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FACTORS AFFECTING THE QUALITY OF TEXAS BUTTER AS REVEALED BY A STATEWIDE SURVEY

By

F. E. Hanson, W. S. Arbuckle, C. N. Shepardson

Division of Dairy Husbandry

AGRICULTURAL AND MECHANICAL COLLEGE OF TEXAS

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This bulletin reports the results of a survey of the quality of butter manufactured in various dairy producing sections of Texas. The data presented include information concerning common manufacturing methods, feeding practices, quality of cream, score value and the physical and chemical analyses of 273 samples of butter produced over a period of 32 months from eight different sections of the State.

The survey showed that the manufacturing methods were fairly uniform in the different sections. Pasture was available to a small per cent of the producers during the entire year, but was most abundant from March through June. Cottonseed feeds were present in a large number of the rations throughout the year. Abundance of cottonseed feeds on dry pastures in July, August and September was associated with a firm gummy body and a flat flavor condition in the butter examined. The presence of green pasture in the ration was important for the production of butter free from the firm gummy body defect. The use of starter and a ripening period prevented the flat flavor condition.

Although the defects encountered in the butter examined included weedy, old cream, oxidized and flat flavors and a firm gummy body condition, the average score of the butter ranked a commercial grade of a medium first. The score of the butter was fairly uniform for all sections of the State, and most of the defects in the butter examined could be associated with the quality of the cream from which the butter was made.

The average analytical values for Texas butter are shown and reveal that Texas butter was harder, had a higher melting point and a lower iodine number than the normal values generally given for these constants.

CONTENTS

FACTORS AFFECTING THE QUALITY OF TEXAS BUTTER AS REVEALED BY A STATEWIDE SURVEY

F. E. Hanson[1], W. S. Arbuckle[2], and C. N. Shepardson[3]

Rightly or not Southern butter is often critized on the principal butter markets because of certain flavor and body characteristics. Consequently, this butter suffers a price discrimination which amounts to considerable loss to the Southern butter manufacturers. It has been established that the predominance of the Jersey breed of cattle, and the abundance of cottonseed feeds in the South result in the production of butter with a high melting point (4). This butter has a firmer somewhat gummy body and less desirable spreading qualities, but has greater heat resisting properties than butter from States where a majority of the cattle are of breeds that produce softer fats, and where cottonseed feeds are fed less extensively. Butter manufactured by Texas creameries constitutes a large percentage of the butter produced in the South and is subjected to the criticism given Southern butter. The work of Kemmerer and Fraps (6) shows the vitamine A potency of commercial butter sold in Texas, but further information concerning the quality of butter produced in different parts of the State and during various seasons of the year has not been well established. The following study was conducted in order to obtain information concerning the factors affecting the quality of Texas butter.

Survey

A number of creameries representing various dairy producing sections of the State cooperated in making a statewide survey of butter quality. Once a month, during a 32-month period from March, 1938 to October, 1940, each creamery sent a pound of butter to the Texas Agricultural Experiment Station for analysis. Two hundred seventy-three samples of butter from these Texas creameries were received, scored and analyzed. Information was also secured concerning the manufacturing operations and the general feeding practices of the producers. For the purpose of comparison, butter samples were also obtained monthly for a period of one year from a New Mexico, a Nebraska and an Iowa creamery.

Butter Examination

To secure complete information upon quality and composition of the butter, each sample received was examined for flavor and body defects and was analyzed for moisture, fat, salt and curd content and the pH of the serum. The following determinations were also made: hardness and slipping point values for both the butter and butterfat; fat values includ-

[1]Former Associate in Dairy Manufacturers, Texas Agricultural Experiment Station, resigned August 31, 1942.
[2]Associate in Dairy Manufacturers, Texas Agricultural Experiment Station.
[3]Head, Department of Dairy Husbandry, Agricultural and Mechanical College of Texas.

ing melting point, saponification number, iodine absorption number, Reichert-Meissl number, thiocyanogen number and the percentage soluble and insoluble acids of the butterfat.

Scoring of the butter was done organoleptically by two experienced butter judges.

The moisture, fat, salt and curd content of the butter was determined by the modified Kohman method (1). The pH determination of the butter serum was made with a Coleman glass electrode potentiometer. The serum was obtained for the determination by the following procedure: after melting the butter samples most of the fat was decanted and the remaining fat, together with the serum, was poured into test tubes. The test tubes were tightly stoppered and centrifuged in an inverted position so that after centrifuging, the serum would be in the stoppered end of the tube. Then the tubes, still inverted, were placed in a refrigerator in order to solidify the fat. After the fat had solidified, the serum was poured off, adjusted to the proper temperature, and the pH determined.

The firmness of the butter was found by the use of a penetrometer developed by this laboratory. This apparatus has been described in a previous publication (3). The firmness of the butter was expressed as the weight of mercury required to press a plunger into the butter. The plunger was 4 mm. in diameter and was depressed 14.7 millimeters.

The slipping point of the butter was determined by the method described by Jameison (5).

The butterfat was prepared for analysis by melting and filtering the butter in an electrically heated oven.

Hardness of the butterfat was determined by the apparatus which was used for determining the hardness of the butter. Each sample of butterfat was poured into round tinned metal boxes 3-inches in diameter and 1¼-inches high which held 4 ounces of butterfat. The fat was hardened in this container for three hours or longer at 10°Fahrenheit. The determinations were made at 60°F. after the samples had been tempered for 24 hours or longer at this temperature. An average of five determinations on each sample was taken for the hardness value.

The slipping point of the butterfat was determined on the hardened fat that was prepared for the hardness test.

The Wiley method (2) was used to determine the melting point.

The saponification number was determined by the method described by the A.O.A.C. (2) with the exception that Nile blue indicator, 0.2 per cent of Nile blue in alcohol solution, was used instead of phenolphthalein. The Nile blue indicator gave a much sharper titration end point. This was especially true when the alcoholic potassium hydroxide solution was not perfectly colorless.

The iodine absorption number was determined by the Hanus method (2).

The Reichert-Meissl number was determined by the A.O.A.C. method (2) except that the samples of fat were saponified according to the method of Spitzer and Epple (7).

The thiocyanogen number was found according to the directions given by Jameison (5) except that 0.5 gm. of fat and 50 ml. of thiocyanogen solution were used as directed by Stebnitz and Sommer (8).

The percentage of soluble and insoluble acids was determined by the A.O.A.C. method (2).

RESULTS

Figure 1. shows the location of the creameries and the sections of the State represented in the survey. Each section was represented by one or more creameries during the entire 32-month period. The creameries failed occasionally to send butter but sufficient regularity was practiced so that it is believed that the record obtained is representative throughout the period.

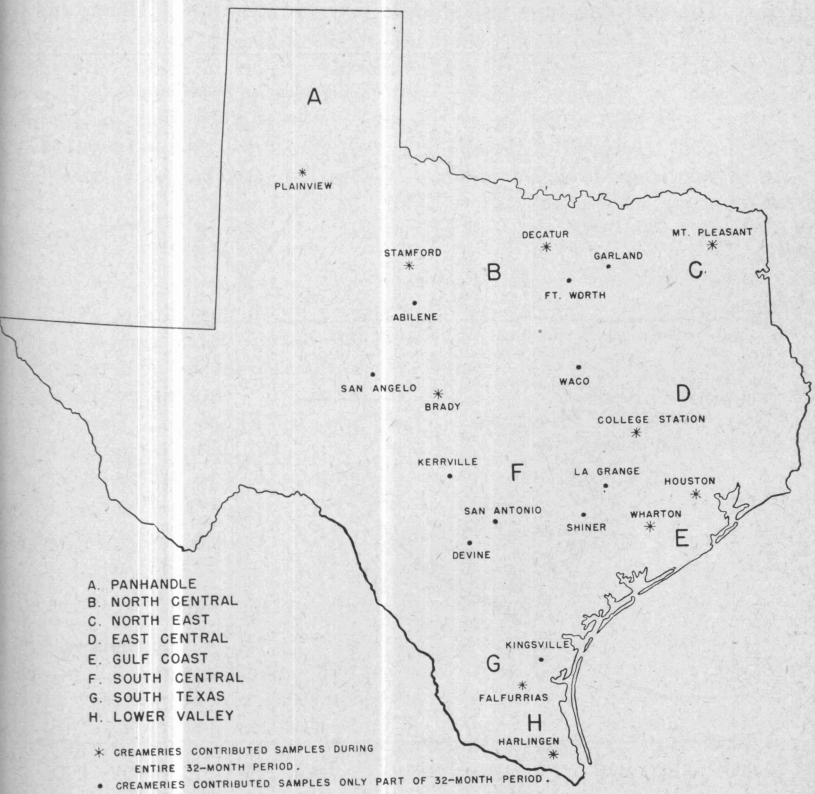

Figure 1. Location of Creameries in Sections of Texas Which Were Represented in the Butter Quality Survey.

Manufacturing Methods

A summarization of the information supplied by the plant managers concerning the manufacturing operations indicates that the average test of the cream churned was approximately 35 per cent. Neutralization was a common practice and various neutralizers were used. Most of the creameries pasteurized the cream by the holding method at 150°F. for 30 minutes although a few creameries used the flash method and some pasteurized at a temperature as high as 170°F. for 15 minutes. Very few creameries followed the practice of adding starter and ripening the cream. The above mentioned factors were uniform throughout the year. Manufacturing methods followed by the different creameries were somewhat variable, but there was no very distinct seasonal variation in the manufacturing methods. The churning acidity was higher and the time required to cool the cream after pasteurization was longer during the summer. Also the churning temperature averaged approximately 5°F. less, and the temperature of the wash water ranged 3 to 7°F. lower in the summer. The churning time was slightly longer during the summer, and the

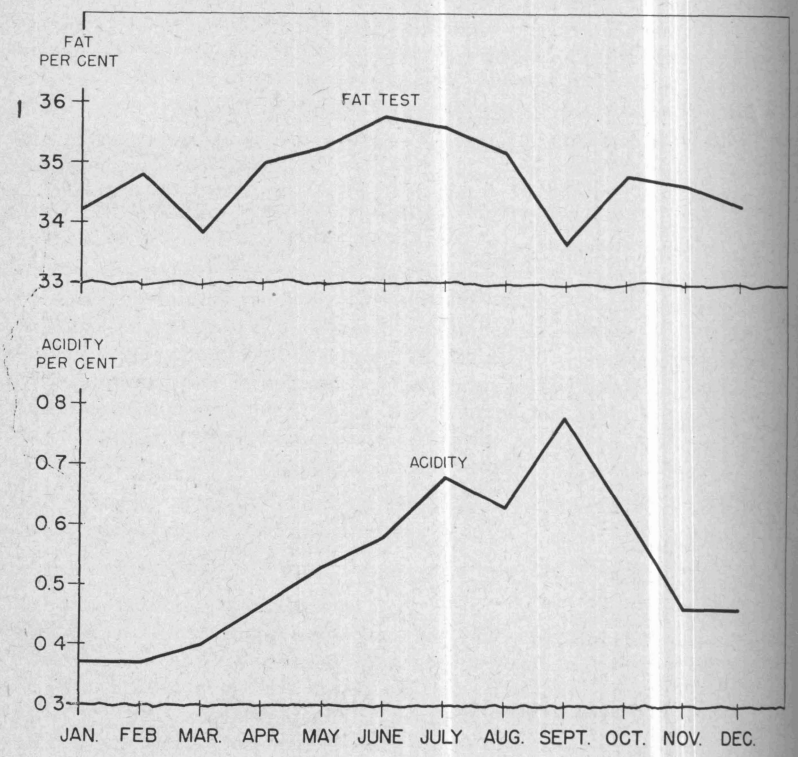

Figure 2. Monthly Trend of the Fat Test and the Acidity of the Cream (Av. of 185 Samples).

butter was worked an average of 3 to 10 minutes less during the spring and summer months.

Figure 2. shows the monthly trend of the fat test and the per cent acidity of the cream. Both the fat test and the acidity of the cream were somewhat higher during the summer months. The higher acidity was probably due to the storage of the cream at high temperatures before delivery to the creamery. This partly accounts for the lower score butter that was produced from April through October.

Feeding Methods

Feeds composed chiefly of cottonseed, cottonseed products, sorghums and native grasses were used extensively by the producers. The common concentrate feeds included: kafir, milo, hegari, corn, oats, wheat and rice bran, rice products and cottonseed products. Pasture and hay were composed of Johnson grass, alfalfa, Sudan, Bermuda, cane, oats, prairie and clovers.

The data presented in Table 1 were taken from information supplied by the plant managers concerning the feeds being used by the majority of their producers at various times of the year. Table 1 shows the monthly influence on feeding practices. The greatest amount of pasture was available in the five months of March, April, May, June and July. Cottonseed meal was fed quite uniformly throughout the year. In only a few cases were seed or hulls fed alone. A combination of meal and seed, or meal and hulls, or meal, seed and hulls in the ration occurred frequently especially during August, September, October, November and December.

Table 1. Monthly Percentages of Butter Produced on Rations Containing Various Feeds

Month	Number samples	Percentage of butter produced on rations containing the following feeds:						
			Cottonseed products					
		Green pasture	Meal	Seed	Hulls	Meal and Seed	Meal and Hulls	Meal, Seed and Hulls
January	7	14.3	57.1	0	0	0	14.3	28.6
February	10	30.0	60.0	0	0	0	0	40.0
March	20	70.0	50.0	10.0	0	15.0	5.0	20.0
April	18	94.4	27.8	16.7	0	0	27.8	27.8
May	12	83.3	50.0	16.7	0	0	25.0	8.3
June	22	90.9	45.5	0	0	4.5	22.7	27.3
July	19	73.7	63.2	0	0	10.5	0	26.3
August	19	57.9	31.6	5.3	5.3	26.3	10.5	21.0
September	18	38.9	38.9	0	0	5.6	16.7	38.9
October	14	28.6	42.9	0	0	7.1	28.6	21.4
November	16	28.6	43.8	6.2	0	6.2	18.8	25.0
December	15	25.0	46.7	0	0	6.7	33.3	13.3

Monthly Trend in Score Value and Composition of Texas Butter

Figure 3. shows the monthly trend in the score value, moisture, fat, salt and curd content and the pH value of the serum of the butter examined.

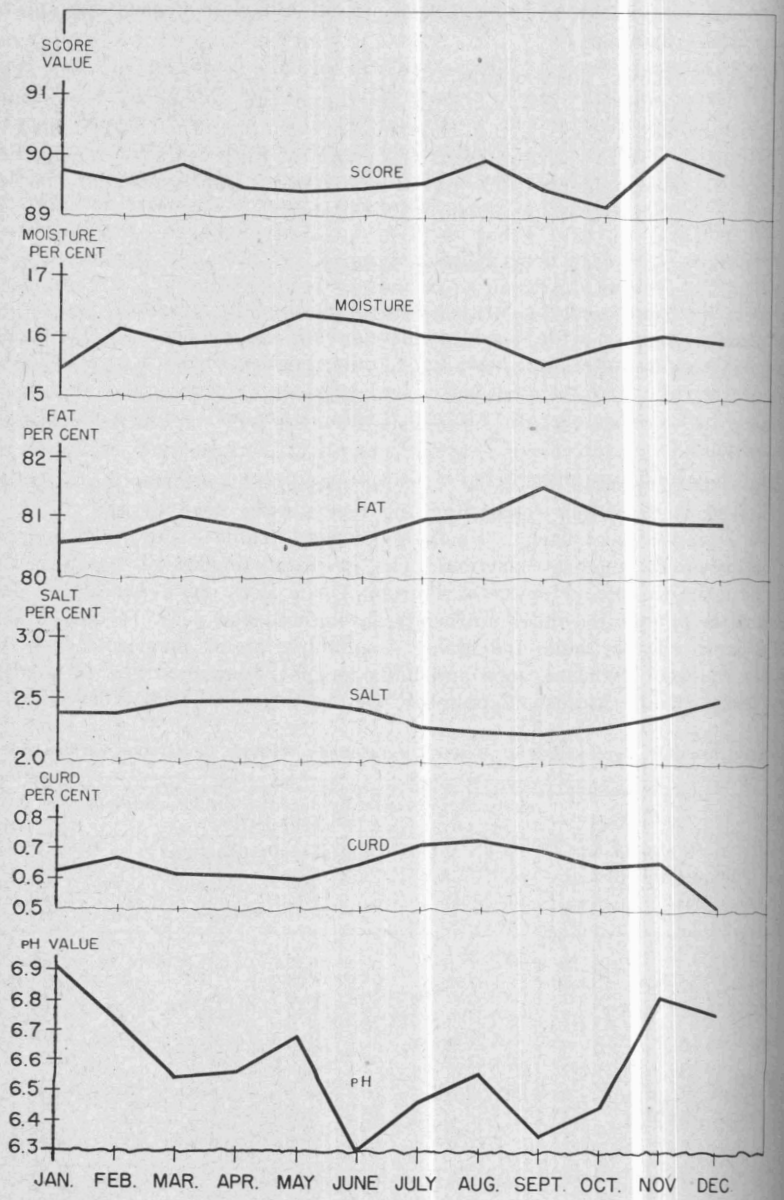

Figure 3. Monthly Trend of the Score Value, Moisture, Fat, Salt and Curd Content and pH Value of the Butter Examined.

The highest score butter was produced in November. The butter produced during the months of April, September and October ranged lower in score value. Butter having the lowest score was produced in the month of October. The highest moisture content of the butter occurred during May, and the lowest percentage moisture was in January. The fat content was fairly uniform during the year, the lowest percentage occurring in May and the highest in September. A slightly higher salt content was encountered during March, April, May and December with the lowest amount in September butter. The butter produced during July, August and September was highest in curd content. The pH of the butter serum ranged from 6.3 in June to 6.9 in January. These values show a fairly definite trend during the year. The lowest pH values occurred in June, September and October with the highest values occurring during November, December, January and February. The variations in the score value and the composition of the butter were closely associated with the quality of the cream from which the butter was made. The results show that the average score of butter manufactured under Texas conditions ranked a commercial grade of a medium first.

Flavor and Body Defects

The common flavor and body defects encountered and the frequency of their occurrence during the survey are shown in Table 2. The weedy flavor was most common as about one-third, or 82 of the 273 samples examined, were criticized as having this favor defect. Twenty-seven per cent of the butter had an old cream flavor, 24 per cent had an oxidized flavor and 19 per cent of the butter was flat or lacking in flavor.

The most serious body defect was a gummy condition with 25 per cent of the butter examined being criticized for this defect. About 6 per cent of the butter was leaky, 3 per cent sticky, 3 per cent mealy and 2 per cent was crumbly.

Figure 4. shows the monthly distribution of the five defects most commonly encountered. The weedy flavor was encountered much less frequently during the months of December, January and February. It was greatest in March, July and August. Old cream flavor was noticed in a certain amount of the butter throughout the year, but the defect was most serious in the butter produced during August. The oxidized, tallowy flavor was present in a large per cent of the butter produced during February, December and June. The flat flavor occurred most frequently in the butter produced during February, June, July, August and September. The butter produced in October, March and January was more free from the flat flavor defect.

The gummy body characteristic very definitely appeared to be a seasonal defect. It seemed to be more common from June through October than from November through May. It began to be encountered to a greater extent in May butter and continued to gradually increase through September. The defect was quite prevalent during October, but was much less in November butter.

Table 2. Monthly Distribution of Defects in Texas Butter During a 32-Month Period

Type of Defect	Months												
	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
		Number of Flavor Defects											
Weedy	3	3	9	8	8	9	12	12	6	5	5	2	82
Old cream	4	5	6	5	5	8	6	13	7	6	5	4	74
Tallowy, oxidized	1	5	5	6	7	8	3	7	5	5	2	5	59
Flat	2	5	2	4	5	8	5	7	8	1	2	3	52
Heated	3	1	2	1	4	6	3	5	5	3	4	1	38
Stale, storage	5	3	0	1	2	2	0	0	1	10	3	2	29
Miscellaneous	1	2	4	3	4	2	2	2	1	4	0	0	25
Neutralizer	1	0	0	5	3	2	1	3	3	2	1	0	21
Bitter	0	1	2	0	1	0	3	0	3	0	0	0	10
Sour	0	1	4	0	1	0	0	0	0	1	0	0	7
Fishy	2	0	1	0	2	0	0	0	0	0	1	1	7
Rancid	1	0	0	0	0	0	0	1	0	1	0	1	4
	Number of Body and Texture Defects												
Gummy	2	2	3	3	6	8	9	11	9	9	3	3	68
Leaky	2	4	1	4	1	1	0	1	0	0	1	2	17
Sticky	1	1	0	2	0	1	1	0	0	0	1	2	9
Mealy, gritty	1	1	1	1	0	0	0	0	1	2	1	1	9
Crumbly	2	0	0	1	0	0	0	0	0	0	2	0	5
Mottled, wavy	0	0	1	1	0	0	0	0	1	0	0	0	3
No. samples examined	19	18	23	26	28	26	25	29	21	25	17	16	273

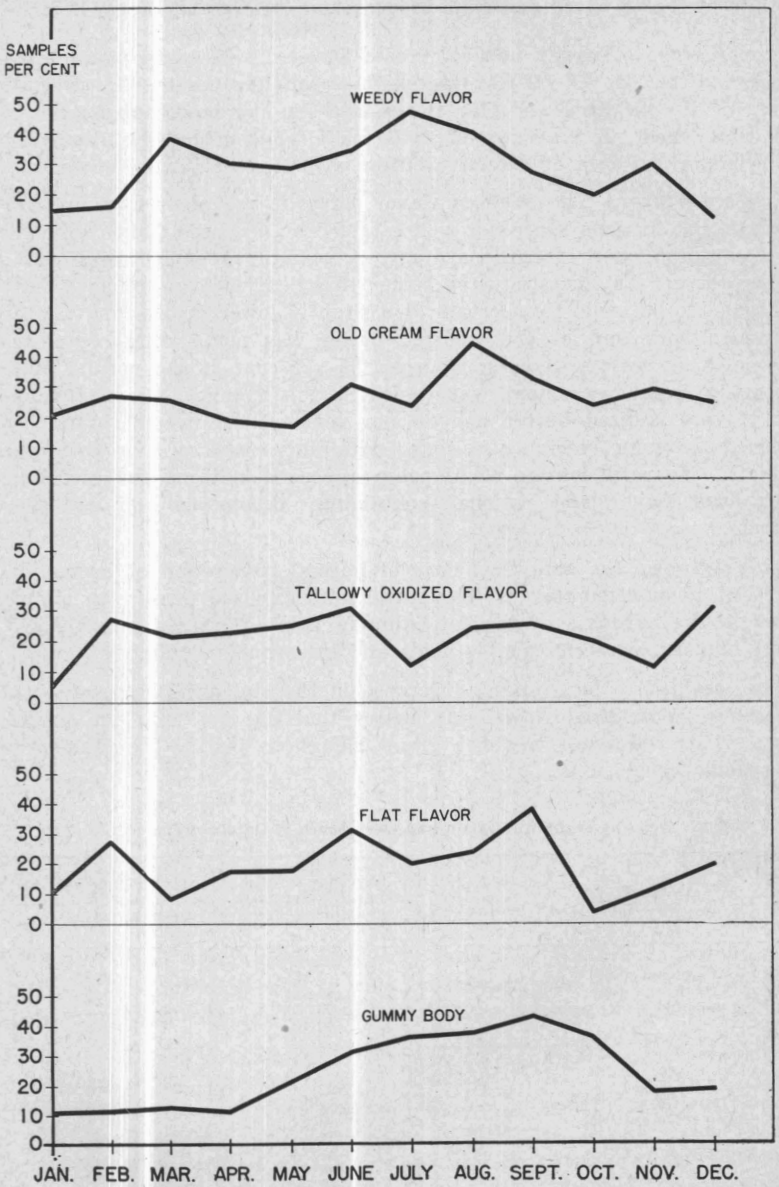

Figure 4. Monthly Trend in the Occurrence of the Five Most Common Defects in the Butter Examined.

Study of the Oxidized and Flat Flavors and the Gummy Body Defects

The presence of weedy and old cream flavors in butter is known to be caused by the use of off-flavored or poor quality cream. However, the causes of the oxidized and flat flavor and gummy body defects are not well established. A further study was made which included a comparison of the analytical data of defective butter with that of normal butter.

Oxidized Flavor. The oxidized flavor defect is prevalent in many dairy products, but its causes are not well established. Oxidized flavor resembles the flavor and odor of cardboard and is sometimes called cardboard or tallowy flavor. In this study the butter that developed an oxidized flavor was found to be made from cream of a slightly lower acidity and fat test. Sixty-eight per cent of the oxidized butter was made from cream that was cooled on surface coolers; whereas, 35 per cent of the normal butter was made from cream that was cooled in this manner. Twenty-five per cent of the oxidized butter and 38 per cent of the normal butter was produced by cows receiving rations containing cottonseed or cottonseed products. No very definite relationship appeared between the occurrence of oxidized flavor and rations containing cottonseed or cottonseed products.

Table 3 shows the analytical data of normal butter and of butter that possessed an oxidized flavor. The butter with oxidized flavor was slightly higher in the hardness of the fat, slipping point of the butter, Reichert-Meissl number, per cent soluble acids and thiocyanogen number.

There seemed to be a slight difference in the analytical data of butter possessing an oxidized flavor and butter that did not have an oxidized flavor. This difference was not great enough to justify the drawing of any specific conclusions.

Table 3. Relation of the Analysis to the Occurrence of Oxidized Flavor in Butter

Analysis	Average for 65 samples possessing an oxidized flavor	Average for 208 normal samples free from oxidized flavor
Acidity of cream, per cent	0.43	0.55
Fat test of cream, per cent	34.22	36.03
Moisture content of butter, per cent	16.13	15.92
Fat content of butter, per cent	80.80	80.93
Salt content of butter, per cent	2.40	2.36
Curd content of butter, per cent	0.67	0.64
pH value of butter serum	6.52	6.62
Hardness of butter, gm	582.15	592.07
Hardness of fat, gm	759.39	710.40
Slipping point of butter, °C	36.90	36.44
Slipping point of fat, °C	34.90	34.95
Melting point of fat, °C	35.69	35.60
Saponification number	226.80	225.93
Iodine absorption number	31.74	31.99
Reichert-Meissl number	31.01	30.50
Thiocyanogen number	28.07	27.05
Soluble acids, per cent	4.05	3.87
Insoluble acids, per cent	88.19	88.36

Flat Flavor. As the term implies, flat flavor is a defect in which the butter has a mild flavor or lacks full flavor. Forty-two per cent of the butter with a flat flavor also had a gummy body. Only 21 per cent of the butter with normal flavor was gummy. Forty-nine per cent of the flat flavored butter and 39 per cent of the normal flavored butter was produced on dry feed. In this survey little relationship was found between the occurrence of flat flavor and heavy feeding of cottonseed products. The flat flavor condition occurred considerably less frequently in the butter produced by creameries that used starters and let the cream ripen. Table 4 shows the average of the various analyses for flat and normal flavored butter. The acidity of the cream and the moisture content of the butter were lower for the butter that possessed the flat flavor than for normal butter. Also the flat flavored butter was harder, the hardness of the fat and the saponification number were higher, but the iodine number was lower than for normal butter. Otherwise there was little difference in the analytical data for the flat flavor butter and the normal butter.

Table 4. Relation of the Analysis to the Occurrence of Flat Flavor in Butter

Analysis	Average values for 52 samples of butter possessing a flat flavor	Average values for 221 samples of normal flavor butter
Acidity of the cream, per cent	0.37	0.55
Fat test of cream, per cent	36.20	34.53
Moisture content of butter, per cent	15.80	16.01
Fat content of butter, per cent	81.32	80.80
Salt content of butter, per cent	2.16	2.41
Curd content of butter, per cent	0.69	0.64
pH value of butter serum	6.64	6.59
Hardness of butter, gm	610.73	558.40
Hardness of fat, gm	831.00	697.24
Slipping point of butter, °C	36.65	36.53
Slipping point of fat, °C	35.03	34.93
Melting point of fat, °C	35.66	35.61
Saponification number	226.87	225.96
Iodine absorption number	30.58	32.23
Reichert-Meissl number	30.08	30.74
Thiocyanogen number	27.70	27.11
Soluble acids, per cent	3.84	3.92
Insoluble acids, per cent	88.25	88.34

Gummy Body. Gumminess is a body defect of butter. When gummy butter is placed in the mouth, it gives the impression of a firm condition and does not melt readily, but seems to stick to the roof of the mouth.

In the total of 273 samples of Texas butter examined, 68 samples, or about 25 per cent, had a gummy body defect. It has been reported that cottonseed products in the cow's ration may cause gummy butter, and that succulent feeds in the ration reduces gumminess. Table 5 shows the relation of feeding practices to the occurrence of gumminess in the butter examined. The data show that when green pasturage was present in the ration the occurrence of the gummy condition was considerably less than when green pasturage was not available. Also the gummy condition was present in a greater per cent of the butter when cottonseed or cottonseed

Table 5. The Relation of Rations Containing Cottonseed Products With and Without Green Pasturage to the Occurrence of Gumminess in Butter

Cottonseed Product Fed	With green pasture			Without green pasture		
	Number of samples	Samples gummy	Samples gummy	Number of samples	Samples gummy	Samples gummy
		Number	Per cent		Number	Per cent
Meal	55	7	12.7	31	18	58.1
Seed	6	0	0	3	2	66.7
Hulls	0	0	0	1	1	100.0
Meal and seed	8	3	37.5	7	5	71.4
Meal and hulls	15	5	33.3	17	13	76.5
Meal, seed and hulls	27	8	29.6	20	14	70.0

hulls were fed in combination with cottonseed meal. In all cases studied, the presence of pasturage reduced the percentage of gummy butter encountered.

As already stated, gumminess was very definitely a seasonal defect. It seemed to be much more common in the summer and autumn months than in the winter and spring. In Figure 5. the average monthly weather

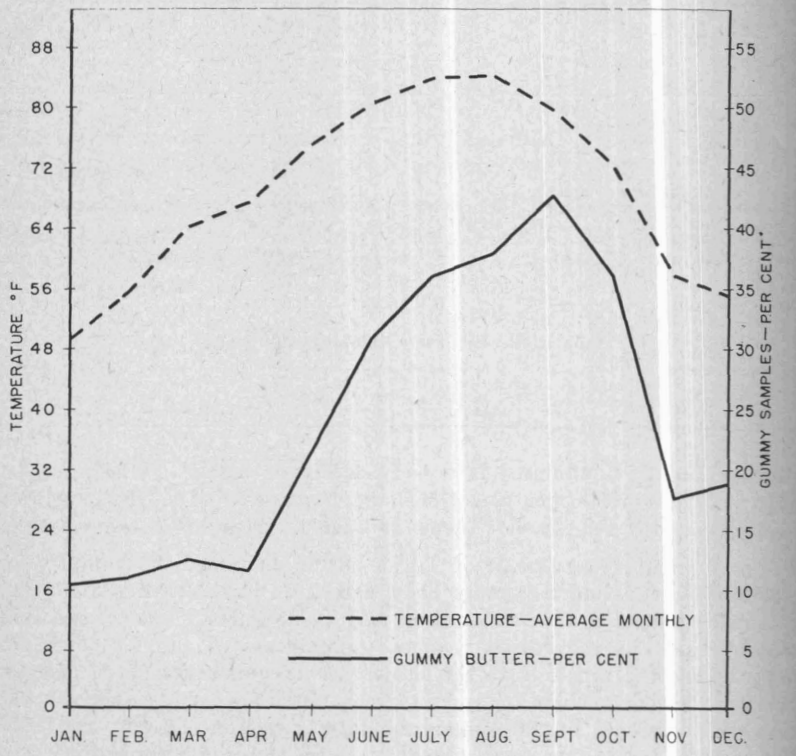

Figure 5. Relation of Weather Temperature to the Occurrence of Gumminess in Butter (Av. of 32-month period).

temperature at College Station, during the 32-month period, is plotted together with the percentage of gummy butter. There was a very close relationship between higher weather temperature and the occurrence of the gummy body defect. It has been observed that butter exposed to high temperature and then cooled will become gummy. Some of the gummy butter may have been caused by exposure to the summer heat at some time during the manufacturing process.

Figure 6. shows the relation of weather humidity to the occurrence of the gummy defect in butter. The low humidity occurred through July, August, September and October, and the largest per cent of gummy butter was also produced during these months. It is possible that humidity, through its effect on the quality of pasture and feed and the quality of the cream produced, may indirectly cause gumminess in butter.

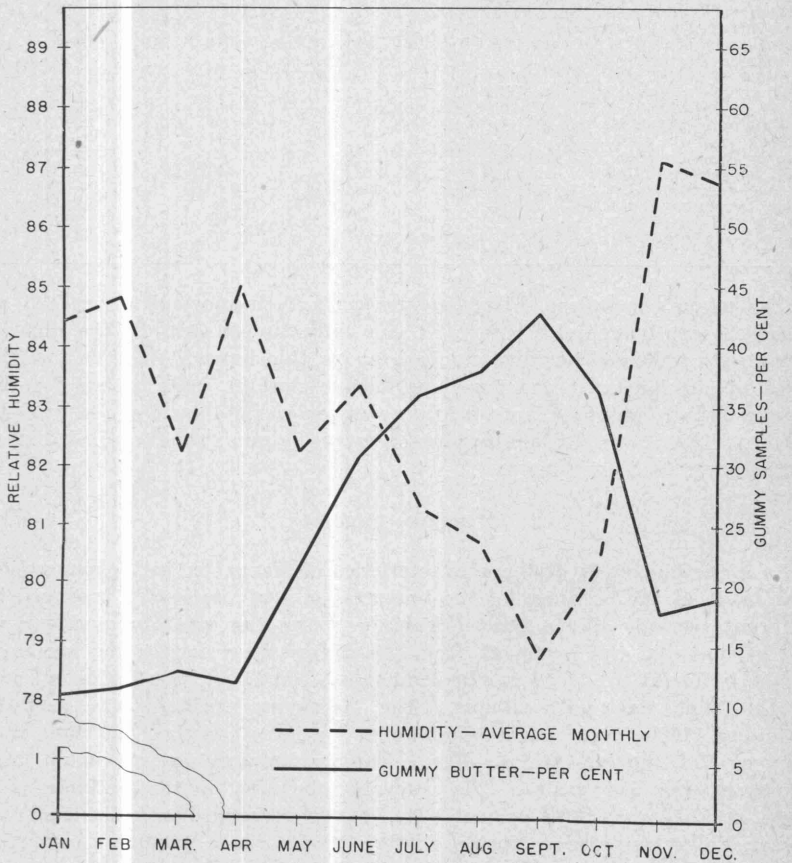

Figure 6. Relation of the Relative Humidity of the Weather to the Occurrence of Gumminess in Butter (Av. of 32-month period).

Table 6 shows the analyses of gummy butter and the analyses of butter free from the defect. The fat of the gummy butter was harder than that of the normal butter. Forty-nine per cent of the gummy butter showed a hardness value of the fat higher than 800 grams; whereas, only 30 per cent of the normal butter was above this hardness value. The iodine absorption number of the normal butter averaged slightly higher than that

Table 6. Relation of the Analysis to the Occurrence of Gumminess in Butter

Analysis	Average for 68 samples of gummy butter	Average for 205 samples of normal butter
Acidity of cream, per cent	0.54	0.52
Fat test of cream, per cent	34.03	35.06
Moisture content of butter, per cent	16.18	15.90
Fat content of butter, per cent	80.91	80.89
Salt content of butter, per cent	2.25	2.41
Curd content of butter, per cent	0.64	0.65
pH value of butter serum	6.41	6.65
Hardness of butter, gm	597.50	591.00
Hardness of fat, gm	833.36	737.38
Slipping point of butter, °C	36.43	36.58
Slipping point of fat, °C	34.85	35.00
Melting point of fat, °C	34.54	35.64
Saponification number	227.00	225.86
Iodine absorption number	31.38	32.09
Reichert-Meissl number	30.20	30.79
Thiocyanogen number	26.46	27.44
Soluble acids, per cent	3.90	3.91
Insoluble acids, per cent	88.34	88.32

of the gummy samples. Fifty-two per cent of the normal butter had an iodine absorption number above 32, but only 36 per cent of the gummy butter had iodine absorption numbers above this figure. Also the melting point of the butterfat and the thiocyanogen number were higher for the normal butter, but the saponification number was higher for the gummy butter. There was little difference between gummy and normal butter in the other data considered.

Hardness Studies

As a further study of the characteristics of Texas butter, a comparison was made of the hardness of the butterfat and of the butter produced in different sections of the State. Table 7 shows the monthly averages of the hardness of the butterfat from the different sections. The hardness of the butterfat produced in the Panhandle, Northeast, South Central and South Texas was quite similar. The maximum hardness was between 1031 and 1168 grams, and the minimum hardness for these sections was between 514 and 608 grams. The difference between the maximum and minimum was 654 grams. The average hardness of the butterfat for these sections was 820 grams. The North Central, East Central and Lower Valley sections comprise another group which produced butterfat of about the same hardness. The maximum hardness for this group ranged from 820 to 868 grams, and the minimum hardness ranged between

Table 7. Monthly Averages of the Hardness of Butterfat Produced in Different Sections of Texas

Section	Hardness in Grams by Months												
	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
Panhandle	760	902	825	811	700	690	608	628	844	971	1077	1168	832
North Central	*	587	868	671	684	757	749	788	*	616	644	784	715
Northeast	881	716	778	549	668	805	793	799	1015	907	1122	915	834
East Central	638	722	706	669	743	709	712	710	759	820	736	686	709
Gulf Coast	587	634	493	556	667	709	708	763	788	744	697	651	667
South Central	833	672	600	514	645	665	726	820	1067	839	1099	898	782
South Texas Plains	737	655	707	900	623	825	854	910	1031	827	886	1034	832
Lower Valley	661	624	736	593	835	714	846	*	804	743	759	814	739

*No samples examined.

Table 8. Monthly Averages of the Hardness of Butter Produced in Different Sections of Texas

Section	Hardness in Grams by Months												
	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
Panhandle	772	738	646	603	489	456	456	336	564	712	812	1013	633
North Central	*	582	342	425	493	541	534	554	*	628	568	861	553
Northeast	819	738	607	522	532	431	470	573	709	681	957	953	666
East Central	735	646	555	513	532	467	567	513	657	826	769	713	625
Gulf Coast	627	377	361	418	445	382	507	450	520	569	634	556	487
South Central	662	671	528	547	487	419	475	485	660	682	866	874	613
South Texas Plains	722	642	487	649	505	517	551	625	818	735	818	903	665
Lower Valley	643	607	502	506	627	420	500	*	538	607	703	655	574

*No samples examined

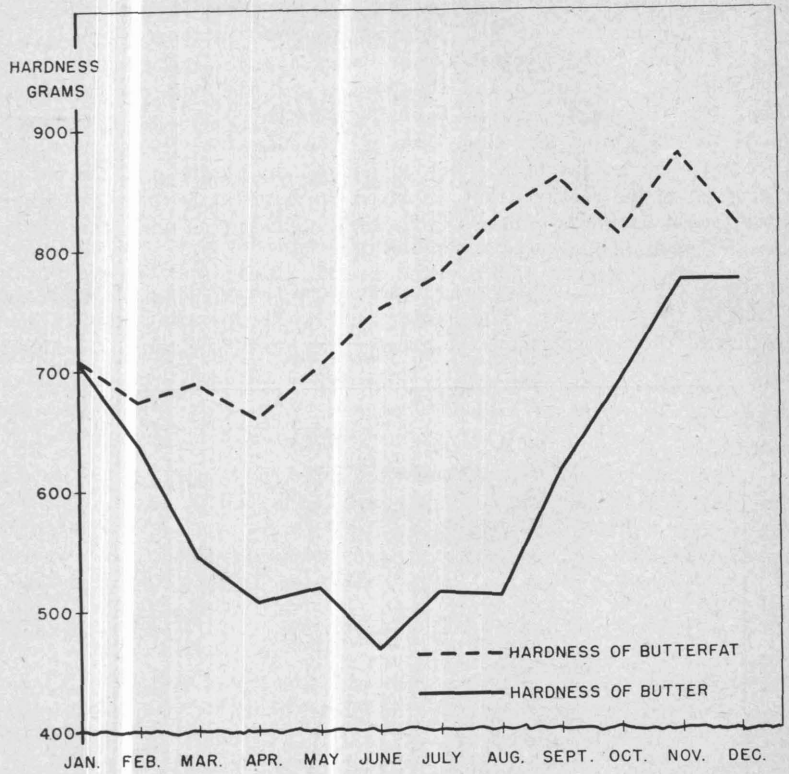

Figure 7. Relation of the Hardness of Butter to the Hardness of the Butterfat.

587 and 622 grams. The difference between the maximum and minimum was 281 grams, and the average hardness of the butterfat was 721 grams. This was somewhat less than the previous group. The butterfat from the Gulf Coast section had a maximum hardness of 788 grams, and a minimum of 493 grams. The difference between the maximum and minimum hardness for this section was 295 grams, but the average hardness of the butterfat was only 667 grams. There was not only a variation in the average hardness of the butterfat produced in the different sections, but the monthly value was also different for the various sections. It is interesting to observe that the hardness of the butterfat produced during the summer from all sections of the State approached the same value, but the hardness of the butterfat produced during the winter varied greatly. A partial explanation for these differences may be the variation in temperature conditions and the kind and quality of winter pasturage and feeds.

Table 8 shows the monthly averages of the hardness of the butter produced in different sections of the State. In the Panhandle, Northeast,

South Central and South Texas sections, the hardness of the butter was similar to the hardness of the butterfat produced in those sections. In the East Central, North Central, Lower Valley and the Gulf Coast sections, the hardness of the butter and the hardness of the butterfat were less similar. For the yearly average values, the hardness of the butter ranged from 88 to 199 grams less than that of the butterfat. The greatest difference between the hardness of the butter and the hardness of the butterfat occurred in the sections that produced the buterfat having the highest and the lowest hardness values. Less difference occurred when the butterfat was of medium hardness.

Figure 7. shows the monthly relation between the hardness of the butter and that of the butterfat. The hardness of the butter was quite different from that of the butterfat for the greater portion of the time. The hard-

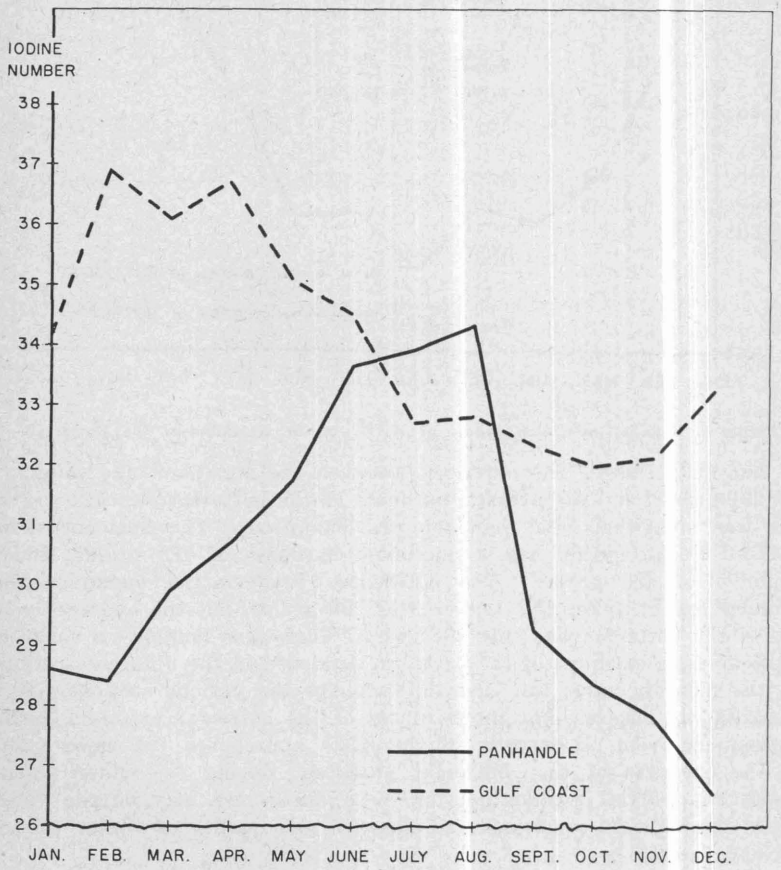

Figure 8. The Iodine Absorption Numbers of Butter Produced in the Panhandle and Gulf Coast Sections.

ness of the butterfat gradually decreased from January through April, then it increased during the summer months through November, except for a slight decrease in October. The butterfat usually had a higher hardness value, and generally the butter and butterfat hardness differed greatly from March through September. However, the hardness of both approached the same value during the winter months, and in some instances, the winter butter was actually harder than the butterfat.

In comparing the hardness values with other analytical data, it was noted that there was an inverse relationship between the iodine absorption number and the hardness of the butter. Since there is a close inverse relationship between the iodine absorption number and the hardness, and as the hardness of the Panhandle and Gulf Coast butter differed considerably, the iodine absorption number of the butter from the two sections should also vary. Figure 8. shows the iodine absorption numbers of the butter produced in these two areas and indicates the expected wide variation between the iodine numbers.

There was a direct relationship between the hardness of the butter and the melting point and slipping point of the butterfat. An inverse relationship was found between the hardness of the butter and the thiocyanogen number. No relationship was evident between the other analytical values considered and the hardness values.

Other Analytical Data

A study of other analytical data shows certain monthly trends. Figure 9. shows the monthly trend in the slipping point of the butter and the butterfat and the melting point of the butterfat. The lower slipping point values for the butter occurred during the period from April to November, inclusive. These values ranged from 36.0°F. to 37.2°F. and averaged 36.6°F. for the year. The slipping point value for the butterfat was lowest in the months of April and May and was higher during the remaining months. This value ranged from 34.0°F. in May to 35.7°F. in November, and averaged 35.0°F. for the year. The melting point of the fat was lower from April through July, and the highest values occurred from November through February. The melting point ranged from the lowest value of 34.8°F. in May to the highest value of 36.6°F. in November. The average value was 35.7°F. for the year.

Figure 10. gives the monthly trend in the Reichert-Meissl, iodine absorption and saponification numbers of the butter examined. The Reichert-Meissl number reached the highest value of 33.5 in February, and then gradually decreased until it was the lowest at 29.1 in December. The value remained practically the same during the summer and fall months with a slight increase occurring in November. The average Reichert-Meissl value of the butter examined was 30.6. The seasonal variation in the iodine absorption number has an inverse relationship to the slipping point of the butter and the slipping and melting points of the butterfat. The highest value of 34.4 was in April, and the lowest value of 29.6 in Novem-

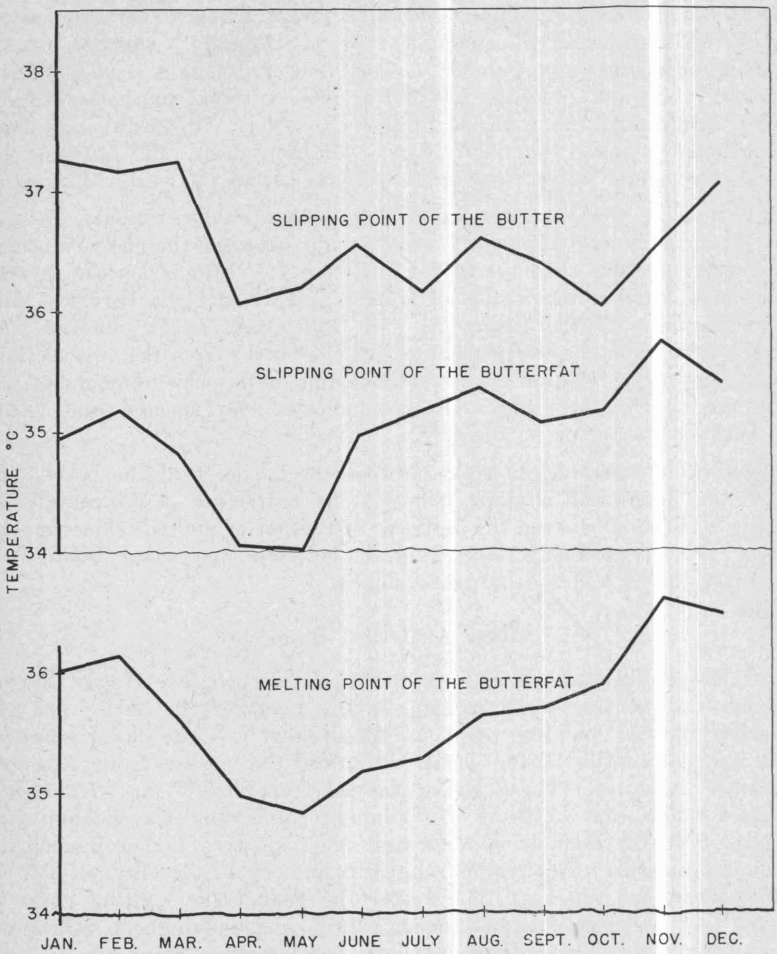

Figure 9. Monthly Trend of the Slipping Point of the Butter and the Butterfat and the Melting Point of the Butterfat.

ber. The average iodine absorption number was 31.8. The seasonal variation in the saponification number was similar to that of the iodine absorption number. The highest value of 229.0 occurred in May, and there was a gradual decrease except for a slight increase during July, November and December, until the lowest value 223.3 was reached in January. The average saponification number of the butter examined was 226.2.

The variations found in the per cent soluble and insoluble acids and the thiocyanogen number are shown in Figure 11. Little variation oc-

curred in the per cent soluble acids as this value ranged between 4.2 and 3.6 per cent, and the average value was 3.9. The per cent insoluble acids was lowest in April and highest in December. There was a gradual

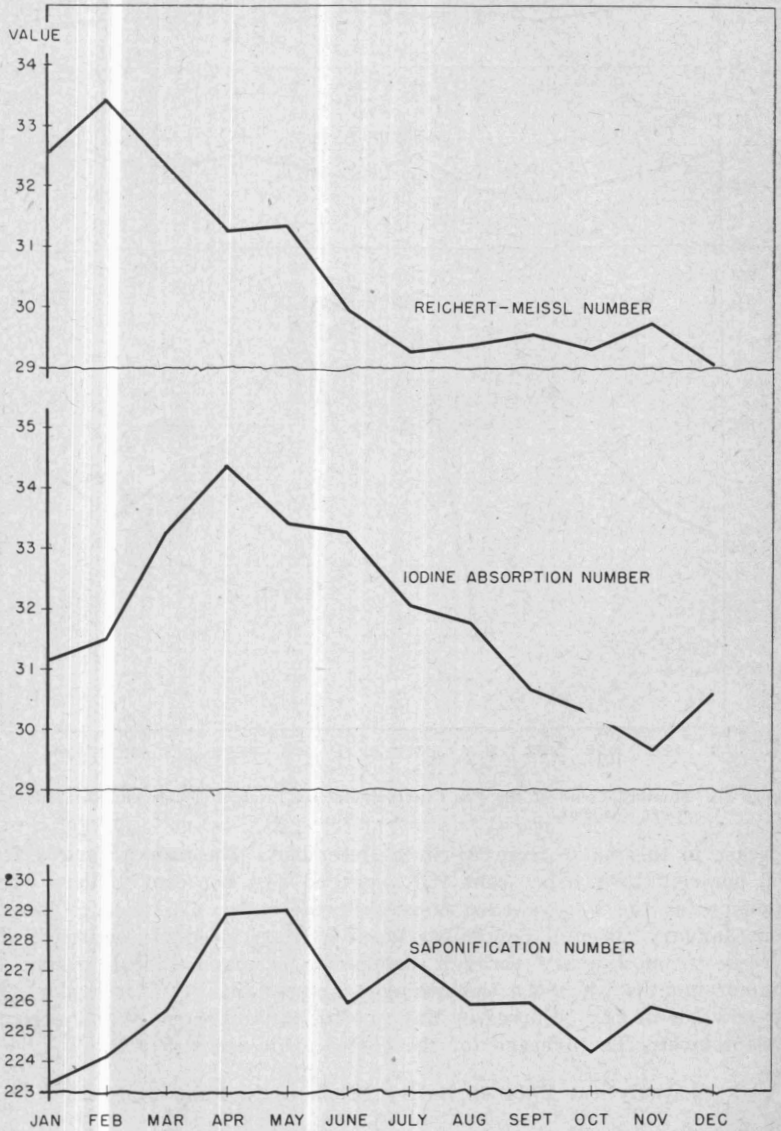

Figure 10. Monthly Trend of the Reichert-Meissl, Iodine Absorption and Saponification Numbers of the Butterfat.

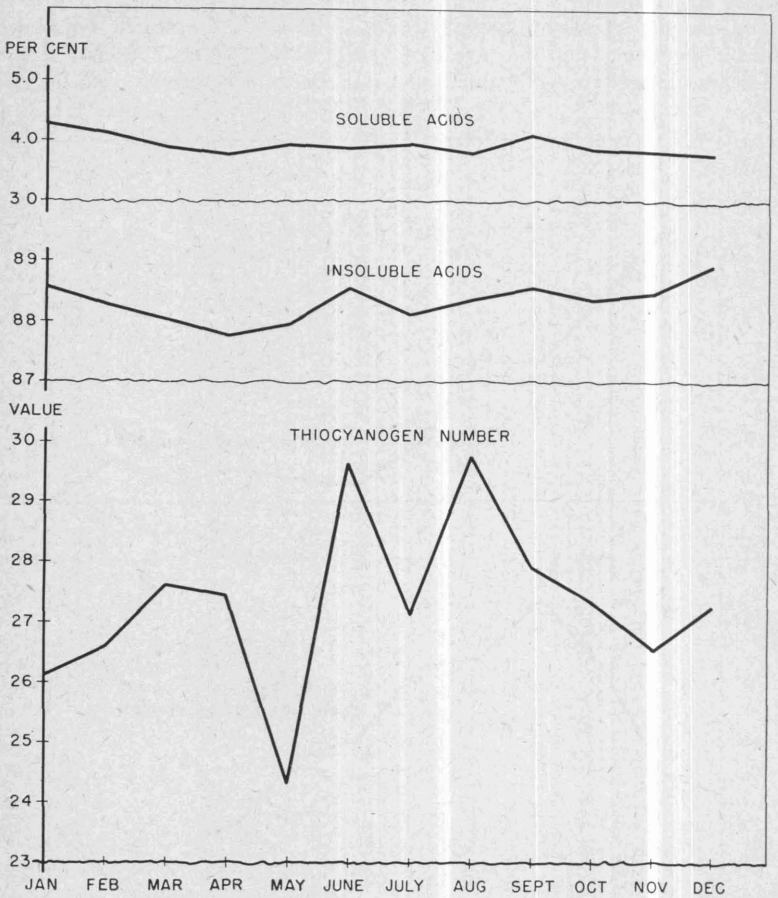

Figure 11. Monthly Trend of the Per Cent Soluble and Insoluble Acids and the Thiocyanogen Number.

increase in this value from April to December. The values ranged from 87.8 per cent to 89.0 per cent and averaged 88.4 per cent. There was a tendency for the thiocyanogen number of the butter examined to increase from January through September when a sharp decrease occurred. The increase from January through September occurred except during the summer months when the thiocyanogen number was very irregular. The lowest value of 24.4 occurred in May and the highest value of 30.0 occurred in September. The average for the butter examined was 27.4.

Analytical Data of Butter Produced in Four States

The data secured upon butter produced in Texas were compared with that of butter from New Mexico, Nebraska and Iowa. The analytical

Table 9. The Analytical Data of Butter Produced in Four States

		Fat content of cream Per cent	Acidity of cream Per cent	pH value of butter serum	Hardness of butter Grams	Hardness of butterfat Grams	Slipping point of butterfat Degrees C.	Slipping point of butter Degrees C.	Melting point of butterfat Degrees C.	Reichert-Meissl number	Iodine absorption number	Saponification number	Soluble acids Per cent	Insoluble acids Per cent	Thiocyanogen-iodine number
Texas	Range	33.7–35.8	.37–.78	6.3–6.9	465–775	660–880	34.0–35.7	36.0–37.2	34.8–36.6	29.0–33.5	29.6–34.4	223.3–229.0	3.6–4.2	87.8–89.0	24.4–30.0
	Ave.	34.76	.59	6.59	609	763	34.97	36.58	35.67	30.62	31.77	226.16	3.92	88.40	27.41
New Mexico	Range	29.0–33.0	.60–.95	6.2–7.4	430–830	595–1045	34.1–35.7	35.0–36.1	34.4–36.4	27.0–31.5	29.2–34.0	221.6–229.1	2.5–4.3	89.6–87.7	22.4–32.0
	Ave.	31.29	.66	6.86	669	823	34.92	35.59	35.58	28.73	31.41	225.32	3.74	88.86	26.25
Nebraska	Range	29.0–39.0	.32–.75	6.2–6.9	205–620	360–750	30.8–34.0	32.1–35.5	31.2–35.1	26.8–30.3	28.0–40.6	219.2–231.2	2.2–4.3	86.7–89.7	22.2–35.0
	Ave.	33.04	.50	6.59	383	484	32.89	34.20	34.85	28.35	34.08	225.74	3.55	88.51	29.17
Iowa	Range	30.0–32.0	.16–.79	6.3–7.3	140–460	310–510	31.3–33.2	32.0–35.8	32.4–34.7	26.8–33.5	30.0–40.0	219.1–227.6	2.7–4.7	87.9–89.8	25.6–34.6
	Ave.	31.22	.28	6.84	320	383	32.45	33.77	33.18	29.43	35.26	224.81	3.68	89.03	30.70

data of the butter from the four States are shown in Table 9. It was found that the fat test of the cream, from which Texas butter was manufactured, was slightly higher throughout the year than that for the butter from the other States. The acidity of the cream used in Texas butter was the highest during the warmer months and was the highest for the 12 month average except for the New Mexico butter. The yearly average of the pH value of the butter serum in Texas butter, although it was irregular, was somewhat lower than that from Iowa and New Mexico and about the same as that from Nebraska.

The gummy defect was less prevalent in the butter received from Nebraska and Iowa, and the defects occurred at a later date in butter from those States. Texas butter was gummy during May, June, July, August, September and October. Butter from New Mexico was gummy in June, July, August and September, while the butter from Nebraska was gummy in August and September, and that from Iowa showed gumminess in September.

The softest butter produced in Texas was as hard as the hardest butter received from Iowa. The butter produced in New Mexico was quite similar to Texas butter in hardness, and the Nebraska and Iowa butter were similar. The yearly average for the hardness of the butterfat of Texas butter was about 200 to 300 grams greater than that of the Nebraska and Iowa butter, and the New Mexico butterfat was approximately 60 grams greater than the value for Texas butterfat.

The Texas butter had a higher slipping point value than butter from the other States. The slipping point value of the butterfat of the Texas and New Mexico butter was similar but was higher than that of the Nebraska and Iowa butter. The same was true of the melting point values. The average melting point of the fat of Texas butter was slightly more than two degrees greater than that of the Iowa butter.

The Reichert-Meissl number of Texas butter was higher from January through September than that of the butter from the other three States; however, this value for Texas butter averaged the lowest for the remaining months. The average Reichert-Meissl number for Texas butter was approximately 1.2 higher than the average value for the butter examined from any of the other States.

The iodine absorption number was much more uniform throughout the year when compared to the values of the Nebraska and Iowa butter which were much higher during the spring and summer months. The iodine absorption number of Texas and New Mexico butter was very similar and was considerably lower than that of the Nebraska and Iowa butter.

The saponification number of Texas butter was lower in the winter and higher in the summer than that for the butter produced in the other States. The variation was not as great for the Texas butter, and the yearly average value was somewhat higher. The per cent soluble acids

was higher, the per cent insoluble acids was practically the same, and the thiocyanogen number was lower for Texas butter than those values for the butter produced in the other States.

DISCUSSION AND CONCLUSIONS

The results of the survey of the quality of Texas butter indicate that the manufacturing methods were fairly uniform throughout the State. The high acidity of the cream encountered during the summer months was common and was probably due to the storage of the cream at high temperatures before delivery. This probably accounted for the lower score butter produced from April through October. Old cream flavor was common during this time as well as weedy or feed flavors.

Pasture was available to a small per cent of the producers throughout the entire year; however, it was most abundant for about five months during the spring and summer. Cottonseed meal was present in a very high per cent of the rations throughout the year. Also large amounts of cottonseed and cottonseed hulls were fed. Abundance of cottonseed feeds on the dry pastures in July, August and September was associated with an extremely firm gummy body and a flat flavor condition in the butter examined. The five most commonly occurring defects found in the butter examined could be associated with the quality of the cream and feeding practices.

A comparison of the analytical data of butter possessing oxidized or flat flavor or a gummy body with butter of normal flavor and body showed that generally the analytical data were slightly different for the defective butter. There was an indication that a relationship existed between these defects and the analysis of the butter.

A relationship appeared to exist between the feeding practices and the occurrence of gummy butter; usually the presence of abundant pasturage was associated with a reduced amount of gumminess. Also there was a close relationship between weather temperature and humidity and the occurrence of this defect. Thus, it appears that temperature treatment of the cream during storage and in preparation for the churning process is of considerable importance in producing a butter with the desired body characteristics. A relationship existed between the method of pasteurization employed and the occurrence of the gummy defect. Creameries that used the Rogers high temperature method of pasteurization of cream consistently produced butter free from gumminess, yet this defect was prevalent in the butter produced by creameries using the vat method of pasteurization in the same locality. Also a higher per cent of the butter was gummy when made from cream cooled on surface coolers than when the slower vat method of cooling was used.

The hardness of the butter from various sections of the State was practically the same during the summer; however, the winter butter varied markedly in hardness. This indicates that the differences in

hardness of the butter from the different sections may be partially due to feeding conditions and the quality of winter pasture.

The analytical data show the following values for constants of Texas butter: hardness of the butterfat, 763 gm.; slipping point of the butterfat, 35.0°C.; melting point of the butterfat, 35.7°C.; Reichert-Meissl number, 30.6; iodine absorption number, 31.8; saponification number, 226.2; per cent soluble acids, 3.9; per cent insoluble acids, 88.4 and the thiocyanogen number, 27.4.

A comparison of the average values obtained for Texas butterfat with the normal values and with those of butter produced in Northern States show that the hardness, slipping and melting point, Reichert-Meissl number, saponification number and the per cent soluble acids were all greater than the values generally given for normal butter. The iodine absorption and the thiocyanogen numbers were lower than normal and the per cent insoluble acids was approximately normal. The higher melting point of the butterfat produced in Texas offers definite advantage in manufacturing processes, in transportation and in influencing consumer acceptance during the warm months.

The results of this survey offer a basis for further investigations concerning the specific effect of certain feeding, production and manufacturing methods on maintaining and improving the marketing qualities of Texas butter.

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