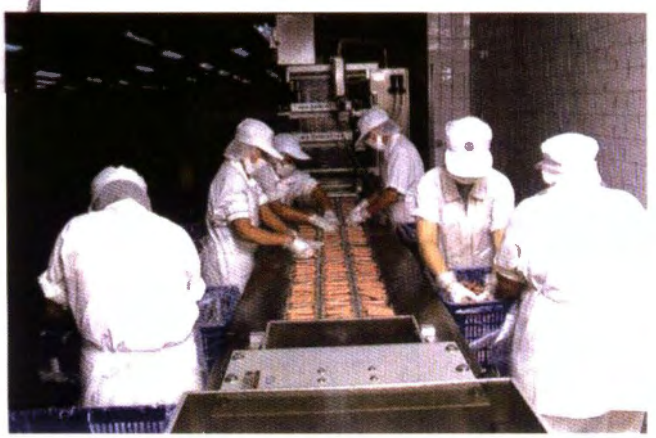
In order to provide various products to the customers，in recent years，domestic as well as foreign products have been introduced to Taiwan. In the future, more business sites and markets will be open to augment the sale.

With the modern technique, equipment, professional workers and numerous experts, Taiwan Farm runs the first domestic meat-processing plant of the international standard. Taiwan Farm can produce a maximum of several tons processed meat products by slaughtering about one thousand pigs daily. To provide consumers the best products, Taiwan Farm owns its great research and development department to make new products and keep close communication with foreign research institutes.

全產品圖

At present, on the production line, the area for refrigeration chamber is 396 pings (one ping equals to 3.30579 square meter), among which the area for quick-freezing freezers is 166 pings, storage freezers area is 230 pings,plus 24 new freezing machines. The area of meat-processing plants is 700 pings, well equipped with several hundred machines for food manufacture.

Taiwan Farm produces daily more than 30 tons processed meat products done by the modern automated machinery.



Sings Kout Trading Co., Ltd.

Sings Kout Trading Co. Ltd., founded in 1986, is a pork processing factory with continuous operations from slaughtering, dissecting to processing. The CEO, Dr. Yang, is a physician whose strong medical background is fundamental to the high quality products of Sings Kout. Sings Kout is the only "double outstanding" factory awarded by CAS in slaughtering and processing pork. In addition, Sings Kout acquired many international certificates, such as ISO 9001, HACCP and Traceability. As a consequence, Sings Kout is certified by the Ministry of Agriculture, Forestry and Fisheries (MAFF) of Japan, Agri-Food and Veterinary Authority (AVA) of Singapore as an assigned manufacturer of heat-processed food. Our products are deeply appreciated by high-end consumers in Taiwan, Japan and Singapore.

Sings Kout always stands on the concept of producing the best food to our consumers. The slaughtered porkers are all from contracted farms that have certified by the government. Our products also have to pass many inspections, including β-agonists, microbes, heavy metals, antibiotics, hormones and drug residuals, to guarantee the products made from Sings Kout are safe, healthy and delicious.

Sings Kout Trading Co., Ltd.
http://www.singskout.com.tw
Tel:+886-8762-4567~9
Fax:+886-8762-0075
e-mail:sk7722@ms23.hinet.net

Sings Kout Building

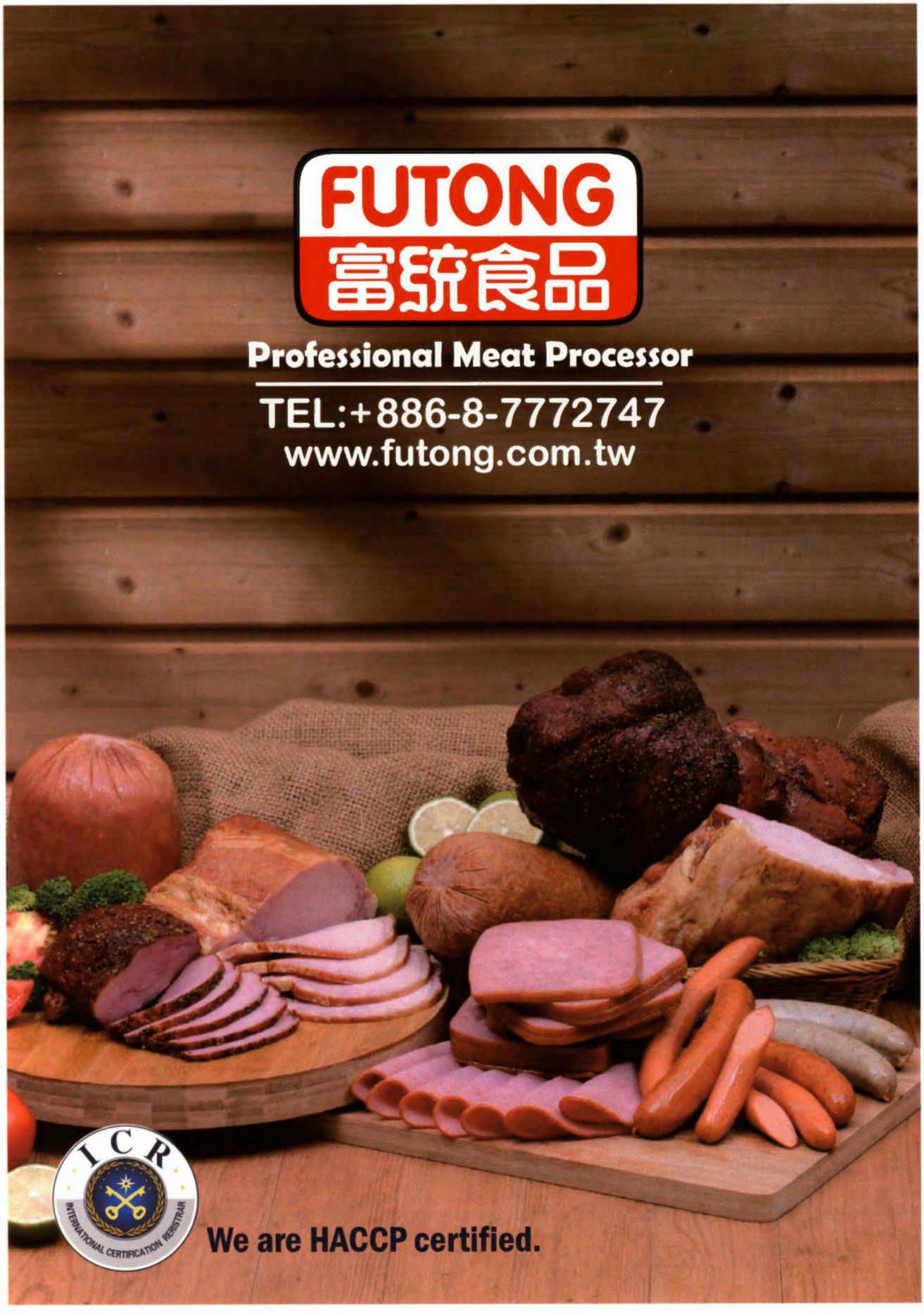
Clean Room

Japanese Roasted Pork Bun

Theme Sausage

Orange Taiwanese Sausage

Roasted Pork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ICR
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We are HACCP certified.

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History of Shangli Meat Industry Company

1. Story

In 1959, the founder of Shangli Meat Industry Company Mr. Zhan Jing-guo who just retired from military service. In order to make living, he and his friend bought a head of hog carcass and each got half of carcass for selling every day. This pork business from one half carcass for each initiated Mr. Zhang's pork industry carrier for 50 years.

Mr. Zhang insists his principle「quality first, earnest service」to trust his gests , therefore, even though in the shortage of food resources time he still active to promote his business. He went out to sell pork of half of carcass every day by bicycle and chapman with empty conch along the street. When the customers heard「Bu, BuBu」sound they knew the Zhang's pork coming.

For several decades, Mr. Zhang encouraged the employees that every thing must be faithful transcendence and work hard restless. This spirit let him develop this successful meat industry business in 1970 that was the same time as the economic development in Taiwan.

2. History of Shangli Meat Industry Company:

In 1984 Shangli Meat Industry Company was established in response to the modernization of meat for policy on southern meat transported to northern market.

In 1998 the company was awarded「CAS Good Food Certification」by Council of Agriculture, Administrative Yuan.

In 2002 the company constructed a modernized meat packing plant at Nan-Kong

Industrial Park, Nantou, and established a brand of pork「Active pork」and「Native black hair pork」.

In 2004 the company led first to cooperate with Caloful Company to promote the strategy of「Taiwanese pork quality assurance」all the way.

And established a model for supply and distribution of Taiwanese GHP Pork from farm to table.

In 2008 the company was awarded as first one meat packing plant for sightseeing in Taiwan by Ministry of Economic Affairs and certified the traceability system of pork and HACCP practice.

In 2009 the company established a museum of Active Pork Brand which is only one in Taiwan.

JIN KU FOOD CO,. LTD.

The company was founded more than 40 years, engaged in the pork industry. To promote the integration of production and marketing system for many years with the implementation of a unified government policy to enhance meat quality and health and safety. Furthermore, the company also passed to obtain a number of quality certification such as CAS, HACCP and traceability. Three years ago(2008), the company first completed production, manufacturing, and marketing supply chain, through the good pig farms and supermarket strategic alliance to produce safe, secure, certified traceability delicious pork.

Appendix Ⅱ : The outstanding pig breeding farm Fortune Co.

胸部寬深、肩部寬闊、肋骨開張．
Extra wide deep chest, bold shoulder and big rib capacity.

頸部修長、下顎緊實無贅肉．
Long clean neck and trim jaw.

後臀豐滿結實、尾根置高、腿厚寬伸延至飛節．
Big thick rump with high tail setting and express muscle through stifle and center ham region.

步行強健．
Superb athletic movement.

優良品種、代代相傳

背膘薄、生長快、飼效好、屠體質量特優．
Lean, fast growing, feed efficient and superior carcass quality.

蹄趾對稱、四肢結構健全．
Big even square toes and excellent feet and leg structure.

腹線平直、乳頭排列整齊、間隔適中．
Well-balanced underline and evenly spaced.

福昌开曼集团
FORMOSA FORTUNE CAYMAN LSLANDS GROUP

广州市福昌种畜场有限公司
GUANG ZHOU FORTUNE SWINE BREEDING FARM CO.

广西贺州巨东福昌种猪研发有限公司
GUANG XI HEZHOU JUDONG FORTUNE SWINE RESEARCH & DEVELOPMENT CO., LTD.

广西福昌种猪科研有限公司
GUANG XI FORTUNE SWINE RESEARCH & DEVELOPMENT CO., LTD.

浙江福昌种畜研发有限公司
ZHE JIANG FORTUNE SWINE RESEARCH & DEVELOPMENT CO., LTD.

CHINESE-STYLE MEAT PRODUCTS PROCESSING SCIENCE AND TECHNOLOGY

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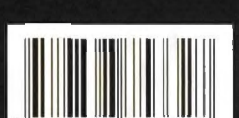

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