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THE INFLUENCE OF THE TEMPERATURE OF CURING UPON THE COMMERCIAL QUALITY OF CHEESE.

GEO. A. SMITH.

PUBLISHED BY THE STATION.

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THE INFLUENCE OF THE TEMPERATURE OF CURING UPON THE COMMERCIAL QUALITY OF CHEESE.

GEO. A. SMITH.

SUMMARY.

Experiments have been carried on at the Station during 1899 and 1900 in which cheeses cured at temperatures common under ordinary factory conditions were compared with similar cheeses cured at lower temperatures.

Of the cheeses made in 1899 those cured at 60°F. and below scored, on the average, almost 5 points higher on flavor and 2.5 points higher on texture, than those cured at 65°F. and above. In 1900, the average difference in flavor of the lower temperatures was 5.1 points on flavor and 2.7 points on texture.

INTRODUCTION.

The importance of the dairy industry in New York has led this Station to devote much attention to questions arising in that great branch of Agriculture. One of our leading dairy interests is the manufacture of cheese, this State producing about one-half of the total amount made in the United States. Consequently any change in methods by which the quality of this product is improved or the cost to produce it is lessened, will be of great financial benefit.

In all other lines of manufacture, competition has compelled close study of details to insure economical production of products perfectly adapted to the market sought, each factor being carefully examined by itself and in its relation to other factors and to the finished product. In cheese production, however, though it is a manufacturing enterprise and one of great importance, this

business-like, systematic study of details has been given by very few makers. It will, perhaps, not appear so strange that such is the case when we consider the development of the cheese industry. The time is not yet very remote when practically all New York State cheese was made in the home dairy, no factories being in existence. Then it would be noticed in a community that one farmer was more successful than his neighbors in handling the milk from his herd, and secured a better price for his products. To avail themselves of this advantage from better management of the milk, these neighbors turned over to this better qualified manufacturer the raw material from their own herds. As the economy in handling products in quantity became apparent, to say nothing of improvement in quality, it led to a rapid extension of the system, until the factory business has grown to its present proportions and home cheese-making has become almost a lost art.

The entire procedure in successful cheese-making has been founded, until within a few years, on tradition and good judgment. Experience rather than a knowledge of principles has been the maker's guide. At first the young man who had worked for that successful dairy farmer long enough to acquire a thorough knowledge of his methods was employed when a new center of cheese-making was established; but the building of new factories soon outstripped the supply of men well prepared to manage them. So long as each factory could get for its head a trained man of good judgment, thoroughly impressed with the necessity of strictly observing the constantly varying conditions of the atmosphere and well aware of the effect of these and other conditions upon the quality of his product, these coöperative factories were fairly successful. When the demand for factories became greater, men competent to manage all of them were not available; and the mediocre cheese-maker, handicapped as he often was by his location in a factory poorly planned and cheaply constructed, could not produce first-class cheese. Good cheese was still made by the masters of manufacture; but the tendency of the entire output was toward deterioration in quality. This means lessened consumption and lower prices.

These conditions still prevail to too great an extent, though decided efforts have been made within the past few years, and

with some success, to restore New York cheese to its position as the standard of quality in the great markets. The object of the Station in publishing this bulletin is to point out at least one weak point in the system of cheese handling as at present conducted and to suggest a possible practical improvement.

EXPERIMENT IN CURING CHEESE.

GENERAL CONDITIONS.

Believing that it would be easy to demonstrate faults in the present system of curing, we have carried on quite extended work along this line. Conditions have been so arranged that cheeses made practically alike could be cured at the temperatures secured under average factory handling and at much lower temperatures. Experiments made elsewhere [1] on a laboratory scale indicated that keeping the cheese comparatively cool during the time of curing would give a better product; and comparison of the many cheeses in our tests, cured at different temperatures, establishes the fact beyond doubt.

MAKING THE CHEESE.

The foundation of good dairy products is a healthy cow, in sanitary surroundings, well fed and well cared for, yielding her milk to a clean milker, into clean utensils. These essentials we sought to secure, then aerated and cooled the milk in good, pure air as soon as possible after milking, and kept it till needed in a cool, clean place. In making the cheese the following method was used: As soon as the milk is received in the morning it is heated to 84° and then tested for acidity using the Marschall rennet test, the showing required in the test cup being four spaces. This indicates an acidity which, under our conditions, will mature the curd sufficiently for drawing the whey in about two and one-half hours. With such an amount of acid at the start, the curd will, at the end of the time given, show one-eighth inch, fine threads upon the hot iron.

In very few cases was the milk sufficiently "ripe" immediately after heating to secure the best results as we handle it; therefore,

[1] Wis. Agrl. Expt. Sta. Ann. Rpt. 1897, p. 194.

carefully prepared sour milk was added in moderate quantity. By this method the milk in a very short time reaches the acidity required. We believe that, when milk does not contain quite enough acid, the addition of a sufficient amount of sour milk to secure the proper degree of ripeness quickly is much more satisfactory and safe than holding the milk until the acid develops normally. If gas-forming bacteria are present in abundance, holding the milk allows them to increase and doubles the liability to "gassy" curd. As soon as the milk shows proper conditions by the Marschall test, rennet is added at the rate of 2½ ounces to 1000 pounds of milk, this amount of good rennet extract being sufficient to coagulate properly ripened milk so that, with intelligent handling of the curd, the loss of solids is as small as possible.

The curd is cut in about 30 minutes from the time the rennet is added, using care to have the pieces of curd uniform in size and fine enough to make a proper separation of moisture easy.

The stirring of the curd commences as soon as the cutting is completed and continues, without increasing the temperature, until the separation of water from the curd is well started. The heat is then gradually increased, taking about one hour to reach the extreme of 98° F. If at this point there is a sufficient separation of water from the curd, so that the latter has a firm appearance and has reached such a stage of contraction that it does not pack, and the heat is uniform throughout the mass, the vat is covered and allowed to stand, the curd being occasionally stirred to prevent matting together and to keep it even throughout. Under these conditions, with proper acidity at the start, the hot iron test should show one-eighth inch threads in about one hour from the time the extreme temperature of 98° is reached; when the whey should be drawn and the curd piled on the sides of the vat. When this curd has sufficiently matted, it is cut into pieces four or five inches square and turned. The turning is continued at short intervals until the curd is solid and the unassimilated water has been thoroughly drained from it. The curd may now be piled for a short time until it becomes mellow to the touch and has a flaky, fibrous texture. It is now ready to be put through the curd mill, spread out and properly aired, and

reduced in temperature to 82° to 84° before salting. Two and one-half pounds of salt is used to 1000 pounds of milk and the curd allowed to stand until the salt is dissolved and the curd itself becomes silky in appearance; when it is put to press. The time required for the entire process is from five to five and one-half hours.

The details of the manufacture have been given in full so that those who are familiar with cheese-making may see that the cheeses thus made would promise good results when cured.

They were then placed in the curing rooms at different temperatures and removed at various dates, for scoring.

RESULTS.

In studying the question it was necessary to plan the work so that the differing temperatures in the separate curing rooms should be the only factors not alike in the manufacture and curing of the cheeses compared. The detailed plans of the cheese curing rooms and the method of temperature control have been given in a previous bulletin[2]; so the description will not be repeated here, further than to say that each of the six insulated curing rooms can be kept automatically at a uniform temperature at any point between 40° and 90° F. The refrigeration worked in a very satisfactory manner. In each room cloth is suspended in such a way as to be continuously wet; so that the percentage of saturation may be kept as nearly uniform as possible in all the rooms.

Cheese made during 1899.—In 1899 four rooms were used, in which the temperature was kept at 70°, 65°, 60° and 55° respectively. The time of making, date of scoring and the marks given each cheese are shown in Table I, the scale of judging being 50 points for perfect flavor and 25 points for perfect texture. The scoring of June 20 was by M. T. Morgan, one of the experts of the State Department of Agriculture, that of Sept. 5, by judges at the State Fair; and that of Oct. 16 by Jas. A. Brown and Sons of Utica.

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[2] Bulletin No. 153 of this Station, pp. 307, 311.

TABLE I.—SCORING OF CHEESES CURED AT DIFFERENT TEMPERATURES, 1899.

Cheese made	Cheese cured at a temperature of																					
	70° F.				65° F.						60° F.						55° F.					
	Scored				Scored						Scored						Scored					
	June 20.		Sept. 5.		June 20.		Sept. 5.		Oct. 16.		June 20.		Sept. 5.		Oct. 16.		June 20.		Sept. 5.		Oct. 16.	
	F.	T.	F.	T.	F.	T.	F.	T.	F.	T.	F.	T.	F.	T.	F.	T.	F.	T.	F.	T.	F.	T.
March 20	42	21	40	20	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
March 20[1]	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	49	25	....	....
March 22	....	....	....	....	44	24	44	24	....	....	....	....	....	....	....	....	....	....	....	....	....	....
March 24	....	....	....	....	....	....	....	....	....	....	49	25	49	25	....	....	....	....	....	....	....	....
March 28	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	49	25	49	25	....	....
April 3	43	20	....	....	....	....	....	....	....	....	....	....	....	....	....	....	49	25	....	....	....	....
April 14	45	23	....	....	47	24	....	....	....	....	49	25	....	....	....	....	49½	25	....	....	....	....
April 24	....	....	42	22	....	....	45	23	....	....	....	....	49	25	....	....	....	....	49	25	....	....
May 31	46	23	41	20	....	....	....	....	....	....	50	25	50	25	....	....	....	....	....	....	....	....
July 21	....	....	....	....	....	....	....	....	47	25	....	....	....	....	48	25	....	....	....	....	49	25

[1] Kept in 70° room until April 30.

From this table it will be seen that, without exception, of cheeses made at the same time or a few days apart, those cured at the lower temperatures scored higher. The difference was less in texture than in flavor, but, with the high temperature of 70°, texture also was poor. Taking the average scores of the cheeses cured at 65° and above, and at 60° and below, the latter show a gain of almost 5 points in flavor and 2½ points in texture. Concerning the cheeses made July 31, and later sent to Utica, Mr. Brown, the scorer, says: "The cheeses all good; the 55° F. very fine."

On Sept. 20, 1899, a lot of cheese was made from milk containing 5 per ct. of fat and put in the 55° room. In June, 1900, one of these cheeses was sent to E. J. Burrell, Little Falls, N. Y., to test; and, on June 26, he writes: "I have tested the cheese and can say that it is especially fine. The flavor is clean and nutty, the texture is perfect and the curd breaks down beautifully. If the factory men of the country were to manufacture cheese of this description for home-trade purposes, the sale would be largely increased for home consumption and we, practically, would be entirely independent of England."

Cheese made during 1900.—During the season of 1900 considerable more cheese was made, with, practically, the same results as to flavor and texture as in 1899. In August Mr. D. W. Whitmore, 89 Warren St., New York, kindly agreed to score for us several lots of cheese which were to be sent at dates about a month apart through the fall and winter. The cheeses sent upon any date were from the same lot of milk, made at the same time and handled as nearly alike as possible except that each was cured at a different temperature. Mr. Whitmore knew these cheeses only by number, not by the temperature of curing; so was entirely unbiased in his scoring. The comparison of these cheeses is shown by Table II.

TABLE II.—SCORING OF CHEESES CURED AT DIFFERENT TEMPERATURES, 1900.

Cheese		No. 1—80°		No. 2—75°		No. 3—70°		No. 4—65°		No. 5—60°		No. 6—55°	
Made.	Scored.	F.	T.	F.	T.	F.	T.	F.	T.	F.	T.	F.	T.
July 27.	Sept. 1.	42	21	43	23	45	23	47	24	48	25	45	25
July 30.	Oct. 1.	42	21	43	22	43	22	48	24	49	24	49	24
Aug. 1.	Nov. 1.	39	20	41	20	43	22	44	24	47	24	47	24
Aug. 3.	Dec. 1.	42	21	44	22	44	22	46	24	49	25	49	25
Aug. 8.	Dec. 31.	38	20	39	20	42	21	44	22	48	24	50	25

Taking the average scores of the cheeses as given in this table, those cured at and below 60° show a commercial scoring 5.1 points better in flavor and 2.7 points better in texture than those cured at 65° and above.

Concerning the shipment of Sept. 1, Mr. Whitmore says: "No. 5 is especially fine; No. 6 very good but the flavor not quite perfect, being a little sharp." This was unquestionably due to the slower curing at the low temperature, the cheese not having quite time enough to ripen fully in five weeks at 55°. Of the next lot the scorer says: "There is no question but what Nos. 4, 5 and 6 are of a better quality from a commercial standpoint than Nos. 1, 2 and 3. Considering the time when they were made we think they have held very well indeed." In his letter referring to the lot made Aug. 1, Mr. Whitmore says: "Nos. 1, 2 and 3 of this lot of cheese are rather inferior to any you have previously sent me, especially No. 1. If these cheeses were made from the same vat it is almost impossible to comprehend how there can be so much difference in the curing; as Nos. 4, 5 and 6 are of very good quality." Writing concerning the cheeses sent Dec. 1, the comments are: "Nos. 5 and 6 are very nearly perfect cheeses. Considering they were made four months ago we might say no cheese could be made that would show better at the expiration of that time." Of the last lot Mr. Whitmore's letter says: "Nos. 1 and 2 are about the poorest we have had from you and Nos. 5 and 6 the best, particularly No. 6. This we call, so far as flavor and texture are concerned, a perfect August cheese. It would seem that the results

secured with all these different cheeses which show practically the same thing, namely, that the same cheese uniformly shows a loss of quality from curing at the high temperature and uniformly holds flavor and texture in the lower temperature, being nearly perfect cheese at the end of five months, should convince the producer of the desirability of making the conditions for curing the cheese much more favorable than is the rule at the present time."

Prof. Robertson, of Canada, in his address to the State Dairy Association at Watertown, said that in the Canadian experiments recently conducted, they had secured practically the same results as those here reported, and that Canadian manufacturers are working to improve their factory curing rooms. By lining the rooms with building paper and by ceiling them some improvement was secured; but when there was added a cold air duct the gain was marked. This duct is placed deeply enough in the ground and made long enough so that the air is decidedly cooled before its introduction into the curing room; and the temperature is thus materially reduced.

The cheese cured in such rooms is of enough better quality to secure an advanced price; and the gain in selling value of the product of one year, more than repaid the cost of the improvements. With these facts before him the cheese-maker ought not to hesitate long before planning some means of securing lower temperatures in his curing rooms than those now commonly the rule. The improvement presents only a simple question of profit and loss; for cheese of good quality cured as were those in our 60° room must please the consumer and thus add to the demand for cheese and increase its price.