Minor Thesis in Dairy Husbandry

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THE EFFECT OF VARIATIONS IN PROCEDURE ON THE YIELD AND MOISTURE CONTENT OF CHEDDAR CHEESE

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Introduction

This experiment was undertaken primarily for the purpose of studying the effect of variations in the procedure on the yield and moisture content of cheese of the cheddar type. A knowledge of the proper methods required in the control of moisture in cheese is of the highest importance to the cheese industry, as soft or high moisture cheese is short-lived and hence is not suitable for southern markets or shipment abroad, while ~~very~~ very low moisture in cheese reduces the yield and hence is not so profitable to the cheese maker.

Below is a review of the literature pertaining to the different methods which affect the moisture content and yield of cheddar cheese.

Review of Literature

Sammis, Guzuki and Laabs[1] studied the effect of different but fixed acidity at time of setting on the moisture content of curds by raising the acidity of the first vat to 0.25 percent with dilute hydrochloric acid, of the second vat to 0.20 percent with the same acid, while the acidity of the third vat was left at 0.17 percent. After cutting, the whey tested 0.17 percent, 0.13 percent and 0.11 percent acidity, respectively. From results secured in this experiment the authors conclude that moisture separates more

rapidly when the concentration of acid in solution in the whey witin and around the curd is 0.17 percent than when it is 0.13 or 0.11 percent and more rapidly at 0.13 percent than at 0.11 percent.

In a second experiment by the same investigators, in which the acidity of the milk was raised to 0.177, 0.21, and 0.26 percent, respectively, in the three vats, not by the use of hydrochloric acid but by natural ripening, then fixed by pasteurizing to 150°F., and afterwards cooled to and set at a temperature of 86°F, similar results were secured.

In a third experiment with varying and unfixed acidity, the results secured led the authors to conclude that while in the preceding experiments the rate at which moisture separates from curd in whey was shown to be more rapid at moderately high than at low acidity, in this experiment the rate of moisture separation was not proportionately increased after the acidity passed above 0.18 percent.

In experiments reported by the Professor of Dairy Husbandry at the Ontario Agricultural College in his report for 1910, the average percent of acid in the low acid group of experiments at the time of dipping was 0.172, while in the high acid group it was 0.192. He secured a slightly increased yield and a better quality of cheese by dipping at the lower percent of acidity.

Fisk[2] in ten determinations found that a higher yield and a better quality of cheese was made by dipping at 0.16 percent acidity when compared to dipping at 0.20 percent acidity.

At the New York Experiment Station[4] in experiments to test the effect of heating curd to a low and high temperature, the higher temperature gave a ~~similer~~ smaller yield.

In Wisconsin Research Bulletin No. 7[1] is reported an experiment in which four vats were heated after cutting in thirty-five minutes, to 86°F., 98°F., 104°F., and 110°F., respectively, with all other factors the same. From this experiment the authors conclude that the temperature to which the vat is heated after cutting has a very marked influence on the rate of removal of moisture while the curd is in the whey. The higher the temperature the more rapid the separation of whey, under the conditions described.

Van Slyke and Publow[3] state as the most common causes of excessive moisture the following; (1) Cutting curd coarse or when too hard; (2) insufficient heating of curd in whey; (3) heating too rapidly, thus hardening the outside of the pieces of curd and preventing escape of whey; (4) low degree of acidity before removing whey, usually associated with, or caused by, insufficient heating; (5) allowing curd to lie in whey too long and re-absorb whey; (6) insufficient stirring of curd after removal of whey; (7) high piling of curd; (8) prolonged maturing in cheddaring operation and postponement of milling in case of soft curd; (9) insufficient amount of salt; (10) soaking curd in water previous to salting.

Thom and Fisk[5] give as the causes of insufficient moisture the following: (1) Cutting curd too fine; (2) cutting curd too soft; (3) stirring curd too much by hand as the last of the whey is being removed; (4) high acid at dipping; (5) insufficient piling of the curd after and during the cheddaring process; (6) large amount of salt; (7) high temperature and low humidity in curing room.

Plan of Experiment

In this experiment is included a study of the effects on yield and moisture content of the following important factors in cheesemaking:

1. High acid (a) at setting; (b) at dipping; (c) at milling, and (d) at salting.
2. Length of time between setting and dipping.
3. Care of milk.
4. Heat after cutting.

Methods used in making Experimental Cheese

In each vat in this experiment the quantity of milk used was 86 pounds, A pound to a pound and a half of started was used when it did not interfere with the plan of the experiment. The milk in every case was strictly sanitary.

Coloring at the rate of 2 ounces and rennet at the rate of 4 ounces per 1000 pounds of milk were used.

The standard acid percents used unless otherwise stated were as follows:

1. Adding rennet - - - - - - - 0.20
2. Drawing whey - - - - - - - 0.17
3. Dipping after piling - - 0.24 to 0.3
4. Milling - - - - - - - - - - 0.65 to 0.9
5. Salting - - - - - - - - - - 0.9 to 1.2

Only the results secured with cheeses made on the same day are comparable. Milk of the same composition and quality in every respect was secured by pouring 172 pounds into a vat and thoroughly mixing it after which it was divided into equal portions.

A complete set of records was kept on every cheese as the work proceeded. Each day only one part of the process was varied.

Methods of Moisture Determination

The moisture content of the different cheese was determined at the close of the curing process, or about two months after being made.

A large trier plug was taken about half way between the center and edge of the cheese. From this plug approximately ten grams of cheese were weighed into an evaporating dish accurately to the third decimal place. The weighed samples from seven of the cheeses were then placed in the drying oven and evaporated to constant weights, after which the other seven were likewise treated. From this data the loss of moisture was determined and the percent of moisture calculated.

Effects of High Acid

At Setting. - In this experiment each vat contained 86 pounds of 4% milk to which was added one pound of starter. The high acid vat was set at 0.27 percent acidity while the low acid vat was set at 0.20 percent acidity. Both vats were carried from this point through the successive steps as outlined above. The results are given in Table I.

Table I - Effect of High Acidity at Setting

Treatment	Loss of fat in whey per 100 lbs. milk Pounds	Yield green cheese per 100 lbs. milk Pounds	Yield cured cheese per 100 lbs. milk Pounds	Moisture in cured cheese Percent
High Acid	0.26	10.5	10.25	38.01
Low Acid	0.36	10.5	10.30	37.91

In studying this table we see yield of cheese and moisture content are approximately the same, the difference in each case probably being within the experimental error. Hence neither high nor low acidity of milk at time of setting affected the yield or moisture content of the cheese.

At Dipping. - In this experiment 86 pounds of 3.7 percent milk were used with one and one-half pounds starter to each vat. Both vats were treated in a similar manner up to the time of dipping when the low acid milk was set at 0.165 percent acidity and high acid milk at 0.22 percent acidity. In Table II are shown the effects of such treatment.

Table II - Effect of High Acidity at Dipping

Treatment	Loss of fat in whey per 100 lbs. milk Pounds	Yield green cheese per 100 lbs. milk Pounds	Yield cured cheese per 100 lbs. milk Pounds	Moisture in cured cheese Percent
High Acidity	0.18	10.25	10.1	36.71
Low Acidity	0.54	10.0	9.75	36.93

By considering the loss of fat in the whey as not due to the treatment received at dipping, the yield of cheese in both cases is practically the same, while only a difference of .2 percent moisture is secured in favor of the low acid treatment at dipping.

At Milling.- One and one-half pounds of starter were added to 86 pounds of 4.0 percent milk for each vat in this experiment. The treatment varied only at the time of milling, when the high acid milk was milled at 0.9 percent acid while the low acid milk was milled at 0.7 percent acid. The results are given in Table III.

Table III - Effect of High Acidity at Milling

Treatment	Loss of fat in whey per 100 lbs. milk Pounds	Yield green cheese per 100 lbs. milk Pounds	Yield cured Cheese per 100 lbs. milk Pounds	Moisture in cured cheese Percent
High Acid	0.18	11.0	10.75	38.56
Low Acid	0.26	10.5	10.3	36.82

High acidity at milling in this experiment shows that the yield of cured cheese is increased .44 of a pound per 100 pounds of milk and the moisture content 1.74 percent.

At Salting. - In this experiment 86 pounds of 3.8 percent milk with a pound and a half of starter were weighed into each vat. The treatment varied only at salting when the high acid vat was salted at 1.2 percent acid while the low acid vat was salted at 0.8 percent acid. In Table IV the data secured is given.

Table IV - Effects of High Acidity at Salting

Treatment	Loss of fat in whey per 100 lbs. milk Pounds	Yield green cheese per 100 lbs. milk pounds	Yield cured cheese per 100 lbs. milk Pounds	Moisture in cured cheese Percent
High Acidity	0.18	10.25	10.12	38.20
Low Acidity	0.18	10.87	10.75	38.23

These results show a slight increase in yield in favor of low acidity at salting.

Effect of Length of Time Between Setting and Dipping

In this experiment one vat of milk was treated with one pound of starter and dipped at 0.17 percent acid while the other vat received no starter but was dipped at the same acidity. Each vat contained 86 pounds of 3.7 percent milk. Table V shows the effects of such treatment.

Table V - Effect of Length of Time between Setting & Dipping

Treatment	Loss of fat in whey per 100 lbs. milk Pounds	Yield green cheese per 100 lbs. milk Pounds	Yield cured cheese per 100 lbs. milk Pounds	Moisture content in cured cheese Percent
Starter	0.45	9.5	9.45	33.02
No starter	0.54	9.25	9.06	35.56

The results of this table are contradictory as the yield is greater where the moisture is lowest and hence are of no value.

Effects of Care of Milk

In this experiment one vat of milk was kept over night at a temperature of 70° to 63° F., while the other was maintained at a temperature of 55° to 53° F. Each vat contained 86 pounds of 3.8 percent milk. This treatment furnished the data in Table VI.

Table VI - Effect of Care of Milk

Treatment	Loss of fat in whey per 100 lbs. milk Pounds	Yield green cheese per 100 lbs. milk Pounds	Yield cured cheese per 100 lbs. milk Pounds	Moisture content per 100 lbs. milk Percent
High Temp.	0.36	9.56	9.43	37.46
Low Temp.	0.54	9.56	9.18	36.07

This experiment shows a slightly increased yield and moisture content in favor of maintaining the milk at the higher temperature over night.

Effect of Heating after Cutting

In this experiment two vats containing 86 pounds of 3.8 percent milk to each of which was added one and a half pounds of starter, were treated similarily except that one vat was heated to 98°F. while the other vat was heated to 102°F. In both cases forty five minutes were required to complete the heating. The results are given in table VII.

Table VII - Effect of Heat after Cutting

Treatment	Loss of fat in whey per 100 lbs. milk. Lbs.	Yield green cheese per 100 lbs. milk. Lbs.	Yield cured cheese per 100 lbs. milk. Lbs.	Moisture content of cured cheese Percent.
High Temp.	0.22	10.06	9.87	35.36
Low Temp.	0.22	10.56	10.50	37.61

This experiment shows both a decrease in yield and moisture content due to the high heating.

Conclusions

1. High acidity at milling increases both the yield and moisture content of cheese.

2. High acidity at salting decreases the yield of cheese.

3. In winter, milk maintained over night at a temperature at which bacterial action proceeds unhindered, gives a higher yield and moisture content than does milk maintained at a lower temperature.

4. High heating after cutting reduces both yield and moisture content.

5. High acidity at either setting or dipping does not affect the yield or moisture content of the cured cheese.

Bibliography

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