

Comparison of Vat Performance of Meito, Rennilase and Calf Rennet During Cheddar Cheese Making from Buffalo Milk

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ABSTRACT

Fungal rennets, namely, Meito and Rennilase were compared with calf rennet for manufacture of buffalo milk cheddar cheese, using them alone or as 50:50 mixtures of their own and with calf rennet. The rennets and their combinations had statistically identical cheese vat performance to calf rennet with regard to curd characteristics, acid development, milk solids losses in whey, yield of cheese and gross composition of fresh buffalo cheddar cheese and therefore modifications in the existing procedure for manufacture of buffalo milk cheddar cheese using calf rennet were not required. It is concluded that these coagulants can be successfully used as calf rennet substitutes provided that they also compare favourably during ripening.

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INTRODUCTION

In recent years, for cheese-making, milk coagulants derived from *Mucor* species, viz. *Mucor pusillus* Lindt and *Mucor miehei* have found greater acceptance as calf rennet substitutes Green (1977). Successful cheddar cheese-making trials, using these fungal rennets have been reported by many workers (Phelan, 1973; Robertson and Gilles, 1969; Wigley, 1947). However, all these reports are on the cheddar cheese made from cow milk and information on technological suitability of *Mucor* rennets for manufacture of cheddar cheese from buffalo milk is lacking.

In view of this, two commercial preparations, namely, Meito (derived from *M. pusillus* Lindt) and Rennilase

(derived from *M. miehei*) were selected and compared with part (50%) or full replacement of calf rennet for manufacture of buffalo milk cheddar cheese. In this paper we report the performance of the above rennets and the combinations, during cheese-making with respect to (i) curd characteristics (ii) influence on acid production (iii) milk solids losses in cheese whey (iv) yield of cheese and (v) composition of fresh cheese.

MATERIALS AND METHODS

Calf rennet (activity: 100000 units/g; Chr. Hansen's), Meito rennet (activity: 300000 units/g; Meito Sangyo Co. Ltd., Japan) and Rennilase (activity: 150000 units/ml.; Novo Industries, Denmark) were used as coagulants for

cheese-making in the following combinations.

- (1) Calf rennet (C)....Control
- (2) Meito rennet (M)....alone
- (3) Rennilase (R)....alone
- (4) Calf + Meito (CM)....1 : 1 (w/w)
- (5) Calf + Rennilase (CR)....1 : 1 (w/v)
- (6) Meito + Rennilase (MR)
.....1 : 1 (w/v)

The above rennets and the combinations were added in quantities sufficient to give a setting time of 30-35 min at 32° C.

Cheddar cheese culture No. 1288 (Wiesby Lab; West Germany) was used as starter culture throughout the study. Ninety kg. of fresh, pooled, standardised (casein to fat ratio 0.686), pasteurized (72° C for 15-16 sec.) buffalo milk having 4.57% fat and 3.135% casein was used for cheese-making.

In all, eighteen batches of cheese, three for each rennet and rennet combination, were prepared as per the method of Van Slyke and Price (1952), as outlined for cow milk cheddar cheese, with the following modifications: higher rate of starter addition (1.5%), slightly higher temperature of setting (32° C), cooking at low temperature (36° C) for a shorter time (≤ 60 min) and early as well as high piling during cheddaring.

The cheese whey obtained was analysed for titratable acidity. (Is: 1479, Part I, 1961) fat. (Is: 1224, Part, I, 1977) total solids and total protein. (Is: 1479, Part II, 1961). The non-protein-nitrogen (NPN), soluble in 12% TCA was determined by Kjeldahl method.

The representative samples of fresh cheeses were analysed for moisture (IS: 1479, Part II, 1961) fat (IS: 2785, 1964) salt and total protein Kosikowski (1970).

The data obtained were subjected to statistical analysis as per Steel and Torrie (1960).

RESULTS AND DISCUSSION

Manufacture of cheddar cheese from buffalo milk:

The details of comparative performance of various rennets during cheddar cheese-making from buffalo milk are depicted in Table 1. The data show that all the rennets gave almost identical setting time, ranging from 33 to 35 min. The vats set with C, M, R and CM rennets had same setting time of 35 min, whereas the vats set with CR and MR showed a slightly shorter setting time of 33 min. The little shorter setting time observed with CR and MR rennets could be attributed to somewhat higher setting acidity (0.18%) of milk set with these rennets.

The measurement of NPN liberated at cutting showed identical values for different rennets and their combinations, ranging from 0.034 to 0.035%. This is in agreement with the results of Kikuchi *et al.* (1968) who observed similar trend of release of NPN at cutting while manufacturing cheddar cheese from cow milk using calf rennet, *Mucor pusillus* Lindt rennet and their combinations.

The influence of the milk coagulants on acid development at different stages of cheddar cheese-making revealed similar pattern. The final acidity at milling for C, M, R, CM, CR and MR rennets was 0.466, 0.469, 0.468, 0.470, 0.475 and 0.473% respectively, showing that starter activity during cheese-making was neither stimulated nor inhibited by any of the rennet or rennet combination tested. Similar results have been reported by Nelson (1969) for

TABLE 1

Comparative performance of various rennets during cheddar cheese-making from buffalo milk.

Manufacturing stage	Unit	Rennet used					
		C	M	R	CM	CR	MR
Ripening of milk:							
Acidity of milk at ripening	% L.A.	0.165	0.165	0.165	0.168	0.171	0.171
Rate of addition of starter	% (w/w)	1.5	1.5	1.5	1.5	1.5	1.5
Temperature of milk	°C	30	30	30	30	30	30
Time spent for acid development	Min	45	45	45	45	45	45
Milk acidity at renneting	% L.A.	0.174	0.174	0.174	0.177	0.180	0.180
Setting or Renneting:							
Rate of rennet addition	g or ml*/ 100 L	3.75	1.75	2.0*	1.25+1.25*	1.25+1.25*	1.0+1.0*
Temperature of milk	°C	32	32	32	32	32	32
Time taken for setting	Min	35	35	35	35	33	33
Cutting:							
Whey acidity	% L.A.	0.09	0.09	0.09	0.10	0.10	0.10
NPN of whey at cutting	%	0.035	0.035	0.034	0.034	0.034	0.034
Cooking :							
Final temperature of cooking	°C	36	36	36	36	36	36
Period	Min	60	60	60	60	60	60
Final acidity of whey	% L.A.	0.127	0.127	0.127	0.133	0.133	0.133
Cheddaring:							
Initial acidity of whey	% L.A.	0.167	0.170	0.163	0.170	0.170	0.170
Final acidity of whey	% L.A.	0.444	0.450	0.453	0.456	0.447	0.458
Period	Hr. Min.	2.30	2.32	2.30	2.38	2.35	2.35
Milling:							
Time after addition of rennet	Hr. Min.	4.50	4.52	4.50	4.58	4.53	4.53
Acidity at milling	% L.A.	0.466	0.469	0.468	0.470	0.475	0.473
Salting:							
Amount of salt	g/100 L	400	400	400	400	400	400
Pressing:							
Period	Hour	18	18	18	18	18	18
Yield after pressing	Kg	11.750	11.500	11.420	11.500	11.420	11.330

Average of 3 trials

*Rennilase added on volume basis.

cheddar cheese-making from cow milk using calf rennet, *M. pusillus* Lindt rennet and their mixture.

The quality of curd, its characteristics and behaviour at different stages of cheese-making did not show any appreciable differences for the various rennets and their mixtures. The total time for cheese-making also was almost similar for all the vats set with different rennets.

The weight of cheese obtained with different rennets varied from 11.33 kg

for MR rennet cheese to 11.75 kg for C rennet cheese. However, the differences in yield were non-significant.

Composition of cheese whey

Table-2 contains the data on fat, protein and solids contents of cheddar cheese whey obtained by using different coagulants and collected upto the end of cheddaring. The mean values for fat content were identical (0.27%) in all whey except in case of whey from rennet C which was little lower than other coagulants (0.25%). The

TABLE 2

Composition of cheese whey obtained with different rennets.

Rennet	constituent(%)		
	Fat	Total protein	Total solids
C	0.25 (0.20-0.30)	0.999 (0.960-1.040)	6.57 (6.25-6.69)
M	0.27 (0.20-0.30)	1.011 (0.98-1.050)	6.52 (6.32-6.65)
R	0.27 (0.20-0.35)	1.011 (0.940-1.052)	6.68 (6.34-7.00)
CM	0.27 (0.20-0.30)	1.018 (1.00-1.04)	6.48 (6.16-6.84)
CR	0.27 (0.20-0.30)	1.007 (0.97-1.04)	6.66 (6.43-6.84)
MR	0.27 (0.20-0.30)	1.017 (0.98-1.04)	6.65 (6.48-6.77)

Figures in the parentheses indicate range.

average values for protein content ranged between 0.999 and 1.018%. The lowest value was observed in case of rennet C and the highest in case of rennet CM. The average solids content of whey ranged from 6.48% for CM rennet to 6.68% for rennet R. The whey from cheese made with other rennets showed intermediate values.

The differences in the values of fat, protein and solids contents of whey from different rennets were statistically

non-significant and were well within the limits normally and practically observed with cheese-making from buffalo milk. Thus, all the milk coagulants studied proved equal to rennet C, used as control.

The trend of losses of fat, protein and solids observed in the whey obtained from buffalo milk in the present study is supported by the findings of Robertson and Gilles (1969) for protein, Labuschagne and Jaarsma (1970) for

solids content in cheddar cheese whey obtained from cow milk using calf and *Mucor* rennets. On the other hand, some workers (Green and Stackpoole 1975; Labuschagne and Jaarsma, 1970; Richardson, *et al.* 1967) have reported higher fat losses in cheese whey obtained from *Mucor* rennets. Reps *et al.* (1974 a, b, c) and Poznanski *et al.* (1974) reported higher N losses in whey obtained with Meito rennet. The higher losses of fat and protein were attributed to softness of curd with these *Mucor* rennets.

TABLE 3

Average composition of cheddar cheese made with different rennets.

Rennet used	Constituent (%)				
	Moisture	Total solids	Fat	Protein	Salt
C	36.92 (35.58-38.22)	63.08 (61.78-64.20)	32.28 (31.48-33.18)	24.50 (23.31-25.11)	1.52 (1.49-1.56)
M	37.12 (36.45-37.56)	62.88 (62.44-63.57)	32.58 (31.59-33.22)	24.78 (24.59-25.04)	1.48 (1.36-1.62)
R	36.78 (36.08-37.59)	63.22 (62.41-63.92)	32.40 (32.00-32.80)	24.89 (24.45-25.33)	1.53 (1.44-1.65)
CM	37.20 (36.24-37.81)	62.80 (62.19-63.76)	32.43 (32.20-32.56)	24.75 (24.40-25.06)	1.56 (1.53-1.58)
CR	37.05 (36.35-37.60)	62.95 (62.40-63.55)	32.30 (32.01-32.79)	25.01 (24.72-25.30)	1.53 (1.44-1.64)
MR	37.35 (36.95-37.89)	62.65 (62.11-63.05)	32.40 (31.49-32.86)	25.01 (24.63-25.46)	1.54 (1.47-1.63)

Figures in the parentheses indicate range.

MR and CM respectively, whereas the lowest values for these constituents were noted in R, C, C and M cheeses respectively.

The variations observed in the values of these components were well within the limits experienced with normal cheddar cheese-making. Compositionally, cheeses made from buffalo milk using *Mucor* rennets and their mixtures were comparable to C rennet used as control.

The above findings are in agreement with those of Wong *et al.* (1976) and others (Green and Stackpoole,

Composition of cheese

The data in Table 3 represent average composition of fresh cheddar cheese made from buffalo milk using different rennets. The ranges of mean values for moisture, fat, protein and salt for cheeses made with different rennets were 36.78 - 37.35, 32.28 - 32.58, 24.50 - 25.01 and 1.48 - 1.56 % respectively. The highest values for moisture, fat, protein and salts were observed in cheeses made with MR, M, CR and

1975; Labuschagne and Jaarsma) 1970; Nelson, 1969; Robertson and Gilles, 1969) who obtained comparable results for calf rennet and *Mucor* rennets for cheddar cheese made from cow milk.

Published data on proximate composition of buffalo milk cheddar cheese made with fungal rennets are not available for comparison. However, the values observed in the present study, for cheeses made with calf rennet, *Mucor* rennets and their mixtures, for moisture, fat and protein are almost comparable to those obtained by Czulak (1964) for moisture, Neogi and Jude

TABLE 4
Average yield of cheese and recovery of fat, protein and total milk solids in cheese.

Rennet used	Yield %	Per cent recovery		
		Fat	Protein	Total milk solids
C	12.86 (12.59-13.14)	92.32 (87.43-96.18)	78.74 (74.79-80.84)	56.69 (54.40-59.31)
M	12.59 (12.59)	91.15 (89.70-92.27)	77.97 (75.87-79.28)	55.39 (54.93-56.17)
R	12.50 (12.04-12.86)	90.00 (86.91-93.09)	77.75 (73.56-81.27)	55.24 (53.05-57.67)
CM	12.59 (12.32-13.14)	90.69 (88.31-93.33)	77.83 (71.11-78.56)	55.24 (53.58-57.57)
CR	12.50 (12.04-13.14)	89.75 (85.05-95.05)	78.09 (75.87-81.45)	54.99 (52.40-58.56)
MR	12.41 (12.04-12.86)	89.40 (83.67-93.26)	77.52 (75.78-78.59)	54.55 (53.07-56.65)

Figures in parentheses indicate range.

(1978) for fat and Bhattacharya *et al.* (1970) for protein in cheddar cheese made from buffalo milk using calf rennet as coagulant.

Yield of cheese and recovery of milk constituents

The data reported in Table-4, on per cent yield of cheese (kg of cheese per 100 kg milk), exhibited highest yield of 12.86% with rennet C and lowest of 12.41% with MR rennet. The other coagulants showed yield values within this range.

The ranges for mean values for recovery of fat, protein and milk solids were found to be 92.32-89.40, 78.74-77.52 and 56.69-54.55% respectively for buffalo milk cheddar cheese made with different rennets. The highest recovery of these components was observed with rennet C followed by rennet M except for protein recovery, in which rennet CR was little superior to rennet M. Least recoveries for all the three components were observed with MR rennet.

This could be attributed to higher moisture content of the cheese. The observed differences in the yield and recovery of fat, protein and milk solids in cheddar cheese made with different rennets, however, were statistically non-significant and therefore the various coagulants studied could be considered equally satisfactory from yield and recovery points of view as compared to rennet C used as control.

The above observations on yield of cheddar cheese made from buffalo milk with calf rennet, Mucor rennets and the mixtures are supported by similar findings of Robertson and Gilles (1969) and others (Nelson, 1969, 1975; Phelan, 1973) for cheddar cheese made from cow milk using calf and Mucor rennet. As against this, Kikuchi *et al.* (1968) and Wigley (1974) reported lower cheese yields with Mucor rennets as compared to calf rennet used as control in cow milk. Labuschagne and Jaarsma (1970) reported lower recovery of fat in cow cheddar cheese made with Mucor rennets compared

to calf rennet, owing to higher fat losses in whey.

The comparative data on yield and recovery of milk constituents in cheddar cheese made from buffalo milk using *Mucor* rennets are lacking. However, the values of yield and recovery of fat and milk solids noted in the present study are comparable to those obtained by Bhattacharya *et al.* (1970) for cheddar cheese made from buffalo milk using calf rennet as the coagulant.

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