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Nebraska
COOPERATIVE EXTENSION WORK
IN AGRICULTURE AND HOME ECONOMICS
U.of N. Agr. College & U.S.Dept. of Agr. Cooperating
W.H. Brokaw, Director, Lincoln

Extension
Circular
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WHAT ABOUT CHEESE FOR NEBRASKA?

H.P. Davis and P. A. Downs
Dairy Husbandry Department

Many inquiries have been made about American cheddar (ordinary cream) cheese making in Nebraska. Can cheese be made successfully? Is the climate suitable for ripening cheese? What is the cost of a cheese factory? What are the returns from milk made into cheese? Can Nebraska cheese be marketed profitably? In other words, is Nebraska a suitable place to make cheese?

Efforts will be made to answer these questions so that those interested may know the possibilities and limitations of the cheese industry especially from the standpoint of the cooperative factory.

Climate

Ideally, cheese making is adapted to regions where cold water is available in the summer time to cool the evening milk and keep it in good condition for delivery the following morning. Cool nights in the summer time facilitate keeping milk in good condition for morning delivery. Hot nights make it difficult to keep milk sweet and free from gas forming bacteria unless special care is taken to cool it promptly and keep it cold. Western Nebraska where the elevation is higher would likely be better adapted climatically than the eastern section for cheese making. With unfavorable climatic conditions greater care is necessary to produce good cheese.

Cows

In order to operate with reasonable economy, it is necessary that the cheese factory receive at least 5,000 pounds of milk daily. This must all be delivered in the morning before ten a. m. and preferably before nine a. m. Under ordinary circumstances this means that the cows producing the milk must be within a radius of not over 6 or 7 miles and preferably not over 2 or 3 miles from the factory. With cows that will produce a gallon and a half daily (approximately 13 pounds) it will take about 400 cows to support a factory running at the minimum capacity. The State Department of Agriculture states that the cows that furnish milk for cheese making must be tested for and be free from tuberculosis in accordance with the dairy law.

Building

The cost of a cheese factory equipped depends upon the size of factory and the amount of apparatus. Where a new factory is to be established, the equipment and building should be as simple as possible to meet the needs so as to keep the cost low.

For a small factory, a building 28 or 30 feet by 40 feet can be arranged to good advantage. The factory should be so located that the receiving room is at least 30 inches higher than the work floor in order that the milk will flow from the weigh can into the vat. Generally a good location for the receiving room is in the middle of one end of the building with the driveway graded up so that cans may be unloaded conveniently. The arrangement of the rooms depends upon the position of the

building, in general a factory will consist of four rooms, namely, the making room or work room, boiler room, curing room, and store room. The receiving room or platform is commonly set out as an addition to the main building and above all things it should be screened from the work room. Great care should be used in selecting the building site especially in regions where there is much wind and dust. Never set a building either on a road or at a cross road, in such a position that the prevailing wind will blow dust into the factory. If necessary place the factory back a distance from the road to avoid the dust and have it protected by trees. The building should be set apart from other buildings, especially those where there are likely to be flies. It is desirable to have the factory as close as possible to the shipping point since handling cheese does not improve its quality and adds materially to the cost.

Floor. The floor should be of concrete, wood float finish, sloped one-half inch to the foot toward floor drains. These drains should be ample, not less than 4 inches in diameter and preferably larger and should be protected by traps to prevent odors from coming up the sewer. The concrete should extend along the walls for a height of from six to eight inches.

Windows - Doors - Walls. Windows and doors must be screened and ceilings and walls must be kept free of any material that might drop into the milk. The walls may be of any material that may be readily cleaned. A hard plaster is quite satisfactory.

Rooms. A coal bin should be provided in the boiler room and the curing room should be equipped with shelves. The latter should be so arranged that it can be kept at a fairly uniform temperature which will require double walls and a means of proper ventilation. Air must be circulated for proper curing.

Water

The water supply must be ample, pure and free from contamination. If a city water supply is not available a good well that is capable of furnishing plenty of water is necessary. The well and pump may be located in the boiler room for convenience. It is convenient to have an elevated storage tank or an air pressure water system.

Sewage Disposal

If possible the factory should be placed on a slight elevation to facilitate drainage and sewage disposal. If the soil is very porous, the sewage may be taken care of by using a long line of tile ending blindly. Usually however, some type of septic tank is desirable and necessary. Never discharge cheese factory sewage into streams.

Equipment

For a plant that handles 5,000 pounds of milk a day the following equipment is considered necessary:

	Estimated Cost
1 Boiler 10 H. P. (Marine type preferable)	$175.00
1 Steam engine, 4 H.P.	75.00
1 Pump to raise water from well	25.00
1 Scale, 600 lb. platform	70.00
1 Weigh can, 60 gal.	25.00
1 Babcock tester, 24 bottles, steam, with glassware	45.00
1 Cheese vat, 700 gal. capacity	250.00
1 Cheese press, gang, double wood automatic, daisy type	150.00
1 Agitator, power	70.00
1 Curd mill	40.00

1	Starter can, 30 gal.	$145.00
1	Paraffin tank	30.00
1	Wash sink	20.00
1	Scales for weighing cheese	30.00
1	Separator (Special type to separate both milk and whey)	500.00
1	Strainer and rack for vat	8.00
1	Whey tank, 700 gallon capacity, piping, jet, etc.	150.00
1	Conductor head and spout	15.00
1	Truck - 4 wheel - $2\frac{1}{4}$ ft. by 4 ft.	27.00
1	Wisconsin curd test outfit, 12 bottle size	25.00
1	Marschall rennet test outfit	4.00
1	Acid test outfit	5.00
1	Thermometer	1.00
	Composite sampling jars, - 2 for each patron	5.00
1	Curd knife - horizontal 3/8 inch	6.00
1	Curd knife - vertical 3/8 inch	6.00
1	Curd pail	2.50
30	Cheese hoops, Daisy style	90.00
2	Rakes - hand	1.00
1	Curd fork	1.00
1	Cheese knife	1.00
1	Cheese trier	1.00
1	Dipper,-sampling	.50
1	Graduate 12 oz.	1.00
1	Graduate 16 oz.	1.50
2	Dippers 1 gal. size	3.50
2	Dippers, 1 gal. strainers	3.50
3	Pails, tin	6.00
2	Pails, galvanized	2.00
1	Flue scraper	2.00
	Shafting, hangers, pullies, pipe and fitting	75.00
	Belts	15.00
1	Coal shovel	1.50
2	Brooms	3.00
1	Floor brush	1.50
1	Rubber squeegee for drying floor	1.50
6	Brushes - washing	3.00
1	Stencil set	1.00
	Total - - - - - - - - - -	$ 2120.00

The list of equipment given above includes a combination cream and whey separator. Such a separator may be omitted from the equipment, but since approximately $1\frac{1}{2}$ pounds of butterfat can be obtained from each 1,000 pounds of whey, its usefulness and economy are apparent. For example, 5,000 pounds of milk would yield approximately 4,500 pounds of which which would produce approximately $6\frac{3}{4}$ pounds of butterfat which should bring the ordinary butterfat prices. A combination separator would also permit the separation of milk if that were desirable.

Supplies

Besides equipment certain supplies are essential before the factory can start operating. These are as follows:

Coal	Paraffin	Cheese color	Sulphuric acid (commercial)
Cheese salt	Scale boards	Rennet extract	Preservative for milk Samples
Cheese bandages	Cheese boxes	Starter culture	

Supplies-Cont'd.

Cheese cloth circles	Cheese box fasteners	Washing powder

Capital Required

In order to operate a cheese factory with reasonable efficiency it is necessary to have the building, equipment, and three months supplies paid for and have a working capital large enough to handle operations for three months. It is possible to operate with a smaller amount of capital but that may necessitate asking the patrons to wait for the payments for their milk. Any business is likely to be embarrassed by lack of working capital, so it is desirable to have enough to finance operations until returns from cheese sold are available. In other words after the building, equipment, and three months supplies are paid for, there should be enough capital left to pay the patrons for milk for three months and to pay the cheese-maker for an equal time. Following such a plan, the cheese will be ripe enough to sell even if it is completely ripened at the factory.

Milk - Quantity and Quality

Clean milk properly cared for means a good quality of cheese. Dirty and improperly handled milk means unsalable cheese. Milk for cheese making must be sweet, clean in flavor, free from sediment, and reasonably free from gas forming bacteria. To obtain such milk farmers must use clean (sterilized or scalded) utensils, wipe off with a damp cloth the flanks and udder of each cow before milking, use small top milk pails and cool the milk below 50° F. as soon as possible after milking and keep it cold until delivered. It is of the greatest importance that all milk utensils, pails, cans, strainers, etc. should be rinsed with cold or luke warm water immediately after use and then washed thoroly with hot water, washing powder and stiff brush after which they should be rinsed with clear water and scalded with boiling water or sterilized. After washing, utensils may be allowed to dry upside down in a sunny place protected from dust and flies. Usually patrons carry back whey for hogs and poultry feeding in the same cans in which milk is hauled. The necessity of careful washing at the farm is therefore apparent.

Morning's milk even in the summer if delivered within two hours after milking need not be cooled. Evening's milk during the warm months, must be cooled promptly after milking and kept cool until delivered. A common way of cooling milk is by the use of a covered water tank connected with the well in which the cans of milk are set. The best arrangement is for the water to flow in at the bottom and out at the top. All water pumped should flow through the tank. If at all possible, a cake of ice should be placed in the tank on hot nights in summer. The factory can assist patrons by carrying on hand, equipment and supplies such as brushes for washing utensils, washing powder, etc. in localities where these supplies cannot readily be obtained.

While good cheese may be made from both high ahd low testing milk, best results are obtained from milk containing a medium percentage of butterfat. The yield of cheese is smallest from milk of a low percentage of butterfat and highest from milk of a high percentage of butterfat. The reason is that milk of high percentage of butterfat usually has a higher percentage of other milk solids altho the proportion is not always uniform.

In general the larger the quantity of milk received the more economically the cheese can be made. One cheese-maker can handle up to about 5,000 pounds of milk or one vat full each day. Additional milk will usually necessitate an extra vat, additional equipment and a helper. Under good conditions it takes about 7 hours from the time the milk is set until the cheese is in the press.

Methods of Paying for Milk

There are numerous methods of paying for milk for cheese making of which several will be described. The true basis of payment is upon the actual quantity of cheese made from a particular lot of milk. Since all milk will not yield the same proportion of cheese, it is necessary to have some comparison of the yield of cheese from milk containing varying percentages of butterfat. This is shown in the following table:

Yield of Cheese from Milk of Different Fat Content*

Fat in Milk	Weight of Cheese Containing 37% Moisture	
Percent	Per pound of Fat in milk	Per 100 lbs. milk
3.00	2.77	8.30
3.25	2.73	8.88
3.50	2.70	9.45
3.75	2.67	10.03
4.00	2.65	10.60
4.25	2.63	11.17
4.50	2.61	11.74
4.75	2.59	12.31
5.00	2.58	12.90

(1) Pooling. Of the various methods of paying for milk, the pooling system is the easiest to operate and likely to be the most unfair if the milk from different patrons varies greatly in percentage of butterfat. Under this system the profits from the sale of cheese are divided among the patrons in proportion to the weight of milk delivered by each. The table giving yield of cheese indicates why pooling is unjust.

(2) Yield Value. Payment for milk on the basis of average yield of cheese as shown in the foregoing table is common and if the cheese-maker controls the moisture content of his cheese it gives satisfactory results to the patrons. The price of cheese less the cost of manufacture is taken as the unit for figuring. For example, if cheese is selling for 18 cents per pound and it costs 3 cents to make it, the base price for figuring would then be 15 cents. The following would be the returns for 100 pounds of milk of different percentages of butterfat.

3.0% milk = 8.30 lbs. cheese at $.15 = $1.245 per 100 lbs. milk
3.5% milk = 9.45 lbs. cheese at $.15 = $1.417 per 100 lbs. milk
4.0% milk = 10.60 lbs. cheese at $.15 = $1.590 per 100 lbs. milk
4.5% milk = 11.74 lbs. cheese at $.15 = $1.761 per 100 lbs. milk
5.0% milk = 12.90 lbs. cheese at $$.15 = $1.935 per 100 lbs. milk

*New York Agricultural Experiment Station, Geneva, N.Y.

The disadvantage of this method is that the moisture content may vary or other losses may occur so that the actual yield may not agree with the estimated yield. In this case the factory would either pay out more than it received or be ahead as the case might be. For this reason other methods have been devised which agree very closely with the above methods but which are based upon the actual pounds of cheese made and the pounds of fat received.

(3) Fat Test. If the highest testing milk brought in by patrons is never more than 1% of butterfat above the lowest testing milk, the fat test method is the simplest and gives good results and will agree within 2 cents on a dollar with the yield values.

For example if 5 patrons each delivered 100 lbs. of milk:

WT. OF MILK	100 lbs.	100 lbs.	100 lbs.	100 lbs.	100 lbs.	500 lbs.
TEST	3%	3.5%	4%	4.5%	5.0%	
FAT	3.0 lbs.	3.5 lbs.	4.0 lbs.	4.5 lbs.	5.0 lbs.	20.0 lbs.
Estimated Yield of Cheese	8.30 lbs.	9.45 lbs.	10.60 lbs.	11.74 lbs.	12.90 lbs.	52.99 lbs.

If 53 pounds of cheese were made from this milk which contained 20 pounds of butterfat and the cheese less the cost of manufacture brought 15 cents, the price per pound would be:

$\frac{53 \times .15}{20}$ = $.397. Using this figure for the milk of each of the above patrons would give the following:

FAT	3.0 Lbs.	3.5 Lbs.	4.0 Lbs.	4.5 Lbs.	5.0 Lbs.
Price of Fat	$.397	$.397	$.397	$.397	$.397
Returns per 100 Lbs. milk	$1.191	$1.389	$1.588	$1.786	$1.985

These figures differ from those obtained under yield value.
For milk of slight variation in percentage of fat the Fat Test method is accurate enough.

(4) Fat plus .6. Under conditions where there is variation of 1% or more in the percentage of fat in the milk received, the fat plus .6 method of payment gives more accurate results.

WT. OF MILK	100 Lbs.	100 Lbs.	100 Lbs.	100 Lbs.	100 Lbs.	Total 500 Lbs.
Test	3.0%	3.5%	4.0%	4.5%	5.0%	
Test + .6	3.6%	4.1%	4.6%	5.1%	5.6%	
Fat	3.6 Lbs.	4.1 Lbs.	4.6 Lbs.	5.1 Lbs.	5.6 Lbs.	23.1 Lbs.
Estimated Yield of Cheese	8.30 Lbs.	9.45 Lbs.	10.60 Lbs.	11.75 Lbs.	12.90 Lbs.	52.99 Lbs.

Then following the same principle used in the fat test method

$\frac{53. \times .15}{23} = \$.345$ the price per pound of butterfat.

Applying this price the patrons would receive the following amounts per 100 Lbs. of milk.

Test	3.0%	3.5%	4.0%	4.5%	5.0%
Fat	3.6 Lbs.	4.1 Lbs.	4.6 Lbs.	5.1 Lbs.	5.6 Lbs.
Price of Fat	$.345	$.345	$.345	$.345	$.345
Returns per 100 Lbs. milk	$1.242	$1.414	$1.587	$1.759	$1.932

These values are practically identical with the yield values and when the actual yield of cheese is used in place of the estimate yield, the fat plus .6 gives fair results to all.

Cost of Making Cheese

The cost of making cheese will depend upon the equipment of the factory, the cost of building or rent on building, the quantity manufactured, and the salary and efficiency of the cheese-maker. Usually the cost runs between 3 cents and 4 cents pound of cheese. This only includes the cost of manufacture and the curing in the factory for a short time. It does not include cost of selling and marketing. The larger factories where 15,000 lbs. of milk or more are handled daily will reduce the cost of manufacture to the smaller figure while smaller factories will approach or may even exceed the larger figure.

Methods of Selling

Many factories in cheese making regions sell their product green (unripened) or but slightly cured at the factory or f. o. b. cars at their station. This plan is advantageous to the small factory that does not have good ripening and selling facilities. Usually the purchasers are cheese dealers, wholesale grocers or jobbers, many of whom will cure the cheese in their own warehouses. Some buyers prefer to buy the cheese unparaffined. Any sales that are made to retail dealers or small jobbers and small wholesale grocery firms must be of partially or fully ripened cheese. This necessitates ripening at the factory and the keeping of a considerable quantity of cheese on hand. Under this plan considerable capital is tied up in cheese that is ripening and there is an extra cost due to handling during curing and due to shrinkage. The length of time needed to ripen cheese depends to a very large extent upon the method of manufacture. The actual time may vary from three weeks to six months depending upon the type of cheese desired. Six weeks is a very common length of time to ripen cheese at normal temperature. Cheese may be kept for long periods in cold storage which necessarily increases the cost. Where several cheese factories are close together they may cooperate in storing or in selling cheese. Nebraska cheese is not now known on the market and would have to establish its merit.

Returns from Cheese Making

The principal cheese markets are in Wisconsin and in general those markets established the price for the various grades of cheese. Frequently the price is quoted f. o. b. shipping point. The cost of shipping cheese from Wisconsin to Nebraska varies with the quantity but would be a little less than one cent on a pound.

(Over)

Since Nebraska sells dairy products primarily upon the butterfat basis, a comparison of the relationship between butterfat and cheese would be useful.

Using the figures for cheese yields from milk of different pertentages of fat as given in the previous table, a series of factors has been worked out which shows the relationship of butterfat to cheese. The following table shows the cheese production factors for different kinds of milk.

Butterfat Test of Milk %	Cheese Yield Per 100 Lbs. Milk Lbs.	Cheese Yield Per Lb. Butterfat Lbs.
3.0	8.30	2.760
3.1	8.518	2.748
3.2	8.755	2.736
3.3	8.989	2.724
3.4	9.220	2.712
3.5	9.450	2.700
3.6	9.684	2.690
3.7	9.916	2.680
3.8	10.146	2.670
3.9	10.374	2.660
4.0	10.600	2.654
4.1	10.832	2.642
4.2	11.062	2.634
4.3	11.291	2.626
4.4	11.519	2.618
4.5	11.740	2.610
4.6	11.978	2.604
4.7	12.210	2.598
4.8	12.441	2.592
4.9	12.671	2.586
5.0	12.900	2.580

To use this table for determining the comparative returns from 100 pounds of milk whether used for cheesemaking or sold as butterfat either one of the following formulas may be used:

Formula 1. Price per pound of cheese paid the patron multiplied by cheese yield per pound of butterfat equals the equivalent price of butterfat to bring equal returns to the patron. The price per pound of cheese paid the patron is in a cooperative factory the market price of cheese minus the cost of manufacture.

Example:- Suppose the factory pays 15 cents per pound of cheese to the patron who supplies 100 pounds of 3.6 per cent milk. Then 15 x 2.69 = 40.35 cents pthe price of butterfat that would yield equal returns to the patron. If the price of butterfat is above 40.3 cents then the sale of butterfat is more profitable and if below that price it is more advantageous to sell to the cheese factory.

Formula 2. Price of butterfat divided by the cheese yield per pound of butterfat equals the price paid the patron per pound of cheese. Example: If butterfat is 38 cents per pound and the patron delivers 4.0% milk. 38 ÷ 2.65 = 14.34 cents per pound that the cheese factory would pay the patron per pound of cheese to equal 38 cents per pound for butterfat.

Because of the variation in yield of cheese in milk of different percentages of butterfat no single factor can be given. Using the table supplied, an approximately accurate relationship between the market price of cheese and the price of butterfat may be obtained as follows: If the price of butterfat is known, use formula 2 and divide by the cheese yield per pound of butterfat and to the result add 4 cents to get the market price of cheese to bring equal returns. Example: If the milk is 3.5% in test, and the price of butterfat is 42 cents, then 42 ÷ 2.70 = 15.55 cents per pound of cheese paid patron + 4 cents = 19.55 the market price of cheese.

If the market price of cheese is known, then use formula 1 as follows: Suppose the market price of cheese is 21 cents and the patron supplies 4.1% milk. 21 - 4 = 17 x 2.642 = 44.91 cents the price of butterfat to equal cheese at 21 cents. In all the comparisons it must be borne in mind that whey and skim milk are considered to be equal in value and that the cheese maker works with maximum efficiency and holds his moisture at 37%.

Method of Hiring Cheesemaker

The method of hiring the cheesemaker varies in different sections of the country. In localities where much cheese is made it is sometimes possible to hire a cheese maker who will supply all the equipment for making cheese except the building. Under such an arrangement the patrons must guarantee a definite quantity of milk and pay him an agreed price per pound for cheese manufactured. The agreed price varies from 2.0 cents to 2.5 cents and the supplies are purchased by the patrons.

When the building, equipment, and supplies are furnished the cheese maker may be paid at a rate of 3/4 of a cent to 1.25 cents per pound of cheese made. In either case it is good practice to set the price at such a figure that 1/4 of a cent per pound may be paid as a bonus for cheese of the best quality. This encourages the cheese maker to value quality over yield.

Another method is to hire the cheese maker at a stipulated salary per month. This will vary from $125.00 to $200.00 per month. Following this plan the cheese maker has the least personal interest in the quality of product or the efficiency of operation of the factory.

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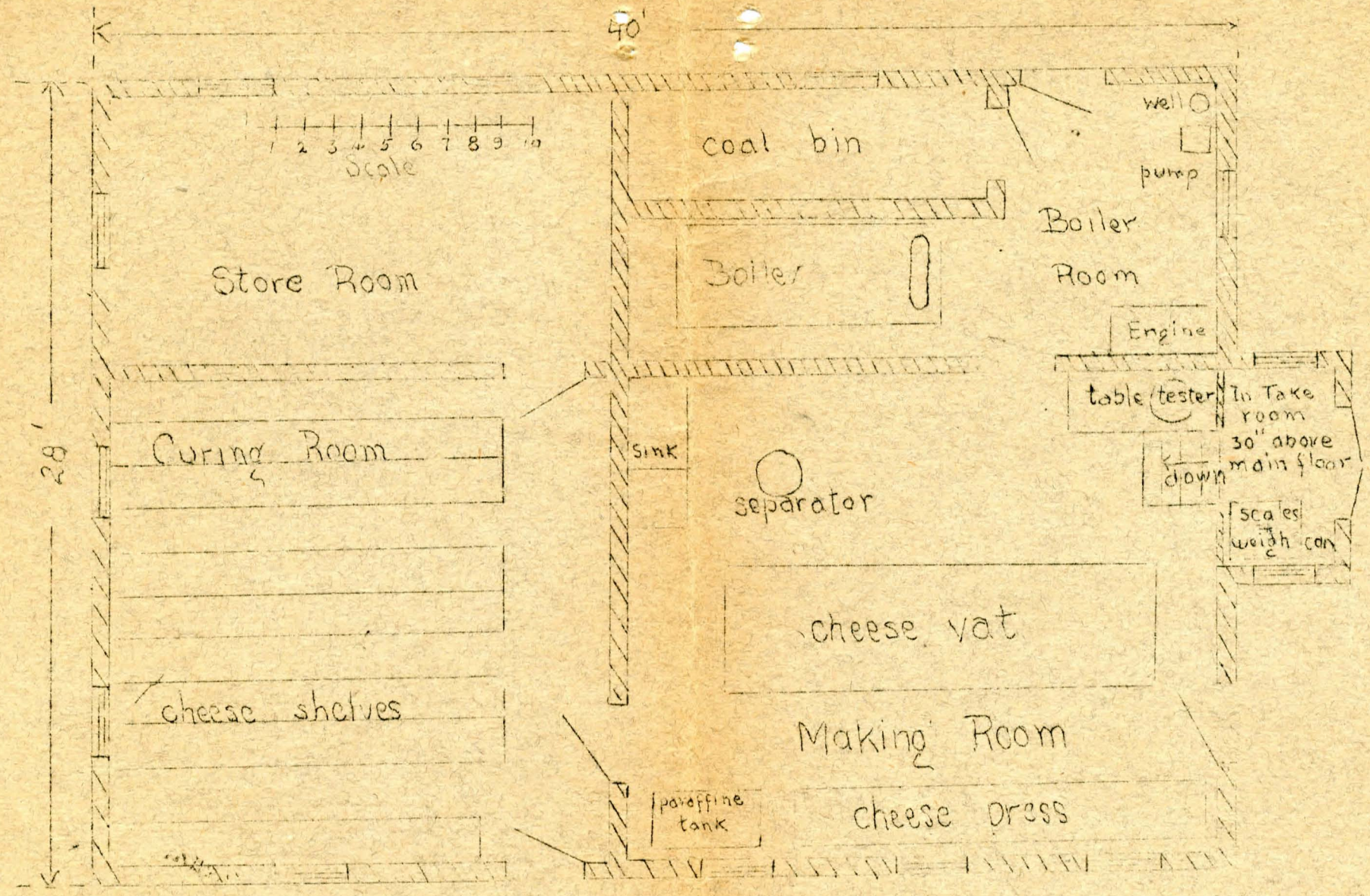

SMALL CHEESE FACTORY PLAN

3510-E for making and curing cheese f[illegible] about 500[illegible] lbs. milk daily