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EXPERIMENTS IN CURING CHEESE

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Experiments in Curing Cheese

BY G. L. MCKAY

SUMMARY

On the 29th of August, 1898, experiments were commenced with a view of determining the feasibility of central curing rooms, and the effects of climatic conditions on the curing of cheese.

Cheese made at Iowa College Factory were shipped by express, fresh from the press, to one of the best factories in Canada to be cured. We also sent some to Guelph Ontario Dairy School to be cured. Cheese made at Black Creek Factory and at Guelph Dairy School were sent here, fresh from the press, to be cured. Shipping the cheese 750 miles by express during the heat of summer did not affect the flavor.

Cheese cured in musty ice box at temperature of 55° compared favorably with cheese cured in well ventilated room at a moderately low temperature during the month of October. Cheese cured in ice box scored 2 $\frac{3}{4}$ points higher on flavor and $\frac{1}{2}$ a point higher on texture.

Cheese can be exposed the first five days to a temperature as high as 90° without injuring its flavor, if sufficient acid has been developed to make a firm-bodied cheese and it is cured at 60° afterwards.

Cheese cured at a temperature of 60°, with a high per cent of moisture, scored higher than cheese cured at a temperature above 65°.

Adding artificial moisture through pine shavings in a box worked very satisfactorily in the curing room, and left no bad odors.

Fumigating with formaldehyde gas, to destroy the mold-producing bacteria, gave good results.

INTRODUCTION

The annual make of the 72 cheese factories in the state of Iowa is 4,212,432 pounds. The relative importance of the cheese-making industry in Iowa is shown by the statement that the number of pounds of cheese made is equivalent to the output of but twenty of the average creameries of the state.

The amount of butter made in all the Iowa creameries during the year 1899 was 87,972,470 pounds, most of which was exported, while we imported a small amount of cheese. The probable reason is that the climate here is better adapted to butter making than to cheese making.

As the state is especially adapted to grazing, we should not only manufacture all the cheese consumed in the state, but should also export a large quantity.

With a view of testing the feasibility of central curing rooms, and the effects of climate on the curing of cheese, experiments were commenced in 1898.

The writer is greatly indebted to Mr. R. M. Ballantyne, of Stratford, Ontario, Canada, and Prof. Dean, of Guelph College, Ontario, Canada, for valuable assistance rendered in connection with experiments. Black Creek cheese factory, owned by the Honorable Thomas Ballantyne and Sons, has become famous, both in English and Canadian markets, for the fine brand of cheese made there.

Specimens of cheese from this factory were selected to make comparisons with cheese manufactured at our school. The Black Creek factory is probably one of the best constructed factories in America, made with stones and brick and having dead air spaces in the walls, so that the temperature can be controlled at the will of the maker.

The cheese-making room is 35 feet wide by 125 feet long, without including boiler room or weighing porch. The curing



room is 38 feet by 70 feet, with a division through the center, so as to permit the heating of one room while the other is kept at a low temperature. The curing room is cooled, when necessary, by the use of ice. It has shelf room for 2,000 cheese and making room capacity for 66,000 pounds of milk daily.

Mr. Ballantyne had no means of determining the per cent of moisture in his curing room, but it was undoubtedly high, as he wrote that they had been troubled with excessive moisture.

Our curing room is partly under ground and is built of stone. The stone wall is 18 inches thick, studded inside and plastered, having an air space between the two walls. The floor is cemented. The room has been divided into three rooms for experimental work. Room No. 1, or the main curing room, contains 3,285 cubic feet. Room No. 2 contains 1,074 cubic feet, and room No. 3 contains 834 cubic feet.

Side ventilators, six inches by twenty-four, are placed in the wall near the floor, with a ventilator extending from room No. 3 up through the roof.



The temperature of the rooms was controlled by ice boxes, which were constructed of 2-inch lumber and covered on outside and inside with galvanized iron. They were set on legs six

inches from the floor and had 2 x 4 oak pieces set in the bottom to place the ice on. Below the ice were three shelves, made of galvanized iron, extending from side to side of the box, with fall enough to carry off the water, thus permitting the air to come in contact with the water. These boxes have nearly air-tight covers, which can be opened or closed as desired, to regulate the temperature. Box in room No. 1 has a capacity of 20 cubic feet, that in room No. 2 a capacity of 12 cubic feet, and in room No. 3 a capacity of 7 cubic feet.



Different methods were used to add artificial moisture to rooms No. 2 and 3. The most satisfactory method used was a box constructed of inch lumber, 14 inches high, 24 inches long and 6 inches deep, with a small slide door at the end. The sides were constructed of inch cleats placed about one inch apart. The box was filled with pine shavings, which were saturated with fresh, cold water every morning and evening by immersing the box in water, and then it was put over the ventilator. Thus the air, in passing up through the shavings, became laden with moisture. We were able to carry an increase of 15 per cent more moisture in room No. 3 by this method.

EXPERIMENTS

In making the cheese the following method was used: As soon as the milk was received in the morning it was heated to a temperature of 86° . The Marshall rennet test was used for testing the ripeness of the milk. When coagulation took place and the milk stopped at four the vat was set, using $3\frac{1}{2}$ ounces of rennet. The whey was removed in about three hours from the time of setting, when the curd showed an acid of $\frac{1}{16}$ to $\frac{1}{8}$ of an inch, stringing out in fine threads on the hot iron. In most cases the milk was sufficiently ripe for setting as soon as it was heated. The cheese made at Ames was made for export trade, so as to compare favorably with the Canadian cheese.

On the 29th of August, 1898, 1500 pounds of milk was made into two cheeses at the college factory. One was shipped, fresh from the press, to be cured at Black Creek Factory, and the other was left in our own curing room.

Mr. Ballantyne shipped to Ames an 84-pound cheese, fresh from the press, to be cured in our curing room, keeping back a cheese of the same lot to be cured at Black Creek Factory.

The cheese received from Mr. Ballantyne, also the cheese made from the same lot of milk as the one we made and sent to be cured in Black Creek Factory, were placed in room No. 2 and cured at an average temperature of 65° . Highest range of temperature 68° , and the lowest 60° . It was only held at 68° for a short period.

The cheese were scored by the writer at thirty days and then again at sixty days. The same standard for scoring was used in all the different lots scored at Ames—45 for flavor; texture, 30; color, 15, and finish, 10.

**CANADIAN CHEESE CURED AT AMES, IOWA, AND RETURNED
TO GUELPH, CANADA, TO BE SCORED.**

| Scored | Scorers | Flavor | Close-ness | Color | Tex-ture | Finish | Total |
|---------------|-------------------|--------|------------|-------|----------|--------|-------|
| Nov. 17, 1899 | G. L. Brill..... | 32 | 14 | 15 | 18 | 10 | 89 |
| | A T. Bell..... | 35 | 14 | 15 | 17 | 10 | 91 |
| | I. W. Stinhoff... | 32 | 14 | 15 | 18 | 10 | 89 |

**IOWA AND CANADIAN CHEESE CURED AT AMES AND SCORED
BY G. L. MCKAY.**

| | Date Scored | Flavor | Tex-ture | Color | Finish | Total |
|---|---------------------|--------|----------|-------|--------|-------|
| Iowa cheese No. 3, { made June 7th. } 1899, at Ames.... { | July 15th, 1899 ... | 38 | 29 | 15 | 10 | 92 |
| | Aug. 15th, 1899... | 37½ | 29 | 15 | 10 | 91½ |
| | Oct. 20th, 1899.... | 36 | 29 | 15 | 10 | 90 |
| Iowa cheese No. 4, { made June 8th. } 1899, at Ames.... { | July 15th, 1899 ... | 40 | 29½ | 15 | 10 | 94½ |
| | Aug. 15th, 1899... | 40 | 29½ | 15 | 10 | 94½ |
| | Oct. 20th, 1899 ... | 38 | 29½ | 15 | 10 | 92½ |
| Cheese made at Guelph College June 24th and cured at Ames... { | Aug. 1st, 1899.... | 40 | 29 | 15 | 10 | 94 |
| | Sept 1st, 1899.... | 40 | 29 | 15 | 10 | 94 |
| | Oct. 1st, 1899.... | 38 | 29 | 15 | 10 | 92 |
| | Oct. 20th, 1899.... | 37 | 29 | 15 | 10 | 91 |

On June 21st, 1899, 1,500 pounds of milk was made into three cheeses, weighing 49 lbs., 50 lbs. and 50½ lbs., respectively, and lettered A, B and C. A was cured in room No. 3 with an average temperature of 63 degrees and 95 per cent. of moisture. Cheese B was cured in room No 2, average temperature 66 degrees and 85 per cent. of moisture. Cheese C was cured in room No. 1, where the temperature varied from 65 degrees to 75 degrees, and the per cent. of moisture varied from 75 degrees to 85 degrees

CHEESE SCORED JULY 21ST, 1899, BY G L. MCKAY.

| | Flavor | Texture | Color | Finish | Total |
|----------------|--------|---------|-------|--------|-------|
| Cheese A | 40 | 29½ | 15 | 10 | 94½ |
| Cheese B | 40 | 29½ | 15 | 10 | 94½ |
| Cheese C..... | 39½ | 29 | 15 | 10 | 93½ |

CHEESE SCORED AUGUST 20TH, 1899, BY G. L. MCKAY.

| | Flavor | Texture | Color | Finish | Total |
|----------------|--------|---------|-------|--------|-------|
| Cheese A. | 40 | 29½ | 15 | 10 | 94½ |
| Cheese B. | 40 | 29½ | 15 | 10 | 94½ |
| Cheese C. | 37½ | 28 | 15 | 10 | 90½ |

CHEESE SCORED SEPTEMBER 19TH, 1899, BY G. L. MCKAY.

| | Flavor | Texture | Color | Finish | Total |
|----------------|--------|---------|-------|--------|-------|
| Cheese A. | 39½ | 29½ | 15 | 10 | 94 |
| Cheese B. | 39 | 29 | 15 | 10 | 93 |

Cheese C became sharp in flavor and was cut and sold before final scoring.

On October 18th, 600 pounds of milk was worked up into cheese, making six young Americas, weighing 10 pounds each. Two of these were put in a room in my house, under which a hard coal stove burned during the winter months. These cheeses were cured in butter tubs and were lettered S. and R. The tub marked S. had a shelf about half way up the side on which the cheese was placed and the tub was filled with water up to the shelf. Cheese R. was cured in a tub without any water. The room was at an average temperature of 56 degrees.

Y. A. CHEESE SCORED DECEMBER 5TH, 1899, BY G. L. MCKAY.

| | Flavor | Texture | Color | Finish | Total |
|----------------|--------|---------|-------|--------|-------|
| Cheese S. | 42 | 29 | 15 | 10 | 96 |
| Cheese R. | 42 | 29 | 15 | 10 | 96 |

Y. A. CHEESE SCORED JANUARY 5TH, 1900, BY G. L. MCKAY.

| | Flavor | Texture | Color | Finish | Total |
|----------------|--------|---------|-------|--------|-------|
| Cheese S. | 42 | 29 | 15 | 10 | 96 |
| Cheese R. | 42 | 29 | 15 | 10 | 96 |

Y. A. CHEESE SCORED FEBRUARY 15TH, 1900, BY G. L. MCKAY.

| | Flavor | Texture | Color | Finish | Total |
|----------------|--------|---------|-------|--------|-------|
| Cheese S. | 42 | 29 | 15 | 10 | 96 |
| Cheese R. | 41 | 29 | 15 | 10 | 95 |

Y. A. CHEESE SCORED APRIL 14TH, 1900, BY G. L. MCKAY.

| | Flavor | Texture | Color | Finish | Total |
|----------------|--------|---------|-------|--------|-------|
| Cheese S. | 41 | 29 | 15 | 10 | 95 |
| Cheese R. | 39½ | 29 | 15 | 10 | 93½ |

On May 1st, the cheeses were cut and sent to the Station chemist, Dr. Weems to be analyzed for water, with the following results: Cheese S. had 31.58 per cent of water, and cheese R. 31.50 per cent of water.

On June 6th, 1900, 1500 pounds of milk were made up into three cheeses. These were made firm, like export cheese. Two of them were cured in room No. 3, at an average temperature of 62 degrees, while the other was placed in a vacant room in the dormitory, where no precaution was taken against high temperature, which sometimes ran as high as 92 degrees. The high temperature had no detrimental effect on the cheese up to the sixth day, when it began to swell, and oil flowed; then the flavor began to show the effect of the heat and deteriorated very rapidly. We did not think it necessary to keep a record of these, further than to note that the two cheeses cured in room No. 3 at a low temperature, came out all right.

On June 15th, 1900, 1250 pounds of milk was made up into two large cheeses and two young America cheeses. One of each variety was placed in room No. 3, while the other two were put in a dormitory room where they were exposed to a high temperature which went up as high as 92 degrees. The large cheese after being exposed to this temperature for five days was returned to room 3, and cured without any perceptible loss in weight or quality.

CHEESE SCORED AT THIRTY DAYS BY G. L. MCKAY.

| | Flavor | Texture | Color | Finish | Total |
|---|--------|---------|-------|--------|-------|
| Large cheese placed in dormitory for 5 days.. | 40 | 29 | 15 | 10 | 94 |
| Large cheese cured in Room 3. | 40 | 29 | 15 | 10 | 94 |

SCORED BY G. L. McKAY.

| | Flavor | Texture | Color | Finish | Total | |
|----------------------|--------|---------|-------|--------|-------|------------|
| Canadian cheese..... | 43 | 30 | 15 | 10 | 98 | At 30 days |
| Ames cheese | 42½ | 30 | 15 | 10 | 97½ | At 30 days |
| Canadian cheese..... | 42½ | 30 | 15 | 10 | 97½ | At 60 days |
| Ames cheese..... | 41¾ | 30 | 15 | 10 | 96¾ | At 60 days |

The cheeses, when seventy days old, were shipped back to Canada and scored by the well known experts, Hon. A. F. McLaren and R. M. Ballantyne, both cheese buyers and exporters. Accompanying these were two other 10-pound cheeses that were made October 3rd. These were made up from a vat of 1200 pounds of milk. One of these—cheese No. 1—was cured in room No. 1 where no attempt was made to control moisture or temperature, although there was little variation in temperature owing to the coolness of the weather.

Cheese No. 2 was cured in one of the boxes in which ice had been kept during the summer and the wood on which the ice rested had become thoroughly saturated with moisture, giving the box a very strong, musty odor. The object in curing the cheese in this box was to see if the odor would affect the flavor of the cheese. After the cheese had been in the box a few days it was completely covered with mould. The temperature of the box ranged from 50 to 55 degrees during the time it was curing. The box was kept closed except when turning the cheese, thus keeping a heavy, close atmosphere.

SCORED BY HON. A. F. McLAREN.

| | Flavor | Texture | Color | Finish | Total |
|---|--------|---------|-------|--------|-------|
| Canadian cheese cured in Black Creek factory | 41 | 27½ | 15 | 10 | 93½ |
| Iowa cheese cured in Black Creek factory..... | 37½ | 26½ | 15 | 10 | 89 |
| Canadian cheese cured at Ames, Iowa | 40 | 27 | 15 | 10 | 92 |
| Ames cheese cured at Ames, Iowa. | 36½ | 26½ | 15 | 10 | 88 |
| Ames cheese cured in musty ice box, Ames, Iowa..... | 40½ | 27½ | 15 | 10 | 93 |
| Ames cheese cured in room No. 1, Ames, Iowa..... | 37 | 26½ | 15 | 10 | 88½ |

SCORED BY R. M. BALLANTYNE.

| | Flavor | Fixture | Color | Finish | Total |
|--|--------|---------|-------|--------|-------|
| Canadian cheese cured at Ames, Iowa | 40 | 30 | 15 | 10 | 95 |
| Ames cheese cured at Ames, Iowa | 39 | 30 | 15 | 10 | 94 |
| Canadian cheese cured at Black Creek factory | 41 | 30 | 15 | 10 | 96 |
| Ames cheese cured at Black Creek factory | 40 | 30 | 15 | 10 | 95 |
| Iowa cheese cured in ice box at Ames, Iowa | 40 | 29 | 15 | 10 | 94 |
| Cheese cured in Room No 1 | 38 | 29 | 15 | 10 | 92 |

On September the sixth, 1898, 1,255 pounds of milk was made up into cheese, making 120 pounds of green cheese or two cheeses of 62 and 64 pounds respectively. The 64 pound cheese was cured in room No. 3 with an average temperature of 60 degrees. Highest range of temperature 65 and lowest 56 degrees. Cheese No. 2 was cured in room No. 2 with an average temperature of 65. Highest range of temperature 68 for a short period and lowest 60 degrees. The per cent of moisture in room No. 3 was 95 and in room No. 2 it was 85.

CHEESE SCORED BY G. L. McKAY.

| | Flavor | Texture | Color | Finish | Total |
|-------------------------|--------|---------|-------|--------|-------|
| Cured in Room No. 2 ... | 42 | 30 | 15 | 10 | 97 |
| Cured in Room No. 3 ... | 42½ | 30 | 15 | 10 | 97½ |

Cheese cured in room No. 3 had a richer, milder flavor than that cured in room No. 2.

On June 7th, 1899, 1000 pounds of milk was made up into two cheeses weighing 51 and 48 pounds respectively, cheese being numbered 1 and 3. No. 3 was cured at Ames and No. 1 was sent to Guelph College, Canada, to be cured.

On June 8th, 1889, 1000 pounds of milk was made up into two cheeses weighing 49 and 51 pounds respectively. These were numbered 2 and 4. No. 4 was cured at Ames, and No. 2 was sent to Guelph College to be cured. Average temperature of Guelph College curing room was 59.4; highest range 67 for a short period; lowest range 52 for a short period. Average per cent of moisture, 85.

Score used at Guelph: Flavor 40, closeness 15, color 15, texture 20, finish 10, total 100.

AMES CHEESE SCORED JULY 27TH, 1891, BY G. L. BRILL, OF GUELPH.

| | Flavor | Close-ness | Color | Tex-ture | Finish | Total |
|----------------------------------|--------|------------|-------|----------|--------|-------|
| Cheese No. 1, made June 7th..... | 36 | 13 | 13 | 17 | 10 | 89 |
| Cheese No. 2, made June 8th..... | 37 | 14 | 14 | 18 | 10 | 93 |

**AMES CHEESE SCORED BY PROF. DEAN, OF GUELPH.
AUGUST 15TH, 1899.**

| | Flavor | Close-ness | Color | Tex-ture | Finish | Total |
|-----------------------------------|--------|------------|-------|----------|--------|-------|
| Ames cheese No. 1, made June 7th. | 37 | 13 | 13 | 16 | 10 | 89 |
| Ames cheese No. 2, made June 8th | 38 | 14 | 14 | 18 | 10 | 94 |

**AMES CHEESE SCORED SEPTEMBER 19TH, 1899, BY
R. W. STRATTON.**

| | Flavor | Close-ness | Color | Tex-ture | Finish | Total |
|-----------------------------------|--------|------------|-------|----------|--------|-------|
| Ames cheese No. 1, made June 7th. | 36 | 13 | 13 | 18 | 10 | 90 |
| Ames cheese No. 2, made June 8th. | 36 | 14 | 14 | 18 | 10 | 92 |

AMES CHEESE No. 2, SCORED NOVEMBER 17TH AT GUELPH.

| | Flavor | Close-ness | Color | Tex-ture | Finish | Total |
|------------------------|--------|------------|-------|----------|--------|-------|
| By G. L. Brill..... | 32 | 13 | 12 | 15 | 10 | 82 |
| By A. T. Bell..... | 32 | 14 | 13 | 16 | 10 | 85 |
| By I. W. Stinhoff..... | 29 | 14 | 14 | 16 | 10 | 83 |

On June 24th Prof. Dean shipped one cheese, fresh from the press, to Ames to be cured, and kept one cheese from the same lot at Guelph to be cured.

CANADIAN CHEESE CURED AT GUELPH, SCORED JULY 27TH, 1899.

| | Flavor | Close-ness | Color | Tex-ture | Finish | Total |
|----------------------------|--------|------------|-------|----------|--------|-------|
| Scored by G. L. Brill..... | 37 | 14 | 14 | 18 | 10 | 93 |

CHEESE SCORED AT TWENTY-ONE DAYS BY G. L. MCKAY.

| | Flavor | Texture | Color | Finish | Total |
|--------------------------------------|--------|---------|-------|--------|-------|
| Small cheese cured in dormitory..... | 36 | 26 | 15 | 10 | 87 |
| Small cheese cured in Room 3..... | 39½ | 29 | 15 | 10 | 93½ |

No attempt was made during the above experiments to keep an accurate record of the shrinkage, but in every case tested, the shrinkage was much greater where we had a low per cent of humidity and a high temperature.

Room 3, where artificial moisture was added, gave us a lot of trouble with mold for a time. Some tests were made in fumigating the room with formaldehyde gas, which gave good results. Burning wood alcohol while generating formaldehyde gas did not affect the temperature of the room to any extent.

The most striking difference in any of the tests made, was in the lot of cheese made October 3rd, 1898. The ice box where cheese No. 2 was cured, had been closed for some time, and the odors of the box were quite repulsive, yet this cheese scored three points higher on flavor than the other cheese from the same curd that was cured in a well ventilated room.

In conversation with Hon. A. F. McLaren, one of the judges, after the scoring had been completed, concerning the method of curing he expressed the opinion that the difference in flavor was due more to the evenness of temperature in the ice box than to the excessive amount of moisture it contained. From this it would seem that cheese will not take up odors after being manufactured.

In room 2 where 85 per cent of moisture was maintained, the result seemed to be as good as where 90 to 95 per cent was maintained.

It would seem that one of the benefits of excessive moisture, would be the saving of weights of cheese, as less shrinkage would take place than when the atmosphere was dry.

When a free circulation of air was permitted, we had less trouble with mold. It would seem where air is kept moving, that a heavy per cent of moisture can be carried.

In adding artificial moisture by use of sheets, the difficulty is that the excessive moisture rots the sheets; also they fill

up sometimes with sediment from the water, which renders them useless unless sediment is removed.

We found the box containing the pine shavings, as constructed by the writer, to work in every way satisfactorily, leaving no bad odors in the room. From what experiments we conducted with the formaldehyde gas generator, we would prefer it to the spraying system, as it is more easily operated and more effective.

It seems that while some countries are better adapted for cheese making than others, owing to the cool climate, good cheese can be made in most any place or country where there is good grazing if due precautions are taken, as cheese made in Canada and that made in Iowa, compared very favorably in quality.

In Iowa, where the climate is warmer and dryer, it is necessary that more precaution should be taken to quickly aerate and cool the milk as soon as it is drawn. Better curing rooms are necessary and moisture can be added artificially, so that the climate in curing room would differ very little from the climate in best cheese belts in the world.

For the above reasons it would seem that centralized curing rooms would be of great benefit to the cheese industry of the country, as they could be better constructed and a more uniform temperature maintained.

The cheese shipped to Canada to be cured, and the cheese shipped from Canada to be cured at Ames, were sent over 750 miles by express, with practically no protection in the hottest season of the year; yet they showed up almost as well when cured and scored by experts as the cheese that were kept in the curing room at home.

Temperature does not seem to affect the quality of the cheese the first four or five days. This is possibly due to the extra amount of moisture at this period, and the heat not being able to penetrate the cheese.

From results obtained in these experiments, would recommend a temperature of 60 degrees and 85 per cent moisture for curing cheese.

