DUCK AND GOOSE MEAT PRODUCT PROCESSING TECHNOLOGY

MING-TSAO CHEN AND AIMIN JIANG
HERBERT W. OCKERMAN

DUCK AND GOOSE MEAT PRODUCT PROCESSING TECHNOLOGY

Edited by

Ming Tsao Chen, Ph. D.

Department of Animal Science
National Chung-Hsing University
Taichung, Taiwan

Aimin Jiang, Ph. D.

College of Food Science & Technology
South China Agricultural University
Guangzhou, Guangdong, China

Herbert W. Ockerman, Ph. D.

Department of Animal Science
The Ohio State University
Columbus, Ohio, U. S. A.

ACKNOWLEDGEMENT

I would like to express my sincere thanks to Mr. C. C. Tien (President of Emperial Food Co., Ltd), Mr. S. T. Chiu (President of Shinsei Frozen Foods Co., Ltd) and C. T. Yang (President of Non Sheng Foods Co., Ltd) for their generous financial support to publish this book. I also want to extend my warmest acknowledgements to Miss Belinda Liu for her help to design the cover of the book and to my former students Mei-Hua Tseng and Fong-Jen Chang for their help to type the draft of this book.

Author: Ming Tsao Chen, Ph. D.

January 1, 2012

Contents

Chapter 1. Introduction

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meat small goods from different areas in the book of Chinese-style Meat Products Processing-Science and Technology (unpublished). In this book the author also collected many formulas of duck and goose meat products to provide the readers and processors reference.

Meat and egg products from waterfowl play an important role in the poultry industry in Taiwan. Ducks provide both meat and eggs for the consumption. Duck meat comes mainly from mule ducks and partial from Peking ducks and spent laying ducks. Trends in the market however shows an increasing demand for Muscovy. In the Southern Asian countries this bird has attracted attention. The duck has the advantage of being able to adapt to a hot and humid environment. It is hardier and more resistant to diseases, Utilization of duck meat is different among the breeds. Meat from Peking ducks is used as raw material for roasted duck which is known all over the world. Peking duck besides is used for roasted duck, it is also used for processing duck roll, duck steak and ham. Muscovy ducks have red meat, an especially pleasant taste and a size suitable for cutting up and further processing. Muscovy duck meat is used for both fresh consumption and stewed with Chinese herb medicine such as ginger duck(gian mu ya) which is very famous and popular product during winter season. Mule ducks, a crossbreed between selected Peking and Muscovy lines are used for meat consumption and cured duck processing.

Roasted duck is a 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 the 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 Lanttem 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 .is differ from the products from other methods. 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, gingerroot, and anise and simmered for at least 1.5 hours, with the water and seasonings are 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).

The contents of this book will cover duck and goose slaughtering and carcass grading, quality of duck and goose meats, physicochemical changes pre-and post-slaughtering, microbiological properties of duck and goose meat, food additives for waterfowl meat processing, manufacturing technology of duck and goose meat products, roasting and marinating of duck and goose meat, and nutrition of duck and goose meat.

Reference:

1. Cai, Yusi1. 2010. Beijing roast duck and Quan Ju De. In Stories befind Chinese dishes. Rediscovering China. Pp. 59.

Chapter 2. Breeds of Meat Ducks and Geese

Breeds of meat ducks in Taiwan

Most duck meat is produced by the heavy breeds-White Pekin, Muscovy and mule ducks. The duck breeds in Taiwan and their performance had been described by Huang(1972) and Tai(1986). One of these breeds mule duck is the major meat breed in Taiwan, which occupies 75-80% of the total (Cheng et al., 2003).

1. White Pekin ducks

   The breed of White Pekin duck originated from China was introduced into Taiwan. White Pekin ducks are ideally suited for meat production. They produce excellent quality meat, and they reach market weight(3-3.5kg) in 8 weeks. White Pekin ducks are large white-feathered birds. They have orange-yellow bills, rddish-yellow shanks and feet, and yellow skin.

2. Muscovy

   The Muscovy is related to the other breeds mentioned in this section. The breed originated from South America. Numerous varieties of Muscovies exist: the white variety is the most desirable for market purposes. Muscovies produce and provide meat of excellent quality and taste when they are marketed before 17 weeks of age. But their low egg production makes them unsuitable for use on large commercial duck farms. However, Moscovies make extremely good setters. They will hatch and care for approximately 30 ducklings from the 40-45 eggs they produce annually. Thus they have excellent possibilities for small general farms that have special retail outlets. In Taiwan we use male Muscovies to cross white kaiya females to produce mule ducks.

   The Muscovies are generally used for ginger stewed duck preparation (Jiang -Mu-Ya)-a kind of Chinese herbs foods for health.

3. Mule ducks

   Mule ducks obtained from intergeneric crosses are the major source of meat ducks in Taiwan. Mule ducks are produced from 3-way crossing 1) Pekin duck(♂)x white Tsaiya(female) to obtain white Kaiya(female), then cross with Muscovy(♂) to obtain mule duck. The mule ducks produce satisfactory meat yields but they are sterile.

Breeds of ducks raised in China

There are many varieties of ducks produced in China. They have different characteristics and traits of the performance. The breeds of ducks are named by the

localities from different provinces. They include Jingdinya (Fuken Province), Shaoshingya (Zhejiang), Jengchangya (Suchurn), Gouyuya (Jiangsu), Pekin duck (Pekin), Putien black duck (Fuken, Putien area), Chungshanmaya (Guangdon), Linwuya (Hunan, Linwu area), Shuishan maya (Hunan, Shuishan area), Dayeeya (Jiangsi), Chaohuya (Anhui), Liangcheng baiya (Fuken, Liangcheng area), Shang maya (Fuken), Shinyeeya (Kuizhou), Gushuya (Hernan), Weishan maya (Shangdong), Wendon black duck (Shangdong), Nantien, Hungshangya (Hunan), Menyungya (Hubei), Suchurn maya (Suchurn), Hangchung maya(Shangsi), Yungnan maya (Yungnan), Tongtin maya (Lake Tongtin), Jinsee damaya (Guangsi) etc.

These ducks are used for cooking by two styles cuisine---Pekin-style and Guangdon-style cookery as well as the local specieties.

Breeds of geese raised in Taiwan and China

Breeds of geese in the world can be divided into two breeds: 1) Chinese geese and 2) European geese.

Chinese geese originated from Anser cygnoides and have been domesticated. The European geese originated from Anser anser and have been domesticated. They belonged to Aves (class), Anser (order), Anhimidae (family), and Anser (genus).

Chinese geese include Shipu geese, An geese, Fonghua geese, Onesee white geese, Suchurn white geese, Minbei geese (Northern Fuken), Hoen geese, Yong kong geese, Changlow grey geese, Taihu geese, I-Lee geese, Lotus white geese, Fongcheng geese, Lion head geese and Hezong geese which are distributed over Mainland China.

In Taiwan, besides Chinese geese, we also introduced white Roman geese and Landaise geese from France to mate Chinese geese to produce meat geese for meat consumption.

References：

1. Ash, W. J. 1974. Raising Ducks. Farmers' Bulletin. 697. USA.
2. Chao, S. 1991. Raising and Processing of Geese. Jiangsu Technical Publishing Co., China.
3. Cheng et al. 2003.Breeding and genetics of waterfowl, World's Poultry Sci. J. 59:509.
4. Huang, H. H. 1972. The duck industry of Taiwan. CAJCORR, Animal Industry series, No. 8.

Canards Pekin
Pekin Duck

Muscovy Meat Duck

Blanc
White

Gris
Grey

Mule Duck

Blanc
White

Gris
Grey

Geese

Blanc
White

Gris
Grey

Chapter 3. Water Fowl Slaughter Process

1. Pre-slaughter handling

An unacceptable proportion(5-10%) of water fowls are damaged in Taiwan during catching and transportation to the slaughterhouse, resulting in ducks- and geese stress and downgrading of the carcasses and, in consequence, an economical loss to the industry. The animal welfare implication are equally untenable.

The literature on catching and transportation of water fowls has been very few reviewed. Chen et al have worked on effect of stresses before slaughter on changes of the physiological, biochemical and physical characteristics of duck muscle. The stressors having a deleterious effect on carcass quality have been identified.

These include handling of ducks and geese, inversion, partial immobilization, confinement, motion, vibration, noise, air movement and temperature and humidity.

1.1 Catching

Generally, ducks and geese are caught by hand and carried to the transport unit by one leg. a procedure which causes the birds seriously stressed and resulting in abnormal quality such as DFD meat.

There are four systems for harvesting poultry. they are loose crates, fixed crates, modules and multiple-floor modules. Loose crates are often used in ducks and geese catching, which are made of wood, wire or plastic to define the birds.

Empty crates are taken from the lorry into the shed, where a team of catchers fills the individual crates. Fewer birds are filled in each crate in summer to reduce the heat stress. The birds are caught by one leg and passed into the crate through a flapped opening at the top, which in sufficiently large to insert the bird, but not so large as to allow it to get out easily. Once a crate has been filled, it is taken to the lorry then loaded in truck.

Loose crates have the advantage of providing a flexible system at low capital cost but they have a high labour requirement. The process has to be careful, or it will result in injury and downgrading of carcass.

1.2. Transportation

The two critical aspects of transportation by open-sided vehicles are exposure of the birds to the prevailing climate and to high wind speeds(80km/h). The protection provides varies from system to system, and several methods have been introduced for reducing the degree of exposure in

adverse weather conditions.

In cold, wet conditions, wind increases the chill factor, whereas in hot. humidity conditions, it will provides a beneficial cooling effect. In warm weather, the numbers of birds filled in each crate should be reduced.

1.3. Reception and unloading

The reception of the birds are brought into the slaughterhouse in some countries, the reception area is under cover and sufficient size to contain all the transport trucks awaiting unloading. It is better to arrange the vehicles enter the building at one side and leave at other after washing, therefore avoiding cross-contamination. In warm weather, additional ventilation provided by fan is necessary and evaporative cooling devices are sometimes used to regulate the environment to prevent the birds overheating and too humid.

Unloading for loose crates, when the crates arrive at the slaughterhouse on the transport vehicle in stacks eight high, they are unloaded from the vehicle one by one and placed on a conveyor system, which carries them to the hanging station.

Here the crates are opened, the birds removed and hung on the killing line. The empty crates are then washed and brought back to the vehicle. The crates are generally moved by a combination of driven belt-conveyors and roller track, but nylon chain conveyors are becoming more popular since they do not have to be tensioned and show very little wear.

Some slaughterhouses do not place the crates of the birds in killing line immediately when the truck arrives, the birds are unloaded into a holding area(lariage or a fence) for resting a given time. During holding the birds are fasted, supplied clean water for drinking. After suitable resting the birds are driven tenderly to killing line. The process the birds are not got much stress and resulting in good carcass quality.

Comment: Most of slaughterhouse hold the birds in cages or crates on the truck under the receiving area, while in Long Island, USA, when the ducks in crate transported to the slaughterhouse are unloaded in the lariage where supply water for free drinking and allow the ducks to get sufficient rest. The authors found the ducks are hold in lariage or fence to allow the ducks to rest for 2-4 hour, and this will produce a normal carcass quality. Otherwise, if the resting time is too short, it will cause the duck meat to be DFD-like meat. For geese, in Taiwan, most slaughterhouse purchase geese from geese farm and feed about one month in fence and administrate hormone for fattening.

2. Slaughter process

For killing, the birds may be hung by legs at a convenient height for bleeding or they may be placed in killing cones, fastened to a wall or in a rack. Openings at the bottom of the cones allow the fowl's heads to protrude. The geese are killed by this method, but ducks are occasionally. Commercially, most birds are hung on shackles attached to an overhead conveyer.

2.1. Stunning(immobilization)

In order to reduce thrashing about before and following the bleeding operation, with resultant possible bruising and discoloration, various methods of immobilization such as gas-stunning or electrical stunning are employed.

Electrical stunning is usually carried out in an electrically charged water bath by dragging the heads of the birds through water in which an electrode is submerged.

The shackles of the killing line simultaneously touch an earth electrode, causing an electrode current to run through the whole body of the bird.

2.2. Killing

Ducks and geese are most commonly killed by severing left jugular vein and carotid artery of the bird. Geese may be stunned by striking them sharply on the back of the head at the base of the brain with a stick, then bleeding them in the same manner as ducks. Ducks and geese may be immobilized or controlled by placing them for killing in funnels or cones of proper size for the birds. This method will prevent many bruised, broken and discolored wings. Use of cones also saves the operator from painful beatings from powerful thrashing wings.

2.3. Bleeding

In order to avoid the improper bleeding to cause dressed carcass discolored it requires not only the best practical bleeding operation, but also the most feasible bleeding time, prior to scalding.

2.4. Scalding

After bleeding, the birds are scalded by immersing in hot water or by spraying-scalding. Scald tanks are much more widely used than spraying-scalding systems which only has positive benefits for carcass hygiene.

During scalding the birds are immersed for up to 3.5 min in the scalding tank, depending upon the water temperature, usually, 60-65℃ At the higher temperature, feather removed is greatly facilitated, and the birds only need to immerse in the scalding tank for 2-2.5 min. The water must be circulated continuously by means of pumps or agitators at the centre of the tank and overflow.

2.5. Defeathering

Defeathering process includes picking, pinning and singeing. Defeathering may be done by hand with the birds hanging at a convenient height, or by mechanical feather pickers. Ducks and geese are picked by wax picking. The rough-picked birds are coated with a melted wax of special formula. The operation of pinning consists of hand removal of any remaining pin feathers by use of short-bladed pinning knives. In singeing, the hair-like feathers remaining on the birds after picking are removed by passing through a bank of gas flames burning continuously or burning intermittently by means of automatic controls.

2.6. Eviscerating

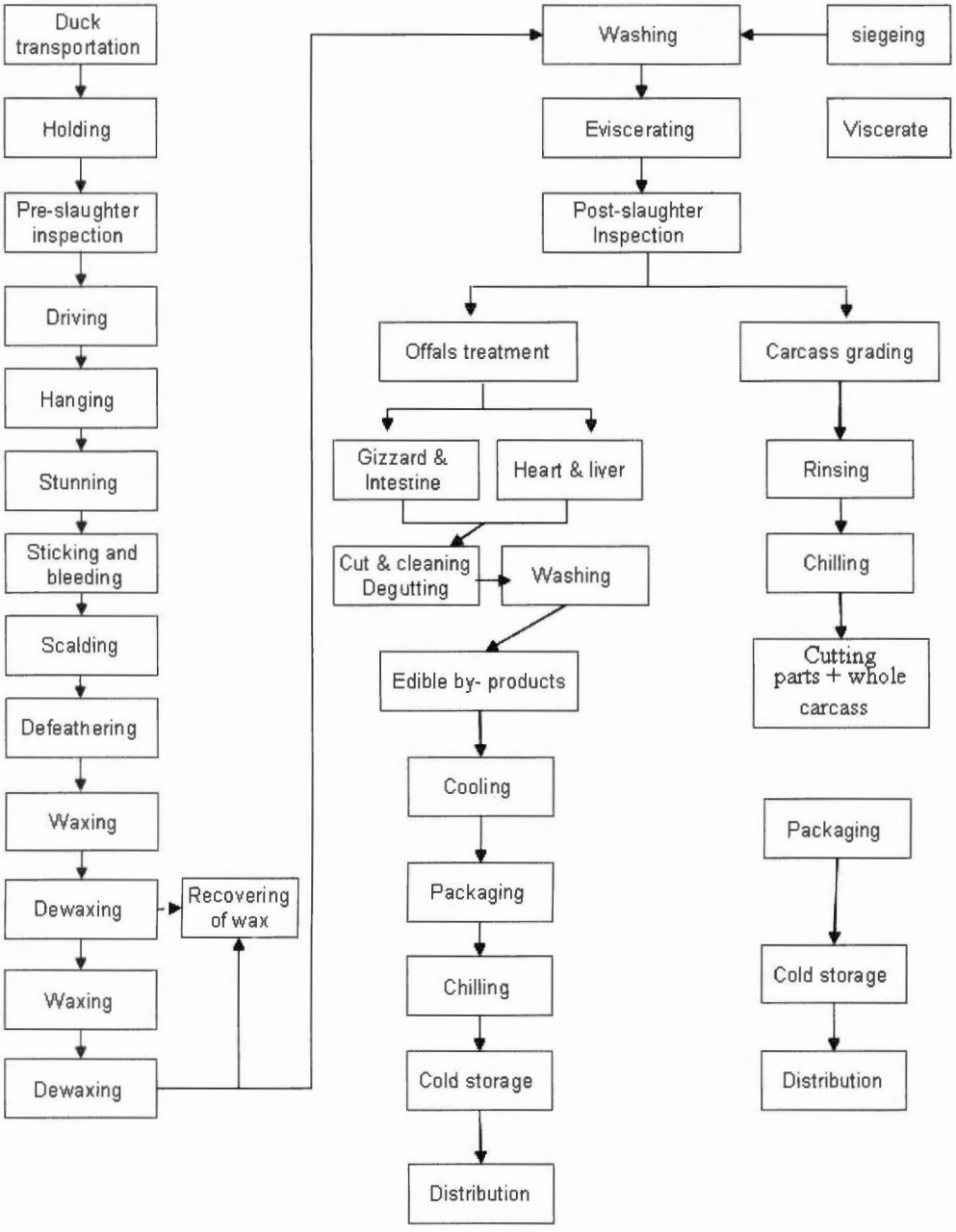
Before eviscerating the carcass must be washed and cleaned. Eviscerating may be performed by hand or machine. A mechanical vent-cutter is sometimes used. This has a central pin, which is put into the vent. The vent is then sucked by vacuum and cut by a revolving, cylindrical blade. The connection with the intestine is not severed. The initial cut is enlarged with scissors to allow to remove the viscera.

The viscera are divided into edible and inedible, the edible viscera includes heart, gizzard and liver are separated and washed. The lungs and any other materials remaining within the carcass are removed with a special hand-tool or by suction, using a lung gun. All edible viscera mast be washed and cleaned Intestines must be washed out the contents and cleaned if provided for consumption.

The gizzards require cleaning, entail splitting and washing out the contents, peeling off the hard lining and a final wash.

2.7. Chilling and packaging

Duck Slaughter Process Flow Chart


Duck transportation
Holding
Pre-slaughter inspection
Driving
Hanging
Stunning
Sticking and bleeding
Scalding
Defeathering
Waxing
Dewaxing
Recovering of wax
Waxing
Dewaxing
Washing
siegeing
Eviscerating
Viscerate
Post-slaughter Inspection
Offals treatment
Carcass grading
Gizzard & Intestine
Heart & liver
Rinsing
Cut & cleaning Degutting
Washing
Chilling
Edible by- products
Cutting parts + whole carcass
Cooling
Packaging
Packaging
Chilling
Cold storage
Cold storage
Distribution
Distribution

CCP OF DUCK SLAUGHTER PROCESS

FARM TO SLAUGHTERHOUSE

1) broken feet and wings
2) Air contamination
3) Fasting and water supply

STUNNING AND KILLING

Bloody, electricity, voltage, bone broken

BLEEDING

1) Duration 2)Right site of sticking or cutting

SCALDING AND DEFEATHERING

1) Temperature and time
2) Cleanness of carcass and damage
3) Microbial contamination

WAXING

1) Kind of wax
2) Temperature
3) Recovering of wax and feather removed

CUTTING OF FEET AND CLAW

Position of cutting and breaking %

EVISCERATION

1) Cross contamination
2) Contamination of contents of intestine flow out or broken

HIGH PRESSURE SPRAYING & WASHING

1) Water volume and temperature
2) Cleanness status
3) Prevention of contamination

CHILLING(air, ice or water)

1) Chilling water cross contamination
2) Microbial growth(crushed ice)
3) Chlorine concentration
4) Temperature, volume of water and time

GRADING AND WEIGHING

1) Temperature of cutting room
2) Utensil, equipment and machine sanitation
3) Personal hygiene
4) Packaging material contamination
5) Normal operation
6) Temperature of products control

REFRIGERATION AND FREEZING

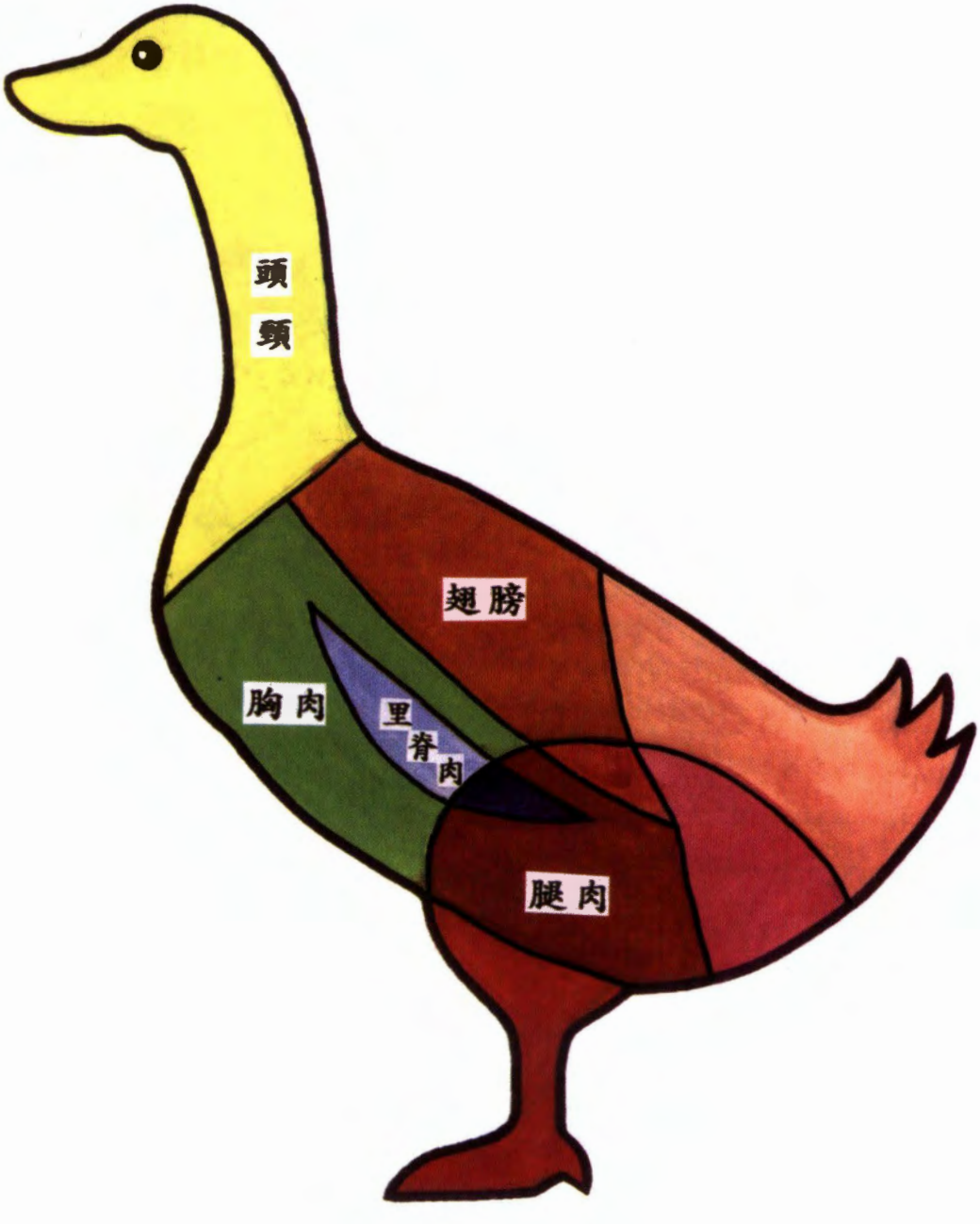
1) Temperature of refrigerator
2) Cleanness of refrigerator and freezer
3) Storage life
4) First-in first out

Chapter 4. Duck and Goose Carcass Grading and Cutting

Carcass grading and standardization are a procedure by which carcasses, or yield attributes of the products or economically important traits. Grading serves to segregate products into standardized group which have common characteristics such as appearance, physical properties or edible portion.

Grading is also very important for duck and goose breeding and marketing. In Taiwan we don't have a good system or standard for duck and goose carcass and meat grading. The author and coworkers had tentatively set up a carcass and meat grading system to provide the processors' reference. It will be introduce as follows:

The duck feature is as following picture：



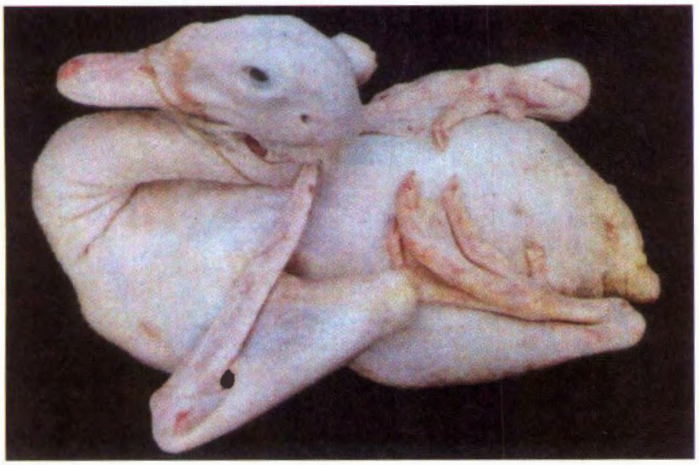
Grading Standard of Meat-type Duck Carcass

Grade	Grade A	Grade B	Grade C
Conformation	Normal	Normal	Abnormal
Keel bone	Normal	Normal	Slightly crooked
Back	No deformities	No deformities	Carcass is whole
Leg & wing	No broken bone allowed	No broken bone allowed	Broken bone allowed
Fleshing	Plump, full breast On both sides of Keel bone	Moderately plump	Slightly plump
Fat(abdominal and Subcutaneous fat)	Properly deposit	Slightly much deposit	too much or too less deposit
Pins	No pins left	Some pins are left	Many pins are left, (scattering)
Skin and bone are damaged	No	No	Bruised skin or broken are allowed
Color	Yellow or white No prominent discoloration	Yellow or white No prominent discoloration	Bloody, spotted and discoloration
Maturity	Suitable	Suitable	Too old or too young
Carcass weight	2.5kg	2.5kg	exceed 2.5kg

Classification of Fresh Products of Duck

Breeds of Ducks include mule duck and Peking duck which are at age of 10-14 weeks and 8 weeks, respectively.

Code D01

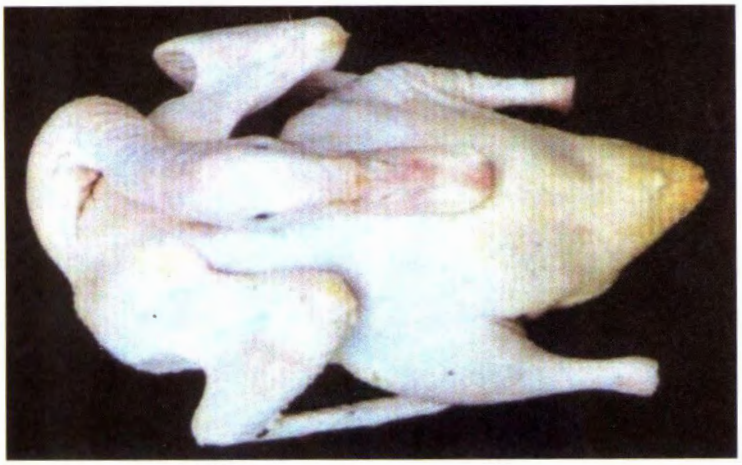


Name：Duck carcass

Description：Defeathered, bleeded, eviscerated, carcass w/o opening abdomen cavity

Carcass weight：Large 3000g above
Medium 2000-2999g
Small 1500-1999g
Out of grade < 1500g

Code D02

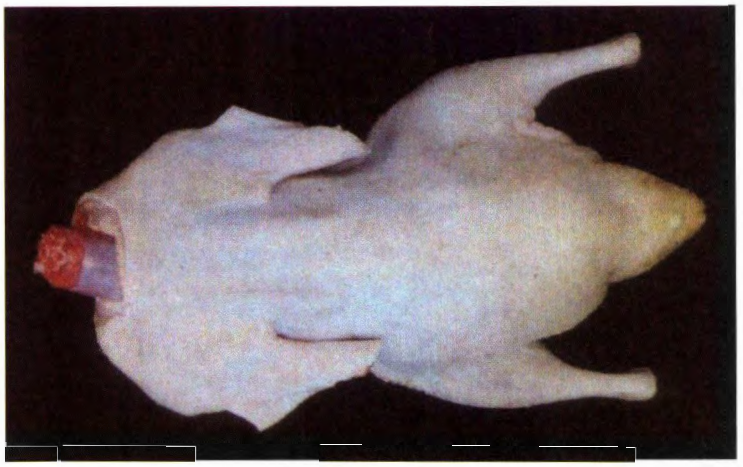


Name：Dressed duck carcass

Description：Eviscerated, feet and wings are removed from the joint between humerus and radius + ulna, dressed carcass w/o opening abdomen.

Carcass weight：Large 2000-2700g
Medium 1700-1999g
Small 1200-1699g

Code D03

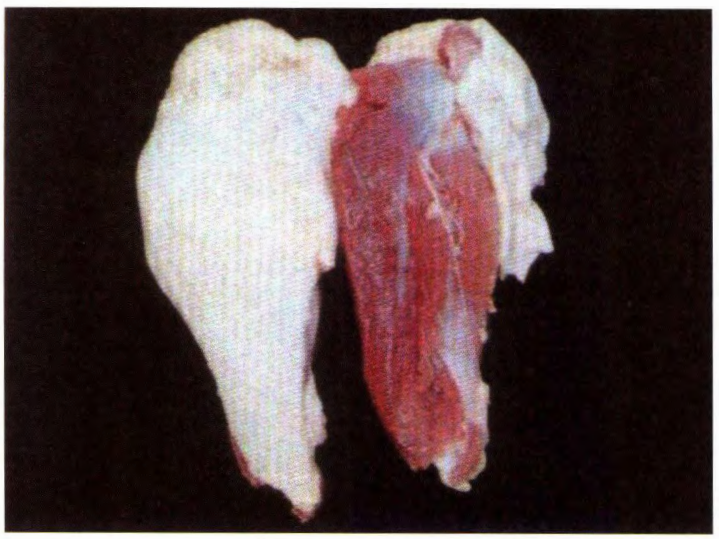


Name：Duck carcass w/o feet and wings

Description：Eviscerated, head and neck, wings and legs are removed, abdomen is not opened.

Carcass weight：Large 1600-2500g
Medium 1400-1599g
Small 1100-1399g

Code：D04

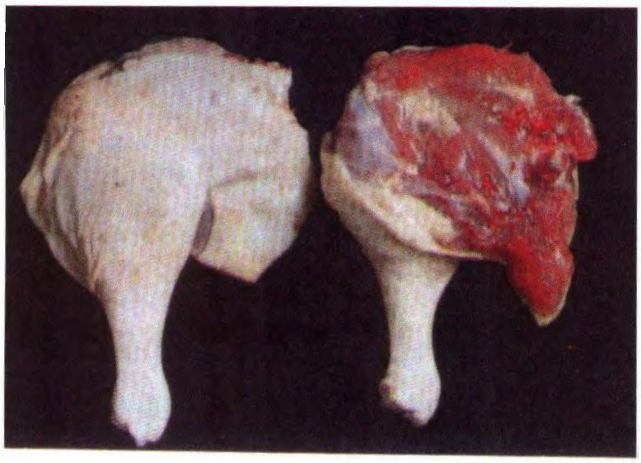


Name：duck breast

Description：Deboned breast with skin

Weight(one piece)：Large 350g
Medium 250-349g
Small < 249g

Code：D05

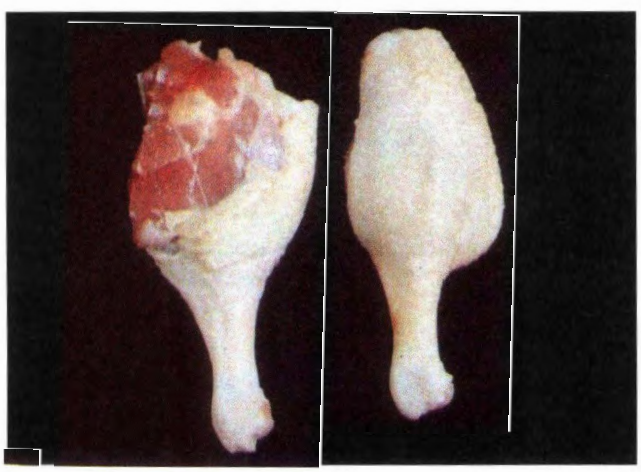


Name：Duck thigh

Description：The part from ischium + pubis bones to kneel joint

Weight：Large >200g
Medium 180-199g
Small <179g

Code：D06

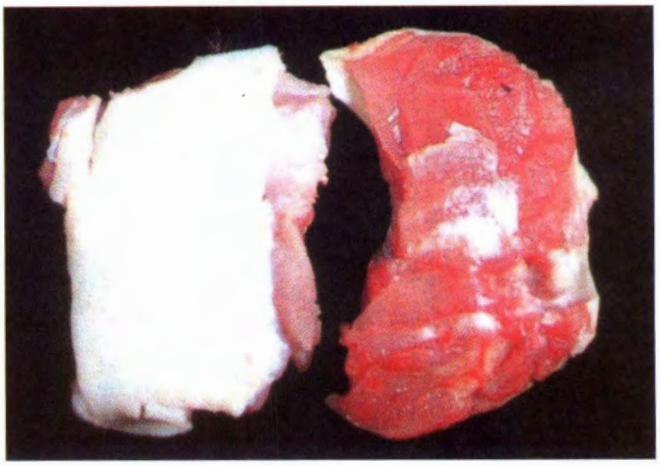


Name：Duck drum stick

Description：the part from tibia joint to kneel joint, and trim off exceed skin and fat

Weight：Not regulated, depend on the duck steak cut location

Code: D07-1

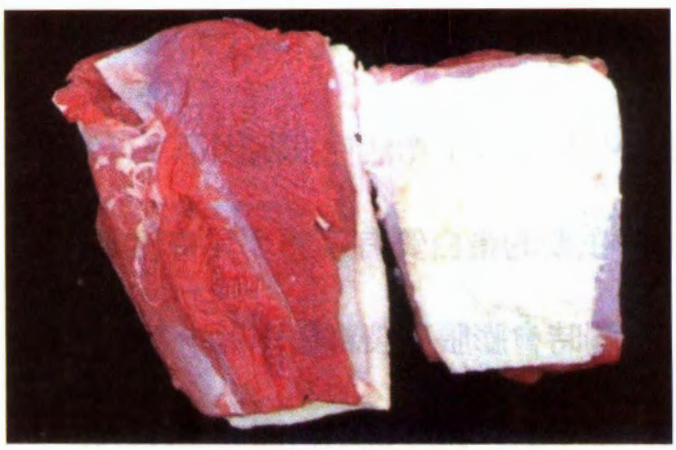


Name：Duck steak

Description：the meat with skin which cut off from ischium + pubis bone to the joint between femur and tibia(wim or without femur bone)

Weight: Not regulated

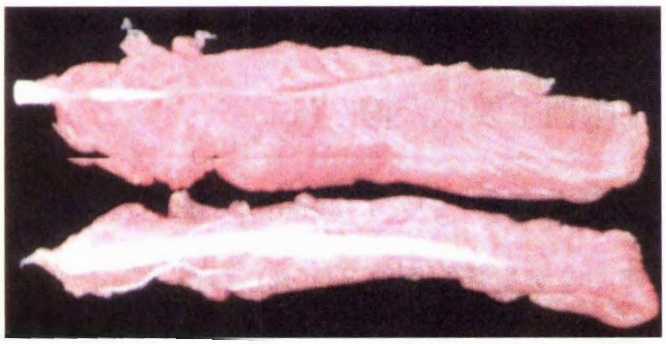
Code : D07-2



Name：Duck steak

Description：some plants use breast as steak, the weight is the same as D04.

Code：D08

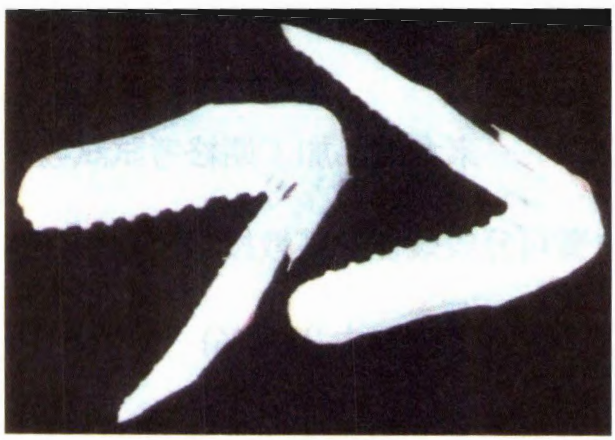


Name：Sasami

Description : Inner layer of breast muscle at the part of inner layer meat of breast.

Weight: Not regulated

Code: D09



Name：Duck wings

Description：The part cut off from middle section of upper carpal bone to tip of wing

Weight：Not regulated

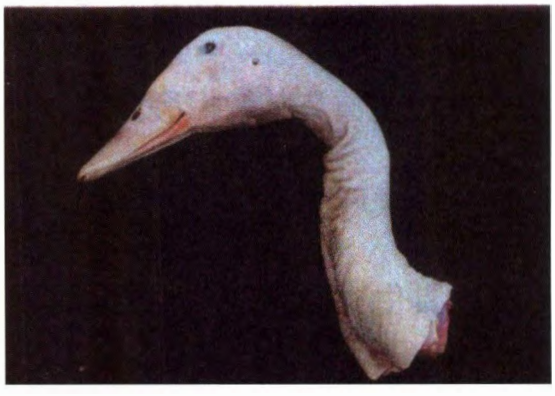
Code：D010

Name：Duck feet

Description：Location cut depending on demand, sometime cut off at the joint between fibula and tibia; sometime at the location near the metatarsus of 1st phalanges

Weight：Not regulated

Code：D011



Name：Head and neck

Description：Cut off at the location between neck and back

Weight：counted by the number

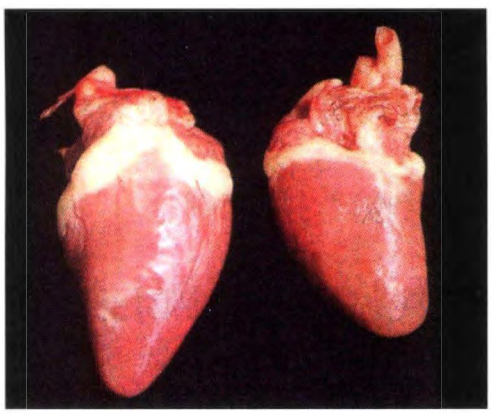
Code：D012

Name：Coccygeal vent

Description：cut off from the location at 7 position of the figure.

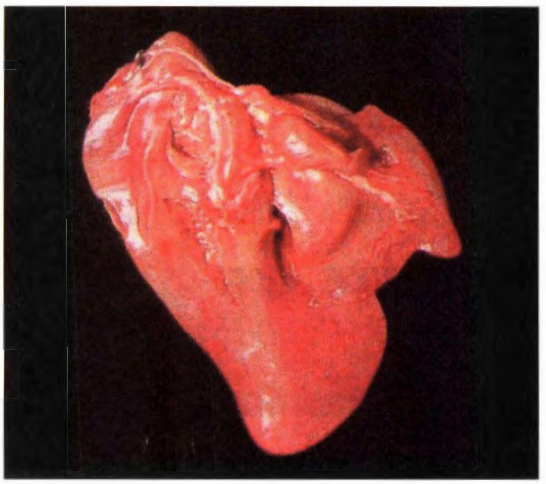
Weight：counted by the numbers

Code：D013



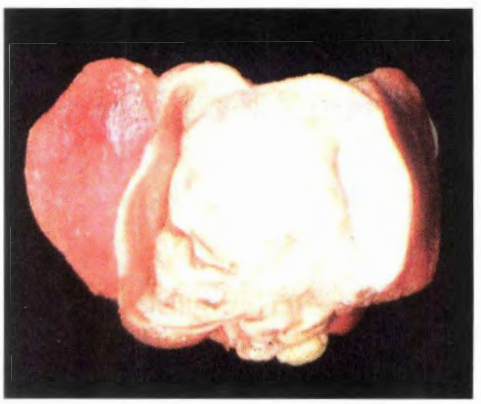
Name：Duck heart

Code 14



Name：Duck liver

Code：D015



Name：Duck gizzard

Comparision on the characteristics and cuttability of carcass between mule duck and Peking duck*

Breed / Age(weeks) / Items	Mule duck			Peking Duck					
	6	7	8	6		7		8	
				♂	♀	♂	♀	♂	♀
Live weight(kg)	1,767	2,221.7	2,491.7	3,015	2,908	3,220	3,025	3,541.7	2,891.7
Dressing%	57.44	61.48	63.38	62.98	63.39	54.33	65.88	61.75	66.01
Breast	13.402	19.488	22.645	22.297	21.558	22.462	23.415	23.853	23.317
Back	19.554	18.227	17.913	19.297	20.560	21.000	21.667	22.043	21.247
Thigh	19.788	16.247	15.055	14.200	14.390	13.132	13.643	14.077	14.048
Wings	12.726	12.615	12.445	9.485	9.584	8.990	9.458	9.470	9.908
Head & neck	13.086	14.400	14.137	13.362	14.048	14.197	13.045	14.097	13.068
Legs	3.596	3.083	2.898	2.678	2.324	2.398	2.502	2.752	2.553
Edible portion	9.844	7.437	7.378	8.058	6.742	6.772	6.115	5.818	6.242
Inedible part	8.040	6.355	5.640	7.588	7.424	6.420	6.273	6.735	6.095
Abdominal fat	0.592	0.933	0.510	1.857	2.410	2.133	2.472	2.715	2.193
breast	8.160	7.040		13.897	13.658	16.338	14.942		
Skin Abdominal	6.534	12.505		11.010	10.506	17.915	18.765		
Skin thicken breast	3.440			5.983	6.260				
Abdominal	4.780			8.083	7.720				

*No. of duck：6 weeks of age：mule ducks are 5 birds, and Peking ducks are 6 birds(♂) and 5 birds(♀)

7 and 8 weeks of age：all are 6 birds.

PERCENTAGE OF VARIOUS PARTS OF GEESE AT SEVERAL AGES

(based on chilled weights)

Age in Wks.	No. Of birds	Feet	Head	Neck	Total giblets	Remaining	Total Drawn weight	Waste	Wing tips
		%	%	%	%	%	%	%	%
8	12	3.6	5.8	4.4	7.6	65.2	77.3	22.9	1.7
10	24	3.6	6.4	4.4	6.5	68.5	79.4	20.4	1.6
12	18	3.4	6.3	4.1	6.7	68.1	78.9	21.0	1.5
13	33	3.3	6.6	3.8	6.7	68.4	78.6	21.4	1.5
14	38	3.2	6.4	3.9	6.3	68.1	78.4	21.6	1.4
19	13	2.7	6.1	3.5	5.5	69.5	78.5	21.6	1.2

AVERAGE LIVE, DRESSED, DRAWN, AND COOKED WEIGHTS OF COOKED CARCASSES OF GEESE

Age in Wks.	No. Of birds	Live weight	Dressed weight	Drawn weight	Cooked weight	Total edible meat	Total bones	Drippings
		lbs	lbs	lbs	lbs	lbs	lbs	lbs
8	4	9.0	8.0	6.2	4.2	3.0	1.2	1.1
10	4	9.8	8.5	6.7	4.6	3.4	1.2	1.2
12	4	11.4	10.0	8.0	5.4	4.1	1.3	1.6
13	4	13.2	11.4	9.0	5.5	4.2	1.3	1.6
14	4	11.4	9.9	7.8	5.2	3.7	1.2	1.7
19	4	12.7	11.1	8.7	5.3	3.9	1.1	1.7

PERCENTAGE OF EDIBLE MEET AND BONES OF COOKED CARCASSES OF GEESE

Age in Wks.	Percent Total Edible meat of			
	Live wt.	Chilled weight	Total drawn weight	Percentage bones of live weight
8	33.4	37.3	48.2	13.0
10	34.4	39.6	49.7	12.3
12	35.9	40.9	51.1	11.0
13	31.8	36.7	46.4	9.5
14	32.6	37.6	47.3	10.2
19	31.1	35.1	44.8	8.5

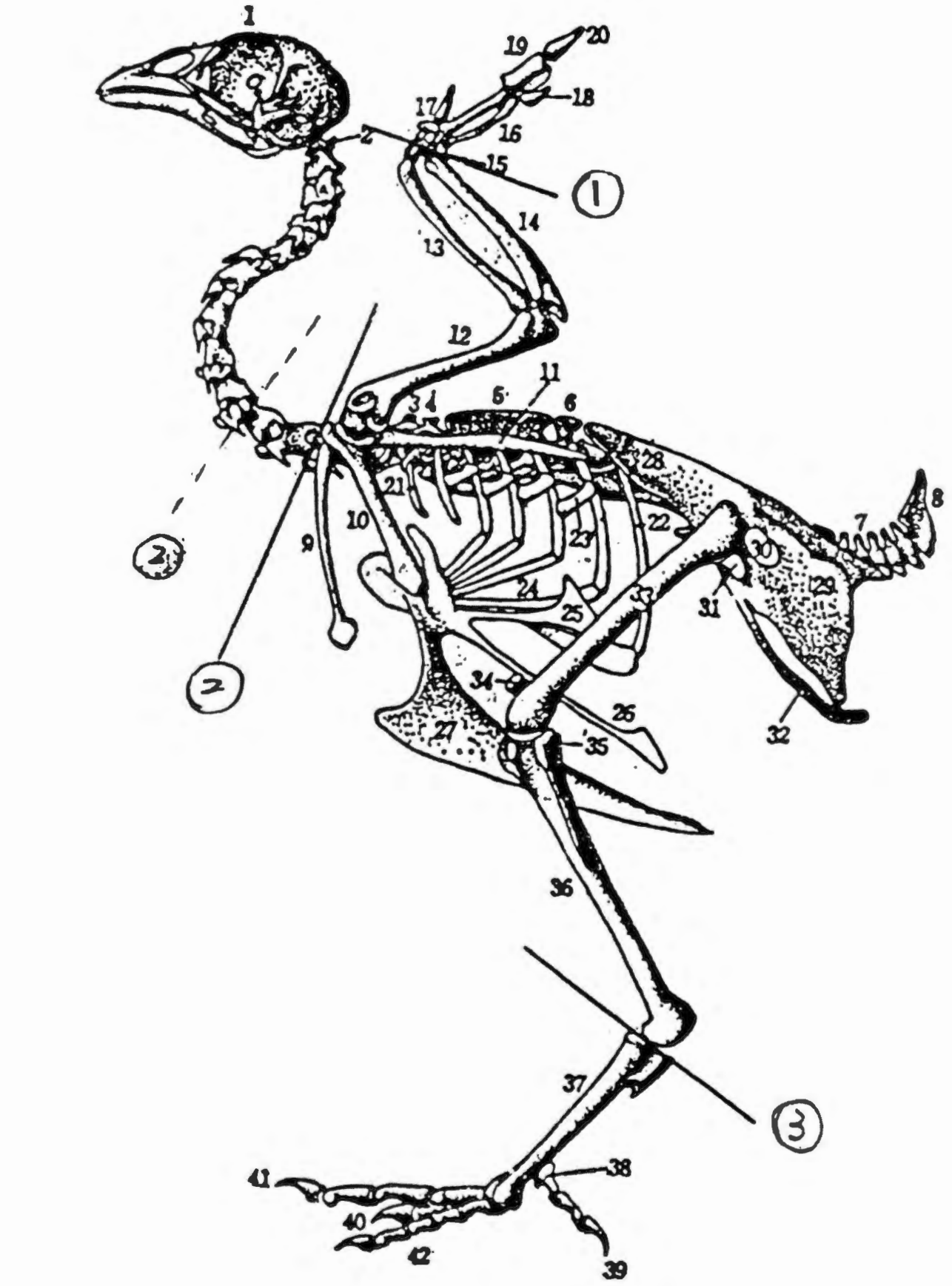
O.A.C. Poultry Products Lab. Data

Sources：Snyder, E. S. and Orr,H. L. Poultry meat-processing, Quality factors and yields. Ontario OOA, Canada.

Differentiation of goose meat between healthy and sick geese

Items	Healthy goose	Sick goose
Bleeding and muscle Color	Bleeding well, cut surface of meat flat and clean, appears in bright red color	Poor bleeding, cut surface of meat flat but appears in dark red color
Skin	Surface is dry and firm and Slight red color	Surface is roughly, dark red, appear purple red spot
Fat	Milky or light yellow	Dark red
Muscle	Cut surface is dry, luster, Muscle without elastic, appears in rose red ,breast Is white with slight red	Cut surface is not dry, dark red color, without elastic

Source: Chao Shiao(1991): Feeding and Processing of Geese. Jiang Shu Technological Publishing Co., China.


1
19
20
18
17
16
2
15
1
14
13
12
11
5
4
6
28
21
10
9
22
27
7
8
2
24
25
31
29
30
34
26
27
35
32
36
37
3
41
38
40
42
39

Skeleton of duck

I. Cutting site

(1) Joint between ulna and carpal bone

(2) Joint between neck bone and backbone

(2') wrong position

(3) Joint between pibula and tibia

II. Name of skeleton

1. sku11
2. Atlas
3. 14th cervical vertebrae hind part of
4. First thoracic vertebrae
5. Second to 5th thoracic vertebrae
6. 6th thoracic vertebrae
7. Coccygeal vertebrae
8. Pygostyle
9. Clavicle
10. Coracoid
11. Scapula
12. Humerus
13. Radius
14. Ulna
15. Carpal bone
16. Metacarpus
17. Phalanges
18. 4th finger bone
19. -20 3rd finger bones
21. 1st rib bone
22. 7th rib bone on vertebrae
23. Uncinate process
24. 5th rib bone at thoracic part
25. Process exterior branch on hind part of breast
26. Process interior branch on hind t part of breas
27. Stennum
28. Ilium
29. Ischium
30. Ischitic foramen
31. Ischium/pubis foramen
32. Pubis
33. Femur
34. Patella
35. Fibula
36. Tibia
37. Metatarsus
38. Bone of toe at metatarsus
39. 42 1st to 4th bones of toes

Locomotion system

Fig. Skeleton of duck, left lateral view. The bones of the anterior extremity are shown separately.

1. Premaxilla, Os incisivum
2. Nostril, Nares
3. Nasal bone, Os nasale
4. Maxilla, Os maxillare
5. Frontal bone, Os frontale
6. Eye cavity, orbita
7. Parietal bone, Os parietale
8. Temporal bone, Os temporale
9. Occipital bone, Os occipitale
10. Bones of mandible
11. First cervical vertebra, Altas
12. Second cervical vertebra, Axis
13. Last cervical vertebra
14. Fused thoracic vertebra, Notarium, Os dorsale
15. False ribs, Costae asternales
16. True ribs, Costae sternales
17. Breastbone, Sternum
18. Pelvic bones, Ossa pelvis
18'. Ilium, Os ilium
18". Ischium. Os ischii
18'". Pubis, Os pubis
19. Ischiatic foramen. Foramen ischiadicum
20. Coccygeal vertebrae, Vertebrae caudales
21. pygostyle
22. Femur
23. Patella
24. Tibia
25. Fibula
26. Sesamoid bone, Os sesamoides
27. Metatarsus (Tarsometatarsus)
28. Bones of toes
29. Scapula
30. Coracoid bone, Os coracoides
31. Joint cavity for Humerus
32. Clavicle, Clavicula
33. Humerus
34. Radius
35. Ulna } Ossa antebrachii
36. Radial carpal bone, Os carpi radiale
37. Ulnar carpal bone, Os carpi ulnare
38. Metacarpus
39. Finger bones

Locomotion system

Fig. Skeleton of the goose, left lateral view. The bones of the anterior extremity are shown separately.

1. Premaxilla, Os incisivum
2. Nostril, Nares
3. Nasal bone, Os nasale
4. Maxilla, Os maxillare
5. Frontal bone, Os frontale
6. Eye cavity, orbita
7. Parietal bone, Os parietale
8. Temporal bone, Os temporale
9. Occipital bone, Os occipitale
10. Bones of mandible
11. First cervical vertebra, Altas
12. Second cervical vertebra, Axis（Epistropheus）
13. Last cervical vertebra
14. Fused thoracic vertebra, Notarium, Os dorsale
15. False ribs, Costae asternales
16. True ribs, Costae sternales
17. Breastbone, Sternum
18. Pelvic bones, Ossa pelvis
18'. Ilium, Os ilium
18". Ischium. Os ischii
18'". Pubis, Os pubis
19. Ischiatic foramen. Foramen ischiadicum
20. Coccygeal vertebrae, Vertebrae caudales
21. pygostyle
22. Femur
23. Patella
24. Tibia
25. Fibula
26. Sesamoid bone, Os sesamoides
27. Metatarsus (Tarsometatarsus)
28. Bones of toes
29. Scapula
30. Coracoid bone, Os coracoides
31. Joint cavity for Humerus
32. Clavicle, Clavicula
33. Humerus
34. Radius
35. Ulna } Ossa antebrachii
36. Radial carpal bone, Os carpi radiale
37. Ulnar carpal bone, Os carpi ulnare
38. Metacarpus
39. Finger bones

Chapter 5. Physiological, biochemical and physical characteristics of duck Muscle

It has been recognized that stress can produce changes to the metabolites of the muscle of farm animals, thereby causing differences in the quality of their meat. The nature of these effects depends on factors such as the duration and severity of the stress. In general, pale, soft and exudative muscle (PSE) develops from animals suffering a severe short-term stress, and dark, firm and dry muscle (DFD) develops from animals subjected to prolonged stress. DFD meat has the major disadvantages of being unattractive in appearance and having a favourable pH for bacterial growth.

Descriptions of the changes on the meat have been restricted to pork, beef and lamb (Fischer et al., 1988) and there have been no reports on how stress affects poultry and duck meat in particular. In Taiwan, ducks have been found with DFD-like muscle after suffering stress from transport, fasting and forced exercise (Liu and Chen, 1989). This experiment was, therefore, carried out to study the physiological, biochemical and physical changes which occur in duck muscles after the birds have experienced stress.

Blood and muscle pH and lactate content

Although both the pH and lactate content of serum increased slightly as the fasting time progressed, the differences were not significant (Table 1). The acid-base balance or self-buffering capacity of the blood probably accounts for the lack of any marked change in pH (Siegel et al., 1974). The changes in pH and lactate content of breast and thigh muscles induced by the different stressors and occurring during post-mortem storage at 4℃ are shown in Fig. 1.

These show that fasting before slaughter increased the pH and decreased the lactate content of both breast and thigh muscles. The muscle with the higher pH experienced the greater decrease in lactate. The lactate content of thigh muscle was found to be lower than that in breast muscle, especially from the muscles of those ducks which had been fasted for 24 h and exercised for 10 min. These muscles also had the highest pH values. These results agree with findings elsewhere (Bate-Smith and Bendall, 1949; Howard and Lawrie,1956 ; Newton and Gill, 1980/81; Liu and Chen, 1989)

Table 1. Effect of stress on the pH of blood and lactate content of serum

Treatments[1]	Blood pH	Lactate in serum(μmole/ml serum)
Control	7.71 ±0.06	9.29±2.27
8 h fast + 10 min enforced exercise	7.75 ±0.08	9.92±3.51
24 h fast + 10 min enforced exercise	7.75 ±0.09	9.59±2.01

[1]n= 12 per treatment mean.

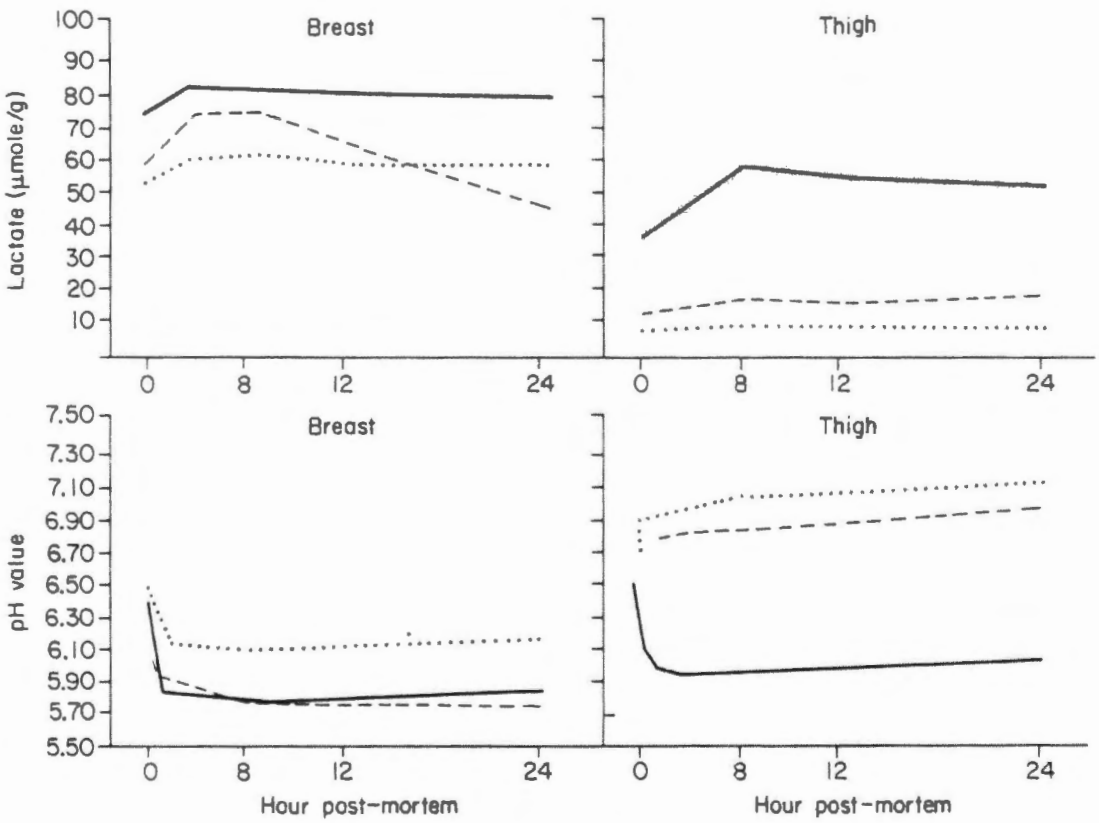


Fig 1. Changes of pH and lactate content of duck breast and thigh muscle obtained for different stress during post-mortem storage at 4℃ (n = 20).---, control ; ---, 8 h fast + 10 min enforced exercise; …, 24 h fast + 10 min enforced exercise.

Table 2. Effect of stress on the activities of lactate dehydrogenase (LDH), creatine phosphokinase (CPK). acid phosphatase (A CP), alkaline phosphatase (ALP) in serum.

Treatments	Serum			
	LDH[1]	CPK[2]	ACP[3]	ALP[3]
Control	1128 ±203[a]	226±100[a]	0.61±0.28[a]	10.8 ±3.2[a]
8 h fast + 10 min enforced exercise	1439 ±244[b]	319±104[a]	0.60±0.24[a]	13.7 ±4.5[a]
24 h fast + 10 min enforced exercise	1546 ± 182[b]	302±144[a]	0.57±0.18[a]	13.3±3.5[a]

Mean values obtained from 20 replicate determinations. Values with the same superscripts are not significantly different (P<0.05).

[1]BB (Berger-Broida) U/ml.

[2] μmole/min/l.

[3] 1 BLB Unit = mmole/h/l.

Table 3. The effect of stress and storage time on extractability of myofibrillar protein of breast muscle (percentage of total protein content)

Treatments	Extractability (%) Storage time (h)		
	1	8	24
Control	26.6±12.1[a]	28.6±11.0[ab]	36.0±14.1[b]
8 h fast + 10 min enforced exercise	28.8±8.5[a]	33.7±9.5[ab]	36.2±13.7[b]
24 h fast + 10 min enforced exercise	27.8±9.0[a]	36.6±8.6[ab]	39.2±8.2[b]

Mean values obtained from 12 replicate determinations. Values with the same superscripts are not significantly different (P>0-05).

Enzyme activity in the serum

The effects of the stress on LDH, CPK, ALP and ACP activities are shown in Table 2. In agreement with the results of Altland and Highman (1961) and Fowler et al. (1962), it was shown that stress caused the activity of serum LDH to increase significantly ($P < 0.05$) and those of CPK and ALP to increase slightly.

Changes in the extractability of myofibrillar proteins (Table 3)

Stress appeared to have only a limited effect on the extractability of the myofibrillar proteins, there being no significant differences across treatments. However, the extractabilitv of myofibrillar proteins increased significantly with storage time. Sayre and Briskey (1963) found no differences in the extractabilitv of myofibrillar proteins from muscles with pH values higher than 6 at different stages of the post-mortem rigor process. They also showed that extractability was not affected by the temperature of the muscle.

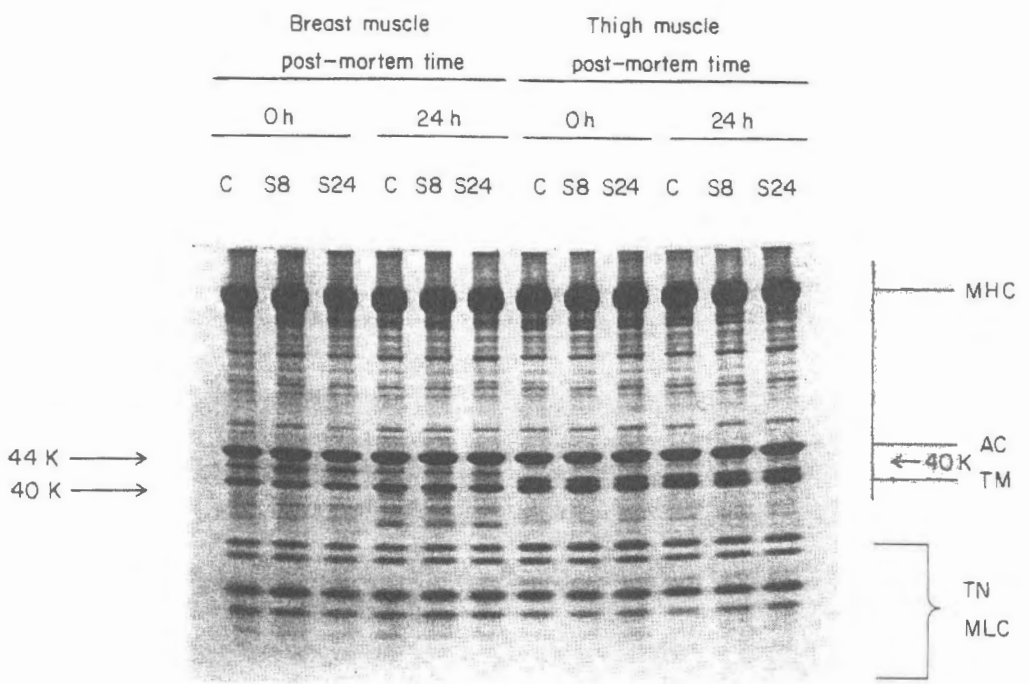


Fig 2. SDS-polyacrylamide gel electrophoretic pattern changes of myofibrillar protein of duck muscle post-mortem. C, control; S8, 8 h fast + 10 min enforced exercise; S24, 24 h fast + 10 min enforced exercise; MHC, myosin heavy chain; Ac. actin; TM. tropomyosin; MLC, myosin light chain; TN. troponin.

Electrophoretic behaviour of myofibrillar protein (Fig. 2)

No differences could be detected in the electrophoretic patterns between the muscles taken from the control ducks or from those which had been stressed. Breast and thigh muscle differed in having components of different molecular weights between the bands of actin and tropomyosin, that for breast muscle being 44 kDa while that for thigh muscle was 40 kDa. Two components were gradually degraded with time in storage, the myofibrillar protein in breast muscle being the more seriously degraded. The band of the component (30 kDa) which appeared in the gels of breast muscle stored for 24 h seemed to be a product of troponin-T degradation, a result which agrees with those of Koohmaraie et al. (1984), Olson et al. (1977) and Penny et al. (1974).

Table 4. Effect of stress and storage time on the ATPase activity of myofibrillar protein (breast)

Treatments	Activity (μmole/mg/min) Storage time (h)		
	1	24	Time difference
Control	0.098[a]	0.139[a]	*
8 h fast + 10 min enforced exercise	0.131[b]	0.151[a]	*
24 h fast + 10 min enforced exercise	0.121[b]	0.155[a]	*

Mean values obtained from 18 replicate determinations. Values will the same superscripts are not significantly different ($P<0.05$).

* Means between treatments of storage time are significantly different ($P<0.05$).

Table 5. Effect of stress and storage time on the ATPase activity of myofibrillar protein (thigh)

Treatments	Activity (μmole/mg/min) Storage time (h)		
	1	24	Time difference
Control	0.117[a]	0.113[a]	NS
8 h fast + 10 min enforced exercise	0.102[a]	0.116[a]	NS
24 h fast + 10 min enforced exercise	0.098[a]	0.129[a]	NS

Mean values obtained from 18 replicate determinations. Values with the same superscripts are not significantly different ($P> 0.05$).

NS, means between treatments of storage time are significantly different ($P> 0.05$).

Table 6. Effect of stress on the colour and pH of breast muscle after 24 h storage at 4℃ post mortem.

Treatments	L-value	α-value	b-value	pH value
Control	31.84^{a}	13.43^{a}	6.12^{a}	5.78^{a}
8h fast + 10 min enforced exercise	29.40^{b}	12.14^{ab}	4.79^{b}	5.98^{b}
24h fast + 10 min enforced exercise	27.16^{c}	11.27^{b}	3.60^{c}	6.25^{c}

Mean values obtained from 20 replicate determinations. Values with the same superscripts are not significantly different (P> 0.05).

Table 7. Effect of stress on the colour and pH of thigh muscle after 24 h storage at 4℃ post mortem.

Treatments	L-value	α-value	b-value	pH value
Control	31.32^{a}	15.16^{a}	6.07^{a}	6.06^{a}
8h fast + 10 min enforced exercise	24.91^{b}	13.33^{a}	4.07^{b}	7.01^{b}
24h fast + 10 min enforced exercise	24.00^{b}	14.35^{a}	3.78^{b}	7.14^{b}

Mean values obtained from 20 replicate determinations. Values with the same superscripts, are not significantly different (P> 0.05).

ATPase activity of myofibrillar protein (Tables 4 and 5)

ATPase activity of the myofibrillar protein of breast muscle from stressed ducks was higher than that from controls after storage for 1 h, and there were no significant differences induced by the different stressors. The ATPase activity was, however, higher in breast muscle samples stored for 24 h compared to that in samples stored for only 1 h. In contrast, the activity of ATPase in the myofibrillar protein of thigh muscle was unaffected by either stress or time of storage. These results agree with the data of Goll and Robson (1967), Penny et al. (1967) and Ikeuchi et al. (1978, 1980). It has also been shown that the activity of the natural actomyosin-Mg^{2+}-ATPase complex gradually increased with time after death and that the ATPase activity of the natural actomyosin from breast muscle of broilers was lower than that of the natural actomyosin from thigh muscle (Hay et al., 1972). In contrast, Wolfe and Samejima (1976) reported no differences between broiler thigh and breast muscle ATPase activity while that of duck thigh muscle was variable. Further studies will be required to resolve this apparent discrepancy.

Colour changes in duck muscle

The breast and thigh muscles from the stressed ducks had significantly lower L- and b-values but similar α-values to those of controls (Tables 6 and 7). Although the L-values differed, it was difficult to decide whether the colour had changed or not. The colour of the breast muscle between the control and stressed ducks could be seen to be different, and demonstrated a DFD-effect. The colour of thigh muscle was also slightly affected by the stressors. Visually, the colour of muscle from the control ducks was bright red, and the colour of muscle from the stressed ducks became darker with fasting time.

Conclusions

Stresses imposed on ducks before slaughter caused the activities of LDH, CPK and ALP in the serum to increase, but did not significantly affect the extractabilitv of the myofibrillar protein from either breast or thigh muscle.

ATPase activity was higher in the breast muscle from stressed birds than from controls 1 h after death and increased with storage time. There were no significant differences observed in the ATPase activities in thigh muscles from ducks subjected to the various treatments. Consequently, the breast muscle of ducks stressed before slaughter was DFD-like and its darkness became more intense the longer it was stored. The muscle from unstressed ducks and for those fasted for only up to 4 h resulted in meat of the preferred red colour.

Components with molecular weights of 44 kDa (in breast muscle) and 40 kDa (in thigh muscle) were also identified. It is recommended that ducks should not be fasted too long or subjected to other stressors before slaughter.

Chapter 6. Microbiological Properties of Ducks and Geese

There are very few researches related to waterfowls-ducks and geese meats' spoilage and processing. The most researches are focused on chicken and turkey meats. Kraft(1971) isolated 24 strains of microorganisms from poultry carcasses and fresh poultry meat (Table 6.1).These bacteria can be divided into two groups: 1) pathogenic organisms which may be the source of illness, and 2) non-pathogenic organisms which do not cause foodborne diseases, but may cause the poultry meat spoiled. The major pathogenic organisms are listed in Table 6.2. Some research workers have investigated contamination of duck and geese with pathogens. Siems et al(1975) evaluated 25 samples of ducks and 25 samples of geese, they found 80% of duck samples and 16% of geese samples were positive incidence of Salmonella spp. contamination, respectively. Kawantes and Issac (1975) examined 3 ducks on Listeria spp contamination and found 100% positive. Kasrazedeh and Genigeorgis (1987) investigated the contamination of *Campylobacter* spp.of duck offals and found liver, gizzard, heart and skin had 34, 20, 6 and 6.7% positive, respectively. And Cabrita et al.(1992) also examined live ducks and found 40.5% of birds contaminating Campylobacter spp. In Taiwan we also found the fresh duck carcasses frequently incidence in Salmonella spp. contamination. This is a big problem with safety of duck meat products. Fortunately, because the eating habits are different from western-countries. Most foods we cook well. It does not too often occur the foodborne illness. However, in this chapter the author would like to remind the processors to pay more attention to sanitation and safety of ducks and geese processing to prevent foodborne disease.

Table 6.1 Microorganisms isolated from poultry meats*

Achromobacte	*Actinomyces*	*Aerobacter*
Alcaligenes	*Arthrobacter*	*Bacillus*
Brevibacterium	*Corynebacterium*	*Escherichia*
Flavobacterium	*Gaffkya*	*Haemophilis*
Lactobacillus	*Microbacterium*	*Micrococcus*
Neisseria	*Paracolbacterium*	*Proteus*
Pseudomonas	*Salmonella*	*Sarcina*
Staphylococcus	*Streptococcus*	*Streptomyces*

*Source: Kraft (1971)

Table 6.2 Pathogenic organisms commonly found in poultry meats

Campylobacter jejuni	*Clostridium perfringens*
Salmonella spp.	*Staphylococcus aureus*
Yersinia enterolitica	

Microbiological aspect of spoilage of poultry meats

The surface of freshly chilled poultry meat carry in large number of psychrophilic organisms throughout the processing normally. The most proportion of psychrophilic organisms usually isolated from freshly processed carcasses include strains of pigmented and non-pigmented *Pseudomonas spp., Alteromonas putreficiens, Acinetobacter spp., Moraxella spp.,*and *Enterobacteriaceae.* These organisms only a small proportion of organisms growing in/on the poultry meats. If the low temperature of scalding at 50 to 52°C is employed, and when carcasses are also chilled, these organisms are unable to resist the scalding process. Therefore, the sanitation of equipment and water during chilling of processing are very important to control the numbers of microorganisms contaminating the poultry products. During chilling, the number of psychrophiles may reach a relatively population. In general, when the poultry products are stored at 2°C for 4-6days, psychrophiles will reach a given numbers. Some factors affecting psychrophiles number and putrefaction of poultry meat are as follows:

1. Chilling methods(cold air or water bath).
2. Storage temperature.
3. Microbial composition and population after processing.
4. Natural materials(skin, muscle and other tissues).
5. Packaging materials(density, air, carbon dioxide and water penetrating ability, and interior gas composition).
6. Antibiotics, preservatives and ionic irradiation treatments.

Chilling

In Taiwan and China immersion chilling is the most widely used method for ducks and geese carcasses chilling. With this type of system, movement of the birds through water in a state of constant agitation has a washing effect which removes numerous organisms from both the inner and outer surfaces of the carcasses.

Usually the washing effect of immersion chilling reduces both coliform counts and total viable microbial counts from carcass by 50-90%. Surkiewicz et al.(1996) showed that level of Salmonella on contaminated carcasses were reduced during

chilling, although the incidence of Salmonella positive birds in their study remained at 20.5%. Addition of hypochlorite to water-chilling systems, which is commonly practiced in some countries, or chloride dioxide are effective means of overcoming any problems.

By maintaining a total chlorine residual of 45-50mg/liter and a water usage of 2.5liter/carcass. Many researchers reported that *Pseudomonas spp.* are the key spoilage microorganisms of the fresh poultry meats, the others are *Acinetobacter, Moraxella, Brochothrix thermosphacta*, Atyical *Lactobacilli* and *Enterobacteriaceae.*

Storage temperature

Temperature is an important factor for microbial growth, the lower the temperature, the lag phase of organism growth the longer, and the generation time is also longer. For example, the generation time for *Pseudomonas* is shown in Table 6.3.

Table 6.3 The generation time for *Pseudomonas spp.*

Temperature(°C)	generation time(hr)
-2	36.4
1	12.4
5	7.4
10	4.7
15	2.2
20	1.4
25	0.89
36	0.96

However, a typical mesophilic organisms such as *Escherichia coli* can not grow at -2, -5°C, and its generation time at 10°C is 14hr.

In general, the generation time for the spoilage organisms isolated from the surface of chicken carcasses averaged at 12 hr for *Pseudomonas spp.*, 14 hr for *Acinetobacter.*

Another case, store the eviscerated turkey carcasses(air chilling) at 5, 2, 0 and -2°C, respectively, the times for incidence of off-odor are 7.2, 13.9, 22.6 and 38 days, respectively. These data provide the information that the lower temperature is an effective way for poultry meat storage.

Spoilage order of parts of poultry carcass

The eviscerated poultry carcass under cold storage the surface is the easiest

contamination by the spoilage organisms, and off-odor first occurs in the cavity of carcass. The neck is a part of the quickest spoilage. However, the storage life of cuts and offals is shorter than the whole carcass. The reason for this may be due to the cuts and offals exposed surface area is too greater and they are also contaminated through the processes post-chilling.

Chemical and physical aspects of spoilage

Autolytic activities of poultry meat post-slaughter play an important role in the changes of freshness of poultry meat or carcasses. Especially, the retard growth of microorganisms. Some research workers try to disclose the reasons for the conditions of meat and appearance and flavor changes as well as off-flavor. They found that the most important changes are nucleotides, proteins and lipids. It is also very important for pH value, color, tenderness, and water holding capacity changes to meat quality.

Treatments for extending storage-life of poultry meats

Some approaches for extending storage-life of poultry meats such as antibiotics, organic acids and ionized irradiation and other have been used to extend dressed carcasses or cuts storage-life. Usually the objectives of the treatments are 1) to reduce spoilage organisms, 2) to inhibit pathogenic organisms growth.

Antibiotics-Tetracycline that was the first antibiotics used in 1950-1960, but the poultry industry did not apply since they considered the incidence of antibiotics -resistant strains. And the radiation method was also not accepted by the poultry industry and the consumers. Thus the best approach to reduce the contamination of the spoilage organisms on duck and goose carcasses or meats is to apply organic acids such as sorbic acid, lactic acid, citric acid, tartaric acid, acetic acid and ascorbic acid. Here the author wants to provide a formula for the industry to use, they are as follows: Acetic acid 2.0%, lactic acid 1.0%,citric acid 0.25%, ascorbic acid 0.1% plus water to make 100%. The solution can be used to spray on the surface of carcass or meat.

Problems with duck and goose products processing

Some of the processing of waterfowls like roasted duck and goose in order to make the skin crispy, usually dry the skin of dressed carcass in the air after slaughter. Even open a hole from vent or abdomen, and bloom between the skin and meat of the carcass with air pump then hang on the rack and dry in the air or sun-heat. This may cause the carcass spoiled, it may not be detected by organoleptical evaluation. Although dried surface of carcass can retard microbial growth, but the ambient temperature may provide a good condition for microbial growth and chemical reaction. These processing procedures are not like western-style meat processing

under a poor environment condition.

Another problem the used marinade or broth stock is repeatedly used, the author considers this may produce much free radicals from fat oxidation left in the used stocks. Or produce lysinoalanine -a carcinogenic substance from the protein denatured by cooking. These problems with safety and hygiene of the products needs to be solved to protect the consumers.

References:

1. Chen. et al. 1992. Bulletin of Grading and Specification of Poultry Carcass, National Chung-Hsing University.
2. Marenzi, C. 1985. Microbiological, chemical and physical aspects of spoilage in fresh poultry meat. 7th European Symposium on Poultry Meat Quality. Denmark.
3. Mead, G.C. 1989. Processing of Poultry, Elsevier Applied Science, USA.
4. Waldroup, A.L. 1996. Contamination of raw poultry with pathogens. World's Poultry Sci. Journal, 53(3):7-23.

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. Hurdle effect.

3. Concept for clean rooms in meat plants.

4. Homeostasis and hurdle technology.

1) Homeostasis is the tendency to uniformity or stability in the normal status(internal environment) of the organisms.

5. 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)
1 l) Preservatives(organic acids, GDL etc.)

Chapter 7. Utilization of waterfowl products

Introduction

Meat and eggs products from waterfowl play an important role in the poultry industry in Taiwan. Ducks provide both meat and eggs for me consumption and geese mainyl provide meat. Duck meat comes mainly from mule ducks and partly from Peking ducks and spent laying ducks. Trends in the market however show an increasing demand for Muscovy. In the Southeast Asian countries this bird has attracted attention. The duck has the advantage of being able to adapt to a hot and humid environment. It is hardier and more resistant to diseases.

There is an abundant variety of waterfowl breeds m Taiwan. Besides the famous Peking duck and Chinese geese, many new breeds and varieties are also found in the island, and their productivity is as good as or even better than older varieties. Some foreign breeds have been imported in recent years so there are many opportunities to utilize hybrid vigour in production. Chinese like to eat waterfowl meat and eggs, and the meat usually is prepared by roasting and salting methods; besides the original flavour of meat, Chinese aromas and spices are added, which enhances the flavour. Also, waterfowl eggs, especially those of ducks, are cured with salt and special preparations. The Chinese often use them as an appetizer with wine.

Utilization of duck meat is different among the breeds. Meat from Peking ducks is used as raw material for roasted duck which is known all over the world. Peking duck besides is used for roast duck. it is also used for processing duck roll. duck steak and ham. Muscovy ducks have red meat, an especially pleasant taste and a size suitable to cutting up and further processing. Muscovy duck meat is used for both fresh consumption and stewed with Chinese herb medicine such as ginger duck (gian mu ya) which is very famous and popular product during winter season. Mule ducks, a cross between selected Peking and Muscovy lines are used for meat consumption and cured duck processing. It has a texture and taste which is highly appreciated by connoisseurs.

Basic research on duck meat:

Since 1971 Chen et (1971, 1973a,b, 1974)have done some studies on curing of duck meat and reported: 1.Influence of pre- and post-chill treatments on cure diffusion, 2.Influence of NaCl concentration on color formation and stability, 3.Effects of drying and smoking processes on formation and 4.Change of nitrite and nitrosopigments during storage. At that time, they found the myoglobin content of duck muscle is 0.38mg per gram which is close to the myoglobin content in porcine

muscle. And the myoglobin content in thigh is higher than in the breast muscle.

Other basic researches, Chen et al. first found DFD duck meat caused by stress (Liu and Chen, 1988 and 1989, Lin et al., 1990, Chen et al., 1991). They also studied the characteristics of duck carcass and meat (1984).

Duckling in Taiwan has been traditionally marketed in the form of a whole carcass and Chinese-style processed food such as roasted duck, cured duck cake (Ban-Ya) and marinated duck parts and pickled duck (Chen et al. 1992). There are very few processed products on the market, thus, recently, the processors have attempted to develop new products such as duck roll, duck ham, duck meatballs and smoked breast and thigh to make consumers easier to prepare than the traditional products. One of the new developed processed products is duck roll which becomes popular on the market. The products are processed by tumbling with salt to extract the salt soluble proteins as a binder (Chen et al. 1985 1992; Huang 1993). For the consumers health concern, it is a trend to reduce sodium salt content in food. Interest in use of hydrostatic pressure in the food industry is increasing (Suzuki 1988). Researches have showed that the high hydrostatic pressure could be used to induce gelation of muscle protein (Macfarlane et al. 1984; Okamoto et al., 1990; O'Shea et al., 1979; Yamamoto et al., 1990). Salt soluble proteins (myofibrillar proteins) are used as a binder for manufacturing restructured meat products such as duck roll. duck ham etc. These products are traditionally made by heat induced gel to bind meat cuts or particles. Suzuki (1988) reported that the natural actomyosin formed a spongious gel at low salt concentration by high pressurization. A combination of high pressure treatment and low salt may be used for manufacturing duck roll or steak. No research related to the restructured duck meat bound by high pressure induced gel has been done. Therefore, Chen et al. (1995) have investigated effect of hydrostatic pressure on thermal properties and electrophoretic behavior of duck meat proteins as compared with the heat effects. The changs of electrophoretic patterns of sarcoplasmic proteins in pressurized duck meat paste were less than the heated sample that correspond to the changes in DSC thermogram. It was found that me transition temperature and denatured enthalpy as well as electrophoretic behavior of muscle proteins in the heated and pressurized duck meat paste were altered by salt addition.

Manufacture of Chinese-style Duck Products

Chen et al.(1985) used ninety-day old mule ducks (live weight approx. 2.8 kg) to manufacture the special Chinese-style duck products such as eight delicious duck, steamed and fried duck, smoked duck, boiled and salted duck and barbecued duck, by the traditional processing methods. The products were packaged in vaccum, and stored under refrigeration and freezing. The samples were taken out from the cooler

and freezer every one week to determine their storage life, chemical composition and palatability.

The result of panel test indicated that boiled salted duck, smoked duck and steamed and fried duck were more acceptable than other products.

The refrigerated and frozen products were reheated and evaluated their palatability, the scores of the panel test were the same as the control (without chilling and freezing). However, the chilled samples were more palatable than the frozen samples. The result of shelf life test showed the VBN content for chilled and frozen samples increased as storage time, and TBA values had the same trends as VBN changed, but irregularly. And it was also found that the higher the fat content of the samples, the higher the TBA values detected. The bacterial counts for all samples had no remarkably change during cold storage.

Eight treasure duck (Ba Bao Ya) is processed with salt, MSG, pepper and wine, meat, dried cuttle fish, mushroom, carrot, peanuts, bean and dried shrimp which are mixed with steamed glutenous rice and filled in duck carcass, then sealed the opening and steam cooking for one hour.

Crispy skin duck (shang su ya) is prepared by pickling the duck carcass in pickle solution of pepper, star anise, salt, MSG, then pressed and cooked for 30 minutes, afterward cooked in hot oil to become golden color and crispy.

Camphor and tea smoked duck (zhang cha ya) is prepared by the same method of pickling, then steamed for one hour and smoked with tea leaf and brown sugar for ten minutes and cooled.

Boiled salted duck is prepared by pickling in the solution of pepper, star anise, salt, MSG and ginger for three hours, then steamed or cooked for one hour and cooled.

Ginger-root duck (gian mu ya) Most Chinese mink male Muscovy duck cooked with herb medicine may stimulate the teenager matured, so many mothers stew muscovy with Chinese herb medicine for their children who reach the age of 20 years old. In recent years, a company (king Food Company) operate a chain store to serve a health food name "Ginger-root duck" which is prepared by cooking muscovy duck with Chinese herb medicine, ginger-root, wine and water, sesame oil etc.

Smoked duck steak and duck roll Duck breast meat is used to prepare duck steak and ham, deboned thigh is used to prepare duck roll. Duck steak is processed with trimmed fillet being tumbled and cured, chilled, dried, smoked, steamed and dried again, then packed. If duck roll, after tumbled, the cured meat is stuffed in casing and then dried, smoked, cooked and dried, chilled and packed.

Peking roasted duck: Qianmen Roast duck is a very famous roasted duck in Peking. The burgundy carpet is slightly dingy, and the stairway leading to the main

dining room is poorly lit. But pay no attention to these minor details. If you are lucky enough to obtain a reservation, this is truly where the best Peking duck in the city is served. And as you may well believe from the condition of the carpet, the Qianmen Roast Duck has been serving excellent food for over 120 years.

Pressed salt duck(ban ya): 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.

Hang-roasted duck: De-feather and clean the duck, cut a hole beneath the wing, remove the giblets and air-pipe, soak the carcass in boiling water for a while, take out and pat dry for later use. Insert a roasting fork from the thighs through the breast till penetrated through me head: tie the thighs to me fork with iron wires firmly. Apply the mixed coating ingredients (vinegar and malt sugar) onto the carcass, then spread the wings wide with bamboo sticks, roast in an oven for later use. Place the marinade into the carcass through the small hole beneath the wing. seal up the hole and anus with paper, roast in an oven strong heat for about 30 minutes to serve.

Roasted squashed duck (roasted pipa ya): Paunch and clean the duck, cut open from the breast, squash, sow in the mixed marinade onto the abdominal cavity. Insert a roasting fork from the tail through the spareribs till penetrated through the head, insert another roasting pin across the carcass to flatten the duck; tie the thighs to the fork with iron wires firmly. Pour boiling water onto the duck, apply evenly with the coating ingredients, roast dry in an oven, take out, apply another layer of the mixed sauces, put back into the oven and roast over strong heat for another 30 minutes to serve.

Duck blood is used to prepare blood rice cake.

We also isolated the TGase from duck blood which had a very higher activity than the blood from other animals.

Salted duck gizzards：

Place the ingredients consisting of star anise, pepper, allspice, clove etc. in a clean kitchen bag, tie up me opening for later use. Bring the above ingredients added water, salt and soy sauce to the boil in a pot, reduce to low heat and keep simmering for about 20 minutes. Clean the duck gizzards. marinate with raw salt for about 1 day, stirring occasionally. Clean the marinated gizzards with water, soak in water for 10

minutes, rinse with warm water, strain water off for later use. Place the duck gizzards into the brine, bring to the boil and then reduce to low heat, keep simmering for about 25 minutes, remove from fire and let cool off to serve.

Goose meat processing：

Tea-goose is a new and popular goose meat product. The formula and processing method of tea-goose are the commercial secret and it is limited to be home made. Our lab (Shieh, Liu and Chen. 1997) tried to develop the formula, processing and optimum storage condition for tea-goose. The special delicate fragrance of tea-goose is the most important characteristics. Fatty acid composition and volatile compounds of tea-goose were also analyzed, and the best formula were obtained.

The volatile compounds of oolong tea, goose meat and in tea-goose meat were measured. The volatile compounds of tea-goose meat obtained from oolong tea and smoking process, were limonene, furfural, 2- acetylfuran + 6-methyl-3, 5- heptadien -2-one, 5-methylfurfural, linalool and 4-terpineol. The volatile compounds of tea-goose meat also contained hexadecanal and hexadecanol.

Steamed Goose：

Put the marinade into the abdominal cavity. Sew up the tail with a needle. Apply evenly with dark soy sauce and brown in boiling oil. Steam in a steamer.

Spiced goose：

Place the herbs and spices in a clean kitchen bag, tie up the opening, set aside for later use. Bring the ingredients to the boil in a pot, switch to low heat and keep cooking for about 15 minutes, set aside for later use. Paunch, clean and drain the goose, place into the brine and bring to the boil, switch to medium heat and keep simmering for 45 minutes, remove from heat and let cool off to serve. Mix chopped garlic with vinegar as dipping sauce.

Roasted Goose：

Paunch and clean the goose, discard the feet, remove the lungs and air-pipe out from the tail. Put me marinade into the carcass from the tail, sew up with a needle; mix the coating ingredients well for later use. Pour the marinade into the carcass from the tail, sew up with a needle; mix the coating ingredients well for later use. Pour boiling water onto the carcass, apply evenly with the coaling ingredients. Hang the goose up with a hook, let wind-dry and then roast in an oven over strong heat for about 40 minutes, turning occasionally to ensure even heating.

Roasted goose livers：

Clean me goose livers, marinate for about 15 minutes, skewer with a roasting pin, roast in an oven over low heat for about 20 minutes to serve.

Spiced goose feet and wings

Discard the yellow membrane and hair of the goose feet and wings, wash clean, cook in water till tender, strain water off for later use. Place the herbs and spices in a clean kitchen bag, tie up the opening for later use. Cook the herbs and spices with water, light soy sauce, rock sugar, salt and wine in a pot for about 20 minutes, dump the goose feet and wings in, switch to low heat and keep simmering for about 10 minutes, scoop out and cut up into serving pieces. Serve with sesame oil.

Egg products of waterfowl

The utilization of duck eggs as human food as Pikul (1995) reported, and he indicated that duck eggs could be used to prepare boiled scrambled, poached and fried eggs, pickled eggs, mayonnaise, confectionary products, deep-fat-fried or cooked minced meat balls and patties. These facts may be very strange and attractive to European people, but not to oriental people, especially for Chinese. Chinese have eaten duck eggs both fresh and processed since very long time ago. The consumption of duck eggs in Taiwan is very popular. The most popular egg products are salted duck eggs, pidan(thousand year eggs), salted yolk which is used as mooncake fillings. When duck eggs are placed in pickle and cured for 25 days then taken out of the container and break the shell to get the salted yolk. An improved method for salted yolk has been created by Yeh(1997). The salted yolk is prepared as the follows: duck eggs are broken the shell and separated into yolk and egg white, then placed yolk in pickle solution of propyl alcohol, water and salt (propyl alcohol : water = 8:2, and salt content is 9% based on the mixture of propyl alcohol and water) until the yolks are solidified.

Pidan(thousand year egg) is prepared by putting the duck eggs in pickle solution which consists of salt. tea leaf, sodium hydroxide, ash, water. It also come out the organic pidan which is soaked in a pickle solution of Chinese herb medicine and tea leaves. The process of duck eggs continued to develop. Besides the traditional preserved eggs and salted eggs, the instant egg foods such as hot spring eggs, steamed eggs, egg rolls, and fried eggs. have been progressively developed.

Literatures

1. Li-Chih Chen, Chin-Wen Lin and Ming-Tsao Chen. 1971. Influence of pre-and post- chill treatments on cure diffusion of duck meat. J.Chin. Agri.Soc.9:l-8.

2. Chen, M. T. 1973. Influence of sodium chloride concentration of curing solution on color formation and fat stability of cured duck meat. Chin. Soc. Anim. Sci. 2:27-34.
3. Chen. M. T. 1973. Effects of drying and smoking processes on color formation of cured duck meat. J. Chin. Agri. Soc. 11:92-96.
4. Chen, M. T. 1994. Slaughter and processing of goose. Agriculture Bulletin of NCHU Vol. 14, Chapt. 4, pp. 27-35.
5. Chen, M. T. and L. C. Chen.1995. Effects of pressurization and heat treatments on physical, chemical and histological properties of duck muscle. Proceeding for 10th European Symposium on Waterfowl, Halle, Germany, pp 351-354.
6. Chen, M. T., S. L. Guo, S. F. Chen. R. S. Chang, Y. C. Chiu, and A. Chou. 1985. Manufacture of Chinese-style duck products and their evaluation. J. Chin. Soc. Of Anim. Sci., 14:181-187.
7. Chen, M. T., S. S. Lin and L. C. Lin. 1991. Effect of stresses before slaughter on changes to the physiological, biochemical and physical characteristics of duck muscle. British Poultry Sci. 32:997-1004.
8. Lin, S. S., L. C. Lin and M. T. Chen. 1990. Effect of ante-mortem stress on post-mortem changes of microstructure and physical characteristics of duck muscle. J. Chin. Agir. Chem. Soc. 28:95-103.
9. Luo, Y. Z. 1990. Roasted and Spiced Food in Hong Kong. Food Paradise Publishing Co., Hong Kong.
10. Pikul, J. 1995.Utilization of duck eggs as human food. Proceedings for 10th European Symposium on waterfowl, Halle, Germany, pp.321- 328.
11. Shieh, P. R. 1997. Study on manufacturing and properties of tea-goose. Master thesis, NCHU.
12. Simonds, Nina.1990. China's Food. Harper Collins Publishers. NY, USA. pp.75, 241.
13.Wiebe Van der Sluis.1993. Waterfowl production increasing slowly. World Poultry-Misset. 9:10-13.
14. Yeh, A. I. 1997. Salted yolk. Patent No. 183932.

Chapter 8. Manufacturing technology

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:

1. 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, 1/2 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, 1/2 cup Shao-shing wine, 2 cups soy sauce, 8 cups water, 1 tbsp rock sugar and 1/2 tbsp salt.

   Preparation of stock:

   Saute 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 chum-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-lu, 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 lOg, amomuml5g, cinnamon twig 2 g, dried ginger 15g, cumin 5g, licorice 5g, wild peppercorn l0g, tangerine peel 5 g, cassia bark 2 g, dried red pepper 5 g, clove 2 g, bay leaf 1g, nutmeg 2 g.
   B. Old ginger 300g, green onion 600g.
   C. Seasonings: Salt 300g, MSG l00g, rock sugar 600g, soy sauce 2 liters, rose wine 300ml, Shao-shing wine 300ml, water 20 liters, yellow colorant 2tsp.
   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	×	50 min	10 min
Goose wing	low	×	40 min	1 hour
Goose claw	low	×	40 min	1 hour
Goose gizzard	low	×	40 min	1 hour
Chicken leg	low	×	20 min	1 hour
Goose liver	low	×	20 min	1 hour
Goose heart	low	×	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

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 l00, 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 l0g.

Green onion 15 g. ginger l0g. dark soy sauce 35 g, Shao-shing wine l00g.

a. Boil seasonings, then add spices and cook until fragrant appearing.

b. Cook "a"with green onion, ginger and soy sauce to boiling.

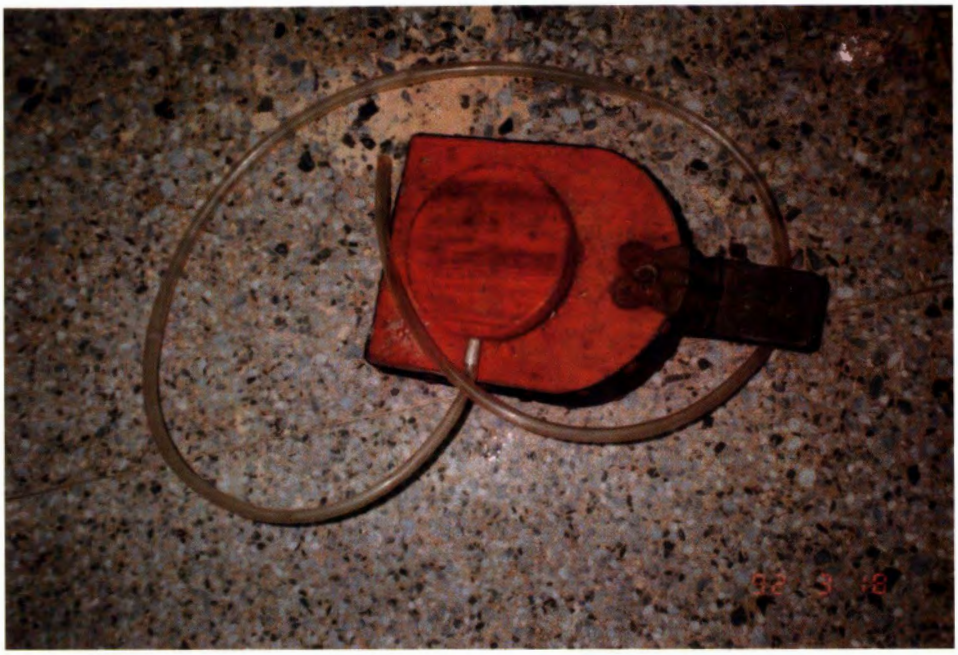
c. Cool

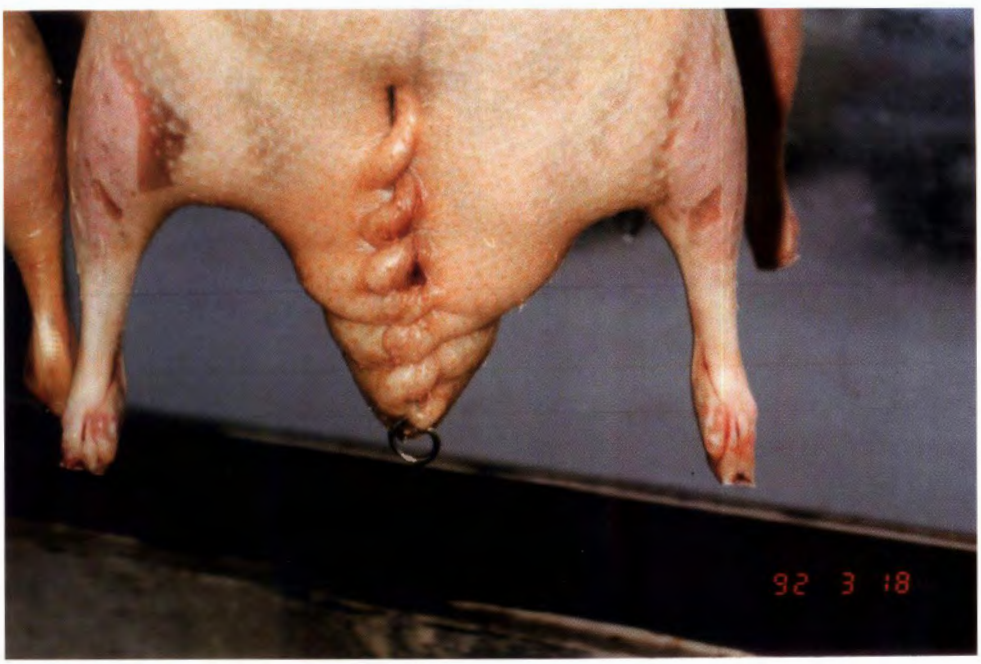
C. Preparation of spiced rice duck

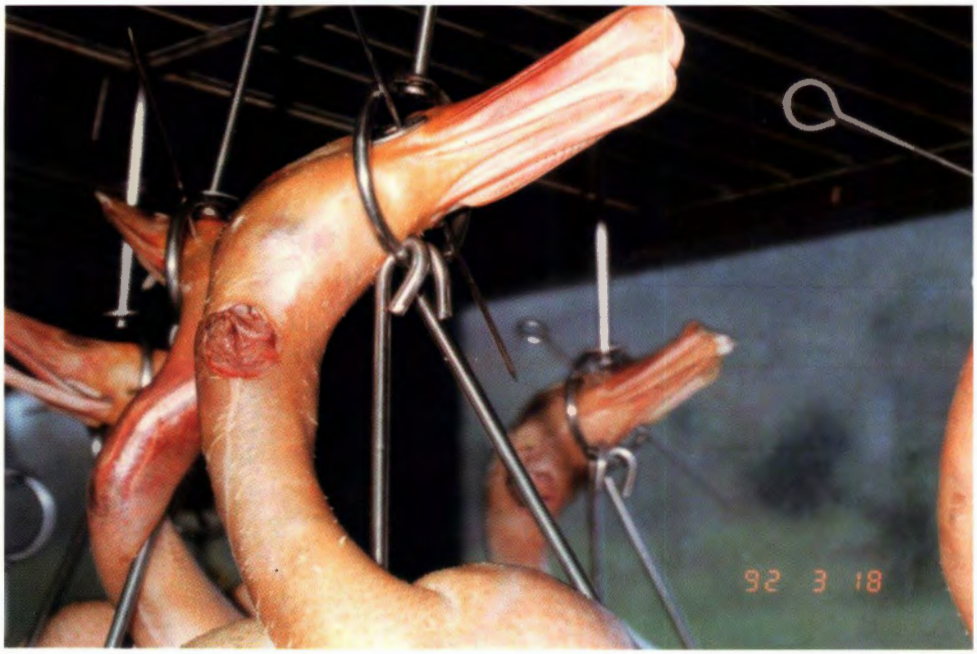
a. Soak the treated duck in cold stock for 4-5 hour.

＊ Comment

The author do not recommend to cook the foods with the used stock(lao lu). Since the used stock is heated repeatedly, residual fat or protein may be caused deterioration. The fatty acids may be oxidized to produce free radicals, and free amino acids may react with reducing sugar to incidence in browning reaction and result in some harmful compounds.




92 3 18


92 3 18

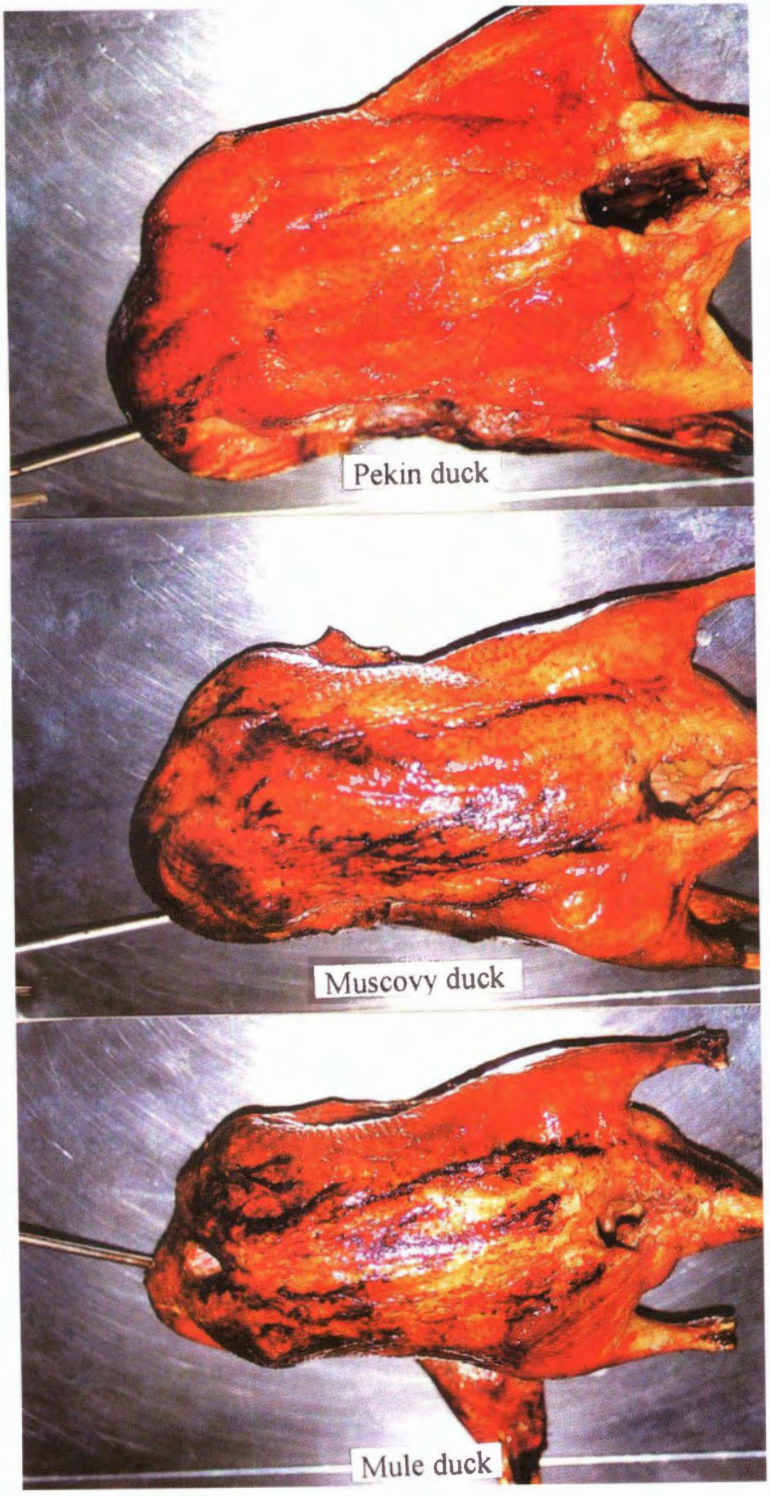


Fig2. Comparison of the appearance of roast duck on different breeds.

Factors affecting on crispiness of roasted duck skin

1. Surface of dressed duck is wet when the duck is placed into the oven or stove.
2. The oven or stove is not preheated before the duck placed in.
3. To open the door of oven or stove frequently during roasting.
4. Heat loss is due to the door opened for too long time.
5. Density of duck hung in the oven or stove is too high.

Processing Technology

1. Curing and smoking of poultry products (Mast, 1978)
   1) Use top quality birds.
   2) Develop a brine containing salt, sugar, curing salt and additional spices or flavorings of your choice.
   3) Soak poultry in brine at a temperature of 4-5℃.
   4) Wash birds thoroughly after curing in brine.
   5) Allow birds thoroughly after curing in brine.
   6) Smoke at time and temperature which will yield desired result.
   7) Reach an internal temperature of 68.5℃ for a ready to eat, fully cooked product.
   8) Package product adequately for refrigerated storage or freeze and hold at -18℃.

A typical smoke house schedule for smoked duck ham

Time(hours)	Dry bulb	Wet bulb	Relative humidity	Dampers	Smoke
1	54.4℃	-17℃	-	Open	Off
2	60℃	-17℃	-	Closed	On
2	68.3℃	51.7℃	41%	Closed	On
1	76.7℃	60℃	43%	Closed	On until desired color is Reached
2*	118.3℃	68.3℃	46%	Closed	Off

*Hold at the temperature until an internal temperature of 71.1℃ to 73.9℃ is reached.
From Cordray and Huffman(1986), Stadelman et al.(1988)

A typical process for frankfurter manufacture for poultry meat:

1) Combine mechanically separated duck and goose with ice water(water : ice=1 :1),salt, seasonings, sodium erythorbate, sodium nitrite and optional ingredients.
2) Emulsify.
3) Stuff into casings and link.

4) Cook in a fast air-circulated smokehouse using gradient heating. The end external Temperature should be 82℃ with an internal temperature at 71℃ to 72℃.
5) Shower.
6) Chill.
7) Peel and vacuum package.

Descriptions of the cook cycle during smoke house treatment

	Dry bulb temperature,℃	Relative humidity, %	Duration, min
Cook Cycle I*			
Cooking I	70	53	10
Cooking II	75	71	10
Cooking III	80	100	15
Cook Cycle II			
Cooking I	70	53	20
Cooking II	80	100	15
Cook Cycle III			
Cooking I	80	100	35

*Cook Cycles I, II, and III are different stages of cooking in the smoke house.
Reference: Stech, I, Usborne, W. R., and Mittal, G. S.(1988): Influence of smokehouse air flow, air changes and cook cycles on texture and shrinkage of wieners. J. Food Sci., 53, 421-424.

Marinade and marinating

Marinade is a mixture prepared with spices, herbs and seasonings as well as water used to prepare foods, especially meat products.

Marinating is one of the oldest methods of altering or enhancing flesh-protein products. It is wonderfully adaptable , and works well, depending on the ingredients combination with different kinds of meats.

Marinades and marinating are an excellent way to add value to existing cuts and portions in addition to expanding product lines. Besides, it also can add flavor and enhance the products' palatability. There are a lot of people think that marinating means simply throwing meat cuts in a vat filled with liquid spices. They probably think so because that is what everyone does at home. However, when you are marinating on a commercial basis you have to consider the processing conditions such as time and temperature as well as the combination of herbs and spices. At home you

can do a little, but that's lot more risky when you make the products on large scale.

The processors must understand how ingredients and fluids work and what exactly marinating does. At its core it is not a process of flavoring, but one of tenderization.

Most marinades are built-around a low-grade acid such as lemon juice or vinegar which works to break down toughness in connective tissue. This occurs when the marinades cause collagen swelling in connective tissue which in turn disrupts the hydrogen bonds in the collage is fibrils. The marination process may also include use of enzyme tenderizers such as papain, bromelin, ficin. Commercial tenderizing is often mechanical, the processors can choice the suitable tenderizing methods depending on the type of product that they want to produce. The traditional home makers are very few to think to apply these methods to their processing. Therefore, this is a big area for developing in marinades. The author also wants to point out some problems with meat marinating such as old marinade reused, sanitation and safety of marinating during processing and handling.

Spicy and hot soup concentrate

Ingredients	g
Cassia bark	37.5
Citrus peel	18.8
Wild pepper	37.5
Star anise	10
Clove	37.5
Cinnamon stick	18.8
Cardamom	15
Licorice	56.3
Luo han guo	50
Nutmeg	37.5
Red pepper, dried	37.5
Kaempferol	37.5

Spices

Chopped ginger

Chopped garlic

Seasonings

Hot pepper powder(upward to sky)	300g
Gound 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 saute then take out for use.
2. Add the spices in to wok and fry to saute 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, 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 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	10 valves
Red pepper	3 fruits
Other ingredients	
Coriander stems	20g
Bone concentrated soup	300cc
Sugar cane	200g
Seasonings	
Star anise	10g
Soy sauce	300cc
Roak 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 saute, the pack the into the marinade bag and tied and store for use.
2. Add spices in wok and fry them to saute and take out for use.
3. Add sugar in wok and fry evenly, add other seasonings, marinade bag, and spices (l, 2) and cook with big fire until boiling, and turn to small fire 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
Garli	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 saute 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

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 saute 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	
Citrus peel	3g
Licorice	6g
White pepper grains	3g
Star anise	4 grains
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	100 g
Rock sugar	50g
Salt	30g
Caramel colorant	50cc

Procedures:

1. Place spices into wok and fry to saute and cool for use.
2. Pack the marinade ingredients into the bag and tie.
3. Add seasonings and bone concentrated soup and spices(l) to the wok(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.

Hunan marinade bag

Ingredients	
Star anise	8 grains
Wild pepper	75g
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 saute and cool for use.
2. Add star anise and wild pepper and fry to saute, then pack them with other marinade ingredients into bag and tie.
3. Add seasonings and the materials of (1,2) 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	6 grains
Churn-Gong	37.5g
Bay leaf	18.8g
White pepper grains	75g
Cardamom	5 grains
Nutmeg	37.5g
Other ingredients	
Green onion	4 sections
Ginger	100g
Carrot	100g
Radish	200g
Bone concentrated soup	1000cc

Procedures:

1. Add trace oil and green onion and ginger into wok and fry them until saute 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	10g
Cassia bark	8g
Sand ginger	15g
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
Ouloong 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 5 minutes.
4. Cool and store for use.

Chapter 9. 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 to develop cured meat color-nitrosyl myoglobin and inhibit microbial growth especially Clostridium botulinum which may causes a mortal intoxification-botulism.

Therefore, so far, there are not anything being able to play a role on both functions.

Nitrite usage level and its effects:

l.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	

Cured meat color development

Potassium Nitrate(KNO_3)------->KNO_2

$KNO_2 + CH_3CHOHCOOH$------->$HNO_2 + CH_3CHOHCOOK$

$2HNO_2$------->$NO+NO_2+H_2O$

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

(Nitrosyl myoglobin---cured meat color)

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

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. Glycerine, 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.

Chapter 10. Duck meat processing

Duck meat processing

Spiced duck tongues

Ingredients:

Duck tongues:30, garlic 3 valves, green onion 1, south ginger 38g

Marinade ingredients:

Star aniseed 2grains, xanthoxylum 1/2 slices, cassia bark 2 slices, fennel 1/2 tsp, clove 1/2 tsp, amomum 2 grains, tangerine peel 1 slice.

Seasonings:

Rice wine 75 mL, dark soy sauce 1 tbsp, rock sugar 1 tbsp, chicken essence 1/2 tbsp, caramel 1/2 tbsp and sufu 1 block.

Procedures:

1) Clean duck tongues, blanch(dip the tongues in boiling water), remove dirt from throat by chopsticks. Then rinse in running water.
2) Remove garlic skin, cut green onion and slice ginger.
3) Put 2 tbsp vegetable oil in preheated pan and fry garlic, onion and ginger to fry garlic, onion and ginger to become golden color, add marinade ingredients to fry to be aromatic, and cool, then put into cotton bag as marinade bag.
4) Add 4 glasses of water, marinade bag and seasonings and duck tongues into a cooker, and cook until boiling by high-heat, then turn to low-heat for 5 min, then turn off heat.
5) Cover the cooker and simmer for 15 min, take out and cool.

Duck meat sausage

Raw material:

Duck meat 2.75kg、porcine back fat 1.36kg、goat casing 20g

Curing agents:

Sodium nitrite 0.3g、Salt 60g、Glucose 20g

Spices and seasonings:

Chopped winter onion 225 g、butter 30g、chopped garlic 30g、Red wine 720g、chopped sage 4g、chopped coriander 9g、Black pepper powder(course ground) 7g、chopped thyme 1g

Procedures:

1. Fry chopped winter onion with butter until softened.
2. Add garlic and red wine.
3. Grind duck meat and back fat separately with fine plate.
4. Blend ground duck meat with sodium nitrite and salt to extract salt soluble protein to bind fat and develop cured meat color, then mix ground fat.
5. Mix meat mixture with onion, garlic and other spices thoroughly.
6. Stuff the mixture into goat casing and link.
7. Smok the sausage slightly.
8. Cook the products to internal temperature reaching 70℃.

Smoked duck ham

Formula	%
Duck meat	100.0
Salt	1.6
Sodium nitrite	0.01
Sodium glutamate	0.50
Cane sugar	1.00
Polyphosphate	0.25
Spices*	0.35
Sodium erythorbate	0.05
Potassium sorbate	0.20
Isolated soy protein	2.0
Rice wine	2.0
Water	17.0

*A mixture of spices: garlic powder: five spices white pepper : cinnamon : ginger powder: licorice =1:1:1:1:1:0.5

Processing procedures:

1. Raw duck selection

Healthy, disease-free, plump and moderate matured duck is used and slaughtered

according to GMP procedure. After slaughtering the duck carcass is fast chilled to the internal temperature below 5℃. The carcass is no feathers residue and blood spot.

2. Deboning and trimming

   Carcass is cut, remove breast; thigh is cut along the mid-line and removed bone. During manufacturing, must inspect carefully whether any broken bones residue. Trim off tendon and ligament and visible fat. The thick part of meat such as breast and thigh is cut shallowly and don't damage the skin to aid the brine distribution.

3. Brine preparation

   Mix the ingredients of the formula well to prepare the brine for curing.

4. Tumbling process

   Put the duck meat and brine into the tumbler and start the machine at 15rpm, tumbled for 15 min. and interval stopped for 30 min, the process is continued for 24 hours in -2℃ chilling room.

5. Curing

   After tumbling, the tumbled meat and brine moved to curing room at below 5℃, cured for 12 to 24 hours.

6. Reforming and pressing

   Place cellophane paper at the bottom of the mold and place the thigh or breast duck meats on the paper, the lean meat side up and skin down, then place another cut of thigh or breast surface to surface, skin up. Then put the trimmings inside of the big cut of meats and pressed and molded. Meanwhile, punch several holes of the cellophane casing to help air and water come out.

7. Drying, smoking and cooking schedule:

   Color development: 40℃, 45 min.

   Drying: 45-50℃, 60 min.

   Smoking: 60℃, 80 min.

   Cooking: The smoked ham is cooked at 75-80℃ to the internal temperature at 73℃, then roasted at 60℃ for 20 min.

8. Chilling, packaging and storing.

The flow chart of processing

Raw meat selection→ deboning and trimming → ingredients
Mixing →tumbling → curing → reforming and
Pressing → drying → smoking → cooking → roasting → chilling →packaging
(see page 85 The processing flow chart of restructured duck steak and ham).

Roasted Peking duck

Raw material:

Peking duck or mule duck 3kg

Coating syrup:

Vinegar 160 g, brown vinegar 40 g, malt sugar 40 g,

Marinade:

sugar 3tbsp, salt 2 tbsp , star anise 4 grains, proper amount of ginger, garlic, five spices 2 tbsp.

Procedures:

1) Paunch and clean the duck carcass, remove feet, discard lungs and airpipe out from the tail.
2) Put the marinade into the abdomen of the carcass from the tail sew up with a needle, mix the coating syrup ingredients well for use.
3) Pourboling water onto the duck carcass, dry and spread coating syrup evenly.
4) HANG the duck carcass up with a hook, let air-dry and then roast in an oven for about 25 min, turn occasionally so as to ensure even heating.

Hong Kong-style spice broth

Ingredients:

Amomums 10g	Onion 3 sections
Star anise 10g	Ginger 20g
Cassia bark 8g	Water 1600mL
Kaempferia 15g	Soysauce 600mL
Clove 5g	Rice wine 100mL
Xanthoxylum 5g	Sugar 120g
Fennel 3 g	
Bay leaf 3g	
Licorice 5g	

Broth preparation:

1) Put all herbs into cotton bag, and tie used as marinade bag.
2) Press onion and ginger with knife back and Place in vat, add water to cook until boiling.
3) Add soy sauce and rice wine into vat and cook until boiling.

4) Add sugar and marinade bag(3), and keep cooking by low-heat to be boiling (about 5 min) and fragrantly.

Hong-Kong style spiced duck wings

Duck wings 10 pieces

Hong-Kong style spice broth 2000mL, Soy sauce as desired.

Procedures:

1) Clean duck wings and blanch in boiling water.
2) Add marinade and cook until boiling then place" 1" chang to weak heat and cook for 25 min, turn off heat and soak for 30 min, then take out and pour sesame oil.

Spiced duck neck, tongue, claw, feet, wings and head

Raw materials: neck, tongue, claw, feet, wings and head

Marinade ingredients (for 100kg raw materials use) :

Sodium nitrite 3g	Salt 3.78kg
Sugar 1.5kg	Sodium isoascorbate 0.05g
Anka red 5g	Anka yellow 5g
Red pepper powder 50g	Ginger powder 50g
Licorice powder 100g	

Procedures:

Processing flow chart

1. Receiving
2. Thawing
3. Curing
4. Taking out
5. Marinating and cooking
6. Chilling to below 25℃
7. Vacuum packaging
8. Retorting(115℃, 27 min. or 121℃, 18-19 min)
9. Chilling to the internal temperature of the product below 20℃
10. Packaging and storing at 0-25℃
11. Distributing

Marinating program

Temperature	time
1.90℃	12-15min
2.88℃	10min
3.85℃	8min

4.Soaking at 60-65℃ for 90min.

Spiced duck wings

1. Raw materials: Duck wings 10

2. Ingredients: Rice wine 30mL

Caramel marinade: as desired.

Caramel marinade ingredients: Amomum 2g, cassia bark 15g, star anise 5g, fennel 3g, licorice 5g, xanthoxylum grains 4g and bai kou 3g.

Spices: green onion 2 sections, ginger 15g, garlic 30g.

Caramel solution: rock sugar 100g, brown sugar 100g and hot water 200mL.

Marinade broth: soy sauce 250g, rock sugar 100g, salt 20g and water 1500g

Procedures of making caramel colorant:

1) Fry rock sugar and brown sugar with a little of frying oil in frying wok by low-heat to melt sugar and heat until bubbles occurring. During frying occasionally stir the syrup.
2) Stop fire and add hot water into melt sugar, then turn on the heat and stir the syrup evenly for use.
3) Wash and clean green onion and cut into sections ; wash, press and crush ginger root; remove skin of garlic and crush ; then fry with soy sauce to aromatic.
4) Add rock sugar, salt and water into (3), then add caramel syrup(2) and keep heating until boiling.
5) Rinse the marinade ingredients and drain off, then pack in the cotton bag for use.
6) Add (5) in (4) and heat until boiling, then turn to low-heat and cook for 15 min until appearing fragrant to be used as caramel marinade broth.

3. Spiced duck wings processing:

1) Pluck feather and wash and clean wings for use.

2) Dip the wings in boiling water several times until no blood coming out when insert and remove the steel needle, then quickly rinse in the running water to remove the smear and make the meat firm.
3) Boil the caramel marinade broth and rice wine, then add rinsed duck wings in and the marinade broth must cover the duck wings, and keep heating until boiling again, turn on slight heat and marinate for 50min, then turn off the heat.
4) Take out the duck wings and after cooling, add some caramel marinade broth on it and store in the cooler.

Smoke duck wings

1. Ingredients

Duck wings 10

Iced caramel marinade broth 3000mL

Seasonings: sugar 50g, black tea chips 5g, and sesame oil 1tbsp.

2. Iced caramel marinade broth:

A. Ingredients: Amomum 2 grains, cardamom 2 grains, sha-jiang 10g, fennel 3g, xanthoxylum 4g, licorice 5g, star anise 5g and clove 2g.

B. Marinade ingredients : green onion 2 sections, ginger 50g, garli 40g, water 3000mL, soy sauce 800g, sugar 200g and rice wine 50mL.

C. Preparation:

a) Wash and clean green onion and cut into sections and press; remove ginger and garlic skin and wash, then slice and press for use.
b) Crush amomum and cardamom and pack the ingredients 2-A in the cotton bag and tied.
c) Fry marinade ingredients with oil (3 tbsp), then add other ingredients and (b), then cook by high-heat until boiling, then turn to low-heat and keep cooking for 10 min to occurring aromatic.

3.Smoked duck wings preparation:

1) Wash and clean duck wings, and dip in boiling water for 1 min and rinse in running water, then drain for use.
2) Cook iced marinade broth by high-heat until boiling, then add (1) duck wings and cook by low-heat for 8 min, then turn off the heat and marinated for 20 min and take out and drain off.
3) Take a wok and place a aluminum foil on the bottom of the wok and add some sugar and black tea chips; then place a rack on the middle of wok and place the marinated duck wings on the rack, and cover the wok.

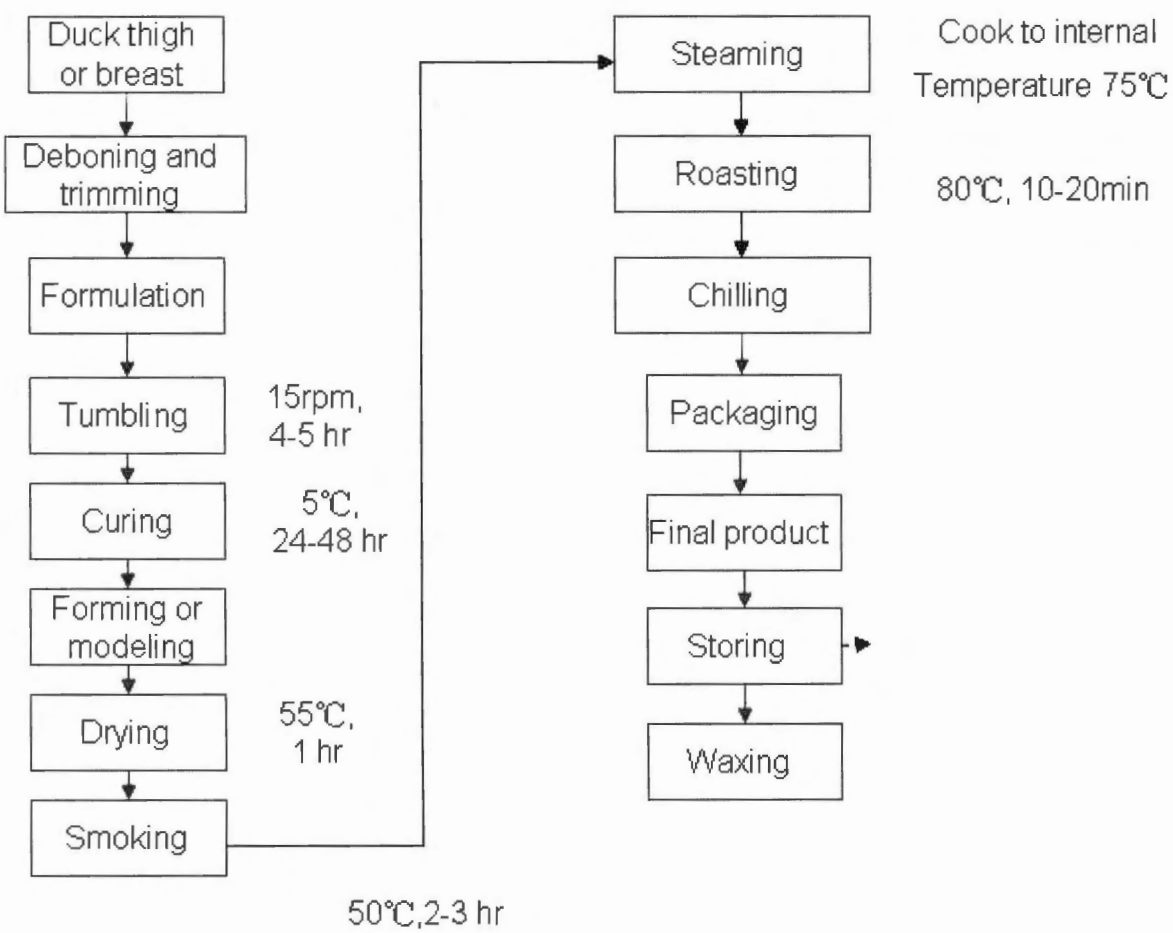
4) Turn on the gas by medium-heat to produce smoke ; during smoking for a while you must check the color of wings. As the color becomes desirable you can turn over the side of wings and keep smoking. When both sides of the wings become good color, then turn to low-heat to simmer the wings about 5 min, then turn off the heat and keep simmering for 2 min, and take out to spread sesame oil on the surface of duck wings and pack in box and store in the cooler.

Smoked duck tongue

1. Ingredients:

Duck tongues 20, Iced marinade broth 2000mL, sugar 50g, black tea chips 5g, and sesame oil 1 tbsp.

2. Preparation is same as smoked duck wings



The processing flow chart of restructured duck steak or ham

Duck meat salty pie processing

Salty pie crust (pate a brisee):

Ingredients :

1. Low gluten flour 500g , sweet butter 280g , whole egg 2 , water 80 ml, salt 6 g
2. Cooked red cabbage:
   Red cabbage 1kg, coarse salt desirable amount, sliced onion 350 g, apple 250g, red wine 300ml, red wine vinegar 140ml, pork stock 400ml, white pepper 3g, juniper berry seed 5g, coriander seed 1g, water 500ml.
3. Chopped onion 1/2 bulb, chapped garlic 1 tsp, vegetable oil desirable amount, duck breast (with fat) 450g, salt, white pepper desirable amount, whole egg 1.
4. Duck thigh immerse in lard 1, water + yolk desirable amount.
5. Sauce.
   Onion slice 1/2 bulb , beer 100 ml, veal stock 100 ml, salt and white pepper desirable amount.

Duck meat salty pie

1 Pie crust preparation :

1.1 sieve low gluten flour , and 1 cube of butter and then knead and add other ingredients into a dough.

1.2 wrap with a film and place in refrigerator for lavening.

Cook red cabbage with red wine

1. cut cabbage into 5 mm wide, add salt 5% by total weigh of cabbage, and mix and rub.
2. Drain the pickle solution out and ferment for 2 days in the bowl, then take out to rinse.
3. Fry whole cut of bacon , then add onion and keep frying to be soften .
4. Add drained red cabbage and apple dice($1cm^3$). After fried, add other ingredients, during frying, to remove bubbles and cook for 40 min, and then remove bacon.

Duck meat pie preparation:

1. Chop onion and garlic and fry it with vegetable oil to be softened, then cool.
2. Grind duck breast with fine plate, and mix with (1) and egg, salt and white pepper.
3. Fry oil to immerse duck thigh meat to be brown and fragile, remove bone and cut into a suitable size for use.
4. Knead the crust into 2-3 min thick, then place in a mold, and trim the extra edge, and place half of (2) material, then place 100g red cabbage, finally place another

half of (2), and press from upside to become firm or tightly.

5. Cover 2-3 mm thick crust, and trim the edge, and knead the dough into the rope-shape, and use yolk liquid to stick the edges, and press the yolk liquid into crevice.

   Stick a kneaded grapevine-like dough on top with yolk liquid for decoration. Finally roll an aluminum foil into a tube and insert in central of pie as a chimney, and spread the surface with yolk liquid and bake at 160℃.
6. oven for 30 min.

Sauce preparation:

1. Fry garlic and onion with vegetable oil, and cook with beer for a while.
2. when the soup becomes thick, add in veal stock and cook again, until the taste becomes heavily, then add salt and pepper, finally filtrate.
3. Place pie in plate and pour the sauce on the pie.

Duck meat broth or stock

Formula 1.

Ingredients:

Vegetable oil and unsalted butter as desired.

Duck bone 2 kg

Onion 100g

Celery 30g

Diced carrot 20g

White wine 600mL

Water 3000mL

Garlic 1 bulb

Tomato 1

Salt as desired

Preparation:

1. Heat vegetable oil and butter.
2. Fry chopped duck bone to become golden brown, then add spices and keep frying.
3. Add white wine, water, crushed garlic, tomato and salt, and cook with low-heat for 2 hr.
4. Filtrate, then cook again to reduce the volume to 300-400mL.

Formula 2(Red and white basic duck stock)

Ingredients:

Duck neck 1.5kg

Vegetable oil as desired

Garlic 1/4 bulb

Red onion, sliced 100g

Shitake mushroom cap, thinly sliced 200g

Brandy 300mL

Red wine or white wine 750mL

Lubepert wine 100mL

Veal stock 1 liter/beef broth 800mL/chicken stock 1 liter

Preparation:

1. Cut duck neck into proper pieces as desired size and fry it with oil.
2. Fry garlic and red onion in another frying pan, and add shitake mushroom.
3. Add (2) into (1), then add brandy, or white wine during boiling, remove dirt and bubbles.
4. Cook to reduce the volume by one half, then add the remaining ingredients, and keep cooking to be sticky and thicker.

Formula 3

Ingredients:

Duck bone and trimmings totally 500g

Red onion 2 bulbs

Garlic 1 bulb

Olive oil and sweet butter as desired

Chicken broth 2.5 liters

Preparation:

1. Cut duck bone and trimmings into small pieces.
2. Desk in red onion and cut into 4 parts and chop garlic.
3. Fry chopped bone and meat with olive oil to become light brown.
4. Add butter and cook to be caramel-like.
5. Add 1 cup chicken broth and cook to become caramel-like.
6. Repeat (5) step for 3 times, and at 4^{th} time add the rest of chicken broth and cook.
7. Heat butter in another cooker, fry step(2) and cook well until color changed., then add to step 6.

8. Cover and slightly boil for 1 hr.
9. Filtrate, boil again and remove bubbles and floating oil.

Potato duck meat pie(Duck hamburger plus hot spring egg)

Ingredients:

1. Red wine stewed duck meat duck breast or thigh 150g; onion 1/4 bulb, celery 25g, carrot 15g, salad oil, sweet butter as desired, red wine 200mL, veal stock 50mL, bay leaf, salt and white pepper powder are as desired.
2. Mashed potato 450g, garlic 25g, white pepper powder and salt are as desired, milk 100mL, cream 100mL, sweet butter 20g.
3. Pie crust 4.5 pieces, cream as desired, Gruyere cheese(ground) 30g.
4. Duck meat hamburger.

   Duck thigh 200g, breast 400g, fried chopped onion with vegetable oil 1, whole egg 1, salt 9g, white pepper powder 1g, cream 20mL, bread powder 10g, star anise 10g.
5. Vegetable oil as desired, green onion 6 sticks, sweet butter, salt, white pepper are as desired.
6. Balsamico vinegar sauce 360mL, cream 300g, salt and white as desired.
7. Spring egg 6, coarse ground black pepper as desired.

Preparation:

1. Red wine stewed duck meat
   1) Grind red wine stewed duck meat.
   2) Chop vegetable, then fry with vegetable oil and butter to be softened. Add (1) and fry again.
   3) Add red wine, veal stock, bay leaf, salt and white pepper and cook for 20-30min by low-heat.

2. Prepare mashed potato:
   1) Cut potato into 1 cm cubes and chop garlic, then blanch in the boiling water.
   2) Drain out the water, and place in oven to evaporate water, then filtrate with net filter.
   3) Cook milk and cream, mix with 2), then add butter, salt and white pepper.

3. Crust wrapping and then baking

1) Cut 1 pieces of crust into 4 parts: One person needs 3 pieces, and spread the cream liquid on the crust, then fold the crust from the edge, and place in a mold by a diameter of 8.5cm.
2) Cook 50g mashed potato (one serving), and add with 10g red wine stewed duck meat(RWSDM), then wrap in 1), followed by piling 10g RWSDM, cover with 5g cheese.
3) Bake in 170℃ convection oven for l0min.

4. Duck meat hamburger preparation
   1) Grind duck meat and mix well.
   2) Fill 100g(l) in the mold, and fry in pan to two sides becoming brown, and bake at 170℃ oven for 8 min.

Luon flavor duck liver paste

Ingredients:

1. Duck breast 800g, duck fat liver 500g, porcine neck meat 450g, pork back fat as desired.
2. Salt 27.5g, brown sugar 5g, white pepper 7.5g.
3. Brandy 45mL, Rubeport wine 80mL, green pepper grains 15g, spices powder, chopped garlic, thyme, bay leaf are as desired, fried onion 70g, and salt, dill, water cress, trevise, vinegar sauce, mustard seed and pickle cucumber are as desired.

Preparation:

1. Cut duck breast, duck liver, pork, 250g back fat and duck fat liver into 4-5 cm pieces, separately.
2. Mix meat with ingredients(2), brandy, Lubeport wine, green pepper grains, spice mixture powder, chopped garlic, thyme, bay leaf, fried onion and salt well. And cure for over night(meat:salt= 1 kg: 14-16g).
3. Coarse grind the mixture of step(2).
4. Slice back fat into thin slices and stick on the wall of mold. Fill step (3) into mold, then place thyme and bay leaf on the top and cover.
5. Bake or steam step(4) at 180 ℃ for 20min.
6. Cool and serve.

I-Lan dry cured duck

1. Raw meat: Dressed duck 1.5-2.0kg(3-4 month of age).
2. Ingredients:

   Salt 4.1%, sugar 1%, potassium nitrate 0.15%, MSG 0.5%, white pepper powder 0.1%, star anise 0.07% (crushed).
3. Procedures:
   1) Trim duck carcass.
   2) Fry salt with star anise to become brown color and aromatic, then cool.
   3) Premix salt and potassium nitrate, then other ingredients thoroughly.
   4) Rub and spread the curing agents on the duck carcass inside and outside surface, and place in the vat. Press with stone on the top of duck carcasses and cure for 2 days. After 24 hours, turn carcass up side down to allow the curing ingredients distribute evenly. Curing temperature is at 2-5 ℃.
   5) After curing, soak the cured ducks in 16-18℃ water to remove surface salt to allow the meat even saltiness.
   6) Stretch the cured duck carcass with bamboo sticks(see picture).
   7) Drying at 50-55℃ or dry by sun-heat until dry.
   8) Smoking (optional) : use bagasse of sugar cane or wood chips at 30-35℃.
   9) Cool.

Nan-An cured duck cake

1. Raw meat: Dressed duck carcass 2.1kg
2. Ingredients: Salt 150g, star anise 50g, sodium nitrite 0.4g.
3. Procedures:
   1) Cut and open abdomen and remove lung and kidney, then wash and drain.
   2) Fry salt and star anise, then cool for use.
   3) Premix sodium nitrite with star anise salt mixture, thoroughly.
   4) Spread the cure mixture(3) over the duck carcass and pile in the vat and press with heavy stones and cure for about l0days. During curing, turn both sides of carcass every day.
   5) After curing, take out to remove extra salt, and dry by sun-heat at day time, and soak in the original brine at night to cure duck meat completely. Repeat this process for 5 days.
   6) Finally, hang cured duck and dry in the air until skin becomes oily or place on the table to press to get shinning appearance.

Steamed salted and spiced duck

1. Raw meat: Dressed duck carcass 1800g
2. Ingredients: Xanthoxylum 2tbsp, salt 2tbsp, sugar 1tbsp, wine 4tbsp, cassia bark 2 pieces, star anise 4 stars, finnel 1tbsp, ginger 3 slices and green onion 5 sections.
3. Procedures:
   1) Clean dressed duck and drain.
   2) Fry xanthoxylum (wild pepper) and salt until salt becomes yellow color.
   3) Mix xanthoxylum salt with the rest of spices, sugar.
   4) Spread seasonings over the surface of duck carcass and cavity to cure for 3 hr.
   5) Place ginger and green onion in the duck cavity of duck carcass.
   6) Place the duck and one cup of vinegar on the steamer, then steam for 40min and cool for service.

Crispy Babaoya(crispy duck stuffed eight treasures)

1. Raw meat: Dressed duck carcass 2.1kg
2. Ingredients:

   Glutinous rice 3 cups, softened mushroom 3, diced cooked ham 1/4 cup, lotus seed(soaked) 2tbsp, green beans 1 tbsp, chopped soaked shrimp 1 cup, diced duck gizzards 1, oil 2 tbsp, chopped onion 1 tbsp, soy sauce 2 tbsp, wine 1 tbsp, salt 0. 5 tsp, flour 3 tbsp, pepper trace, chopped onion 2tbsp, oil 2tbsp, sesame 1tbsp and frying oil half level of wok.
3. Procedures:
   1) Wash and clean dressed duck. cut neck of duck, then cut along the midline of abdominal side, and cut the white membrane between duck skin and meat, and remove the vertebrate and remain the original shape.
   2) Dice the soften mushroom and gizzard, fry the chopped onion, then add mushroom, lotus seeds, gizzard, diced cooked ham, bamboo tip dices, green beans, dried shrimp with oil in wok, then sprinkle soy sauce, salt, MSG, pepper and seasonings then turn off heat. Add glutinous rice and mix well.
   3) Stuff the glutinous rice mixture into duck abdominal cavity about 80% full, then sew with string by needle, and place in pan(breast toward up) flatly, and steam for 1 hr.
   4) Remove the moisture from the surface of steamed duck, then spread soy sauce and colorant and sprinkle flour and fry the duck in preheated oil by high-heat until the duck surface becomes crispy and golden brown color.

5) Take out finished product and drain off oil and place on the pan, then take off the sewing string, cut along midline of abdomen from the breast side, sprinkle chopped green onion on the surface, then preheat 2 tbsp fried oil, 1 tbsp sesame oil on the chopped green onion for serving.

Stewed duck with five spices and soy sauce (Wuxiang Jiangya)

1. Raw meat : Dressed duck 1. 5kg
2. Ingredients:

   Salt 1 tbsp, soy sauce 1 cup, wine 3 tsp, five spices(xanthoxylum, tangerine peel, star anise, fennel) trace, as desired, green onion 2 sections, ginger 2 slices, rock sugar 0.5cup, boiled water 6 cups.
3. Procedures :
   1) Dip dressed duck in boiling water for 3 min and drain.
   2) Spread salt on the surface of duck inside and outside of cavity.
   3) Boil soy sauce, wine, rock sugar, onion, ginger and five spices in 6 cups of water, and cook duck with the above seasonings by low-heat for 2 hr. During cooking, turn the duck up and down.
   4) Take out the cooked duck and cool until the surface becomes dry, then cut into proper size for serving.

Spiced pressed duck (Yazoubain)

1. Raw meat : Dressed duck 1. 8kg
2. Ingredients: Marinade ingredients include green onion and ginger trace, xanthoxylum 1tbsp, star anise 3 stars, soy sauce 3tbsp, salt 1.5cup, wine 3tbsp, water 15cups, MSG trace.

   Brown sugar 3tbsp, sugar cane skin trace, coriander trace.
3. Procedures:
   1) Cook all marinade ingredients by medium-heat for l0min.
   2) Dip cleaned dressed duck in boiling water for 5min, until the blood in the abdominal cavity disappears.
   3) Cook duck with marinade by low-heat for 15min. During cooking turn the duck up and down once. After cooking the cooked duck is still marinated for 1hr.
   4) Take cooked and marinated duck out and dry in the air for 1hr.
   5) Smoke the duck with brown sugar and sugar cane skin on the rack on the wok and covered for 20min to the duck skin becomes golden brown color or in smoking house when large scale processing.

Camphor and tea smoked duck (Changchaya)

1. Raw meat : Dressed duck 1. 8kg
2. Ingredients: Salt 3tbsp, xanthoxylum 2tbsp, sodium nitrite 0.18g, chopped wood 2cups, black tea leaves 0. 5cup, tangerine peel trace and frying oil 8cups.
3. Procedures:
   1) Wash and clean dressed duck and drain.
   2) Fry xanthoxylum and salt, cool and mix with sodium nitrite well and spread the mixture on the surface inside and outside of duck cavity.
   3) Remove xanthoxylum from duck surface and tie neck of duck and hang and dry in the air for about 6hr.
   4) Smoke the cured duck with the chopped wood, black tea leaves and fruit peel, during smoking, turn the duck back and abdomen sides and smoke until the skin becomes tea yellow color.
   5) Steam the smoked duck in the steamer by high-heat about 2hr. And fry in hot oil by high-heat until the skin becomes golden brown color and crispy.

Crispy fried duck on mashed taro(Yuni xiangsuya)

1. Raw meat : Dressed duck(half carcass) 900g.
2. Ingredients: Soy sauce 2tbsp, star anise 1 grain, green onion 2 sections, ginger 2 slices xanthoxylum 1tsp, taro 450g, cassava starch 2/3cup, lard 3tbsp, pepper 1/4tsp,salt 0.5tsp, dry shrimp 1tbsp and diced bacon 2tbsp.
3. Procedures:
   1) Wipe the water from the dressed duck skin and stain with soy sauce for 15min.
   2) Fry the duck (place back down)by very hot oil for 1min until skin becomes brown yellow color.
   3) Take out the fried duck and place on the plate(skin on top) and sprinkle onion, ginger, star anise on, and steam in the steamer by high-heat for 1.5hr.
   4)Mix 0.5cup hot water with starch to make dough. Steam taro and mash into paste, then mix with dough, lard, MSG, salt, pepper, diced shrimp and bacon with hand thoroughly.
   5) Remove all bones from the steamed duck carefully and place in the plate (pre-sprinkle with dry starch). The skin on the bottom, make duck flat, sprinkle some starch, then place mashed taro on duck, and sprinkle some starch again, then fry by low-heat in oil until the color becomes golden yellow(about 3min). when place the duck with taro paste, it must be careful to move into hot oil slowly.
   6) Cut the fried duck into 1 square inch and place on the plate for serving. When eating the consumer can dip in the mixture of ketchup and chili sauce and sugar.

Steamed duck with glutinous rice

1. Raw meat : Dressed duck (half carcass).
2. Ingredients:
   1) Marinade ingredients: Sugar 0.5tsp, salt 1tsp, wine tbsp, soy sauce 2tbsp and pepper some.
   2) Fillings ingredients: Glutinous rice 4cups, diced ham 3tbsp, diced soften mushroom 2tbsp, lotus seed (or peanuts) 1/2cup, dried shrimp (soften) 1/3cup, duck gizzard 1, oil 5tbsp, wine 0. 5tbsp, soy sauce 1tbsp, salt 0.5tsp and coriander some.
3. Procedures:
   1) Steam duck by high-heat for 1hr and take out to cool.
   2) Remove all bones by hands and cut into 1 inch width square.
   3) Array the square duck meat on the bowl (the skin on the bottom) and mix the marinade ingredients, and pour on the duck meat, and turn the bowl lightly to allow the duck meat absorb the marinade solution.
   4) Fry diced mushroom, shrimp, ham, gizzard and soften lotus seed in preheated hot oil, then pour wine in, followed by soy sauce, salt, then turn off heat. Add cooked glutinous rice and mix well.
   5) Add (4) glutinous rice on the duck bowl and make flat and steam by high-heat for 40-60min.
   6) Cool for serving.

Stewed duck with plum sauce (Meijiangluya)

1. Raw meat : Dressed duck 1 carcass.
2. Ingredients :

   Soy sauce 1. 5cup, green onion 2 sections, ginger 3 slices, five spices (including xanthoxylum 1 tbsp, star anise 3grains, tangerine peel 1tbsp, licorice 2 pieces), wine 3tbsp, sugar 0.5cup, dried salted plum 75g, sour plum 300g, rock sugar 300g and frying oil 6cups.
3. Procedures:
   1) Wash and clean duck, and drain.
   2) Dip the duck in soy sauce for 5 min, and fry in very hot frying oil to become golden color.
   3) Use 2 tbsp oil to fry onion, ginger and add the used soy sauce, wine, sugar and five spices(packed in cloth bag) with 8cups water, then place duck in and cooked by low-heat for 1.5hr, during cooking turn the sides 2 times, and cool.
   4) Soften sour plum and dried plum with 1cup hot water, add rock sugar and blend

it(press plum nuts out) in wok, add (3) sauce 3 cups and cook and blend into sauce by low-heat.

5) Cut duck (3) and sprinkle plum sauce for serving.

Deep fried crispy duck cake (Xiangsuyabian)

1. Raw meat : Dressed duck 1.
2. Ingredients:
   1) Xanthoxylum 6 tbsp, salt 4 tbsp, green onion 4 sticks, ginger 4 slices, wine 2 tbsp.
   2) Tofu skin 24 pieces, frying oil half wok, toss bread 48 sl ices, sweet sauce 12 tbsp, green onion 60 sections.
   3) Egg batter ingredients: Chopped green onion 8 tbsp, egg 4, flour 12 tbsp and water 2cups.
3. Procedures:
   1) Fry xanthoxylum and salt by low-heat until color becomes yellow, cool and mix with crushed onion and ginger and wine, then rub on the surface of duck, and cure for over 6hr.
   2) Steam the cured duck on the plate in the steamer by high-heat for 2.5hr until duck meat well cooked, then cool and tear the duck meat into flosses.
   3) Beat egg and blend with flour and water to become batter, then add the chopped onion.
   4) Cut tofu skin into 5 inch x 8 inch, then every 2 pieces pile flatly, and spread a layer of egg batter, and sprinkle some duck flosses, then place one more tofu skin on it, and spread a layer of egg batter and sprinkle duck meat flosses again. The above process repeated 4 times, and cover 1 piece of tofu skin and spread egg batter and spread duck flosses on the half of skin, then fold into 1/2 of skin into 5 inch x 4 inch, the open site fixed with tooth tip.
   5) Fry (4) and pile tofu skin with duck meat flosses by low-heat to be crispy and golden brown color. Then cut into 1.5 inch square size for serving.

Stuffed duck with egg yolk

1. Raw meat: Duck breast, deboned thigh 100%
2. Ingredients (based on the weight of duck meat):
   Salt 2%, soy sauce 1%, pepper 0. 2% and salted duck egg yolk as desired.
3. Procedures:
   1) Wash duck meat, drain.

2) Tumble duck meat with salt, soy sauce and pepper for 3hr continuously to extract salt soluble proteins.
3) Take out duck meat from the tumbler, and flaftly place on a cheese cloth, then place salted egg yolk, and make a roll, and wrap the roll with cheese cloth.
4) Steam the duck roll by high-heat for 1hr.

Smoked duck steak (see page 85)

1. Raw meat: Breast
2. Ingredients (based on the weight of meat):
   Salt 1.5%, sugar 4%, MSG 0.5%, polyphosphate 0.3%, sodium nitrite 0. 01%, five spices 0.07% and liquid smoke as desired.
3. Procedures:
   1) Remove thigh and breast from the dressed duck carcass.
   2) Mix the duck meat with the curing agents and tumble for 3hr at 3℃.
   3) Take out and trim, form in mold and freeze.
   4) Steam by medium-heat, then roast in oven until color becomes golden yellow.

Jellied duck meat

1. Raw meat: Duck meat trimmings 100%
2. Ingredients(based on the weight of duck meat)
   Water 100%, radish and carrot 10%, coriander 5%, ginger 1%, soy sauce 4%, wine 1.5%, rock sugar 4%, salt 0.8%, MSG 0. 3%, agar 1.5%, star anise 0.2% and cassia bark 0.2%.
3. Procedures:
   1) Wash radish and carrot, cook to be soften and cut into dices.
   2) Chop coriander, and place at bottom of mold.
   3) Cure the duck meat trimmings with soy sauce, wine, rock sugar, salt and MSG at 3-5℃ for 1hr.
   4) Put ginger, star anise and cassia bark in the cloth bag, and cook with duck meat by high-heat until boiling, then change to mild-heat for 2hr, and add agar and cook to dissolve.
   5) Mix carrot and radish well, then put in the mold to form, then chill at 2-3℃.

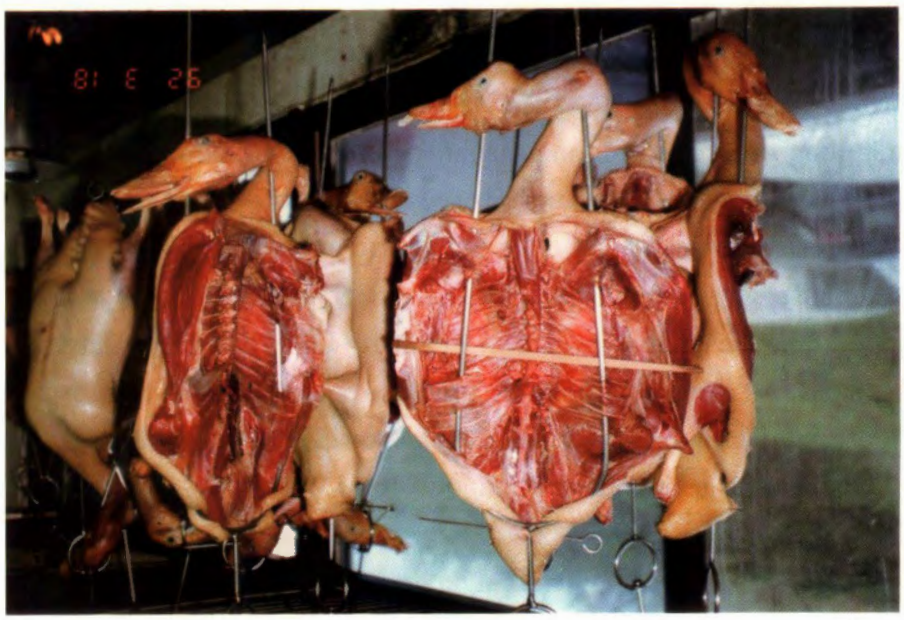
Duck meat tarco

1. Raw meat: Duck meat (lean) 15%, Duck trimmings 60%, Duck skin 10% and fatty meat 15%.
2. Ingredients (based on the weight of duck meat):
   Black pepper 0.1%, salt 1.6%, sugar 3%, MSG 0.8%, polyphosphate 0.3%, salted duck egg 5, seaweed skin(several pieces), nitrite 0.01%, ice water as desired.
3. Procedures:
   1) Wash and clean duck skin and cook then grind through l/8 in. plate of grinder.
   2) Grind lean, trimmings, fat through l/8in. plate of grinder and cool at 4℃ for 12hr.
   3) Add sugar, MSG, polyphosphate and chop for 3-5min.
   4) Add salt and blend for 1 min, add ground fat and blend for 3min, then add black pepper.
   5) Mix carrot and beans well, then place in mold and cook well, cool and slice for serving.

Duck roll

1. Raw materials:
   Duck meat 90%
   Skin with fat 10%
2. Ingredients(Based on the weight of duck meat and skin):
   Polyphosphates 0.3%
   Salt 1.5%
   Sugar 1%
   MSG 0.5%
   Sodium bicarbonate 0.5%
   Sodium nitrite 0.01%
   Soy sauce 0.5%
   Garlic powder 0.17%
   Ginger powder 0.17%
   Cinnamon powder 0.2%
   Licorice 0.2
3. Preparation
   1) Chop duck meat coarsely.
   2) Grind duck skin by 0.64cm plate and chilled.
   3) Chop meat (1) with phosphate slurry, slush ice, salt until the meat becomes tacky.
   4) Add ground skin with fat, other ingredients and mix an additional 2 min.

5) Stuff the mixture into plastic casing(120mm diameter).
6) Cook in 85℃ water to internal temperature of meat to 82.2℃.
7) Then chill in 15℃ tap water.
8) Chill the roll in slush ice overnight in a 4℃ cooler.



Chapter 11. Goose meat processing

Nanjing roasted goose (l)

1. Raw materials:

   Dressed goose carcass (cut wings and feet).

2. procedures:

   1) Open a hole under right wing and eviscerate all offal, wash and clean.

   2) pour boiling water at 100℃ on the skin and hang on rack and dry in the air.

   3) Heat malt and water(l :6) to become brown color and pour on the carcass skin and hang on the rack and dry in the air.

   4) Put star anise, ginger, onion in abdominal cavity and inject 100℃ water 70-l00mL into the cavity.

   5) Roast the goose carcass (2-2.5kg) in preheated oven at 230-250℃ for 50-60min. during roasting turn the body sides. When one side becomes golden brown, then turn another side facing to fire.

Nanjing roasted goose (2)

1. Raw material:

   Dressed goose 2.5kg, Cut off feet and tip of wings. Open a hole under the right wing to eviscerate. Wash and clean the carcass, then soak in cold water for 1 h, and hang and drain.

2. Seasoning ingredients:

   Syrup for coating (malt : water=l:5), star anise 2grains, ginger 2-3 slices, red onion 1 bulb.

3. Procedures:

   1) Pour 100℃ boiling water on air cooled dressed goose carcass surface to allow the muscle and skin shrink to become firm.

   2) Brush the syrup on the goose body surface to allow the goose become brown color, and hang and dry in the air.

   3) Insert a bamboo stick into goose cavity from vent, and cut a hole to abdominal cavity, and put the seasonings inside.

   4) Pour 100℃ boiling water 70-l00mL from the vent into cavity, when the goose hang in the oven the water will evaporate(gasification) at high temperature to form these sharp cooked outside to achieve the effect of crispy outside and tender inside.

   5) Roast the goose in 180-200℃ oven for 30-40 min to cook well, then rise the

temperature to 240-250℃ sharply roast for 5-10 min to produce aroma and become golden brown color surface.

6) Cool and remove bamboo stick from vent and collect the juice from the cavity. Add some water, MSG, soy sauce, salt and sugar to cook for serving.

Roasted goose

1. Raw material: Dressed goose carcass (2.5-3kg)
2. Ingredients (based on goose carcass weight of 50kg):
   1) Salt 2kg, five spices 200g, mix well.
   2) Sauce ingredients: Fermented soy beans (dou-shu) + garlic + oil + salt=1 kg.
   3) Sugar 200g, wine 50g, chopped green onion l00g, sesame sauce l00g light soy sauce 200g, mix well.
   4) Malt syrup (100g malt + 0.5kg water)
3. Procedures
   1) Cut wings and feet, wash, clean and drain.
   2) Put 1 tbsp five spices salt into abdominal cavity or soy sauce 2 tbsp and mix thoroughly.
   3) Seal the vent with steel needle, and pour 70℃ hot water on the surface of carcass and dry in the air.
   4) Spread malt syrup on the surface of carcass and dry in the air.
   5) Roast the goose in preheated oven at low-heat for 20 min, the back of goose faces to fire until dried, the turn the breast side facing to fire and change heat to 200℃ for 25 min.

      During roasting turn the goose body sides occasionally.
   6) Take out and spread peanut oil on the surface for serving.

Crispy roasted goose

1. Raw materials: Dressed goose carcass 3.5kg.
2. Ingredients:
   1) Syrup formula:
      a. Malt(syrup) l00g, white vinegar 500g.
      b. Honey 50g, red vinegar (Zhejiang) 200g, white vinegar 200g, Chijew(rice wine) l0g.
      c. White vinegar 2500g, rice wine 1500g, red vinegar 500g, honey 250g, malt syrup 750g and sliced lemon 250g.
      d. Water 1250g, vinegar l000g, honey 150g, malt syrup 150g, rice wine 200g.
      e. Water 1250g, vinegar 2500g, honey 400g, malt syrup 400g and rice wine 250g
      f. Egg white 150g, milk 50g.

3. Five spices salt:

   Salt 350g, sugar 150g, kaemferia powder 25g, star anise l0g, chicken concentrate l0g, peanuts butter 25g, sesame oil 15g and ethyl malt powder 5g.

4. Plum sauce formula:

   1) Plum 200g, chopped garlic l0g, chopped ginger l0g, tangerin peel 5g, lemmon 30g, mint 25g, white vinegar 50g and rock sugar 110g.

   2) Plum 500g, sesame sauce 50g, peanuts butter 50g, white vinegar 150g, sugar 150g, five spices l0g, chopped garlic 15g, light soy sauce l00g and Tsu-hao sauce l00g.

Shun-Jin roasted goose

1. Ingredients:

   Dressed goose 1 bird(3.2kg).

   Coating syrup: vinegar 160g, Zhe vinegar 40g and malt 40g.

   Marinade ingredients : sugar 3 tsp, salt 2 tsp, star anise 4 grains and five spices some(as desired).

2. Procedures:

   1) Wash and clean carcass, cut off feet, remove lung and throat from tail(vent).

   2) Put 2 sections of green onion and 2 slices ginger into abdominal cavity from vent and sew the vent with stainless steel needles.

   3) Prepare coating syrup for use.

   4) Dip the goose in boiling water(Chum-tang), drain and spread the coating syrup on the surface of goose.

   5) Hook the goose, dry in the air and hang in preheated stove and roast for 40 min until become golden brown color, turn the goose body sides during roasting.

   6) Cool and serving.

Roasted goose wings

1. Marinade ingredients:

   Polyphosphate 0.5kg, salt 5-7kg, sugar 2kg, MSG 0.4kg, Shaoshing wine 1kg, onion cassia bark, bay leaf as desired.

2. Procedures:

   1) Mix all marinade ingredients well and add water to make up to 100kg, then boil and cool for use.

   2) Cure goose wings in marinade solution by 20-30% of wings weight at 5℃ for 20-24h.

3) Wash the cured goose wings and drain, then spread butter oil on wings and roast at 170℃ for 20min, then spread butter oil again, and keep roasting for another 15-20min. During roasting coat butter oil or malt syrup one or two times.
4) Optionally, the roasted wings can be smoked by brown sugar to be a good smoke flavor.
5) cool and pack.

Roasted goose liver

1. Raw materials:
   Goose liver 600g
2. Marinade ingredients:
   Sugar 4 tbsp, salt 1 tbsp, anka red(rice) some, light soy sauce 1 tbsp, five spices some chopped ginger some, seafood sauce 1 tsp, fermented soy beans 1 tsp, sesame sauce 1 tsp and rose liquor 1 tsp.
3. Procedures:
   1) Wash goose livers, and mix with marinade ingredients evenly and cure for 10 min.
   2) Hang on the preheated oven and roast by medium-heat for 20 min.

Goose meat sausage

1. Raw materials:
   Goose meat 50%, lean pork 10-20%, pork fat 40-30% to make up 100%.
2. Ingredients (based on the weight of meat):
   Soy protein isolate 2%, corn starch 10%, ice water 30-50%, salt 2.8%, polyphosphate 0.2%, sodium nitrite 0.01%, sodium isoascorbate 0.05%, sugar 1%, MSG 0.5%, white pepper powder 0.2%, garlic powder 0.17%, onion powder 0.17%, cinnamon powder 0.15%, and licorice powder 0.15%.
3. Procedures:
   1) Grind lean pork, goose meat coarsely by 3mm plate, and grind pork fat, separately.
   2) Blend ground lean pork and goose meat with polyphosphate, salt and ice water, Na-nitrite to extract salt soluble proteins.
   3) Emulsify meat matrix with ground fat then mix with other non-meat ingredients. During cutting the temperature of batter should be maintained below 15℃.
   4) Stuff the batter into natural casing or collagen casing.
   5) Dry the product at 60℃ for drying casing surface and developing cured meat

color for 30min.

6) Smoke the product at 65-70℃ for 20-30 min.

7) Cook at 80℃ until the internal temperature reach to 75 ℃.

8) Spray the cooked product with cool water, then chill in the cooler.

9) Package and store.

Goose liver sausage

1. Raw materials:

Goose liver 30%, lean pork 25-30%, pork back fat 40-50%.

2. Ingredients(based on meat weight):

Salt 2.0%, Sodium nitrite 0.01%, Sodium isoascorbate 0.05%, polyphosphate 0.3%, five spices 3.8%, onion 2.0% and butter as desired.

3. Procedures:

1) Soak goose liver in red wine and store in the refrigerator overnight.

2) Cook lean pork and fat in 80℃ water for 40-50 min, then grind it.

3) Fry onion with butter oil.

4) Fry goose liver with butter oil and cut into dices.

5) Chop goose liver with sodium nitrite, polyphosphate, Na-isoascorbate, ice water, then salt, add other non-meat ingredients as meat batter.

6) Fill the liver batter into casing or fill in a mode.

7) Cook the product in 78-80℃ water for 1.5h to internal temperature up to 65℃.

8) Cool and pack.

Goose meat sausage(2)

1. Raw materials:

Goose meat 57%, pork back fat 20%, Corn starch or potato starch 10% soy protein isolate(ISP) 3% and ice water 10%.

2. Ingredients(based on raw material weight):

Chopped onion 5%, chopped garlic 0.6%, red wine 6%, parsley 0.2%, sodium nitrite 0.01%, salt 1.3%, black pepper 0.15%, glucose 0.44 and sage 0.08%.

3. Procedures:

1) Coarsely grind lean goose meat and back fat, separately.

2) Chop the lean goose meat with salt, nitrite, glucose and some ice water to extract salt soluble proteins, then add ground fat and ISP to make an emulsion.

3) Add other ingredients and the rest of water.

4) Stuff the batter into goat casings.

5) Roast the sausage at 70-90℃ for 25-60 min.
6) Cook the roasted product at 80-85℃ until internal temperature reach to 70℃.
7) Chill the product to 5℃ with ice water.
8) Dry in the air and pack.

Nanjing steamed salted goose

1. Raw material: Dressed goose(cut off feet and tip of wings at second ankle) 2kg.
2. Seasoning ingredients:
   Salt 5%, star anise 0.025% (based on goose weight and fry with salt), ginger 2 slices, green onion 1-2 sections, star anise 2 grain.
3. Procedures:
   1) Marination : put one part of fried star anise salt nto abdominal cavity, and turn up and down to distribute the salt in cavity.
   2) Rub and spread the rest of star anise salt on the surface of thigh and breast, neck, vent and mouth.
   3) When rub salt on the thigh from down to up to make muscle and bone separated for salt easily to penetrate into muscle, then cure the salted goose for 2-4h.
   4) Drain the blood residue out of the carcass.
   5) Shape and hook the carcass, then pour the boiling water on the surface to cause muscle and skin shrink and the shape plump, and dry in the air.
   6) Cooking:
      a. Cook green onion, ginger, star anise until boiling, the turn off fire, and inject into the cavity from vent.
      b. Lift up thigh and pour the hot (a) soup into the vat and let the temperature of inside and outside of carcass be same.
      c. Put the goose carcass under the soup and simmer for 20 min until bubbles appear, then stop cooking, at this time, the soup in vat is above 85 ℃.
      d. Again, poise (lift up) the goose thigh and pour the hot soup into the cavity of goose and replace in the vat, and cover the vat to cook for more 20 min until the soup near boiling, then stop cooking.
      e. Take out the cooked goose and pour out the soup into the vat, and simmer for about 5-l0min, then take out for serving.

Note:

1) During simmering, the water temperature can not be over 85 ℃, unless the fat in muscle will melt out, cause meat become tough.
2) Cut cooked goose must wait the temperature cooled down, and pour the

cooked soup if cut when the cooked goose temperature is still hot, the juice easily comes out and hard to get good cut smoothly.

Steamed goose (pressed goose-Taiwanese-sty le)(l)

1. Raw material:

   Dressed goose

2. Ingredients:

   White soy sauce, sweet sauce, ginger, green onion, salt. sugar and white pepper powder as desired,

3. Procedures:

   1) Cut cartilage bone at back of carcass of goose, and remove the offal, then stretch with bamboo frame to prevent the goose meat broken when boil in hot water.

   2) During boiling, puncture the thigh, breast and back of carcass about 30-40 times to allow the seasonings penetrate into meat.

   3) Mix salt, sugar, white pepper and MSG well and rub on the surface of carcass inside and outside, then insert green onion and ginger slices into abdominal cavity of goose from vent.

   4) Steam the goose in steamer until the meat to be easily inserted by stainless steel needle and without blood coming out, then turn off the fire and cover steamer to simmer for 15 min, then turn another side to keep simmering for another 15 min, and take out.

   5) Cool the steamed goose well, then pour white soy sauce and broth and slice for serving

Note:

If the consumers like to eat smoked goose, the product can be smoked with brown sugar in the Wok.

When serving the cooked goose can be dipped in sweet sauce added with ginger strips or basil.

Steamed goose (2)

1. Raw material:

   Dressed goose 2.6kg, green onion 2 sections, Taro 646g, dark soy sauce 1 tbsp mushroom 60g.

2. Marinade ingredients:

   Soy cheese 1 tbsp, dou-shu (fermented soy beans) 1 tbsp, chopped garlic 1.5 tbsp,

chopped ginger 2 tsp, wine 2 tsp, dark soy sauce 2 tsp and sugar 1 tsp.

3. Procedures:
   1) Soften mushroom and remove the stem and mix with wine and sugar.
   2) Wash goose carcass and drain, and spread salt 1 tsp, 1/3 marinade mix on abdominal side, put mushroom and onion into cavity and sew the vent with the stainless steel needle.
   3) Spread dark soy sauce on the skin, and fry to be slight brown, then spread the rest of marinade mix(2/3) added 2 tsp salt on the skin.
   4) Remove taro skin, cut and fry to become brown color.
   5) Place goose and taro on the plate and steam for 2.5h. As taro cooked well remove out.
   6) Cut taro and place on the plate then place the steamed goose cuts on the taro, add the mushroom and pour the broth and sesame oil.

Steamed goose (3)

1. Raw material:
   Dressed goose 3.0kg 1 bird, dark soy sauce as desired.
2. Marinade ingredients:
   Dou-shu 1 tbsp, salt 1 tbsp, sugar 2 tbsp, soy cheese 1 block, chopped garlic, rose wine and five spices as desired.
3. Procedures:
   1) Wash dressed goose, spread marinade ingredients on the surface of the goose, and place green onion and ginger into abdominal cavity from vent, and sew the vent with stainless steel needle.
   2) Dip the goose in the boiling water until without blood coming out when insert the needle and plug out.
   3) Take out the goose and spread dark soy sauce to stain the brown color, then steam again for 45 min or soak in dark soy sauce to make a golden brown color.

Drown goose(Steamed goose marinated in liquor)(Tsuier)

1. Raw material:
   Thigh and breast of goose, green onion and ginger.
2. Seasonings:
   Shao-shing wine or rice wine 5 cups, goose broth stock 5 cups, salt 5 tbsp, cinnamon sticks and bay leaf as desired.
3. Procedures:

1) Wash and clean thigh and breast, and dip them in the boiling water to remove the blood from the meat.
2) Cook the cleaned thigh and breast with ginger and green onion for 15 min, then add 2 tbsp wine and turn off the fire.
3) Take out the product and mix with 5 tbsp salt.
4) Mix the marinade ingredients in the above broth(2), then soak the thigh and breast for 4h.
5) Take out and drain, then cut and pack.

Spiced goose feet

1. Raw material:

   Goose feet 5 pairs.
2. Marinade ingredients:

   Star anise, cassia bark, xanthoxylum, kaempferia, amomum, clove and tangerine peel 23g for each. Water and light soy sauce 2 liters for each. Rock sugar 320g salt 80g and wine 80g.
3. Procedures:
   1) Remove waxy skin and pin feather on the feet and claw and wash.
   2) Dip the feet and claws in the boiling water until blood disappears, then take out and rinse in the running water for gelling and drain.
   3) Put the marinade ingredients in the cotton bag and cook for 20 min, then put feet and claws in the marinade solution, then turn to low-heat for boiling 10 min. Take out and cut, pour sesame oil for serving.

Plum sauce spiced goose

1. Raw material:

   Dressed goose 1 bird(3.2kg)
2. Seasoning ingredients:

   Salted plum 320g, rock sugar 200g, Dou-shu 4 tbsp, chopped garlic 1.5 tbsp, green onion 3 sticks, ginger 40g, wine as desired.
3. Coating agent: Dark soy sauce 1 tbsp.
4. Procedures:
   1) Wash and cut feet and tip of wings, spread coating agent.
   2) Fry the goose in boiling oil.
   3) Denut plum, mash rock sugar and shell and clean ginger.
   4) Fry green onion, mashed ginger, chopped garlic, and add in dou-shu and plum,

sprinkle some wine and mix with mashed rock sugar well, then fill in the abdominal cavity.

5) Place the goose breast upward and steam well, cool and cut for serving.

6) Remove ginger and green onion from the soup or broth, and add starch as thickening agent to make broth to pour on the cooked goose.

Smoked goose

1. Raw material:

   Dressed goose 1 bird (3.2kg)

2. Ingredients (based on the weight of goose carcass):

   Salt 3%, oil 1%, xanthoxylum (wild pepper) 0.05%, cassia bark 0.025%, fennel 0.025%, ginger 0.2%, sugar 1%, and five spices 0.5%.

3. Procedures:

   1) Cook ingredients in the water until boiling, then dip the goose carcass in the boiling broth for 15-20 min, during boiling turn the goose 2-3 times to allow the hot broth going to the cavity .and cook another 7-10 min, during cooking remove the bubbles. Then turn off the heat and simmer for 7-10 min.

   2) Cook the goose until without blood coming out when insert into the stainless steel needle and plug out, then take out and hang in the air to dry

   3) Place the cooked goose on the iron frame (rack) fixed in the wok, at bottom of which place a aluminum foil, put some brown sugar on it and heat by high-heat until smoke occurring, then cover the wok to smoke the goose(50g of sugar per goose).

   4) Smoke for 2-3 min with sugar, then open the cover of wok and brush sesame oil on the goose surface to obtain better appearance and flavor when the goose is still hot.

Chaozhou spiced goose(formula 1)

1. Raw material:

   Dressed goose carcass 1 bird(2.56kg), water 8 cups and brown sugar 80g.

2. Marinade ingredients:

   Sichuan xanthoxylum, star anise, clove, amomum, licorice and cassia bark 70g for each. Plus water 8 cups.

3. Seasonings:

   Ginger 3 slices, ginger powder 2 tbsp, spring onion 3 slices, chopped southern ginger 2/3 cup, coriander 20g, chopped kaempferia(sand ginger) 2 tbsp, light soy

sauce 2 cups, rose wine 0.5 cup, coarse salt 1 tbsp and brown sugar 40g.

4. Dipping sauce:

   Chopped garlic 3 cloves and Chaozhou vinegar 3 tbsp.

5. Procedures:

   1) Cut feet and wings off, make a hole between the neck and breast, wash goose and drain. Dip in boiling water for 5 min and take out to rinse in the running water to cool, and drain.

   2) Boil brown sugar in 0.5 cup of water in the pot to make coating syrup and spread the syrup on the surface of the goose.

   3) Turn the goose body over at the same time until the syrup dry, then place the goose in a plate and steam for 1 h.

   4) Cook the marinade ingredients mixture for 20 min with mild-heat. Add seasonings and the grease from the steamed goose and keep boiling. Put the goose into the marinade solution, cover the vat and keep boiling by mild-heat for 30 min, turn it over during boiling. Then turn off the heat and simmer for 20 min.

Spiced goose(Formula 2)

1. Raw material:

   Dressed goose 2kg/per birdx50.

2. Seasoning ingredients:

   l)soy sauce 2.5kg, salt 3.75kg, sugar 2.5kg, cassia bark 150g, star anise 150g tangerin peel 50g, clove 15g, amomum or cardamom l0g, anka red rice 375g ,green onion 1.5kg, ginger 150g, wine 2.5g and sodium nitrite 10g.

3. Procedures:

   1) Rub dressed goose with salt. and sprinkle some salt in abdominal cavity and cure for1 -2 days in summer, or 2-3 days in winter. Then hang for draining.

   2) Cook the seasoning ingredients, and put 1 -2 cloves, trace amomum, onion 20g ginger 2 slices and 1-2 tbsp wine per bird until boiling. Then put goose in it and keep cooking with high-heat to boiling, then turn to weak-heat for 40-60min. After the wings open, then take out and cool it.

   3) Spread marinade :

      Marinade ingredients: Used marinade 2.5kg, anka rice 0.15kg, sugar 2kg wine 75g and ginger 20g.

Preparation:

1) Cook used marinade with the rest ingredients, and keep stirring during cooking until the broth become sticky.

2) Cool and spread on the surface of cooked goose.

Spiced goose(Formula 3)

1. Raw material:

   Dressed goose 1 bird

2. Seasoning ingredients:

   Star anise 1 tbsp, licorice 2 pieces, amomum 1 grain, clove 1 tsp, coriander as desired, kaempferia 5 grains, tangeria peel 1 pieces, light soy sauce 75g, rock sugar 50g, salt 2 tbsp and water 2 cups.

3. Procedures:

   1) Dip the dressed goose in the boiling water for a while, then take out, remove lung.

   2) Cook marinade ingredients with medium-heat for 30 min, then place goose in, and turn to low-heat for 50min.

   3) Turn off heat and keep marinating for 1 h and take out to cool down.Cut and add chopped coriander for serving.

Goshu five spices cured goose

1. Raw material:

   Dressed goose

2. Marinade ingredients:

   Water 100kg, salt 50.75kg, star anise 300g, xanthoxylum 200g, fresh ginger 500g, cassia bark l00g, fennel 250g and red pepper l00g.

   Preparation of marinade solution:

   Dissolve salt in water and boil it to become saturated solution.

   Add xanthoxylum, star anise, ginger, cassia bark, fennel and red pepper and cook well.

3. Procedures:

   1) Shape, soak goose in cool water for 4-5h to remove blood from carcass take out to press the carcass.

   2) Curing:

      a. Put 3/4 fried salt into goose cavity, and turn upside down to distribute the salt.

      b. Rub the thigh and breast with the rest of salt and put the cured goose in the marinade solution and pile in the vat. After 12h take out to remove the brine from the cavity, then replace in the vat to cure for 8 h.

      c. Then take out goose one by one to inject the marinade solution from right

wing opening, and replace and pile in the vat.

d. Press the goose down under the marinade solution by the cover.

3) After 24-36h, repeat marinating, take out and drain out all marinade solution, hang and dry in the open air or dry by IR oven until the yield reach 70%. The color of end product becomes light yellow and result in cured meat flavor and packaged.

4) Cook for serving:

a. Dip in clean warm water for 3 h to remove dirt and reduce salt from the goose meat before cooking.

b. Put green onion 3 sections, ginger 3 slices and star anise 1 grain into the cavity and boil it, then simmer for 5-10 min.

Dry cured goose thigh

1.Raw material:

Goose thigh

2.Curing agents(based on the weight of thigh):

Salt 6.25%, star anise 0.375%.

3. Marinade ingredients:

Water 100%, salt 50-70%, crushed ginger l00g, onion 200g.

4.Procedures:

1) prepare curing agent mixture: fry salt with star anise until salt becomes dry and brown.

2) Prepare marinade : boil all ingredients in water for use.

3) Curing of thigh

a. Remove the thigh from goose carcass, shape it to a shape like willow leaf. Trim off extra fat from the thigh, wash and clean the thigh.

b. Rub the fried salt with star anise on thigh and pile on the vat for 8-10 h.

c. Marinade the cured thigh with marinade solution for another 8-10h.

d. Wash and remodel, tie the bone of thigh and hang and dry in the air. Remodel and shape once a day, repeat 2-3 times. Trim the skin around the margin and rub the thigh to make it to become plum shape and looks like a willow leaf.

e. Fermenting: After 3-4 days drying, remove to fermenting room and hang on the wooden rack at suitable space to get good aeration and ferment for 2-3 weeks under the control temperature and relative humidity.

f. Cooking can be divided into two methods

a) Cook cured thigh with ginger and star anise until boiling and simmer at 85℃ for 30 min.

b) Steaming: Wash and clean, soak the cured thigh in warm water, slice the thigh and place on plate, add ginger 2 pieces, green onion 3 sections and star anise 2 grains and steam for 30 min.

Steamed cured goose breast

1. Raw material:

Goose breast 500g

2. Ingredients

Egg 1, corn starch l00g, fresh ginger 15 g, green onion 15 g, baking soda 2.5g sugar 5g, MSG 2.5g, light soy sauce 5 g and liquor 5 g.

3. Procedures:

1) Blend egg, mix with crushed ginger, chopped green onion, liquor, baking soda well then cure the breast for 20 min. Remove onion and ginger, then add MSG sugar light soy sauce, egg and corn starch and mix well and cure the breast for 1-2 h again.

2) Take out the cured breast and steam for serving.

Dry cured goose gizzards

1. Raw material:

Fresh goose gizzards 100 pieces and salt 0.75kg.

2. Procedures:

1) Treatment of gizzards

a. Cut at middle of right side of gizzard and open with a oblique knife to remove the residual feeds.

b. Scrape and remove a layer of yellow membrane inside of gizzard cavity. Wash gizzard inside and outside, and wipe the dirt juice from inside. If it is necessary rub the gizzard inside with salt to remove the rancid residues.

2) Curing of gizzard : Cure the gizzard with salt for 12-24 h, then wash and clean in water to remove the dirt from the surface .

3) Penetrate the cured gizzards with string by every 10 gizzards for 1 string, then dry by sun-heat for about 3-4 days. Shape at about 70% dried.

4) Put gizzards on the table, press by right hand, and paddle and press 2-3 times by knife of kitchen to make the thick part of gizzard flatly, so that it is easy to dry.

5) Dry in the air and park.

Comment:

1. Soak the gizzards in warm water to remove the salt and soften before Eating.
2. Cook the product until boiling and simmer for 1 h, cool and slice for Serving.

Western-style roasted goose

1. Stuffing ingredients:

   Butter 3 tbsp, fried chopped onion 2 tbsp, salt 0.5 tsp, celery 1.5 cups (l/4 in dices) dry bread 3 cups(1/4 in dices), chopped apple 1.5 cups, plum meat 1.5 cups (225-338g)and lemon juice 3 tbsp.

2. Procedures:

   1) Stuff breast and abdominal cavity with the stuffing ingredients.
   2) Pull neck skin attach to back and fix with stainless steel needle. Put wings on two sides of breast flatly.
   3) Sew the opening of abdominal cavity with 4-5 small steel needles. Penetrate through the needle from middle part to top of body like tying shoe laces with cotton strings Tie the end of thighs with cotton strings and tie up to body of goose. At last, penetrate the top of tail with needle on two thighs.
   4) After stuffing, roast at once, place the tied goose breast to face down on the frame in uncovered plate and roast at 163℃ oven by mild-heat. Don't add water or oil.
   5) During roasting, Collect the melt oil in the plate and remove it in another container to prevent the oil over change color or browning, and keep light color for another cooking use. When the goose meat is roasted to 2/3 doneness, turn the goose body(breast) over until roasted well.
   6) Doneness test:

      Move the thigh up and down, if the joint is easy to turn off, and the meat of thigh should feel very tender.

Roasting time schedule

Carcass weight (kg)	temperature (℃)	time(hours)
1.8-2.7	163	2-3
2.7-3.6	163	3-3.5
3.6-4.4	163	3.5-3.75
4.4-5.3	163	3.75-4.25
5.3-62	163	4.25-4.75

Tea smoked goose(Cha-er)

1. Raw material:

   Dressed goose 1 bird (3kg)

2. Seasoning ingredients:

   Oolong tea leaves 3 8g, sugar 3 8g, salt as desired, ginger 40g, xanthoxylum 6g, sodium nitrite 0.3g and hot water 2kg(depend on covering the goose body)

3. Procedures:

   1) soak tea leaves in hot water(90℃) to dissolve sugar, salt, ginger, xanthoxylum and Na-nitrite.

   2) Cure the dressed goose in the above solution for 24 h, before dipping puncture the goose thigh and breast several times.

   3) Roast the cured goose in preheated oven at 165℃ for 40 min.

   4) Cool for serving.

Foe gras(goose fatty liver) paste

1. Raw material:

   Fatty liver 30%, pork back fat 30%, soy protein isolate 3%, wholw egg 4%, starch 3%, emulsifier and spices as desired, and ice water 30%.

2. Procedures:

   1) Wash and desinew the fatty liver.

   2) Cut liver and mix with salt, sugar and wine, precook, cool and grind.

   3) Add back fat and emulsify it.

   4) Fill the emulsion in can, vacuum and seal, retort and cool, store.

Roasted goose

1. Ingredients

Dressed goose carcass(about 3-3.5kg)	1 bird
While vinegar	160g
Brown vinegar	40g
Maltsugar	40g
Sugar	12g
Salt	8g
Aniseed	4 stars
Ginger	5g
Garlic	5g
Five spice powder	5g

2. Equipment

Built-in oven

Hooks

Stainless steel needles

Roasting pins

3. Processing procedure

3-l. Dressing carcass, cut feet and cleaning, remove the guts, air-pipe out from the tail.

3.2. Prepare coating ingredients with white vinegar and brown vinegar and malt sugar for later use.

3.3. Mixing other ingredients as marinade for later use.

3.4. Put the marinade mix into the abdominal cavity from the tail, sew up with a needle for later use.

3.5. Pour boiling water onto the carcass, apply evenly with the coating ingredients.

3.6. Hang the goose up with a hook on rack, and dry in the air until the outside skin. then roast in an oven over strong heat for 40 min. or longer. During heating turn occasionally to ensure even heating.

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 13g, wild pepper 13g, allspice 13 g, clove 13 g, cassia bark 13g, amomum 13g and licorice 2g.

Seasonings:

Water 2.56kg. light soy sauce 2.56 kg, rock sugar 640g, salt 160g 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.

Reformed duck or goose roast

Formula(based on meat weight)

Deboned duck or goose meat	100%
Ice water	10
Salt	1.0
Polyphosphate	0.25
Sugar	1.0
Monosodium glutamate	0.5
White pepper powder	0.17
Onion powder	0.17
Cinnamon powder	0.05
Wine	0.5

Procedures:

1) Tenderize thigh and breast meat with a blade tenderizer.
2) Tumble the meat, salt, ice water, polyphosphate, sugar, MSG and other ingredients by a program of tumbling for 15 min, and resting for 30 min, then repeat this program for 4 h in cooler at 0-5 ℃.
3) Stuff into moulds.
4) Freeze in the freezer at -30℃.
5) Thaw and roast.

Cooked duck or goose roll

Formula:

Breast meat	65%
Trimmings	25%
Skin	10%
Ice water	12%
Dextrose	1.5%
Salt	1.5%
Polyphosphate	0.3%

1) Grind breast meat by a kidney plate grinder.
2) Blend ground meat with 1/2 salt, phosphate and ice water to extract the salt soluble protein.
3) Chop skin and trimmings with the rest of the ice water, salt, phosphate and dextrose to yield a fine emulsion.
4) Mix emulsion with the protein matrix as meat batter.
5) Stuff the mixture into casing.
6) Cook the product to internal temperature of 72 ℃.
7) Cool with ice water.

Cantonese-style roasted goose

Processing procedures:

1) Eviscerating(open abdominal cavity):Open abdominal cavity from inside of right wing to remove gizzard and viscera.
2) Cut feet and wings, then put head to face operator and turn breast upward, and right-hand insert a 10-12 cm long bamboo stick which is splitted to Y-shape from mouth to abdominal cavity to stretch the goose cavity.
3) Blanching(Churn-tang, dipping in boiling water) in boiling water to shrink the skin.
4) Rinse in running water and cool and dry the goose body, then coat inside and outside of the body with syrup.
5) Put about 200g five spices salt, 2 grains star aniseed into abdominal cavity before roasting.
6) Roasting: hang the goose into preheated stove at medium-heat, and the back of goose toward heat, breast faces to stove wall, cover the stove to roast for 25 min until the goose meat to well done and becomes slightly red.
7) Sparkle oil on the roasted goose and serve.

Nanjing dried goose gizzards

1 .Ingredients:

Goose gizzard: 100(yellow membrane are removed and cleaned), salt 4%, sugar 1%, MSG 0.5%, star anise 0.5% and xanthoxylum 0.5%.

2. Procedures:

1) Fry salt with star anise, xanthoxylum, and cool, then mix sugar and MSG.
2) Cure gizzards with the salt mixture for 12-24 h.
3) Wash the cured gizzards, then penetrate the gizzards with string every 10 gizzards for one string, and dry in the air under sun heat for 3-4 days.
4) Shape and remodel : place the gizzards on the table, and press flatly by hand and press and rub for 2-3 times to make the gizzards flat.
5) After curing, hang the products in the air which can be stored for 6 months.

3. Serving

1) Soak the cured gizzards in clean water and clean.
2) Cut the gizzards into slices and pour sesame oil on the gizzard slices for serving.

Multi-taste sliced goose gizzards

1. Ingredients:

Goose gizzards(defatted, membrane removed and cleaned) ?kg

Curing agents : water 100kg, salt 21 kg and sugar 0.25kg

2. Marinade ingredients:

Clove 30g, nutmeg 50g, amomums 40g, star anise 40g, xanthoxylum 40g, tangerine Peel 40g, sugar 2.5kg, soy sauce 1kg, wine 0.25kg, green onion 150g, ginger 150g and water 50kg.

3. Procedures:

1) Cure the washed and cleaned goose gizzards in curing agents at 4-10 ℃ for 8-12h.
2) Put the marinade ingredients in the cotton bag and add water soy sauce, sugar, onion and ginger, and cook with gizzards for 15 min and simmer for 15 min, then take out to cool.
3) Cut the marinated gizzards into 0.3mm thickslices.
4) Soak the gizzard slices in the marinade broth(2) 5 kg, add 0.5kg soy sauce, sugar 0.25kg, ginger powder 15 g, MSG 30g, red pepper powder, chili oil 30g and cook until boiling, then quickly dip the sliced gizzards for 10-15 sec, then take out to cool.
5) Pack the product in the bag by vacuum or boxes.

Dried goose meat jerky

1. Ingredients(based on meat weight):

   Goose meat: desinew, deboned, skinned, defatted goose thigh and breast. Goose fat(lean : fat=3:1).

   Sugar 13-15%, fish sauce 8%, egg 3%, white pepper powder 0.2%, MSG 0.5%, salt 2%, polyphosphate 0.3%, anka red as desired.

2. Procedures:

   1) Grind goose meat and fat coarsely, separately.

   2) Chop ground meat with salt, polyphosphate and crushed ice to extract salt soluble proteins.

   3) Add ground fat and other ingredients and mix thoroughly and stand for 20 min in cooler.

   4) Place the emulsion on the plate flatly and evenly, thickness is 0.15cm.

   5) Dry the emulsion at 65-70℃ oven for 4-5 h. Remove the meat jerky from the plate and cool to be the product which contains 18-20% moisture.

   6) Bake the product at 170-200℃ infrared oven to be golden brown color, then press flatly, and cut it into 8x12cm size and pack 58-60 pieces for 1 kg in a bag.

Fried shredded goose meat

1. Ingredients(based on meat weight):

   Goose meat: deboned, skinned, defatted and cut into 4-5cm strip, wash and clean. Ginger 0.4%, onion 0.4%, star anise 0.4%, cinnamon 0.4% which are packed in a bag, Salt 1%, sugar 8-10%, Chichiew(wine) 0.5%, white soy sauce 7-8% and MSG 0.4%

2. Procedures:

   1) Cook goose meat with equal volume of water, add ginger, onion, star anise, cinnamon bag by high-heat.

   2) Stir during cooking occasionally and cover the cooking vat.

   3) Remove the bubles on the top and oil and dirts.

   4) Add wine and boil for 20 min, then change heat from high to low gradually. After 30min, cook by weak-heat and simmer for 2 h until meat cuts are shredded.

   5) Take out the shredded meat and place on the pan to remove connective tissue, broken bone, and green onion, ginger and other spices.

   6) Replace the shredded meat into vat, add proper amount of water and broth(2), and cook by high-heat until boiling, then change to low-heat.

   7) Remove the oilets on the top and add white soy sauce, salt, wine and keep cooking and remove the oilets.

8) Condense the soup and add sugar and MSG, then turn heat to low-heat until dry. Stir during heating.
9) Bake and fry the shredded meat by low-heat, and turn both sides to prevent burning during frying.
10) Fry the shredded meat until the moisture becomes to less than 20%.
11) After frying, shred the fibrous meat to become golden brown shreddles.
12) Cool and pack

Chapter 12. Chemical properties of fresh duck meat and roasted duck

1 .Introduction

Meat and egg products from waterfowl play an important role in the poultry industry in Taiwan. Ducks provide both meat and eggs for the consumption. Duck meat comes mainly from mule ducks and partial from Peking ducks and spent laying ducks. Trends in the market however show an increasing demand for Muscovy. In the Southern Asian countries this bird has attracted attention. The duck has the advantage of being able to adapt to a hot and humid environment. It is hardier and more resistant to diseases.

Utilization of duck meat is different among the breeds. Meat from Peking ducks is used as raw material for roasted duck which is known all over the world. Peking duck besides is used for roasted duck, it is also used for processing duck roll, duck steak and ham. Muscovy ducks have red meat, an especially pleasant taste and a size suitable for cutting up and further processing. Muscovy duck meat is used for both fresh consumption and stewed with Chinese herb medicine such as ginger duck(gian mu ya) which is very famous and popular product during winter season. Mule ducks, a crossbreed between selected Peking and Muscovy lines are used for meat consumption and cured duck processing. It has a texture and taste which is highly appreciated by connoisseurs.

The purpose of this chapter was to compare the weights of skin and abdominal fats and total fatty acid and free fatty acid composition among different breeds of ducks raised in Taiwan.

Duck breeds and carcasses : dressed carcasses of Peking duck, Muscovy duck and mule duck were purchased from the local poultry slaughterhouse. Peking ducks were slaughtered at age of 75-80 days, Muscovy ducks were slaughtered at age of 130-135 days, and mule ducks were slaughtered at 80-85 days. All duck carcasses were dressed and stored at -20℃ until required for use. The carcasses were thawed at 4℃ chilling room for 24 hrs before used for testing. The chemical composition, fatty acid composition and fat distribution of carcass were analyzed.

Thickness of fat tissue and fat distribution of carcass :The frozen carcass was cut by saw from the low site of neck(4cm below atlas), upper back(8cm below atlas), lower back(18cm below atlas) and lower abdominal(24cm below atlas), then measured the skin thickness of neck, breast, abdominal, upper back and lower back, thigh and tail and fat distribution with a ruler and took photographs(table 2 and fig. 1).

2. Roasted duck preparation procedure

1) Abdomen opened place of the dressed duck carcass was tied with steel needle and blow air from neck skin of carcass(between skin and meat).

Distribution of Fat in Carcass

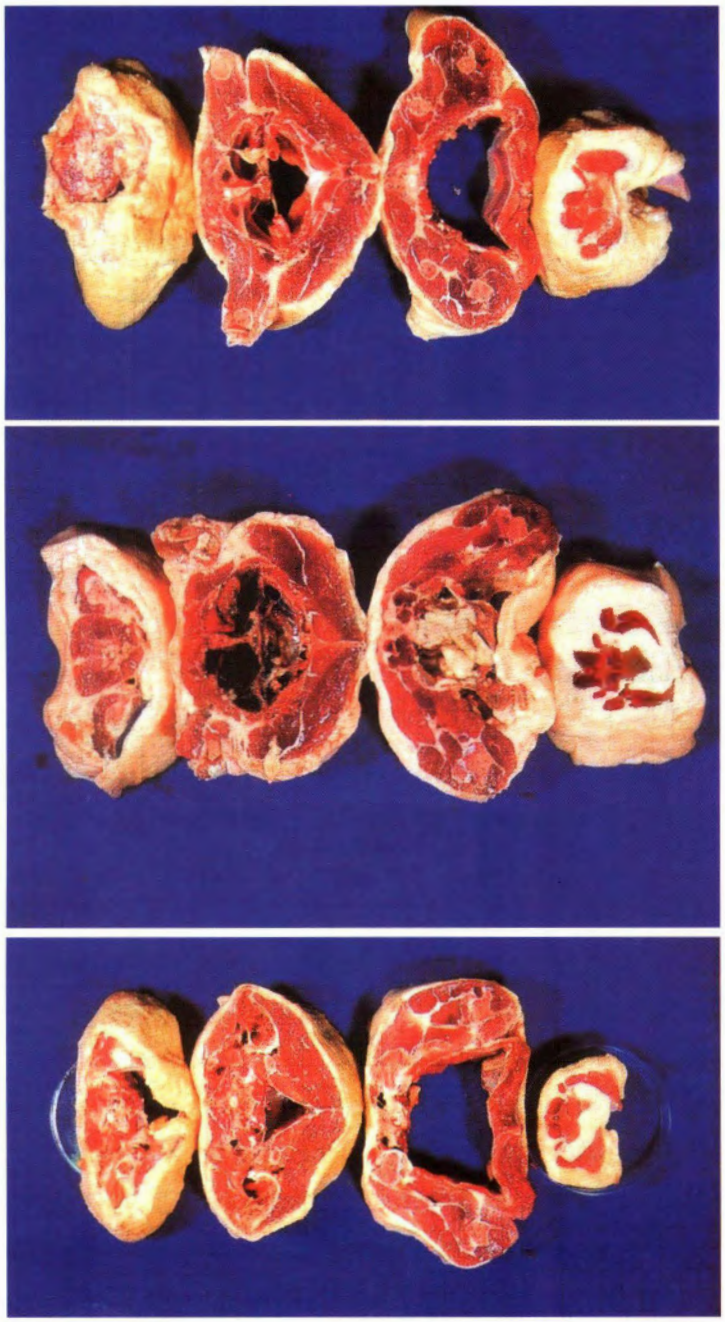


Fig. 1. Comparison of the distribution of fat on carcass from different duck breeds

2) The carcass of duck was hanged on the rack and poured boiling water(95℃) onto the surface of skin and dried in the air.
3) Spreading the coating syrup(a mixture of maltose syrup 150g, cane sugar 50g, vinegar 400g and water 400g, then cooked until all ingredients dissolved).
4) Then the air dried and syrup spreaded duck was hanged on the oven with a steel hook. The roasting temperature program was 130℃, 40-50min, then 220 ℃, 7 min. During roasting, turning the duck occasionally so as to ensure even heating.
5) The roasted duck was chilled in the air for use(see picture).

3. Characteristics of duck carcass and roasted duck

3.1 Carcass weight, abdominal fat weight, skin weight and thickness and fat

distribution Tables 1, 2 and fig. 1 showed carcass weight, abdominal fat weight and skin weight and thickness of different portions from three main breeds of ducks raised in Taiwan.

3.2 Carcass weight

The result revealed that the carcass weight of Muscovy duck was the highest, and followed by Peking duck, then mule duck was lowest($p<0.05$) (Table 1). This result was found as the same as the findings of Huang(1999). Chen et al (1984) and Baeza(1999) indicated that the growth rate of Peking duck was higher than mule duck and Muscovy duck, however, feeding period of Muscovy duck was longer than other breeds. In general, the slaughtered age of Muscovy duck is 15 weeks, mule duck is 10 weeks and Peking duck is 8 weeks.

3.3 Abdominal fat weight

The weight of abdominal fat in Peking duck was the highest among the three breeds($p<0.05$), but there were no significant difference between Muscovy and mule ducks($p>0.05$)(Table 1). This result was the same as the work of Huang (1999). Chen et al.(1984) also indicated that the abdominal fat weight of Peking duck was higher than that of mule duck. Stadelman and Meinert(1977) reported that duck after sex matured muscle growth rate became slow, but fat deposition became fast. Since Peking duck is a breed of early maturation, therefore, fat deposits easily and abdominal fat is also more(Baeza, 1999).

3.4 weight of different parts

The weights of skin from abdomen, neck, breast, thigh, upper back and lower back of Peking duck were nearly higher than those of other two breeds (p<

0.05)(Table 1). However, no significant difference was found in different parts of carcass between Muscovy and mule ducks(p>0.05). These results are in agreement with the study of Chen et al.(1984).

3.5 Chemical composition of duck meat

Table 1. Comparison of the carcass weight, abdominal fat and skin weight(g) of different parts from duck by breeds.

Carcass weight	Breeds						SEM
	Pekin duck 2752.6^{y}		Muscovy duck 3014.8^{x}		Mule duck 2563^{z}		35.7
	g	%	g	%	g	%	
Abdominal fat weigh	73^{x}	2.6	41^{y}	1.3	37^{y}	1.4	5.5
Different parts							
Abdomenal skin	174^{bx}	6.3	86^{ay}	2.8	82^{by}	3.1	3.1
Neck skin	91^{dx}	3.3	75b^{by}	2.4	92^{ax}	3.5	3.7
Breast skin	204^{ax}	7.4	90^{ay}	2.9	96^{ay}	3.7	3.4
Upper back skin	83^{ex}	3.0	49^{cdy}	1.6	52^{cy}	2.0	2.9
Lower back skin	120^{cx}	4.3	62^{cy}	2.0	59^{cy}	2.3	3.1
Thigh skin	57^{fx}	2.0	66^{cx}	2.1	59^{cx}	2.3	2.9
SEM	3.2		3.2		3.2		

n=6.

$^{a-f}$ Different superscripts at the same column indicate significantly different(P< 0.05).

$^{x-z}$ Different superscripts at the same row indicate significantly different(P< 0.05).

Table 2. Comparison of thickness of skin on different parts from duck by breeds.

Different parts	Breeds		
	Pekin duck	Muscovy duck	Mule duck
Lower neck skin	15	4	7
Breast skin	6	5	4
Abdomenal skin	12	3	5
Upper back skin	7	3	4
Lower back skin	8	6	7
Thigh skin	8	6	4
Tail	18	7	12

Table 3. Comparison of moisture content(%)of different parts from duck by breeds.

	Breeds			
Different parts	Pekin duck	Muscovy duck	Mule duck	SEM
Breast meat	72.7 ^{ax}	72.9 ^{ax}	73.9 ^{ax}	0.7
Thigh meat	42.4 ^{ax}	73.6 ^{ax}	74.4 ^{ax}	1.0
Neck skin	40.1 ^{bx}	47.1 ^{bx}	51.9 ^{bx}	4.5
Breast skin	27.0 ^{cx}	32.9 ^{cx}	34.2 ^{cx}	2.0
Abdomenal skin	23.3 ^{cx}	31.9 ^{cx}	33.4 ^{cx}	3.1
Upper back skin	28.9 ^{cx}	43.4 ^{by}	47.7 ^{by}	3.3
Lower back skin	24.6 ^{cx}	27.1 ^{cx}	27.0 ^{cx}	2.0
Thigh skin	27.8 ^{cx}	34.0 ^{cx}	35.0 ^{cx}	2.2
SEM	2.1	2.7	3.0	

$^{a-f}$ Different superscripts at the same column indicate significantly different($P< 0.05$).

$^{x-z}$ Different superscripts at the same row indicate significantly different($P< 0.05$).

Table 4. Comparison of ash(%) of different parts from duck by breeds

	Breeds			
Different parts	Pekin duck	Muscovy duck	Mule duck	SEM
Breast meat	1.2^{ax}	1.4^{ax}	1.0^{ax}	0.13
Thigh meat	1.0^{bx}	1.1^{bx}	0.9^{ax}	0.06
Neck skin	0.3^{cx}	0.3^{cx}	0.3^{bx}	0.06
Breast skin	0.2^{cx}	0.3^{cx}	0.1^{bcx}	0.02
Abdomenal skin	0.2^{cx}	0.2^{cx}	0.1^{cx}	0.03
Upper back skin	0.2^{cx}	0.3^{cx}	0.2^{bcx}	0.02
Lower back skin	0.2^{cx}	0.3^{cx}	0.2^{bcx}	0.03
Thigh skin	0.2^{cx}	0.2^{cx}	0.2^{bcx}	0.03
SEM	0.04	0.05	0.06	

$^{a-c}$Different superscripts at the same column indicate significantly different($p<0.05$).

$^{x-z}$Different superscripts at the same row indicate significantly different($p<0.05$).

Table 5. Comparison of fat content of different parts from duck by breeds

	Breeds			
Different parts	Pekin duck	Muscovy duck	Mule duck	SEM
Breast meat	5.7^{cx}	1.9^{cy}	1.6^{cz}	0.2
Thigh meat	9.4^{dx}	2.9^{cy}	2.1^{cy}	0.3
Neck skin	49.3^{cx}	40.0^{bx}	40.5^{dx}	3.3
Breast skin	65.4^{abx}	46.7^{by}	55.3^{bz}	1.3
Abdomenal skin	70.3^{ax}	54.4^{ay}	60.5^{abz}	1.6
Upper back skin	63.9^{bx}	42.2^{by}	48.2^{cy}	2.0
Lower back skin	69.9^{ax}	57.5^{ay}	56.1^{by}	2.0
Thigh skin	59.6^{bx}	45.5^{by}	49.2^{cy}	2.4
SEM	1.8	2.6	1.8	

$^{a-c}$Different superscripts at the same column indicate significantly different($p<0.05$).

$^{x-z}$Different superscripts at the same row indicate significantly different($p<0.05$).

Table 6. Comparison of protein content of different parts from duck by breeds

	Breeds			
Different parts	Pekin duck	Muscovy duck	Mule duck	SEM
Breast meat	21.0^{ay}	22.2^{ax}	21.1^{ax}	0.1
Thigh meat	20.8^{ax}	20.9^{ax}	20.5^{ax}	0.2
Neck skin	9.4^{by}	12.4^{bx}	11.2^{bx}	0.5
Breast skin	5.7^{dy}	6.5^{ex}	5.8^{dy}	0.2
Abdomenal skin	5.3^{dy}	6.7^{cx}	6.5^{dx}	0.3
Upper back skin	7.3^{cx}	8.3^{cdx}	6.7^{dx}	0.6
Lower back skin	7.8^{cx}	7.4^{dex}	8.0^{cdx}	0.6
Thigh skin	8.4^{bcx}	9.7^{cx}	9.5^{cx}	0.6
SEM	0.4	0.4	0.4	

$^{a-c}$Different superscripts at the same column indicate significantly different($p<0.05$).

$^{x-z}$Different superscripts at the same row indicate significantly different($p<0.05$).

Table 7. Comparison of moisture content (%) of breast and thigh with or without skin from roast duck

	Breeds			
Different parts	Pekin duck	Muscovy duck	Mule duck	SEM
Breast meat (without skin)	61.2^{az}	63.4^{ay}	65.1^{ax}	0.3
Thigh meat (without skin)	57.7^{aby}	64.2^{ax}	62.6^{bx}	0.6
Breast meat (with skin)	52.8^{by}	58.3^{bx}	60.3^{cx}	0.8
Thigh meat (with skin)	45.7^{cx}	57.6^{bx}	58.7^{cx}	0.1
SEM	1.2	0.4	0.5	

$^{a-c}$Different superscripts at the same column indicate significantly different($p < 0.05$).

$^{x-z}$Different superscripts at the same row indicate significantly different($p < 0.05$).

Table 8. Comparison of ash content (%) of breast and thigh with or without skin from roast duck by breeds.

	Breeds			
Different parts	Pekin duck	Muscovy duck	Mule duck	SEM
Breast meat (without skin)	1.2^{ay}	1.3^{ax}	1.4^{ax}	0.04
Thigh meat (without skin)	1.0^{b}	1.0^{b}	1.1^{b}	0.06
Breast meat (with skin)	1.3^{a}	1.3^{a}	1.2^{b}	0.05
Thigh meat (with skin)	1.1^{ab}	0.9^{b}	1.1^{b}	0.08
SEM	0.07	0.05	0.06.	

$^{a-c}$Different superscripts at the same column indicate significantly different($p < 0.05$).

$^{x-z}$Different superscripts at the same row indicate significantly different($p < 0.05$).

Table 9. Comparison of fat content (%) of breast and thigh with or without skin from roast duck by breeds.

	Breeds			
Different parts	Pekin duck	Muscovy duck	Mule duck	SEM
Breast meat (without skin)	7.9^{dx}	4.6^{dy}	4.1^{cy}	0.4
Thigh meat (without skin)	13.5^{cx}	8.4^{cy}	8.5^{by}	0.7
Breast meat (with skin)	19.2^{bx}	11.3^{by}	10.2^{by}	0.3
Thigh meat (with skin)	24.7^{ax}	14.2^{ay}	17.4^{ay}	1.2
SEM	0.6	0.4	0.7	

$^{a-d}$Different superscripts at the same column indicate significantly different($p<0.05$).

$^{x-z}$Different superscripts at the same row indicate significantly different($p<0.05$).

Table 10. Comparison of protein content of breast and thigh with or without skin from roast duck by breeds.

	Breeds			
Different parts	Pekin duck	Muscovy duck	Mule duck	SEM
Breast meat (without skin)	25.1	25.8^{a}	25.2^{a}	0.3
Thigh meat (without skin)	22.8	21.6^{b}	22.6^{b}	0.8
Breast meat (with skin)	21.6^{y}	23.7^{abx}	24.4^{ax}	0.5
Thigh meat (with skin)	20.0	22.3^{b}	19.2^{c}	1.8
SEM	1.7	0.4	0.7	

$^{a-c}$Different superscripts at the same column indicate significantly different($p<0.05$).

$^{x-y}$Different superscripts at the same row indicate significantly different($p<0.05$).

The chemical compositions of duck meat fresh and roasted ducks from different breeds of duck raised in Taiwan are shown in tables 3 to 10 which include ash, moisture, fat, protein contents.

3.6 Composition of fatty acids

3.6.1 Fresh duck meat

3.6.1.1 Composition of total fatty acids

Total fatty add composition of breast and thigh meats of fresh duck carcasses from different breeds were shown in Table 11. Fatty add composition for breast and thigh meats of fresh duck inspite of breeds were observed the highest level in oleic add($C_{18:1}$, 43.2-54.6%), the second higher level was stearic add($C_{18:0}$) and the lowest level was linolenic acid ($C_{18:3}$). These results were the same as the report of Leskanich and Noble(1997), Sheard et al.(2000). The total fatty acids and polyunsaturated fatty acid of breast and thigh meats of fresh duck carcass were observed no significant difference among the different breeds($p>0.05$). Monounsaturated fatty acid content of breast meat was found the lowest in Muscovy duck carcass, and the highest in mule duck. However, no significant difference was found between Peking duck and Muscovy duck, or Peking duck and mule duck($p>0.05$). Monounsaturated fatty acid of fresh thigh meat was found the lowest in mule duck and the highest in Peking duck($p>0.05$), but no significant difference was found between Muscovy and Peking ducks or Muscovy and mule ducks. These findings were different from the ostrich and pigs. The breeds may affect the fatty acid composition of ostrich and pig(Sales, 1998; Riette et al., 1997; Thomas et al., 1977). Total fatty acid composition of skin subcutaneous fat from different parts of fresh duck carcasses of different breeds were shown in Table 12. The results were found that oleic acid content was the highest in the fat of skin and palmitic acid ($C_{16:0}$)was the next, while lauric acid($C_{14:0}$), stearic acid($C_{18:0}$) and linolenic acid($C_{18:3}$) were the lowest in all parts of carcass. However, no significant difference in monounsaturated and polyunsaturated fatty acids of skin fat was found among the fresh duck carcass of different breeds. Saturated fatty acid content of skin fat from different parts of fresh duck carcass for mule duck was the highest among three different breeds. No significant difference in saturated fatty acids of skin fat(except back fat) was found between Muscovy and Peking ducks. Sarra(1985) and Pikul(1985) also indicated that different parts may affect fatty acid composition of poultry meat.

Table11 .Comparison of total fatty acids(%) of breast and thigh meat from duck by different breeds.

Parts	Breeds	Total fatty acids (%)								
		$C_{14:0}$	$C_{16:0}$	$C_{18:0}$	$C_{18:1}$	$C_{18:2}$	$C_{18:3}$	SFA	MUFA	PUFA
Breast	Pekin duck	0.2^{b}	30.3	2.6^{b}	51.4^{ab}	11.1^{ab}	1.4	33.2	51.4^{ab}	12.5
	Muscovy	0.1^{b}	22.4	6.2^{a}	43.2^{b}	11.9^{a}	1.4	28.8	43.2^{b}	13.4
	Mule duck	0.7^{a}	29.2	3.9^{ab}	54.6^{a}	7.5^{b}	2.3	33.9	54.6^{a}	9.8
	SEM	0.1	1.7	1.0	2.4	4.2	0.4	2.7	2.4	3.8
Thigh	Pekin duck	0.3^{b}	23.9	3.6^{b}	53.8^{a}	12.8	0.9^{b}	27.8	53.8^{a}	13.8
	Muscovy	0.2^{b}	22.6	6.2^{a}	47.5^{ab}	10.4	10.0^{a}	29.0	47.5^{ab}	20.4
	Mule duck	1.0^{a}	25.9	4.5^{a}	45.1^{b}	9.8	7.1^{ab}	31.5	45.1^{b}	17.0
	SEM	0.09	1.6	0.4	2.0	4.3	2.3	1.5	2.0	2.1

$^{a-c}$ Different superscripts at the same column indicate significantly different($p<0.05$)

SFA : total saturated fatty acid($C_{14:0} + C_{16:0} + C_{18:0}$).

MUFA : total monounsaturated fatty acid($C_{18:1}$).

PUFA : total polyunsaturated fatty acid($C_{18:2} + C_{18:3}$).

Table 12. Comparison of total fatty acids(%) of different skins from duck by different breeds.

Parts	Breeds	Total fatty acids(%)								
		$C_{14:0}$	$C_{16:0}$	$C_{18:0}$	$C_{18:1}$	$C_{18:2}$	$C_{18:3}$	SFA	MUFA	PUFA
Neck skin	Pekin duck	0.9^{a}	20.0^{a}	3.8^{a}	49.7^{a}	15.2^{b}	0.7	24.8^{b}	49.7^{a}	16.0^{b}
	Muscovy	0.5^{b}	23.6^{b}	5.4^{b}	44.6^{ab}	23.1^{ab}	0.6	29.5^{ab}	44.6^{ab}	23.8^{a}
	Mule duck	0.5^{ab}	26.3^{c}	3.2^{a}	42.8^{b}	26.1^{a}	0.7	30.2^{a}	42.8^{b}	26.9^{a}
	SEM	0.09	0.6	0.3	1.4	1.2	0.2	0.5	1.4	1.1
Breast skin	Pekin duck	0.6	23.7	3.2^{b}	49.8^{a}	14.9^{b}	0.3	27.6	49.8^{a}	15.3^{b}
	Muscovy	0.5	23.7	5.3^{a}	43.0^{b}	22.0^{ab}	1.0	29.6	43.0^{b}	23.0^{ab}
	Mule duck	0.5	25.4	3.3^{b}	44.2^{b}	25.4^{a}	0.8	29.3	44.2^{b}	26.2^{a}
	SEM	0.08	1.2	0.3	1.5	1.4	0.2	1.4	1.5	1.5
Abdomen skin	Pekin duck	0.9^{a}	23.2	3.2^{b}	50.1	16.0	0.7	27.4	50.1	16.7^{b}
	Muscovy	0.5^{b}	23.4	5.4^{a}	44.1	22.7	0.9	29.3	44.1	23.7^{a}
	Mule duck	0.5^{b}	25.4	2.7^{c}	38.8	18.4	0.9	28.7	38.8	19.3^{ab}
	SEM	0.05	4.9	0.5	3.9	4.6	0.2	5.1	3.9	1.2
back skin	Pekin duck	0.6	24.1	3.2^{b}	52.2^{a}	17.5	0.3	27.9	52.2^{a}	17.9^{b}
	Muscovy	0.4	24.8	5.9^{a}	43.9^{b}	23.4	0.6	31.1	43.9^{b}	24.0^{ab}
	Mule duck	0.5	25.9	4.2^{ab}	42.7^{b}	24.2	2.3	30.6	42.7^{b}	26.5^{a}
	SEM	0.4	2.3	0.6	1.2	1.8	0.5	2.8	1.2	1.6
Thigh skin	Pekin duck	0.8	24.0	3.0	53.4^{a}	17.0^{c}	0.5	27.8^{b}	53.4^{a}	17.5^{b}
	Muscovy	0.5	24.2	5.7	44.0^{b}	22.9^{b}	1.1	30.5^{a}	44.0^{b}	24.1^{a}
	Mule duck	0.3	25.9	3.7	44.3^{b}	26.4^{a}	0.7	30.0^{a}	44.3^{b}	27.1^{a}
	SEM	0.1	4.6	1.1	1.8	0.8	0.3	1.8	1.8	1.1

[a-c] Different superscripts at the same column indicate significantly different($p<0.05$)

SFA : total saturated fatty acid($C_{14:0} + C_{16:0} + C_{18:0}$).

MUFA : total monounsaturated fatty acid($C_{18:1}$).

PUFA : total polyunsaturated fatty acid($C_{18:2} + C_{18:3}$).

Table13. Comparison of the free fatty acids (%) of breast and thigh meat from duck by different breeds.

Parts	Breeds	Free fatty acids(%)								
		$C_{14:0}$	$C_{16:0}$	$C_{18:0}$	$C_{18:1}$	$C_{18:2}$	$C_{18:3}$	SFA	MUFA	PUFA
Breast	Pekin duck	ND^{b}	19.9^{b}	3.9	41.6	4.4^{a}	3.8	23.8^{b}	41.6	8.3
	Muscovy	ND^{b}	22.2^{b}	7.1	42.0	ND^{b}	5.8	29.4^{ab}	42.0	5.8
	Mule duck	1.5^{a}	31.8^{a}	5.7	54.6	1.3^{b}	4.7	39.0^{a}	54.6	6.0
	SEM	0.1	1.6	1.5	4.2	0.5	1.9	2.9	4.2	1.4
Thigh	Pekin duck	ND^{b}	18.2^{b}	4.4	46.6^{b}	4.4^{a}	5.2	22.7^{b}	46.6^{b}	9.7
	Muscovy	ND^{b}	22.2^{b}	9.5	44.8^{b}	ND^{b}	7.2	31.8^{ab}	44.8^{ab}	7.2
	Mule duck	2.0^{a}	28.1^{a}	5.7	54.8^{a}	1.2^{b}	5.4	35.9^{a}	54.8^{a}	6.7
	SEM	0.1	1.4	0.8	1.4	0.5	1.2	1.7	1.4	0.9

$^{a-c}$ Different superscripts at the same column indicate significantly different($p<0.05$)

SFA : total saturated fatty acid($C_{14:0} + C_{16:0} + C_{18:0}$).

MUFA : total monounsaturated fatty acid($C_{18:1}$).

PUFA : total polyunsaturated fatty acid($C_{18:2} + C_{18:3}$).

Table14. Comparison of the free fatty acids(%) of different skins from duck by different breeds.

Parts	Breeds	Free fatty acids(%)								
		$C_{14:0}$	$C_{16:0}$	$C_{18:0}$	$C_{18:1}$	$C_{18:2}$	$C_{18:3}$	SFA	MUFA	PUFA
Neck skin	Pekin duck	0.3^{ab}	21.4^{b}	4.0^{b}	49.0	9.5^{a}	6.0	25.7^{b}	49.0	15.5
	Muscovy	ND^{b}	21.7^{b}	6.0^{a}	47.4	4.5^{b}	5.4	27.8^{b}	47.4	9.9
	Mule duck	0.3^{a}	29.0^{a}	4.6^{b}	48.5	1.6^{c}	9.7	34.0^{a}	48.5	11.3
	SEM	0.03	1.6	0.3	0.9	0.9	1.7	1.7	0.9	1.9
Breast skin	Pekin duck	0.3^{ab}	24.3	4.3	50.1	7.3	5.0	28.9^{b}	50.1	12.3
	Muscovy	ND^{b}	23.7	5.9	47.5	8.4	6.7	29.7^{b}	47.5	15.1
	Mule duck	0.9^{a}	28.4	4.9	49.7	4.6	9.7	34.2^{a}	49.7	14.3
	SEM	0.1	1.5	0.5	1.1	1.7	1.6	2.0	1.1	2.8
Abdomenal skin	Pekin duck	0.1^{ab}	20.4^{b}	4.0^{b}	48.4	7.7^{a}	6.6	24.6^{b}	48.4	14.3
	Muscovy	ND^{b}	24.3^{ab}	6.3^{a}	46.9	7.2^{a}	7.7	30.6^{ab}	46.9	15.0
	Mule duck	0.5^{a}	27.8^{a}	4.9^{b}	49.9	1.6^{b}	10.1	33.3^{a}	49.9	11.8
	SEM	0.08	1.8	0.3	2.3	0.7	2.1	2.1	2.3	2.2
back skin	Pekin duck	0.1^{b}	22.9^{b}	4.0^{b}	56.2	5.2^{ab}	4.7^{b}	27.0^{c}	56.2	9.9
	Muscovy	ND^{b}	24.6^{b}	5.2^{a}	46.3	7.1^{a}	5.8^{b}	29.9^{b}	46.3	12.9
	Mule duck	1.8^{a}	29.2^{a}	5.6^{a}	51.2	1.1^{b}	11.1^{a}	36.7^{a}	51.2	12.2
	SEM	0.4	0.5	0.2	2.9	1.5	1.4	0.4	2.9	2.4
Thigh skin	Pekin duck	0.1^{b}	23.3^{b}	4.3^{b}	54.8	3.2	5.4	27.8^{b}	54.8	8.7
	Muscovy	ND^{b}	24.6^{ab}	6.3^{a}	45.4	4.7	8.2	31.0^{ab}	45.4	12.9
	Mule duck	0.3^{ab}	28.4^{a}	5.4^{ab}	52.9	1.5	12.0	34.2^{a}	52.9	13.5
	SEM	0.01	1.1	0.4	2.5	0.4	2.4	1.2	2.5	3.1

$^{a-c}$ Different superscripts at the same column indicate significantly different($p<0.05$)

SFA : total saturated fatty acid($C_{14:0} + C_{16:0} + C_{18:0}$).

MUFA : total monounsaturated fatty acid($C_{18:1}$).

PUFA : total polyunsaturated fatty acid($C_{18:2} + C_{18:3}$).

3.6.1.2. Free fatty acid composition of fresh duck

The results of comparison on free fatty acid composition for fresh breast and thigh meat of duck carcass among different breeds showed no significant difference in polyunsaturated fatty acid(PUFA) and monounsaturated fatty acid (MUFA) among the different breeds of duck carcasses($p>0.05$). While MUFA of thigh was found the highest in mule duck and the lowest content in Peking duck. However, there was no significant difference in MUFA of thigh meat between Muscovy and mule ducks or Muscovy and Peking ducks($p>0.05$).

The results of the total free fatty acids(FFA) both fresh breast and thigh meat from duck carcass were observed no significant difference among different breeds(Table 13). No significant difference in PUFA both breast and thigh of fresh duck carcass were found among different breeds($p>0.05$). No significant difference in MUFA content of breast meat was found among different breeds of duck. However, Thigh meat of mule duck contained the highest, and Peking duck contained the lowest in MUFA, but no significant difference was found between Muscovy and mule ducks, or between Muscovy and Peking ducks($p>0.05$). Total parts of SFA content of both breast and thigh was observed that mule duck was the highest, and Peking duck was the lowest ($p>0.05$). However, no significant difference was found between Muscovy and mule ducks, or Peking duck($p>0.05$). The result of MUFA in skin from different parts of duck carcass of different breeds were shown in Table 14. No significant difference was found both MUFA and PUFA in skin from different between different breeds of duck. To SFA, mule duck contained the highest in MUFA, and Muscovy and mule ducks contained the lowest. No significant difference in SFA in skin of neck, breast, abdomen and thigh were found between breeds of duck. However, SFA in back skin was found the highest in mule duck, followed by Muscovy, and Peking duck was the lowest($p<0.05$).

3.6.2. Roasted duck

3.6..2.1 Total fatty acid composition

Total fatty acid composition of breast and thigh meats of roasted duck from different breeds of duck were shown in Table 15. The results showed breast meat of roasted Peking ducks contained the highest in MUFA, followed by roasted mule ducks, while Muscovy ducks contained the lowest MUFA($p<0.05$). No significant difference in total SFA and PUFA were observed among three breeds of duck($p>0.05$). It was also not found significant difference in total SFA of skins obtained from different parts of roasted ducks of different breeds. However, MUFA content of the skins on neck, breast, abdomen and back of the roasted

Peking duck was higher than those of Muscovy and mule ducks. But no significant differences in MUFA and PUFA contents were found between the roasted Muscovy and mule ducks.

Martin(1999) and Miller(1987) indicated that meat through processing would cause fatty acid composition changed. Boiling caused fatty acid composition increased, but changes in individual fatty acid had no a certain tendency.

3.6.2.2 Free fatty acid composition

Table 16 showed the composition of free fatty acids of breast and thigh of roasted ducks of different breeds. No significant difference in total SFA, MUFA and PUFA contents was found in the breast meat among three breeds of ducks. And MUFA content in thigh meat was also found no significant difference among three breeds. However, SFA content was the highest in the thigh of the roasted duck, and followed by the roasted Peking duck and Muscovy duck was the lowest($p<0.05$).

For PUFA content in thigh meat, the roasted mule duck was the lowest, while Muscovy and Peking ducks were higher ($p<0.05$), but no significant difference was found between breeds($p>0.05$).

Table 17 showed free fatty acid composition for the skins of different parts of the roasted duck of different breeds. It was found that total SFA content of skins of breast, thigh and abdomen for Muscovy duck was lower than those of other two breeds($p<0.05$). Roasted Peking duck had the highest in MUFA content in the skins from different parts, and followed by mule duck, and Muscovy duck was the lowest. While PUFA content in skins of breast, thigh and abdomen was found the highest in the roasted Muscovy duck, and Peking duck and mule duck were lower($p<0.05$), but no significant difference was found in PUFA content of the skins from different parts between these two breeds ($p>0.05$). As shown in the above results, it was noted that fatty acid compositions were affected by breeds, parts and roasting.

Baeza (1999) found Peking duck had the highest in SFA, and the lowest in PUFA content, while mule duck had the highest in PUFA content as compared with the difference in fatty acid composition among Peking duck, mule duck and Muscovy duck in this study.

However, the results of this study revealed that fatty acid composition varied in parts and breeds, but the difference was uncertain.

These aspects may be caused by many factors such as chemical composition or muscle fiber type of different breeds(Smith et al., 1993; Baeza, 1999), and

diet composition(Ahn et al., 1996; Enser et al., 2000; Lalic et al., 1996; Leskanich and Noble, 1997; Sheard et al.,2000). It was observed that MUFA content in breast meat and skins from the roasted Peking duck tended to be higher but lower in PUFA content than those of the roasted Muscovy and mule ducks. The reason for these results may be due to Peking duck containing higher fat than the other two breeds of ducks.

Some research work indicated neutral lipids contain mainly SFA and MUFA, while polar lipids contain mainly PUFA. Generally, the neutral lipid content in muscle is relatively constant. Therefore, as lipid level in muscle increases, basically, the neutral lipid content increases, and polar lipids do not change remarkably. This may lead to increase in SFA and MUFA proportion relatively, but decrease in proportion of PUFA(Homstein et al., 1961; Alien et al., 1967; Wood and Lister, 1973; Sharma et al., 1987). Thus, SFA and MUFA contents in the fatty animal tend to be higher.

3.6.3 Volatile components of fresh and roasted ducks

The extracts were isolated from the fresh and roasted duck meats using steam distillation and solvent extraction (Likens-Nickerson steam distillation apparatus, Schultz et al., 1997).

These volatile components were subjected to gas chromatography analysis, and further analyzed using GC-MS. The chromatograms for volatile components of fresh duck meat from Muscovy, mule duck and Peking duck were shown in Fig. 2. And the chromatograms for the volatile components of the roasted duck meat were shown in Fig. 3. The results of the volatile components of the fresh and roasted duck meats identified were shown in Table 18. Totally 38 volatile compounds were identified, including 18 aldehydes, 6 alcohols, 3 ketones, 2 hydrocarbons, 3 carbonyl compounds, 3 heterocyclic compounds and 3 carboxylic acids. A comparison of the components and quantitative differences of the volatiles between fresh duck and roasted duck from different breeds (Tables 18 and 19) shows that the effects of cooking and breed on the components of duck meat may be the reason for quantitative difference. The results revealed that the numbers and concentration of volatile components of the roasted duck meat were higher and more than those of the fresh duck meat. Moody(1983) indicated that in general the fresh meat had less desirable aroma, but the cooked meat had a characteristic aroma attributable to the animal species and the temperature and type or method of cooking. Thus, meat flavor compounds in fact are formed during cooking. The fact also reflects in this study which non-roasted duck meat in spite of breeds, the number and intensity of the volatile components are very

few and relatively low. The major volatile components extracted are aldehydes, alcohols, ketones, hydrocarbons, carboxylic acids, carbonyls and heterocyclic compounds.

3.6.3.1. Aldehydes

Aldehydes have been identified including n-pentanal, n-hexanal, n-heptanal, E-2-hexenal, 2-pentenal, n-octanal, 2-heptenal, n-nonanal, E-2-octenal, 2,4-heptadienal(trans, cis), 2,4-heptadienal(trans, trans), 2-nonenal, E-2-decenal, undecenal, 2,4-decadienal, E,E-2,4-decadienal, 3,2-hexadecanal and l,l-dodecen-l-al(Table 19).

Lee et al.(1987) reported that hexenals found in many foods, probably were primary contributing to the aroma of apple, and 2,4-decadienal had oily flavor and was found in many kind of foods. Additionally, Ohloff and Flament(1978) indicated that aldehydes in meat were derived from oxidation of fatty acid, mainly from PUFA such as linoleic acid, linolenic acid and arachidonic acid. In addition, the aldehydes also contribute to the color development of the roasted meat (Lesimple et al., 1995). Aldehydes are the compounds between alcohol and acids, but they possess chemical reactivity and greater volatility and form characteristic aroma. For example, totally 193 volatile compounds have been isolated and identified from the roasted chicken. Of these compounds, 41 aldehydes are derived from lipids. Two of these compounds-hexanal and 2,4-decadienal contain higher proportion, and play an important role in flavor of the roasted chicken. While, hexanal and 2,4- decadienal mainly result from the oxidation of linoleic acid. Autooxidation of linoleic acid may produce 9-hydroperoxide and 13-hydroperoxide. And 13-hydroperoxide may degrade to hexanal, and 9-hydroperoxide may degrade to 2,4-decadienal. Therefore, it can be noted that aldehydes are very important to the flavor of the roasted meat products. They are the higher proportion of the volatile compounds found in the roasted duck.

3.6.3.2. Alcohols

Six alcohols have been identified in the fresh and roasted ducks of this study(Table 19), including ethanol, isoamylalcohol, 4-methyl-l-pentanol, l-octen-3-ol, 1,12-dodecanediol and 1-heptadecanol. In general, these compounds result from the oxidation of the fatty acid components of lipids(Watanabe and Sato, 1971). Some of aliphatic alcohols are major volatile compounds in the cooked foods. However, saturated alcohols are regarded to be not an important contributors to the aroma of the cooked foods, except they

contain higher concentration(Heam and Reineccius, 1986).

3.6.3.3.Carboxylic acids

Carboxylic acids have been identified in the fresh and roasted ducks in this study including dodecanoic acid, tetradecanoic acid and hexadecanoic acid(Table 19). The result shows hexadecanoic acid contains greater than other two acids for all breeds of ducks both fresh and roasted. Especially, the roasted Peking duck has higher in acid concentration than the others. This may be due to its higher subcutaneous fat content.

3.6.3.4. Ketones

Ketones have been identified in the fresh and roasted ducks, including 2-heptanone, limonone and 2-ethylidenecyclo hexanone(Table 19). Ketones are the volatiles result from the oxidation of the fatty acid components of lipids. In general, these compounds provide desirable aroma. One of those components 2-heptanone is an important aroma of cream(Lee et al., 1987). This compound has not been detected in the fresh duck meat but detected in the roasted duck from all breeds of ducks.

3.6.3.5. Heterocyclic compounds

Heterocyclic compounds have been identified in the fresh and roasted ducks including 1-3-5-trimethylbenzene, 2-propyl pyridine and 1,2-diethyl -4,5 -benzene. The concentration of heterocyclic compounds are low, but they contribute to desirable flavor of chicken meat(Shahidi, 1996). Wu and Liu(1989) compared the flavor compounds of the roasted duck with the boiled duck and found major volatiles in the boiled duck meat included 2-ethyl furan, n-hexanal, 2-heptanone, 2-pentylfuran, n-octanal, n-hexanol, n-nonanal, E-2 -nonenal, n-octanol and decadienals. Besides, those volatile compounds presented in the boiled duck meat, the roasted duck also contain pyrazine, pyridine, thiazole. These findings are similar to the result of this study.

Mottram(1985) also pointed out that different cooking methods may influence the composition of volatile components in meat. The meat cooked by roasting produces much higher heterocyclic compounds than the meat is cooked by boiling. Because the heterocyclic compounds are mainly derived from the products of Maillard reaction under cooking at the temperature above 150℃. However, in general, boiling temperature is not higher than 100℃, thus, it is hard to form heterocyclic compounds. Therefore, the roasted and grilled or smoked duck fillets also contain higher proportion of heterocyclic compounds, including

pyrazines, pyridines, pyrroles and thiazoles(Shahidi, 1996; Lesimple et al., 1995).

In conclusion, the chromatogram patterns of volatiles of the fresh duck meat are different among the three breeds of ducks. This difference may be due to the fatty acid composition and fat content being different among the ducks. The chromatogram patterns of the fresh duck meat are also different from those of the roasted duck meat. However, although there are 38 volatiles being identified, more components have not been confirmed both fresh and roasted duck meats. From the chromatogram can be observed most volatile compounds from all the roasted duck meat appear at the retention time before 60 min. This result seems to be similar to the report of Mottram(1998). Mottram pointed out saturated and unsaturated aldehydes, with 6-10 carbons, are major volatile compounds of all cooked meats. Therefore, in this area more work needs to be done.

To compare the concentration of the volatile compounds in fresh and roasted meats among the different breeds of ducks, the results were found 2,4-decadienal, E,E-2,4-decadienal, hexadecanal and hexadecanoic acid were much higher than other compounds in both fresh and roasted duck meats. However, those compounds in the roasted duck meat are higher than those in the fresh duck meat.

Table15. Comparison of the total fatty acids (%) of breast and thigh meat from different breeds of roasted ducks.

Parts	Breeds	Total fatty acids (%)								
		$C_{14:0}$	$C_{16:0}$	$C_{18:0}$	$C_{18:1}$	$C_{18:2}$	$C_{18:3}$	SFA	MUFA	PUFA
Breast	Pekin duck	0.6	21.2	2.1	53.2^{a}	23.1^{b}	0.2	24.0	53.2^{a}	23.4
	Muscovy	0.5	21.2	1.0	46.7^{b}	29.4^{a}	0.9	22.8	46.7^{b}	30.3
	Mule duck	0.3	21.9	1.3	47.2^{ab}	27.9^{ab}	1.1	23.6	47.2^{ab}	29.0
	SEM	0.1	1.4	0.9	2.1	1.5	0.3	1.8	2.1	2.0
Thigh	Pekin duck	0.6	24.6	2.0^{ab}	51.8	20.2	0.3	27.4	51.8	20.6
	Muscovy	0.5	18.4	0.1^{b}	44.7	24.1	0.4	19.2	44.7	24.5
	Mule duck	0.2	20.7	3.8^{a}	45.4	25.4	1.5	24.8	45.4	26.9
	SEM	0.1	2.2	0.9	4.0	3.9	0.3	2.4	4.0	5.0

$^{a-c}$ Different superscripts at the same column indicate significantly different($p<0.05$)

SFA : total saturated fatty acid($C_{14:0} + C_{16:0} + C_{18:0}$).

MUFA : total monounsaturated fatty acid($C_{18:1}$).

PUFA : total polyunsaturated fatty acid($C_{18:2} + C_{18:3}$).

Table 15-1. Comparison of the total fatty acids (%) of skins from roast duck by different breeds of duck.

Parts	Breeds	Total fatty acids(%)								
		$C_{14:0}$	$C_{16:0}$	$C_{18:0}$	$C_{18:1}$	$C_{18:2}$	$C_{18:3}$	SFA	MUFA	PUFA
Neck skin	Pekin duck	0.4	20.7	1.3	58.9^{a}	17.5	0.7	22.5	58.9^{a}	18.2
	Muscovy	0.3	21.2	2.5	48.2^{b}	26.8	0.8	24.2	48.2^{b}	27.2
	Mule duck	0.3	20.5	3.5	49.4^{b}	24.2	1.3	24.5	49.4^{b}	25.6
	SEM	0.05	1.1	0.6	3.2	4.0	0.1	1.2	3.2	4.1
Breast skin	Pekin duck	0.3	17.4	2.4	60.8^{a}	18.4^{b}	0.6	19.1	60.8^{a}	19.0^{b}
	Muscovy	0.4	19.4	2.6	49.4^{b}	28.2^{a}	0.8	22.5	49.4^{b}	29.0^{a}
	Mule duck	0.4	19.3	2.3	49.7^{b}	23.8^{ab}	1.1	22.1	49.7^{b}	29.6^{a}
	SEM	0.1	1.8	0.8	1.1	2.9	0.1	2.4	1.1	1.4
Abdomen skin	Pekin duck	0.3	20.4	2.0	58.0^{a}	18.2	0.6	22.8	58.0^{a}	18.9^{b}
	Muscovy	0.2	23.4	1.9	44.4^{b}	22.1	4.3	25.6	44.4^{b}	26.4^{a}
	Mule duck	0.3	19.6	1.5	48.3^{b}	28.7	1.1	21.6	48.3^{b}	29.9^{a}
	SEM	0.1	2.2	0.6	2.8	3.3	2.1	1.7	2.8	1.4
Back skin	Pekin duck	0.5	22.1^{a}	2.2	58.7^{a}	17.0	0.7^{b}	24.9	58.7^{a}	17.7^{b}
	Muscovy	0.3	22.9^{a}	2.0	47.8^{b}	25.9	0.8^{b}	25.3	47.8^{b}	26.8^{a}
	Mule duck	0.4	19.8^{b}	2.7	47.1^{b}	28.2	1.4^{a}	22.9	47.1^{b}	29.7^{a}
	SEM	0.1	0.4	0.5	2.3	1.9	0.1	0.7	2.3	2.0
Thigh skin	Pekin duck	0.5	24.0	2.3^{b}	45.1	16.6^{b}	0.6^{ab}	26.8^{a}	45.1	17.3^{b}
	Muscovy	0.3	22.8	2.7^{a}	47.9	25.6^{a}	0.8^{a}	25.8^{a}	47.9	26.5^{a}
	Mule duck	0.4	19.8	2.4^{ab}	47.8	29.0^{a}	0.1^{b}	22.5^{b}	47.8	30.2^{a}
	SEM	0.1	4.7	0.1	5.9	0.9	0.08	0.2	5.9	1.0

[a-c] Different superscripts at the same column indicate significantly different($p<0.05$)

SFA : total saturated fatty acid($C_{14:0} + C_{16:0} + C_{18:0}$).

MUFA : total monounsaturated fatty acid($C_{18:1}$).

PUFA : total polyunsaturated fatty acid($C_{18:2} + C_{18:3}$).

Table 16. Comparison of the free fatty acids (%) of breast and thigh meat from roast duck by different breeds of duck.

Parts	Breeds	Free fatty acids (%)								
		$C_{14:0}$	$C_{16:0}$	$C_{18:0}$	$C_{18:1}$	$C_{18:2}$	$C_{18:3}$	SFA	MUFA	PUFA
Breast	Pekin duck	0.4^{ab}	23.2	2.3	52.4	18.9^{b}	2.4	26.0	52.4	21.4
	Muscovy	0.8^{a}	22.2	1.4	47.2	27.3^{a}	0.05	24.6	47.2	27.3
	Mule duck	0.1^{b}	27.0	3.7	53.0	19.8^{b}	0.6	30.9	53.0	20.4
	SEM	0.08	2.8	1.1	3.8	2.8	1.5	3.9	3.8	2.3
Thigh	Pekin duck	0.5	24.6^{ab}	3.6	45.2	20.8^{b}	4.4	28.8^{b}	45.2	25.2^{a}
	Muscovy	0.4	14.0^{b}	8.7	47.9	27.7^{a}	1.1	23.1^{c}	47.9	28.8^{a}
	Mule duck	ND	34.9^{a}	3.5	49.5	10.1^{c}	1.7	38.5^{a}	49.5	11.9^{b}
	SEM	0.1	6.0	5.1	2.3	2.4	2.3	2.1	2.3	2.0

[a-c] Different superscripts at the same column indicate significantly different($p<0.05$)

SFA : total saturated fatty acid($C_{14:0} + C_{16:0} + C_{18:0}$).

MUFA : total monounsaturated fatty acid($C_{18:1}$).

PUFA : total polyunsaturated fatty acid($C_{18:2} + C_{18:3}$)

Table 17. Comparison of the free fatty acids (%) of skin from roast duck by different breeds.

Parts	Breeds	Free fatty acids(%)								
		$C_{14:0}$	$C_{16:0}$	$C_{18:0}$	$C_{18:1}$	$C_{18:2}$	$C_{18:3}$	SFA	MUFA	PUFA
Neck skin	Pekin duck	2.5^{b}	22.8^{b}	4.9^{ab}	54.4^{a}	4.2	10.8^{b}	30.3	54.4^{a}	15.1
	Muscovy	ND^{a}	30.2^{a}	3.0^{b}	46.4^{b}	0.6	17.6^{a}	33.2	46.4^{b}	18.3
	Mule duck	0.1^{ab}	27.2^{ab}	7.3^{a}	55.5^{a}	0.4	9.2^{b}	34.7	55.5^{a}	9.6
	SEM	0.7	1.9	1.0	2.1	2.7	1.9	2.1	2.1	3.5
Breast skin	Pekin duck	0.5^{a}	14.9	4.5	67.3^{a}	0.1	9.3^{b}	20.0^{b}	67.3^{a}	9.5^{b}
	Muscovy	0.1^{b}	26.1	3.8	49.5^{c}	0.7	16.0^{a}	30.1^{a}	49.5^{c}	16.8^{a}
	Mule duck	0.1^{b}	26.7	4.2	56.5^{b}	0.5	11.2^{b}	31.1^{a}	56.5^{b}	11.7^{ab}
	SEM	0.1	2.7	0.9	0.9	0.3	2.1	2.5	0.9	2.3
Abdomen skin	Pekin duck	0.8^{a}	17.0	3.7	63.8^{a}	ND	11.4^{b}	21.7^{b}	63.8^{a}	11.4^{b}
	Muscovy	ND^{b}	25.7	4.7	44.6^{c}	0.2	21.1^{a}	30.5^{ab}	44.6^{c}	21.4^{a}
	Mule duck	0.08^{b}	29.1	4.7	49.8^{b}	1.9	9.3^{b}	34.0^{a}	49.8^{b}	11.3^{b}
	SEM	0.06	2.6	0.9	3.5	0.7	0.7	2.9	3.5	1.3
Back skin	Pekin duck	0.9^{a}	19.9	3.2	63.5^{a}	ND	10.6^{b}	24.1^{b}	63.5^{a}	10.6
	Muscovy	ND^{b}	28.0	5.1	48.2^{b}	ND	13.6^{a}	34.1^{a}	48.2^{b}	14.6
	Mule duck	0.1^{b}	24.9	4.5	54.8^{a}	ND	14.6^{a}	29.6^{ab}	54.8^{a}	14.6
	SEM	0.1	2.9	1.1	1.0	ND	1.4	2.4	1.0	1.4
Thigh skin	Pekin duck	1.3^{b}	22.7	3.6	60.7^{a}	ND	10.6^{b}	27.7	60.7^{a}	10.6^{b}
	Muscovy	ND^{a}	22.9	5.5	48.7^{b}	ND	18.8^{a}	28.5	48.7^{b}	18.8^{a}
	Mule duck	ND^{a}	20.2	4.8	56.0^{a}	ND	9.0^{b}	25.0	56.0^{a}	9.0^{b}
	SEM	0.3	3.7	0.9	2.0	ND	2.4	3.4	2.0	2.4

$^{a-c}$ Different superscripts at the same column indicate significantly different($p<0.05$)

ND:not detected

SFA : total saturated fatty acid($C_{14:0} + C_{16:0} + C_{18:0}$).

MUFA : total monounsaturated fatty acid($C_{18:1}$).

PUFA : total polyunsaturated fatty acid($C_{18:2} + C_{18:3}$)

Table18. Identification of volatile compounds of ducks and roast duck from different breeds.

Peak No.	Compounds
1	Ethanol
2	2-ethyl furan
3	Diacetyl
4	n-pentanal
5	Toluene
6	n-hexanal
7	Oxylene
8	2-heptanone
9	Heptanal
10	Limonene
11	E-2-Hexenal
12	Dipropyl disulfide
13	2-pentenal
14	Isoamylacohol
15	1 -3 -5-Trimethyl benzene
16	n-octanal
17	2-heptenal
18	4-methyl-l-pentanol
19	n-nonanal
20	2-ethylidenecyclo hexanone
21	E-2-octenal
22	l-Octen-3-ol
23	2,4-heptadienal
24	2,4-heptadienal
25	2-nonenal
26	2-propyl pyridine
27	1,2-diethyl-4,5-dimethyl benzene
28	E-2-decenal
29	Undecenal
30	2,4-decadienal
31	E,E-2,4-Deacdienal
32	Hexadecanal
33	1,12-dodecanediol
34	11-dodecen-l-al
35	1-heptadecanol
36	Dodecanoic acid
37	Tetradecanoic acid
38	Hexadeeanoic_acid

Table 19. Percentage of single in the total volatile compounds from volatile extracts of duck or roast duck from different breeds.

Peak	Compounds	Amount（GC Area%）					
No		Pekin duck	Muscovy	Mule duck	Roast pekin duck	Roast muscovy	Roast mule duck
Aldehydes							
4	n- pentanal	ND	ND	ND	0.15	0.60	0.06
6	n- hexanal	2.30	1.27	ND	1.93	3.92	3.65
9	Heptanal	ND	ND	ND	0.26	0.52	0.23
11	E-2-Hexenal	0.05	ND	ND	0.32	0.55	0.09
13	2-pentenal	0.37	ND	ND	1.14	1.35	0.54
16	n-octanal	0.48	0.47	ND	0.91	0.51	0.26
17	2-heptenal	0.36	1.09	0.10	1.81	2.61	0.45
19	n-nonanal	1.04	ND	0.07	2.05	1.51	0.67
21	E-2-octanal	0.89	2.12	0.07	2.04	2.87	1.02
23	2,4-heptadienal	0.09	ND	0.03	0.38	0.54	0.12
24	2,4-heptadienal	ND	ND	ND	0.34	1.12	0.20
25	2-nonenal	0.14	0.68	0.09	0.87	1.62	1.62
28	E-2-decenal	0.72	ND	0.12	2.71	3.12	3.12
29	Undecenal	0.42	0.58	0.17	2.07	3.19	3.19
30	2,4-decadienal	2.16	1.59	0.16	7.26	6.90	6.90
31	E E-2,4-Deacdienal	1.75	1.53	0.75	8.90	29.47	29.47
32	Hexadecanal	7.79	6.44	0.74	9.90	4.74	4.74
34	11-dodecen-1-al	1.17	1.93	2.09	0.68	0.98	0.98
Alcohols							
1	Ethanol	0.08	ND	ND	0.49	0.40	0.20
14	Isoamylacohol	0.25	0.51	ND	0.89	1.10	0.57
18	4-methyl-l-pentanol	ND	ND	ND	0.51	0.82	0.05
22	l-octen-3-ol	0.87	ND	0.07	2.41	2.31	1.69
33	1,12-dodecanediol	0.44	1.62	0.51	0.93	0.83	0.83
35	1-heptadecanol	0.67	ND	1.59	1.05	0.91	0.91

Ketones							
8	2-heptanone	ND	ND	ND	0.14	0.35	0.06
10	Limonene	0.33	0.55	ND	0.90	0.06	0.47
20	2-ethylidenecyclo hexanone	0.23	ND	0.03	1.35	1.00	0.41
Hydrocarbon							
5	Toluene	0.05	ND	ND	0.31	0.26	ND
7	Oxylene	ND	ND	ND	0.21	0.52	0.04
Carbonyl compounds							
2	2-ethyl furan	0.27	ND	ND	0.49	0.67	0.10
3	Diacetyl	ND	ND	ND	0.19	0.37	ND
12	Dipropyl disulfide	ND	ND	ND	0.13	0.24	ND
Heterocyclic compounds							
15	1-3-5-Trimethyl benzene	ND	ND	ND	0.31	0.52	0.07
26	2-propyl pyridine	0.58	ND	0.06	1.67	0.62	0.62
27	1,2-diethyl-4,5- dimethyl benzene	0.34	ND	ND	1.02	0.46	0.46
Acids							
36	Dodecanoic acid	0.44	ND	0.20	0.69	0.36	0.36
37	Tetradecanoic acid	ND	ND	2.46	1.47	1.47	1.47
38	Hexadecanoic acid	15.29	9.61	5.13	8.66	8.66	8.66
Total		39.57	29.99	14.44	88.05	88.05	74.28

ND : not detected

Chapter 13. Thermal Properties and Electrophoretic Behavior of Heat-and Pressure-Induced Gels of Duck Muscle Proteins

Ducking in Taiwan has been traditionally marketed in the form of a whole carcass and Chinese-style processed food such roasted duck, cured duck cake (Ban-Ya) and marinated duck parts and pickled duck (Chen et al. 1992) . There are very few processed products on the market, thus, recently, the processors have attempted to develop new products such as duck roll, duck ham, duck meatballs and smoked breast and thigh to make consumers easier to prepare than the traditional product. One of the new developed processed products is duck roll which becomes popular on the market. The products are processed by tumbling with salt to extract the salt soluble proteins as a binder(Chen et al. 1985 1992, Huang 1993). For the consumers health concern, it is a trend to reduce sodium salt content in food. Interest in use of hydrostatic pressure in the food industry is increasing(Suzuki 1988). Researches have showed that the high hydrostatic pressure could be used to induce gelation of muscle protein(Macfarlane et al. 1984; Okamoto et al. 1990; O' Shea et al. 1979; Yamamoto et al. 1990). Salt soluble proteins(myofibrillar proteins) are used as a binder for manufacturing restructured meat products such as duck roll, duck ham etc. These products are traditionally made by heat induced gel to bind meat cuts or particles. Suzuki(1988) reported that the natural actomyosin formed a spongeous gel at low salt concentration by high pressurization. A combination of high pressure treatment and low salt may be used for manufacturing duck roll or steak.

Materials and methods

Mule ducks(body weight is from 2.8 to 3.5 Kg) were slaughtered by the commercial procedure and M pectoral is Major and Minor removed from the breast were used for test sample. The muscle was trimmed off the connective tissue and cut into small pieces. The small pieces were placed in a mortar on the ice bath and added with 0, 1 and 2% of salt and crashed and ground into a sticky paste(the final temperature was below 10℃). The duck meat paste was packed in a stainless steel tube(diameter 1.3 cm x height 1.3 cm) and placed in a ice bath. As the samples reach the same temperature, they were packed in a polyethylene bag with vacuum for heat- and pressure- treatments.

High pressure treatment

A high pressure apparatus with oil pressure generator and compressing vessel

(Hikari Koatsu KiKal Co, Japan) was employed. The prepackaged samples were kept in the vessel and compressed up to 5000 kg cm^{-2} with hydrostatic pressure. The vessel temperature during compressing was kept at 25℃ for 15 min. After the prescribed time interval, the pressure was released, the samples were removed the vessel and placed in the ice bath. The cooled sample were heated in the water bath at 65 ℃ for 15 min and, cooled in the ice bath for analysis.

Heat treatment

The duck meat paste was heated in the water bath at 65 ℃ for 15 min and cooled in ice bath for analysis.

Differential Scanning Calorimetry (DSC) measurement

Differential Scanning Calorimetry(DSC) was performed on a ULVAC DSC-7000(Sinku- Riko, Japan). Samples(15- 20 mg) of the duck meat paste were used in this analysis.

SDS- polyacrylamide electrophoresis(SDS- PAGE) analysis

SDS polyacrylamide electrophoresis was performed according to the method described by Lacmmli(1971). Muscle proteins were fractionated using the procedures described by Cheil et al. (1991).

Results and discussion

On the basis for results we assumed that duck muscle protein DSC profiles followed a similar pattern to those of rabbit muscle, the peak on the thermogram for whole duck muscle were labeled 1-3 and assigned as follows: 1) myosin transition 2) sareoplasmic transition and 3) actin transition(Wright, et al. 1977). The heat- and pressure- induced gels were used for DSC measurement. The DSC thermograms of the heat- induced gel with 0- 2% salt of duck muscle paste were showed in Fig. 1A, 1B and 1C. Only one endothermic peak at 79.5, 79 and 77℃ for the heat duck meat paste with 0, 1, and 2% salt appeared on the thermogram, corresponding to the denaturation temperature of actin. It is found the transition temperature of actin lowered with the salt concentration increased. The previous work was found addition of salt lowered the heat- resistance of myofibrillar proteins(Kijowski and Mast 1988). Generally, myosin and actin of the duck muscle were denatured by heating at 65℃ for 15 min and caused endothermic peaks disappeared during DSC analysis. This result was not in agreement with the findings of Wagner and Anon(1985) and Kijowski and Mast(1988). They found preheating of bovine semimembrane and chicken breast at different temperatures, then carried out DSC analysis. The endothermic peaks

disappeared at different preheating treatments. This result was found the heat-resistance of muscle proteins in duck meat was different from the other species of animals.

There endothermic peaks appeared on the thermogram- myosin(58-56.5 ℃), sarcoplasmic protein(67-64.8℃) and actin(78.5- 74.5℃) when the duck meat pastes with 0-2% salt were pressurized at 2000 kg cm^{-2}, but only one peak appeared on the thermogram of the heated sample(Fig. 1A, 1B and 1C). However only one endothermic peak of sarcolasmic protein appeared at range between 64 and 65℃ on the thermogram above 3000 kg cm^{-2}. The higher the pressure the flatten the peaks.

The transition heat (△H) decreased with an increasing pressure (Table 1). Tmax and △H of the muscle proteins of the duck decreased with the salt concentration increased in both heated and pressurized samples. These results were consistent with the findings of Quinn et al.(1980) aad Kijowski and Mast(1988). The endothermic peaks of myosin and actin disappeared from the DSC thermograms of the duck meat pastes with 0-2% salt by pressurization above 3000 kg cm^{-2} indicated two proteins were denatured. This result was similar to that the fibrous actin without ATP becoming irreversibly denatured by 1500 kg em^{-2} pressurization, and completely denatured by the pressure increased up to 3000 kg cm^{-2} (Ikkai and Oil 1966) and that activity of Mg- ATPase of actin remarkably decreased by pressurization at 3000 atm and 5000 atm(Ko et al. 1991). Sarcoplasmic protein peaks appeared on the thermogram of pressure- induced gel indicated the sarcoplasmic proteins were still not denatured completely by pressurization at 2500- 5000 kg cm^{-2} (Fig 1A and 1B). The composition of the sarcoplasmic protein are very complicate, the major components are soluble sarcoplasmic protein, enzymes, mitochondria, myoglobin, hemoglobin and some pigment proteins(Judge et al. 1989). It is possible these proteins are denatured by higher passure since myoglobin and hemoglobin are globular proteins. For example, α-helix structure of the native bovine serum albumin(BSA) is reduced from 70% to 39% when BSA is heated at 80℃. However, if it is pressurized at 600 Mpa, 9 min and 3 times, theα- helix structure still remains 67% and the endothermic peaks have no significant change on the DSC thermogram, but its denatured enthalpy decreased by 61% . This indicates that it is needed the pressure above 600 Mpa, 9 min, and 3 times to cause BSA denatured(Hayakawa et al. 1992). In addition, Suzuld et al.(1963) found that pressurization at 4000 kg cm^{-2} of isolated horse serum albumin was a reversible denaturation. △H(enthalpy) decreased with increasing pressure applied, the result showed △H for the sample pressurized at 5000 kg cm^{-2} was the lowest, the degree of denaturation was the highest, and the △H of the sample pressurized at 5000 kg cm^{-2} was the lowest than that of the heated sample. However, the gel strength of the pressurized sample was not higher than that of the heated

sample. The reason for this difference needs to do more work to evaluate it.

In spite of pressurization or heating treatments, T_{max} tended to decrease with the salt concentration increased(Fig. 1A and 1B) Goodno and Swenson(1975) proposed that the association between myosin and hydrogen ion, monovalent action(Na^+ and K^+ would change the charge of myosin molecule and disturb the balance of electrostatic forces of the native configuration of protein maintenance. The denaturation needs less energy, thus T_{max} value decreases contrastly. In conclusion, the denaturation temperature of muscle proteins in duck meat decreased up to 4000 kg cm^{-2} as the pressure increased, then increased at 5000 kg cm^{-2}. The total denatured enthalpy decreased with the pressure increased for the duck meat with various salt concentrations. However, the transition temperature and denatured enthalpy were also affected by the salt conentration.

SDS-PAGE analysis for myofibrillar protein of duck breast muscle with 0-2% salt treated by heating and pressurization was shown in Fig.2. The electrophoretogram revealed that the amount of myosin heavy chain(MHC) and actin in the pressurized duck breast muscle were higher than those of the heated samples and that the concentration of MHC and actin tended to decrease with increasing pressure.

However, tromyosin(TM) and Troponin-T(TN- T) of the duck breast muscle heated at 65℃ did not disappear form the electrophoretogram. Samejima et al.(1991) also reported that these two components remained stable when the meat sample was heated up to 70℃ and appeared on the electrophoretogram of the extract from the heated induced gel of myofibril. However, it is found that TN- T did not appear on the electrophoretogrram of the sample pressurized at different levels but TM still appeared on the electrophoretogram of the samples pressurized at 2000- 5000 kg cm^{-2} and the concentration increased with the pressure increased. The 30 KDa component of protein appeared on the electrophorotogram in spite of flesh, healed or pressurized duck meat and it remained no remarkable change. The amount of myosin light chain(MLC)-1, troponin-I, MLC-2 and MLC-3 of the heated duck breast muscle were lower as compared with those components in the fresh duck muscle. This was consistent with the previous report(Samejima et al. 1991) which indicated that myofibrillar were heated at 50℃ caused MLC and troponin solubility decreased and resulted in less amounts of these components on the electrophoretogram. Yamamoto et al.(1900) studied on the pressure-induced gel of myosin and indicated that myosin light chain-1 and 3 easily dissociated from the gel of myosin pressurized at 210 Mpa for 5- 8 min. Fig. 2 showed MLC- 1 and MLC- 3 appeared on the electrophoretogram of the duck breast nmscle pressurized at 2000- 5000 kg cm^{-2}, but their concentration decreased with the pressure increased, and light chains nearly disappeared at the pressure up to 5000 kg cm^{-2} (Fig, 3A, 3B and 3C). SDS- PAGE analysis of

sarcoplasmic proteins showed only the components of 65, 39, 22 and 13KDa appeared on the electrophoretogram of the heat-induced gel of the duck meat paste and the concentrations were lower than those of the fresh or pressurized samples(Fig 4). These results also corroborated the DSC thermal properties which the endothermic peaks of sarcoplasmic protein disappeared from the heated samples but it remained on the pressurized samples. There was a component of l00KDa appeared on the electrophoretogram of sarcoplasmic protein of the sample pressurized at 2000 kg cm^{-2} and became faintly detectable in the sample pressurized at 3000 kg cm^{-2}. This phenomenon might be associated with an increase in muscle protein sloubility caused by pressurization (Macfarlane and Mckenzie 1976; Macfarlane 1974). However, the real reason still needs more work to be done. In addition, electrophoretogram of the sarcoplasmic protein of the pressurized duck meat paste showed the amount of the protein components decreased with the pressure decreased. Especially, the pressure up to 3000 kg cm^{-2} the amount of 73, 65 and 54 KDa components remarkably decreased. If the pressure raised above 4000 kg cm^{-2} the component of 54 KDa disappeared from the electrophoretogram. However, the component of 28 KDa disappeared but 19 KDa component appeared on the electrophoretogram as the sample pressurized at 3000 kg cm^{-2}. It was found that the amount of the 16 KDa component gradually decreased and 13 KDa component increased for both samples of pressurized and heated duck meat paste as compared with the fresh sample(Fig 5A, 5B and 5C). These results were consistent with the previous report of Liu(1985), which indicated the amount of 16 KDa component of sarcoplasmic protein in the duck meat increased but the amount of 13 KDa component decreased with an increasing storage time.

Temperature and the enthalpy of denaturation as well as the electrophoretic behavior of muscle proteins in the heated and pressurized duck meat paste were altered by salt addition.

References

1. Ikkai, T. Ooi, T. 1966. The effects of F- G transformation of actin Biochemistry 5 1151-1160.
2. Kijowski, J. W. Mast, M. G .1988. Effect of sodium chloride and phosphates on thermal propertiesof chicken meat protein. J Food Sci 53 367- 370, 387.
3. Liu, D. C. Chen, M. T. 1989. Effects of fasting time before slaughtering and storage temperatureon the biochemical and histological characteristics of duck muscle. Proceeding for 35th International Congress of Meat Science and Technology Vol III). Copenhagen, Denmark, pi 251- 1256.
4. Macfarlane, J. J. Mckenzie, I. J. Turner, R. H. 1984. Binding of comminuted meat: Effect of high pressure. Meat Sci 10 307- 320.

5. O'Shea, J. M. Tume, R. K. 1979. Pressure-induced changes in myofibrillar proteins. Aust J BiolSci 32 415-421.
6. Samejima, K. Lee, N. H. Yamamoto, K. Ishioroshi, M. Asghar, A. 1991. Protein extractability and gel formability of myofibrillars isolated from skeletal and cardiac at different post- mortem periods. The Basic Studies on the Utilization of cardiac and smooth muscle edited by Samejima K Rakuno Gakuen University, Japan.
7. Suzuki, K. Miyosawa, Y. Suzuki, C. 1963. Protein denaturation by high pressure Measurements turbility of isoelectric ovalbumin and horse serum albumin under high pressure. Arch Biochem Biophy 101 225- 228.
8. Suzuki, T. 1988. High pressure treatment of muscle proteins. Meat Sci (Japan) 29 145- 154.
9. Wright, D. J. Leach, I. B. Wilding, P. 1977. Differential scanning Calorimetry studies of muscle and its constituent proteins. J Sci Food Agric 28 557- 564.
10. Yamamoto, K. Miura, T. Yasui, Y. T. 1990. Gelation of myosin filament under high hydrostatic pressure. Food Structure 9 267- 277.

Table 1. The changes of transition heat (△H*) of heatinduced and pressure-induced gel of duck meat pastes with different NaCl concentrations.

Treatmeats	NaCl concentration(%)		
	0%	1%	2%
65℃ 15min	1.626 ± 0.236^{C}	1.699 ± 0.248^{BC}	1.598 ± 0.272^{C}
2000kg/cm^{-2} 15min	4.165 ± 0.745^{A}	3.325 ± 0.577^{A}	3.324 ± 1.115^{A}
3000 kg/cm^{-2} 15min	2.867 ± 0.678^{B}	2.197 ± 0.73^{B}	2.430 ± 0.173^{B}
4000 kg/cm^{-2} 15min	1.831 ± 0.151^{Ca}	1.849 ± 0.86^{Ba}	1.481 ± 0.159^{Cb}
5000 kg/cm^{-2} 15min	1.194 ± 0.564^{C}	1.063 ± 0.346^{C}	1.117 ± 0.228^{C}

All values are mean +SD

* :The unit of△ H is mcal/mg dry matter.

ab Means within a row not sharing a common letter were significantly different($p< 0.05$).

ABC Means within column not sharing a conmon letter were significantly different($p<0.05$).

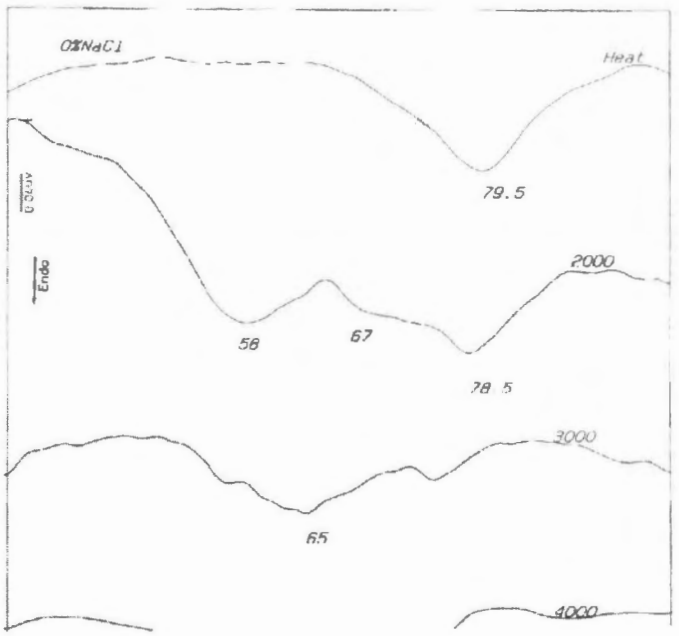


Fig 1. DSC thermogram of duck meat paste after heat and pressurization treatments (A)without salt (B) l%NaCl (C) 2%NaCl.

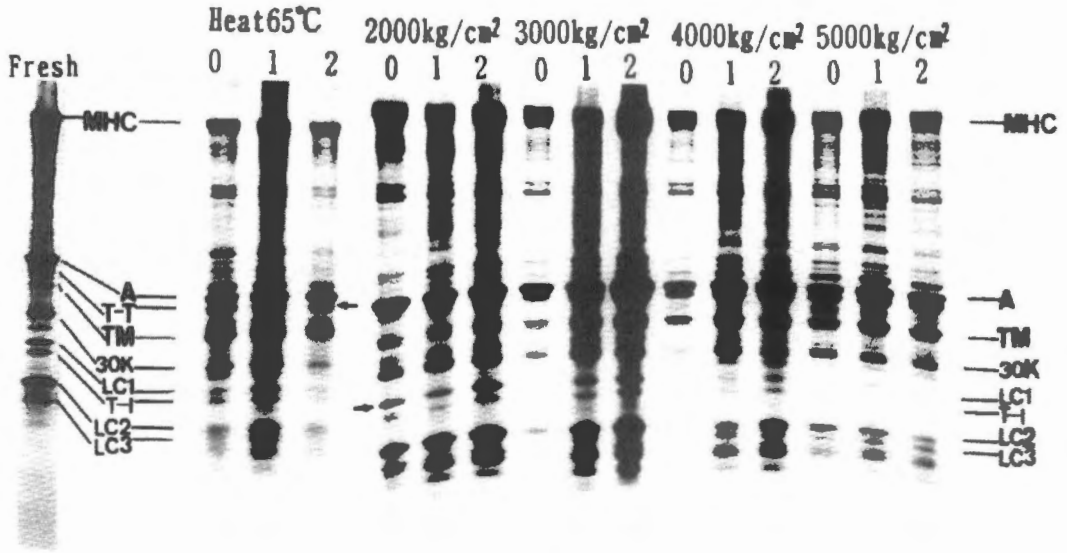
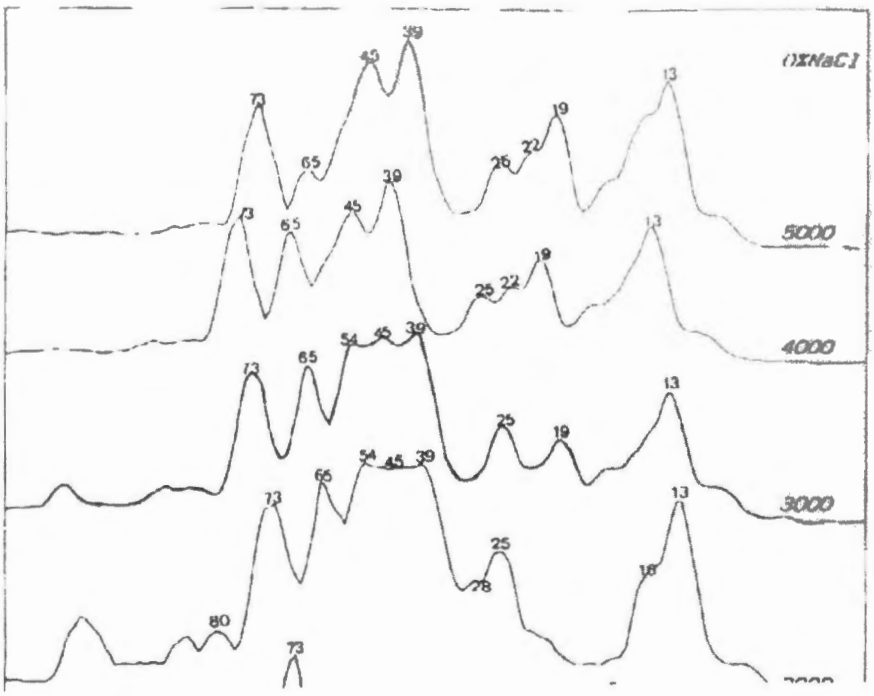


Fig2. SDS-gel electrophoretogram of myofibrillar proteins of duck meat pastes with different NaCl concentrations after heat and pressurization treatments.
0, 1, 2：0, 1 and 2 % of NaCl HMC：myosin heavy chain A: actin T-T: troponin-T TM: tropomyosin 30K: 30K dalton LCl: myosin light chain 1 T-I: troponin-I LC2：myosin light chain 2 LC3:myosin light chain 3



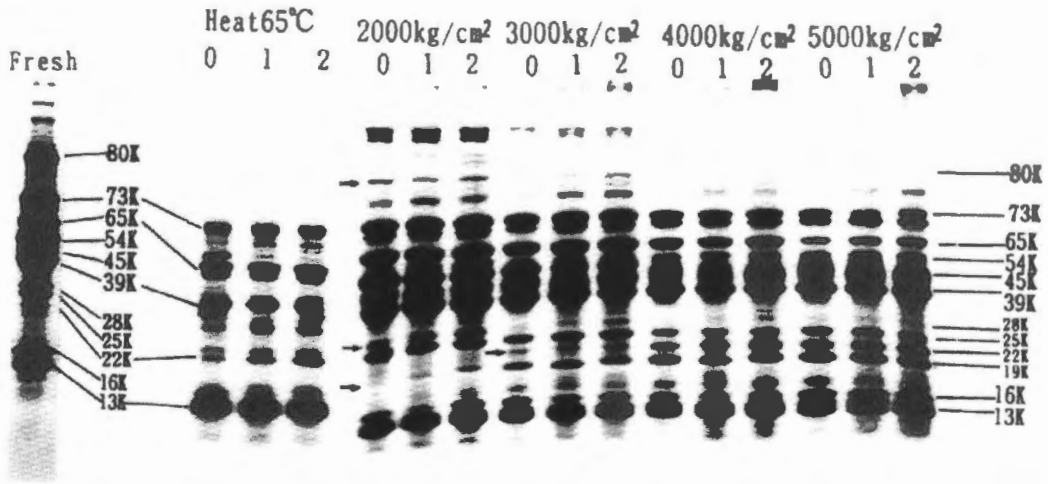
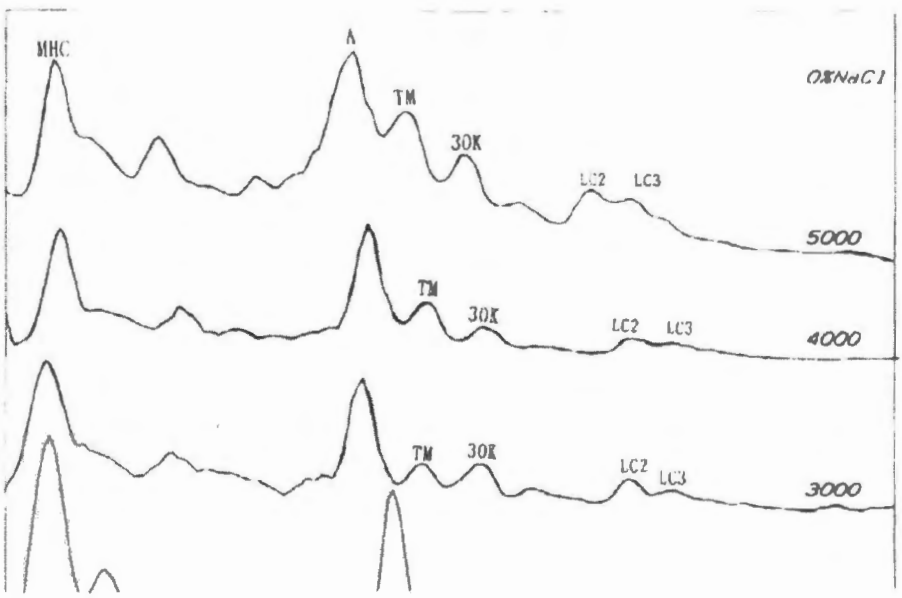


Fig3. SDS-gel electrophoretogram of sarcoplasmic proteins of duck meat paste with different NaCl concentrations after heat and pressurzation treatments. 0, l, 2 : 0, l and2% of NaCl.



Chapter14. Processing of tea smoked goose and its chemical composition and flavor compounds

According to the Account Record of Taiwanese Agriculture Annual Report(1996), there were 7,744,000 birds of geese raised in Taiwan. Goose meat tasted delicious and tender and it is very acceptable to the consumers. Normally goose is not convenient for the consumers to cook at home due to its big carcass, therefore, almost people consume goose meat products by eating out or precooked products in Taiwan.

Precooked goose meat products such as roasted goose, salted goose and smoked goose are very popular in the market. Tea-smoked goose is a new and popular goose product. The formula and processing method of tea-smoked goose are the commercial secret and it is limited to be home-made. So we try to develop the formula and processing procedure such as injecting and massaging, smoking. The good formula and procedure are obtained(Liu et al., 2001). Goose farming is the third poultry industry in Taiwan, just behind chicken and duck. Duck and goose products are special poultry products which are mostly preferred by Chinese, thus, the flavor and aroma characteristics are very important to the product palatabililty. Very few publications are focused on volatiles of duck and goose. The main purpose of this study was to investigate the volatile compounds of the tea-smoked goose product to know what special compounds exist in the product.

Formula:
See table 1.

Procedures

1. Preparation of pickle solution: Ingredients of pickle solution were indicated in Table 1. Boiling tap water and cooling to 95~96℃, then put Oolong tea leaves in the boiled water for 5 min. After then removed the tea leaves, and added ginger powder, pepper, monosodium glutamate, salt and sugar, and mixed thoroughly, then cooled to the room temperature. Then the mixture was added with sodium nitrite and polyphosphate and stirred vigorously.
2. Tea smoked goose preparation: The chilled dressed goose carcasses of White Roam breed at the age of 100 days(carcass weight was about 3 kg)were purchased for processing tea smoked goose from the local market. The carcasses were injected with pickle solution as Table 1 by 20% based on carcass weight and socked in vat covering the pickle solution at 4℃ for 48h, then steam cooked at 90℃ for 60 min. The cooked carcass was dried and smoked with tea leaves and brown sugar(1 :4) for

2.5 min. then cooled, and cut the smoked goose into breast and thigh parts and packaged by vacuum.

Table 1. Formula of pickle solution of tea smoked goose*

Ingredients	Percentage%
Oolong tea leaves	1.7
Cane sugar	7
Common salt	12
Sodium nitrite	0.02
Polyphosphate**	0.3
Sodium glutamate	0.5
Ginger powder	0.2
Pepper powder	0.2
Water	200

*Based on weight of goose carcass.

**Polyphosphate includes sodium pyrophosphate anhydrate and sodium polyphosphate (1:1).

Chemical composition of tea smoked goose meat

Table 2 shows the chemical composition of tea smoked goose meat. From the result shows thigh meat contains higher fat content and lower moisture than those in breast meat. There are no significance in ash and protein contents found between thigh and breast meats.

Table 2. Chemical composition of breast and thigh meat of tea-goose*

Meat type	Moisture(%)	Ash(%)	Fat(%)	Protein(%)
Breast	62.99 ± 3.36^{a}	2.96 ± 0.21^{a}	12.60 ± 2.92^{b}	20.89 ± 2.88^{a}
Thigh	57.59 ± 2.48^{b}	2.73 ± 0.27^{a}	19.72 ± 4.13^{a}	19.43 ± 4.62^{a}

Means±SD.

n=6.

a,b Means within the same column without the same superscripts are significantly different($P<0.05$).

* The table was obtained from our previous report published in J. of Agriculture Assoc. of China, 2:436-449,(2001).

Volatile components of tea leaves, goose meat and smoked goose meat analysis

1.Volatile components of tea leaves

The total ion chromatograms of separated constituents in flavor concentrates of oolng tea leaves analyzed on GC-MS are shown in Table 5 and Fig. 1.It was observed that the volatile compounds isolated from the tea leaves had 54 components identified. Ten major peaks of these components on the spectrum were identified by retention time on gas chromatogram of standards.

These compounds included the following: ethanol, acetaldehyde, linalool, 2,6-dimethyl cyclohexanol, 2-pyridinamine, 3,3-dimethylpentane, hexanoic acid, trans-geraniol, beta-ionone and nerolidol (Fig. 1). This result is in agreement with the data reported by Lee et al. (1984). They found that the flavor volatile compounds of tea included linalool, geraniol, indole and nerolidol, exceptionally less indole was found in this study. Lee et al. (1984) proposed that quality of oolong tea was affected by nerolidol, geraniol and indole. Geraniol gives tea a good taste, sweet, grass-like and orange aromas, and nerolidol possess slight tea aroma (fragrant). Chen et al. (1996) suggested that flavor compounds of pyrazine and furfurals were the products resulting from Mailard reaction caused by baking of tea leaves. These compounds posses heavy baked flavor. 2,5-and 2,6-dimethyl pyrazines were also identified in this experiment. Beta-ionone was the intermediate product from the degradation of carotenoid by heating. Linalool posses light almold aroma, and floral aroma (Lee et al., 1984). The linalool was oxidized to produce linalooloxide when it was heated. Indole has grapefruit-like and light sulfur odor which are special aromatic components of some fermented tea (Lee et al., 1984). Other compounds included aldehydes and esters with benzene ring such as benzaldehydes which were resulted from polyphenolic compounds by heating. 2-pyridinamine derived from the cyclisation of pyridine compounds with amino acids (Wu, 1987) posses a good smell; whenever, the concentration is higher, its smell becomes pungent and undesirable.

2. Volatile compounds of goose meat

A total of 20 compounds were identified from the extracts of goose meat (Table 6 and Fig. 2). These compounds included 9 aldehydes such as hexanal (peak 2), heptanal (peak 4), E-2-heptenal (peak 5), octanal (peak 8), E-2-octenal (peak 9), nonanal (peak 10), 2-ethyl-4-pentenal (peak 11), decadienal (peak 14), and 2,4-decadienal (peak 16); 6 alcohols such as 1-pentanol (peak 1), 7-octen-4-ol (peak 6), 2-cyclohexen-l-ol (peak 13), octanol (peak 15), 1,12-dodecanediol (peak 18) and 2-dodecen-l-ol (peak 20); 1 alkane such as octane (peak 3); 1furan such as 2-pentyl-furan (peak 7), and 2 acids such as 3-octenoic acid (peak 12) and known

acid (peak 19). Seven flavor components of these compounds were related to aroma of goose meat, which included hexanal, heptanal, octanal, nonanal, 2-cyclohexen-l -ol, 2,4-decadienal and 1,12-dodecanediol. Of these compounds, hexanal posses grass-like aroma (Chen et al., 1996), which is formed from fat oxidation (Lai and Lai, 1994); octanal has a fruity sweet taste and nonanal also has aromatic flavor (Lai and Lai, 1994). Josephson and Lindsay (1987) suggested that C5-C10 unsaturated aldehydes and C6-C10 aldehydes with double bonds were produced from the oxidation of polyunsaturated fatty acids. However, the major volatile compounds of goose meat were aldehydes resulting from the cooking process and oxidative degradation of polyunsaturated fatty acids.

Table 3. Identification of volatile compounds of oolong tea

Peak area	Retention time(second)	Compound
I	8.44	ethanol
	9.63	acetaldehyde
	13.95	butanal
	18.07	l-penten-3-ol
	19.30	pyrazine
	20.63	1-limonene
	23.71	propyl formic acid
	24.20	3(2H)-dihydrofuranone
	28.00	2,5-dimethyl pyrazine
	28.56	2,6-dimethyl pyrazine
	29.00	6-methyl-5-hepten-2-one
II	35.49	acetic acid
	35.90	linalool oxide
	36.52	furfural(2-furan carboxaldehyde)
	37.65	linalool oxide
	38.68	E,E-2,4-heptadienal
	39.18	l-(2-furan)ethanone
	40.24	benzaldehyde
	42.43	linalool
	45.13	2,6-dimethyl cyclohexanol
	45.72	2-pyridinamine
	45.93	3,3-dimethylpentane

Peak area	Retention time(second)	Compound
Ⅲ	47.48	2,4,6-cycloheptatrie
	47.89	1-phenyl-ethanone
	48.45	2-butene-l,4-diol
	48.81	2-methylpentanoic acid
	51.06	l-α-terpineol
	52.37	phenylacetic acid
	53.91	4-ethoxybenzenamine
	54.90	2-hydrobenzoic acid,
	56.71	nerol
	58.55	hexanoic acid
	59.22	trans-geraniol
	59.60	general acetone Ⅱ
	60.31	benzenemethanal
Ⅳ	62.62	Benzene acetonitrile
	63.99	β-ionone
	64.98	1-(1H-pyrr) ethanone
	66.14	Camphene
	66.94	4-(5)-3-buten-2-one
	68.93	d-norolidol
	69.27	Octanoic acid
	72.76	Phenyl benzoid acid
	73.52	2,6-heptadione
	74.30	Heptanoic acid
	75.46	Benzene methanol
Ⅴ	77.65	Hexadecanoic acid
	79.02	Hexanoic acid
	80.60	2-methylpropanoic acid
	81.83	3,6-1,5-heptadiene
	82.15	2-sec-butyl-phenol
	82.53	2(4H)-benzofuranone
	83.90	2-methylbenzaldehyde
	86.05	1H-indole
	88.24	Dodecanoic acid
	89.54	Bicycle(4,1,0) heptan
	93.15	9,12,15-octadecatrie

3. Volatile compounds of tea smoked goose

Table 7 and Fig. 3 showed that 20 volatile components of tea smoked goose meat were identified by GC and GC-MS. These compounds included 5 aldehydes such as pentanal (peak 1), furfural (peak 5), 5-methylfurfural (peak 10), hexadecanal (peak 18) and 9-octadecenal (peak 20); 5 alcohols such as linalool (peak 7), 1,8-cineol (peak 4), octanol (peak 9), 4-terpineol (peak 12) and hexadecanol (peak 15), 3-ethylphenol (peak 16), and 3-methylphenol (peak 17), and 5-methylphenol (peak 11); furan (2-acetylfuran+6-methyl-3,5-heptadien-2-one, peak 6); and other compounds such as limonene (peak 3), E-sabinene hydrate (peak 8 and 10) and piperitone (peak 13).

Of these compounds, there were 7 major volatile components including furfural, 2-acetylfuran+6-methyl-3,5-heptadien-2-ine, 5-methylfurfural, 4-terpineol, piperitone, phenol+2-methylphenol and hexadecanol were found. Chen et al. (1996) proposed that volatile components of furfurals were produced from the Maillard-type reaction caused by baking of tea leaves. The tea smoked goose meat was smoked with oolong tea leave powder and brown sugar, whereas, the furfurals might be derived during the goose meat was smoking. These compounds showed brown and black. Lai and Lai (1994) suggested that phenol compounds were related to the browning reaction, and furfurals reacted with phenols occurring color formation. Carbonyl compounds such as 5-methylfurfural, furfural, pentanal and piperitone were found to be responsible of unique smoking aroma, flavor and color (Chen, 1994). Phenols are important smoke components which contribute unique flavor to meat products. These compounds also possess antioxidative and bacteriostatic action. Alcohols existing in smoke are the products of decompositive distillation of wood, which are carrier of other volatile components. They do not contribute to flavor and aroma of meat products, but do have bacteriostatic effect.

From the above mentioned, the volatile compounds of the tea smoked goose meat such as limonene, furfural, 2-acetylfuran+6-methyl-3,5-heptadien-2-one, 5-methylfurfural, linalool and 4-terpineol come from the smoke combined with the flavor components of oolong tea. These components may give the characteristic flavor and aroma to the tea smoked goose. However, other volatile flavor compounds are probably short chain volatile compounds resulting from the oxidative degradation of fatty acids in goose meat. These aspects of lipid oxidation whether are correct it needed to be further studied.

The volatile composition of goose meat are different from those of chicken meat and duck meat as compared (Shi and Ho, 1994; Lesimple et al., 1995). However, we checked the review of Shahidi et al. (1986) we found 14 of 20 volatile components identified in the uncooked goose meat were the same as those presented in chicken

flavor, but those of the tea cooked and smoked goose were not same. The reasons for these differences are probably due to the difference in the species and cooking process. Depending upon the species and cooking process involved, the secondary reactive pool of intermediates will vary and hence the character of the final meat flavor will vary (Baines and Mlotkiewicz, 1984).

Although many experts attempt to include all of the components which have been found in meat volatile components, no absolute assurance can be given. However, they really give most contribution. In poultry meat, most publications are focused on chicken flavor, but very few on waterfowls such as duck and goose. In Taiwan duck and goose are the second and third biggest poultry industry just behind of the chicken. Especially, duck and goose products are very important foods to Chinese society. Fortunately, the number of volatiles of uncooked or cooked and smoked goose we detected and identified were more than 20 components but were not found by Soncin et al.(2007).

Table 4. Identification of volatile compounds of goose meat

Peak No.	Compound
1	1-pentanol
2	hexanal
3	octane
4	heptanal
5	E-2-heptenal
6	7-coten-4-ol
7	2-pentylfuran
8	octanal
9	E-2-cotenal
10	nonanal
11	2-ethyl-4-pentenal
12	3-octenoic acid
13	2-cyclohexen-l-ol
14	decadienal
15	octanol
16	2,4-decadienal
17	unknown
18	1,12-dodecanediol
19	acid
20	2-dodecen-l-ol

most components are the same as those of chicken meat except

Table 5. Identification of volatile compounds of tea-goose meat

Peak No.	Compound
1	pentanal
2	isoamyl propionate(I.S.)
3	limonene
4	1,8-cineol
5	furfural
6	2-caetylfuran + 6-methyl-3,5-heptadien-2-one
7	linalool
8	E-sabinene hydrate
9	octanol
10	E-sabinene hydrate
11	5-methylphenol
12	4-terpineol
13	piperitone
14	phenol + 2-methylphenol
15	2-ethylphenol
16	3-ethylphenol
17	3-methylphenol
18	hexadecanal
19	hexadecanol
20	9-octadecenal

Fig 1. Gas chromatograms of volatile compounds of oolong tea.

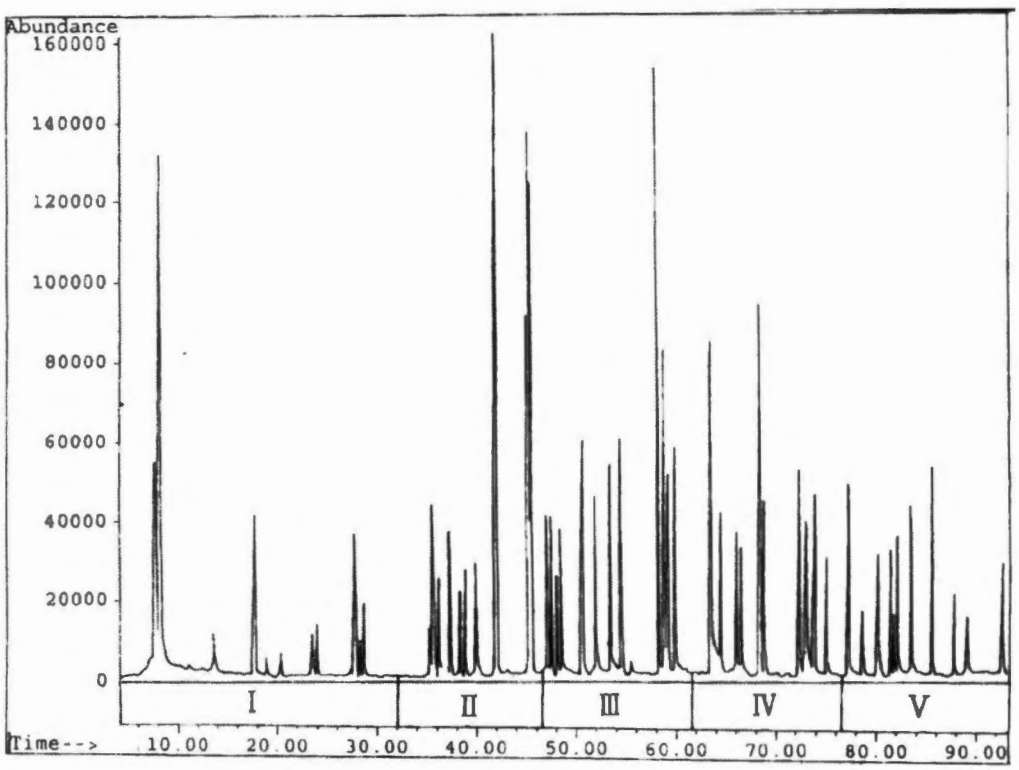


Fig 2. Gas chromatograms of volatile compounds of goose meat.

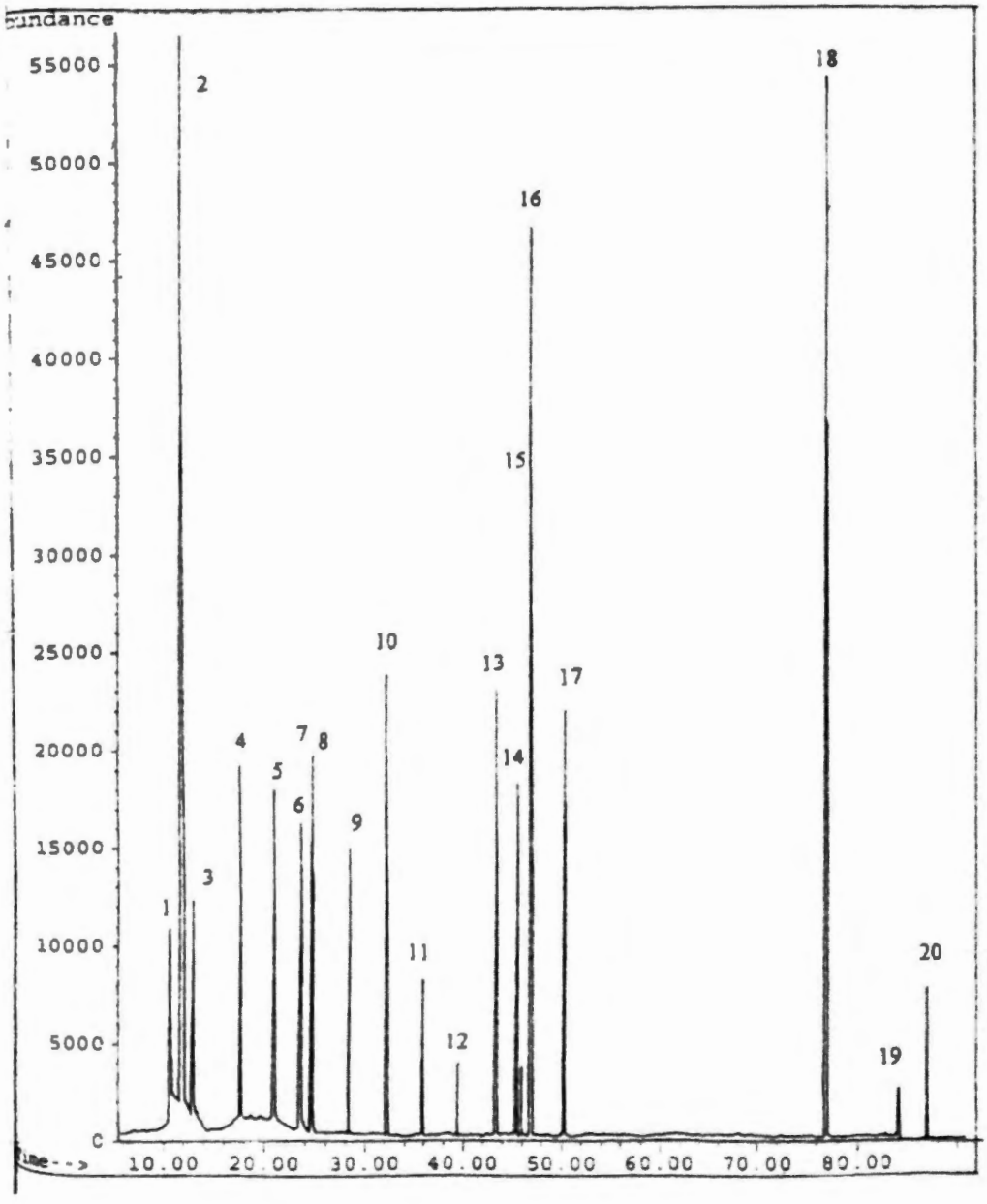
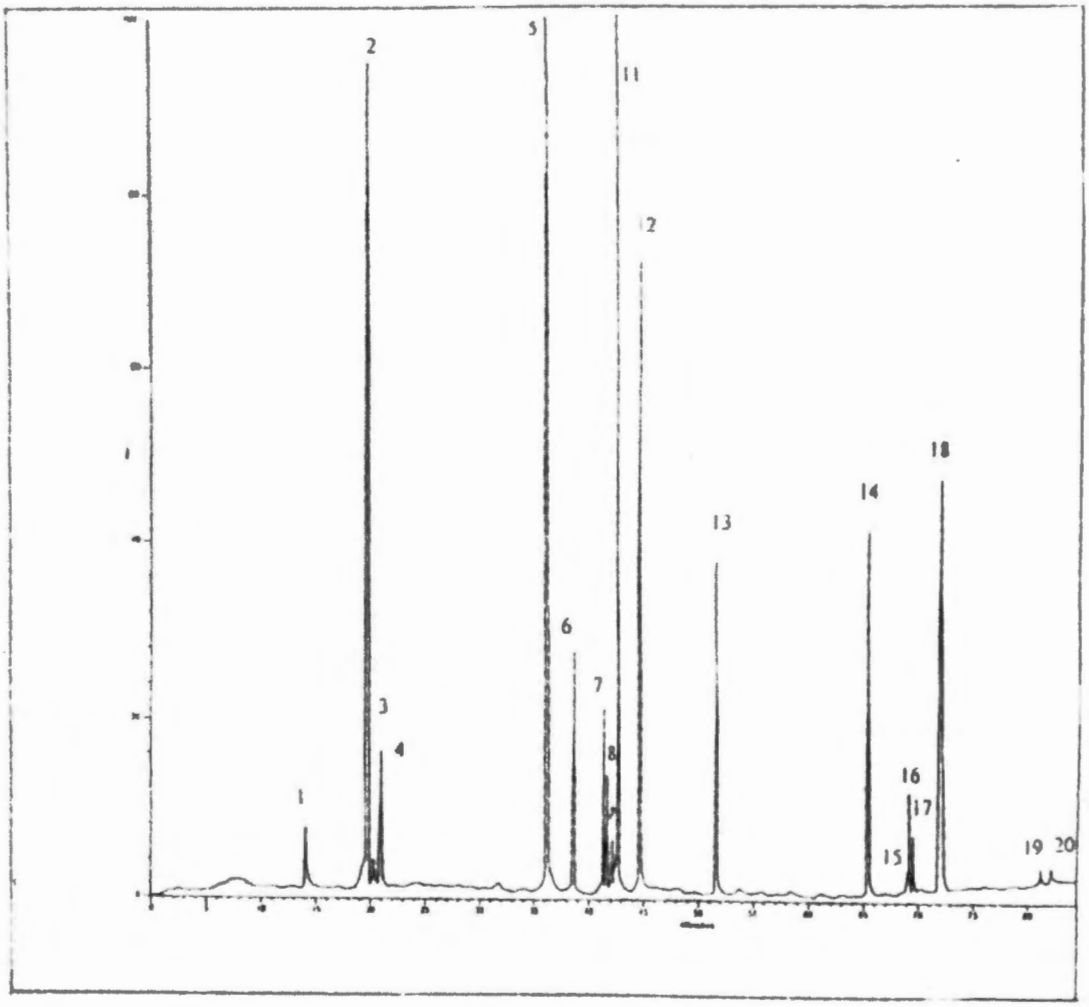


Fig 3. Gas chromatograms of volatile compounds of tea-goose.



Chapter 15. Nutritional value of duck and goose meats

The composition of duck and goose meats like other poultry meats are dependent on species, diet, age, sex and growth environment. Duck and goose meats are both good sources of protein, iron, phosphorus and B-vitamines. Germany professor Dr. Pingel pointed that the water fowl meat contains higher in gama-linolenic fatty acid which is a essential fatty acid. The detail information about nutritional value of duck and goose meats the readers can read the related journal and text books. This chapter only presented the following tables and figures for the consumers reference.

Table1. Proximate composition of raw poultry meat (per 100 g edible portion, flesh plus skin)†

Nutrient	Chicken broilers	Turkey	Goose	Duck
Water	65.99	70.40	49.66	48.50
Calories	215	160	371	404
Protein	18.60	20.42	15.86	11.49
Total lipid	15.06	8.02	33.62	39.34
Carbohydrate	0.00	0.00	0.00	0.00
Fiber	0.00	0.00	0.00	0.00
Ash	0.799	0.88	0.87	0.68

†Posati, 1979.

Table 2 .Vitamin and mineral content of raw poultry meat (Per 100 grams edible portion, meat and skin)†

Nutrient	Chicken roilers	Turkey	Duck	Goose	RDA *
Ascorbic acid	1.6	0.0	2.8	§	60
Thiamin	0.06	0.064	0.197	0.085	1.5
Riboflavin	0.12	0.155	0.210	0.245	1.7
Niacin	6.80	4.085	3.934	3.608	19.0
Pantothenic acid	0.91	0.807	0.951	§	
Vitamin B_6	0.35	0.41	0.19	0.39	2.2
Folacin (mcg)	6	8	13	4	400
Vitamin B_{12}(mcg)	0.31	0.40	0.25	§	3.0
Vitamin A RE=Retinol Equivalent	41	2	51	17	1000
Calcium	11	15	11	12	800
Iron	0.90	1.43	2.40	2.50	18¶
Magnesium	20	22	15	18	350
Phosphorus	147	178	139	234	800
Potassium	189	266	209	308	
Sodium	70	65	63	73	
Zinc	1.31	2.20	1.36	§	15

Copper	0.48	0.103	0.236	0.270
Manganese	0.019	0.020	§	§

†Posati,1979.
‡Recommended dietary allowances, males 19-22. National Research Council (1980).
§ No reliable data.
¶Recommended dietary allowances, females 19-22, National Research Council (1980).

Table3. Fat composition of poultry meat†

Lipid	Chicken	Turkey	Duck	Goose
Total fat‡	15.06	8.02	39.34	33.62
Saturated fat§	29.9	29.5	33.3	27.8
Monounsaturated fat§	44.7	42.9	49.4	56.8
Polyunsaturated fat§	21.0	23.2	13.0	11.0
Cholesterol¶	75	68	76	80

†Posati,1979.
‡ Grams per 100 g edible portion (meat and skin)
§ Grams per 100 g total lipid
¶ Milligrams per 100 g. edible portion (meat and skin).

Total fatty acids of duck carcass:

To compare the total fatty composition of carcass from different breeds of ducks, it was found the total fatty acids in both breast and thigh, the relative orders, from greater to lesser content, are the same in the ranking. They were oleic(43.2-54.65), palmitic(22.4-30.3%), linoleic(7.5-12.8%), stearic(2.6-6.2%), linolenic(1.4-10.0%), and myristic acids(0.1-1.0%). These findings are in agreement with the results of other studies(Leskanich and Noble, 1997; Sheard et al., 2000). There were no significant difference($p>0.05$) in total saturated fatty acids(SFA) and polyunsaturated fatty acids(PUFA) for both breast and thigh among the breeds. While the breast muscle from Muscovy duck had the lowest content of monounsaturated fatty acids(MUFA), but mule duck had the highest content of MUFA($p<0.05$), however, no significant difference($p>0.05$) between Peking duck and mule duck or Muscovy duck. MUFA content of the thigh was the highest in Peking duck and the lowest in mule duck, and no significant difference ($p>0.05$) between Muscovy duck and Peking duck or mule duck(Table 1).

To compare the total fatty acid composition of skins obtained from different breeds of ducks. It was found the same trends as the contents for the breast and thigh from various breeds. No significant differences in MUFA and PUFA for the skins from different parts of various breeds of duck. The skins obtained from mule ducks had the highest content of SFA, but no significant difference was found in all skin from Muscovy and Peking ducks except the back skins. These results seemed to be not the same as the paper reported by Sarra(1985) and Pikul(1985). They reported the parts of the bird carcass had significant effect on fatty acid composition(Table 2).

Free fatty acid composition:

Table 3 showed the free fatty acid composition for the breast and thigh muscles of different breeds of ducks. The data showed no significant difference ($p>0.05$) in total PUFA's between the breeds. It was also found no significant difference in MUFA's of breast muscles between the breeds($p>0.05$). Nonetheless, the content of MUFA's was the highest in the thigh muscle obtained from the mule duck and the lowest in the breast muscle obtained from Peking duck. However, there was no significant difference in MUFA's of the thigh between Muscovy duck and mule duck or Peking duck($p>0.05$). The total free SFA's in both breast and thigh muscles was found the highest in mule duck and the lowest in Peking duck($p<0.05$), but there was no significant differences between mule duck and Muscovy duck or Muscovy duck and Peking duck($p>0.05$). Table 4 indicated the free fatty acid composition of skins obtained from different parts of duck carcass for different breeds. No significant difference was found in both MUFA's and PUFA's of skins from different parts of duck carcass of different breeds($p>0.05$). SFA's contents for the skins from all parts of carcass of mule duck were higher than those of Muscovy and Peking ducks($p<0.05$). However, there were no significant difference in SFA's in the skins from neck, breast, abdominal and thigh between Muscovy duck and Peking duck($p>0.05$). SFA's content of back skin was found the highest from mule duck, then followed by Muscovy and Peking duck was the lowest

The total fatty acid composition of roasted duck:

The total fatty acid composition of both breast and thigh muscles for different breeds of ducks was shown in Table 5. To compare the total fatty acid composition of breast and thigh meat from different breeds of roasted ducks, it was found it had the same trends as those of the fresh carcass. To compare fresh and roasted meats both breast and thigh, the levels of oleic , linoleic increased, but palmitic and linolenic acids decreased. The data showed the breast obtained from Peking duck had the highest content in MUFA's, and followed by mule duck and Muscovy duck in decending rank. The level of MUFA's in the roasted breast meat for Peking, mule and Muscovy ducks were 53.2%, 47.2% and 46.7%, respectively. Which are higher than those of raw breast muscle of duck with except mule duck. It was also found the level of linoleic acid(C18:2) in the roasted breast meat were higher than those from raw duck meat obtained from different breeds. The analyzed data of SFA, MUFA and PUFA in the roasted thigh meat from different breeds of ducks were shown as follows: The relative orders, from greater to lesser content of SFA's were Peking duck(27.4%), mule duck(24.8%) and Muscovy duck(19.2%); MUFA's were Peking duck(51.8%),

mule duck(45.4%) and Muscovy duck(44.7%); and PUFA's were mule duck(26.9%), Muscovy duck(24.5%) and Peking duck(20.6%). To compare the roasted duck meat with the raw duck meat, most of MUFA's and PUFA's levels of both breast and thigh increased in all breeds of the roasted duck, but SFA level decreased.

Table 6 indicated the total fatty acid composition of skins from different parts of the roasted duck of different breeds. The levels of individual fatty acids for all parts of roasted skin had the same trends as those of both roasted breast and thigh meats from all breeds. The ranking from greater to lesser are oleic, linoleic, palmitic, linolenic and myristic acids, of which the ranking are different from those of the raw carcass (palmitic acid are ranked as second in the fresh muscle). There are not a good correspondence for the levels of SFA, MUFA and PUFA's for the roasted skin from all parts of the roasted duck meat from different breeds of ducks(as Table 6).

Free fatty acid composition of both breast and thigh of the roasted duck of different breeds was shown in Table 7. No significant difference in the contents of the total free SFA, MUFA and PUFA's of the roasted breast meat was found among the different breeds of ducks. The MUFA's level was also found no significant difference ($p>0.05$) between the breeds of duck. Nonetheless, the SFA'S content of thigh was the highest in mule duck, then Peking duck and Muscovy duck in decending rank. The PUFA's content of the roasted duck thigh from Peking and Muscovy ducks was significantly higher than mule duck, but there was no significant difference between Peking duck and Muscovy duck. Table 8 indicated the free fatty acid composition of skins obtained from all parts of the roasted duck of different breeds. The data revealed that the free SFA's of the skins of breast, abdomen and thigh of the roasted Peking duck were significantly lower than those of the same parts of the roasted Muscovy ($p<0.05$). All parts of the roasted Peking duck had the highest in free MUFA's, and then followed by mule duck, and Muscovy duck had the lowest. However, the skins located at breast, abdomen and thigh of the roasted Muscovy duck had the highest in free PUFA's, but the lower in the skins obtained from the same parts of Peking and mule ducks. There was no significant difference in the free PUFA's between Peking and mule ducks.

From the above mentioned results, it could be noted that the fatty acid composition of the duck did not affect by breed, part of carcass and roasting. Baeza(1999) compared the fatty acid composition of Peking, Muscovy and mule ducks, and found the Peking duck had the highest level in SFA and the lowest level in PUFA, and mule duck had the highest level in PUFA. However, the results of this study also revealed that there were differences among location, breed, but the variation were not agreeable since the fatty acid composition were affected by many factors such as muscle fiber type, chemical composition and feed composition

etc.(Smith et al., 1993; Banza, 1999; Ahn et al., 1996;Enser et al., 2000; Lalic et al., 1996; Leskanich and Noble, 1997; Sheard et al., 2000). In the roasted duck, it could be found that MUFA's in the breast meat and skins of Peking duck was higher than those in mule and Muscovy ducks, but the PUFA level was lower than those of Muscovy and mule ducks. The reason for these results may be due to fat content in Peking duck was higher than that of Muscovy and mule ducks. The previous studies also indicated neutral lipid contained primarily SFA and MUFA, but polar lipids primarily contain PUFA. In general, polar lipids content in meat is very constant, thus, as lipid in meat increase, commonly, the neutral lipid increased, but polar lipid does not change markedly. However, this caused the levels of SFA and MUFA increase, but PUFA decrease, proportionately(Hornstein et al., 1961; Allen et al., 1967; Wood and Lister, 1973; Sharma et al., 1987)

Chapter16. 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 1/2 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, knive 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:

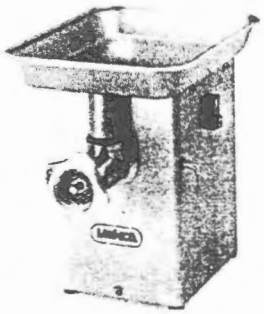
1. To maximize yield and to obtain a uniform yield.
2. To improve color and increase color uniformity.
3. To improve binding ability.
4. To reduce cooking loss.
5. To reduce cooking time.
6. To control the quantity of added substance.
7. To reduce meat product inventory.
8. To increase brine penetration 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:

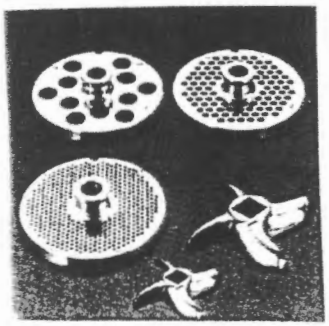
1. Cost of equipment.
2. Connective tissue remain relatively undistributed.
3. Fat removal is necessary for sliced product or for good cohesion in most products.
4. Salt and/or phosphate are usually required.
5. Excessive tumbling lower the integrity of the tissue and
6. A slight rise in product temperature.

Reference:

1. Ockerman, H. W. 1992 Review of tumbling and massaging muscle tissue research. Proceedings of 1 st Academic Seminar on Animal Products Processing of Two sides of Taiwan and China. Pp.55-58.

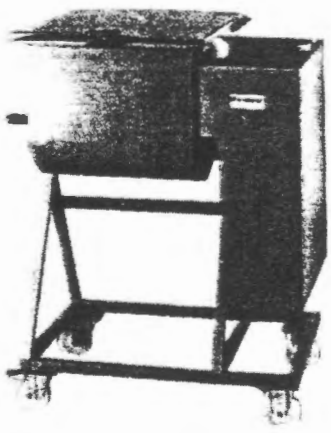


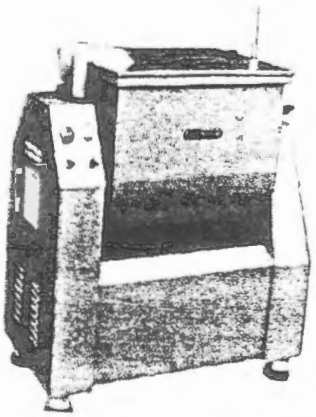
Grinder



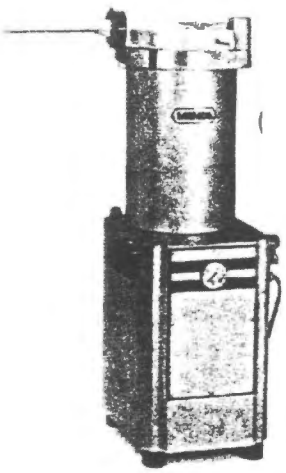
Plates and knife

Cutter or chopper

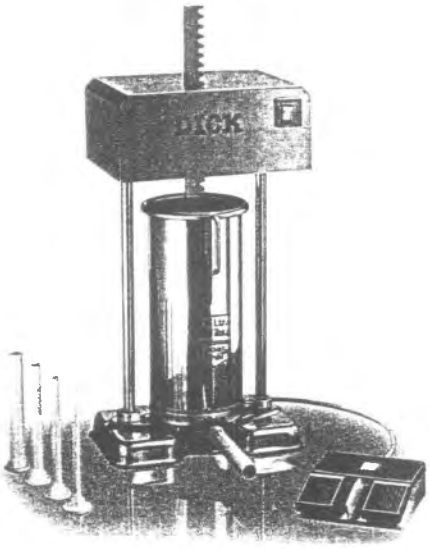




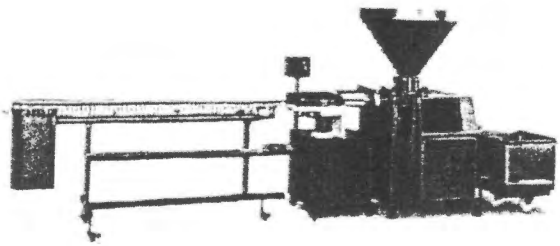
Mixers



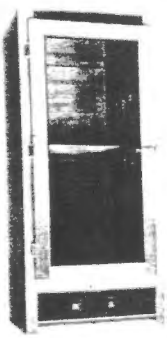
Air pressure filler



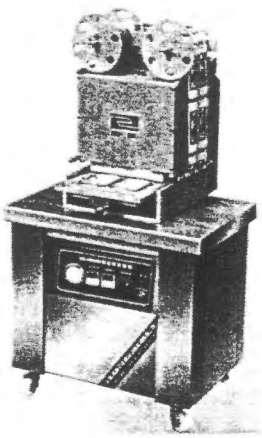
Electrical stuffer



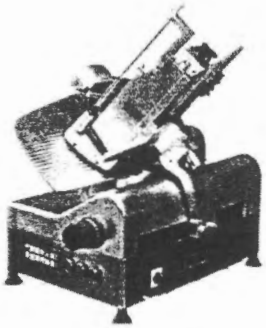
Sausage filler with linker



Sausage dryer

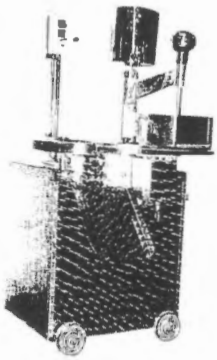


Vacuum packaging machine

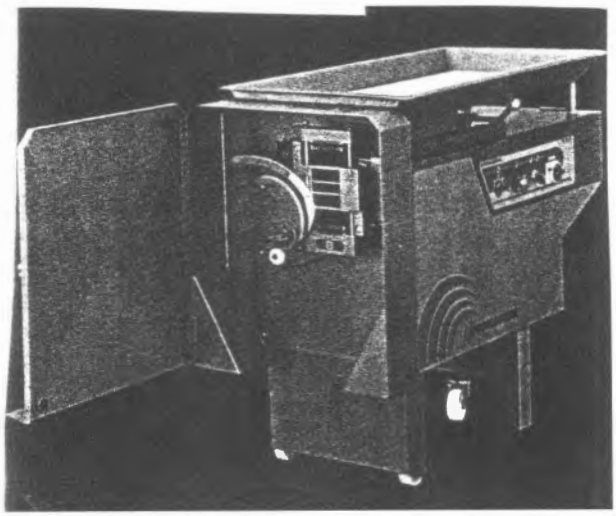


Frozen meat slicer

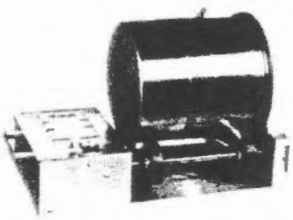
Steak slicer



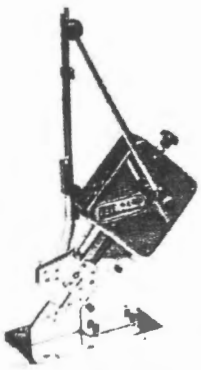
Slicer for pork jen



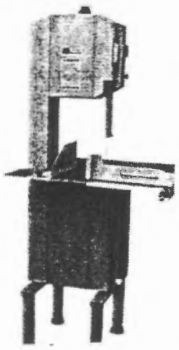
Multi-purpose dicer for cubes, strips & slices

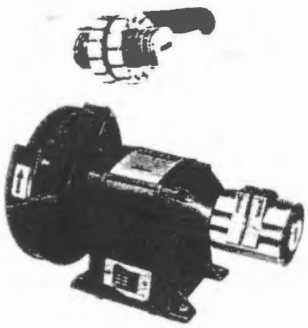


Tumbler



Clipper

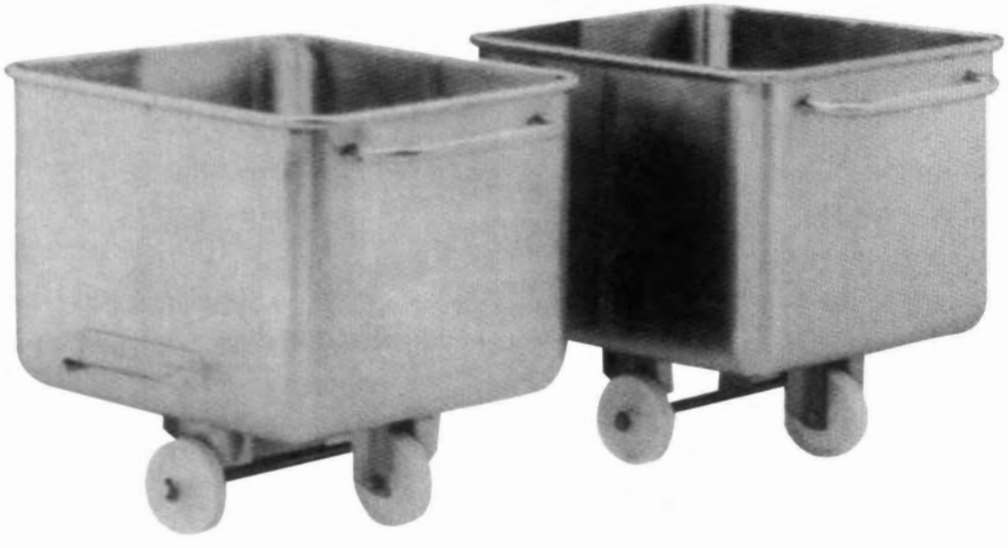




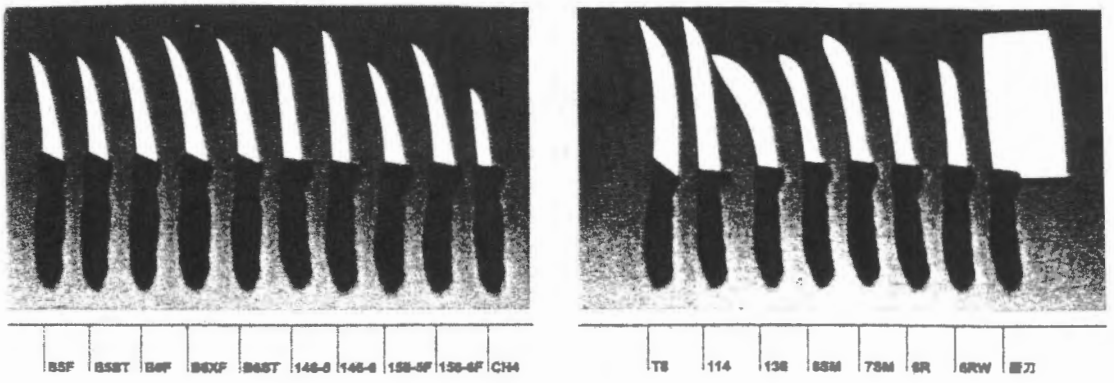
Knife sharpener

Rack for tray cart

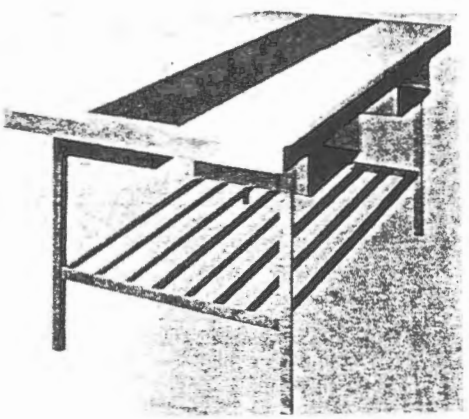
Sausage rack



Meat tank

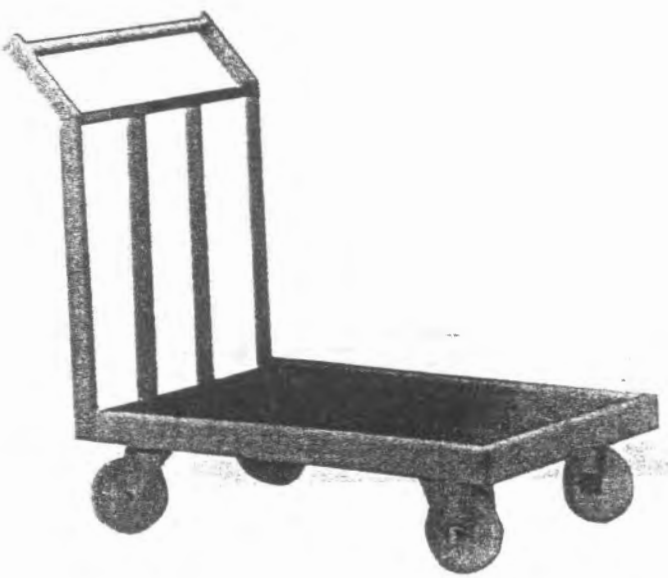


A set of knives



Working table

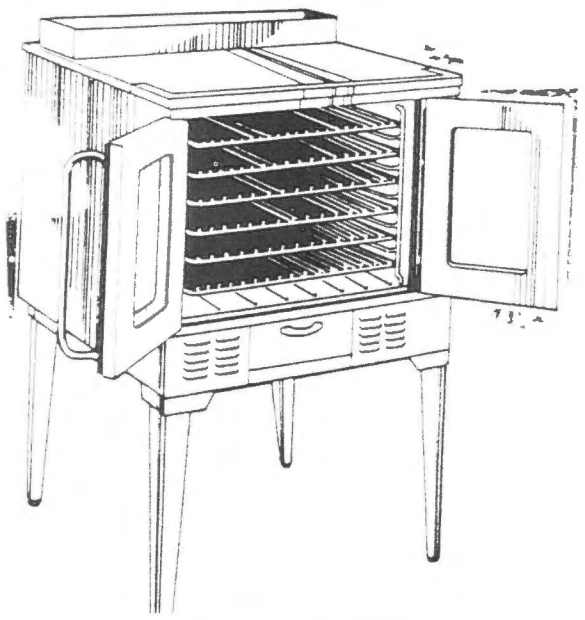
Sharpening steel



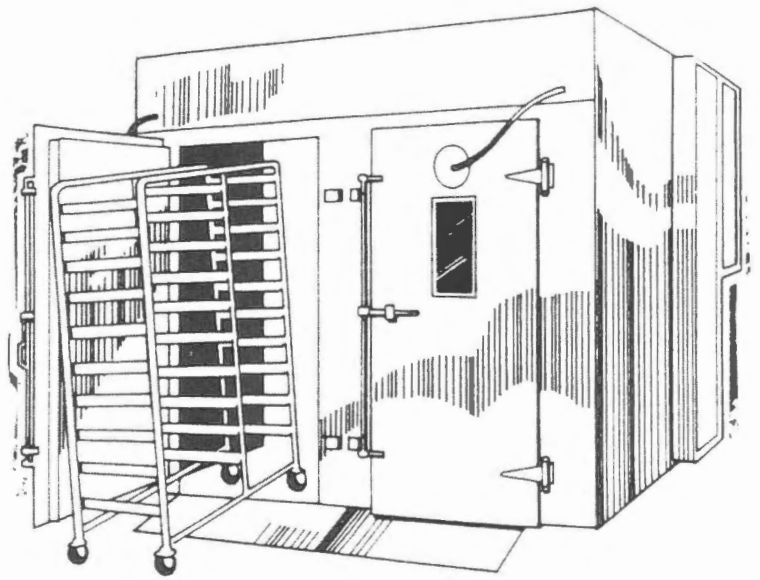
Basket cart

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.



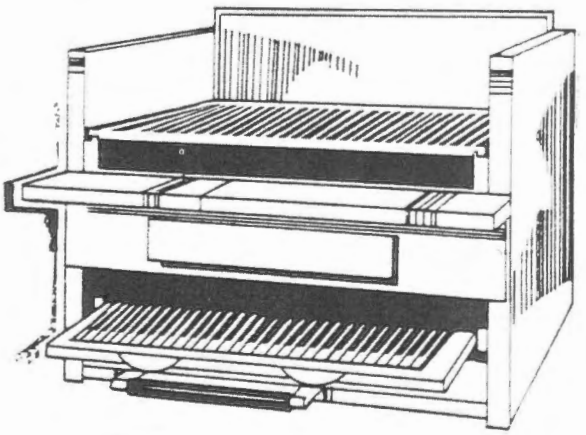
Convection Oven



Convection Oven, Roll-In Type

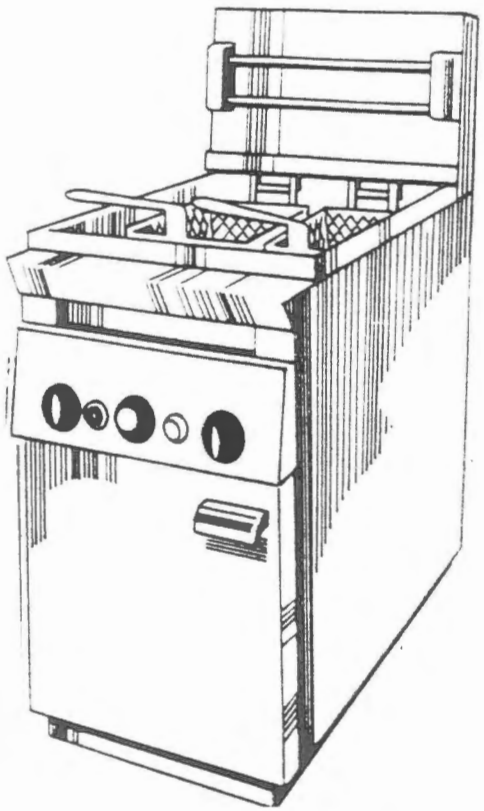
A major improvement in cookery equipment has been the addition of forced air, resulting in the second category of ovens, the convection oven. A compact unit which provides better utilization, of oven space than does the conventional oven, it will handle a variety of foods quickly and efficiently.

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-rat 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 fat or oil.

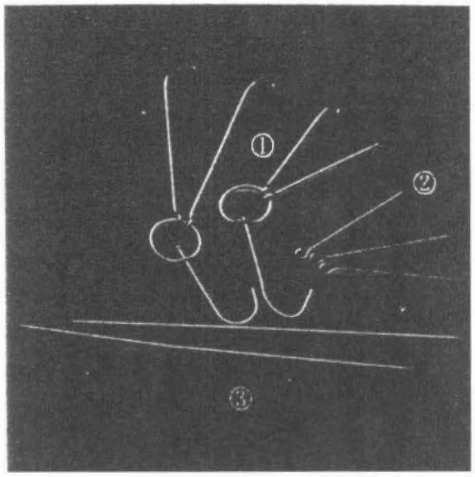
Close stove

Medium-scale built-in oven in restaurants taking coal gas fuel.

Open stove

Up-to date model which takes coal gas as fuel.

Roasting Utensils Frequently Used



1. Hooks

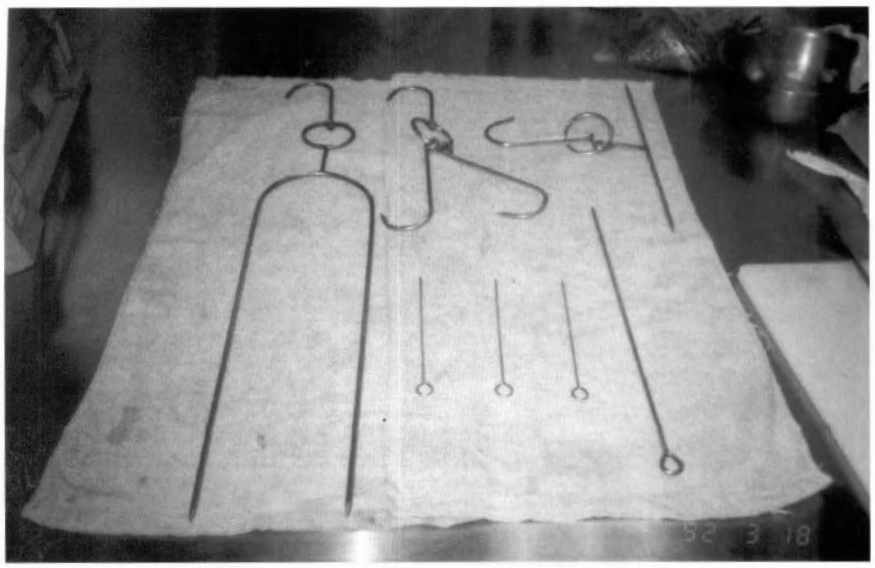
to hang up the food onto the iron bar within the oven.

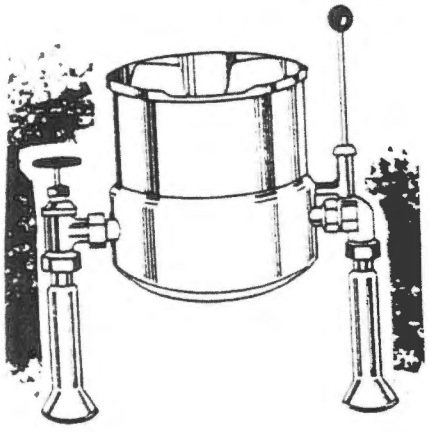
2.Needles

to sew up the openings of the poultry so as to prevent the marinade from spilling out.

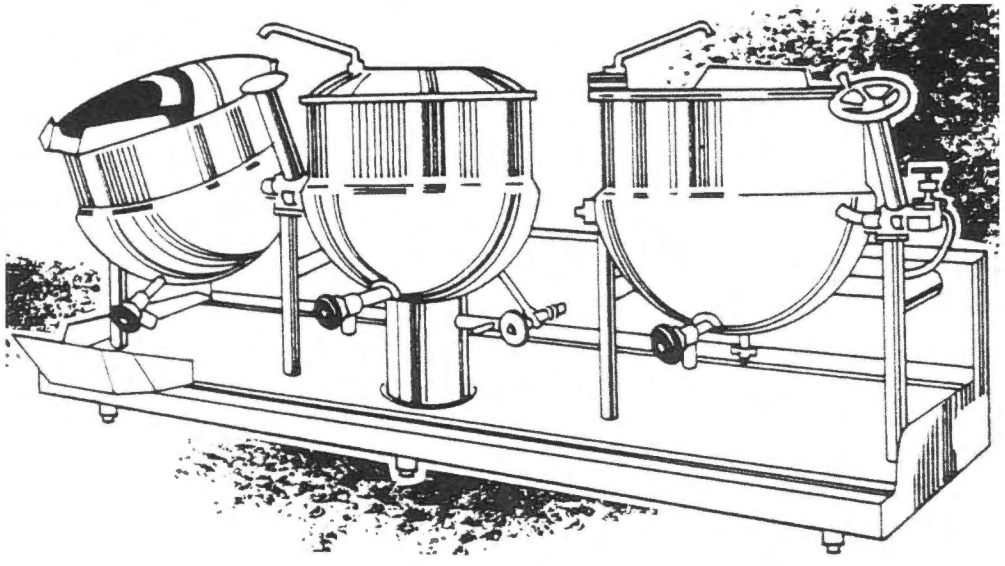
3.Roasting pins

to skewer up the food which are small or unable to be hanged up by the hooks.





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.



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.

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	1,000,000
kg	g	1,000
g	mg	1,000
g	ug	1,000,000
mg	ug	1,000
mg/g	mg/lb	453.6
mg/kg	mg/lg	0.4536
ug/kg	ug/lb	0.4536
Mcal	kcal	1,000
kcal/kg	kcal/lb	0.4536
kcal/lb	kcal/lg	2.2046
ppm	ug/g	1
ppm	mg/kg	1
ppm	mg/lg	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	61	147.2	26.7	80	176.0	35.6	96	204.8	100	212	413
18.3	62	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	240			
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)×5/9　　℉=℃× 9/5 +32

Measure conversion table						
Liter	Kiloliter	U.S. Gallon	Imb Gallon	Barrel	Cubic Feet	Cubic inch
1	0.001	0.264178	0.219975	0.00629	0.035316	61.026
1.000	1	264.178	219.975	6.28995	35.316	61.026
3.78533	0.03785	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-weighy conversion table

Raw materials	1 tea spoon（g）	1table spoon（g）	1cup（g）
Water	5	15	236
Milk	5	15	150
Sugar	3	9	100
Flour	2	7	90
Butter	4	14	225
Baking soda	3.5	12	
Yeast powder	3		
Yolk	4	12	10eggs

References

1. Chen, M. T. and Lin, S. S. (1991):Effect of stresses before slaughter on changes to the physiological, biochemical and physical characteristics of duck muscle. British Poultry Sci. 32:997-1004.
2. Chen, M. T. and Ockerman, H. W. (2011): Chinese-style Meat Processing(in press).
3. Chen, W. (2004): The complete book of roasted and spiced food. The World Books Publishing Co., Shanghai, China.
4. Cheng, A. (2007): The magic of Lu. Wanli Publishing Co., HK.
5. Cheng, M. P. and Ho, C. M. (1955): An experiment on. improvement processing of dry duck of Yilan speciality. J. Agri. Research:5(3-4):97-101.
6. Fu, P. E.(1984): Hundred formulas for spiced, cured, marinated and smoked foods processing, 2nd ed. Tzong-Her Publishing Co., Tainan, Taiwan.
7. Ggs, E. and Stewart, H. W. A. (1964): Poultry meat. ODOA, Canada.
8. Guo, T. W. (2009): Cooking Series for marination. Yenhua Publishing Co., New Taipei city, Taiwan.
9. Gwang, P. S. (2005): The complete book of spice and condiment. The World Books Publishing Co., Shanghai, China.
10. Jan, S. S., Liu, D. C., Wang, L. S. and Chen, M. T.(2001): Comparison on distribution of fat in carcass and chemical composition of fresh duck carcass and roasted duck. J. Agri. Asso. China.
11. Luo, Y. Z.(1990): Roasted and spiced food in Hong Kong. Food Paradise Publishing Co., HK.
12. Marenzi, C.(1985): Microbiological, chemical and physical aspects of spoilage in fresh poultry meat. 7th European Symposium on Poultry Meat Quality. Pp.155, Denmark.
13. Mead, G.C. (1989): Processing of poultry. Elsevier Applied Science. NY, USA.
14. Wen, F. (1989): Ducks and geese. Food Paradise Publishing Co., HK.
15. Yotzu (2009): Marinated foods 300 formulas. Textile Publishing Co., China.

Appendix Ⅰ:

Appendix : Japanese Duck Products


本場フランスより、
フレッシュで空輸。
〈フランス産バーバリーダック〉
フランスでは、水冷却ではなく
冷たい空気で冷却(冷保温)しま
すので肉が水っぽくありません。
•フローズンも有ります。
★ワイルドダッグ(中抜)


①
②
③

208 フォアグラムースの テリーヌ （冷蔵）

約850ｇ 高さ50% 上巾50% 下巾65% 長さ300%

原材料―鴨肉、鴨肉、フォアグラ、豚背脂、生クリーム、卵黄他

生クリームと鵞鳥のフォアグラをムースに加工し、程良くミックスされた鴨肉と鶏肉のファルスで包んだ、テリーヌ風製品。

209 二色 鴨の テリーヌ （冷蔵）

約800ｇ 高さ55% 下巾55% 長さ300%

原材料―鴨肉、鴨肉、生クリーム、卵黄他

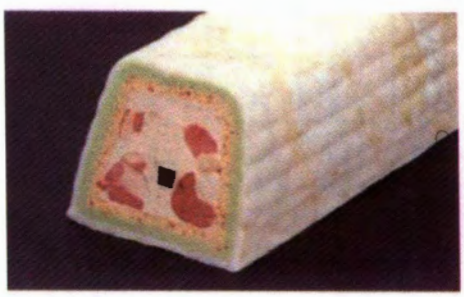
鴨肉と生クリームをジックリ練り合わせ、外側を二色の野菜入り練り肉でカラフルに彩りした。盛り付けに最適な豪華品。

210 鴨肉の クンセイ （冷蔵）

約750ｇ 高さ30% 巾100% 長さ245%

原材料―鴨肉

本場フランス鴨を、調理加工しやすいよう整形し、熟成室で長時間スモークを施した製品。グルメには待望の高級珍味品。



211 鴨肉の テリーヌ （冷蔵）

SHINSEI FROZEN FOODS CO., LTD.

甲等的鳥　謂之鴨

最專業的 振聲 提供最高品質的 ——

英國櫻桃谷鴨肉

櫻桃谷鴨源自於”英國櫻桃谷”，鴨肉色澤呈現粉紅色，油脂中所富含的膠原蛋白，讓肉質等級有如和牛在牛肉中的尊貴。

本草綱目記載：鴨肉屬「甘、冷」，滋陰補虛、除蒸止嗽、利水道。

- ◎ 符熱量低，含高蛋白質，低脂肪
- ◎ 維他命E為牛小排的 1.3 倍
- ◎ 維他命B2的含量為牛小排的 3.25 倍
- ◎ 維他命B1的含量為牛小排的 4 倍
- ◎ 多元不飽和脂肪酸更是牛小排的12 倍

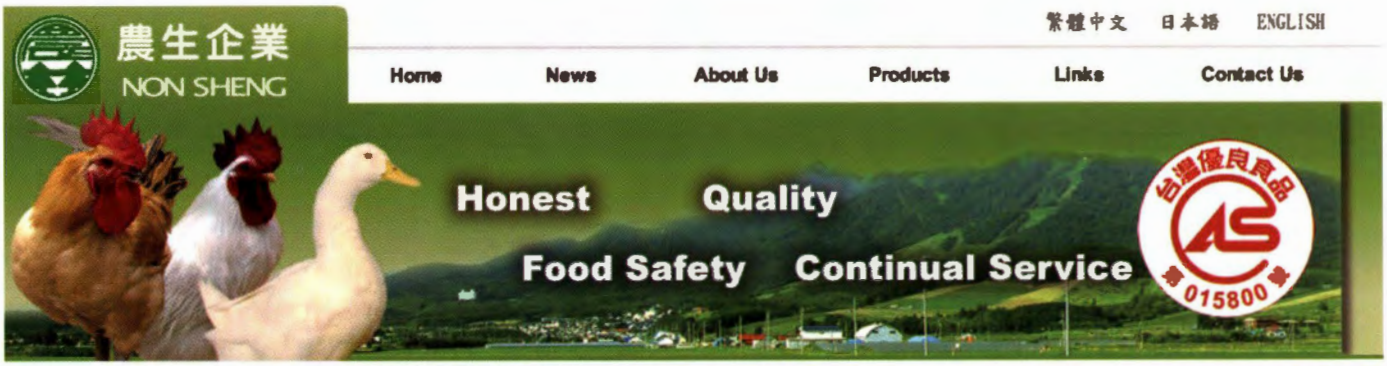
肉品每100公克營養成分比較表

	熱量 (Kcal)	粗蛋白 (g)	粗脂肪 (g)	多元不飽和脂肪酸 (%)	維他命E (α-TE)	維生素B1 (mg)	維生素B2 (mg)	維生素B6 (mg)	維生素B12 (μg)
鴨肉	111	20.90	2.40	36.94	0.26	0.36	0.52	0.38	2.79
雞肉	248	16.10	19.90	33.04	0.26	0.12	0.11	0.39	0.31
牛小排	390	11.70	37.70	2.9	0.2	0.09	0.16	0.21	1.91
梅花肉(豬)	341	15.20	30.60	18.41	0.2	0.65	0.19	0.38	0.84

資料來源：行政院衛生署食品藥物管理局

振聲 振聲冷凍食品股份有限公司
SHINSEI FROZEN FOODS CO., LTD.

Non Sheng Coporation. Ltd



Businesses

Animal Feeds, Frozen Meat Products

Products list

- View All Products
- Feeds
- Poultry Farm
- Chicken
- Duck
- Duck byproduct
- Prepared Food
- Other

Search

Key Words

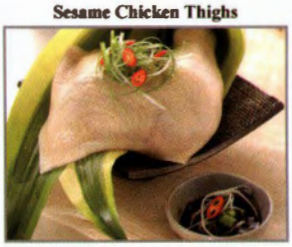
Search

Products

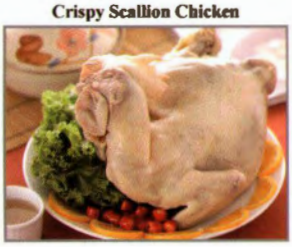
Recorded 1– 9 ,these products have9 lists totally

Roasted Goose Legs

Sesame Chicken Thighs



Crispy Scallion Chicken



Drunk Chicken Thighs (Wine Flavored)

Goose Legs

Black Pepper Goose Breasts

Herbal Scented Goose Halves

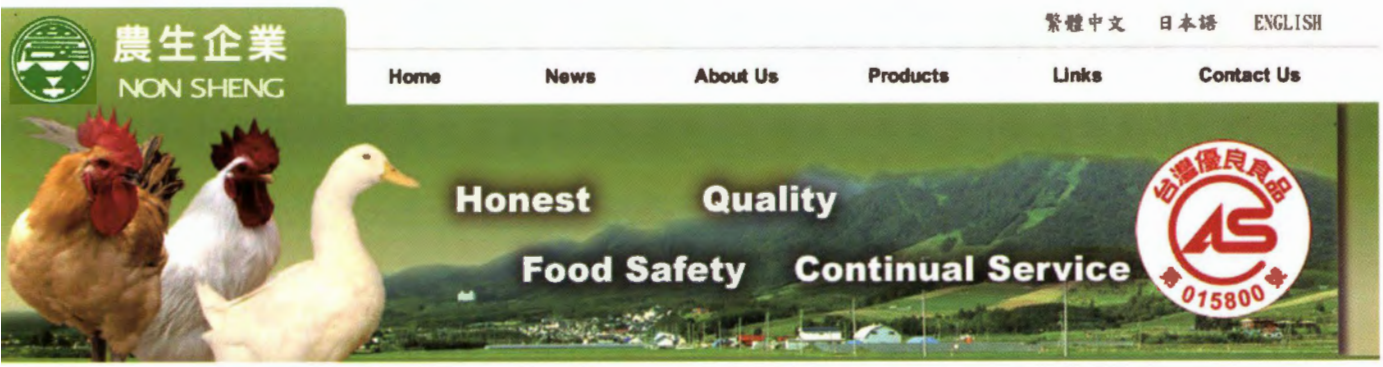
Sesame Chicken Halves

Ginger Boiled Female Duck

Home | News | About Us | Production line | Products | Support | Links | Contact us

Corporate Headquarter and Feed Mill Address
No.21, Huanciou Rd., Lujhu Township, Kaohsiung County 821, Taiwan (R.O.C.) . Tel : 886-7-6951121 . Fax : 866-7-6952918
Cold Storage (With Poultry Processing Facility)
No.11-6, Sinmin Rd., Ligang Township, Pingtung County 905, Taiwan (R.O.C.) . Tel : 886-7-7753313 . Fax : 866-7-6952918 by SW

Non Sheng Coporation. Ltd



Businesses

Animal Feeds, Frozen Meat Products

Products list

- View All Products
- Feeds
- Poultry Farm
- Chicken
- Duck
- Duck byproduct
- Prepared Food
- Other

Search

Key Words

Search

Products

Recorded 1– 9 ,these products have9 lists totally

Peking Roast Duck

Whole Duck

Boneless Whole Duck

Boneless Duck Thighs

Duck Meat Roll

Duck Meat

Duck Breasts

Boneless Duck Legs

Frozen Duck Meat Block

Home | News | About Us | Production line | Products | Support | Links | Contact us

Corporate Headquarter and Feed Mill Address

No.21, Huanciou Rd., Lujhu Township, Kaohsiung County 821, Taiwan (R.O.C.) . Tel : 886-7-6951121 . Fax : 866-7-6952918

Cold Storage (With Poultry Processing Facility)

No.11-6, Sinmin Rd., Ligang Township, Pingtung County 905, Taiwan (R.O.C.) . Tel : 886-7-7753313 . Fax : 866-7-6952918 by SW

帝王食補　簡介

帝王食補薑母鴨創立於民國七十年，三十年前從最初簡單的桶式招牌，路邊攤型的小吃起家。創辦人 田正德先生在三十歲的人生顛峰，得到嚴重肝病，幸好巧遇舊識的中醫，介紹他祖先家傳的帝王藥帖，搭配上家裡飼養的紅面番鴨公，以及傳統食補常用的米酒、老薑和麻油，一起燉煮，成就出一鍋充滿奇蹟的好湯料，濃郁純正的湯頭喝下肚，意外地讓田創辦人生命得以延續而發光。本著分享健康、溫暖的心情，帝王食補開放加盟，1997 年是全台灣薑母鴨鼎盛時期，大大小小品牌薑母鴨店總共約 1000 家，在當時帝王食補已成為全台灣最具代表性的薑母鴨餐廳，也是全台第一家「把路邊攤餐廳化」的薑母鴨連鎖店。面對競爭的餐飲市場，帝王食補將徹底落實「咱ㄟ人情味」的品牌標語，除了不斷的研發新品，從當初單一鍋品”燒酒薑母鴨”販賣到現在相繼推出烏蓼雞、西漢山羊肉...等鍋品。帝王食補更積極改善服務流程與用餐環境，希望藉由貼心又復古的元素，提供消費者更多元、美好的用餐環境。

About Imperial tonic

King Duck was founded in 1981, thirty years ago from the initial simple bucket-type signs, street vendors and snack-type started. Founder Mr. Tian Zhengde peak in the thirty-year-old life, to be serious liver disease, but fortunately the old knowledge of traditional Chinese medicine coincidence, about his well-known ancestor of the imperial medicine posts, with the family on the red-faced muscovy duck feeding the public, as well as traditional tonic used rice wine, ginger and sesame oil, a stew, a pot full of miracles achieved a good soup, rich soup to drink you'll feel pure, accidentally let the continuity of life, founder of field and light. The spirit of sharing healthy, warm feelings,

tonic open to join the emperor, in 1997, the heyday of Taiwan ginger duck, big and small brand ginger duck store a total of about 1000, at the time the emperor tonic has become the most representative of Taiwan ginger duck restaurant, is Taiwan's first "restaurant of the street vendors," ginger duck chain. The face of competitive restaurant market, the emperor tonic will completely implement the "we ㇏ human touch" of the brand slogan, in addition to constantly develop new products, products from the original single pot "Shochu Ginger Duck" launched to now selling black ginseng chicken, goat meat Han ... and other pot products. Imperial tonic to improve service processes and a more positive dining environment, hoping to sweet and retro elements, to provide consumers with more dollars, fine dining environment.

烏蓼雞

薑母鴨

西漢山羊肉

帝王食補

DUCK AND GOOSE MEAT PRODUCT PROCESSING TECHNOLOGY

Edited：Ming Tsao Chen, Ph. D.
Aimin Jiang, Ph. D.
Herbert W. Ockerman, Ph. D.
出 版 者：富林出版社
發 行 人：賴 宏 毅
地　　址：台中市復興路四段 281-4 號
局版臺字第 6395 號
郵 購 處：郵政劃撥第 22091782 號
富林出版社帳戶
電話：(04)22206316・22265067
傳真：(04)22207142
出版日期：2012 年 4 月
ISBN：978-986-87533-3-4　（平裝）

9 789868 753334
ISBN 978-986-87533-3-4