Changes, Cost and Potential of the Cheese Industry in Oklahoma

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Whole milk sold by Oklahoma farmers has increased from 30 percent of total milk marketings in 1930 to over 90 percent in the early 1960's. Most of this growth has been associated with the Grade A fluid milk sector. The manufactured product sector has been an important segment of the dairy industry. However, present trends indicate that milk obtained as a by-product of the Grade A fluid milk sector could become the only source of milk in Oklahoma for manufacturing purposes in future years.

Butter and cheese have been two of the most important manufactured dairy products in Oklahoma. Butter has been made from both farm separated cream and from whole milk. An increasingly smaller percentage of milk (or milk products) marketed by Oklahoma farmers has been used for butter production because of the drastic decrease in the sales of farm separated cream. The quantity of milk used in cheese production has exhibited no trend, although it has been highly variable from year to year. Since the early 1940's, the quantity of milk used in cheese production has represented from four to nine percent of the milk equivalent of dairy products marketed by Oklahoma farmers.

Either cheese or butter and non-fat dry milk solids can be produced from the surplus Grade A milk supplies. Whether the future surplus supplies in Oklahoma will be utilized in cheese or butter production will depend to a large extent upon the relative profitability associated with the manufacturing of each product. This study reports the results of an investigation of costs, revenues, profitability, and organizational possibilities associated with converting Oklahoma surplus milk supplies into cheese.

Production and Utilization

United States

The production of all cheese in the United States has more than tripled since 1930, increasing from 510 million pounds to 1,635 million

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pounds in 1961. Cheese production has consisted primarily of the American cheese varieties, particularly Cheddar. In recent years, production of other types such as Swiss, Brick, Munster, Limburger, Neufchatel and the Italian varieties, has increased in relative importance.

U. S. consumption of cheese has followed the same upward trend as production. Figure 1 shows the relative importance of each component of American cheese utilization. Commercial domestic utilization accounted for about two-thirds of total American cheese consumption in 1962. Noncommercial domestic utilization, which has resulted from distribution of Commodity Credit Corporation purchases of cheese to military agencies, the Veterans Administration, the School Lunch program, and needy families, accounted for almost 15 percent of American cheese production in 1962. In total, over 80 percent of the American cheese produced in the U. S. in 1962 was consumed domestically.

About two-thirds of the increase in domestic cheese consumption has resulted from increased per capita consumption. Per capita consumption of total cheese in the U. S. increased from 4.4 pounds in 1932 to 9.1 pounds in 1962. The increases in per capita consumption have resulted from increased consumer incomes, changes in taste, and increased government purchases for charity distribution.

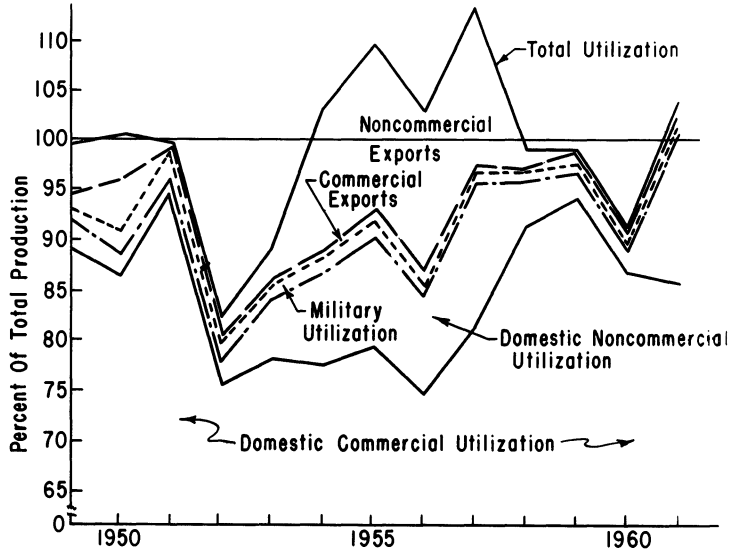

Figure 1. Utilization of American Cheese, United States, 1950-1962.

Foreign consumption of U. S. cheese also flows through both commercial and noncommercial outlets. However, noncommercial exports have become far more important than commercial cheese exports. Noncommercial exports are made possible through Section 416 of the Agricultural Act of 1949 and are shipped to several underdeveloped countries. Noncommercial cheese exports comprised over 98 percent of all cheese exports from 1955 to 1958.

Oklahoma

Oklahoma has not been a major cheese producing state. At its peak in 1945, Oklahoma ranked 13th nationally in American cheese production with 1.8 percent of the national production. By 1960, cheese production decreased until Oklahoma ranked 18th and accounted for only 0.8 percent of the nation's American cheese production. Oklahoma's ranking would have been even lower had it been based on all cheese production rather than on American cheese production since the manufacture of non-American type cheese was relatively unimportant in Oklahoma.

Production of American cheddar cheese in Oklahoma has been rather erratic during the last 20 years (Figure 2). In 1942, Oklahoma production amounted to 13.4 million pounds. The highest annual production during the 20 year period was 15.8 million pounds in 1945. In 1952, annual production amounted to only 4.6 million pounds which was the low for the period.

American cheese production in Oklahoma declined in importance as an outlet for whole milk marketed by farmers from 1942 to 1962 (Figure 2). A record 25 percent of whole milk marketed was utilized in American cheese production in 1942 but declined to 7 percent by 1962. The concurrent decreases in both cheese production and percent of milk utilized for cheese reflects the relative stability of milk marketings and the upgrading of milk to make it available for fluid milk usage.

Cheese production has been highly seasonal in Oklahoma mainly because of the relatively large seasonality in milk production and the disposition of surplus Grade A milk to cheese plants (Figure 3). During the spring months when milk production has been highest, cheese production has been relatively high. The converse has been true for months of low milk production. The fluctuations in seasonal milk utilization percentages suggest that consumption of fluid milk and uses in certain Class II dairy products are more stable and have first claim on available supplies. Thus, the cheese industry has been the residual market for surplus milk and has experienced high seasonal variation in milk receipts.

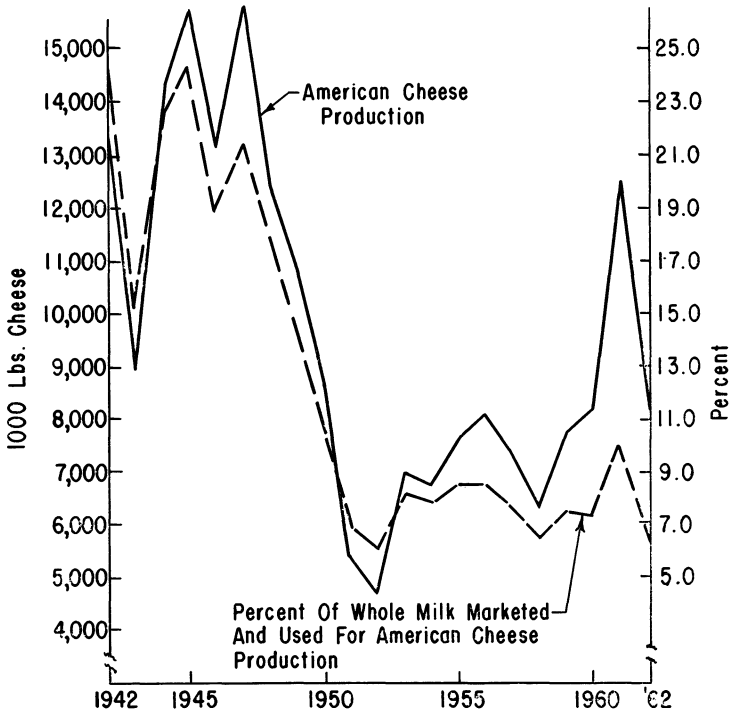

Figure 2. American Cheese Production, Oklahoma, 1942-1962.

Source: U. S. Department of Agriculture, ERS, **Dairy Statistics Through 1960,** Statistical Bulletin No. 303 (Washington, 1962); and **Supplement for 1962.**

While cheese production in Oklahoma has been quite erratic in recent years, estimated cheese consumption has trended upward. There were no data for cheese consumption by Oklahoma consumers. However, per capita consumption estimates for the U.S., combined with Oklahoma population data, provided a rough estimate of the level of consumption in the state.

Consumption greatly exceeded production for most of the period 1945-1960. In 1945, Oklahoma cheese production exceeded the estimated consumption; but by 1960 a deficit of over 11 million pounds existed. This deficit represented 58 percent of the cheese consumed within the state in 1960. The increasing significance of this deficit has made it necessary to transport larger amounts of cheese to Oklahoma from more important cheese producing states.

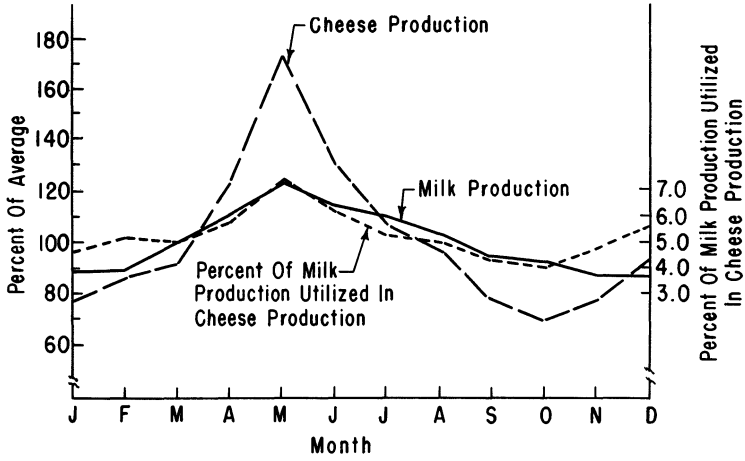

Figure 3. Seasonal Variation of American Cheese and Milk Production, Oklahoma, 1953-1962.

Source: U. S. Department of Agriculture, SRS, **Milk Production and Dairy Products,** Annual Statistical Summaries, Various Issues (Washington); and U. S. Department of Agriculture, SRS, and State Board of Agriculture, **Manufactured Dairy Products,** Various Issues.

Changes in Numbers and Sizes of Oklahoma Plants

During the last 20 years, the number of cheese plants in Oklahoma declined substantially. In 1942, there were 24 plants in Oklahoma. This number declined to five by 1962 and to three by 1964. Figure 4 shows the location of Oklahoma cheese plants in 1944 and 1959.

Table 1 shows Oklahoma cheese plants classified according to annual production for selected years from 1944 to 1962. Average annual cheese production in Oklahoma increased from 753,000 pounds in 1944 to 1,607,000 pounds in 1962. The large increase in average annual plant production indicated progressively fewer small producing plants during the period. In 1944 there were 17 plants producing less than one million pounds annually. By 1962 there were only two plants in this classification. In contrast, there were two plants producing over one million pounds in 1944; but in 1962, three plants were producing above this level.

Associated with the decline in the number of cheese plants, Oklahoma's cheese production became increasingly concentrated in the larger

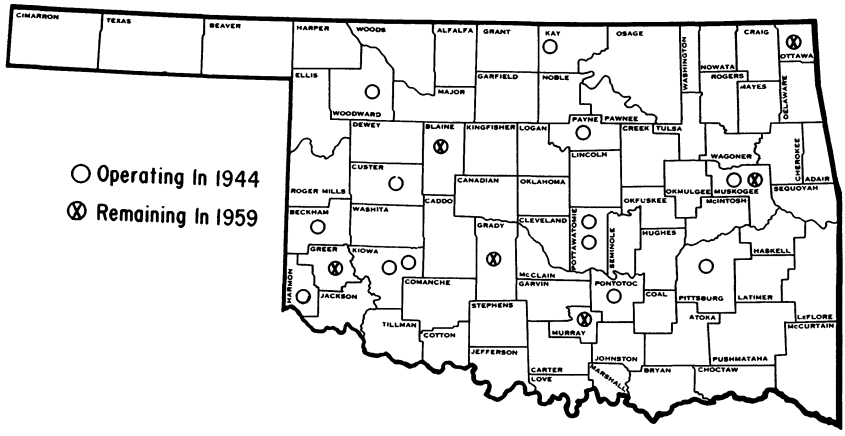

Figure 4. Location of Cheese Plants in Oklahoma by Areas, 1944 and 1959.

Table 1. Number of Cheese Plants by Size Classifications, Oklahoma, Selected Years, 1944-1962

Year	(Size Group (1,000 lbs.)) 0 to 399	400 to 999	1,000 to 1,999	2,000 and over	Total No. of Plants	Average Annual Production Per Plant
	(Number of plants)					(1,000 lbs.)
1944	2	15	2	0	19	753
1949	3	8	4	0	15	716
1954	1	2	2	1	6	1,119
1959	0	3	2	1	6	1,292
1962	2		3		5	1,607

Source: U.S. Department of Agriculture, SRS, and State Department of Agriculture, Oklahoma City, Oklahoma.

plants. The percent of the total yearly production produced by plants in various production classifications is shown in Table 2. In 1944, 23.5 percent of the annual cheese production was produced in plants with a production of over one million pounds. By 1962, production of plants of this size accounted for over three-fourths of the total cheese production.

Cost and Returns in Manufacturing Cheese

Past trends in cheese plant numbers and sizes indicate that a limited number of plants with annual capacity in excess of one million pounds

Table 2. Percentage of Oklahoma Cheese Production Produced in Various Plant Size Classifications, Selected Years, 1944-1962

Year	Size Group (1,000 lbs.)							
	Small				Large			
	Under 400	400 to 699	700 to 999	Group Under 1,000	1,000 to 1,499	1,500 to 1,999	2,000 and over	Group over 1,000
	(Percent of Annual Production)							
1944	3.3	31.8	41.4	76.5	0.0	23.5	0.0	23.5
1949	4.6	25.2	21.4	51.2	32.7	16.1	0.0	48.8
1954	---	---	---	20.3	---	---	---	79.7
1959	---	---	---	25.8	---	---	---	74.2
1962	---	---	---	Under 25%	---	---	---	Over 75%

Source: U.S. Department of Agriculture, SRS, and State Department of Agriculture, Oklahoma City, Oklahoma.

of cheese could service the manufactured milk industry in Oklahoma. Based on survey data and interviews with industry personnel, a plant with daily average milk-intake capacity of 80,634 pounds (eight vats) was selected as the model plant for detailed analysis. The size of this model plant may be near the optimum size for Oklahoma conditions of large seasonality of available milk supplies.

Costs

Cost estimates of manufacturing cheddar cheese in the model plant were developed from (1) input-output data, particularly labor requirements, obtained from a comparable size plant in the state, (2) actual costs incurred by a cheese plant in Oklahoma, (3) cost data from studies of cheese plant operations in other states, (4) cost estimates from equipment manufacturers and real estate agents, and (5) prices reported by the various agencies of the U. S. Department of Agriculture. The methods used and the detailed cost estimates obtained are available in another publication.[1]

The cost of the raw material, milk, was the largest cost involved in producing cheddar cheese in the model plant. The cost of milk varied from a high of 32.74 cents per pound of cheese in October to a low of 31.37 cents per pound of cheese in June. The weighted average annual cost was 31.86 cents, or 84 percent of the total cost of producing one pound of cheese.

The manufacturing cost averaged 6.10 cents per pound of cheese in the model plant, but varied from a low of 4.66 cents in May to a high of 8.04 cents in October. On an annual basis, variable costs represented

[1] Fred K. Hines and Leo V. Blakley, *Costs of Manufacturing Cheese in Oklahoma,* Okla. Agri. Expt. Station Processed Series P-531.

about 63 percent of the total manufacturing cost. Labor cost constituted almost two-thirds of the variable and about 40 percent of the total manufacturing cost.

Gross Returns

Total returns consisted of revenues from the sale of cheese and from the sale of butterfat recovered from whey. The weighted monthly average price of cheese was estimated at 36.19 cents per pound, based on prices of American cheddars on the Wisconsin Cheese Exchange plus two cents. The two cent differential was used to reflect the geographical structure of cheese prices. Prices generally increase in a westerly direction from the North Central states to the West Coast as a result of transportation costs.

The revenue obtained from the sale of butterfat was estimated at 1.39 cents per pound of cheese produced. This estimate varied from month to month because of the seasonality in the prices paid for butterfat in Oklahoma.

Total returns from cheese and butterfat averaged 37.58 cents per pound of cheese produced. The revenue potential was lowest in June at 36.67 cents and highest in December at 39.13 cents per pound of cheese produced.

Net Returns

The optimum daily milk intake for the model plant was approximately 150,000 pounds which required that most vats be used twice each day. At annual average prices, the break-even volume was 90,000 pounds or slightly greater than 100 percent of capacity, with capacity defined as the single use of vats each day.

Net losses would be incurred by the model plant based on operation at an annual volume of 2,750,000 pounds of cheese and on seasonality of receipts comparable with seasonality of cheese production in Oklahoma as shown in Table 3. For the entire year, a loss of $12,571 would be incurred by the model plant with these average milk-intake levels.

An Analysis of the Competitive Position of Cheese Plants in Oklahoma

Milk supplies available to Oklahoma cheese plants consist of manufacturing and surplus Grade A milk. The success of future cheese plant operations within the state depends largely upon the annual volume and

Table 3. Seasonal Variation of Milk Receipts and Cheese Production, Model Cheese Plant, Oklahoma, 1961-1962

Month	Oklahoma Cheese Production		Average Milk Intake Per Model Plant		
	Annual Average	Assumed for Model Plant[1]	Monthly	Daily	Vats[2]
	(1,000 pounds)		(1,000 pounds)		no.)
January	682	176.375	1,856.523	59.888	6
February	706	190.000	1,999.940	71.426	7
March	838	220.000	2,315.720	74.701	8
April	972	253.625	2,660 657	88.989	9
May	1,593	425.250	4,476.182	144.393	15
June	1,324	332.750	3,502.527	116.751	12
July	1,032	256 750	2,702.551	87.179	9
August	895	240.500	2,531.503	81.661	8
September	678	177.500	1,868.365	62.279	6
October	554	148.875	1,567.058	50 550	5
November	567	155.250	1,634.162	54.472	6
December	708	180 875	1,903.890	61.416	6

[1] Based on the assumptions (1) that the model plant would produce 25 percent of the average state production for the two-year period, 1961-1962, and (2) the seasonality of production in percentages, for the model plant would be the same as for the State during the 1961-62 period. The 1962 data subsequently have been revised downward, but the monthly production data in the table were not recomputed. The revision would not change appreciably the seasonality of cheese production, but it would result in an increase in the percentage of State production for the model plant's output.

[2] The approximate number of 10,000 pound vats.

Source: Production data from *Manufactured Dairy Products*, 1963, Oklahoma Crop and Livestock Reporting Service, SRS, USDA, and State Board of Agriculture.

the seasonality of these two sources of milk supply. Also, much depends upon the degree of variability of milk production from year to year.

In analyzing the competitive position of cheese plants in Oklahoma, an attempt was made to estimate the total milk available for manufacturing purposes. It was assumed that all the available milk which, in the past, has been converted to butter or cheese could be utilized in cheese production. Under this assumption three alternative plans were investigated with respect to the number of plants needed to process the milk into cheese and the type of operation most profitable for the plants involved.

Milk Supplies

Milk supplies available to cheese plants consist of manufacturing grade milk and Class II Grade A milk. The estimate of manufacturing milk available for cheese production was derived from data summarized by Oklahoma Livestock and Crop Reporting Service pertaining to manufacturing milk receipts of individual plants in 1962.

The estimate of surplus milk was obtained from Class II utilization data reported in the monthly bulletins of the Market Administrator for the Oklahoma Metropolitan and the Red River Valley milk marketing areas. Approximately 30 percent of total milk receipts in these two areas in 1962 and 1963 was classified as Class II milk.[2] Based on the utiliza-

tion of Class II milk in the Oklahoma Metropolitan Area, it appeared that approximately 70 percent of the Class II milk receipts in the areas could be made available for cheese production.[3] This percentage was used to estimate the availability of surplus milk for cheddar cheese production.

The estimated total quantity of manufacturing grade and Class II Grade A milk that could be made available for cheese production annually was 139 and 162 million pounds, respectively. This was less than 30 percent of total deliveries of whole milk by farmers.

Seasonality

The seasonality of milk receipts is a very important factor in the profitability of cheese plant operations. The seasonality of the aggregate milk supply was based on the seasonality of milk supplies utilized in cheese and butter production in Oklahoma during the period 1958-1962, as shown in Table 4. The seasonality for this supply was significantly smaller than the seasonality of actual cheese production as reported in Table 3.[4] This situation suggests that butter production has been much more stable seasonally than cheese production in Oklahoma which, in

[2] It was estimated that 66 percent of the Red River Valley milk receipts came from Oklahoma. This was based on, in part, the percent of the total population of the marketing area living in the eight Oklahoma counties included in the market order. For information concerning the two milk marketing areas, see: U. S. Department of Agriculture, SRS, *Fluid Milk and Cream Report* (Wash.)

[3] It was assumed that all surplus milk except that utilized in ice cream, cottage cheese, and stock feed production and listed as shrinkage and dumped could be made available for cheese production.

Table 4. Potential Gross Revenue For Use of Total Surplus Milk Supplies in Cheddar Cheese Production, Oklahoma, 1964

Month	Surplus Milk Supply	Potential Cheddar Cheese Production[1]	Revenue Potential	
			Total[2]	Per Pound of Cheese
	(Mil. lbs.)	(Thou. lbs.)	(Dol.)	(Cents)
January	22.0	2,090	811,030	38.8053
February	21.7	2,062	783,770	38.0102
March	23.3	2,214	839,099	37.8997
April	27.4	2,603	960,096	36.8842
May	35.3	3,354	1,230,205	36.6787
June	30.4	2,888	1,059,136	36.6737
July	28 3	2,689	988,838	36.7734
August	25.3	2,404	893,902	37.1839
September	21.2	2,014	769,560	38.2105
October	21.4	2,033	789,339	38.8263
November	22 0	2,090	815,650	39.0263
December	22.9	2,176	851,382	39.1265

[1] These calculations assume a yield of 9 5 pounds of cheese per 100 pounds of milk and are adjusted for differences in cheese yield due to seasonal butterfat differences.

[2] Includes an allowance for the recovery of butterfat from whey and subsequent sale at the average price of butterfat during that month.

turn, implies that butter production has had a higher priority claim than cheese for available manufacturing and surplus milk supplies.

Figure 5 illustrates the effects of seasonality of milk receipts on the cost structure for the model plant operating on a regular basis throughout the year. The solid line depicts the costs when the seasonality of receipts is the same as for 1961-62 cheese production. Positive net returns (the differences between cost and revenue per pound of cheese) would exist only during the months of May and June. Total losses for the year would be $12,571 for processing 2.75 million pounds of cheese.

Costs based on the seasonality of receipts comparable with the seasonality of all milk supplies available for manufacturing are shown in Figure 5. With annual volume held constant at 2.75 million pounds of cheese, the more even pattern of receipts would decrease total losses to $10,669. Slight positive net returns would exist in December and January. Because of the seasonally low prices of cheese and butterfat in the spring months, the break-even volumes were slightly larger than the volumes processed and net losses occurred even in May and June.

[4] The range was only from 85 percent to 140 percent of the annual monthly average as compared with 53 percent to 151 percent for cheese production alone.

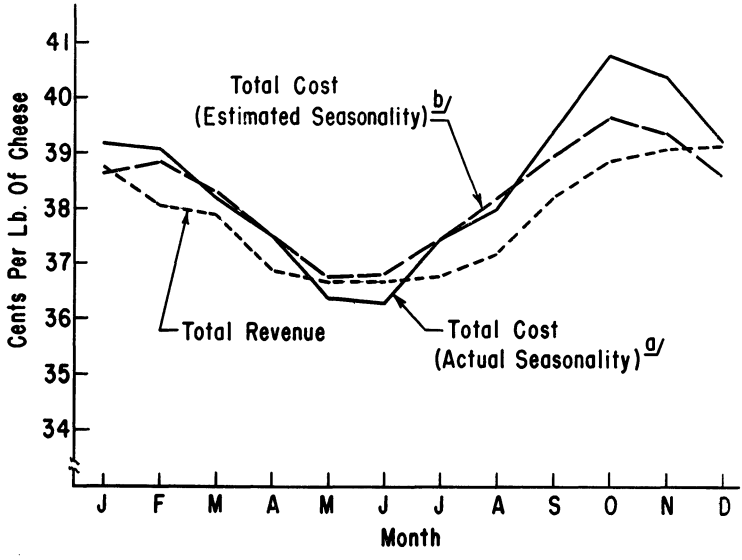

Figure 5. The Effects of Seasonality of Milk Receipts on Costs and Returns, Model Plant Operating on a Regular Basis with Output of 2.75 Million Pounds of Cheese per year.

a Based on seasonality of cheese production in 1961-62.
b Based on seasonality of all milk available for manufacturing.

The cost structure based on a maximum volume in the peak month of 140 to 145 thousand pounds but with seasonality of receipts the same as for all milk available for manufacturing would result in positive net returns in all months. Net returns for the year would be $18,102. However, the level of annual output was higher at 3.6 million pounds of cheese. The difference in net returns (from —$10,669 to +$18,102) with the same seasonality of milk receipts illustrates the effects of operating near break-even levels during the months of short milk supplies and of operating beyond these levels (multiple use of vats each day) during the flush production season.

Alternative Organizations of the Industry

Three alternative organizations of the cheese industry investigated were: (1) Plan A—eight plants operating for the full month for 12 months: (2) Plan B—eight plants operating six months on a regular basis each month and only two out of three days during each of the remaining six months; and (3) Plan C—six plants operating on a regular basis for 12 months.

Plan A involved eight plants of the model plant size operating each day of the year. The number of plants was determined from the total quantity of milk available and the maximum capacity of the model plant size. Annual net returns under Plan A totaled $18,102 for each of the eight plants (Table 5). The month of June had the lowest production cost per pound of cheese, a result of efficiencies possible from relatively high volume of daily milk receipts and from the seasonally low costs of milk. However, revenue per pound of cheese was lowest in June. December had the greatest net returns per pound of cheese and the largest total monthly net returns. The high net returns for December came largely from seasonally high revenue per pound of cheese since production costs in December were still above average.

Plan B involved the possibility of increasing total annual net returns from the eight plants by operating two out of three days during the six months of shortest milk supplies. This type of operation increased fixed costs per unit substantially because of (1) the necessity of acquiring additional storage facilities to store the daily milk intake for the days the plants did not operate, and (2) the additional daily fixed costs which had to be absorbed as a result of idling the plant one-third of the time. Nevertheless, the increase in labor and overall plant efficiency resulted in a lower per unit manufacturing cost than under Plan A. For example, average total unit manufacturing costs in January decreased from 5.78 to 5.14 cents as a result of the larger daily milk volumes. The

Table 5. Costs and Returns Per Model Plant Under Plan A for Processing Surplus Milk in Oklahoma

Month	Average Daily Milk Receipts	Costs Per Pound of Cheese		Net Returns Per Pound of Cheese	Net Returns Total
		Manufactured	Total		
	(Thous. lbs.)	(Cents per lb.)		(Cents)	(Dollars)
January	88.7	5.7825	37.5725	1.2325	3,221
February	96.9	5.4582	37.8782	0.1318	340
March	94 0	5.5674	37.2474	0.6526	1,806
April	114.2	4.9482	36.6282	0.2558	833
May	142.4	4.6514	36.3314	0.3476	1,457
June	126.7	4.7353	36.1053	0.5687	2,054
July	114.1	4.9505	36.5305	0.2425	815
August	102.0	5.2809	37.1709	0.0131	39
September	88.3	5.8018	37.9118	0.2982	750
October	86.3	5 8898	38.6298	0.1962	499
November	91.7	5.6580	38.2880	0.7380	1,929
December	92.3	5.6327	37.5227	1.6033	4,359
Total					18,102

total annual net returns under Plan B shown in Table 6 were estimated as $26,873, almost one-half greater than under Plan A.

Plan C consisted of six model size plants operating on a regular basis for 12 months and was designed to ensure operation at a higher level of capacity through the year. Since the previous plans were set up to process all surplus milk available to the plants, not all the surplus milk could be processed into cheese under Plan C. During the flush months, the extra amount of milk had to be handled at a loss. Under Plan C, all milk above 160,000 pounds, the 24 hour physical capacity of the model plant, was assumed sold at a 20 percent loss.[5] The net effect of this plan was to increase the daily milk volumes per plant, and it required that excess milk be sold at a loss during the two months of May and June. The annual net returns per plant from Plan C were $41,017 (Table 7). This was more than twice the returns under Plan A, and an increase of about one-half over Plan B.

In summary, Plan C would appear to offer the best alternative for organizing the cheese industry of the state if all manufacturing and available surplus milk supplies were to be used in cheddar cheese production. Much would depend on the possibilities of selling the excess milk supplies in May and June and the losses the plant would incur in these transactions. At worst, the butterfat could be separated from milk and sold as butter or butterfat. However, a process of this sort would entail a

[5] Milk in excess of 160,000 pounds daily could not be processed into cheese because of difficulty in labor scheduling due to extremely long hours of operation. The 160,000 pounds of milk would require filling each vat twice and operating approximately 16 hours daily.

Table 6. Costs and Returns Per Model Cheese Plant Under Plan B[1] For Processing Surplus Milk in Oklahoma

Month	Daily Processing Level	Costs per Pound of Cheese		Net Returns	
		Manufacturing[2]	Total	Per Pound of Cheese	Monthly Total
	(Thous. lbs.)	(Cents per lb.)		(Cents)	(Dollars)
January	133.1	5.1416	36.9316	1.8734	4.896
February	145.3	5.1303	37.5503	0.4597	1,184
March	94.0	5.5674	37.2474	0.6526	1,806
April	114.2	4.9482	36.6282	0.2558	833
May	142.4	4.6514	36.3314	0.3476	1,457
June	126.7	4.7353	36.1053	0.5687	2,054
July	114.1	4.9505	36.5305	0.2425	815
August	102.0	5.2809	37.1709	0.0131	39
September	132.5	5.1641	37.2741	0.9359	2.355
October	129.5	5.1838	37.9238	0.9022	2,294
November	137.6	5.1208	37.7508	1.2752	3,333
December	138.5	5.1004	36.9904	2.1356	5,807
Total					26,873

[1] Under Plan B eight plants operate six months on a regular basis and six months on a two out of three day basis. The limited operation months include January, February, and September through December.

[2] Includes additional fixed cost of storage tanks of $96 per month for 12 months and other fixed cost share of $1,727 per month.

Table 7. Costs and Returns per Model Cheese Plant Under Plan C for Processing Surplus Milk in Oklahoma

Month	Daily Processing Level	Costs per Pound of Cheese		Net Returns	
		Manufacturing[2]	Total	Per Pound of Cheese	Monthly Total
	(Thous. Lbs.)	(Cents)		(Cents)	(Dollars)
January	118.3	4.8648	36.6548	2.1502	7,489
February	129.2	4.7081	37.1281	.8819	3,031
March	125.2	4.7536	36.4336	1.4664	5,408
April	152.2	4.7028	36.3828	.5012	2,174
May	160.0	6.0425[1]	37.9288[1]	—1.2498[1]	—5,889[1]
June	160.0	5.1730[1]	36.5430[1]	.1310[1]	597[1]
July	152.1	4.7022	36.2822	.4908	2.199
August	136.1	4.6607	36.5507	.6433	2,538
September	117.8	4.8736	36.9836	1.2264	4,117
October	115.1	4.9293	37.6693	1.1567	3,920
November	122.2	4.7970	37.4270	1.5990	5.569
December	123.1	4.7823	36.6733	2.4527	8,892
Total					41,017

[1] Includes a net loss on the sale of surplus milk of $5,852 in May, and $1,698 in June.

larger loss for the excess. The loss in value of the product would be approximately 37 percent as compared with the budgeted 20 percent loss.[6] When considering the labor and utility costs incurred in the separating process, the total loss would be somewhat higher than 37 percent.

[6] In December, for example, milk cost was $3.50 per cwt. and revenue from the butterfat separated from the milk would be $2.19.

Even though Plan C would result in significantly higher returns per plant than Plan B, the increase in returns to all plants in the state as a group would be small. The aggregate net returns to all plants under Plan C would be about $30,000 or one-seventh greater than the aggregate returns under Plan B. This increase may not be sufficient to offset the potentially higher assembly costs associated with the smaller number of plants in Plan C compared with Plan B.

Summary and Conclusions

Total U.S. cheese production and consumption more than tripled from 1930 to 1962 with American cheese varieties making up about 75 percent of total production. Cheddar cheese represented approximately 90 percent of all American cheese production. Commercial domestic consumption served as the major outlet for domestically produced cheese. The increased consumption resulted from increases in population, and more importantly, a doubling of per capita cheese consumption.

Cheese production in Oklahoma from 1942 to 1962 was rather erratic from year to year and consisted almost entirely of cheddar cheese. Cheese plant numbers decreased from 19 plants in 1944 to only five plants in 1962, and to three in 1964. However, during this same period, average production per plant increased from 753 thousand pounds in 1944 to 1,607 thousand pounds in 1962. The percentage of whole milk sold by Oklahoma farmers utilized in cheese production declined from 25 percent in 1942 to six percent in 1958. It was estimated that cheese consumption within the state greatly exceeded production with the gap getting larger each year.

Estimates of costs, revenues, and seasonal milk supplies were used to evaluate the profitability of cheese plant operations in Oklahoma. The manufacturing cost estimates were derived by the synthetic model procedure and through personal contacts with personnel in a cheese plant in Oklahoma. The model plant was equipped with eight 10,000 pound vats and had an investment in land, building, and equipment of $250,480. Variable labor and supply costs were found to be the largest and the most important costs of the model cheese plant excluding the cost of milk.

The average cost of milk was computed as 31.86 cents per pound of cheese. The average total unit cost was 38.04 cents per pound of cheese for the year. The annual average total revenue, including revenue from the recovered butterfat, was 37.58 cents per pound of cheese. The break-even daily milk volume was computed as approximately 90,000

pounds. Therefore, the profitable range of daily operations required the use of some vats more than once each day.

The seasonality of milk volumes going to the model plant was of great significance in determining the profitability of cheese production in Oklahoma. Based on the seasonality of actual cheese production, net returns (revenue minus costs) per pound of cheese produced in the model plant were highest in June (0.41 cents) and lowest in October (—1.96 cents). Given the estimated seasonality of milk receipts, only production in May and June, proved profitable. Total annual losses of producing cheese were calculated as $12,571 for the model size plant producing 2.75 million pounds of cheese annually.

Three plans were investigated in order to find the most profitable way of utilizing the estimated available milk supply into cheese production. These plans were based on the cost and revenue structure of the model plant, but used seasonality of milk receipts based on both cheese and butter production rather than cheese production alone. Plan A consisted of eight plants operating throughout the year. Annual net returns per plant were estimated at $18,102. Plan B called for these same eight plants to operate on a 2 out of 3 days basis during the six months of shortest milk supply and on a regular basis during the other six months. Annual net returns were estimated at $26,873 per plant under Plan B.

Plan C was based on the operations of only six plants. These plants sold all milk in excess of daily capacity at a 20 percent loss. Although this plan required that each plant sell relatively large quantities of milk during the months of May and June, the total annual net returns for each plant was $41,017, almost one-half larger than under Plan A. The increase was attributed to greater annual production per plant and to a smaller effect of seasonality on plant use. However, the net returns to all plants as a group were only slightly greater under Plan C for six plants than under Plan B for eight plants.

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