Adapted Technology for Small-scale Manufacture of Caerphilly-type Cheese from Cow's Milk in the Western Highlands Region of Cameroon.

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ABSTRACT

Caerphilly Cheese making procedure was modified to suit the conditions and kitchen environment of the average Cameroonian household. Cheese making trials were carried out for over a period of twelve months. Results show that the ripening time for milk increased from 45 minutes to 60 minutes; curd formation time from 45-60 minutes to 60 - 90 minutes, scalding temperatures, method of draining, salting, pressing and maturation temperature have been modified (Fig.1). The acid development pattern during cheese making was normal but with lower values than the standard (0.22, 0.14, 0.18, 0.21 for the standard and 0.15, 0.12, 0.14, 0.21 for the modified procedures respectively, from renneting to after cutting to whey removal and during texturing. The cheese yield is encouraging (1 16g-160g/litre of fresh milk) and its composition is good (fat *25.9%*, dry matter 50.8% and moisture content 48%). The production of the cheese should be encouraged at the household level.

Key words: Adapted Technology, Caerphilly cheese, cow's milk, Cameroon.

Introduction

Cheese making is a very convenient means of preserving milk with high nutritive value. Milk production in Cameroon is mainly by Fulani pastoralists. However, a few families of the native population, the Tikar, now carry out some agro-pastoralism where they keep dairy animals for milk production.

During the rainy season, the quantity of milk produced daily by households is always more than enough for consumption as fresh milk. The left over milk cannot all be sold because it gets sour before reaching consumers in town.

Unlike the Fulanis of Nigeria who process their surplus milk into more stable products like the West African soft Cheese (Joseph and Akinyosoye, 1997), the Fulanis in the North-Western Highlands in Cameroon process their surplus milk into a sour product called "Pendi-dam" (Tienkwia 1990, Fon 199 1). This product, although popular among the Fulanis, does not attract a wide market (Tiku et al. 1999).

A study by Imele and Kameni (1987) revealed that fresh cow milk produced in the North-Western Highlands of Cameroon could be used for cheese making. Another study by the same authors was the adaptation of the standard technology for Edam cheese to suit Cameroon conditions (Imele and Kameni, 1991).

The aim of this study was to adapt a technology to produce cheese which could be acceptable by consumers, matures faster and could be produced using local equipment so as to minimise production cost.

Materials and Methods

Milk. Fresh morning whole milk was collected from the station's dairy herd. The herd was made up of pure Holsteins, Jerseys and Jersey and Holstein crosses with local breeds.

Starter **Culture and Rennet:** Cheese starter culture was obtained from New England Cheese making supply Company and it contained mixed strains of *Lactococcus lactis* subps. *lactis* and *lactococcus lactis subsp. cremoris.*

Calf rennet in powder form was obtained from L.C. GLAD & CO at COPENHAGEN DENMARK.

Two aluminum pots were arranged to give a double-wall jacketed vessel which was used as a cheese vat. Other equipment includes kitchen knives, ladles, cheesecloth, gas cooker, stainless steel buckets and locally fabricated cheese moulds and press.

Davis (1966) describes the standard method for the manufacture of Caerphilly cheese and the equipment used. The cheese was made following the standard method with modifications where necessary (**figure I**).

The trials were carried out twice-monthly using 10, 20, 30 or 40 litres of milk for each trial. This started in January and ended in December giving a total of twenty-four trials.

Analysis.

The milk was analyzed for protein content by formol titration, butterfat by Gerber Method, and titratable acidity (Egan et al. 1981). Acidity was checked at renneting, after cutting, at whey removal and during texturing (**Table 1** and **Fig. 2**).

The matured cheese was analyzed for fat content (Gerber), dry matter and moisture content. (Egan et al 1981) (**Table 3**). The yield was expressed as the ratio of the quantity of cheese obtained to the

Table 1. Acidity, butterfat and protein content of milk used for small-scale manufacture of caerphilly cheese

	Mean	Range
Acidity (% lactic acid)	0.14 ± 0.01	0.13 ± 0.16
Butterfat %	3.79 ± 0.27	3.20 ± 4.20
protein %	3.20 ± 0.17	3.00 ± 3.50

Table 2. Acid development during the process of cheese making

Stage in processing	Acidity % lactic acid			
	A		B	
	M	R	M	R
1. At Renneting	0.22	0.21 - 0.23	0.15 ± 0.007	0.14 - 0.16
2. After cutting	0.14	0.12 - 0.15	0.12 ± 0.008	0.11 - 0.13
3. At Whey-removal	0.18	0.17 - 0.19	0.14 ± 0.008	0.13 - 0.15
4. During texturing	0.21	0.19 - 0.23	0.21 ± 0.027	0.17 - 0.25

Source for Standard Technology: Davis (1966)
A - Standard Technology, B- Adapted Technology, R = Range, M = Mean

Fig 1. Standard and modified methods for Caerphilly Cheese manufactured using adapted technology.

Operation	Standard Method	Modified Method
Milk pasteurisation	H.T.S.T [a] at 73 °C/15 sec and cooled to 32 °C	Batch in waterbath using two aluminium pots, heated by gas cooker. At 73 °C removed immediately and cooled to 30 ± 2°C
Add Starter Culture	At 1.5%, ripen for 45 minutes at 32 °C	At 1.5% ripen for 60 minutes at 30 ± 2 °C in a water bath
Add Rennet	Liquid rennet at 0.03% diluting fivefold with cold potable water.	Weigh calf rennet powder at 0.03% (w/v) of milk, add a pinch of NaCl (common salt) and dilute ten times with cold potable water
Curd formation And cutting	After 45-60 minutes Cut with vertical and horizontal knives to give 6 mm cubes	After 60-90 Cut with a long kitchen knife vertically and then horizontally to obtain cubes of 10mm
Scalding	Heat 34 °C over a period of 20-30 minutes till the curd is firm. Curd is allowed to settle in the vat.	Heat through a waterbath to 37 ±1°C over a period of 15-20 minutes. Stop heating, but allow standing in waterbath with intermittent stirring for 1 hour or until curd is firm. Curd is then allowed to settle.
Draining	Opening the tap of the vat drains off the whey. Curd is cut into conical pieces and piled at the corners and along the ides of the vat. After 15 minutes, piles are cut and pieces piled along sides of vat. Curd is cut and re-piled every 10 minutes	Whey is drained by pouring whey and curd through cheese cloth which retains the curd. The curd is allowed to drain for 15 -20 minutes. Curd is cut into pieces and returned to the processing pot.
Milling	Manual or coarse mechanical milling when pH of whey reaches 0.20% lactic acid.	Hand milling when pH of whey reaches 0.21 ±0.04% lactic acid
Pre-salting (common salt)	Add 1% of wet curd weight. Then mix well with the curd.	Add 1% of wet curd weight. Well hand mixed with the curd.
Moulding	Salted curd is filled into 250mm diameter plastic moulds lined with plastic cheesecloth. For 80 litres of milk, two moulds are needed	The salted curd is filled into a cylindrical metallic mould of 137 mm diameter and 190 mm height lined with cotton cheesecloth. For 20 litres of milk, one mould is needed.
Pressing	initial lightly pressed to maintain whey drainage. After 20 minutes, mould is removed from press, cheese, replace in mould and repress. This is done three times. Each time pressure is increased. Then press overnight at 100kPa.	Two wooden blocks of 135mm diameter and 52mm height are placed one at bottom and the other at the top. The cheese, held in between is pressed lightly, turned over after 15 minuted and pressed more firmly overnight using a screw top locally fabricated press. Pressure not determined.
Salting and Maturation	Demould cheese and transfer to brine bath and leave overnight. Remove from brine, wash, dry and vacuum pack. Store at 10 °C in cheese room for two weeks.	Demould cheese and transfer to a 20% brine bath. Leave in brine for 4 hours per kilogram cheese. Remove from brine, wash, dry and leave in a refrigerator with frequent turning over. After the first day, wrap with a food grade transparent paper (Cling film). The temperature of the refrigerator should be set at 8 ±2°C. The cheese maitures for two weeks.

a) H.T.S.T = High Temperature Short Time

quantity of milk used.

Results and Discussion

The standard procedure for the manufacture of Caerphilly cheese as described by Davis, (1966) and standard equipment used in cheese making have been effectively modified and adapted. Significant modifications can be noted in terms of the equipment. At the level of the procedure, ripening time for milk has increased from 45 minutes to 60 minutes, curd formation time from 45-60 minutes to 60 - 90 minutes, scalding temperatures, method of draining, salting, pressing and maturation temperature have been modified (**Fig. 1**).

The quality of the milk produced on station and used for the trials conforms to that reported and recommended for cheese making by Imele' and Kameni (1987) as far as acidity, butterfat and protein content are concerned. **Table 1** shows the titratable acidity, butterfat and protein content of milk that was used to make Caerphilly cheese which is a semi-hard cheese.

Trends in acid development during the cheese making process are shown on **Table 2**. The range and mean values are indicated for the standard procedure (A) (Davis 1996) and for the experimental procedure (B). These trends are further illustrated on **figure 2**. The acidity values at renneting, after cutting, and at whey removal are lower for the experimental curve (B). The value at "during texturing" is the same for both the standard and experimental curves. However, the experimental curve takes up an additional one hour and thirty minutes. This time is enough to allow the curd to attain correct texture before pressing.

The composition of Caerphilly cheese (fat *25.9%*, dry matter, *50.8%* and moisture content 48%) made using the adapted technology, on the average conforms with values for other semi- hard cheeses (Egan *et al* 1981). Queso Blanco cheese manufactured using adapted technology had 53% water and 23% fat (O'Mahoney and Bekele, 1985). Edam cheese made using similar equipment had fat content ranging from 20-34% and dry matter from *51-65%* (Imele and Kameni 1991)

The cheese yield is encouraging about 140g/litre of milk or 14%. on the average (**Table 4**) as compared to 149g /litre of

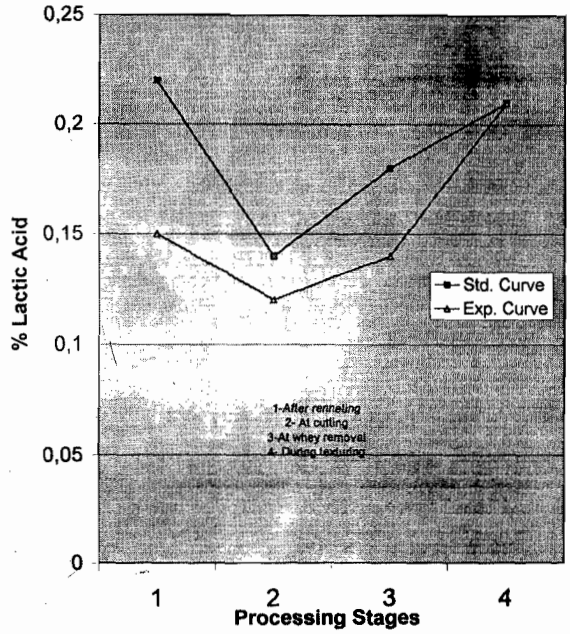
Table 3. Composition of small-scale caerphilly cheese made using Adapted Technology

	Mean	Range
Fat %	25.90 ± 0.90	24-27
Dry matter (%)	50.75 ± 2.89	45-56
Moisture content (%)	47.83 ± 3.86	42-55

Table 4. Cheese yield of small-scale Caerphilly cheesemanufactured using adapted technology

Quantity of Milk (litres)	Weight of manufactured cheese (grams)		
	Mean	Minimum	Maximum
10	1400	1200	1600
20	2600	2000	3300
30	3900	3300	4800
40	5300	5100	6300

Fig 2. Acid development during cheesemaking



milk (Davis 1966) and the yield of Queso Blanco 111g/ litre of milk (O' Mahoney and Bekele, 1985).

Caerphilly cheese is white in colour, has a mild flavour and a firm and close texture (Hilton, 1976). However, the experimental cheese took the colour of the milk, white from December to May, and cream from June to November. Though not evaluated by a panel, the mild flavour of the cheese was highly appreciated by consumers at National Research Exhibitions that took place in the nation's capital city, Yaounde in 1996. This observation corroborates that of Schulthess (1983), that the majority of potential cheese consumers in warm countries prefer mild cheeses.

Edam cheese, made using similar adapted technology, takes 30-40 days to mature with frequent turning over and cleaning (Imele and Kameni 1991). But Caerphilly cheese is wrapped and matures in the refrigerator taking only 14 days. There are hardly any losses due to deterioration during the maturation phase.

Conclusion

The results obtained show that it is possible to adjust some processing steps in the manufacture of Caerphilly cheese, for example, scalding temperatures to obtain a good product. The simple kitchen equipment and locally fabricated cheese moulds and press can be used. The use of small quantities of milk will enable the farmer to adequately and profitably utilize surplus milk.

Acknowledgement

We are grateful to the following: Mr. Chungong Martin Andangfung who worked with us as technician in the Dairy Technology Laboratory. Mr. Simon Ning Ngha and Miss Bande Catherine Acho, all students of the Regional College of Agriculture Bambili; who did some of the work during their industrial attachment at I.R.A.D. Bambui

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