

EFFECT OF VARIATIONS IN THE SALTING RATE ON THE COMPOSITION AND GRADE SCORE OF CHEDDAR CHEESE

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SUMMARY

Gradings were carried out at three weeks and six months after the manufacture of cheeses salted at various rates.

In the case of the fresh cheese, there was a slight decline in quality as the salting rate was increased from low to very high levels. The difference was greatest in regard to body and least in regard to texture.

When matured, the cheeses salted at the higher levels held their grade better and the cheeses salted at the lower levels lost their initial advantage in all grading qualities except colour.

Increased salting rates caused a reduction in the moisture content and an increase in the salt content of the cheeses. However, the percentage of the salt added which was retained by the curd decreased with increasing salting rates from an average of 61.2 per cent. at low levels to an average of 41.5 per cent. at very high levels of salting.

The average salt content and salt concentration of 15 cheeses produced with a normal firm body during the experiment were 1.50 and 4.31 per cent. respectively.

Some observations are made regarding the possibility of different individual cheeses from the one batch being assigned different official grades as a result of differences between the salt contents of the cheeses.

I. INTRODUCTION

The usual methods of applying salt to the curd produced in the manufacture of cheddar cheese have been shown to result in a rather uneven distribution with a corresponding variation among the salt contents of the individual cheeses (Morris 1961). The possibility that this might cause differences between individual cheeses from the one vat of manufacture in regard to grading quality was therefore thought worthy of further investigation, especially in view of the fact that the grade of a vat of cheese is determined by an examination of only one cheese. If the differences in salt content of the order previously reported could have an influence on the grading quality, then it would be possible for a different grade score to be attained by different cheeses from the one vat of manufacture.

Investigations into the effect of the moisture content of cheddar cheese on its grade (Morris 1961) showed that moisture content and grade tend to be related inversely. The addition of extra salt has been shown to cause a lowering of the

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moisture content of the cheese produced (Riddet *et al.* 1933; Whitehead and Harkness 1954). Although in New Zealand Riddet *et al.* stressed the undesirability of relying on the use of salt as a correction for an over-moist condition of the curd, the possibility of gaining improved grades through the use of extra salt as the sole means of reducing moisture content and without any other manufacturing changes was thought worthy of investigation under Queensland conditions.

II. METHODS

(i) *Manufacture of Cheese.*—The co-operation of a commercial cheese-manufacturing company was obtained and use was made of cheddared curd manufactured by methods normally employed in cheese factories in Queensland (Rice and Morris 1954).

After a vat of curd was milled the milled curd was stirred for about 30 min. Four separate lots, each sufficient to make one 80 lb cheese, were then taken, placed apart in an empty vat, and treated with salt at four different rates, designated low, average, high and very high, with a difference of 1 per cent. salt (by weight of curd) between each rate. For the purpose of providing some information from intermediate salting rates, each of the salting-rate categories was divided to allow 0.25 per cent. gradations within the category. The complete range of salting rates used is shown in Table 1.

TABLE 1
SALTING RATES WITHIN DIFFERENT CATEGORIES

Category	Salting Rates Used (%)			
	Batch 1	Batch 2	Batch 3	Batch 4
Low	1 $\frac{1}{4}$	1 $\frac{1}{2}$	1 $\frac{3}{4}$	2
Average	2 $\frac{1}{4}$	2 $\frac{1}{2}$	2 $\frac{3}{4}$	3
High	3 $\frac{1}{4}$	3 $\frac{1}{2}$	3 $\frac{3}{4}$	4
Very high	4 $\frac{1}{4}$	4 $\frac{1}{2}$	4 $\frac{3}{4}$	5

The four trials necessary to complete the salting rates detailed were repeated, thus providing eight batches, each represented by one cheese, within each category of salting rate.

(ii) *Grading and Sampling of Cheese.*—The cheeses manufactured were submitted for grading in the usual way at an age of about three weeks. The salting rates applicable to each cheese were not known to the grader. To increase the range of points allotted to the cheese for body, texture and colour, the special pointing system which had been used in previous experiments (Morris 1960) was again employed, based on the written comments of the grader. At the time of this first grading, samples of the cheeses were taken for laboratory analysis.

(iii) *Analysis of Samples*.—Duplicate determinations of moisture content and salt content were made on each cheese by the following methods:—

Moisture.—Method 15.129 of the A.O.A.C. Official Methods of Analysis (8th Ed. 1955) for cheese moisture was used.

Salt.—Two grams of cheese is weighed into a 250 ml conical flask. 10 ml chloride-free distilled water and 10 ml N/5.85 silver nitrate solution are added and the mixture heated to 70–80°F with gentle swirling of the flask. 10 ml concentrated nitric acid (Analytical Reagent grade) is then added and the mixture boiled gently until the curd is dissolved, the fat layer clear and the precipitated silver chloride granular. The volume is made up to approximately 100 ml with chloride-free distilled water. 2 ml ferric alum indicator solution is added and the contents of the flask are titrated with 0.1N potassium thiocyanate solution until an orange colour persists in the clear liquid layer for 15 sec. After allowing for the result of a blank determination the salt content of the sample is calculated as follows:—

$$\text{Total chlorides (as NaCl) in sample} = \frac{10\text{—ml of KCNS used}}{2} \text{ per cent.}$$

(iv) *Maturing of Cheese and Regrading*.—The cheeses were placed together in store for curing at a temperature of about 45°F until they were 6 months of age. They were then subjected to a regrading by the same grader who had performed the initial grading.

III. RESULTS

(a) Salting Rate and Grading Quality

The results of the two gradings of the cheeses are shown in Table 2. From this it can be seen that in the case of the fresh cheese there is a slight decline in average points scored in all grading qualities as the salting rate is increased from low to very high. The difference between the average points scored by the cheeses in the low group and the cheeses in the very high group is 0.5 for total grade, 0.2 for flavour, 1.6 for body, 0.1 for texture and 0.8 for colour.

It is apparent that the main advantages in grading quality possessed by the low-salt cheese can be attributed to a better body and colour. Cheeses salted at the high and very high rates were frequently commented on as being slightly crumbly and/or slightly corky in body and seamy or slightly wavy in colour. Cracking of the rinds of cheeses was found to be most prevalent in the very high salting category. The points allotted in the grading of the cheeses did not take this into account but it is a serious defect which may detract considerably from the commercial value of a cheese. (In the normal grading system with body and texture combined, the average difference in favour of the low-salt cheese as compared with the very high salt cheese was 0.38 points, while the difference in relation to colour, as assessed by the points allotted to condition, was 0.1 point.)

TABLE 2
COMPARISON OF SALTING RATE WITH GRADE POINTS SCORED BY CHEESE WHEN FRESH AND WHEN MATURE

Salting Rate	Average Points Scored by Fresh Cheese						Average Points Scored by Matured Cheese					
	No. of Batches	Normal System		Special System			No. of Batches	Normal System		Special System		
		Total	Flavour	Body	Texture	Colour		Total	Flavour	Body	Texture	Colour
Low ..	8	91.81	42.1	4.5	4.0	4.8	8	91.1	41.6	3.8	3.4	4.4
Average ..	8	91.7	42.1	4.4	3.8	4.6	8	91.2	41.4	4.1	3.9	4.1
High ..	8	91.6	42.0	3.9	3.9	4.3	8	90.9	41.2	4.4	3.9	3.9
Very High	8	91.3	41.9	2.9	3.9	4.0	8	91.2	41.6	3.9	4.0	4.0

It will be noted that when the cheese was matured the low-salt cheese had lost its initial advantage in grading qualities in relation to all attributes except colour. This was due to the improvement in body and to some extent texture of the very high salt cheese during maturing, whereas the body and the texture of the low salt cheese deteriorated. The very high salt cheese also maintained its flavour score better than did the low-salt cheese.

When fresh, the low-salt cheese scored the highest points in all attributes except flavour, in which it was equalled by the average-salt cheese. When the cheeses were matured the average and the very high cheeses were equal highest in total points, the low and the very high were equal highest in flavour points, the high was best in body, the very high was best in texture, and the low was best in colour.

(b) Salting Rate and Composition of Cheese

The average moisture and salt contents of the cheeses in each salting category are shown in Table 3. The averages of the salt content of the cheese as a percentage of the salt added to the curd are also shown.

TABLE 3
COMPARISON OF SALTING RATE WITH COMPOSITION OF CHEESE AND PERCENTAGE OF ADDED SALT RETAINED

Salting Rate	No. of Batches	Composition of Cheese		
		Average Moisture Content (%)	Average Salt Content (%)	Average Percentage of Salt added Retained by Cheese
Low	8	36.96	0.99	61.2
Average	8	35.66	1.43	54.4
High	8	34.20	1.72	47.6
Very high	8	33.43	1.92	41.5
Average regression coefficients*		-1.21 ± .040	0.31 ± .019	

* These coefficients represent the average change in the factor for each 1 per cent. change in salting rate. Both coefficients are significantly different from zero and the second coefficient is significantly different from unity.

The effect which added salt has on the moisture content of the cheese is well illustrated by these results. Increased salting rate causes a reduction in the moisture content of the curd and an increase in the salt content. However, the increase in salt content is not proportional to the increased amount of salt added to the curd. With higher salting rates the percentage of salt retained by the curd is lower (41.5 per cent. retained with very high salting rates and 61.2 per cent. with low salting rates).

(c) Relation of Salt Content to Body of Cheese

The effect of salting rate on the body and grade of the cheese warranted an examination of the possibility of determining what was the average content of salt in a good-bodied cheese. The number of samples was not sufficient to draw distribution curves and so establish the most commonly occurring salt content for cheese of different degrees of body firmness. However, it was possible to average the results of analyses of the samples divided into three categories representing cheese weak or slightly weak in body, normal or good, firm-bodied cheese, and overfirm or crumbly, corky cheese. Table 4 shows the results of averaging the salt contents of cheese graded into these three categories on the basis of body.

TABLE 4

AVERAGE SALT CONTENT AND SALT CONCENTRATIONS IN CHEESE OF DIFFERENT BODY RATINGS

	Weak Body	Normal Body	Over-firm Body
No. of samples	9	15	8
Average salt content	1.15	1.50	1.96
Range of salt content	0.85-1.6	0.85-1.80	1.85-2.1
Average salt concentration*	3.22	4.31	5.89
Range of salt concentration	2.0-4.6	2.3-5.4	5.3-6.5

$$* \text{ Salt concentration} = \frac{\% \text{ Salt}}{\% \text{ Moisture}} \times 100$$

IV. DISCUSSION

Comparison of the average salt content of cheeses salted at different rates (Table 3) with the average grade attained (Table 2) indicates that with average salting rates (2-3 per cent. by weight of curd) there is no great possibility of different grades being assigned to different cheeses from the one vat of manufacture as a result of varying salt content. The spread of salt content of individual cheeses was previously indicated (Morris 1961) as being about 0.5 per cent. Assuming that this spread occurs evenly on each side of the average salt content of 1.43 per cent., the highest and lowest salt contents could be expected to be about 1.68 and 1.18 per cent., respectively. These contents would allow the cheese to come within the low salt to high salt range, where the difference in grade is not significant.

However, if the salting rate was high (3-4 per cent. by weight of curd) the highest and lowest salt contents of individual cheeses could be 1.97 and 1.47 per cent. respectively. This could bring individual cheeses into the very high salt range and thereby cause a significant difference in grade between certain individual cheeses.

The inadvisability of relying solely on high salting rates as a means of gaining improved cheese grades through attaining lower moisture contents in the cheese is clearly shown by the grading results obtained in this work. The

tendency for high salting rates to promote cracked rinds is a further disadvantage of this practice. The necessary correction of moisture content must be very largely obtained before the salting stage of cheese manufacture is reached.

The average salt content and salt concentration in cheeses of good, firm body were found to be slightly lower than those found by Riddet *et al.* (1933). However, as those authors have pointed out, there are factors other than salt content (such as the level of acidity attained) which have an influence on the body of cheese.

The methods by which the salt content of the cheese is varied must also have an influence, as has been shown recently in experiments with the dry-rubbing of salt on the surface of finished cheddar cheeses (Dawson 1961).

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