<研究論文>

A New Method of preparing and ripening Cheese in the form of a Cheese Slurry

國立安城農業專門大學
食品製造科長. 敎授 李 聖 甲*

—요 약—

치즈의 기존제조공정상의 문제점을 조사정리하였고, 또 새로운 치즈의 숙성법으로 Cheese Slurry를 이용한 제조법을 시험하였다. Cheese Slurry는 제빵, 제과에 좋은 영양의 보강과 풍미를 내는데 가장 적합한 재료로써 잠재력이 큰 것으로 판단되었다.

이 새로운 방법은 치즈의 재래식방법을 약간 변형시켜 적당한 Starter Culture을 이용함으로써 제품의 풍미향상과 제조기간 단축에 뚜렷한 효과를 확인하였다.

ABSTRACT

These preliminary studies have indicated that this approach in the manufacture and rippening of cheese slurry will be of practical application. The slurry thus prepared seems to have great potentiality in being suitable for incorporation into bakery products and the products thus prepared will have better nutritional qualities and flavour.

Indications have also been observed that a definite improvement in the quality of flavour may be obtained by employing suitable starter cultures as well as slight modification in the process.

Introduction

Cheese is considered as one of the excellent food concerning with its nutritional value, digestion and absorption after intake in human body and also good acceptability to consummer.

Cheese was prepared in Asia and in Europe several hundred years, at least before the Christ.[1] Cheese, according to the defination and standards of the Food and Drug Administration of the United States, Department of Agriculture[2] is the product made from the separated curd obtained by coagulating the casein of milk, skimmed milk, or milk enriched with cream. The

* 産業應用技術上(食品製造加工)

coagulation is accomplished by means of rennet or other suitable enzyme, lactic fermentation or by a combination of the two. The curd may be modified by heat, pressure, ripening ferments, special molds, or suitable seasoning. Chedder cheese was the first factory cheese and it is now the most universally made cheese in English-speaking countries.

But there are some problems in traditional cheese making such as requirements of long fermenting time, broad floor and large amounts of energy, therefore, earlier workers has been efforted to find out the short process of cheese making even untill nowadays.

Numerous publications to shorten the processing of cheese slurry were devoted to its study; not only for its academic interest but also for its applications to many field of the related industries.[3~7]

Most of reports dealt with the optimum condition of cheese slurry preparation for example moisture content of slurry, temperature and time of fermenting, concentration of added sodium chloride and trace elements[8,9] for good cheese making.

Shtherland[10] reported that cheese could be made from cheese slurry instead of ripened cheese. Utilization of cheese slurry was reported by Vanslyke.[11]

This communication dealt with the optimum processed conditions for shortening the processing of cheese slurry and its applied to bakery products.

Materials and methods

Sample Preparation

H.T.S.T. pasteurised milk supplied by the BingGre Milk Co. was used for cheese making. Starter cultures used were prepared in the Microbiology Laboratory of BingGre Milk company.

Cheese manufacture

Cheese are prepared using 5 litres of milk per batch. Cheddar cheese was prepared according to standard procedures[12] using starter culture of Lactobacillus bulgaricus and streptococcus thermophilus(mixed strain) and rennet.

Preparation of cheese slurry

Basically, the process was mixing 2 parts of the 24hr. old salted, unpressed cheese curd with 1 part of 5.2% NaCl solution. This mixture was blended at 45°C in a power waring Blender for 2 minutes to form a slurry. At this stage, additives such as cystine hydrochloride (10ppm), reduced glutathione (50~100ppm) were incorporated to study their effects on flavour developmment. Potassium sorbate (0.1%) was added to check microbial spoilage. The prepared slurry was cooled to 30°C and stored at this temperature in a sterilised conical flask for 7 to 12 days for development of flavour. The product was agitated daily to permit representative sampling for analysis.

Chemical analysis:

The stored cheese curd slurry (7 to 10 days) was analysed for soluble nitrogen by measuring optical density[13] pH, moisture and salt were estimated by standard Procedures. The composition are given in Tables 1 and 2.

Microbiological Examination:

Standard plate count, coliforms and yeasts and moulds were determined using approved procedures.[14] The results are given in Table 3.

Sensory Evaluation of cheese slurry:

Cheese slurry prepared with and without addition of glutathione (50ppm) was evaluated for intensity and preference of flavour. Processed cheese from bazaar made into slurry identical with the experimental ones, served as control. The materials and mix were uniformly spread on bread slices of uniform thickness and distributed to the judging panel in coded containers to evaluate the flavour intensity as per the score card given below:

Score card for flavour evaluation in cheese slurry

Flavour Intensity	Flavour Preference
Socre—Intensity	Score—Preference
0—Absent	0—No preference
1, 2—Slight	1, 2—Poor
3—Distinct	3—Fair
4, 5—Pronounced	4, 5—Good

Sample code	Flavour intensity score	Flavour Preference score
.....	.....	.....
.....	.....	.....
.....	.....	.....

A discriminative and communicative panel of 35 members (who were habitual consumers of cheese), participated in the evaluation. The results of evaluation as analysed by varience analysis and Multiple Range Test[15] are given in Table 4.

Effect of incorporation of cheese slurry in Bakery Products

Bread making:

Test baking procedures according to American Association of Cereal Chemists were followed for bread making. The recipe consisted of 100 parts of wheat flour, 2 parts yeast, 1 part salt, 1 part fat, 2.5 parts sugar, 0.3 parts malt-flour, 2mg potassium bromate, 2mg ammonium diphosphate.

Wheat flour obtained from the local market was used in this trial. In this experiment, cheese slurry solids were incorporated at 10, 15 and 20% levels by replacing an equivalent quantity of wheat flour, The salt and sugar contents in the formulations were adjusted after taking into consideration the quantity present in the cheese slurry. The water required for different formulations was also calculated from farinogram reading as well as the water content of the cheese slurry.

The doughs from different formulations were soft, smooth and elastic. The breads were baked at 232°C for 30mts. evaluated as per Table 5.

Preparation of biscuit:

Incorporation of cheese slurry was tried in biscuit formulations by straight dough fermenta-

tion method as well as straight dough method without any fermentation. The percentage composition of recipe used for the fermentation method was 74.5 of flour, 0.3 yeast, 1.2 salt, 7.5 shortening, 1 malt syrup and 0.5 sodium bicarbonate. In the experimental batch, 12.5 parts of cheese slurry solids replaced wheat flour used. The dough which was very smooth and elastic was rolled into 1mm and 1.5mm thicknesses with 16 laminations. The biscuits were baked for 7 to 8mts. at 246°C. However, it was found that the product had uneven puffing as well as baking. As such, the straight dough method without fermentation was tried. Also for the straight dough method, the thickness was reduced significantly to 0.5mm thickness. As in the earlier trials, it was observed that the inner grains of the biscuits were not baked completely. For the straight dough method, the recipe used was similar to that of straight dough fermentation method except that 0.3% of yeast used was deleted. For the dough made, a 4hr incubation period was tried at 35°C, The dough was subjected to a fermentation period 4hrs at 35°C.

Biscuits cut to sizes of 1cm×2cm without any laminations were baked under similar conditions and evalusted for their quality using the following criteria: Uniformity of baking, surface colour, crispness, texture and taste.

Results and Discussion

From Table 1, it is seen that the average total solid content of the slurry was 41.6%. The consistency of the product was found to be suitable for use as cheese-spread. However when the temperature of ripening was raised to 37°C, the consistency was thinner. This may probably be due to higher rate of protein break-down. In the batches where reduced glutathione was added, gas production was higher and the product was not free flowing. The moisture content of the product adversely affected the keeping quality and mould growth was almost inevitable. Mould growth was minimised by addition of potassium sorbate.

Table 1 : Composition of cheese-slurry(Mean of 6 batches)

Total solids	···	41.66%
Fat	···	20.50
Sodium chloride	···	2.80
pH	···	4.7~4.8

Total solid cotent of 41.6% in the product rendered itself easy to be spray-or freeze-dried to obtain cheese powder, with a longer shelf-life. The dehydrated slurry can be used as an ingredient in the manufacture of bakery products.

The slurry had an average 2.8% salt. This resulted in the salt content of the moisture phase of slurry to be approximately that of regular cheddary cheese. This concentration of salt has been found to be ideal for flavour development by singh and Kristoifersen.[4]

The initial pH of the slurry was observed to be 4.7, and no appreciable change in this was found during the ripening period of 10~12 days.

As seen from Table 2, the soluble nitrogen content of cheese slurry increased in the period of ripening. Addition of glutathione further increased soluble nitrogen content.

Kristafferson etal[16] have postulated that active sulfhydryl groups may be intimately associated

Table 2 : Optical density of chesee slurry

Days	0	2	12
Treatment	—	100ppm glutathione	Without
Optical density	0.21	0.52	0.47

with the characteristic flavour development in cheddar cheese. Tomizawa[17] observed that sulfhydryl compounds may cause the exposure of protein-based sulphur groups through activation of the enzyme glutathione-reductase. Milk which is in a dynamic state with respect to protein-based sulphur groups may contain this enzyme.

Microbiological pattern

From Table 3, it is seen that the standard plate count was 136×10^6/g. Most of this flora was of the acid producing types, probably arising out of the starter cultures used.

Table 3 : Microbiological Examination of Cheese Slurry

Standard plate count	Microorganisms/g Coliforms	Yeasts and moulds
136×10^6(mostly acid producers)	Zero	4

Absence of coliforms indicated the cleanliness of the product, Introduction of potassium sorbate considerably limited the growth of yeasts and moulds.

Sensory Evaluation

As can be seen from table 4, the flavour intensity of control cheese was significantly higher (distinct) than the experimental ones which were of comparable intensity (slight to distance).

This new approach of preparing cheese-slurry has shown to develop flavour of slight to distinct intensity. But in this experiment, the effect of glutathione was not significant at the level used (50ppm).

Table 4 : Flavour Intensity and Preference mean scores

Treatments	Cheddar Cheese slurry	Cheddar cheese slurry and GSH 50ppm	Market sample
Flavour Intensity	2.37	2.70	3.26
Flavour preference	2.33	2.40	3.66

Note : Any two mean scores not underlined by the same line are significantly different ($0.01 < p < 0.05$)

Effect of incorporation into Bakery products

It is seen from table 5 that there was no appreciable difference in the specific loaf volume, and crumb structure of bread. However, because of slight excess of water and perhaps due to moulding operation the bread loaves containing 15 and 20% cheese slurry solids had air holes in the loaf. However, the taste and flavour of bread containing cheese slurry solids were comparable and had pleasant cheese flavour. The present investigations have indicated good potential for using cheese slurry solids in broad making. Also there was no significant difference

Tabel 5 : Evaluation of bread samples containing cheese solids

Cheese solids %	Weight gm.	Volume ml.	Specific volume	Crumbstructure
Nil	133.0	530	4.0	Soft and uniform
10	122.5	495	4.0	-do-
15	133.5	530	3.9	-do-
20	144.0	535	3.7	-do-

in the flavour of breads made of cheese alurry with and without glutathione.

Biscuits prepared were crisp, acceptable in taste and had distinct cheese flavour. It can be concluded from these experiments that cheese slurry solids can be incorporated in biscuit formulations with the advantage of improving its nutritional value as well as flavour.

Summary

A new method of preparing and ripening cheese in the form of a slurry was studied. Basically, the process involved blending 2 parts of 24 hours old unpressed and salted green cheese and 1 part of 5.2% sodium chloride solution (45°C) in a waring Blendor.

The slurry thus obtained was ripened at 30°C for 10~12 days. Mild cheddary flavours was observed from 5th day onwards marands, and there was slight distinct cheese flavour in the slurries prepared.

Addition of GSH to slurry at a concentration of 50ppm, did not alter the flavour intensity significantly different from that without GSH.

Soluble nitrogen content was observed to increase with duration of ripening and also added GSH increased the soluble nitrogen content at the end of 10 days.

Bread and biscuits prepared incorporating the cheese solids were highly acceptable and possessed distinct cheese flavour. Baking quality was not adversely affected by the incorporation of cheese slurry as an ingredient in the recipe.

These preliminary studies have indicated the possibility of obtaining cheddary cheese flavour in the slurry within 10 or 12 days and the slurry can find many commercial uses.

Acknowledgements

The author wishes to express his thanks to Dr. Kim Kee Cheul, Professor, Department of Food Technology, Chung Buk National University for his constant encouragement throghout this work.

References

1. Prescott. S.C. and Dunn C.G. 1959 Industrial Microbiology, Mcgraw-Hill book co. Inc. N.Y.
2. Service and Regulatory Announcements 1936 FDA No.2 Revision 5 Nov. U.S.A .
3. Kristoffersen, T., Mikolajcik, E.M. and Gould, I.A. 1967, J. Dairy Sci. 50. 292.
4. Singh, V.K. and Kristofefrsen, T. 1970, J. Dairy Sci. 53. 533.
5. Ibid., 1971, ibid., 54. 1589.

6. Harper, W.J. and Kristoffersen, T. 1970, J. Agr. FOOD Chem. 18. 563.
7. Lee H.J. and Olson, N.F., 1982, Korean J. Dairy Sci. 4. 85.
8. Kristoffersen, T. 1973, J. Agr. Food Chem. 21. 573.
9. Mcgugan, W.A. 1975, J. Agr. Food Chem. 23. 1047.
10. Sood, V.K. and Kosikowski F.V. 1979, J. Food Sci. 44. 1690.
11. Vanslyke L.L. and Price, W.V., 1952, CHEESE, Orange Judd pub. Co. Inc. N.Y. U.S.A.
12. Kosiko waki, F. 1966, Cheese and Fermented Milk Foods, Edward Brothers, Inc., Michigan, 204.
13. Vakaleris, D.G., and Price, W.V. 1959, J. Dairy Sci. 42. 264.
14. A.P.H.A., 1958, Standard Methods for the Microbiological Examination of foods, Academic Press N.Y., U.S.A.
15. Duncun, D.B. 1960, Biometrics, 16, 671.
16. Kristoffersen, T., Gould, I.A., and Purvis, G.A. 1964, J. Dairy, Sci. 47. 599.
17. Tomizawa, H.H. 1962, J. Biol. Chem. 237. 428.
18. Lampert, L.M. 1775, Modern Dairy Products, Food Trade press, London, U.K., 315. 372.
19. Forss, D.G., and Patton, G., 1966, J. Dairy Soi. 47. 89.
20. K.H. Kim and Y.H. Lee, 1981' Korean J. Appl. Microbiol Bioeng 9(3) 153.
21. H.D. Jong and H.J. Lee, 1985, Korean Food Sci. Technol 17(5) 389.
22. S.K. Rhee 1985 Research Reports of Anseong National Junior college of Agriculture No 17.

<p. 30에서 계속>

1980)
Report DTNSRDC-80/012(4727 revised)
3. R.A. Wilson, S.M. Wells and C.E. Heber, DTNSRDC "Powering Prediction for Surface Effect Ships Based on Model Results (AIAA/SNAME 78-744)
4. Hovercraft-Towards the second quarter century by G.H. Elsley & D.J. Hardy (BHC)
5. Hovercraft Skirt Design Requirements by J.E. Rapson (HCL)
6. Responsive Hovercraft Skirts by J.E. Rason (HCL)
7. Hovercraft Design & Construction by G.H. Elsley & A.J. Devereux