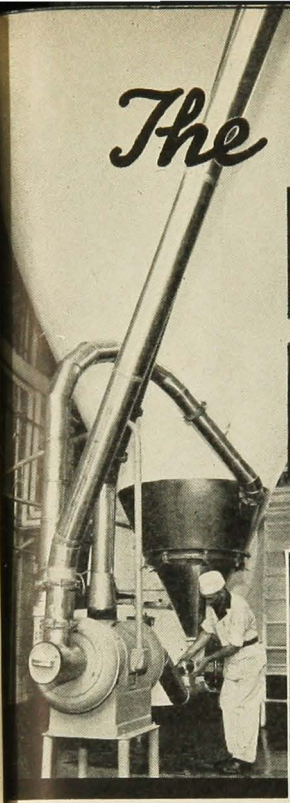
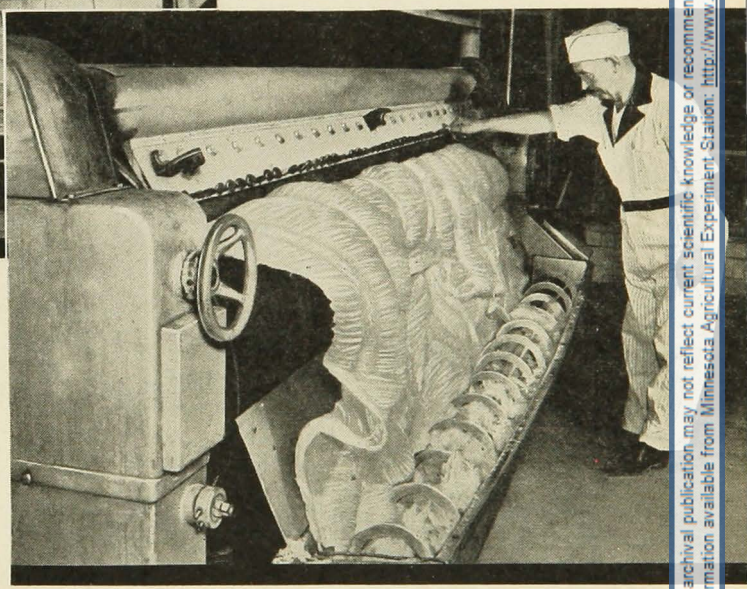
The Minnesota DRY MILK INDUSTRY





by
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Agricultural Experiment Station
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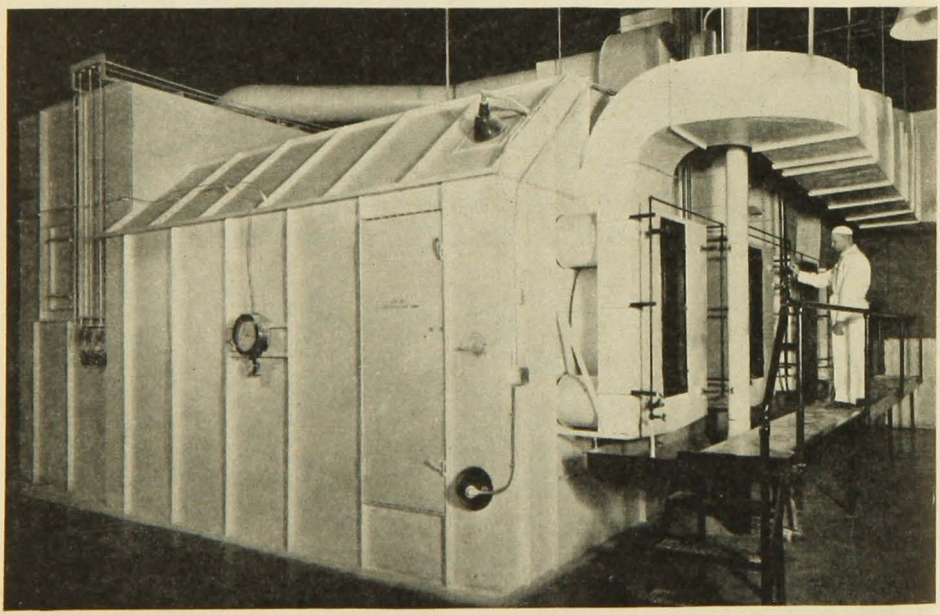


FIG. 1. One type of drier for making spray process dried milk. The front cover shows another type of spray drier (top) and a roller drier.

The Minnesota DRY MILK INDUSTRY

E. Fred Koller[1]

DRY MILK has moved rapidly to the front as a leading war commodity among the dairy products. This product fulfills ideally certain important wartime food requirements in that it includes an unusual combination of valuable food constituents in relatively concentrated form; it can be stored for a considerable period of time and without refrigeration; it can be shipped in a minimum of space; and it can be packaged with little or no use of tin or other critical materials. Because of the importance of Minnesota as a dairy state and the large amount of skim milk and buttermilk available as by-products of its extensive creamery industry, this state is playing a leading part in supplying the wartime demand for dry milk.

IN MEETING the wartime demand for dry milk the Minnesota dairy industry has undergone sweeping changes. It is the purpose of this study to describe these changes and to evaluate the factors involved. If the war continues, it is probable that even greater expansion of this industry will be necessary in this area. This study provides information of value to those who may confront these changes. The study also includes an evaluation of a question of growing concern to Minnesota dairymen: "What are the postwar prospects for this industry?"

The information used in this study was obtained in personal visits to 45 of the larger dry milk plants in the state about May 1, 1943. Information from all other milk drying plants in the state was obtained by mail. The survey schedule and mail questionnaire called for detailed information as to the capacity and dry milk output of the respective plants, sources of milk, problems involved in obtaining milk, prices paid for whole milk and skim milk, market outlets for dried milk products, and prices received for these products. This material was supplemented by statistical reports which these plants make monthly and annually to the Minnesota Department of Agriculture, Dairy and Food.

[1] The author acknowledges the valuable assistance of William H. Dankers of the Division of Agricultural Extension who participated in the field work involved in this study. Appreciation is expressed to dry milk plant managers for their generous cooperation in supplying the basic data.

Wartime Dry Milk Requirements

WARTIME requirements for edible dry milk products have increased at a rate far surpassing the ability of the industry to produce these products. The 1943 requirements were estimated at approximately 700 million pounds of dry milk for our military, lend-lease, and civilian uses. Tentative estimates of 1944 requirements are being placed at about one billion pounds since it is anticipated that large additional quantities of dry milk will be needed to feed the populations of liberated areas in the coming year.

Owing to the reduced rate of output of dry milk thus far in 1943, it has been necessary for the government to limit drastically the portion of the available supplies allocated to the civilian population. Of the estimated 700 million pounds of dry milk required for 1943 there were 210 million pounds to provide for the inclusion of 3 per cent of milk solids in bread (minimum required under Food Distribution Order 1). Inadequate supply has made it necessary to make optional the inclusion of dry skim milk in bakery bread. At one time it was anticipated that, as a phase of the war food program, the dry milk solids content of bread would be raised to the 6 per cent level which would have required in excess of 400 million pounds of dry milk.

In their plans for the fiscal year July 1, 1943 to June 30, 1944, government authorities are counting on total allocable supplies of edible dry milk products of about 665 million pounds (table 1). Of this amount, 468 million pounds, or 70 per cent, have been allocated for war purposes such as military use, lend-lease, foreign relief, and rehabilitation. This leaves 195 million pounds of edible dry milk products for domestic civilian use as compared with apparent civilian consumption of 322 million pounds in 1942, and an average annual consumption of 263 million pounds in the five prewar years, 1935 to 1939. It is apparent that many civilian needs will go unfilled in the year ahead unless unusual strides are made in increasing supplies. The question naturally arises: "Can these large requirements for dry milk be met?"

Table 1. Allocations and Allocable Supplies of Dried Milk Products during the 1943-44 Fiscal Year*

	Dried whole milk	Dried skim (spray)	Dried skim (roller)	Total
		Million pounds		
Total allocable supplies	143.1	291.0	231.2	665.3
Allocations:				
Military and war services	59.4	46.2	15.8	121.4
Lend-lease	38.1	135.8	38.4	212.3
Other exports and shipments†	25.5	19.0	90.0	134.5
U. S. civilian	20.0	90.0	85.0	195.0
Contingency reserve	.....	.....	2.0	2.0
Apparent civilian consumption:				
1942	17.0	305.0		322.0
1935-39 average	17.0	246.0		263.0

*Compiled from "The Dairy Situation" (mimeo), published monthly by the Bureau of Agricultural Economics, U. S. Department of Agriculture, July 1943, page 9.

† Includes Red Cross and foreign relief and rehabilitation.

United States Dry Milk Production

IN MEETING its wartime dry milk requirements, the United States has been fortunate in that it could draw on a sizable milk drying industry established before the war for much of its supplies. For instance, the production of dry skim milk for human use, the principal dry milk product, ranged from 187 million pounds in 1935 to 366 million pounds in 1941 (table 2). In the prewar years, a considerable portion of American dry milk capacity was devoted to the production of dry skim milk for animal feed. With some changes in equipment and special care in processing, much of this capacity becomes available for the production of edible milk powder. The production of dry skim milk for animal feed declined from 160 million pounds in 1940 to 61 million in 1942.

Most of the dry milk produced in the United States is manufactured in the northern dairy belt extending from Minnesota on the west to New York and Pennsylvania on the east. Considerable quantities are produced in California. Ranked in the order of their importance as producers of dry skim milk, the leading states are Wisconsin, New York, and Minnesota (see table 3). Minnesota outranks all the other

Table 2. Production of Four Major Dry Milk Products in the United States, 1935-42*

Year	Dry buttermilk	Dry whole milk	Dry skim milk	
			Human use	Animal feed
	Million pounds			
1935	49.8	19.4	187.5	110.0
1936	50.8	18.2	223.8	125.7
1937	53.1	13.7	244.5	127.7
1938	63.9	21.5	289.1	160.2
1939	62.2	24.5	267.9	140.5
1940	67.9	29.4	321.8	160.0
1941	75.6	45.6	366.0	110.0
1942†	69.4	63.6	565.3	61.0

* Compiled from "Production, by States, of All Manufactured Dairy Products," published annually by Bureau of Agricultural Economics, U. S. Department of Agriculture.
† Preliminary estimates.

Table 3. Dry Skim Milk Production by States, 1938-42*

State	1938	1940	1941	1942†
	Million pounds			
Wisconsin	113.5	118.4	119.7	190.7
New York	68.4	99.2	89.7	88.2
Minnesota	23.1	25.5	34.9	71.0
California	59.9	63.5	57.8	63.7
Michigan	41.9	36.9	31.4	38.9
Idaho	.8	.6	.7	21.8
Ohio	14.1	14.3	13.6	21.2
Pennsylvania	15.2	16.9	17.1	20.1
Indiana	10.2	9.0	11.2	19.2
Missouri	18.2	15.0	18.3	19.1
All other states	84.0	82.5	82.1	72.4
U. S. TOTAL	449.3	481.8	476.5	626.3

* Compiled from "Production, by States, of All Manufactured Dairy Products," published annually by Bureau of Agricultural Economics, U. S. Department of Agriculture.
† Preliminary estimates.

states in producing dry buttermilk.

Since the outbreak of the war there have been significant changes in the dry skim milk production picture. Production in the eastern states with large metropolitan milk markets has tended to decline or level off. The significant increases in production have occurred in the midwestern states, Wisconsin and Minnesota. The 1943 statistics very probably will show further large increases in the dry milk output of these states. Much additional milk drying capacity has been constructed in this area in the past year and much milk has been diverted to the drying industry.

If the large requirements for dry milk are to be met in the year ahead, further increases in output will be necessary in Minnesota and some of the other midwestern states since in this area vast quantities of skim milk are still retained on the farm for feeding livestock (see page 19). Dry milk production in the metropolitan milk sheds of the East and West is declining rapidly this year as the demand for fluid milk in these areas is increasing at a rapid rate under the impetus of improved consumer incomes. Increased demand for other products made from skim milk resulting from the rationing program also has reduced the supplies of skim milk for drying.

Minnesota Dry Milk Production

MINNESOTA has not ranked as an important producer of dried milk products until recent years. Prior to the 1930's only a limited number of driers were in operation in the state. These were engaged largely in producing dried buttermilk, the output of which increased from 2,033,000 pounds in 1921 to 13,656,000 pounds in 1929. Dry skim milk output increased from 361,000 to 8,711,000 pounds in the same period.

In the six-year period from 1937-1942, Minnesota's total dry milk output has more than tripled reaching a total of about 104 million pounds (table 4). The output of dry skim milk for human consumption showed a sevenfold increase in this period. The 1942 output of this product was more than double that of the previous year, which indicates the rapidity with which production has been accelerated to meet wartime demands. The production of dry skim milk for feeding purposes has declined since 1938 as more and more drying facilities have been converted to the production of dry milk for human use. The output of dry buttermilk has continued to expand, but at a greatly reduced rate from 1941 to 1942. It is probable that the output of this product will not increase significantly in the future since the largest proportion of creameries in the state are at present

Table 4. Dry Milk Production in Minnesota, 1937-42*

Year	Total dry milk	Dry skim milk for human use	Dry skim milk for animal feed	Dry buttermilk
		1,000 pounds		
1937	30,072	9,577	7,206	13,289
1938	39,536	13,752	9,301	16,483
1939	38,394	11,454	6,081	20,859
1940	48,964	18,457	7,014	23,493
1941	68,309	29,598	5,327	33,384
1942†	104,050	67,556	3,085	33,409

* Compiled from "Production, by States, of all Manufactured Dairy Products," published annually by Bureau of Agricultural Economics, U. S. Department of Agriculture.
† Preliminary estimates.

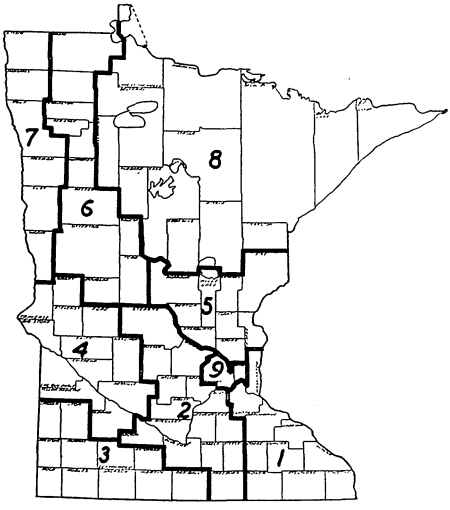


FIG. 2. Type-of-farming areas in Minnesota

drying their own buttermilk or selling it to plants with drying facilities.

Analysis of dry milk output within the state shows the largest volume of production to be in the area which lies within a 100-mile radius of the Twin Cities. As shown in table 5, type-of-farming areas 1, 2, and 5 which border on the Twin Cities (see figure 2), have the largest total output of dry milk products. In this general area the shift to the whole milk basis has been most pronounced in recent years and large quantities of skim milk have been made available for drying purposes. Dry skim milk output in these three areas amounted to 68.2 million pounds or 96.5 per cent of the state total of dry skim. In the remainder of the state total dry milk output is relatively small and the largest part of it is dried buttermilk.

The five leading Minnesota counties in total dried milk production in 1942 were Stearns, 10.7 million pounds; Chisago, 8.1 million; McLeod, 7.4 million; Washington, 7.1 million; and Meeker, 6.9 million. Much of the Stearns County output was in the form of dried buttermilk, the raw material for which was gathered from creameries over a wide area. The dry milk output of the other leading counties is nearly all in the form of dry skim milk for human use.

The annual output of individual drying plants in the state varies widely as shown in table 6. In 28 plants, the output for the year was less than 100 thousand pounds; while in the plant with the largest volume, output amounted to approximately 10 million pounds. It will be observed that in most instances the small-volume plants are those producing dry milk for feed purposes. These plants are local creameries which confine their operations to drying their own buttermilk. The smaller-volume human food driers are also local creameries which have converted their animal feed driers and are drying only buttermilk for human use. The efficiency of the very small-volume drying operation

Table 5. Dry Milk Production by Type-of-Farming Areas in Minnesota, 1942

Type-of-farming area	Total dry milk	Dry skim milk for human use	Dry skim milk for animal feed	Dry buttermilk
		1,000 pounds		
Area 1*	22,518	17,904	972	3,642
Area 2	40,684	18,440	1,379	20,865
Area 3	663	262	.....	401
Area 4	284	.....	.....	284
Area 5	30,541	29,029	470	1,042
Area 6	2,773	.....	.....	2,773
Area 7	4,148	1,247	.....	2,901
Area 8	2,439	674	264	1,501
TOTAL	104,050	67,556	3,085	33,409

* The output for Area 9 has been combined with that for Area 1.

Table 6. Minnesota Dry Milk Plants Classified According to Volume of Dry Milk Output during 1942

Annual output	Total plants	Human food plants*	Animal feed plants
1,000 pounds	Number of plants		
Less than 100	28	2	26
100- 199	17	4	13
200- 399	20	9	11
400- 599	7	6	1
600- 799	5	4	1
800- 999	3	3	.....
1,000-1,999	8	7	1
2,000-2,999	7	6	1
3,000-3,999	2	2	.....
4,000-4,999	2	2	.....
5,000 and over	6	6	.....
TOTAL	105	51	54

* Plants which produce dry milk for both human use and animal feed were classified on the basis of the product with the larger output.

is often very limited. In many cases volume could be increased and efficiency improved by drying the buttermilk of a number of neighboring plants. With larger volume more of the driers could to advantage be shifted to the production of powder for human use.

Classification of Minnesota's dry milk producers into four groups according to type of organization control showed that the two large regional dairy cooperatives serving this area led in total milk powder produced in 1942 by producing 38 million pounds, or 36.5 per cent of the total (table 7). Local cooperative plants manufactured 27.6 million pounds of dry milk during 1942 and local independently controlled plants, 13.5 million pounds.

Table 7. Dry Milk Production of Minnesota Producers Classified According to Type of Organization Control, 1942

Type of organization	Total dry milk	Dry skim milk for human use	Dry skim milk for animal feed	Dry buttermilk
	1,000 pounds			
Two regional dairy cooperatives*	38,044	34,060	473	3,511
Local cooperatives	27,647	19,167	1,218	7,262
National companies	24,805	3,443	1,000	20,362
Local independent companies	13,554	10,886	394	2,274
TOTAL	104,050	67,556	3,085	33,409

* This includes the production of subsidiary companies and affiliated district organizations, but not of local cooperative creameries.

Number, Location, and Type of Plants

IN MAY, 1943, there were 102 drying plants in operation in Minnesota, or the same number as in February, 1942 (table 8). Although there was no change in the total number of plants between these two dates there were, nevertheless, many changes made in order to meet the greatly increased wartime demand for dry milk for human consumption. As the result of new construction and the conversion of animal feed driers there was an increase of 17 plants equipped to dry milk for human use, bringing the total of this type of plant to 57. Animal feed driers decreased by 17 as the result of discontinuances and conversion of equipment for human food production. During the summer and fall of 1943 at least five new plants equipped to produce powder for human consumption will be

Table 8. Number of Dry Milk Plants in Minnesota, February, 1942, and May, 1943

	February 1942	May 1943
Number of human food driers	40	57
Number of animal feed driers	62	45
TOTAL	102	102

completed as will the conversion to food production of at least four more animal feed driers.

Classified according to type of organization control, 67 of the 102 dry milk plants are owned and operated by local cooperatives, in nearly all cases cooperative creameries. Of the 67 local cooperative plants, 35 are producing human food powder and the other 32 are animal feed plants. Fifteen of the 102 plants are locally owned independent plants; 9 plants are controlled by national dairy companies; and 11 are controlled by two regional dairy cooperatives or their subsidiary organizations.

The location of dry milk plants in Minnesota is shown in figure 3. The largest proportion of the plants equip-

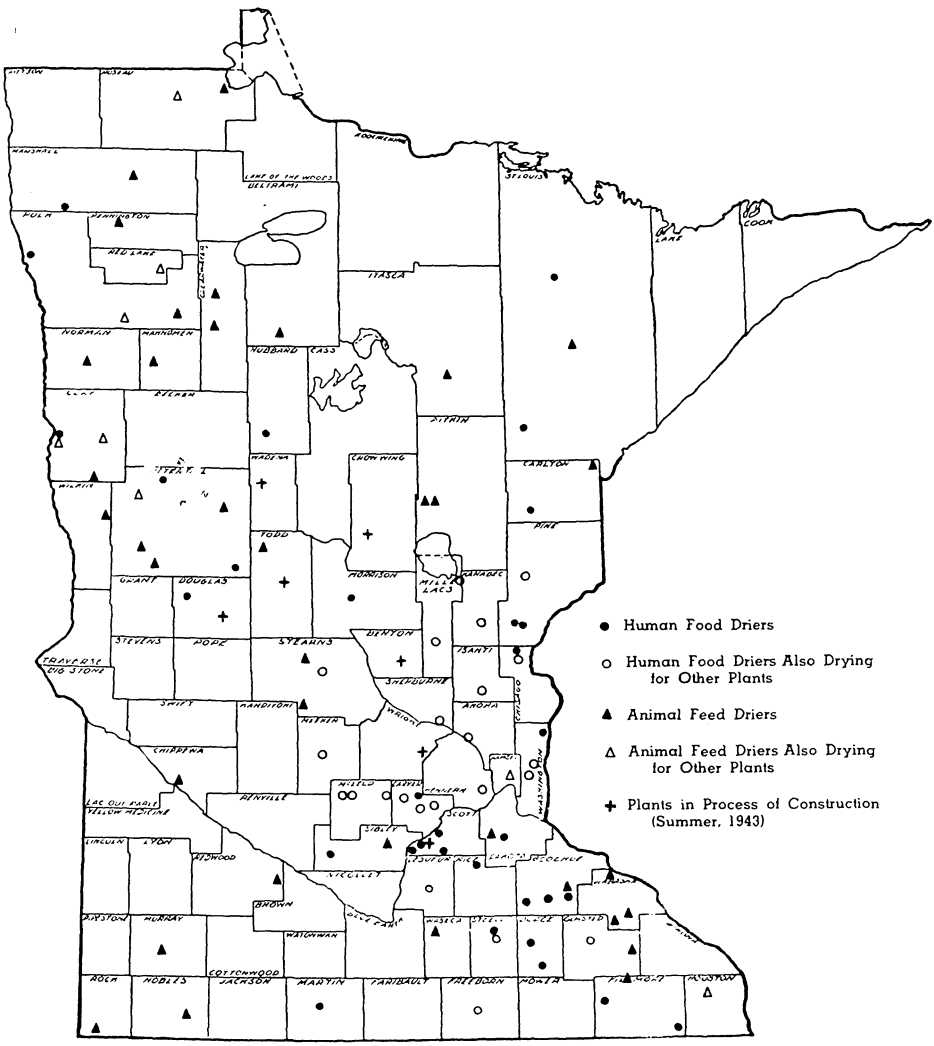


FIG. 3. Location of Minnesota dry milk plants, May, 1943

ped to produce human food are in the southeastern quarter of the state which is also the most intensive dairy area. Figure 3 also shows the location of 23 of the human food driers and 8 animal feed driers which in May, 1943, were drying milk for other dairy plants in addition to their own.

As shown in table 9, by far the largest proportion of the drying equipment in use in Minnesota plants is of the roller type. In May, 1943, 140 roller units were in operation in 97 plants. Most plants had only one of these drying units, but one plant had 6, 3 plants had 4 units, and 8 plants had 3 units. These units varied greatly in size and capacity from small 52-inch rolls with hourly capacities of about 1,200 pounds of fluid milk to the large 120-inch type with hourly milk capacities up to 3,000 pounds. There were 18 spray process units in operation in the state in 10 different plants. Spray process units also varied considerably in size and capacity from the smaller type with an hourly fluid milk capacity of 3,500 pounds to the 9,500 pound per hour units. Roller process equipment was favored in so many plants because of the smaller capital investment and its greater flexibility in handling smaller volume operations. The somewhat more costly spray process equipment has been favored for its finer-texture powder which is desired particularly where dry milk is to be reconstituted for drinking or other purposes.

Table 9. Type of Drying Equipment Used in Minnesota Plants, May, 1943

Type of equipment	Number of plants	Total number of units	In human food plants	In animal feed plants
			Number of units	
Roller process	97*	140	91	49
Spray process	10*	18	18	0

* The total number of plants exceeds 102, or the total in the state, because 5 plants have both roller process and spray process equipment.

Plant Capacity

IN SPITE OF the many wartime priority difficulties involved in obtaining new dehydrating equipment and in converting feed drier facilities to human powder output, the capacity of the industry in Minnesota has been increased significantly in the past year.

Fluid Milk Per Hour

Measured in terms of fluid milk handled per hour, the 102 plants in the state were equipped to handle about 413,000 pounds of fluid milk per hour in May, 1943, as compared with 314,000 pounds in February, 1942, or an increase of 31 per cent (see table 10). The most significant change was in the capacity of human food driers where a 55 per cent increase was effected. The completion of five new plants and the conversion of at least four animal feed driers will add another 47,800 pounds to the hourly capacity of the human food driers sometime before the end of 1943.

The hourly fluid milk capacity of the various drying plants ranged from about 1,200 pounds in the smallest to approximately 34,000 pounds in the largest. As shown in table 11 the hourly capacity of 48 plants was below 2,000 pounds. Most of the plants in the low capacity category are animal feed driers.

It has been possible to effect increases in the hourly fluid capacity of the industry in a number of ways. One method has been the obvious one of adding facilities to an existing plant or building new facilities "from the ground up." Such expansion has been limited by extraordinary difficulties in obtaining the necessary equipment.

Table 10. Capacity, in Fluid Milk Handled per Hour, of Drying Plants in Minnesota, February, 1942, and May, 1943

	February, 1942*		May, 1943		Per cent increase
	Number of plants	Pounds of milk per hour	Number of plants	Pounds of milk per hour	
Human food driers	40	216,175	57	335,505	55.2
Animal feed driers	62	97,880	45	77,590	20.7†
TOTAL	102	314,055	102	413,095	31.5

* Data from a study of dry milk output and capacity in Minnesota by the divisions of Agricultural Economics and Agricultural Extension in February, 1942.

† Decrease.

Among the more important new dry milk installations which have been completed since our entry into the war have been those at Litchfield, Milaca, Sandstone, Brainerd, Belle Plaine, and Owatonna.

Another method of increasing hourly fluid capacity has been that of improving the efficiency of existing dehydrating facilities and eliminating certain plant bottlenecks. A considerable number of plants have increased fluid milk dried per hour by the addition of preheaters and precondensers. As of May, 1943, only 28 out of 57 human food driers were preheating their milk immediately before drying and only 10 plants were precondensing their milk. A considerable increase in hourly capacity could be effected by the relatively simple expedient of installing preheaters in all the plants drying skim milk for human consumption and condensing equipment in some of the large-volume plants. Hourly fluid capacity also could be increased by various adjustments in plant operations and equipment such as maintaining proper flow of milk into the driers, adjusting and sharpening roller knives, polishing rollers, regrinding badly pitted rollers, and proper steam control.[2] A frequent bottleneck is the lack of enough steam generating equipment, a type of equipment which has been particularly difficult to obtain because of the many war demands.

Table 11. Classification of Drying Plants According to Hourly Fluid Milk Dehydrating Capacity, May, 1943

Fluid milk capacity per hour in pounds	All plants	Human food plants	Animal feed plants
	Number of plants		
Less than 2,000	48	13	35
2,000- 3,999	27	20	7
4,000- 5,999	6	4	2
6,000- 7,999	8	7	1
8,000- 9,999	3	3	0
10,000-19,999	7	7	0
20,000 and over	3	3	0
TOTAL	102	57	45

Estimates by roller plant operators of increases in capacity which might be effected by improvements in equipment ranged from 10 to 100 per cent. This possibility should be borne in mind when further increases in the output of the industry are sought. Some of that increase could be obtained by adjustments in existing plants which would be more economical of critical war material than entirely new plants. Furthermore, such adjustment would provide additional output sooner than if new plants were constructed.

Output Per Day

Another measure of capacity is normal daily powder output when driers are operated 20 to 22 hours a day, or continuously except for cleaning time.

[2] Since this is not a discussion of technical operations, only the more obvious changes have been mentioned.

Table 12. Estimated Daily Dry Milk Output at Maximum Capacity, Actual (May 1, 1943) and at Peak of Flush Season in 102 Minnesota Plants

	Maximum capacity	Actual May 1, 1943	Flush season, 1943
		Pounds	
Human food driers	618,000	447,500	568,200
Animal feed driers	130,100	41,600	61,400
ALL DRYING PLANTS	748,100	489,100	629,600
		Per cent of maximum capacity	
Human food driers	100.0	72.4	91.9
Animal feed driers	100.0	32.0	47.2
ALL DRYING PLANTS	100.0	65.4	84.2

As shown in table 12 the estimated daily output, if all plants had been operated at full capacity, would have been about 748,100 pounds of dry milk. Actual daily dry milk output of all plants about May 1, 1943, was approximately 489,100 pounds, or about two thirds of maximum capacity. It will be observed that on the average the animal feed driers were operating at slightly less than one third of capacity while human food driers were at the 72 per cent level.

It was estimated that daily powder output at the peak of the flush season would be about 629,600 pounds in all plants combined, or 84 per cent of maximum capacity. The human food driers estimated that at the peak of the flush season they would be producing at 92 per cent of capacity.

Individual plants varied considerably in the percentage that their May 1 and flush season daily output was of their maximum daily output. On May 1, 1943, one animal feed and 10 human food driers were operating at 100 per cent of capacity, or 20 to 22 hours a day exclusive of cleaning time (table 13). In contrast, 27 animal feed and 3 human food driers reported that their May 1 output was less than 20 per cent of the maximum possible daily output.

It will be noted that at the peak of the flush season 35 human food and 3 animal feed plants expected to be operating at maximum capacity. During the flush season, the milk supplies of most of these plants were in excess of their available facilities, making it necessary to divert milk to other uses or to send it to other drying plants or to casein plants. Among the human food driers, only the 19 plants expect-

Table 13. Minnesota Dry Milk Plants Classified as to Percentage May 1 and Flush Peak Output Are of Maximum Capacity, 1943

Per cent of capacity	May 1 output		Flush peak output	
	Animal feed driers	Human food driers	Animal feed driers	Human food driers
		Number of plants		
0-19	27	3	9	1
20-39	9	8	22	7
40-59	6	9	3	1
60-79	2	16	7	6
80-89	0	6	0	4
90-99	0	5	1	3
100	1	10	3	35
TOTAL	45	57	45	57

Table 14. Daily Dry Milk Output Reported by 102 Minnesota Plants about May 1, 1943

Product	Roller process	Spray process	Total	Per cent of total output
		Pounds per day		
Dry skim milk (human food)	215,800	152,000*	367,800	75.2
Dry skim milk (animal feed)	2,600	400	3,000	0.6
Dry buttermilk (human food)	56,500	13,500	70,000	14.3
Dry buttermilk (animal feed)	48,300	0	48,300	9.9
TOTAL by process	323,200	165,900	489,100	100.0
PER CENT by process	66.1	33.9	100.0	

* A small quantity of dried whole milk is included in this total.

ing to operate below 90 per cent of capacity in the flush season had considerable excess capacity which could have been used to produce food needed in the war effort. With appropriate planning and further coordination among plants, much of the capacity of these plants could have been used to advantage. Seven of the human food driers operating below 40 per cent of capacity were drying only their own buttermilk. With such critical shortages of dry milk products, every effort should be made to direct additional buttermilk or skim milk supplies to these plants. Competitive difficulties between plants have often handicapped the full utilization of these facilities.

On both May 1 and at the height of the flush season, the largest proportion of animal feed driers were operating far below full capacity. Usually these driers operated only 5 to 10 hours a day on 3 days of the week in drying their own buttermilk. Considerable improvement in efficiency in drying could be effected by assembling enough milk for a larger volume of output.

Type of Dry Milk Produced

Under the wartime food program, a great deal of emphasis has been given to obtaining dry milk for human consumption. Table 14 provides a summary of the types of dry milk being produced daily by Minnesota plants about May 1. Of the total dry milk produced each day, about 75 per cent was dry skim milk for human consumption. Of the dry skim milk for human use, 152,000 pounds, or 41 per cent, was of the spray process type. Approximately 14 per cent of the total daily output was dry buttermilk for human consumption.

Analysis of daily output according to the process employed shows that 323,200, or two thirds, was roller process product. Only one third of the output was spray process powder. Spray process powder has been desired for many war purposes because it can be reconstituted more satisfactorily than roller process milk and hence has been sought for shipment to areas where fluid milk is difficult to obtain.

Milk Supplies

ALTHOUGH Minnesota ranks second among the states in total milk production, numerous problems have been encountered in obtaining the large supplies of milk needed for drying purposes. As shown in table 15, the largest proportion of milk produced in the state has in past years been sold to dairy plants on the cream basis and relatively little as whole milk. Under this system, the skim milk has been retained on the farm for feeding hogs, calves, and poultry. The manufacture of dry milk products has necessitated

Table 15. Production and Disposition of Milk in Minnesota, 1935-42*

Year	Milk sold to dairy plants			Used on farm and sold at retail	Total production
	As cream†	As whole milk	Total to dairy plants		
	Millions of pounds				
1935	5,504	682	6,186	1,198	7,384
1936	5,746	814	6,560	1,185	7,745
1937	5,560	925	6,485	1,161	7,646
1938	5,982	1,030	7,012	1,163	8,175
1939	6,052	973	7,025	1,135	8,160
1940	6,140	1,213	7,353	1,052	8,405
1941	6,353	1,450	7,803	1,021	8,824
1942‡	6,244	1,877	8,121	969	9,090

* Compiled from U.S.D.A. "Agricultural Statistics." ‡ Preliminary estimates.
† Milk equivalent basis.

a shift from the long-established system of delivering cream to dairy plants to the delivery of whole milk. The shift to the whole milk basis has involved important changes especially in farm feeding practices and in the equipment and operation of dairy plants.

Shift to the Whole Milk Basis

Table 15 shows that in spite of the difficulties involved a considerable shift to the whole milk basis has occurred in recent years and particularly since the outbreak of the war. Of the 8,121 million pounds of milk (milk equivalent basis) delivered to dairy plants in 1942, 1,877 million pounds, or 23.1 per cent, was sold as whole milk. This is more than double the average deliveries of whole milk during the 5-year period immediately preceding the war, 1935 to 1939. While some of this increase is due to sales of whole milk to cheese factories and other dairy plants, the largest proportion of the increase is

FIG. 4. Tank trucks are used to transport milk from creameries to central drying plants

attributable to expansion of the dry milk industry. Indicative of the change, the skim milk in about 954 million pounds of the whole milk delivered in 1942 was dried as compared with only 152 million pounds in 1935.

Whole milk deliveries are most important in the area which lies within a 100-mile radius of the Twin Cities (figure 5). In this general region, there were 14 counties in 1942 in which over two thirds of the receipts of dairy plants were on a whole milk basis. In 1941 there were only four counties in which whole milk receipts exceeded two thirds of the total.

Counties in which some of the most significant shifts to the whole milk

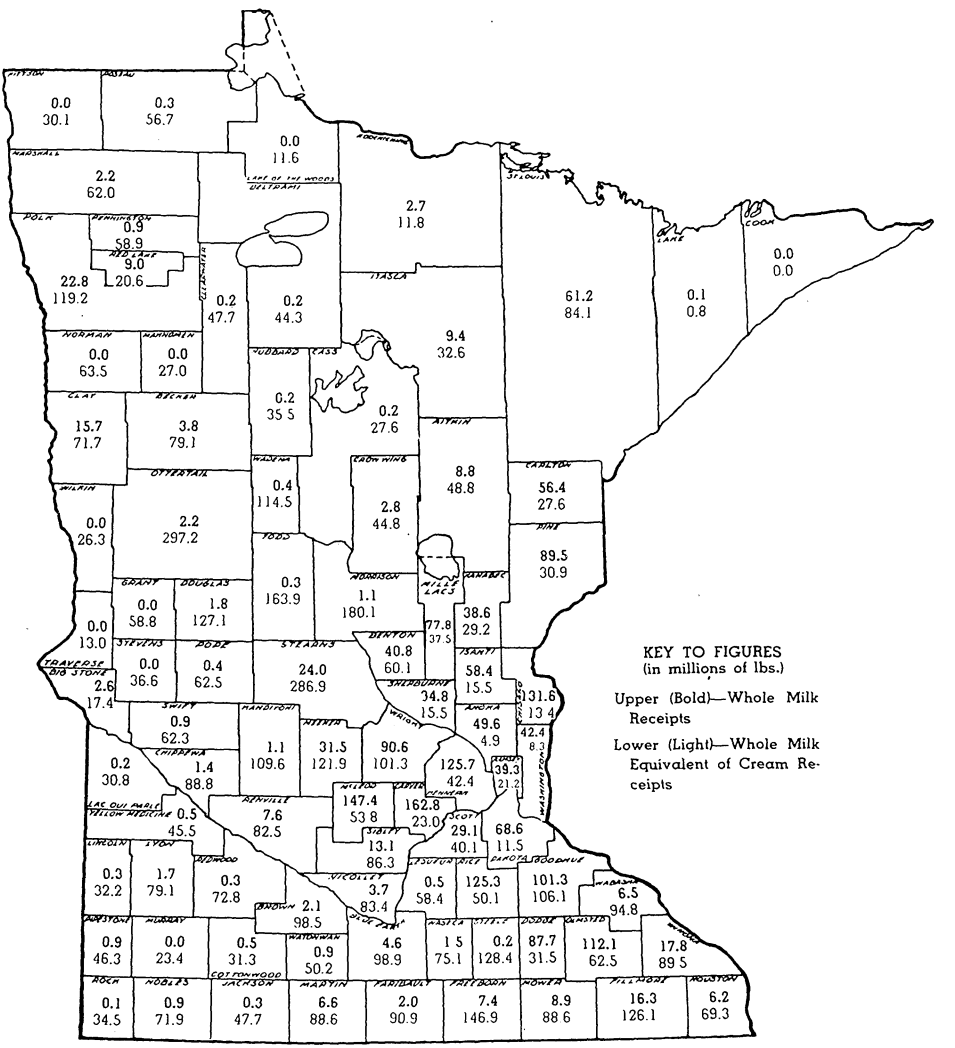


FIG. 5. Dairy receipts of Minnesota plants, 1942
(Compiled from "Minnesota Dairy Products—1942," Minnesota Cooperative Reporting Service)

basis were made during 1942 were Mille Lacs, Chisago, Pine, and Wright. Thus far in 1943 important shifts to the whole milk basis are being made in Morrison, Crow Wing, Benton, Meeker, Wright, and McLeod counties. In these areas an increasing volume of milk is being taken by a number of new or enlarged drying plants.

Milk Supplies of Drying Plants

Plants in this region which produce dry skim milk for human consumption follow two general systems in assembling milk, some receiving it directly from farmers and others from creameries in their supply area. Out of 49 plants which dry skim milk, 26 received all of their supplies directly from farmers and separated it for drying in their own plants.[3] Thirteen additional plants received at least part of their supplies on this basis. Twenty-three plants obtained all or part of their milk from creameries which had assembled it from farmers and forwarded it by tank truck. As of May 1, 1943, these 23 plants were receiving milk from 108 creameries of which 95 sold skim milk and 13 whole milk to the central drying plant.

Drying plants vary considerably as to the number of creameries from which they assemble milk. One plant with a fleet of 21 tank trucks gathered buttermilk from 129 creameries and skim milk from 9 plants. Another large drying plant assembled skim milk from 24 creameries and buttermilk from 34 creameries in its territory. In most instances, the plants drying for others handled the milk of not more than one to 10 plants besides their own. This milk assembly arrangement is an effective way of increasing the volume of a drying plant thereby utilizing more fully its capacity and increasing its efficiency. This advantage is offset in varying degrees by the additional cost of hauling milk from outlying creameries, cost of handling milk, and the cost of equipping creameries with milk plant facilities. Some plant operators and others also object to the indirect creamery assembly of milk because of the increased possibilities of quality deterioration under this system.

Proportion of Milk Received as Whole Milk

Drying plants and creameries which sell milk to these plants show considerable differences in the proportion of their milk supplies which are received on a whole milk basis. The success of a drying enterprise depends largely upon the willingness of dairy farmers in the area to shift to the whole milk basis. Table 16 shows the proportion of milk received in the form of whole milk in 131 creameries and drying plants in the first three months of 1943. In 32 plants, from 90 to 100 per cent of all receipts were in the form of whole milk, while in 12 plants, less than

Table 16. Classification of 131 Minnesota Dairy Plants According to Proportion of Receipts in Whole Milk, First Quarter, 1943

Whole milk receipts*	Creameries selling milk to drying plants	Drying plants receiving from farmers	All plants
Per cent	Number of plants		
0- 9	3	0	3
10-19	5	0	5
20-29	3	1	4
30-39	8	3	11
40-49	13	3	16
50-59	9	3	12
60-69	11	1	12
70-79	11	3	14
80-89	17	5	22
90-100	17	15	32
TOTAL	97	34	131

* In calculating the proportion of whole milk receipts to all receipts, the total receipts include whole milk receipts and the milk equivalent of cream receipts.

[3] In one plant a small quantity of separated skim milk was purchased directly from farmers.

30 per cent of all receipts were in this form. The weighted average proportion of whole milk receipts in all plants combined was about 70 per cent.

A number of factors account for the variation in the proportion of whole milk receipts among plants including (1) the length of time the plant has been on the whole milk basis; (2) the need of milk for feeding purposes; (3) the prices which farmers receive for whole milk relative to the prices of butterfat, livestock, and other farm products; (4) other milk diversion difficulties such as obtaining equipment for holding, cooling, and transporting the larger volume of fluid in whole milk; and (5) initiative exercised by plant managers and others in inducing and helping farmers to shift.

Analysis of the whole milk receipts of 34 plants which have shifted to the whole milk basis within the past year shows that only 43 per cent of their receipts were in this form. In contrast, the drying plants and creameries selling to drying plants which have been receiving whole milk for a year or more showed whole milk receipts equal to 75 per cent of the total. These comparisons indicate that the shift to whole milk tends to take place gradually. When a plant installs milk equipment, there is usually a large group of farmers who wait to see what results may be obtained under the new arrangement or who have difficulty in adjusting their farm operations to the change. Adjustments in feeding with little or no skim milk have been particularly difficult for many farmers.

One of the most important factors retarding the shift to whole milk has been the actual or assumed need of skim milk for feeding purposes. This problem has been particularly aggravated in the past year by protein shortages which have led farmers to place a very high value on skim milk as a protein supplement. In consequence, many of the plants receiving whole milk in the heavier livestock producing areas in southern and south central Minnesota are obtaining a small part of their total receipts in this form.

Long established feeding practices are also retarding the shift to whole milk in some of the heaviest milk producing areas in the state. Much skim milk probably is wasted in overfeeding. The fact that farms in old whole milk areas and large hog farms get along with little or no skim milk suggests that this is not an indispensable feed. Experiments conducted by T. W. Gullickson of the Dairy Division, University of Minnesota, show that many dairy calves have been fed more milk than they actually need. Gullickson says, "By application of the newer facts relating to nutrition, it has been found possible to reduce greatly the quantity of milk required to raise a calf successfully. Where formerly a total of 2,000 pounds or even more of milk was needed to raise a calf, recent experiments have shown that satisfactory results may be obtained by feeding as little as 150 pounds of whole milk. It is recommended, however, that the average dairy farmer feed each calf from 350 to 500 pounds, about half of which may be in some form of either skim milk or buttermilk."[4]

Prices Paid Farmers for Milk

Prices which are paid farmers for milk are particularly significant in determining the proportion of whole milk receipts of a dairy plant. Prices of whole milk relative to prices of butterfat in cream and to prices of livestock and other farm products must be considered in explaining variations in whole milk receipts.

Comparison of prices paid producers for milk to be used in drying is dif-

[4] Gullickson, T. W., "Facts About the Value of Milk for Dairy Calves," (mimeo.) 2 pages, University of Minnesota.

ficult because of varying methods of payment used by different plants. A large majority paid a certain amount for each pound of butterfat and allowed an additional amount for skim milk, the skim milk content being calculated arbitrarily at 80 per cent of the weight of whole milk. Thus if butterfat was quoted at 55 cents and skim milk at 80 cents per hundredweight, a hundredweight of 3.5 per cent milk would result in a payment of $1.92 for the fat and $0.64 for the skim milk content, or a total of $2.56. A number of plants paid a certain amount for each pound of butterfat, but made other arbitrary allowances such as 90 and 100 per cent for skim milk in a hundredweight of whole milk. Other plants paid only for the fat in milk, at higher quotations, but made no separate allowance for skim milk content. As far as could be ascertained, only one of the drying plants and none of the creameries selling to driers were making price adjustments to producers for variations in solids-not-fat.[5] With the rapidly increasing importance of solids-not-fat relative to fat in milk the more equitable method of pricing in which variations in solids-not-fat are considered should be adopted by all plants which buy whole milk. Likewise consideration should be given to differences in quality of whole milk.

Prices quoted for butterfat and for skim milk also vary widely from plant to plant which further handicaps price comparison. A review of March, 1943, milk prices of 104 plants from which quotations were available showed 43 different price combinations ranging from one of 52 cents per pound butterfat and 55 cents per hundred of skim milk to one of 59 cents for butterfat and 80 cents for skim milk.

Skim milk quotations in the first three months of 1943 varied as shown in table 17. Eighty per cent of the March prices for skim milk were 75 cents per hundredweight or over. There was a tendency to quote skim milk prices in the higher ranges and to be less liberal on butterfat payments. This policy was probably followed to encourage patrons to shift to whole milk. In choosing between plants, the patron should consider not only the skim milk quotation, but the complete net return for a given test of whole milk.

Table 17. Classification of Drying Plants and Creameries Selling to Driers According to Prices Paid Farmers per Hundredweight of Skim Milk during the First Quarter, 1943

Price per cwt.	January	February	March
	Number of plants reporting		
$.50-.54	1	0	0
.55-.59	3	2	1
.60-.64	2	3	4
.65-.69	5	9	5
.70-.74	16	13	11
.75-.79	46	41	40
.80-.84	24	29	35
.85-.89	1	4	7
.90-.94	0	0	1
TOTAL	98	101	104

Calculation of the prices being paid per hundredweight of whole milk testing 3.5 per cent showed March quotations ranging from a low of $2.30 to a high of $2.80 (table 18). About 75 per cent of the plants were quoting prices of $2.45 to $2.64 for milk to be used in drying in March. The average price paid by 115 plants in March was $2.53 per hundredweight and only slightly above the quotations for the two previous months. In a number of cases the prices quoted in table 18 will be supplemented by small patronage dividends or other distributions at the end of the year or at some future time. In most cases it was estimated that these distributions would amount to about $0.05 to $0.10 per hundredweight.

Quotations for 3.5 milk varied con-

[5] Nearly all of the large central drying plants paid their supplying creameries on the basis of the solids-not-fat content of their skim milk and buttermilk.

Table 18. Classification of Drying Plants and Creameries Selling to Driers According to Prices Paid to Farmers for 3.5 Milk during the First Quarter, 1943

Prices per cwt.	January	February	March
	Number of plants reporting		
$2.25-2.29	2	0	0
2.30-2.34	4	6	5
2.35-2.39	7	4	4
2.40-2.44	14	15	7
2.45-2.49	29	22	19
2.50-2.54	23	28	30
2.55-2.59	14	16	19
2.60-2.64	8	15	20
2.65-2.69	3	1	6
2.70-2.74	4	4	2
2.75-2.79	0	2	2
2.80-2.84	0	0	1
TOTAL	108	113	115
AVERAGE price	$2.50	$2.52	$2.53

siderably by areas within the state. The highest average prices were quoted in type-of-farming areas 1 and 2 covering the entire southeastern quarter of the state where average March prices were $2.58 (table 19). In these areas the competition between plants for milk supplies has been more intense which is reflected in higher quotations to attract patrons. The large demand for skim milk in feeding the large livestock population in this area is also a factor in forcing prices to a higher level than, say, in areas 5 and 8. Lowest prices for milk were reported in area 7 owing in part to the transportation differential and less competition for milk supplies. Then, too, the plants in this area were relatively new small-volume plants in which output was considerably below maximum capacity. This limits the efficiency with which plants can operate and consequently the prices which can be paid for milk.

Other Factors in Shift to Milk

An occasionally reported deterrent to milk diversion has been the difficulty farmers have experienced in obtaining certain equipment including the extra milk cans required, additional milk coolers, and the extra trucks needed to transport milk. As far as could be observed, these problems have been solved rather promptly and consequently have played no major part in delaying the shift to whole milk.

Table 19. Average Prices Paid Farmers for 3.5 Milk by Drying Plants and Creameries Selling to Driers According to Type-of-Farming Areas in Minnesota, First Quarter, 1943

Type-of-farming area*	January	February	March
Area 1	$2.54	$2.56	$2.58
Area 2	2.55	2.56	2.58
Area 3	.....†	.....†	.....†
Area 4	2.49	2.53	2.53
Area 5	2.45	2.47	2.49
Area 6	none	none	none
Area 7	2.33	2.35	2.36
Area 8	2.37	2.42	2.44
ALL AREAS	2.50	2.52	2.53

* For map of areas see figure 2.
† Only one plant was receiving milk for drying in this area.

Potential Milk Supplies for Drying

ALTHOUGH there has been a large shift to the whole milk basis of dairying in Minnesota, the state continues to be one of the leading sources of milk supplies which may be used in drying. One of the best indicators of potential milk supplies for drying is the quantity of milk sold to dairy plants on the cream basis. Under this system of dairying, the by-product skim milk is left on the farm and is used to feed calves, hogs, and poultry. The skim milk which might have been obtained from this source in 1942 was 5,432 million pounds in Minnesota, or approximately 20 per cent of the United States total (table 20). Other states having large quantities of skim milk from this

Table 20. Estimated Skim Milk Remaining on Farms in Selected States, 1942

State	Skim milk remaining on farms*	Per cent of U. S. total
	Million pounds	
Five leading states:		
Minnesota	5,432	19.6
Iowa	4,452	16.1
Nebraska	1,763	6.4
Kansas	1,637	5.9
North Dakota	1,549	5.6
Other important dairy states:		
Wisconsin	609	2.2
New York	97	.3
California	522	1.9
Pennsylvania	91	.3
All other states	11,578	41.7
U. S. TOTAL	27,730	100.0

* Skim milk remaining on farms was calculated by taking 87 per cent of the whole milk equivalent of cream delivered to dairy plants. Data were obtained from "Farm Production, Disposition and Income from Milk, 1941-42," Bureau of Agricultural Economics, U.S.D.A., April, 1943.

source are midwestern states including Iowa, Nebraska, Kansas, and North Dakota. It will be noted that in the leading dairy states such as Wisconsin, New York, California, and Pennsylvania, the change to whole milk deliveries is almost complete and only negligible quantities of skim milk remain on farms.

The quantities of skim milk remaining on Minnesota farms in 1942 are shown by counties in figure 6. The largest amounts are found in the dairy belt extending diagonally across the state from the southeastern to the west central part. Otter Tail and Stearns counties each had approximately one fourth of a billion pounds.

It must be recognized that not all of the skim milk remaining on farms is immediately available for drying since large quantities are needed for feeding purposes. This is especially true at present because of the limited supply of commercial protein supplements. However, with appropriate financial inducements and a program to assist producers who sell whole milk in obtaining commercial proteins, it will be possible to release large supplies of skim milk for drying in a number of areas in the state. Assuming that adequate substitute proteins could be obtained and that under such circumstances skim milk requirements as an over-all average could be reduced to 500 pounds for each dairy calf,[6] 10 pounds per hen, and 1.5 pounds per pound of hog produced, the total requirement for the state would be about 3,556 million pounds of skim milk.[7] With 4,877 million pounds of skim milk remaining on farms,[8] this would leave 1,321 million pounds available for sale to driers (table 21). With

Table 21. Estimate of Skim Milk Required for Feeding under Certain Assumptions and Probable Surplus for Sale by Types-of-Farming Areas in Minnesota, 1942

Type-of-farming area*	Skim milk remaining on farms†	Total required for feeding‡	Probable surplus for sale
		Million pounds	
Area 1	596	535	61
Area 2	1,259	1,035	224
Area 3	521	697	176§
Area 4	590	551	39
Area 5	335	199	136
Area 6	819	269	550
Area 7	323	117	206
Area 8	362	111	251
Area 9	55	42	13
Not allocated	17	.....	17
STATE total	4,877	3,556	1,321

* For a map of areas see figure 2.
† Compiled from "Minnesota Dairy Products—1942," (mimeo.) published by the Minnesota Cooperative Reporting Service.
‡ It was assumed that skim milk requirements as an over-all average could be reduced to 500 pounds for each dairy calf, 10 pounds per hen, and 1.5 pounds per pound of hog produced.
§ Deficit.

[6] During 1942 an additional amount of whole milk averaging 150 pounds per head was fed to calves. In the above estimate it is assumed that this amount would continue to be used.

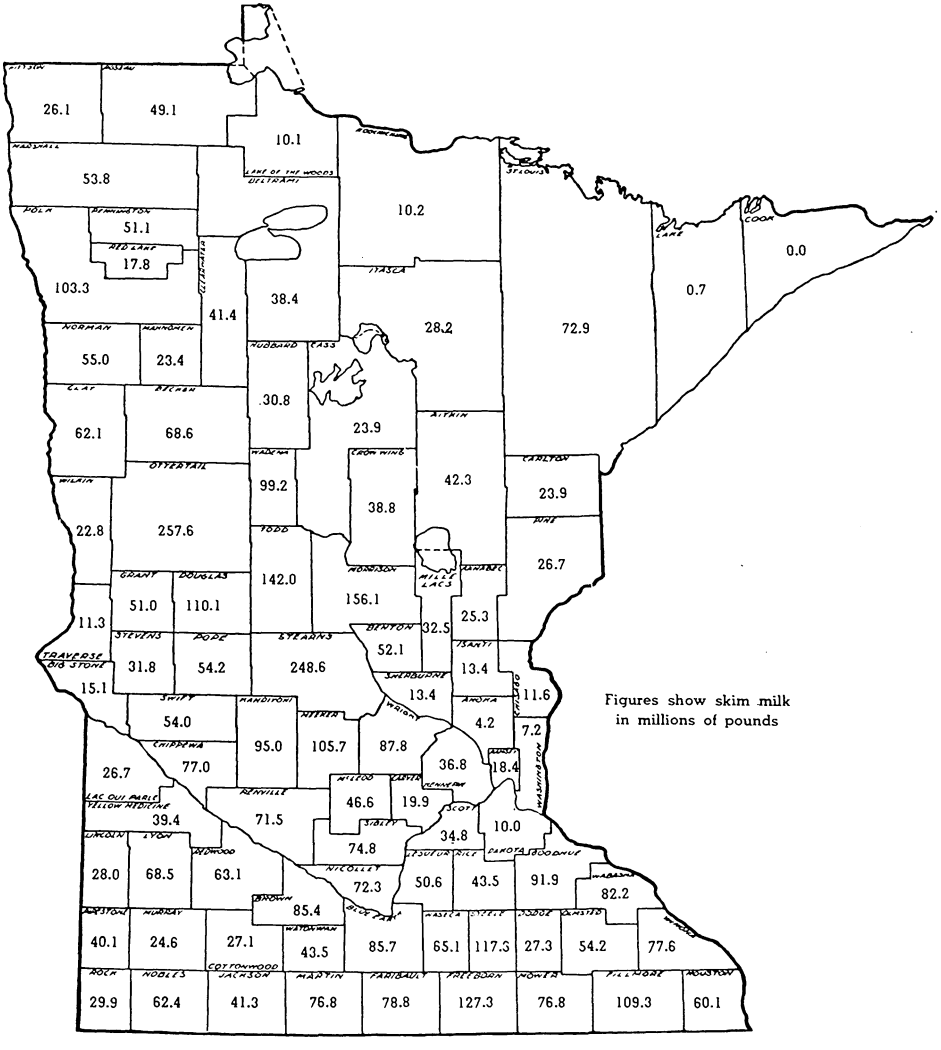
[7] The amount of skim milk used in feeding might likewise be reduced by a price or subsidy policy which would make whole milk dairying relatively more profitable than hog and poultry production thus reducing the demand for proteins in feeding this type of livestock.

[8] The reader will observe a discrepancy between the estimated amount of skim milk remaining on farms in table 20 and table 21 because it was necessary to obtain the data from two sources which differed in their statistical procedures. The data in table 21 are probably somewhat more satisfactory since they are based on complete reports from all dairy plants in the state and were prepared at a later date than those in table 20.

average yields, this quantity of milk should produce about 112 million pounds of powder or more than the state's total output in 1942.

On the basis of the foregoing assumptions, the areas in which significant surpluses of skim milk over the estimated feed requirements may be found are type-of-farming areas 6, 7, and 8 in the northwestern and northern parts of the state (table 21). Other large quantities may be found in area 2 in the south central part of the state. In areas 1, 5, and 9 a large shift to whole milk has already occurred.

The quantities of skim milk avail-



Figures show skim milk in millions of pounds

FIG. 6. Skim milk remaining on Minnesota farms, 1942

(In a few counties with large inshipments of cream, such as Ramsey and Hennepin, the estimate of skim milk remaining on farms is probably too high)

able by areas probably did not change much during 1943. Most of the increased use of skim milk in drying in 1943 occurred in areas 1, 2, and 5.

It may be concluded that one of the best areas for further diversion of milk to drying plants is area 6. This area has large quantities of relatively high quality milk available in well-concentrated localities. For the most efficient assembly and processing of milk, these are very important considerations. Although much milk may be obtainable in areas 7 and 8, there are some special problems involved in shifting dairying to a whole milk basis. Parts of area 7 are not specialized dairy areas and a considerable amount of lower grade cream is sold which indicates that difficult quality problems would be confronted if dry milk expansion were to be undertaken. Much of area 8 would not be desirable for whole milk development since typically the dairy herds are small and scattered over a large territory which would present some difficult transportation problems.

Very large quantities of skim milk remain on the farms of southeastern Minnesota, in areas 1 and 2. Some of these supplies may be tapped immediately without creating difficult feeding problems. If in the course of the war large additional quantities of milk of high quality are needed, they may be obtained from these areas, but increasing provisions must be made to substitute high protein supplements for the skim milk.

Among the less favorable areas for dry milk expansion in the state is area 3 where the demand for skim milk as feed exceeds available supplies.

In general, large potential supplies of milk for drying are available in Minnesota. For the best future development of the dairy industry in this state, it will be well to locate new facilities in the areas with the best supply conditions. In determining dry milk plant locations careful consideration should be given to the adequacy of milk supplies in the immediate area, favorable transportation, the demand for skim milk as feed, and competition from other whole milk plants.

Cost of Dry Milk Plant Operation

OPERATING COSTS of a number of milk drying plants in Minnesota are shown in table 22. These costs, including the cost of packaging, but excluding payments for milk, ranged from slightly less than 2 cents per pound of powder to approximately 3.5 cents, calculated on an annual average basis. The operating costs of human powder plants average higher than those of plants producing animal feed powder. Among the reasons for this are the higher sanitary requirements which necessitate the use of better equipment, more labor, and more costly packaging. The operating costs of a number of spray process plants included among the human food driers tended to raise the average cost for this group.

The per pound costs of dry milk plants are affected significantly by the volume of business, tending to decline as output increases. One plant manager indicated that average costs were about

Table 22. Classification of 55 Minnesota Dry Milk Plants According to per Pound Costs of Operation, 1942

Cost per lb. of dry milk	Human food plants	Animal feed plants
Cents	Number of plants	
Less than 2.00	2	3
2.00-2.24	7	3
2.25-2.49	4	4
2.50-2.74	12	4
2.75-2.99	2	3
3.00-3.24	8	2
3.25 and over	1	0
TOTAL	36	19

1.15 cents per pound when the plant was operated 20 to 22 hours a day compared with nearly 3 cents a pound in the season of low output. Other plants may show even wider variations depending on the changes in their volume from the seasonal high to the seasonal low. The 1942 operating costs show the favorable effects of the large volume of output in that year. Although 1943 volume has been large, cost figures for the first quarter operations in a few plants have tended to be higher owing to increased labor and supply outlays.

The per unit costs shown in table 22 are necessarily approximations as most plants have not developed careful cost accounting techniques in arriving at their per unit cost figures. These calculations are particularly difficult when dairy products other than dry milk are processed in the same plant. In such cases the allocation of labor, power, fuel, and overhead costs generally are made on an approximate basis rather than by careful metering or other precise measurements.

Since it is probable that diversified dairy plants will be more general in this area in the future, plant accountants and auditors should develop better cost accounting systems for plants of this type.

Market Outlets and Prices Received

MARKET OUTLETS through which Minnesota dry milk plants sell their products are shown in table 23. Fourteen out of 49 plants reporting the sale of dry skim milk for human consumption sell through their own dairy marketing cooperatives serving this region. Another 17 plants sell their dry skim milk to the two major national dairy companies. The remainder of the 49 plants reported sales through various outlets including smaller national distributors, bakeries, and direct to the government. Under the government "set aside" orders, most plants have preferred to sell through designated authorized receivers rather than directly to the government.

Animal feed powders are distributed through a wider range of outlets and there is a tendency to sell more directly to the ultimate users. For instance, 11 out of 37 plants reporting sales of dry buttermilk for animal feed sold to feed dealers and mixers which were usually located in the immediate territory.

The prices which dry milk plants receive for their products are subject to "Maximum Price Regulation No. 289" (as amended), issued by the Office of Price Administration. The maximum prices of bulk powdered skim milk for human consumption and bulk powdered buttermilk for human consumption are (September, 1943) 14.5 cents per pound for spray process powder sold to the government and 15.5 cents per pound

Table 23. Market Outlets of Minnesota Dry Milk Plants, 1943

Market outlet*	Dry skim milk for human use	Dry buttermilk for human use	Dry buttermilk for animal feed
	Number of plants		
Two regional dairy cooperatives	14	5	5
Two major dairy companies	17	14	4
Other national dairy distributors	12	5	11
Bakeries	2	0	0
Commission firms	1	1	1
Government	3	0	0
Feed dealers	0	0	11
Others	0	1	5
TOTAL	49	26†	37

* Plants reporting split sales, that is, sales to more than one outlet were classified on the basis of the major outlet.

† Many of the plants in this group are the same as those shown in the first column and tend to sell this product to the same firms as their dry skim milk.

FIG. 7. Dry milk being packed in barrels for shipment

for the same type of powder sold to private users. Roller process powder is sold for 2 cents a pound less than spray process milk.[9]

The survey of actual prices received for dry milk by Minnesota plants as of May 1, 1943, showed that in nearly all cases the price was at or slightly below the ceiling level. Where net prices at the plant were slightly below ceiling prices, the difference was usually due to discounts and selling charges.

As of May 1, 1943, dry milk producers were setting aside 90 per cent of their spray process powder for government account, but no such set-aside was required on roller process powder. As a result, spray process powder sold near the 14.5 cent a pound level; while roller powder, sold principally to private users, netted about 13 cents per pound. More of the producers of roller process powder netted below ceiling prices since many of them were smaller producers and subject to various selling charges.

Wartime Dry Milk Program for Minnesota

INCREASING EMPHASIS in the war food program is being given to utilizing an increasing proportion of the milk produced in fluid milk and in the milk products in which all of the milk solids are used. Such a change would permit the maximum utilization of the nutrients in milk. Because of distance from the larger fluid markets of the country, Minnesota can play its part in this program most effectively through increased emphasis on milk products, particularly dry milk.

Minnesota could supply much of the

[9] These prices are for carlots f.o.b. the plant. L.c.l. quantities may be sold at slightly higher maximum prices. All maximum prices must be reduced by the seller's customary discounts, or allowances for cash or prompt payment.

needed increase in dry milk, but some reluctance is shown in making the necessary changes. Besides inertia, problems involved in making this shift include difficult readjustments in farm feeding and the problem of reorganizing, equipping, and financing dairy plants for this purpose, particularly in view of the fact that the demand may be short-lived.

The following suggestions for increasing the output of dry milk in Minnesota are offered:

1. The dry milk output of plants now in operation can be increased by improvements in their equipment and by increasing their efficiency.

2. Some increase in output can be obtained by more complete utilization of existing facilities. A number of plants operate only a few hours each week drying their own buttermilk. Effort should be directed to obtaining buttermilk supplies from neighboring plants to keep these facilities more fully occupied. In some cases the plants operating below full capacity could install milk-receiving equipment and begin to dry skim milk for human use. The utilization of plant facilities in nearly all drying plants may be improved by a pasture-improving, feeding, and freshening program designed to maintain a better flow of milk in the late summer and fall months.

3. Some plants in the state have unused capacity resulting from the increasing flow of milk supplies into fluid uses. New sources of supply and transportation should be arranged so that all available drying facilities may be utilized.

4. The construction of more dry milk plants in Minnesota is needed at this time (September, 1943) to meet war requirements. Recognizing the emergency character of much of the demand for dry milk, the United States government is encouraging the construction of drying facilities, and to minimize the risk for the local sponsors has offered to purchase newly constructed facilities which it approves. For the central drying plants this includes the complete facilities, while for the local receiving plants it includes all necessary removable equipment except milk cans and trucks. These facilities are then leased to the local sponsors for a period of 5 years with the privilege of renewal for an additional 5 years at an annual charge of 11 per cent of the value of the facilities including one per cent interest on the investment. When the war emergency is declared at an end, the local sponsors may choose to: (1) repurchase the facilities at their depreciated value; (2) continue to lease the facilities; or (3) cancel the lease and turn the facilities back to the government.

The diversion of milk to drying plants could be increased greatly by plans along the following lines:

5. Assist farmers who sell their whole milk in obtaining protein supplements to substitute for skim milk in feeding livestock. This might be arranged by a system of "feed preference" certificates issued to whole milk producers, or in other ways.

6. While some producers have thus far been attracted by the prices paid for whole milk to be used in drying, many others would be encouraged to divert their milk to this use by an increase in returns. The purpose of the increase should be to divert skim milk from feed uses by improving the returns from whole milk dairying relative to the return from hog and poultry production.

Postwar Prospects

WITH A LARGE and growing proportion of the Minnesota dairy industry on a whole milk basis, the dairyman in this area is vitally concerned with the postwar market. Large quantities of milk may be required for relief purposes in war-devastated areas in the immediate postwar period. Since agricultural production in Europe may be restored rather promptly and pressure to reduce expenditures may be strong in this country, these demands are likely to be temporary.

It is yet to be established whether the United States possesses advantages which will enable it to sell any considerable amount of dried milk in the world markets. While the needs for milk in areas not favorably situated for milk production are admittedly large, it must be remembered that there are also many low-cost producers of these products in other parts of the world.

The ultimate hope for sustained dry milk markets depends mainly on the development of domestic outlets. The use of dry milk in various commercial products offers considerable promise of expansion. For instance, at the present time dry milk constitutes less than 3 per cent of the ingredients in bakery bread, but nutrition experts assert that 6 per cent could be used to advantage. If a national nutrition improvement program calling for 6 per cent of dry milk solids in bread were revived in the postwar period, this program would provide a basic outlet for more than 400 million pounds of milk powder.

The use of dry milk in household baking and cooking is another undeveloped outlet. If the housewife is to turn to the use of dry milk, it must be made available in a suitable retail package, its keeping qualities must be assured, and instruction in its use provided. A number of technical problems remain to be solved before a completely satisfactory consumer package of dry milk may be placed on the market. Furthermore, the retail price of dry milk must compare favorably with alternative products such as fluid and evaporated milk. Efficient, low-cost production and distribution must be effected if this is to be done. The Minnesota dairyman has a vital interest in the successful development and sale of dry milk for household uses since it provides a feasible method whereby milk from this area may be used to satisfy many of the demands of consumers in distant city markets.

Dry milk prices may decline considerably in the postwar period but will be stabilized to some degree by the fact that some producers may be expected to return to feeding their skim milk as prices decline. It is also likely that large quantities of skim milk will be used in casein, cheeses, and other products.

In general, the market outlets for dry milk may contract in a few months after the war, but the basic upward trend should be maintained over the longer term. The producers who will be in the best position to take advantage of available postwar markets will be those who have successfully achieved low-cost plant operation and top quality products. It may be suggested that low-cost operation requires careful planning not only in current day to day operations, but even before contracts for construction have been let. Dairy groups considering the construction of new drying facilities should choose their plant sites with due regard to all possible economic considerations. They should also avoid the tendency to overbuild and to build without careful regard to costs. Such errors will handicap or make impossible efficient operation in the future.

SUMMARY

● War conditions have stimulated greatly the demand for dry milk, necessitating a great expansion of the dry milk industry. As a result the Minnesota dairy industry has experienced many significant changes, particularly a large scale shift to the sale of whole milk instead of cream. In shifting to the manufacture of dry milk, important changes were necessary on the dairy farms and in the dairy plants of the state.

● Minnesota's total dry milk production more than tripled in the 6-year period, 1937-1942, to reach 104 million pounds. The 1942 output of dry skim milk for human use was more than double that of the previous year. Minnesota ranks third among the states in dry skim milk production and outranks all other states in dry buttermilk.

● As of May, 1943, there were 102 drying plants in the state of which 57 were drying milk for human use, 17 more than a year earlier. A large number of additional human food driers were being prepared during 1943.

● Minnesota's total drying capacity, in terms of fluid milk per hour, increased 31 per cent from 314,000 pounds in 1942 to 413,000 pounds this year. Capacity of human food driers increased 55 per cent. The hourly capacity of the plants now in operation could be increased considerably by improvements in equipment. At the peak of the flush season, the human food driers were operating on the average at 92 per cent of their maximum capacity. The principal unused or excess capacity was among the animal feed driers.

● Thousands of dairy farmers have shifted from the long established practice of selling only their cream to the sale of whole milk. Of the 8,121 million pounds of milk delivered to dairy plants in Minnesota in 1942, 1,877 million pounds or 23.1 per cent was sold as whole milk. This is more than double the average deliveries of whole milk during the 5 prewar years, 1935 to 1939.

● Drying plants and creameries receiving milk for such plants averaged 70 per cent of their total dairy receipts in whole milk form, but the proportion varied widely among plants. The need of milk for feeding purposes and relative prices received for milk were among the more important factors affecting the degree of shift to whole milk in a given area. In the first three

months of 1943, prices per hundredweight of milk testing 3.5 per cent butterfat averaged $2.50, $2.52, and $2.53, respectively, in Minnesota plants which were receiving milk for drying. In about 80 per cent of the plants prices paid for skim milk were 75 cents per hundredweight or over.

- The prospects are that Minnesota will be called on to expand its dry milk output still more. Although over 800 million pounds of skim milk were used by the state's milk drying industry in 1942, an estimated 5.4 billion pounds remained on the farms. This is approximately 20 per cent of the national total of skim milk remaining on farms and the largest quantity in any state.

- With a moderate reduction in the amount of skim milk used for feeding livestock, an additional 1.3 billion pounds could be made available for sale to driers, enough to produce 112 million pounds of powder or more than the state's total output in 1942. Minnesota's largest surpluses of skim milk over essential feed requirements may be found in the broad dairy belt extending from the southeastern through the west central part of the state.

- Minnesota's wartime output of dry milk may be increased in a number of ways including improvements in the equipment of plants now in operation, by increasing their efficiency, and by more complete utilization of existing facilities. The construction of some new facilities will be necessary, but in these cases the emergency character of much of our present demand should be recognized. Further diversion of milk to drying plants may be encouraged by assisting farmers who sell whole milk in obtaining feed to substitute for skim milk and by increasing the farmer's return from whole milk for drying relative to that derived from other farm products.

- The Minnesota dairyman is vitally concerned with postwar prospects for the dry milk industry. The principal hope for sustained postwar markets for dry milk lies in the development of various domestic outlets including the increased use of dry milk in various commercial products and in home cooking and baking. While the demand for dry milk may shrink sharply in a few months after the war, the basic upward trend should continue over the longer run. The low-cost, high quality producers will be in the best position to take advantage of postwar markets.

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