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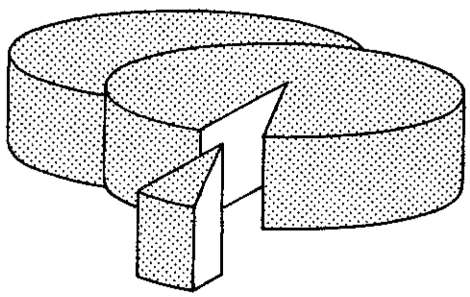
ECONOMIC PERFORMANCE OF 11 CHEDDAR CHEESE MANUFACTURING PLANTS IN NORTHEAST AND NORTH CENTRAL REGIONS



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Part 1 of a Research Effort on Cheddar Cheese Manufacturing

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PREFACE

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This publication is the first in a series of publications on Cheddar cheese manufacturing costs. The series of publications will report the results of a major research effort aimed at helping to answer the following questions:

How do aged Cheddar cheese plants in the Northeast differ from plants in Wisconsin, Minnesota and other important cheese-producing states with respect to efficiency and other key factors affecting their economic performance? How much do operational factors, such as number of operating days per week, number of shifts per day, yield potential of milk supplies and recovery of solids at the plant, affect the costs of production? What are the differences in costs among plants using the most modern commercial technologies (e.g., continuous systems) and those using more traditional batch systems for manufacturing Cheddar cheese? How large a cost advantage do large Cheddar cheese plants have over smaller-scale plants? What would be the impact on manufacturing costs of using ultrafiltration or reverse osmosis processes on milk in Cheddar cheese plants? What is the feasibility and what would be the impact on plant costs of using some of the production capacity in Cheddar cheese plants to produce other cheeses including some specialty, European-style cheeses? In other words, what are the growth opportunities in the other cheeses for the Cheddar cheese industry as it faces increasing competitive pressures?

This publication reports the results of an in-depth study of 11 Cheddar cheese plants in the Northeast and North Central regions. This phase of the study was aimed primarily at providing data and insights on aged Cheddar operations to assist in budgeting the production costs of a large number of cheese operations in later phases of the study. Later publications will report the results of using the economic-engineering approach to budget costs and cost relationships and to isolate the impacts of cost-influencing factors such as size, new technologies and possible product diversification in Cheddar cheese plants. However, this study of the 11 plants also provides some information on similarities and differences among plants producing aged Cheddar cheese with respect to key technical and economic factors.

Financial assistance making this project possible was provided from two sources. One was a research agreement with the Agricultural Cooperative Service of the United States Department of Agriculture. The other source was the Agricultural Research and Development Grants Program of the New York State Department of Agriculture and Markets.

Many have contributed importantly to the development and success of this project. In particular for this phase of the study, we owe our sincere gratitude to the managements of the 11 plants studied in depth. Although their names and the names of their companies will remain anonymous to protect confidentiality, they spent hours, literally days, in visiting with us and providing the necessary data. Stan Payson, a Cornell graduate student, wrote the computer programs used in analyzing the data. Constructive criticisms of the manuscript were made by K. Charles Ling of the Agricultural Cooperative Service, Andrew Novakovic and Brian Henehan of Cornell's Department of Agriculture Economics, and several people in industry. Sandra Basso, Kathy Pierce, and Joe Baldwin were helpful in preparing and processing the manuscript.

DIGEST AND HIGHLIGHTS

The primary objective of the phase of the Cheddar cheese research reported in this publication was to provide a basis for making realistic assumptions for cost budgeting in the other phases of the study to be reported in subsequent publicatons. In these later phases, the economic-engineering approach is used to budget costs and cost relationships and to isolate the impacts of cost-influencing factors such as size, technology and possible product diversification in Cheddar plants.

A second objective of this phase of the study was to ascertain similarities and differences among plants producing aged Cheddar cheese in the Northeast and North Central regions of the United States with respect to key technical and economic factors such as production technologies, manufacturing practices, labor efficiency, utilities, cheese yield potential, cheese fat recovery, seasonality of production, and so on.

Eleven aged Cheddar cheese plants in Minnesota, New York, Wisconsin and two other states were visited and studied. The 11 plants, eight in the North Central region and three in the Northeast, were not a random sample of plants in the two regions. Since the plants were not randomly selected, the results from the plants should not be generalized to other groups of plants with similar characteristics (e.g. cheddaring vs. stirred curd) or located in the same areas (Northeast vs. North Central).

Average total plant capacity for the 11 cheese operations studied was 1,183,000 pounds of milk per day. Plant capacities varied from about 634,000 pounds to 2,100,000 pounds. The average plant size in the North Central region was significantly larger than the plants studied in the northeast: 1,318,000 and 826,000 pounds per day, respectively.

The eleven Cheddar cheese plants studied showed large plant-to-plant variability in some key indicators of performance.

Cheddar cheese composition varied widely between regions and among individual plants. Average cheese composition in the 11 plants was 53.16% fat on a dry basis (FDB) (33.21% fat), 37.57% moisture, and 1.68% salt. FDB ranged between 51.63% and 54.63%. Moisture ranged between 37.07% and 38.03% and salt, between 1.51% and 1.86%. Cheddar cheese manufactured by stirred curd plants, on average, retained more milk fat than the cheese manufactured by cheddaring plants. Northeast plants had a lower cheese moisture than the North Central plants. However, the cheese made in the Northeast plants was produced with the intent of aging it longer than cheese made in the North Central plants. To make a high quality, long-hold cheddar cheese, the industry has found by experience that the cheese moisture must be slightly lower. Lower moisture gives the Northeast a yield disadvantage, which must be factored into the added cost of a long-hold, aged Chedder cheese. The plants in the North Central region also had higher cheese fat than the plants in the Northeast region. Contrary to fat and moisture, the Northeast plants had higher salt content in the cheese than the North Central plants.

Fat recovery in the cheese presented a very important difference among plants and between regions. In general, stirred curd plants retained more fat in the cheese than cheddaring plants. However, one cheddaring plant had similar performances to the stirred curd plants. Cheddaring plants in the North Central region also had higher fat recovery in the cheese than cheddaring plants in the Northeast.

Actual Cheddar cheese yield for the eleven plants studied averaged 9.98 pounds per hundred pounds of milk and ranged from 9.43 to 10.27 pounds. Although the regional milk composition for the plants studied appeared to be similar, the Northeast plants, all of which used cheddaring processes, had lower cheese yields than the North Central plants with similar cheddaring processes. Stirred curd plants had higher cheese yields than cheddaring plants. Yield efficiency compares the potential cheese yield that a plant could obtain from its milk supply with actual yields after those actual yields have been adjusted to comparable moisture and salt levels. Cheese yield efficiency presented important differences among plants and between regions. The cheese yield efficiency for all plants studied averaged 97.10%, ranging between 94.43% and 99.04% for individual plants. Cheese yield efficiency was much higher for the North Central plants using the cheddaring process than for the Northeast plants. Stirred curd plants had higher yield efficiencies than cheddaring plants.

Production labor efficiency was another indicator that varied widely among plants. For the most part, labor efficiency appears to be significantly influenced by size. However, technology and performance also make an important contribution. The Northeast plants studied had considerably lower production labor efficiency than the North Central plants some of which is undoubtedly explained by the Northeast plants being smaller in size.

Labor costs per pound of cheese varied widely among plants studied. Average labor cost(cheese and whey operations) was 6.3 cents per pound of cheese with a range between 3.0 cents and 8.7 cents. Stirred curd plants had a lower labor cost per pound of cheese than cheddaring plants. On the other hand, labor costs per unit of production for cheddaring plants in the North Central were lower than for cheddaring plants in the Northeast. Here again, the fact that the plants studied in the Northeast, on average, were smaller than those in the North Central region undoubtedly contributed significantly to the observed regional differences. The lower labor cost per pound in the North Central plants is even more significant since average wages in the North Central were 25 percent higher than in the Northeast. Wages for all plants averaged $8.40 and ranged from $5.70 to $10.10 for individual plants.

The cost of utilities per pound of cheese varied widely among the 11 cheddar plants. Average kilowatt hour cost varied between plants and between regions. The North Central region, on average, had a somewhat higher cost per KWH than the Northeast. Electricity and fuel costs averaged 2.8 cents per pound including the whey operations. Excluding the whey operations, the unit costs were about half that amount. Average fuel and electricity cost for the North Central plants was about 2.5 cents per pound while it was about 3.5 cents per pound for the Northeast plants. The higher average fuel and electricity cost per pound of cheese in the Northeast plants appeared to be due basically to differences in technology, manufacturing processes and fuel alternatives. Water consumption also showed very large variability. Average water consumption was 25 gallons per 1,000 pounds of milk processed at the plants and it ranged between 9 and 59 gallons per 1,000 pounds of milk. The Northeast plants showed a better performance than the North Central plants with this indicator.

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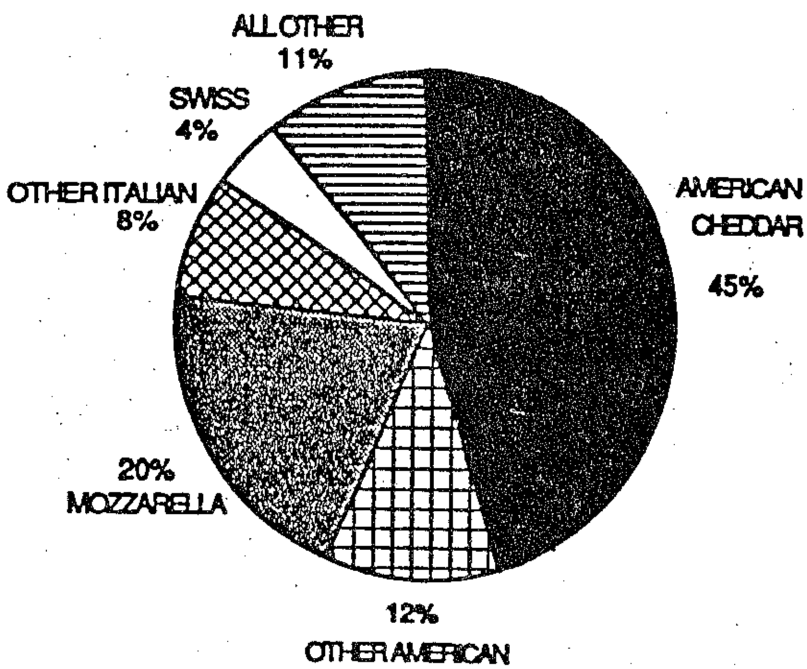
IMPORTANCE AND CHANGING NATURE OF CHEDDAR CHEESE INDUSTRY

Production of All Cheeses

In 1984, approximately 63 percent of the milk produced in the United States was used for manufactured dairy products rather than for fluid milk consumption. Milk utilized in manufactured products has increased more than 35 percent in the last 25 years, from approximately 61 billion pounds in 1960 to 82 billion pounds in 1984 (Table 1). During this period, the production of cheese has grown about 187 percent while the production of butter has declined 27 percent and the production of other manufactured dairy products such as ice cream, etc. has increased only 21 percent. By 1984, cheese represented 29 percent of total milk plant utilization and 47 percent of the milk used in manufactured dairy products.

Many different kinds of cheeses are manufactured in the United States. American cheeses (e.g. Cheddar, Colby, Monterey Jack) continue to have the largest share of milk use with almost 57 percent of the total production (Figure 1). But other varieties (e.g. Mozzarella, Specialty cheeses) have shown a fast growth in production in recent years. Italian varieties represent 28 percent of the production, Swiss cheeses about 4 percent, and other cheese styles almost 11 percent.

Figure 1. Relative Importance of Different Types of Cheese Produced in the United States in 1984.



Source: Adapted from selected issues of Dairy Products-Annual Summary, Crop Reporting Board, Statistical Reporting Service, U.S. Department of Agriculture.

Table 1. Milk Used at Dairy Plants in the United States (Selected Years 1960-1984).

Year	Milk to Plants	Milk Plant Utilization				Milk for Manufactured Products		Manufacturing Use		
		Fluid	Cheese	Butter	Other			Cheese	Butter	Other
	(Bil.Pounds)	(%)				(%)	(Bil.Pounds)	(%)		
1960	111.8	46	12	26	16	54	60.9	22	48	30
1965	116.3	46	14	25	16	54	63.0	25	45	30
1970	110.8	44	18	22	16	56	61.5	32	39	29
1975	110.8	45	22	18	16	55	61.4	39	32	29
1976	115.7	43	25	17	15	57	66.0	44	29	27
1977	118.3	42	24	19	15	58	68.7	42	32	26
1978	117.3	42	25	17	16	58	68.0	44	29	27
1979	119.4	42	26	16	16	58	69.8	45	28	27
1980	124.6	39	27	18	15	60	75.4	45	30	25
1981	129.0	38	28	19	15	62	80.4	45	31	24
1982	131.9	36	29	19	15	64	84.1	46	30	24
1983	136.1	35	30	19	16	65	87.9	47	29	24
1984	131.2	38	29	16	17	63	82.0	47	26	27

Source: Adapted from USDA. Dairy - Outlook and Situation, Economic Research Service (ERS), (selected issues).

Cheddar Cheese Production

Cheddar cheese has been, and continues to be, the number one cheese variety produced in the United States. Total production has increased more than 136 percent during the last 25 years, from 894 million pounds of cheese in 1960 to 2,113 million pounds in 1984. Currently, Cheddar production accounts for approximately 45 percent of total cheese and 80 percent of American cheese production (Table 2).

In general, Cheddar cheese production can be classified into two broad categories: block Cheddar cheese, including short-hold and long-hold Cheddar, and barrel Cheddar cheese. The distinction between these two groups is important because the nature of the product, the manufacturing process, and the production economies are somewhat different. Block Cheddar is a high-moisture cheese and a more consumer oriented product. On the other hand, barrel Cheddar is a low-moisture cheese which is used mainly as a raw material in other processes. Unfortunately, most statistics report Cheddar cheese information only as one group and do not make a clear distinction between block Cheddar and barrel Cheddar.

In recent years, Cheddar cheese production has undergone many of the same adjustments observed in the overall cheese industry. The number of plants has decreased, while the average production per plant has increased as new technological advances have been adopted rapidly in many plants. In 1984, there were 374 plants producing Cheddar cheese in the United States; only 39 percent of the number of plants 25 years earlier (Table 3). The regional distribution of plants continues to be highly skewed, with 48 percent of the Cheddar operations located in Wisconsin.

Not only is Cheddar cheese produced in specialized operations but also in diversified plants where Cheddar usually accounts for a large proportion of the total output. Average annual production of Cheddar cheese increased significantly from about one million pounds per plant in 1960 to nearly six million pounds per plant in 1984. Minnesota has a very high average production per plant. In 1984, Minnesota average plant production of Cheddar was more than 25 million pounds of cheese per year, almost 4.5 times the national average. On the other hand, New York and Wisconsin have a much lower average plant production with 5.9 and 4.8 million pounds per year, respectively (Table 3).

Wisconsin ranks number one in the production of Cheddar cheese with more than 40 percent of the total U.S. production. Minnesota is second with about 18 percent, and New York fifth with about 3 percent of the production. Cheddar production in Minnesota has increased at a faster rate than in other areas of the Country and the State has tripled its market share in 25 years. New York has not increased Cheddar production in the last few years, and its share has declined. New York is now ranked fifth after South Dakota and California, which have moved ahead of New York in Cheddar production since 1981.

About 68 percent of the milk used by the cheese industry in the United States is used in manufacturing American style cheeses (e.g. Cheddar, Colby, Monterey Jack) (Appendix Table 1). In Wisconsin, the proportion of milk into cheese used for American cheese has remained fairly steady over two decades at around 74 percent (Appendix Table 2).

Table 2. Cheddar Cheese Production in the United States, New York, Minnesota, and Wisconsin (Selected Years 1960-1984).

Year	United States	New York			Minnesota			Wisconsin		
	Production	Production	Share of U.S	U.S. Rank	Production	Share of U.S	U.S. Rank	Production	Share of U.S	U.S. Rank
	(Mil.Pounds)	(Mil.Pounds)	(%)	(#)	(Mil.Pounds)	(%)	(#)	(Mil.Pounds)	(%)	(#)
1960	894.3	38.3	4.3	6	49.6	5.5	4	418.5	46.8	1
1965	1007.8	34.3	3.4	6	63.6	6.3	3	482.0	47.8	1
1970	1182.4	40.4	3.4	6	100.2	8.5	2	569.9	48.2	1
1975	1205.0	52.2	4.3	3	235.1	19.5	2	502.2	41.7	1
1976	1524.1	75.4	4.9	3	276.1	18.1	2	661.5	43.4	1
1977	1517.5	74.5	4.9	3	261.6	17.2	2	692.4	45.6	1
1978	1505.5	77.2	5.1	3	277.0	18.4	2	705.8	46.9	1
1979	1597.3	81.9	5.1	3	308.4	19.3	2	733.3	45.9	1
1980	1750.7	71.1	4.1	3	333.2	19.0	2	809.9	46.3	1
1981	1933.1	68.2	3.5	3	368.5	19.1	2	854.7	44.2	1
1982	2157.5	71.7	3.3	4	389.5	18.1	2	885.8	41.1	1
1983	2351.4	78.5	3.3	4	405.4	17.2	2	951.2	40.5	1
1984	2112.8	70.6	3.3	5	376.6	17.8	2	875.0	41.4	1

Source: Adapted from U.S. Department of Agriculture. Dairy Products - Annual Summary, Crop Reporting Board, Statistical Reporting Service, (selected issues).

Table 3. Average Annual Production and Number of Plants Producing Cheddar Cheese in the United States, New York, Minnesota, and Wisconsin (Selected Years 1960-1984).

	United States		New York		Minnesota		Wisconsin	
Year	Number of Plants	Average Production Per Plant	Number of Plants	Average Production Per Plant	Number of Plants	Average Production Per Plant	Number of Plants	Average Production Per Plant
	(#)	(Mil.Pounds)	(#)	(Mil.Pounds)	(#)	(Mil.Pounds)	(#)	(Mil.Pounds)
1960	949	0.9	30	1.3	22	2.3	584	0.7
1965	806	1.1	23	1.5	17	3.7	464	1.0
1970	587	2.0	12	3.4	13	7.7	330	1.7
1975	476	2.5	14	3.7	19	12.4	253	2.0
1976	465	3.3	15	5.0	18	15.3	245	2.7
1977	462	3.3	15	5.0	18	14.5	245	2.8
1978	430	3.5	15	5.1	17	16.3	226	3.1
1979	406	3.9	14	5.9	18	17.1	213	3.4
1980	406	4.3	16	4.4	19	17.5	209	3.9
1981	389	5.0	15	4.5	16	23.0	199	4.3
1982	373	5.8	14	5.1	16	24.3	190	4.7
1983	383	6.1	13	6.0	15	27.0	189	5.0
1984	374	5.6	12	5.9	15	25.1	181	4.8

Source: Adapted from U.S. Department of Agriculture. Dairy Products - Annual Summary, Crop Reporting Board, Statistical Reporting Service, (selected issues).

The situation for Minnesota and New York differs. Cheese manufacturers in Minnesota have increased their dependency on American cheese production, mainly Cheddar. Minnesota increased the share of milk for cheese used in American type cheeses from 70 percent in 1960 to more than 90 percent since 1965 (Appendix Table 3). On the contrary, the cheese industry in New York has increased efforts to develop production of other cheese varieties. Production of American cheese in New York experienced some growth in the latter half of the 70's (Appendix Table 4). Since then, production has been quite erratic, although exhibiting a somewhat decreasing trend. In 1960, New York cheese manufacturers used about 45 percent of the total milk made into cheese for the production of American cheeses. By 1984, this proportion was down to about 28 percent.

OBJECTIVES OF STUDY

The primary objective of the phase of the Cheddar cheese research reported in this publication was to provide a basis for making realistic assumptions for cost budgeting in the other phases of the study to be reported in subsequent publications. In these later phases, the economic-engineering approach is used to budget costs and cost relationships and to isolate the impacts of cost-influencing factors such as size, technology and possible product diversification in Cheddar plants.

A second objective of this phase of the study was to ascertain similarities and differences among plants producing aged Cheddar cheese in the Northeast and North Central regions of the United States with respect to key technical and economic factors such as production technologies, manufacturing practices, labor efficiency, utilities, cheese yield potential, cheese fat recovery, seasonality of production, and so on.

PLANT SURVEY METHODOLOGY

To accomplish the objectives of this phase of the study, an in-depth personal visitation survey was made of 11 aged Cheddar cheese plants. A 10-page, detailed questionnaire was prepared to obtain information on key variables affecting the economic performance of plants. The survey form solicited some general and specific information on things such as product mix, operating technologies and equipment, cheese production, labor utilization and cost, and utilities required in the production process (Appendix B). The more specific information covered three months considered to be representative of the seasonality of production affecting most cheese operations: January, May and September.[1] Agricultural economists, a food scientist, and industry people were consulted in structuring the questionnaire. The questionnaire was pre-tested in advance at two plants before the survey was fully implemented.

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[1]The actual months covered by the questionnaire were May and September, 1984 and January, 1985. May 1984 was not representative of the current operation of one plant. Therefore, information on May 1985 was used for that cheese plant since it was compatible with the other two periods considered in the study and it also provided a similar picture of seasonality.

The target plants identified for the study were medium and large plants producing high-moisture Cheddar cheese (37 to 38%). Small plants were not considered as it was thought that they could not provide all the information required in the questionnaire. Plants with a capacity to process 500,000 or more pounds of milk per day and located in the Northeast and North Central regions of the United States, were considered suitable for the study. Because of time and other resource limitations, the plants visited were confined only to these two traditional Cheddar cheese producing regions.

Most of the plants selected as potential participants in the survey were cheese plants that had taken part in previous Cornell studies or that had already manifested interest in cooperating in new ones. Just a few of the contacted plants refused to cooperate in the study. However, as a result of this selection procedure, there was excellent collaboration from participating plants, and it was possible to obtain all the needed information from each operation. The survey questionnaire was delivered personally to each plant, and the senior author gathered the data by working with administrative and production personnel at the plants. Typically, two days of work were required to complete the questionnaire at each plant.

CHARACTERISTICS OF THE PLANTS SURVEYED

The 11 Cheddar cheese plants studied were located mainly in New York, Minnesota, and Wisconsin.[2] Three of the plants were in the Northeast region and eight in the North Central region. The plants represented a total of seven different organizations. All but one organization were cooperatives.

Production Structure

Cheddar cheese was the most important product for all plants in the sample. The 11 plants studied produced about 263 million pounds of Cheddar in 1984. This represented about 12 percent of the total Cheddar production in the United States, and about 20 percent of the Cheddar production in the areas with participating plants. On average, Cheddar cheese represented 81.3 percent of the total cheese production of the plants in the study.[3] The importance of Cheddar production to each operation ranged from about 44 percent to 100 percent of all the milk used in cheese. One plant produced only Cheddar cheese. The other ten also manufactured other American type cheeses such as Colby, Monterey Jack, and Washed Curd. Several other cheeses like Brick, Muenster, Mozzarella, and Provolone also were made in some operations. Additionally, two cheese plants produced other dairy products such as butter, cottage cheese, ice cream mix, sour cream, and yogurt.

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[2]Reporting the other states in which two surveyed plants are located might violate assurance of confidentiality given to cooperators.

[3]Measured as a percentage of milk used in Cheddar production in relation to total milk utilized in all cheeses.

Capacity of the Plants

Plant capacity reflects the maximum quantity of milk that could be converted into cheese at the plant in a 24-hour operating day, under good manufacturing practices. Average total plant capacity for the cheese operations studied was 1,183,000 pounds of milk per day, and plant capacities ranged from about 634,000 pounds to 2,100,000 pounds[4] (Table 4). The average plant size in the North Central region was significantly larger than in the Northeast region: 1,318,000 and 826,000 pounds, respectively.

Table 4. Plant Capacity, Plant Utilization and Production of 11 Cheddar Cheese Plants in the Northeast and North Central Regions.

Plant Group	Average Cheese Plant Capacity	Total Plant Capacity Utilization[c]	Average Capacity Utilization in Operating days[c]	Milk for Cheese used in Cheddar Cheese[c]	Total Cheddar Cheese Production in 1984
	(Pounds of Milk per Day)	--------------(%)------------			(Million Pounds)
All Plants	1,183,000	71	88	81	23,887
Std. Dev.	503,000	9	9	19	11,449
High Range[a]	2,100,000	85	96	100	42,864
Low Range[b]	634,000	59	73	53	11,072
North Central	1,318,000	69	89	84	27,589
Northeast	826,000	75	85	75	14,013

[a] Average of two highest.

[b] Average of two lowest.

[c] Average for May and September 1984, and January 1985.

Plant capacity utilization differed significantly from one operation to another, both on a monthly basis and on a per cheese-operating-day basis. Total plant capacity utilization for the three months averaged 71 percent, ranging from 59 to 85 percent for individual plants. One plant had a utilization as low as 46 percent in one of the three months and another as high as 98 percent. On the other hand, the observed average plant capacity utilization during the actual cheese operating days was much higher. The average for all plants was 88 percent, ranging from 73 to 96 percent. The plants in the Northeast region had a higher plant utilization for the three month period but a slightly lower average daily plant utilization than the North Central region (Table 4).

[4]The results reported in this study are simple averages of all plants. When ranges are provided, they were obtained from averaging the two highest and the two lowest figures in each category.

When the cheese manufacturing equipment at the plant is consistently scaled throughout, the size of the pasteurizer is one of the major determinants of the maximum capacity of a cheese operation. Some of the plants studied had bottlenecks at other stages of the production process that resulted in lower plant capacities than dictated by the pasteurizer capacity. The maximum plant capacity for cheese making was based on the maximum capacity of the limiting factor. The capacity of the pasteurizers in the sample of plants ranged from 41,000 pounds to 115,000 pounds of milk per hour (Table 5). The daily milk filling time at the 11 plants ranged from 15.1 hours to 18.6 hours when operating at full capacity. The milk filling time per vat varied from 26 minutes to 56 minutes across the plants surveyed.

Generally, the milk silo holding capacities available at the plants studied did not bear any particular relationship to the plant capacities. The operations had milk-silo-capacity to plant-capacity ratios as low as 0.7 and as high as 1.4. The average milk-silo-capacity to plant-capacity ratio for all plants was 1.1 (Table 5).

Table 5. Milk Silo Capacity, Pasteurizer Capacity, and Practices for Filling Cheese Vats at 11 Cheddar Cheese Plants in the Northeast and North Central Regions.

Plant Group	Milk Silo Capacity/ Plant Capacity	Milk Pasteurizer Capacity	Milk Filling Time of Cheese Vat	Plant Milk Filling Time at 100% Cap.	Maximum Daily Filling Times per Vat
	(Ratio)	(Pounds /Hour)	(Minutes /Vat)	(Hours /Day)	(#)
All Plants	1.1	67,000	40	17.5	5.2
Std. Dev.	0.3	26,000	11	1.5	0.6
High Range[a]	1.4	115,000	56	18.6	6.1
Low Range[b]	0.7	41,000	26	15.1	4.3
North Central	1.2	73,000	40	18.0	5.0
Northeast	1.0	51,000	42	16.1	5.8

[a] Average of two highest.

[b] Average of two lowest.

Major Manufacturing Processes, Practices, and Equipment

The cheese plants studied used two processes for manufacturing high-moisture (37-38%) block type Cheddar cheese. Seven operations had a cheddaring process, and four used a granular or stirred curd process. Both processes were represented in plants studied in the North Central region while all the plants studied in the Northeast region used cheddaring processes.

The plants studied had several different kinds of equipment and plant layouts. Cheese operations with two-tier and three-tier systems were observed. In a plant with a two-tier system, the cooking and the cheddaring, or the stirring of the curd, take place in two different pieces of equipment (e.g. cheese vats and cheddaring/salting tables). With the two-tier system, the salting of the curd is done in the same equipment as the cheddaring or the stirring of the curd. In a three-tier system, the cooking and the cheddaring also take place in two separate pieces of equipment. However, unlike the two-tier system, the salting of the curd is done in a separate or third piece of equipment. Thus, a three-tier system has cheese vats, an automatic cheddaring device, and salting tables.

Both open and enclosed cheese or cooking vats of several sizes were used in the 11 plants. All but one of the cheese plants studied had cheese vats of only one size and of the same type. In general, the trend appears to be to replace open cheese vats with enclosed ones.

The Draining Matting Conveyor (DMC) was the most common cheddaring device among the seven plants in the sample using a cheddaring process. In plants with a DMC, the salting of the curd was done either on open tables or in enclosed salting finishing vats (EFVs). A 640-pound block line for hooping the cheese was used by all plants with this particular cheddaring technology. Both stainless steel and wooden 640-pound boxes were used at these plants. Additionally, some operations also had cutting facilities to convert 640-pound blocks to 40-pound blocks. Cheddaring devices such as traditional tables, Cheddarmatics (Ched-o-Matic process), and Bellsiros (Australian system) were observed in other Cheddar cheese operations with a cheddaring system.

The four plants in the sample with a granular or stirred curd process operated with regular open tables or enclosed salting finishing vats (EFVs) for stirring and salting the curd. Three of these operations had Wincanton block formers and highly automated packaging equipment.

Only two operations studied still hooped the cheese using a regular 40-pound block line. Two plants also produced a very small proportion of their cheese in smaller sizes such as daisies, midgets and three-pound wheels.

Starter culture practices varied considerably at the cheese plants studied. Ten had regular bulk starter tanks, and a few also used direct vat set systems (i.e. some used both). External and internal pH controlled starter media systems also were available and used by some of the cheese plants.

Cheese storage capacity and practices varied substantially in the Cheddar cheese operations studied. Some plants held the cheese for no more than ten days, usually only enough time for the cheese to be cooled to a required temperature prior to shipping. In these plants, a different organization often was responsible for marketing the cheese. Other plants kept the cheese for a longer period of time. In some cases, cheese was stored for several months, especially when the product was marketed or sold as aged Cheddar cheese.

Since whey processing is an area that can be either very costly or an important source of revenues for the cheese operation, manufacturers have given much attention to their whey operations lately. Several different types of whey processing systems were observed in the sample of plants. Six plants had only one method of whey disposal, while the other five had two or more options. Whey condensing (40% solids) was the most common practice, being used in six plants. Four plants produced partially concentrated whey (less than 40% solids) and three plants produced powdered whey. Only one plant sold uncondensed whey and another reported dumping about 10 percent of the whey production.

Production Schedules

The Cheddar cheese plants studied worked with several different daily and weekly production schedules. The daily operating schedules differed among plants, but in general the operating schedule was very consistent throughout the year for each individual plant. On the other hand, the weekly production schedules usually differed from plant to plant and also seasonally in a given plant based on milk availability.

Daily production schedules for the cheese plants normally ranged between 21 and 24 hours. But some plants had unusual production schedules. For example, during some periods of the year, a 26-hour day operating schedule was observed. Under this schedule, the daily production cycle ran about two hours beyond the normal 24-hour day. Therefore, each day the new daily cycle started about two hours later than the previous day. The two additional hours in every operating day were accumulated during the week and were compensated later with a "technical" down-day.

The cheese plants operated with 5-day, 6-day, and 7-day weekly production schedules during the reported months. Although most plants tried to have long operating weeks, availability of milk supply was a constraint for some plants during certain periods of the year.

CHEDDAR CHEESE PRODUCT AND MANUFACTURING CHARACTERISTICS

Milk composition, cheese composition, fat recovery, fat losses, and cheese yields and efficiencies are important factors contributing to the economic performance of Cheddar plants. Data to permit the comparison of the 11 plants surveyed on these characteristics were obtained from five Cheddar production days randomly selected in each of the three months considered in the study.[5] Simple averages of each indicator were determined for each plant and some of the results were grouped by manufacturing process and by region.

An Important Note

Since the 11 plants studied were not a random sample, the results should not be interpreted as necessarily representing any particular groups of plants, say plants in the Northeast vs. plants in the North Central. Moreover, as in other types of operations, wide variability in performance existed among plants in some key performance indicators with, in some cases, one plant being significantly different. To partially ameliorate the influence of a plant with a large difference

[5]May and September 1984 and January 1985

in performance in a given respect, the ranges in performances reported were obtained by averaging the two highest and the two lowest figures in each instance. Yet, this wide variability with only a small sample leads to some averages being quite different than if performance of one of these outlying plants had not been considered.

Components of Milk Used in Cheese

Milk composition is a very important factor in cheese manufacturing. Milk components such as fat, protein, and casein determine potential cheese yields at the plant and affect the actual performance of cheese operation during the year. Data from another more detailed research study[6] indicated that milk composition varied considerably between the Northeast and the North Central regions (on a full-year basis) as well as among plants located in each of these areas. The study by Barbano et al. indicated that milk received in a large sample of plants in the North Central region generally had higher fat and higher milk protein content than plants in the Northeast. Milk components also varied seasonally (Figure 2).

Average fat in the milk received at the 11 plants studied was 3.72% for the three months considered, and the three-month average for the individual plants ranged from 3.61 to 3.85% (Table 6). Average milk protein for all plants was 3.24% in the same period, ranging from 3.18 to 3.31% in individual plants. The average case in-fat ratio for the milk used in Cheddar manufacturing was 0.68 for all plants.

Table 6. Average Composition of Milk Received by 11 Cheddar Cheese Plants in the Northeast and North Central Regions (May and September 1984, January 1985).

Plant Group	Number of Plants	Milk Fat	Milk Protein	Milk Casein/ Fat
	(#)	(%)	(%)	(Ratio)
All Plants[a]	11	3.72	3.24	0.68
Std. Dev.	-	0.09	0.05	0.01
High Range[b]	2	3.85	3.31	0.69
Low Range[c]	2	3.61	3.18	0.66
North Central	8	3.72	3.23	0.68
Northeast	3	3.72	3.24	0.68

[a] Milk composition data showed very large plant to plant variation.

[b] Average of two highest.

[c] Average of two lowest.

[6]D.M. Barbano, M. E. Della Valle, and N. F. Olson. National Milk Composition Study, unpublished monthly data summaries, Department of Food Science - Cornell University and Walter V. Price Cheese Research Institute - University of Wisconsin, 1984

The fact that the data in Table 6 show that the milk composition in the two regions is the same should not be extrapolated to all cheese plants or all milk in these regions, because the composition data are biased by several factors. The data in this study represent only five days' milk composition in each of the three months studied. The previous study on milk composition by Barbano et al. was a more representative sampling (52 samples, one each week for the year). In addition, the study by Barbano et al. included 11 cheese plants in the Northeast instead of only three used in this study. One of the three Northeast plants in this study had a very much higher fat and protein than the other two Northeast plants and therefore makes it appear that the milk composition in the North Central and the Northeast is similar. However this difference does not influence the subsequent evaluation of cheese yields and fat losses in this study because they are expressed as a percent of theoretical yield or as a percent of available milk fat. Thus, the actual yield difference is not important when looking and measuring efficiencies in each plant.

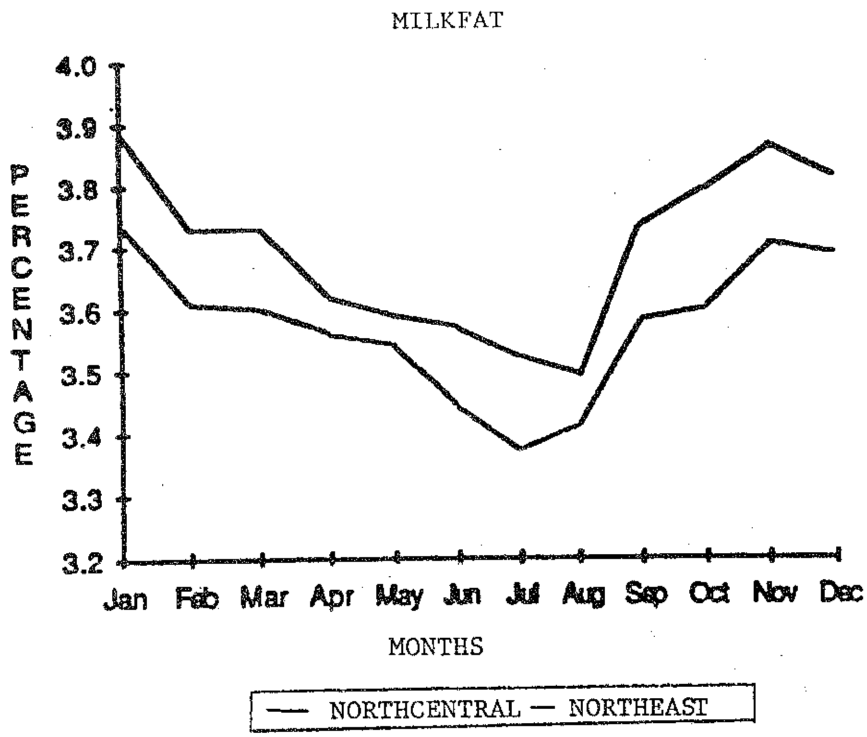
Standardization of the milk used in Cheddar cheese was not a common practice for the plants surveyed. Only one plant used milk standardization as a regular practice in Cheddar manufacturing. On the other hand, several plants standardized the milk for manufacturing other dairy products and other cheeses.

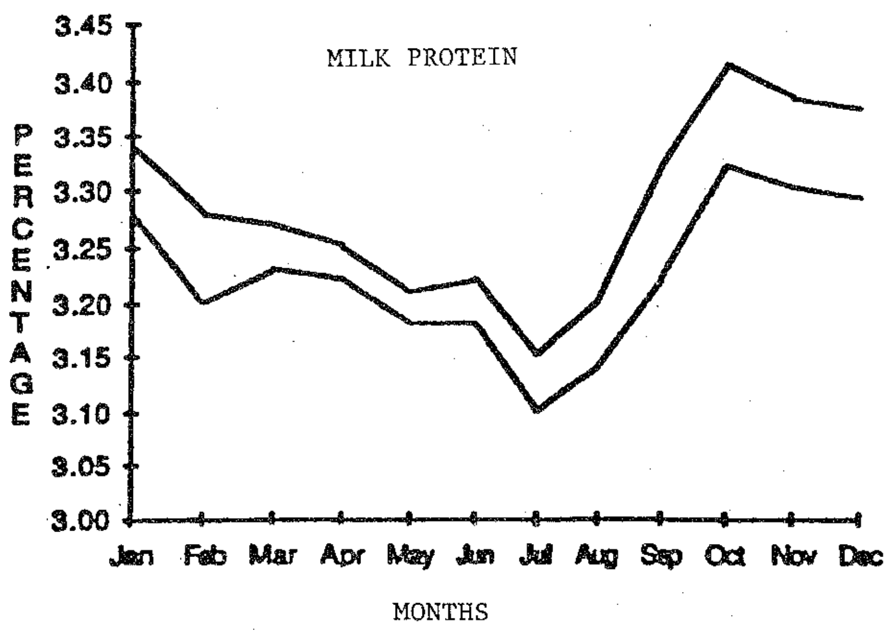
Cheddar Cheese Composition

High-moisture (37-38%) white and colored Cheddar cheeses were manufactured at the 11 cheese plants studied. Information on Cheddar cheese composition was obtained for the plants for five randomly selected Cheddar cheese production days for each of the three months in the study. Average Cheddar cheese composition for the sample of plants was 37.57% moisture, 53.16% fat on a dry basis (FDB), and 1.68% salt (Table 7). As expected, the cheese manufactured with the granular or stirred curd process on average retained more fat than the cheese manufactured with cheddaring systems. The cheese made with stirred curd process averaged 37.70% moisture, 53.95% (FDB), and 1.72% salt. On the other hand, the cheese made with the cheddaring processes averaged 37.44% moisture, 52.71% (FDB), and 1.66% salt.

Also, a regional difference in Cheddar cheese composition due, to some extent, to actual production practices used at the plants was observed as well as that due to the type of process used in manufacturing (i.e. cheddaring vs. stirred curd). For example, cheddaring plants in the Northeast had, on average, 0.47% lower moisture, 1.25% lower FDB, and 0.09% higher salt, than plants using the cheddaring process in the North Central region. Average total plant capacity for the 11 cheese operations studied was 1,183,000 pounds of milk per day. However, the cheese made in the Northeast plants was produced with the intent of aging it longer than cheese made in the North Central plants. To make a high quality, long-hold Cheddar cheese the industry has found by experience that the cheese moisture must be slightly lower. Lower moisture gave the Northeast a yield disadvantage, which must be factored into the added cost of a long-hold aged Cheddar cheese. This is a product quality judgement and can be dependent on customer and market factors for each plant.

Figure 2. Seasonal Variation of Milk Fat and Milk Protein in the Northeast and North Central Regions in 1984.





Source: D. M. Barbano, M.E. Della Valle, and N.F. Olson. National Milk Composition Study, unpublished data summaries, Department of Food Science - Cornell University and Walter V. Price Cheese Research Institute - University of Wisconsin, 1984.

Table 7. Cheddar Cheese Composition at 11 Plants in the Northeast and North Central Regions (May and September 1984, January 1985).

Plant Group	Cheese Moisture	Cheese Fat	Cheese Fat on a Dry Basis (FDB)	Cheese Salt
	(Percent)			
All Plants	37.57	33.21	53.16	1.68
Std. Dev.	0.33	0.65	1.07	0.13
High Range[a]	38.03	34.15	54.63	1.86
Low Range[b]	37.07	32.41	51.63	1.51
North Central	37.67	33.41	53.59	1.67
Northeast[c]	37.17	32.66	51.99	1.72
North Central/ Cheddaring	37.64	33.20	53.24	1.63
Cheddaring	37.44	32.97	52.71	1.66
Stirred Curd	37.70	33.61	53.95	1.72

[a] Average of two highest.

[b] Average of two lowest.

[c] All cheddaring plants.

Fat Recovery and Fat Losses

For a manufacturer good control of the fat losses at different stages of production is very important. Otherwise, high fat losses may prevent the plant from achieving the theoretical yields. The total amount of fat lost during manufacturing can be determined by comparing the pounds of original fat in the milk with the pounds of fat recovered in the cheese. This comparison measures the total fat recovery in the cheese. The Van Slyke equation assumes that Cheddar cheese plants should recover 93% of the original milk fat in the finished product. None of the 11 plants studied achieved 93% fat recovery (Table 8). The sample plants recovered on average 89.4% of the fat. However, considerable variability was observed in the performance of individual plants. Fat recovery for the cheese plants ranged from 85.0% to 92.1%. In general, granular or stirred curd plants recovered more fat than cheddaring plants, although there were exceptions. Cheddaring plants in the North Central region performed better in fat recovery than plants in the Northeast, all of which used the cheddaring process (Figure 3). Fat recovery in the North Central plants using the cheddaring process was 3.75% higher than in the Northeast. The actual fat recoveries observed for the Northeast are in agreement with a more extensive previous study that observed fat recoveries ranging from 82.83% to 87.16% in four New York Cheddar cheese factories[7].

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[7] D. M. Barbano, and J. W. Sherbon. "Cheese Yields in New York", J. of Dairy Science, 67:1873-1883, 1984.

Table 8. Fat Recovery and Fat Losses in Cheddar Cheese Manufacturing at 11 Plants in the Northeast and North Central Regions (May and September 1984, January 1985).

Plant Group	Whey Fat Test at Draw[d]	Fat Loss Up to Draw[e]	Fat Loss after Draw[f]	Fat Recovery in Cheese[g]
	(Percent)			
All Plants	0.32	7.68	2.94	89.36
Std. Dev.	0.07	1.68	1.12	2.55
High Range[a]	0.46	10.70	4.69	92.13
Low Range[b]	0.26	6.12	1.62	85.03
North Central	0.29	6.95	2.40	90.66
Northeast[c]	0.40	9.66	4.40	85.92
North Central/ Cheddaring	0.32	7.59	2.74	89.67
Cheddaring	0.35	8.48	3.45	88.06
Stirred Curd	0.26	6.30	2.05	91.64

[a] Average of two highest.

[b] Average of two lowest.

[c] All cheddaring plants.

[d] Two cheese plants did not perform this test on a regular basis. The test was estimated for those two plants considering the milk composition and the fat recovery in the cheese for each day for which information was reported.

[e] Expressed as a percentage of the original milk fat. Fat loss up to draw was estimated dividing pounds of fat in the whey at draw by pounds of fat in the milk times 100.

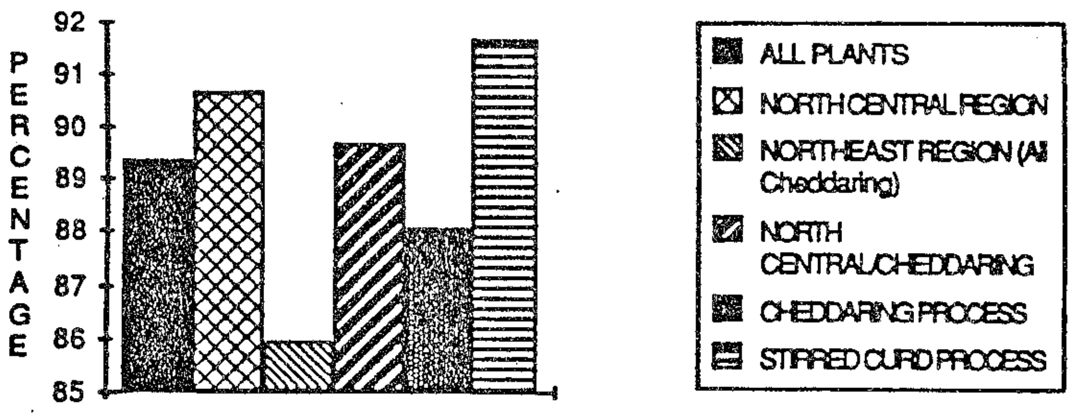
[f] Expressed as a percentage of the original milk fat. Fat loss after draw was determined by subtracting from 100 fat recovery in the cheese and fat loss up to draw.

[g] Expressed as a percentage of the original milk fat. Fat recovery was measured dividing the fat in the cheese by the fat in the milk times 100.

Most of the fat lost during Cheddar cheesemaking (i.e. fat not recovered in the cheese) is lost in the whey by the end of the cooking step. Therefore, fat content of cheese whey at draw, just before whey begins to drain from the cheese vats, is a good indicator of yield performance. Average whey fat at draw was 0.32% for the 11 plants studied, and it ranged from 0.26% to 0.46% (Table 8). Total fat losses during cheesemaking can be divided in two groups:

fat losses before draw, and fat losses after draw. The 11 plants studied lost, on average, 7.68% of the original milk fat before draw, and 2.94% after draw. In general, plants studied in the North Central region had lower fat losses than plants in the Northeast region. As expected, plants using a stirred curd process lost less fat after draw than plants with a cheddaring process. The fact that the stirred curd plants had lower fat loss up to draw than cheddaring plants (6.30% vs. 8.48%) should not be attributed to the stirred curd process itself but to other milk quality, equipment and management factors in those specific cheese plants.

Figure 3. Fat Recovery in Cheddar Cheese at 11 Plants in the Northeast and North Central Regions (May and September 1984, January 1985).



COMPARISONS OF FAT RECOVERY

Source: Table 8

Cheddar Cheese Yields

Product yields are important in Cheese manufacturing plants. Cheese yields vary not only among plants but also within plants on a day-to-day basis. Many factors can contribute to the yield variations at a plant. Managers need timely information on yields to accurately evaluate a plant's performance.

Actual Cheddar cheese yields for the plants studied averaged 9.98 pounds of cheese per 100 pounds of milk for the three months (May and September 1984, January 1985) considered (Table 9). The range for the individual average actual yields was from 9.43 to 10.27 pounds. Here again plants in the Northeast region had lower product yields than the group of plants with similar cheddaring operations in the North Central region. Stirred curd plants had considerably higher yields than cheese operations with cheddaring processes.

Table 9. Actual, Composition Adjusted, and Potential Cheddar Cheese Yields at 11 Plants in the Northeast and North Central Regions (May and September 1984, January 1985).

Plant Group	Actual Cheese Yield[d]	Composition Adjusted Cheese Yield[e]	Cheese Yield Potential[f]	Cheese Yield Efficiency[g]
	------------- (Pounds/CWT)	-----------		(%)
All Plants	9.98	9.90	10.19	97.10
Std. Dev.	0.29	0.27	0.20	1.69
High Range[a]	10.27	10.18	10.48	99.04
Low Range[b]	9.43	9.40	9.92	94.43
North Central	10.10	9.99	10.20	97.95
Northeast[c]	9.67	9.65	10.17	94.84
North Central/ Cheddaring	10.07	9.98	10.21	97.75
Cheddaring	9.90	9.84	10.19	96.50
Stirred Curd	10.12	10.01	10.20	98.15

[a] Average of two highest.

[b] Average of two lowest.

[c] All cheddaring plants.

[d] Actual yields were determined for the month by dividing total pounds of Cheddar cheese by total pounds of milk used multiplied by 100.

[e] Adjusted yields were determined by mathematically adjusting pounds of cheese for each month to a 37% moisture and a 1.7% salt. Total composition adjusted cheese weights for each month divided by total milk used in the month for Cheddar cheese and multiplied by 100, equals total composition adjusted yield.

[f] Yield potentials were based on milk fat and casein content of the milk in the same months as actual and composition adjusted yields were measured. The Van Slyke formula was used with a 93% fat recovery and 37% moisture.

[g] Yield efficiency was measured by dividing composition adjusted yield by yield potential multiplied by 100.

Potential cheese yields vary and are determined by the composition of the milk received for processing. Potential or theoretical cheese yields were calculated for each plant studied using the Van Slyke cheese yield formula:

Theoretical Cheddar cheese yield = {[(0.93 x milk fat) + (milk casein - 0.1)] x 1.09 / [(1 - desired cheese moisture) / 100].

The desired cheese moisture used in the theoretical yield calculations was 37%. The 0.93 factor assumes 93% fat recovery. The 1.09 factor in the Van Slyke formula assumes a 1.7% salt content in the cheese.

The average potential or theoretical yield for the specific days and plants in this study was very similar for the plants in the cheddaring and stirred curd group as well as for the two regions (Table 9). Thus, it is likely that actual yield differences for the study plant groups were due to differences in milk quality factors or the performance of manufacturing systems and the management of the production process of individual plants.

Plant-to-plant differences in moisture and salt content of Cheddar cheese made necessary a mathematical adjustment of actual yield data to an equal moisture and salt basis for comparisons. The adjustment was to a 37% moisture and 1.7% salt.[8] Both the composition adjusted and the theoretical cheese yields were used to determine the yield efficiency for each cheese operation.

Cheddar cheese yield efficiency indicates how effectively plants convert theoretical cheese solids from their milk supply into actual cheese yield. In other words, yield efficiency compares the potential cheese yields that a plant could obtain from its milk supply with their actual yields after those actual yields are mathematically adjusted to the same moisture and salt levels. Average moisture and salt adjusted Cheddar cheese yield efficiency for all plants was 97.1%, with a range form 94.4 to 99.0%. Plants in the North Central region had a 98.0% yield efficiency while plants in the Northeast region only had a 94.8% yield efficiency (Table 9). These results for the Northeast plants again are similar to ones reported by Barbano and Sherbon (1984) in their previous study of New York Cheddar cheese plants. The four plants included in that study had cheese yield efficiencies from 93.6% to 96.6%. This regional difference in efficiency most likely was due to both manufacturing process and management. Cheddaring plants in the North Central region had almost three points of higher yield efficiency than cheddaring plants in the Northeast. On the other hand, the group of stirred curd plants outperformed the group of cheddaring plants with 98.2% yield efficiency for the former and 96.8% for the latter (Figure 4).

Summary of Cheddar Cheese Composition and Manufacturing Performances

Significant differences in Cheddar cheese composition and in manufacturing performance were observed for the sample of plants, both among individual plants and among groups of plants. On average, stirred curd plants had higher cheese moisture and cheese fat, cheese fat recovery, cheese yields and cheese yield efficiencies than cheddaring plants. Likewise, the cheddaring plants studied in the North Central region performed somewhat better than the cheddaring plants studied in the Northeast region. Because the cheese operations visited were not selected in a random manner but based on willingness to participate in this study, caution again should be observed in generalizing the results observed in the plants surveyed in the two regions to other plants located in those areas.

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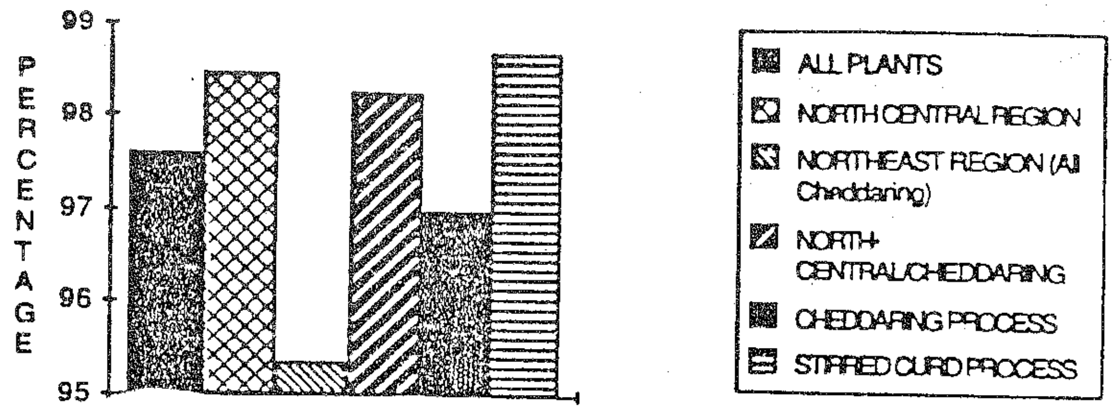
[8]Adjusted Cheddar cheese yield = actual Cheddar cheese yield x [(100 - Cheddar cheese moisture and salt test) / 100] / (1 - 0.387)

Figure 4. Cheddar Cheese Yield Efficiency at 11 Plants in the Northeast and North Central Regions (May and September 1984, January 1985).



COMPARISONS OF YIELD EFFICIENCY

Source: Table 9

COST AND PERFORMANCE INDICATORS

Labor and utilities are important costs in manufacturing Cheddar cheese. Other studies indicate that labor accounts for approximately 30 to 60 percent of the costs of production, aside from the costs of milk, and utilities between 10 and 15 percent.[9,10]. Thus, plant performance as regards the use and cost of labor and utilities is important in evaluating and comparing different manufac-uring plants.

Detailed information on labor and utilities used in production were obtained, and cost and performance indicators were calculated for the 11 surveyed plants. The labor and utility cost and performance indicators are presented on two bases: the cheese plant only (excluding the whey processing operation) and the cheese plant plus the whey operation. Most plants did not have exact figures on the cost and utilization of utilities for the whey processing operation. Therefore, factors provided by individual plants were used to estimate the utility requirements in the whey plant. In general, the cost and performance indicators discussed in this section are for the cheese and whey operations considered together only. The estimates for the cheese plants alone which involved some managerial judgement, are reported in the corresponding tables with the information on the total plant.

Because of the difficulty in breaking down the labor and utility information for individual cheese products at the plant, the indicators presented were calculated for all cheese production in each operation. But this does not pose significant problems in evaluating and comparing the plants studied since Cheddar was the major product for all plants, and most of the other cheeses manufactured

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[9]E. M. Babb Cost and Financial Performance of Wisconsin Cheese Plants, Purdue University, Agr. Exp. Sta., Station Bulletin No. 298, November 1980.

[10]K. Ch. Ling Dairy Product Manufacturing Costs at Cooperative Plants, USDA, Agricultural Cooperative Service (ACS), Research Report No. 34, November 1983.

were American type cheeses with very similar production processes that used the same equipment and technology.

Production Labor Efficiency

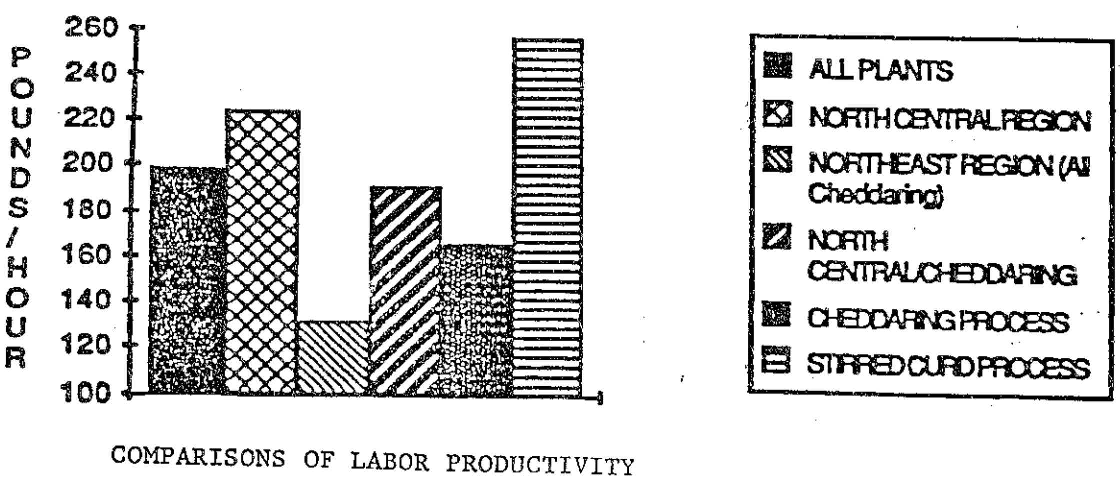
Cheddar cheese production is a fairly labor intensive process. As noted, labor costs for existing cheese operations have been reported as being as low as 30 percent and as high as 60 percent of total production costs. In general, Cheddar cheese is a low-margin, high-volume oriented industry. Therefore, the managements of Cheddar cheese plants need to monitor labor efficiency closely, since small differences in labor performance can have large impacts on the final economic performance of the operations.

Production labor efficiency was measured by estimating the pounds of milk processed per hour of labor and the pounds of all cheese produced per hour of labor. The labor considered included people involved in the receiving, pasteurizing, starter culture, cheesemaking, pressing, hooping and chilling storage operations. The plant labor also included laboratory, whey handling, plant cleaning, maintenance and engineering personnel as well as the foreman, production clerk and plant manager. The plant labor measured in this study did not include office workers or personnel involved in cheese aging, retail packaging, sales, marketing or delivery.

Labor productivity varied widely among individual plants and between plants in the two regions studied (Figure 5).

Milk processed per hour of labor (cheese and whey operation) averaged 1,959 pounds for all plants, with a range of 1,163 and 3,297 pounds (Table 10). Cheese production per hour of labor averaged 198 pounds in all 11 plants ranging between 114 and 337 pounds (Table 10). In general, stirred curd plants processed more milk and produced more cheese per hour of labor than cheddaring plants. Plants in the Northeast region processed an average of 856 less pounds of milk per hour of labor and produced 92 fewer pounds of cheese per hour of labor than plants in the North Central region. Comparing cheddaring plants in the two areas,

Figure 5. Cheese Production per Hour of Labor at 11 Cheddar Cheese Plants, Cheese and Whey Operations, in the Northeast and North Central Regions (May and September 1984, January 1985).



Source: Table 10

the ones in the North Central still had considerably higher labor productivity than those studied in the Northeast. Since the plants studied in the North Central were considerably larger than the plants in the Northeast, economies of size, which are important in Cheddar operations, undoubtedly explain much of the difference in labor productivity observed between the plants in the two regions.

Table 10. Production Labor Efficiency at 11 Cheddar Cheese Plants in the Northeast and North Central Regions (May and September 1984, January 1985).

Plant Group	Cheese and Whey Operations[d]		Cheese Operations Only[e]	
	Milk Processed per hour of Labor	Cheese Production per hour of Labor	Milk Processed per hour of Labor	Cheese Production per hour of Labor
	(Pounds)			
All Plants	1,959	198	2,210	223
Std. Dev.	781	80	860	89
High Range[a]	3,297	337	3,648	373
Low Range[b]	1,163	114	1,271	131
North Central	2,192	223	2,478	252
Northeast[c]	1,336	131	1,497	146
North Central/ Cheddaring	1,885	191	2,220	224
Cheddaring	1,650	165	1,910	191
Stirred Curd	2,499	255	2,736	279

[a] Average of two highest.

[b] Average of two lowest.

[c] All cheddaring plants.

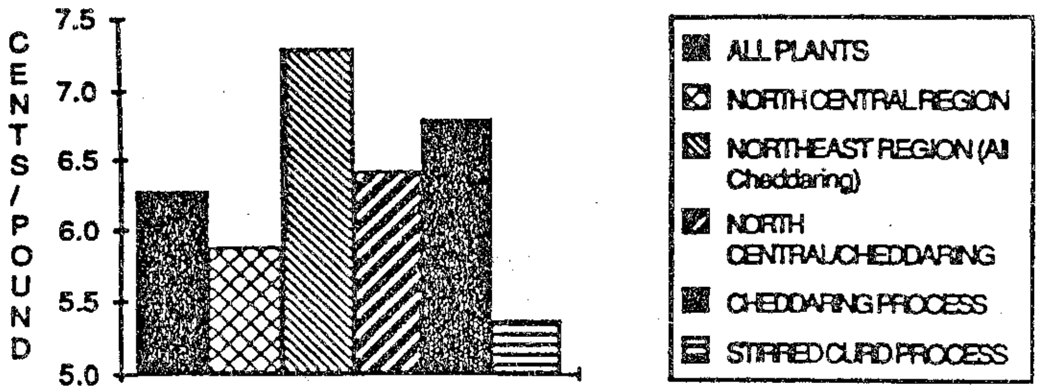
[d] Determined for each individual plant by dividing total pounds of milk processed into cheese or total cheese production by number of plant labor hours reported for the same period.

[e] Number of labor hours reported for whey processing are not included.

Plant Labor Cost

Plant labor cost per 100 pounds of milk or per pound of cheese varied widely (Figure 6). Plant-to-plant differences in unit labor cost were due not only to differences in wages and total labor cost per hour (i.e. wages and fringe benefits), but also to the large differences in labor productivity.

Figure 6. Labor Cost per Pound of Cheese at 11 Cheddar Cheese Plants, Cheese and Whey Operations, in the Northeast and North Central Regions (May and September 1984, January 1985).



COMPARISONS OF LABOR COST

Source: Table 11

Average labor cost (cheese and whey operation) was 62.8 cents per 100 pounds of milk with a plant-to-plant variability of more than 55 cents, from 30.6 to 85.0 cents per hundredweight (Table 11). Average labor cost per pound of cheese was 6.3 cents with a range between 3.0 and 8.7 cents. Some operations were very labor intensive with minimal and fully depreciated equipment and building costs.

The Northeast plants had a much higher labor cost per unit of production than the North Central plants. Average labor cost in the Northeast plants was about 11.3 cents higher per 100 pounds of milk and 1.4 cents more per pound of cheese than in the North Central plants studied. These differences in labor costs are even more significant considering that the average cost per hour of labor in the North Central was about 25 percent higher than in the Northeast. Stirred curd plants had 12.7 and 1.5 cents lower labor costs per hundred pounds of milk and per pound of cheese respectively, than plants with a cheddaring process. Here again, the fact that the plants studied in the Northeast, on average, were smaller than those in the North Central undoubtedly contributes significantly to the observed regional differences.

Table 11. Labor Cost per Unit of Production at 11 Cheddar Cheese Plants in the Northeast and North Central Regions (May and September 1984, January 1985).

Plant Group	Cheese and Whey Operations[d]		Cheese Operations Only[e]	
	Labor Cost per cwt of Milk	Labor Cost per pound of Cheese	Labor Cost per cwt of Milk	Labor Cost per pound of Cheese
	(Cents)			
All Plants	62.8	6.3	55.8	5.6
Std. Dev.	17.7	1.8	16.9	1.7
High Range[a]	85.0	8.7	78.3	7.8
Low Range[b]	30.6	3.0	27.3	2.7
North Central	59.7	5.9	53.1	5.2
Northeast[c]	71.0	7.3	63.1	6.5
North Central/ Cheddaring	64.6	6.4	55.7	5.5
Cheddaring	67.4	6.9	58.9	5.9
Stirred Curd	54.7	5.4	50.5	5.0

[a] Average of two highest.

[b] Average of two lowest.

[c] All cheddaring plants.

[d] Determined for each individual plant by dividing total payroll dollars by pounds of milk processed into cheese or pounds of cheese reported for the same period.

[e] Same as previous one except that payroll dollars reported for whey processing are not included.

Wages varied more from plant to plant than from region to region. The average wage for all plants was $8.40 per hour, but it ranged from $5.70 to $10.10 per hour for individual plants (Table 12).

Utility Cost and Consumption

The cost of utilities is important in Cheddar cheese production. Previous studies, indicate that utilities account for between 10 and 15 percent of total production costs in existing Cheddar cheese plants (Babb, 1980; Ling, 1983).

Table 12. Wages and Fringes for 11 Cheddar Cheese Plants in the Northeast and North Central Regions (May and September 1984, January 1985).

Plant Group	Wages[c]	Labor Cost including Fringes	Fringes
	----------($/Hour)---------		(%)
All Plants	8.40	11.10	33
Std. Dev.	1.60	2.10	2
High Range[a]	10.10	13.40	36
Low Range[b]	5.70	7.50	31
North Central	8.90	11.70	32
Northeast	7.10	9.50	34

[a] Average of two highest.

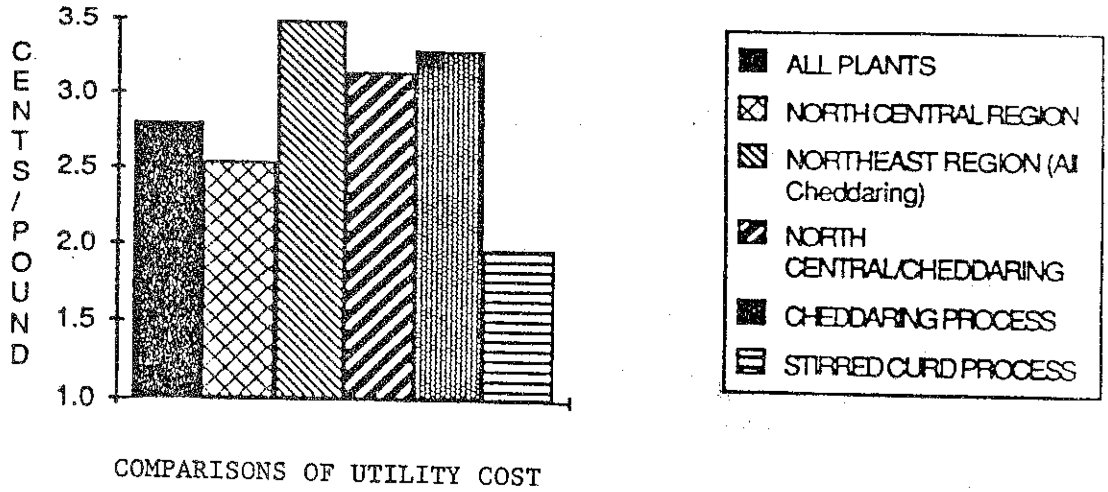
[b] Average of two lowest.

[c] Determined for each individual plant by dividing total payroll dollars by number of plant labor hours reported for each month.

Electricity and fuel cost as well as water consumption, like labor, varied widely among the studied plants (Figures 7 and 8). The average cost per kilowatt hour varied significantly from plant-to-plant and differed between regions: 5.6 cents in the Northeast and 4.7 cents in the North Central. Electricity and fuel utilization variability seemed to be more the result of differences in technology, manufacturing process, or fuel alternatives, than the result of differences in management performance. On the other hand, it appears that the differences in water consumption could only be explained by differences in the philosophies of cheese plant managements. Because of the low marginal cost of water, water consumption tended not to be closely controlled at cheese operations.

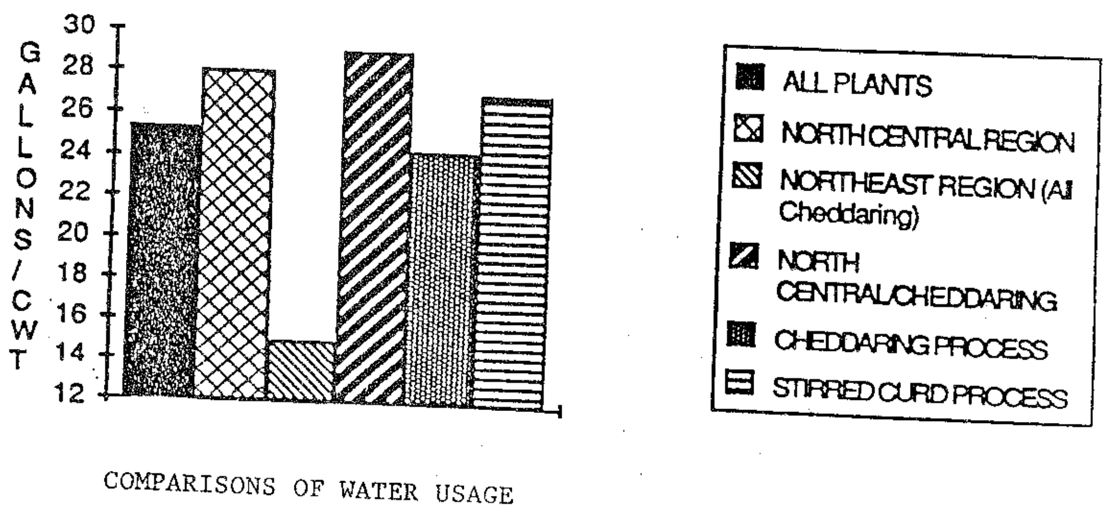
Electricity and fuel cost averaged 27.9 cents per 100 pounds of milk, and 2.8 cents per pound of cheese in the 11 study plants when the whey operation is included (Table 13). The electricity and fuel cost varied widely among individual plants. Electricity and fuel cost ranged from 17.0 to 42.9 cents per 100 pounds of milk, and from 1.7 to 4.4 cents per pound of cheese. The difference in electricity and fuel cost among cheddaring plants in the two regions was not very significant, compared to the difference observed between plants with cheddaring process and plants with stirred curd process. Average electricity and fuel cost for plants with stirred curd or granular process was 12.5 cents per 100 pounds of milk and 1.3 cents per pound of cheese lower than for the study plants with the cheddaring process.

Figure 7. Electricity and Fuel Cost per Pound of Cheese, Cheese and Whey Operations, at 11 Cheddar Cheese Plants in the Northeast and North Central Regions (May and September 1984, January 1985).



Source: Table 13

Figure 8. Water Consumption per Hundred Pounds of Milk, Cheese and Whey Operations, at 11 Cheddar Cheese Plants in the Northeast and North Central Regions (May and September 1984, January 1985).



Source: Table 13

Table 13. Selected Utility Cost and Consumption per Unit of Production at 11 Cheddar Cheese Plants in the Northeast and North Central Regions (May and September 1984, January 1985).

Plant Group	Cheese and Whey Operations[d]			Cheese Operations Only[e]	
	Elect. & Fuel Cost per cwt of Milk	Elec.& Fuel Cost per pound of Cheese	Water Consumption per cwt of Milk	Elec.& Fuel Cost per cwt of Milk	Elec.& Fuel Cost per pound of Cheese
	-----(Cents)-----		(Gallons)	-----(Cents)-----	
All Plants	27.9	2.8	25	13.8	1.4
Std. Dev.	8.7	1.0	18	4.4	0.5
High Range[a]	42.9	4.4	59	21.2	2.1
Low Range[b]	17.0	1.7	9	8.5	0.9
North Central	25.7	2.5	28	12.7	1.3
Northeast[c]	33.8	3.5	15	16.7	1.7
North Central/ Cheddaring	31.5	3.1	29	15.0	1.5
Cheddaring	32.5	3.3	24	15.7	1.6
Stirred Curd	20.0	2.0	27	10.4	1.0

[a] Average of two highest.

[b] Average of two lowest.

[c] All cheddaring plants.

[d] Determined for each individual plant by dividing utility cost or consumption by pounds of milk processed into cheese or pounds of cheese reported for the same period.

[e] Utility costs allocated for whey processing are not included.

Most cheese operations had their own water well and, in general, an almost unlimited water supply. This might explain to some extent some of the large variability in water usage. Average water consumption for all plants was 25 gallons per 100 pounds of milk, but the average consumption ranged from 9 to 59 gallons per hundredweight. In general, plants in the Northeast performed better in this regard than plants in the North Central, with 13 gallons lower consumption per 100 pounds of milk.

Summary of Labor and Utility Indicators

Cost and performance indicators for the 11 Cheddar cheese plants studied indicate that utilization and cost of labor and utilities vary widely from plant to plant. Production labor efficiency (expressed as pounds of cheese per man-hour) also differed considerably between the two regions and across different manufacturing processes, giving the North Central region and the granular process a considerable advantage over the Northeast region and the cheddaring process. Labor productivity appeared to be strongly related to the size of the plants. As the plant size increased, the pounds of cheese processed per hour of labor increased substantially. This could explain, up to a degree, some of the regional and other group differences observed. On the other hand, labor costs per hundredweight of milk and per pound of cheese did not differ as significantly as might be expected considering the large differences in labor productivity between the two regions, mostly because of lower wages in the Northeast plants. Labor costs were much higher for cheddaring plants than for stirred curd plants. Electricity and fuel costs were also higher for cheddaring plants than for stirred curd plants, whereas there was not a significant regional difference. On the other hand, water consumption was the only calculated indicator that gave the Northeast plants a better performance than the North Central plants.

Appendices

Appendix Table 1. Milk Used in Cheese Production in the United States (Selected Years 1960-1984).

Year	Milk Utilization in Cheese	Percentage of Total Milk Production	American Cheese		Other Cheeses	
			Milk Utilization		Milk Utilization	
	(Mil. Pounds)	(%)	(Mil. Pounds)	(%)	(Mil. Pounds)	(%)
1960	13,329	10.8	9,653	72.4	3,676	27.6
1965	15,735	12.7	11,459	72.8	4,277	27.2
1970	19,566	16.7	14,266	72.9	5,300	27.1
1975	23,881	20.7	16,452	68.9	7,430	31.1
1976	28,828	24.0	20,718	71.9	8,110	28.1
1977	28,858	23.5	20,473	70.9	8,385	29.1
1978	29,918	24.6	20,737	69.3	9,180	30.7
1979	31,536	25.6	21,834	69.2	9,702	30.8
1980	33,924	26.4	23,765	70.1	10,160	29.9
1981	36,483	27.5	26,212	71.8	10,271	28.2
1982	38,903	28.7	27,540	70.8	11,363	29.2
1983	41,006	29.4	29,314	71.5	11,692	28.5
1984	38,718	28.6	26,403	68.2	12,315	31.8

Source: Adapted from USDA. Dairy Products - Annual Summary, Crop Reporting Board, Statistical Reporting Service, (selected issues).

Appendix Table 2. Milk Used in Cheese Production in Wisconsin (Selected Years 1960-1984).

Year	Milk Utilization in Cheese	Percentage of State Milk Production	American Cheese Milk Utilization		Other Cheeses Milk Utilization	
	(Mil. Pounds)	(%)	(Mil. Pounds)	(%)	(Mil. Pounds)	(%)
1960	5,975	33.7	4,398	73.6	1,577	26.4
1965	7,048	37.4	5,167	73.3	1,881	26.7
1970	8,546	46.4	6,483	75.9	2,063	24.1
1975	9,373	49.6	6,843	73.0	2,530	27.0
1976	10,981	54.1	8,263	75.2	2,717	24.7
1977	11,282	53.6	8,560	75.9	2,721	24.1
1978	11,584	54.5	8,619	74.4	2,965	25.6
1979	12,152	55.6	9,101	74.9	3,051	25.1
1980	12,933	57.8	9,788	75.7	3,145	24.3
1981	13,779	59.9	10,728	77.9	3,051	22.1
1982	14,331	61.7	10,970	76.5	3,362	23.5
1983	14,911	62.7	11,439	76.7	3,472	23.3
1984	14,254	60.7	10,475	73.5	3,780	26.5

Source: Adapted from USDA, Dairy Products - Annual Summary, Crop Reporting Board, Statistical Reporting Service, (selected issues).

Appendix Table 3. Milk Used in Cheese Production in Minnesota (Selected Years 1960-1984).

Year	Milk Utilization in Cheese	Percentage of State Milk Production	American Cheese		Other Cheeses	
			Milk Utilization		Milk Utilization	
	(Mil. Pounds)	(%)	(Mil. Pounds)	(%)	(Mil. Pounds)	(%)
1960	746	7.3	526	70.5	220	29.5
1965	729	6.8	667	91.5	61	8.4
1970	1,581	16.4	1,323	83.7	257	16.3
1975	3,024	33.8	2,645	87.5	379	12.5
1976	4,150	44.9	3,750	90.4	400	9.6
1977	3,934	41.5	3,530	89.7	404	10.3
1978	4,292	47.2	3,873	90.2	420	9.8
1979	4,597	50.3	4,215	91.7	381	8.3
1980	4,957	52.0	4,593	92.7	364	7.3
1981	5,399	53.7	4,986	92.4	413[a]	7.6
1982	5,488	53.1	5,084	92.6	404[a]	7.4
1983	5,714	52.4	5,355	93.7	358[a]	6.3
1984	5,381	52.1	4,976	92.5	405[a]	7.5

[a]Estimated

Source: Adapted from USDA. Dairy Products - Annual Summary, Crop Reporting Board, Statistical Reporting Service, (selected issues).

Appendix Table 4. Milk Used in Cheese Production in New York (Selected Years 1960-1984).

Year	Milk Utilization in Cheese	Percentage of State Milk Production	American Cheese		Other Cheeses	
			Milk Utilization		Milk Utilization	
	(Mil. Pounds)	(%)	(Mil. Pounds)	(%)	(Mil. Pounds)	(%)
1960	903	8.9	405	44.9	498	55.1
1965	969	8.8	397	41.0	572	59.0
1970	1,152	11.1	462	40.1	689	59.8
1975	1,528	15.3	568	37.1	960	62.8
1976	1,831	18.0	811	44.3	1,020	55.7
1977	1,847	18.1	805	43.6	1,043	56.5
1978	1,990	19.1	830	41.7	1,160	58.3
1979	2,123	20.0	886	41.7	1,236	58.2
1980	2,168	19.8	766	35.3	1,402	64.7
1981	2,246	20.3	757	33.7	1,489	66.3
1982	2,415	21.8	783	32.4	1,632	67.6
1983	2,636	22.5	847	32.1	1,789[a]	67.9
1984	2,695	23.6	764	28.3	1,931	71.7

[a]Estimated

Source: Adapted from USDA. Dairy Products - Annual Summary, Crop Reporting Board, Statistical Reporting Service, (selected issues).

Appendix B

CONFIDENTIAL

Date: ____________
(month/day/year)

CHEESE MANUFACTURING PLANT QUESTIONNAIRE

R.D. Aplin - D.M. Barbano - J.K. Mesa-Dishington

Departments of Agricultural Economics & Food Science
Cornell University
305 Warren Hall
Ithaca, NY 14853-7801
(607) 256-3068

Cheese Manufacturer ____________
Plant Address: ____________

Manager ____________
Tel. No. ( )

Contact ____________
Tel. No. ( )

___Cooperative

___Privately Owned

___Single Plant Operation

___Multiplant Operation

PLANT PRODUCTION

1) a) Cheeses processed at the plant:

Item	Yes	No	Item	Yes	No
Cheddar	___	___	Mozzarella		
Colby	___	___	Fresh Cheese Curd	___	___
Brick	___	___	Other:	___	___
Jack	___	___	___	___	___
Muenster	___	___	___	___	___

b) Other dairy products processed at the plant. Do NOT include cheese by-products (e.g., whey, cream).

2) Did the plant have any significant interruptions in the cheese operation or changes in equipment and capacity of the plant during the last 12 months? ___Yes ___No
If Yes, explain: ____________

3) There are ______ cheese vats in operation at the plant.

4) The rate of milk flow into a vat is __________ pounds/hour.

5) On average, the pounds of milk filled into a vat are __________ pounds.

6) The minimum amount of clean-up time (including mid-day short clean-up) required before starting next day's production is _____ hours.

7) The maximum plant capacity in a 24-hour day, including clean-up time, is __________ pounds of milk made into cheese.

8) The maximum plant capacity for production of cheddar cheese in a 24-hour day, including clean-up time, is __________ pounds of milk made into cheddar cheese.

9) The total raw milk storage capacity at the cheese plant is __________ pounds.

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EQUIPMENT AND PRODUCTION PROCESSES

10) Which of the following processes or items of equipment are used at the plant for cheddar production?

	YES	NO
a) VATS:		
- standard open rectangular vat	___	___
- enclosed circular vat (double-o type)	___	___
- other ______	___	___
b) CHEESEMAKING:		
- automatic cheddaring	___	___
- automatic salting	___	___
- salting tables	___	___
c) HOOPING:		
- wincanton block former	___	___
- 640 pounds line	___	___
- regular 40 pounds line	___	___
- other ______	___	___
- other ______	___	___
d) STARTER CULTURE ROOM:		
- high temperature short time pasteurizer for starter culture media	___	___
- regular bulk starter tanks	___	___
- internal pH control media	___	___
- external pH control system	___	___
- direct vat set cultures	___	___
e) LABORATORY:		
- infrared milk tester	___	___
- microwave oven	___	___
- analytical balance	___	___
- milko tester	___	___
- electronic somatic cell counter	___	___
- bacteriology testing	___	___
f) WHEY HANDLING:		
- pasteurizer	___	___
- evaporator	___	___
- dryer: spray	___	___
drum	___	___
- UF unit	___	___
- RO unit	___	___
- crystalization tanks	___	___
- separator	___	___
- fine saver	___	___

11) Does the plant have its own water supply? ___Yes ___No

12) Does the plant have its own waste handling unit? ___Yes ___No

13) Does the plant have a waste heat reclaim system? ___Yes ___No

14) What has been the disposition of the separated sweet liquid whey at the plant during the last 12 months? (give your best estimate)

		PERCENT OF TOTAL WHEY SOLIDS (%)
a) Uncondensed whey sold for further processing		___
b) Partially concentrated whey sold for further processing (less than 35% solids)		___
c) Condensed whey sold		___
d) Dried human food grade		___
e) Dried animal feed		___
f) Fractionated		___
g) Dumped		___
i) municipal sewer	___%	
ii) private sewage treatment plant	___	
iii) land spreading	___	
iv) other ______	___	
h) Giving it back to the farmers		___
i) Other ______		___
TOTAL	100%	100%

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15) Describe the most recent major investment made at the plant: ______

16) Describe the most recent major investment considered but not yet made at the plant: ______

17) What steps have been taken at the plant during the past three years to reduce the production costs? ______

18) Have any specialty cheeses (European-style cheeses) been produced or considered to be produced at this plant using the current plant capacity and equipment? ___Yes ___No

If Yes, explain: ______

MANUFACTURING SUPPLIES

19) What type of rennet is used in the production of cheddar cheese at the plant?

Rennet			Percentage of cheddar cheese made with it (%)
Calf :	___Yes	___No	___
Microbial :	___Yes	___No	___
Other animal:	___Yes	___No	___
			100%

20) How much rennet is used in manufacturing cheddar cheese per thousand pounds of milk? ______ ounces/1000 pounds of milk. Is the rennet single or double strength? ______

21) What is the average percentage of innoculant used for the starter culture? ______%

LABOR

22) The average number of hours in a normal full-time employee work week is ______ hours/man/week (including hours of overtime if it is a regular practice).

23) Does the plant hire part-time labor? ___Yes ___No

If Yes, the average number of hours in a normal part-time employee work week is ______ hours/man/week.

Fringe Benefits

24) Report the average number of days per year that a typical full-time plant employee receives for each of the following benefits:

Vacation allowance	______days
Paid holiday allowance	______
Sick pay allowance	______
Personal days	______

25) Does the plant pay any of the following benefits for a typical plant employee?

Life insurance	___Yes	___No
Medical expenses	___Yes	___No
Dental expenses	___Yes	___No

We need some of the information in this section of the questionnaire for three different months of the year to obtain a picture of seasonality. (May, September 1984 and January 1985)

---

26) What was the average number of days per week and hours per day (including clean-up time) for manufacturing cheese at the plant during the following periods?

Production Schedules	May 1984	September 1984	January 1985
WEEKLY			
Average days/week	______ days	______ days	______ days
DAILY			
Average hours/day	______ hours	______ hours	______ hours

27) How many full-time equivalent people are needed to produce cheddar cheese under any of the previous daily production schedules? The number of hours per day mentioned above determines the production schedules. Pool production centers together if such is the case for the plant and include fractions of people if necessary.

What is a typical wage or salary for a worker in each of the production centers? Indicate the unit of time for the reported salaries or wages in each center (e.g., per year, per month, per week, per day, per hour).

NUMBER OF FULL-TIME EQUIVALENT WORKERS
(Estimate)

Daily Cheddar Cheese Production Schedules Hours/day for cheese production*	MAY 84 ( )	SEPT 84 ( )	JAN 85 ( )	Average or Typical Wages/Salaries (yr,mo,wk,day,hr)
Receiving room				
Pasteurization room	____	____	____	$________
Starter culture room	____	____	____	________
Cheesemaking room	____	____	____	________
Pressing/Hooping room	____	____	____	________
Cheese chilling room	____	____	____	________
Refrigeration, maintenance and boiler room	____	____	____	________
Laboratory	____	____	____	________
Whey handling center	____	____	____	________
CIP-Cleaning room	____	____	____	________
Waste treatment center	____	____	____	________
Plant Management/ Supervision	____	____	____	________
Clerical production staff support personnel	____	____	____	________
Other________	____	____	____	________
	____	____	____	________
TOTAL FULL-TIME EQUIVALENT WORKERS	____	____	____	

*Get hours/day from last line of question 26.

If you wish to report the following labor information on the basis of a four- or five-week payroll period rather than on a calendar month basis, please specify the time period which applies:

i) covering the month of May 1984
ii) covering the month of September 1984
iii) covering the month of January 1985

Labor figures are for the following periods:

	Beginning			Ending		
i)	______ (month)	____ (day)	1984,	______ (month)	____ (day)	1984
ii)	______ (month)	____ (day)	1984,	______ (month)	____ (day)	1984
iii)	______ (month)	____ (day)	198_,	______ (month)	____ (day)	1985

<u>INCLUDE</u>: People or portion of people involved in receiving raw milk, pasteurizer room, starter culture room, cheesemaking, pressing, hooping and chilling storage room. Also include people in laboratory, whey handling center, plant cleaning, maintenance, engineers, foreman, production clerk, plant manager or superintendent.

<u>EXCLUDE</u>: People or portion of people involved in pre-receiving the milk (fieldman or milk hauler). Also exclude office clean-up, office workers, cheese aging or dry storage room, retail packaging, delivery, sales and marketing personnel.

---

28) Cheese <u>Processing or Manufacturing Labor</u>: Do <u>not</u> include labor in <u>laboratory</u> and <u>whey handling centers</u>. <u>Include</u> hours and wages of both, <u>full-time</u> and <u>part-time</u> workers.

Report the number of hours and total payroll dollars for all production labor from the receiving room to the time when the fresh cheese is moved out of the chilling room. Include labor in receiving, pasteurizing, starter culture, cheesemaking, pressing, hooping, chilling, refrigeration, maintenance and boiler room, CIP, waste treatment center, direct production management and supervision and any other labor involved directly in the production process.

Period	Number of Hours	Payroll (dollars)	(%) Part-time Payroll (estimate)
May 1984	_ _ _,_ _ _	$_ _ _,_ _ _	____
September 1984	_ _ _,_ _ _	$_ _ _,_ _ _	____
January 1985	_ _ _,_ _ _	$_ _ _,_ _ _	____

29) Report the number of hours and payroll dollars for all labor in the <u>laboratory</u>:

Period	Number of Hours	Payroll (dollars)	(%) Part-time Payroll (estimate)
May 1984	_ _ _,_ _ _	$_ _ _,_ _ _	____
September 1984	_ _ _,_ _ _	$_ _ _,_ _ _	____
January 1985	_ _ _,_ _ _	$_ _ _,_ _ _	____

30) Report the number of hours and payroll dollars for all labor in the <u>whey handling center</u>:

Period	Number of Hours	Payroll (dollars)	(%) Part-time Payroll (estimate)
May 1984	_ _ _,_ _ _	$_ _ _,_ _ _	____
September 1984	_ _ _,_ _ _	$_ _ _,_ _ _	____
January 1985	_ _ _,_ _ _	$_ _ _,_ _ _	____

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PLANT PRODUCTION

31) Frequency of raw milk receipts at the plant: (days/week or days/month, whichever is more convenient)

May 1984	____ days/week		____ days/month
September 1984	____ days/week	or	____ days/month
January 1985	____ days/week		____ days/month

32) Total milk receipts and milk utilization at the plant:

	MAY 1984 (pounds)	SEPT 1984 (pounds)	JAN 1985 (pounds)
+ Beginning milk inventory	____	____	____
+ Raw milk received at the plant from all sources	____	____	____
- Milk received and moved to other plants (NOT processed at the plant)	____	____	____
- Milk used in the production of cheese	____	____	____
Cheddar	____	____	____
Colby	____	____	____
Brick	____	____	____
Jack	____	____	____
Muenster	____	____	____
Fresh cheese curd	____	____	____
Mozzarella	____	____	____
Other:	____	____	____
____	____	____	____
____	____	____	____
- Milk used in the production of other dairy products	____	____	____
- Milk inventory at end of the month	____	____	____
- Milk shrinkage	____	____	____

33) Is any standardization of the milk done for the production of cheese? (removing or adding cream or solids-not-fat)

___Yes ___No

If Yes, please answer the following two questions:

a) Indicate if any standardization was done for the milk used in cheddar cheese manufacturing during the following periods:

May	1984	___Yes	___No
September	1984	___Yes	___No
January	1985	___Yes	___No

b) Milk products used or produced at the plant as a result of standardization of milk used for cheddar cheese production:

	Used for standardization (product pounds)	Produced as a result of standardization (product pounds)
Fresh cream:		
May 1984:	____	____
September 1984:	____	____
January 1985:	____	____
Nonfat dry milk:		
May 1984:	____	N/A
September 1984:	____	N/A
January 1985:	____	N/A
Other: ____		
May 1984:	____	____
September 1984:	____	____
January 1985:	____	____

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34) A "plant operating day" is one on which cheese is manufactured at the plant. How many operating days did the plant have in each of the following months?

	Cheese Operating Days
May 1984	____ days
September 1984	____ days
January 1985	____ days

35) Number of vats of cheese produced at the plant:

	May 1984 Vats (number)	September 1984 Vats (number)	January 1985 Vats (number)
Cheddar	____	____	____
Colby	____	____	____
Brick	____	____	____
Jack	____	____	____
Muenster	____	____	____
Mozzarella	____	____	____
Fresh cheese curd	____	____	____
Other:	____	____	____
____	____	____	____
____	____	____	____
TOTAL	____	____	____

36) Pounds of cheese produced at the plant:

	May 1984	September 1984	January 1985
Cheddar	____	____	____
Colby	____	____	____
Brick	____	____	____
Jack	____	____	____
Muenster	____	____	____
Mozzarella	____	____	____
Fresh cheese curd	____	____	____
Other:	____	____	____
____	____	____	____
____	____	____	____
TOTAL	____	____	____

37) Total pounds of cheddar cheese produced at the plant in 1984:

____________ pounds

38) What percentage of the cheddar cheese production was processed directly in the following forms:

	May 1984	September 1984	January 1985
500 pound barrel	____	____	____
640 pounds block	____	____	____
40 pound block	____	____	____
Other ____	____	____	____
____	____	____	____
____	____	____	____
TOTAL	100%	100%	100%

39) Pounds of whey cream produced at the plant:

		Fat (%)
May 1984	________ pounds	____
September 1984	________ pounds	____
January 1985	________ pounds	____

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C O N F I D E N T I A L

We require the following production information for any five operating days (do not need to be consecutive days) in each of the calendar months covered by this survey. Please try to use typical cheddar cheese full production days for your plant. If in the selected days other cheeses were produced, please report the number of vats of cheese manufactured each day:

MAY 1984 - NUMBER OF VATS

	( ) DAY 1	( ) DAY 2	( ) DAY 3	( ) DAY 4	( ) DAY 5
Cheddar					
All other:					
TOTAL					

SEPTEMBER 1984 - NUMBER OF VATS

	( ) DAY 1	( ) DAY 2	( ) DAY 3	( ) DAY 4	( ) DAY 5
Cheddar					
All other:					
TOTAL					

JANUARY 1985 - NUMBER OF VATS

	( ) DAY 1	( ) DAY 2	( ) DAY 3	( ) DAY 4	( ) DAY 5
Cheddar					
All other:					
TOTAL					

40) Weight of the milk used for cheddar cheese production and composition of the milk in the vat:

Period	Day	Date	Pounds of milk plus starter used for cheddar cheese production only	Average fat (milk+starter used for cheddar cheese) (%)	Average protein (milk+starter used for cheddar cheese) (%)
May 1984	1				
	2				
	3				
	4				
	5				
September 1984	1				
	2				
	3				
	4				
	5				
January 1985	1				
	2				
	3				
	4				
	5				

41) Composition of unseparated whey:

Period	Day	Date	Average fat in unseparated whey (%)
May 1984	1		
	2		
	3		
	4		
	5		
September 1984	1		
	2		
	3		
	4		
	5		
January 1985	1		
	2		
	3		
	4		
	5		

42) Total weight and composition of aged cheddar cheese:

Period	Day	Date	Total weight of cheddar cheese produced (pounds)	Moisture (%)	Fat (%)	Salt (%)
May 1984	1					
	2					
	3					
	4					
	5					
September 1984	1					
	2					
	3					
	4					
	5					
January 1985	1					
	2					
	3					
	4					
	5					

43) Composition of other cheese by-products:

Period	Day	Date	Volume of whey cream (pounds)	Percentage fat in whey cream (%)	Volume of whey fines (pounds)
May 1984	1				
	2				
	3				
	4				
	5				
September 1984	1				
	2				
	3				
	4				
	5				
January 1985	1				
	2				
	3				
	4				
	5				

UTILITIES AND SERVICES

44) For the calendar months on which some of the previous information has been reported, or for a four- or five-week period covering those months (whichever is more convenient), please report the following information on utilities:

a) Electric bill:

May 1984: Consumption ______ KW hours
Total cost: $______
Time period which applies: ______

September 1984: Consumption ______ KW hours
Total cost: $______
Time period which applies: ______

January 1985: Consumption ______ KW hours
Total cost: $______
Time period which applies: ______

b) Water bill:

May 1984: Consumption ______________ cubic feet or gallons
Total cost: $ ______________
Time period which applies: ______________

September 1984: Consumption ______________ cubic feet or gallons
Total cost: $ ______________
Time period which applies: ______________

January 1985: Consumption ______________ cubic feet or gallons
Total cost: $ ______________
Time period which applies: ______________

c) Sewer bill:

Basis for determination of cost: ______________

May 1984: Total cost: $ ______________
Surcharge: ______________
Sewer rent: ______________ per ______
Time period which applies: ______________

September 1984: Total cost: $ ______________
Surcharge: ______________
Sewer rent: ______________ per ______
Time period which applies: ______________

January 1985: Total cost: $ ______________
Surcharge: ______________
Sewer rent: ______________ per ______
Time period which applies: ______________

d) Fuel cost:

OIL:

May 1984: Consumption: ______________ gallons
Total cost: $ ______________
Time period which applies: ______________

September 1984: Consumption: ______________ gallons
Total cost: $ ______________
Time period which applies: ______________

January 1985: Consumption: ______________ gallons
Total cost: $ ______________
Time period which applies: ______________

GAS:

May 1984: Consumption: ______________ therms
Total cost: $ ______________
Time period which applies: ______________

September 1984: Consumption: ______________ therms
Total cost: $ ______________
Time period which applies: ______________

January 1985: Consumption: ______________ therms
Total cost: $ ______________
Time period which applies: ______________

OTHER FUEL: Kind ______________

May 1984: Consumption: ______________ in what unit ______
Total cost: $ ______________
Time period which applies: ______________

September 1984: Consumption: ______________ in what unit ______
Total cost: $ ______________
Time period which applies: ______________

January 1985: Consumption: ______________ in what unit ______
Total cost: $ ______________
Time period which applies: ______________

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45) Laboratory services: Amount paid for outside contracted laboratory testing. Do not include testing of individual milk producers.

	Cost	Period
May 1984:	$__________	from ____ (month) ____ (day) to ____ (month) ____ (day)
September 1984:	$__________	from ____ (month) ____ (day) to ____ (month) ____ (day)
January 1985:	$__________	from ____ (month) ____ (day) to ____ (month) ____ (day)

46) Approximately what is the total cost per year for required government certificates or license fees at the plant?
$_ _ _ _,_ _ _ _

COMMENTS (if any): ______________________________

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