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Quality Aspects of Butter Marketing in South Dakota

E. Feder

D. F. Breazeale

R. Newberg

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AGRICULTURAL ECONOMICS AND DAIRY HUSBANDRY DEPARTMENTS
AGRICULTURAL EXPERIMENT STATION
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Summary

The future well-being of the dairy industry in South Dakota may depend to a large extent on progress made in improving butter quality. About two-thirds of the dairy output in the state is exported to other states, mostly as bulk butter. Little of this butter qualifies as Grade A, and a sizeable proportion of it is below Grade B. Improvement in quality is necessary if South Dakota butter is to command top prices on the wholesale markets. It is particularly important in the light of the increasing competition which butter faces from margarine as a spread.

Data for the study were gathered from a sample of 20 creameries in 1950 and from all of the South Dakota creameries in 1951. These data shed some light on the relationship between butter quality and prices received by creameries. The data also provide information on the relationship between the different measures of butter quality and various cream procurement, processing, and butter marketing methods prevailing in South Dakota at the time of the surveys.

The butter grading standards established by the U. S. Department of Agriculture are generally accepted as the most satisfactory measure of butter quality in common use. The Federal Food and Drug Administration depends partly on the water-insoluble acids (WIA) tests to determine whether butter is fit for human cosumption.

WIA and Federal Grades

WIA tests of butter measure the degree of decomposition. An effort was made to determine the relationship between WIA and Federal grades. Results show that as Federal grade declines there is some tendency for WIA values to increase. However, the ranges of WIA values were so wide within each grade, that the grades would not be of much value in estimating WIA values. Results indicate there is some relationship between pH and certain flavors detected in butter.

A comparison was made of the values found on the comparatively simple fatty acids titrations and the water-insoluble acids test to determine whether or not they were sufficiently closely correlated so that the fatty acids test could be used in place of the WIA test for factory control. However, there was so much deviation of samples from the line of regression that use of the fatty acids test as factory control method cannot be recommended.

Analyses were made of 280 samples of butter for fat content. Fifty-one samples were below the minimum fat content (80 percent).

An excessively high butterfat content was found in a large proportion of the butter samples. Better control of fat content would result in substantial financial gains for many creameries.

Butter Quality and Creamery Practices

An effort was made to determine the relationship between butter quality (measured by Federal grades) and various practices followed by creameries. Results indicate that differences in butter qual-

ity between creameries are strongly associated with methods followed in procuring cream. The cream station and direct railroad methods of procurement generally resulted in the lower quality of butter than did truck routes and door delivery. A similar relationship between quality and procurement method was found when quality was measured in terms of chemical tests.

Location and density of cream sales apparently were related to quality to the extent that these things were related also to method and frequency of cream procurement.

Wide differences exist between creameries in volume of production, facilities and methods of handling and processing. Results of the study do not suggest that either size or type of plant affect quality. However, practices and control exercised within plants have a material effect on the quality of butter produced and on profitability of operations.

Information was obtained on different practices followed in storing and shipping butter and differences in sales agreements obtained by creameries. Most of the butter sold out of the immediate locality was packaged in boxes weighing from 60 to 66 pounds. Considerable financial loss was incurred by some creameries due to failure to fill boxes in accordance with weights marked on the boxes. Practices followed in sale of different qualities of butter differed among creameries. Some apparently followed the practice of selling poor grade butter locally. Others sold the better grade locally. Many did not differentiate.

Sales agreements differed widely among creameries and many creamery managers were not sure of the nature of their agreements. In general, creameries which usually put out higher quality butter received more favorable prices for all of their butter, even for lower grades. Uniformity in quality of butter also appeared to command some price premium.

Quality Aspects of Butter Marketing in South Dakota

ERNEST FEDER, DELBERT F. BREAZEALE, and RICHARD NEWBERG[1]

Introduction

Quality improvement is one of the foremost problems facing the butter industry in South Dakota. Quality is one of the basic factors affecting prices and consumption of the product. The butter industry has experienced a serious decline in demand for butter during recent years. Most butter produced in South Dakota is Grade B or lower and some one-fourth of it does not meet the minimum quality requirements for government purchase under the price support program. If the market for South Dakota butter is to be expanded, quality improvement is one of the major problems which must be solved.

Dairying is an important source of cash farm income for South Dakota farmers, although it is not generally a major farm enterprise. Farm sales of dairy products accounted for about 6 percent of the State's total cash farm income in 1950, 1951, and 1952. Dairying is important to many farm families because it yields an income the year around. Also, it provides more stability of income than do most farm enterprises. Consequently, dairying often is expanded when the price level is low and is used as a shock absorber in the case of crop failure.

More than four-fifths of the butterfat marketed in South Dakota is sold as farm separated cream. Most of the cream is manufactured into butter. South Dakota exports about two-thirds of its total dairy output to other states, mostly as butter. As a butter producing state, South Dakota ranked twelfth in 1951 and eleventh in 1952.

The butter industry has suffered from declining demand for butter for a number of years. Per capita consumption of butter in the United States declined from 17.3 pounds in 1939 to 8.7 pounds in 1952. During the same period there was a 5.5 pound increase in the consumption of margarine.

Numerous studies have found that the reason for shifting from butter to margarine was the difference in prices between the products. These studies have found also that the majority of the consumers preferred the taste of butter. A few tests have been made of consumer preferences for high quality butter

[1]Former Associate Economist, Dairy Husbandman, and Assistant Economist, respectively, South Dakota Agricultural Experiment Station.

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R. J. Baker, associate dairy husbandman, made pH and fat acidity analyses of the butter samples. A. F. Dombrowski, Bureau of Business Research, University of Nebraska, helped with the tabulation and statistical analyses.

Travis W. Manning, assistant economist, helped prepare this report from a more detailed manuscript.

Copies of the detailed manuscript may be obtained from the senior author.

as compared to margarine. The results indicate that high quality butter competes much more successfully with margarine than does low quality butter.

The butter industry is currently engaged in a campaign to promote the consumption of butter. This effort is not likely to succeed unless the industry provides the consumer with a high quality product which is definitely superior in taste.

Objectives

Purposes of this study were to determine the quality of South Dakota butter and to measure the influence of various factors on quality.[2] The specific objectives were:

(1) To measure the quality of butter manufactured in South Dakota according to the butter grading standards of the United States Department of Agriculture and according to certain chemical and physical tests. An additional objective was to compare different measures of quality.

(2) To analyze the effects on quality of various factors, such as procurement, processing, shipping, and laws and regulations.

(3) To determine what incentives existed for quality improvement. The nature of butter sales agreements were examined to determine their influence on quality.

Scope of Study

Data used in this study were obtained principally from two surveys. The first survey included 21 South Dakota creameries. This survey was part of a regional study made in 1950 by the North Central Regional Committee on Dairy Marketing Research.[3]

The 102 creameries in the state were stratified according to ownership and volume of butter production in 1948. All plants having 1 million pounds or more butter production were included. A stratified sample was selected from the plants having less than 1 million pounds output. Data were secured from the plants concerning butter production, sales agreements, and prices received for butter. Federal butter graders visited the plants, once in spring and once in summer, and graded churnings of butter on hand.

The second survey, made in 1951, included all creameries in South Dakota. A similar butter grading procedure was followed in all of the plants in 1950. Chemical and physical analyses were made of samples of butter collected in the survey. Additional information was obtained for each of the plants.

There were 92 creameries operating in South Dakota in 1951. However, several plants did not churn butter the year around. There were 89 plants in operation when the plants were visited in the spring and 90 in the summer of 1951. Several plants did not have sufficient butter on hand to be sampled at the times they were visited.

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[2]Studies of other aspects of the costs and methods of butterfat procurement and butter manufacturing have been planned by the North Central Regional Committee on Dairy Marketing Research. See Ernest Feder and Sheldon W. Williams, *Dairy Marketing in the Northern Great Plains; Its Patterns and Prospects*, North Central Regional Publication No. 47, South Dakota Agricultural Experiment Station Bulletin 438, 1954, p. 1.

[3]Hugh Cook and others, *Butter Pricing and Marketing at Country Points in the North Central Region*, North Central Regional Publication No. 26, University of Minnesota Agricultural Experiment Station Technical Bulletin 203, 1952.

Measures of the Quality of South Dakota Butter

Quality of butter can be measured by several criteria. The U. S. Department of Agriculture has established official standards for different grades. These are based primarily on flavors detected in the butter. Color, body, and salt also are taken into consideration.

The Food and Drug Administration inspects butter to determine whether it is fit for human consumption. Degree of fat decomposition as measured by the water-insoluble acids (WIA) test is one of the principal criteria used. Butter also must meet minimum statutory requirements as to fat content.

This section was aimed primarily at measuring the quality of South Dakota butter by use of various standards. The relationships between fat acidity, pH, WIA, and the various quality criteria were analyzed to determine whether chemical tests might provide simpler and more objective standards. Results of this section are used in later sections to determine the effect of various factors on quality of South Dakota butter.

Quality of Butter in Terms of Federal Grades[4]

Under the regulations prevailing at the time of the surveys, Federal grades for butter were determined by four major characteristics—flavor, body, color, and salt. The kind and intensity of the predominating flavor determine the initial grade classification. When more than one flavor is discernible, the lower flavor determines the grade classification. The final grade may be lower than the initial grade if the butter is sufficiently defective with respect to body, color, or salt.

Some flavors are present in the cream when it reaches the creamery. Others are introduced during the manufacturing process or during storage. For example, a "weedy" flavor has its origin on the farm; a "neutralizer" flavor may originate in the plant; a "storage" flavor develops in the cooler or warehouse. However, processing or storage flavors are sometimes related to the flavor or the condition of the cream which was acquired before reaching the plants. A "neutralizer" flavor, for instance, is related to high acidity of the cream.

The standards adopted in 1954—while following the same general pattern—put greater emphasis on the pasteurizing, neutralizing, and churning process. As a result, certain flavors, formerly in the Grade B classification, are now in Grade C. In addition the "cooking grade" (CG) has been eliminated from the new standards. Table 35 shows the changes in classification of flavors and defects in detail.

Quality of South Dakota Butter

In spring and summer 1950, 292 churnings, representing nearly 344,-

[4]The data presented in this section were based on the Federal standards in effect from 1943 to 1954. In 1954 a new set of standards was adopted and the impact on these data was studied.

000 pounds of butter manufactured by 20 sample creameries, were graded in the plants according to Federal standards. In 1951, butter from 691 churnings, representing about 759,000 pounds, was graded in a survey of all South Dakota plants. These churnings represented about 3 percent of the estimated annual production of the sample plants, and approximately 12 percent of their estimated production in the months in which the butter was graded.

In 1950, 81 percent of the graded butter (in terms of weight) was Grade B (90 score) and 19 percent was Grade C (89 score). In 1951, 83 percent was Grade B, 15 percent Grade C, and the remainder (about 1 percent each) Grades A (92 score) and CG (cooking grade). The slight difference between the 1950 and 1951 results was not statistically significant.

Importance of Butter Flavors

The most frequently occurring flavor in the butter which was graded B was "definitely old cream" flavor. This flavor usually is associated with butter manufactured from farm separated sour cream which otherwise has no predominant flavor defects. In 1950, 67 percent, and in 1951, 79 percent of the butter was designated by this flavor (Table 1). "Acidy" and "utensil" flavors in the butter accounted for 19 and 10 percent in 1950 and 1951, respectively. A small proportion was found to have feed, musty, and barn flavors. On the whole, flavors resulting primarily from farm and handling practices were found in about 90 percent of all Grade B butter in both years.

Table 1. Distribution of Grade B Butter by Flavors in South Dakota Creameries Surveyed in 1950 and 1951

Flavors Stemming Primarily From:	Percentage of Total Weight of Grade B Butter	
	1950	1951
Farm and Handling Practices		
Old Cream	67	80
Acidy	12	4
Utensil	7	6
Weed, Musty, Barny	5	2
Subtotal	**91**	**92**
Plant Operation		
Neutralizer	9	6
Other		2
Subtotal	**9**	**8**
Total	**100**	**100**

"Neutralizer" flavors are present if cream is over-neutralized, usually as a result of inaccurate processing methods. Faulty plant operation may also result in other defects, such as scorching or body or salt defects. In 1950 and 1951, 9 and 8 percent of the butter showed these defects.

Among the churningswhich were Grade C, "definitely stale" and "definitely metallic" flavors were the most frequent (Table 2). Most of

Table 2. Distribution of Grade C Butter by Flavors in South Dakota Creameries Surveyed in 1950 and 1951

Flavors Stemming Primarily From:	Percentage of Total Weight of Grade C Butter	
	1950	1951
Farm and Handling Practices		
Stale	60	27
Metallic	22	37
Sour, Cheesy, Yeasty, Fishy	7	11
Weedy, Musty, Barny	4	7
Subtotal	**93**	**82**
Plant Operation		
Alkaline, Neutralizer, Other	7	18
Total	**100**	**100**

the Grade C butter apparently suffered from improper and lengthy handling and storage of cream on the farm or during movement to the plant.

Impact of New Federal Standards

If the new Federal standards of 1954 had been in force in 1950 and 1951, and assuming no changes in farm production, marketing, or processing methods of cream, the proportion of Grade B butter in the state would have been considerably lower. The proportion of C or "below grade" would have been considerably higher (Table 3).

Butter Quality as Measured by Chemical Analyses

Samples of butter obtained at the creameries by state dairy inspectors were analyzed in the Dairy Department laboratory, Brookings, for acidity in the fat and the pH of the butter serum. Portions of these samples were sent to the State Chemical Laboratory, Vermillion, where they were analyzed for fat and WIA. The tests for fat acidity were made according to the method of Breazeale and Bird.[5] The method of Hillig was used for the WIA determinations.[6]

Analyses for Acidity

The WIA content of butter is a measure of the amount of decomposition which has occurred in the fat, usually before the cream was churned into butter. The comparatively simple fat acidity titrations were made to determine if they would correlate closely enough with the WIA tests to be of value as a factory control method.

The pH value of butter is an indication of proper acidity control in the manufacture of butter from sour cream. Values between 6.6 and 7.0 are considered most desirable. Certain flavor defects are more likely to occur when the pH values are higher or lower than this range.

A total of 368 butter samples from the churnings inspected by the federal graders (97 in 1950 and 271 in 1951) were subjected to the chemical tests mentioned above. In general, as fat acidities increased, the WIA values also increased; the correlation coefficient was 0.711. There was so much deviation of some samples from the line of regression that the use of the fat acidity test as a factory control method cannot be recommended. The pH values of these samples showed a slight correlation with fat acidities but none with the WIA determinations.

[5]D. F. Breazeale and E. W. Bird, "A Study of Methods for the Determination of Acidity in Butterfat." *Journal of Dairy Science*, 21: 335-344, 1938.

[6]Fred Hillig, "Determination of Water-Insoluble Fatty Acids in Cream and Butter." *Journal of the Association of Official Agricultural Chemists*, 30:575-582. 1947.

Table 3. Distribution of South Dakota Butter Graded in 1950 and 1951 According to Federal Grading Standards of 1943 and 1954*

	Federal Grades (Percent in Each Grade)							
	1943 Standards				1954 Standards			
Year	A	B	C	Below Grade	A	B	C	Below Grade
1950		81	19			58	37	5
1951	1	83	15	1	1	68	23	8

*See Table 34 for comparison of 1943 and 1954 grading standards.

Table 4 shows that as the grades of butter became lower (declined in quality), the average of the WIA values increased. These data indicate the importance of good quality butter if satisfactory WIA values are to be obtained. However, the ranges of WIA values were so wide within each grade, that the Federal grade would not be of much value in predicting what the WIA test of an individual sample would be. Further, statistical analysis of the data showed little or no relationship between specific flavor defects and either pH or WIA values.

Table 4. Relation of WIA Values to Federal Grades of Butter

Grade	No. of Samples	WIA Values	
		Range	Average
A	6	77-226	131
B	256	42-423	163
C	94	37-539	224
CG	12	83-467	250

Analysis for Butterfat Content

The minimum butterfat content of butter is 80 percent as defined by United States and South Dakota standards. It is not illegal to manufacture butter with more than 80 percent fat, but increasing financial losses are incurred by the creameries as the percentage of fat in the butter exceeds this legal limit. Consequently, buttermakers usually attempt to obtain a fat content of about 80.2 percent.

During the 1951 survey 280 samples of butter were analyzed for fat in the State Chemical Laboratory. Of these, 51 contained less than 80.0 percent fat, 70 contained between 80.0 and 80.5 percent fat, 91 contained between 80.5 and 81.0 percent fat, and 68 contained more than 81.0 percent fat. These data indicate that much improvement should be made in composition control. The number of samples containing substandard fat should be greatly reduced.

Financial returns could be increased by lowering the amount of fat in more than half of the churnings. For example, a plant making 450,000 pounds of butter containing 81.5 percent fat, could have made 457,294 pounds containing 80.2 percent fat. At 60 cents per pound, this would have increased its earnings by $4,376.40.

Factors Affecting the Quality of South Dakota Butter

Butter quality is affected by the methods practiced in handling cream on farms, moving cream from farm to plant, and processing, storing, and shipping butter. Creameries have little control over the handling of cream before it leaves the farm. However, they may be able to influence the method and frequency of moving cream from farm to plant. They have direct control from the time the cream reaches the plant until it is shipped out as butter.

A number of laws and regulations affect butter quality by defining minimum standards and prescribing certain handling methods. Analyses were made of the effects on butter quality of various handling methods. These are discussed under the headings of procurement, manufacturing, storing, and shipping. Brief attention is given to the effects of laws and regulations relating to butter quality.

Procurement

Methods of Procurement

South Dakota creameries obtain their cream by one or more of the following methods of cream procurement: (a) farm truck routes, (b) direct door delivery by farmers to the plant, (c) company owned or independent cream stations, (d) direct railroad shipments by farmers to a distant plant. Fifty of the 88 plants obtained their cream through two methods, 23 used only one method, and the remaining 15 plants obtained their supply through three or four methods in 1950 (Table 5).

A larger proportion of the cooperative creameries than of independently owned plants relied on two methods of procurement, but among some of these cooperatives the second method was relatively unimportant.[7] Independently owned plants, particularly centralizers, generally relied more heavily on a variety of methods.

Among the smaller plants—both cooperatives and independents—door delivery played an important role. Twenty of the 21 small creameries obtained all their supply at the door (Table 5).

[7]Independent plants in this report are all individually owned creameries, partnerships, and stock companies, including centralizer plants. Cooperatives include cooperative centralizers. A centralizer is defined in this report as a larger creamery which obtains a substantial proportion of its cream through cream stations or direct railroad shipments.

Table 5. Number of Cream Procurement Methods Used by 88 South Dakota Creameries, by Size and Type of Organization, 1950

Size and Type of Organization	Number of Procurement Methods Used			
	1	2	3	4
	(Number of Plants)			
1,000,000 lbs. and over				
Cooperatives		2	1	—
Independents		—	—	3
Subtotal		**2**	**1**	**3**
500,000 to 999,999 lbs.				
Cooperatives	2	5	2	—
Independents	—	1	2	—
Subtotal	**2**	**6**	**4**	—
Less than 500,000 lbs.				
Cooperatives	6	24	—	—
Independents	15	18	6	1
Subtotal	**21**	**42**	**6**	**1**
Total	**23**	**50**	**11**	**4**

Whether plants relied on one or more cream procurement method, the bulk of their supply usually was obtained from a single source, here referred to as the "primary" source. In 59 of 82 plants, over 70 percent of the cream supply was received through their primary method. Farm trucks were used by 35 plants, door delivery by 33 plants, and cream stations by 14 plants as the primary procurement method. A few plants used two or three methods in about equal proportions. Thus, they had no primary method (Table 6). Direct rail shipment was not a primary method for any plant, although 10 creameries received some cream by rail. No plant received more than 35 percent of its total supply of cream by direct rail shipment.

The relative importance of the cream procurement method may vary for individual plants from year to year. The cream station method accounted for the largest proportion of cream purchased by South Dakota plants. The 20 creameries, for which data on cream purchases were obtained in 1949, received about 4 million pounds of butterfat through cream stations. Truck routes and direct delivery each accounted for about 2 million pounds. On the basis of this sample, it is estimated that South Dakota creameries obtained approximately 42 percent of their cream supply through cream stations and direct railroad shipments combined, about 30 percent through truck routes, and 28 percent through direct door delivery (Table 7). Thus, approximately 70 percent of all cream received at South Dakota plants was obtained by methods which afford the plant comparatively little control over the frequency of delivery.

The larger plants which rely heavily on cream stations have established a far-flung procurement system which is characterized by the operation of numerous cream stations and shipment of cream over long distances. It is not uncommon for cream stations to be located 150 miles away from the plant. Direct railroad cream shipments travel as far as 400 miles, some originating west of the state line. Some plants pick up their cream from the sta-

Table 6. Distribution of 82 South Dakota Plants by Primary Method of Cream Procurement and by Type of Organization, 1950*

Percent of Cream Delivered by Primary Method	Primary Procurement Method and Type of Organization						
	Truck Routes		Cream Stations		Door Delivery		
	Coop.	Indep.	Coop.	Indep.	Coop.	Indep.	Total
	(Number of Plants)						
91—100	9	1		2	7	15	34
81— 90	8	1	1	2		2	14
71— 80	5	2		1		3	11
61— 70	5			2	2	1	10
51— 60	2	1		3	1	1	8
41— 50		1	1	2		1	7
31— 40							4
Total	**29**	**6**	**2**	**6**	**10**	**23**	**88**

*Six plants procured equal amounts by two or more methods.

Table 7. Estimated Total Cream Purchases by Method of Procurement and Size of Plant, South Dakota, 1949

Size of Plant (Lbs.)	Estimated Total Butterfat Purchases (Lbs.)	Percentage Purchased Through Truck Route	Door Del.	Cream Station	Railroad
1,000,000 and over	5,600,000	18	6	69	7
500,000 to 999,999	7,000,000	16	38	33	13
Less than 500,000	13,500,000	43	32	25	—
Total	**26,100,000**	**30**	**28**	**37**	**5**

tions on regular truck routes. Others obtain their station receipts through regular railroad shipments.

Cream procured through farm truck routes or direct door delivery usually travels no farther than 15 to 25 miles. Plants located in more sparsely producing areas, or plants with larger volumes, may receive cream from as far as 50 miles by these methods.

Independent plants accounted for about 82 percent of all cream station purchases and 73 percent of all railroad receipts. Cooperatives accounted for about 87 percent of all farm truck route receipts. Cooperatives and independents received about equal proportions by door deliveries.

Location of Production

One-half of the creameries in South Dakota were located in the 15 easternmost counties where sales of farm separated cream were heaviest.

The density of farm sales appeared to affect the method by which plants procured their cream supply (Table 8). Creameries were

Table 8. South Dakota Creameries by Primary Method of Cream Procurement, Type of Organization, and Dairy Areas, 1950*

Primary Procurement Method and Type of Organization	Dairy Areas† Milk Area II	Cream Areas III (2.00 or more)	IV (1.50 to 1.99)	V (1.00 to 1.49)	VI (0.50 to .99)	VII (.00 to .49)‡
		(Number of Plants)				
Truck Routes						
Independent		2	2	1	1	—
Cooperatives		17	6	5	1	—
Sub-total		**19**	**8**	**6**	**2**	—
Door Delivery						
Independent	1	6	4	3	7	2
Cooperatives	2	3	2	1	2	—
Sub-total	**3**	**9**	**6**	**4**	**9**	**2**
Cream Stations						
Independent	1	1	3	1	4	2
Cooperatives	1	—	—	—	1	—
Sub-total	**2**	**1**	**3**	**1**	**5**	**2**
Total	**5**	**29**	**17**	**11**	**16**	**4**
Total Number of Plants in area	5	32	19	12	17	4

*Excludes plants for which no primary method existed.
†Milk Area II: Counties in which whole milk sales predominate. Cream Areas III-VII: Counties which cream sales predominate.
‡Pounds of butterfat per acre of land in farms.

classified according to their location by counties, and the counties were divided according to the density of sales of farm separated cream.

As density of farm sales decreased, plants tended to shift from truck routes and door delivery to cream stations and railroad receipts. For example, of the 29 creameries in the area of heaviest cream sales, only one used cream stations as its major source of supply. In areas where sales were sparse, only two plants out of 20 used truck routes as a primary procurement method. The proportion of plants using more than two methods of procurement increased as density of cream sales declined.

Seasonality of Production

The production of milk is subject to large seasonal variation. For the years 1946-50, milk production on South Dakota farms in the peak months of May, June, and July was twice the production of the low months of November, December, and January.[8]

The 20 plants visited in 1950 furnished information on total cream purchases in 1949, as well as purchases for the individual months of June 1949 and February 1950. Cream purchases of those plants for June 1949 represented 12.5 percent of the year's total. Purchases for February 1950 were equal to only 6 percent of total purchases in 1949. This conformed to a fairly well established pattern in the state. During the period 1944-50, 13.2 percent of South Dakota creamery butter was produced in June and 6.6 percent in February.[9]

Location of the plants apparently affected the seasonality of purchases and of production significantly. Plants located in denser cream marketing areas had a smaller seasonal variation than plants in sparser areas (Table 9). This may reflect the tendency of farmers in these sparser areas to discontinue selling cream in wintertime.

Since many of the state's cooperatives were located in denser cream marketing areas, they apparently had a slightly more regular production pattern than independent plants. The proportion of annual butterfat purchases made in February was lower for independents than cooperatives (Table 10).

Procurement methods and seasonality of butter production were not found to be significantly related. Plants which obtained their cream supply primarily from cream

[8] *South Dakota Dairying*, South Dakota Crop and Livestock Reporting Service, 1953, p. 10.

[9] *Production of Manufactured Dairy Products, 1944-50*, U. S. Department of Agriculture, Bureau of Agricultural Economics.

Table 9. Seasonal Purchases of Farm Separated Cream by 20 South Dakota Plants by Dairy Areas, June 1949, February 1950

Dairy Areas	Number of Plants	Percentage of Annual Purchases Made in	
		June (1949)	February (1950)
Area III-V (1.01 lbs. of BF per acre and over)	15	12.0	6.3
Area VI-VII (up to 1 lb. of BF)	5	15.0	4.1

Table 10. Seasonal Purchases of Farm Separated Cream by 20 South Dakota Plants by Primary Procurement Method and Type of Organization, June 1949, February 1950

	Number Of Plants	Percentage of Annual Purchases Made in	
		June (1949)	February (1950)
Primary Procurement Method			
Truck Routes	6	12.3	6.3
Door Delivery	5	12.5	7.2
Cream Stations	7	12.6	5.6
Type of Organization			
Cooperatives	9	12.4	6.7
Independents	11	12.5	5.5

stations purchased slightly less cream in February than plants with truck routes or door delivery as the primary procurement method. This may be related to location and density of cream sales.

Seasonal fluctuations in milk and butter production were greater in South Dakota than in Minnesota or Nebraska. However, the seasonal pattern was more stable from year to year in South Dakota than in Minnesota. This may be attributed to the almost exclusive use of farm separated cream for butter manufacturing and the inability to divert whole milk into alternative manufactured dairy products. About 85 percent of the milk equivalent sold by farmers was sold as farm separated cream. As a result, there was a close relationship between changes in volume of farm production of milk and the manufacture of butter by plants.

The predictability of the seasonal pattern has certain marketing advantages for South Dakota creameries. It enables buyers to rely on these plants as regular suppliers of butter. In recent years annual variation in butter production has been somewhat less in South Dakota than in the United States as a whole. Since seasonal production is relatively stable and predictable in South Dakota, buyers are better able to plan their purchases for the year from South Dakota creameries.

Relation of Procurement Methods to Quality

The most significant factor affecting butter quality appeared to be the creameries' methods of procuring their cream supply. Plants which obtained their cream mainly from farm truck routes had a considerably higher percentage of Grade B butter for the entire 1950-51 period than plants which obtained their cream primarily through door delivery or cream stations (Table 11). As the proportion of cream obtained from truck routes increased, the quality of butter improved fairly consistently.

A statistical analysis of the relationship between procurement method and quality was run. Results indicated that quality of butter, produced by plants having truck routes as their primary method of procurement, was significantly better than quality of butter produced by plants having either door

Table 11. Amount of Butter Graded and Proportion of Grade B Butter of Primary Procurement Method, South Dakota 1950-51*

Primary Procurement Method	Number of Plants		Amount of Butter Graded (1,000 Lbs.)		Percentage of Grade B Butter†	
	1950	1951	1950	1951	1950	1951
Truck Routes	7	38	82.5	297.6	93	92
Cream Stations	7	14	185.9	260.0	78	74
Door Delivery	6	30	64.7	163.5	72	85

*Excludes plants in which butter was graded only once in 1951.
†Includes a few churnings of Grade A butter.

Table 12. Distribution of Grade C Butter in South Dakota Plants by Primary Cream Procurement Method, 1950 and 1951

Primary Procurement Method	Number of Plants		Amount of Grade C Butter (1,000 Lbs.)		Amount per Plant (1.000 Lbs.)	
	1950	1951	1950	1951	1950	1951
Truck Routes	4	14	5.5	23.5	1.4	1.7
Cream Stations	6	9	40.2	66.7	6.7	7.4
Door Delivery	5	13	18.1	25.2	3.6	1.9

Table 13. Distribution of Butter Flavors in South Dakota Plants by Grade and Season, 1950-51

Grade B Butter			Grade C Butter		
Flavors Stemming Primarily From	Season		Flavors Stemming Primarily From	Season	
	Spring	Summer		Spring	Summer
Farm and Handling	**(Percent)**			**(Percent)**	
Practices			Stale	26	56
Old Cream	74	78	Metallic	44	23
Acidy	8	5	Cheese, Yeasty, etc.	9	
Utensil	6	6	Feed and Barn	12	1
Feed and Barn	3	3		91	80
Subtotal	**91**	**92**	Neutralizer and Other*	9	20
Plant Operation			**Total**	**100**	**100**
Neutralizer	9	5			
Other*	†	3			
Subtotal	**9**	**8**			
Total	**100**	**100**			

*Including churnings with body and salt defects.
†Less than 1 percent.

delivery or cream stations as their primary method of procurement (.001 level of significance).

The largest proportion of Grade C butter was found in plants with primarily cream station procurement (Table 12).

Incidence of some specific flavors among the graded churnings in the plants was subject to a high degree of variability. During both 1950 and 1951 the proportion of various butter flavors remained about the same in spring and summer among the butter graded B, while Grade C had a considerably higher proportion of "stale" flavored butter in summer than in spring. Since there was considerably more Grade C butter in summer than in spring, apparently much of the cream sold by farmers had been held on the farm under unfavorable cooling conditions resulting in rapid deterioration of the

Table 14. Distribution of Butter Flavors in South Dakota Plants by Grade and by Primary Procurement Method, 1950-51

Grade B Butter				Grade C Butter			
Flavors Stemming Primarily From	Primary Procurement Method (%)			Flavors Stemming Primarily From	Primary Procurement Method (%)		
	TR	CS	DD*		TR	CS	DD*
Farm and Handling Practices				Stale	44	43	39
Old Cream	82	69	75	Metallic	31	32	33
Acidy	5	12	†	Yeasty, Cheesy, Fishy, or Sour	6	4	2
Utensil	3	8	8	Feed or Barn	3	6	9
Weedy and Musty	1	5	3	**Subtotal**	**84**	**85**	**83**
Subtotal	**91**	**94**	**86**	Neutralizer	4	4	7
Plant Operation				Other‡	12	11	10
Neutralizer	7	5	12	**Subtotal**	**16**	**15**	**17**
Other	2	1	2	**Total**	**100**	**100**	**100**
Subtotal	**9**	**6**	**14**				
Total	**100**	**100**	**100**				

*TR=Truck routes; CS=Cream station; DD=Door Delivery.
†Less than 1 percent.
‡Including churnings with body and salt defects.

cream and, consequently, of the butter manufactured (Table 13).

In both years, the largest proportion of Grade B butter with "old cream" flavor was encountered among plants with truck routes as their primary supply method. Plants with other primary procurement methods showed a higher proportion of Grade B butter characterized by more undesirable flavors (Table 14).

Statistical analyses of the relationships between various chemical tests and type of procurement were run. Results indicated there was a significant relationship between values obtained on the various chemical tests of quality and type of procurement (.001 level of significance). Results also indicated that significantly poorer quality butter was obtained where the principal method of procurement was through cream stations as compared with either truck routes or door delivery (.001 level of significance).

Fat acidity values and WIA tests of butter samples were significantly higher for creameries which obtained cream primarily from cream stations than for those with primarily truck routes or door delivery (Table 15).

Fat acidities for butter samples from creameries with truck routes were significantly lower than from those with door delivery as their primary procurement method. How-

Table 15. Relation Between Primary Procurement Methods of South Dakota Creameries and Chemical Tests of Butter, Spring and Summer, 1951

Primary Procurement Method and Season	No. of Samples	FA Av.	WIA Av.
Truck Route			
Spring	67	.70	101
Summer	47	.81	201
Total	**114**	**.74**	**145**
Cream Station			
Spring	24	.96	162
Summer	25	1.25	292
Total	**49**	**1.11**	**228**
Door Delivery			
Spring	51	.71	110
Summer	40	.92	225
Total	**91**	**.80**	**161**

ever in terms of WIA tests, the samples from the former were not significantly better than those from the latter.

Location of creameries apparently influenced the quality of butter to the extent that procurement practices tended to vary with the density of cream supplies in the various areas of the state. Plants in denser cream producing areas along the eastern edge of the state manufactured a higher quality of butter than plants in sparser areas (Table 16). In addition to differences in procurement methods, the sparser areas usually had higher summer temperatures and greater farm-to-town distances than the denser eastern areas. Many farmers did not sell cream the year around and may have been less well equipped to keep cream properly cooled and stored.

The number of times cream is collected from stations is only one factor bearing on quality. The condition of the cream also depends on the frequency of delivery by farmers and the storage and cooling facilities of the stations. Other things being equal, more frequent station pickup would result in higher quality than less frequent pickup.

The most common frequency of delivery of cream in South Dakota creameries in May 1951 was twice per week (Table 17). A few creameries received cream only once per week by some methods.

Manufacturing

Butter Production

Total butter production in South Dakota declined from a peak of 47 million pounds of creamery butter in 1941 to 30 million pounds in 1952. This represents a decline of 36 percent.

The number of plants declined from 120 in 1942 to 88 in 1952—a decline of 27 percent (Table 18). During the 1940-50 period, the number

Table 16. Proportion of Grade B Butter Produced by 83 South Dakota Plants by Dairy Areas and Season, 1951

Dairy Areas	No. of Plants	Proportion of B Butter		
		Spring	Summer	Total
Milk Area II*	3	100	29	67
Denser Cream Areas III-V	60	87	89	88
Sparse Cream Areas VI-VII	20	86	67	77

*This includes four counties in the Black Hills in which a large proportion of milk is sold as whole milk but in which cream sales are sparse.

Table 17. Distribution of South Dakota Creameries by Procurement Method and Number of Cream Deliveries Per Week, May 1951

Procurement Method	Cream Deliveries Per Week					
	One	Two	Three	Four	Six	Seven
	(Number of Plants)					
Farm truck routes	4	45	1	–	–	–
Cream station—rail shipment	–	–	7	–	3	–
Cream station—truck shipment	–	5	7	3	–	–
Rail shipment by farmers*	4	2	1	–	–	–
Direct door delivery*	5	75	1	–	–	1

*Average number of deliveries per patron.

Table 18. Butter Production and Number of Creameries in South Dakota, 1940-53

Year	Butter Production (Million Lbs.)	Number of Plants
1940	44	115
1941	47	115
1942	46	120
1943	43	118
1944	37	116
1945	34	109
1946	37	105
1947	35	104
1948	31	102
1949	31	99
1950	32	96
1951	34	92
1952	30	88

Source: U. S. Department of Agriculture, Bureau of Agricultural Economics.

of plants in all size groups decreased, but the largest decrease occurred among the plants producing less than 500,000 pounds of butter. In more recent years, the number of plants producing 1 million pounds and over has increased.

Total production decreased in all size groups, but large plants have recently gained at the expense of small and medium sized creameries, and there are indications that this trend may continue (Table 19).

The decline in cream production from 1930 to 1935 affected the larger sized plants most adversely. However, in more recent years large creameries have been able to gain both absolutely and relatively. Average production per plant decreased in all size groups after 1940.

The relatively slow adjustment in plant numbers to the decline in butterfat production resulted in less than full utilization of equipment and plant. In a relatively large proportion of the creameries this resulted in a low ratio of actual to potential plant output even during the flush season.

Of the 20 creameries visited in 1950, 16 were producing at less than one-half of churning capacity. Only 1 of the 20 plants operated at more than three-fourths of capacity in June 1949, and 7 operated at less than one-fourth of capacity (Table 20). Generally the smaller the output, the lower was the ratio of actual to potential output.[10] In most of the plants, production in February 1950 was only about one-half of June production. As a result, many creameries operated their churning equipment only infrequently during this low season. The data on actual butter production in 18 plants indicated that 7 plants in June 1949 and

[10]The cooperatives operated at slightly nearer full capacity (46 percent) than independent plants (40 percent).

Table 19. Distribution of Butter Production by Size of Plants, South Dakota, 1925-50

Year	Size of Plants: Less than 500,000 Lbs.		500,000-999,999 Lbs.		1,000,000 Lbs. & over	
	Number	Production (Million Lbs.)	Number	Production (Million Lbs.)	Number	Production (Million Lbs.)
1925	73	10	3	2	7	16
1930	81	12	12	8	11	21
1935	92	15	13	9	7	12
1940	92	18	16	12	7	14
1945	90	16	15	11	4	8
1950	77	14	13	9	6	10

Source: U. S. Department of Agriculture, Bureau of Agricultural Economics.

Table 20. Utilization of Estimated Churning Capacity by 20 South Dakota Creameries, June 1949

Relation of June Production to Estimated Churning Capicity* (percent)	Number of Plants	Estimated Average Monthly Churinng Capacity† (Pounds)	Average Size of Churns (Pounds)	Actual Production Per Plant		
				June 1949 (Pounds)	February 1950 (Pounds)	Relation of February to June (percent)
0-25	7	131,657	1,371	26,110	10,980	42
26-50	8	177,600	1,850	70,794	39,554	56
51-75	4	216,000	2,250	140,886	64,954	46
76-100	1	115,200	1,500	87,590	54,780	63

*June 1949 production as percentage of estimated churning capacity.
†Estimated on basis of four churnings per day, 24 days per month, with available churns in plant (rated capacity).

15 plants in February 1950 did not receive enough cream to make one full churning per day (Table 21).

There were various reasons why many plants often filled their churns to less than rated capacity. In some plants, the holding capacity of vats was not adequate; in others, buttermakers preferred to churn different grades of cream separately, to preserve the quality of their cream by churning it as soon as possible, or to make smaller churnings because of easier and better handling.

Conversely, some plants regularly turned out churnings with weights approaching or even exceeding the rated capacities of their churns. In 10 of 18 plants, it was found that one-half or more of the churnings on hand weighed less than 90 percent of the rated capacity of their churns. In seven plants, one-fourth or more of the churnings weighed less than 80 percent of capacity. Ten plants had some churnings with weights exceeding the rated churn capacity.

Plants which received their cream mainly through cream stations tended to have a larger proportion of low weight churnings (less than 80 percent of rated churning capacity) than other plants of similar size. The other plants which had many such low-weight churnings were very small creameries.

The available data suggest that one of the results of a decline in cream supply was a tendency for some plants to churn in quantities which were below the rated capacity of their churns. However, strong positive relationship between churning weights and utilization of churning capacity was not evident.

Table 21. Utilization of Churning Facilities in 18 South Dakota Plants, June 1949 and February 1950

Churnings Per Month*	No. of Plants		Av. No. of Churnings*	
	June 1949	February 1950	June 1949	February 1950
Less than 10	1	7	6	6
10-19	3	5	16	15
20-30	3	3	22	26
30 or more	11	3	55	48

*These figures were calculated by dividing monthly butter production by rated capacity of churns.

Plant, Equipment, and Labor

Many of South Dakota's creameries were housed in buildings not originally built to serve as creameries. Of the 20 plants surveyed in 1950, only 10 were originally built as creameries.[11]

In 1950 none of these 20 plants had a cream receiving room separate from the processing room. The processing equipment in many plants was simple. Among the small creameries, it usually consisted of one churn, one to three pasteurizing vats, and an occasional dump-vat. Many small plants dumped cream through a screen directly into the vats and returned the unwashed cans to farmers or washed them by hand. The seven medium sized plants had one to two churns, from two to four pasteurizing vats, and in some cases extra holding facilities. The most common additional equipment was a can washer.

Among the three large plants, one had only a single churn, four pasteurizing vats, and a buttermilk drier. The other two had considerable additional equipment.

Four plants had "print" machines and one had a wrapping machine for 1-pound packages. On the whole, the independent plants had more equipment than cooperative creameries.

The work force of the small plants generally consisted of the owner or manager who also was the buttermaker, one or two full-time, and one part-time employee. As volume increased, a separate buttermaker and office help were usually added. The largest plant also had a plant superintendent and a regular work force exceeding 10 full-time men.

Specialization in Butter Manufacturing

South Dakota creamery butter is made almost exclusively from farm separated sour cream. The few creameries that had a fluid (whole) milk intake used it almost entirely for bottling purposes and only when in surplus was some of the whole milk separated in the plant. Some of the plant separated cream was used in ice cream.

In the 20 creameries surveyed in 1950, 3 percent of the total butterfat intake was in the form of whole milk and 97 percent was in the form of farm separated cream. The proportion of butterfat receipts in whole milk was greater in the small plants. A few plants, all independently owned, had relatively large bottling operations and produced bottled milk and cream for the city or town population (Table 22).

These creameries had little, if any, diversification in their dairy operations. The firms diversified only to the extent of handling other commodities. Medium and small creameries usually engaged in such sidelines as poultry and eggs, feed, wool, or locker plant operation.

Size of Plants and Ownership

In contrast to cream procurement method, the size and type of plant did not appear to affect the quality of the product significantly. While in 1950, the largest plants had a much higher proportion of Grade B

[11]Since 1950 several plants have undergone structural changes and purchased new equipment.

Table 22. Butterfat Receipts of 20 South Dakota Creameries by Size of Plant and Form of Product, 1949

Size of Plant (Pounds)	Number of Plants	Number of Plants Receiving Whole Milk	Total Butterfat Receipts* (1,000 Lbs.)	BF Receipts in Farm Separated Sour Cream (1,000 Lbs.)	Proportion in Whole Milk (percent)	Butter Produced (1,000 Lbs.)
1,000,000 and over	3	1	4,043	4,012	–	4,986
500,000 to 999,999	6	4	3,345	3,190	5	3,911
Less than 500,000	11	3	1,920	1,780	7	2,237
Total	**20**	**8**	**9,308**	**8,982**	**3**	**11,134**

*Including a very small amount of farm separated sweet cream.

butter than medium plants, the situation was reversed in the following year. This could probably be attributed to the fact that in the second year more creameries with cream station procurement were included among the largest plants. The smallest creameries showed the greatest uniformity in quality from one year to the next.

Cooperatives, on the whole, produced a better quality of butter than independent plants, possibly because a large proportion of cooperatives depended on truck routes for their supply (Table 23). Also, cooperatives produced a more uniform quality. Of 19 plants in which butter was graded both in 1950 and in 1951, 22 percent of the cooperatives had only Grade B butter in both years, as compared with 10 percent of the independents.

The fact that the quality of output varied or shifted from one year to the next, as between size groups and types of plants, does not suggest that either size or type of plant in itself affects quality or uniformity of quality.

Testing and Grading of Cream

There appears to be little uniformity in the practices of sediment testing followed by South Dakota

Table 23. Distribution of Butter by Size of Plant, Type of Organization, and Grade, South Dakota, 1950 and 1951

Size of Plant and Type of Organization (Lbs.)	Years and Grade (Percent) 1950 A	B	C	CG	1951 A	B	C	CG
1,000,000 and Over								
Cooperatives		100	–	–	–	74	26	–
Independents		87	12	1	–	73	24	2
Subtotal		**90**	**10**	*	–	**73**	**26**	**1**
500,000 to 999,999								
Cooperatives		79	21	–	–	92	8	–
Independents		71	29	–	–	94	5	1
Subtotal		**74**	**26**	–	–	**93**	**7**	*
Less than 500,000								
Cooperatives		90	10	–	2	88	8	2
Independents		72	28	–	1	79	18	2
Subtotal		**83**	**17**	–	**1**	**84**	**13**	**2**
All Cooperatives		87	13	–	1	86	12	1
All Independents		78	22	*	1	81	17	1

*Less than 1 percent.

creameries (Table 24). One plant specified "one pint off the bottom for each patron," and one plant maintained an extended sediment testing program for all cream received from stations.

Table 24. Sediment Testing Practices of 18 South Dakota Creameries, 1950

Frequency of Sediment Tests	No. of Plants
Once a week	1
2-3 times each month for first week	1
Twice a month	1
1-2 times per month	1
Once a month	6
Once a month, one day	1
Once a month but not regularly	2
Every two months	1
Not regularly, once a week some patrons	1
Not regularly	2
Twice a year for each patron	1

Seventeen creameries reported that they graded the cream by smell and taste, and three reported that they did not. But of 18 creameries reporting, only seven churned different grades of cream separately (two of them only in warm weather). In the summer of 1950, several creameries reported that they shipped their undergrade cream "elsewhere."[12]

Of the 88 plants, 65 reported the acidities of cream before and after neutralization. The acidity of the cream before neutralization, as reported by the plants, averaged .572 in spring for 95 churnings and .633 in summer 1951 for 53 churnings. The reported range was .18 to 1.00 in spring, and .40 to .90 in summer. Eighteen batches in spring and 24 in summer were reported as having an acidity exceeding .60. The acidity of the cream after neutralization varied from .11 to .33 with most plants reporting an acidity of .20.

Butter Shipment and Storage

Total butter production in South Dakota was between 50 and 56 pounds per person for the years 1950 to 1952. Since this was considerably in excess of per capita consumption, a large amount of butter was available for shipment to other states.

Three plants sold almost all their butter in 1-pound packages. Print sales made up about 32 percent of the total sales of the 20 plants. Over half of the print sales went to creamery patrons or local wholesalers, mainly for local consumption. Most of the butter sold locally in print was packaged and cartoned by hand (Table 25).

[12]In 1951, 78 plants stated they did not churn separately different grades of cream. Of the 10 creameries which did, the majority were large or medium-sized plants. Eighteen plants stated they shipped undergrade cream elsewhere and five indicated they did not buy undergrade cream.

Table 25. Sales of Bulk and Print Butter by 20 South Dakota Creameries, by Size of Plant, 1949

Size of Plant (Lbs.)	Total Butter Sales (Lbs.)	Percent Total Sales of Bulk Butter	Percent Total Sales of Print Butter		
			Out of Area	Local Wholesale	Patrons and Retail
1,000,000 and over	5,190,536	60	26	12	2
500,000 to 999,999	3,901,493	78*	1	18	3
Less than 500,000	2,237,728	67	7	22	4
Total	**11,329,757†**	**68***	**14**	**16**	**2**

*All bulk was shipped except for small quanities sold locally for making ice cream.
†1949 sales exceeded production slightly because of inventory changes and interplant transactions.

Sixty-eight percent of the butter was packaged in fiber boxes weighing 60 to 66 pounds each. Creameries shipping butter in bulk usually included a small amount of butter in excess of the weight marked on the fiber box to compensate for loss of weight through shrinkage. Among the 17 plants this reported average varied from 3 to 8 ounces per box. The most common allowance was 4 ounces per box. It is not clear whether the overage was determined by the creamery operators or was part of the selling agreement with the buyers. But buyers check the marked weights of shipments. Nine creameries reported that they had been docked for underweight shipments by their buyers during 1949. The most commonly cited reason for dockage was a defective scale in the creamery.

Creamery managers may be able to prevent losses from docking or from unnecessarily large overage by making arrangements for periodic scale inspections.[13]

Quality of Bulk and Print Butter

Do plants ship their better quality butter in bulk in interstate commerce and market their poorer quality in print locally?

A comparison between bulk and print butter showed no difference in quality in the combined 1950-51 gradings (Table 26).[14] The large creameries had only an insignificant amount of Grade C print butter on hand (less than 1 percent). There was therefore no indication that print butter sold locally by creameries was of a quality inferior to that sold in bulk.

Table 26. Quality of Bulk and Print Butter on Hand in South Dakota Creameries, 1950-51

Total Pounds in Bulk Butter	561,517
Percentage in B Grade	87
Total Pounds in Print	161,493
Percentage in B Grade	86

Some plants may sell their poorer quality of butter locally. However, many plants probably follow the opposite practice. This is indicated by the following:

Total number of plant visits in which the grader found both bulk and print butter in 1950-51	127
Number of visits during which the grader found:	
Proportion of Grade B same in print as in bulk	88
Proportion of Grade B lower in print than in bulk	18
Proportion of Grade B higher in print than in bulk	21
All print butter Grade C, all bulk in Grade B	6
All print butter Grade B, all bulk Grade C	4

Destination of Shipped Butter

Eighty-one percent of the June 1949 and February 1950 shipments went directly to large markets outside of the state: Chicago, Omaha, New York, and the Twin Cities (Table 27). Although the remainder was sold to buyers within the state, much of it probably was shipped out of the state later.

Excluding butter shipped from plants to their own home company, the largest proportion of butter shipped in 1949 was sold to whole-

[13] A financial loss through dockage or excessive overage results from the buyers paying for full pounds only. For further details see Cook and others, op. cit. p. 16. That plants should include ⅓ to ½ pound per box does not appear justified if plants ship only relatively short distances.

[14] Only plants which had both bulk and print churnings at the time of the graders' visits were included in this comparison. Plants which shipped print butter out of state in large quantities were excluded. Print butter on hand was assumed to be for the local trade.

salers and distributors outside the state (Table 28).

Type of Transportation and Frequency of Shipments

Although creameries are usually located near railroads, the majority shipped their butter by truck. Some of the reasons were that (1) railroad transportation had been discontinued or was inconvenient, (2) when less than carload lots were involved truck shipment was less expensive, or (3) plants could pool their shipments more conveniently by truck.

Table 27. Destination of Shipped Butter, 19 South Dakota Creameries, 1949-50*

Destination	Percentage of Total Shipments
Out-of-State	**81**
Chicago	32
Omaha	26
New York	13
Twin Cities	6
Other	4
South Dakota	**19**

*One of the 20 plants in the survey sold its entire output locally.

Table 28. Shipped Butter Sales, by Type of First Receiver, 16 South Dakota Creameries, 1949*

Type of First Receiver	Percentage of Shipped Sales
Wholesalers-Distributors	61
Meat Packers	30
Other Dairy Plants and Co-op Sales Agencies	8
Other	1

*Three plants which shipped directly to their home company were not included.

Of the 19 plants that shipped butter, two, located on a large transcontinental railroad line, shipped all their butter in "straight carload lots." One plant made small express shipments to out-of-state retail stores. Railroad shipments made up approximately 31 percent of all butter shipments.

The method of delivery of creameries selling to meat packers appeared to be determined largely by the packers. In most other cases, it depended on the arrangements made by the creamery operator with the carrier. Meat packers apparently picked up butter at the plants on regularly scheduled days. Creameries not selling to packers also arranged for regular pick-up days, usually once or twice a week, depending on the season. Frequency and size of shipments varied a great deal from shipment to shipment, from plant to plant, and from season to season. Large plants tended to ship more often and in larger amounts than did smaller plants. Most plants shipped more frequently, and in larger amounts, during the high than during the low season (Table 29). Plants which divided their output among several buyers generally shipped more often and in smaller

Table 29. Frequency and Size of Shipment, by Size of Plant, 18 South Dakota Creameries, 1949-50*

Size of Plant (Lbs.)	Average Number of Shipments		Average Size of Shipments (1,000 Lbs.)	
	June 1949	Feb. 1950	June 1949	Feb. 1950†
1,000,000 and over	8.0	4.0	21.1	18.6
500,000 to 999,999	6.0	4.6	14.0	18.1
Less than 500,000	4.8	4.1	4.8	3.1
All plants	5.6	4.3	13.1	9.3

*Of the 20 plants in the survey, one sold only locally, and one large plant did not furnish detailed information.
†Four plants did not ship in February 1950.

amounts than those selling to a single buyer.

Of the 160 shipments reported by 18 plants in June 1949 and February 1950, 22 weighed 20,000 pounds or over at the plant, and thus could benefit from lower transportation rates for carload lots. These 22 shipments were made by five plants.[15] The average size of shipments was below 10,000 pounds for at least half the plants (Table 30). Smaller shippers can take advantage of lower rates by pooling with other creameries.

The above information suggests that many creameries adhered to a fairly regular shipment schedule, regardless of the amount of butter to be shipped either because it was convenient for the buyers or because of their own preferences. In many plants the weights in shipments going to a single buyer varied 200 to 300 percent from shipment to shipment within a 4-week period.

Table 30. Distribution of Plants by Average Size of Shipment, South Dakota, June 1949 and February 1950

Average Size of Shipment at Plant (Lbs.)	Number of Plants	
	June 1949	Feb. 1950
20,000 and over	3	1
15,000 to 19,999	3	2
10,000 to 14,999	3	1
5,000 to 9,999	3	4
Less than 5,000	6	6

Storage Facilities

With present marketing practices which involve little holding of butter for longer periods of time for purposes of price shopping, the majority of the 20 South Dakota creameries had adequate space for storing and cooling butter prior to shipment. Managers of only two of the 20 creameries in the survey thought their storage facilities were inadequate from the point of view of space. Four of the plants could store only 10,000 pounds of butter or less, but the others had sufficient space for at least 20,000 pounds.

The amount of storage space was affected not only by butter output, but by the other enterprises in which the plant was engaged as well. Coolers can be used for more than one commodity. Creameries which were in the poultry, fluid milk, or locker business, often had more than one cooler. Several plants had sufficient storage space to accumulate enough butter for several carloads if they wished.

While in most cases coolers may have been adequate insofar as space was concerned, they did not always seem adequate from a sanitary point of view. Some coolers were found to be moist and musty, and some had temperatures exceeding 45 degrees at the time of the visit. In some of the plants butter storage was a neglected phase of marketing and could have been improved.

Storability of Butter

For creameries which produce mostly Grade B butter, the problem of storability is of great concern. While it has not been usual for the trade to store butter for over 6 months, longer storage has occurred in recent years under the support program. Butter stored by the government is kept in public cold storage warehouses, at temperatures below 0 degrees F.

[15] One large plant not included in these data stated that it shipped only carload lots but gave no detailed information on its shipments.

Until recently it was held that butter could not be stored for longer than a year without considerable deterioration. A report by the U. S. Department of Agriculture on regradings of butter purchased in 1949 and 1950 under the support program throws further light on the storability of this commodity from the point of view of grades.[16]

Table 31 shows the proportions of butter originally graded A and B at purchase time that remained in these grades after 6 months or longer. While Grade A butter kept its grade slightly better than Grade B for the shorter period, the Grade B butter appeared to retain its grade for the longer period. However, the largest proportion of Grade A butter was downgraded because of "storage flavor," which is permissible in Grade B butter.

Table 31. Storability of Grade A and B Butter

Original Grade	Percentage Remaining in Same Grade	
	After 6 Months	After a Year or More
A	97.2	41.0
B	92.6	80.6

Source: *Regradings of Butter Purchased and Stored in 1949 and 1950 Under the Milk and Butterfat Price-Support Program*, Production and Marketing Administration, U. S. Department of Agriculture, June 1951, Tables 10 and 11.

While the regradings show the quality of butter when taken out of storage, no information is available as to the characteristics of the various grades after butter is moved into retail channels. Some wholesalers maintain that storage butter deteriorates very rapidly once it is removed from cold storage.

Laws and Regulations

A comparison of the state laws and regulations and the data from the surveys indicated considerable discrepancy between legal requirements and practices followed. The state law requires that the acidity of Number 1 cream shall not exceed 0.6. It also requires a minimum discount of 2 cents on Number 2 cream. However, creameries, as a rule, did not discount prices on cream because of excessive acidity.

Similarly, the provisions with respect to sediment testing, cream stations recordkeeping and other practices were not always observed. Creameries or stations sometimes accepted and paid for cream which should have been rejected.

Laws and regulations are as good as their enforcement. Strict enforcement of sanitary food laws is essential to insure the marketing of quality products. More inspectors are needed to insure the proper enforcement of these laws. South Dakota employs 14 inspectors to supervise and enforce 13 sanitary laws. Of these, four inspectors are employed to enforce the cream grading and testing law. This involves the inspection and supervision of 80 creameries, 400 to 500 licensed cream stations, and other dairy plants.

Many of the state's provisions appear to be nearly unenforceable in the form in which they stand. These include provisions with respect to acidity tests and price differentials for various grades of cream. Much greater responsibility is placed on creameries than on the farmers who often market a product without proper regard for responsibilities

[16] *Regradings of Butter Purchased and Stored in 1949 and 1950 under the Milk and Butterfat Price-Support Program*, Production and Marketing Administration, U. S. Department of Agriculture, June 1951.

which they have toward the consuming public. Perhaps it would be wise to shift some of the responsibility toward cream producers. Provisions with respect to proper cream cooling and storage methods on farms are generally inadequate. Sanitary and storage requirements for cream stations need to be improved.

The relationship between decomposition of cream and health should be clarified. Dairy products, like other foods, are potential carriers of disease, thus care should be taken in handling and processing them.

Sales Agreements and Returns to Creameries

Do plants which produce high quality butter obtain market prices sufficiently high to provide an incentive for other plants and for farmers to improve quality?[17]

Improvements in quality may be achieved through changes in marketing and processing methods by farmers, handlers, and creameries. Such changes would involve costs which could be justified only by correspondingly higher returns from the sale of higher quality butter.

In order to appraise the effects of quality on plant returns, other factors influencing returns to plants must be considered. In many instances quality considerations can influence the extent to which these other factors operate. Some of these other factors are:

(1) Size and regularity of shipments. Larger shipments are preferred by buyers since they facilitate handling at wholesale markets. Regular shipments are preferred because they enable buyers to plan their purchases over time.

(2) Location of the plant with respect to markets. In general, the greater the distance from the market, the lower the net price to creameries.

(3) Method of transportation and size of shipment. Net prices to creameries are affected by shipping costs. These in turn depend on the type of carrier used and the freight rate. Pooling small shipments with other plants may result in savings through lower rates.

(4) Gross price received from the buyer. This price depends on the agreement with the buyer. It is determined by: (a) the quotation used, (b) the day to which the quotation refers, (c) premiums or discounts, and (d) how the butter quality is determined, (whether or not shipments are accepted and priced on the basis of Federal

[17]See also: Cook and others, op. cit.; *The Establishment of Central Market Butter Prices in Chicago and New York*, U. S. Department of Agriculture, Production Marketing Administration, Marketing Research Report No. 53, 1953; "Effect of Location on Prices Received by Creameries for Butter," (unpublished) U. S. Department of Agriculture, Agricultural Marketing Service, 1954; and *Butter Pricing by Iowa Creameries*, Farm Credit Administration Circular C-136, 1950.

grades or buyers' own grades.)[18]

The nature of the final agreement between plant and buyer may depend on bargaining ability. However, the bargaining ability of the seller may be affected by size and regularity of shipment, location of plant, and quality factors. A well informed manager of a plant producing uniformly high grade butter and regularly shipping large quantities throughout the year, is in an advantageous position to exact a favorable agreement.

The analysis of prices received during a relatively short period of time may not reveal fully the extent to which a single factor, such as quality, may affect returns to plants. This is due to the character of butter price fluctuations in the central markets, particularly the changes in differentials between various scores on carlot and less-than-carlot quotations.[19] In addition, butter purchases by the government, which were made extensively in that period, may have an effect on the market.

In contrast, an examination of the terms of agreements—while not susceptible to quantitative measurements—should reflect the long-run advantages which the creameries can expect to obtain from high or uniform quality of output.

Sales Agreements for Bulk Shipments

Fifteen of the 20 plants in the 1950 survey shipped bulk butter to buyers in various markets and 12 of them shipped butter regularly the year around. The 15 plants had 19 sales agreements. Most of these agreements were informal, some of them concluded over the telephone. Only one plant had a written agreement with its buyer. Oral agreements appeared to be relatively vague and included few details on the use of quotations or grades.

The agreements, as they were reported by the operators, did not always correspond to the terms under which specific shipments in June 1949 and February 1950 were paid for by the buyers. One plant obtained more than it had reported, and other plants received slightly over the reported agreement for a few individual shipments. However, six plants received less than they reported for all or part of their shipments.

Much of the butter was paid for without reference to grade or qual-

[18]The price of butter received by the plant is usually based on one of the quotations published in the large central markets, such as Urner-Barry in New York or Price Current in Chicago. However, the use of quotations is not a simple matter. Agreements can specify not only the specific score to be applied, but also whether a single day's quotation is to be used or the average of a week; the high, middle, or low point of a range (if the quotation shows a price range); or whether carlot or less-than-carlot quotations are to be applied.

[19]The average price differentials in June 1949 and February 1950 for various quotations were as follows:

Item	Average Price Differential in Cents Per Pound	
	June 1949	Feb. 1950
Chicago 90: CL vs. LCL	.89	.50
Chicago 89: CL vs. LCL	1.10	.78
CL: 90 vs. 89	3.28	1.21
LCL: 90 vs. 89	3.39	1.49
Chicago 90 CL vs. 89 LCL	4.28	1.99
Chicago 90 LCL vs. 89 CL	2.39	.71
Chicago 92 vs. 90 CL	1.66	0.00
Chicago 90 CL vs. NY 90 (Top quotation)	.79	2.00
Chicago 90 LCL vs. NY 90 (Top quotation)	.10	2.50
Chicago 89 CL vs. NY 89 (Top quotation)	.44	1.68
Chicago 89 LCL vs. NY 89 (Top quotation)	1.44	2.44

(Based on Chicago Price Current and New York Urner-Barry Quotations. Different quotations for CL and LCL shipments only in Chicago, for 89 and 90 score butter.)

ity. Only about 25,000 pounds of the nearly 1 million pounds shipped were sold on Federal grade certificates. In some cases, the buyer indicated his own grades.

Prices Received for Bulk Shipments

Average monthly prices, f.o.b. market (Chicago or New York), received by the 15 South Dakota creameries tended to be lower for the plants with lower than for plants with higher quality (Table 32). The relatively small number of plants, and the fact that data were not available for a larger number of months, did not permit a definite conclusion that the differences in prices were due exclusively to differences in quality. Thus, some price incentive for higher quality of butter appeared to exist even in the short-run.

Differences in prices received for specific shipments of which the precise quality in terms of Federal grades was known did not reflect so much differences in the quality of these individual shipments as differences in average quality of output of the creameries. This indicates that buyers generally paid prices according to the plants' long-run quality of output rather than according to the quality of specific shipments.

The following conclusions may be drawn from the analysis of sales agreements:

(1) For plants with an average quality of output of 90 percent United States Grade B or better, market prices or price quotations were agreed upon which corresponded quite closely to the 90 score quotation of the Chicago or

Table 32. Average Monthly Prices for Bulk Shipments Received by 15 South Dakota Creameries, F. O. B. Market, by Size of Plant and Average Quality of Output

Plant Number and Size of Plant	Average Quality of Output (Percent U. S. Grade B)*	Average Prices F.O.B. Chicago for Shipments to Chicago or Based on Chicago Quotations†		Average Prices F.O.B. New York for Shipments to New York or Based on New York Market	
		June 1949	Feb. 1950	June 1949	Feb. 1950
Over 500,000 pounds					
I	100	58.27	61.63	———	63.34
II	100	57.00	61.78	———	———
III	90	———	61.78	57.00	———
IV	79	56.55	61.38	———	———
V	75	56.45	61.05	———	———
VI	49	55.03	59.55	———	———
Less than 500,000 pounds					
VII	96	56.21	61.80	———	———
VIII	93	———	———	56.87	62.45
IX	91	———	———	56.05	———
X‡	84	53.11	———	———	———
XI	84	56.42	61.06	———	———
XII	80	55.52	61.00	———	———
XIII‡	73	52.61	———	———	———
XIV	70	———	60.47	54.36	———
XV‡	62	———	———	56.68	———

*Quality of output based on percent of United States Grade B as found in four gradings in spring and summer 1950 and 1951.

†For plants selling f.o.b. plant, a freight rate to Chicago has been estimated from actual rates paid by nearest plants shipping to Chicago.

‡These plants shipped no butter in February 1950.

New York markets. Some premiums were received in form of the use of higher score quotations, or a premium above the 90 score quotation, hidden premiums in form of carlot prices when only small shipments were involved, or a discount which was smaller than the actual freight rate to the market.

(2) Smaller plants obtained slightly less advantageous agreements than the larger plants.

(3) With some exceptions, plants with quality of less than 90 percent Grade B output agreed on discounts below 90 score quotations or agreed on the use of 89 score quotations. The use of the less-than-carlot quotations appeared to be one way in which buyers discounted for quality, even if shipments were relatively large.

(4) Prices paid to creameries (in terms of agreements or quotations used) were more uniform for plants with higher than for plants with lower quality. Buyers tended to vary their discounts, or the score of the quotation for plants with lower quality, sometimes from shipment to shipment. This probably indicates that buyers check the quality of the individual shipments more closely for these plants and that the market for poor quality is less steady than for higher quality butter.

(5) Since in the majority of cases no grade or quality for individual shipments was expressly stated by the buyer, buyers seemed to be fairly well aware of the quality of output of the plants, and a general tendency for quality as measured by Federal grades to coincide with the buyers' estimate of the plants' quality of output could be observed. The application of grades was more frequent for plants with lower quality.

(6) In some cases creamery operators apparently were not sure what prices they were getting for their butter. Some operators did not understand the terms of their agreements, particularly the nature of the quotations used. It is difficult to see how quality premiums can encourage improvements in quality for plants where the managers do not know the nature of their agreements or the nature of the various types of quotations.

In summary, plants with higher quality output appeared to be able to reach more favorable agreements with their buyers which should result, in the long-run, in higher returns to plants.

Table 33. Ratings for Defects in Body, Color, and Salt Under New and Old U. S. Standards for Grades of Butter

Defect	Rating			
	Slight		Definitely	
	Old	New	Old	New
Gummy	½	½	1	1
Leaky	½	½	1	1
Spongy or weak	½	½	1	1
Mealy	½	½	1	1
Crumbly	½	½	1	1
Sticky body	½	½	1	1
Wavy color	½	½	1	1
Color specks	½	1	1	2
Sharp salt	½	½	1	1
Ragged boring	1	1	2	2
Grainy	1	1	2	2
Streaked	1	1	2	2
Mottled	1	1	2	2
High color	—	—	1	1
Gritty salt	1	1	2	2
Short	—	½	—	1

Source: *Federal Register.*

Table 34. Classification of Flavors in Creamery Butter According to Old and New U. S. Standards for Grades of Butter

Old U. S. Standards	New U. S. Standards
GRADE AA	
Fine, highly pleasing	
S. Normal feed*	S. feed
D. cooked	D. cooked (fine)
GRADE A	
Pleasing and desirable	
S. Coarse-acid cream	S. coarse-acid
S. smothered	S. smothered
S. heated (summer defect)	S. aged
S. aged (butter)	S. storage
S. storage	S. bitter
S. bitter	S. flat
S. flat	D. feed
D. normal feed	D. cooked (coarse)
D. cooked	
GRADE B	
S. weedy (common)	S. weedy
S. musty	S. musty
S. rape, cabbage, turnip	
S. woody	S. woody
D. old-cream flavor	D. old cream
D. coarse-acid cream	D. coarse acid
D. acidy	
D. utensil	S. utensil
D. scorched	S. scorched
D. neutralizer	S. neutralizer
D. storage	D. storage
D. aged	D. aged
D. greasy	
D. bitter	D. bitter
	D. smothered
	S. whey
GRADE C	
S. obnoxious weeds	
S. onion or garlic	S. wild onion or garlic
D. sour	S. sour
D. fruity	S. fruity
D. yeasty	S. yeasty
D. cheesy	S. cheesy
D. alkaline	S. oily
D. oily	S. metallic
D. metallic	
D. cabbage, rape, turnip	
D. weedy (common)	D. weed
D. musty	D. musty
D. stale	D. stale
D. barny	S. barny
D. scorched-neutralizer	D. neutralizer
	D. scorched
	D. whey
	D. woody
	D. utensil
GRADE CG	
D. obnoxious weeds	
D. onion or garlic	
D. fishy	
P. yeasty	
P. fruity	
P. cheesy	
P. alkaline	
P. stale	

*S. stands for slightly, D. for definitely, and P. for pronouncedly.
Source: *Federal Register.*

Table 35. Effect of Total Defects in Body, Color, or Salt on Initial Flavor Classification

Initial Flavor Classification	Final Grade After Total Defects of ½		1		1½		2		2½	
	Old	New	Old	New	Old	New	Old	New	Old	New
AA	AA	AA	A	A	A	A	B	B	B	B
A	A	A	B	B	B	B	C	C	C	C
B	B	B	C	C	C	C	CG		CG	
C	C	C	C	C	C	C	CG		CG	