Sjournals
Scientific Journals
Scientific Journal of Veterinary Advances (2014) 3(2) 34-41
ISSN 2322-1879
doi: 10.14196/sjvs.v3i2.1232

Contents lists available at Sjournals
Scientific Journal of Veterinary advances
Journal homepage: www.Sjournals.com

Original article

Assessment of rural dairy products in north kordofan state, Sudan-1

F.M. El-Hag[a], M.M.M. Ahamed[b], I. Bushara[c,*], K.E. Hag Mahmoud[d], M.A.M. Khair[e], O.E. Elbushra[a], T.K. Ahamed[f]

[a]*Agricultural Research Corporation (ARC), El-Obeid Research Station, PO Box 429 El-Obeid, Sudan.*
[b]*Institute of Environmental Studies, University of Khartoum, Khartoum, Sudan.*
[c]*Dept. Animal production, Faculty of Natural Res & Environmental studies, University of Kordofan, El-Obeid, Sudan.*
[d]*State Ministry of Agriculture, Animal Resources and Irrigation, Kordofan State, El-Obeid, Sudan.*
[e]*Agricultural Research Corporation (ARC), Wad Medani, Sudan.*
[f]*Food Research Centre, Shambat, Sudan.*

*Corresponding author; Dept .Animal production, Faculty of Natural Res & Environmental studies, University of Kordofan, El-Obeid, Sudan.

ARTICLE INFO

Article history,
Received 05 February 2014
Accepted 17 February 2014
Available online 28 February 2014

Keywords,
Rural dairy products
Cows
Goats

ABSTRACT

Rural dairy processing situation in western Sudan (North Kordofan) was assessed through a structured questionnaire. Some rural dairy products were sampled and assayed for bacteriological and chemical composition. The objectives were to investigate traditional dairy products and evaluate their nutrients composition and hygienic situation. Descriptive statistics were used for the statistical analysis of the survey data, a randomized complete block design for the cheese samples data. There were seasonal fluctuations in quantities of milk processed. Most of the producers (62.7%) used mixed cow, sheep and goat milks for cheese processing. Braided cheese had a high cost of production compared with white soft cheese. Major production constraints stated were marketing, fluctuations in milk supply and shortage of water. Milk sources reported were from nomadic and transhumant herds, and to a lesser extent from villages and only very few of the producers had their own dairy animals. Cheese samples (white soft and braided) contained variable chemical constituents that varied from location to another. Staphylococcus, bacillus, Corynebacterium, and Aerococcus were all detected in these samples, but they were free from Coliform

bacteria.

1. Introduction

Food processing is an important measure for the preservation of food constituents as sources of nutrients and cash for many people in the world. Milk as a food is an ideal medium for the growth of bacteria and if kept at above 16°C the bacteria present will multiply rapidly thereby causing deterioration in quality (O'Connor, 1993). Therefore, surplus milk needs to be processed to preserve its valuable constituents for a long time.

In Sudan, milk is traditionally preserved into different product e.g. ghee, butter, cheese … etc. The traditional cheese making in the country is concentrated in The White Nile and Kordofan States. However, in some other areas where there is surplus fresh milk, no suitable method of preservation is available (Macquat and Bujanble, 1960; Ibrahim, 1970). In these areas where refrigeration or chilling means are not available, the importance of fermentation is obvious as it is the only method of preserving most of the milk nutrients.

In Kordofan region, traditional cheese making is a seasonal activity. During the rainy season when plenty of milk is available, few people are actively engaged in making cheese. This, perhaps, is the most commonly practiced method of chemical preservation of milk in the Sudan (Ibrahim, 1970).Rural development projects in the area have many mobile laboratories or units for cheese making, scattered along the migration routes and camping areas of transhumant tribes in North Kordofan State (Ahmed, 1985). However, no thorough investigation of traditional processing methods and quality of dairy products in the area has been undertaken. This work was carried out with an ultimate objective of assessing rural dairy products situation and quality in North Kordofan, and comparing cheeses made from goat and cow milk.

2. Materials and Methods

2.1. Area of study

This study was carried out in western Sudan (North-Kordofan state) under semi-arid conditions; latitude 11o 15’ N, longitude 27o 32’ E. Average temperature varied between 30 – 35oC with peaks above 40oC. Summer rainy season extends from July to October during which many animal herders are engaged in cheese making from surplus milk.

2.2. Assessment of cheese quality products of local producers

A total of 51 dairy local producers were interviewed using purposive sampling technique. The interview focused on milk type (animal source), handling, processing, and marketing and production constraints. 24 samples of dairy products included 6 braided cheeses and their whey, 6 white cheeses and their whey. Samples were collected from three different geographical locations and analyzed for bacterial contamination and biochemical composition.

2.3. Chemical analyses

Chemical analyses for milk, cheese and whey were carried out, fat was determined by the Gerber method, crude protein (CP) according to Kejldahl method, total solids (TS) and water by the draft oven method (Marshall, 1993). Lactose was determined as outlined by Taylor (1970), while pH and ash were estimated according to AOAC (1990).

2.4. Bacteriological analyses

Media preparation and chemical tests of bacteria were carried out as shown by Cowan and Steel (1981). Viable bacterial counts were done according to Schalm et al. (1971).

2.5. Statistical analyses

Descriptive statistics were used for the questionnaire. For chemical composition data, random complete block design was utilized. Duncan multiple range test was used to test mean separation (Steel and Torrie, 1980).

3. Results

3.1. Questionnaire of rural dairy products

Fifty one (51) rural cheese processing producers were interviewed through a structured questionnaire. The majority of the respondents (78.4%) reported that they produced cheese during rainy season, a time of high milk availability (Table 1).

There was a complete consensus among the interviewed farmers that there were fluctuations in milk quantity and handling during the period of production. Also there was no treatment made to the milk from collection to the time of processing. Braided cheese recorded the highest production rate (29.4%) followed by white cheese (25.5%), while the combined production of both shuddered cheese and white cheeses recorded the lowest percentage (2.0%). One third of persons interviewed (32.14%) reported that they also produced ghee and fermented hard milk, 28.58% produced soft fermented milk and ghee while farmers producing soft fermented milk, ghee, hard fermented milk and butter recorded the lowest percentage (3.57%) (Table1).

Table 1
Production season, milk supply situation and processing of rural dairy products as reported by the respondent farmers (%).

	Frequency	Percent
Production Season		
One Season	40	78.4
All around the season	11	21.6
Fluctuation in milk quantity		
Yes	51	100.0
No	0	00.0
Time between milk receipt and processing		
Direct manufacture	51	100.0
Storage	0	00.0
Treatment of milk before processing		
Yes	0	00.0
No	51	100.0
Type of cheese produced,		
White	13	25.5
Braided	15	29.4
White + Braided	9	17.6
White + Rome	1	2.0
Braided + Rome	2	3.9
White + Braided + Rome	11	21.6
Any other type of dairy products		
Yes	28	54.9
No	23	45.1
Type of other dairy products		
Ghee	2	7.14
Hard fermented milk (HFM)	1	3.57
Butter	1	3.57
Soft fermented milk (SFM)+ ghee	8	28.58
Ghee + HFM	9	32.14
HFM + SFM + ghee	6	21.43
HFM + SFM + ghee + butter	1	3.57

The bulk of milk for these rural dairy processing units was reported to be purchased from nomads (54.9%) and to a lesser extent from villages (19.6%) and only very few (2.0%) of the producers had their own dairy animals. The majority of the respondents (58.8%) reported that they mixed cow, sheep and goat milks for cheese processing, whereas the use of goat + cow milk recorded the lowest percentage (3.9%). Quantities of milk processed into cheese in these units ranged from 50 to 200 liters/day in the majority (39.2%) of units surveyed, while 7.8% of the interviewed producers stated that they processed quantities of milk in the range of 500-650 liters/day. Half (51.0%) of the respondents reported that they used plastic barrels as milk containers and for cheese storage, whereas the use of both plastic and metal barrels recorded the lowest percentage (10%). The majority (80.4%) of the producers reported that they used cheese cloth to separate the whey from coagulated cheese (Table 2).

Table 2
Milk sources, quantities used and equipment used in cheese processing as reported by respondent farmers (%).

Milk Source	Frequency	Percent
Village	10	19.6
Nomads	28	54.9
Own dairy animals	1	2.0
Village + nomads	9	17.0
Village + own dairy animals	1	2.0
Nomads + own dairy animals	2	3.9
Type of milk used in processing		
Cow	19	37.3
Cow + goat	2	3.9
Cow + goat + sheep	30	58.8
A mount of milk used per day		
50 – 200 liter	20	39.2
201- 350 liter	9	17.6
351 – 500 liter	12	23.5
501 – 650 liter	4	7.8
More than 650 liter	6	11.8
Milk containers		
Plastic barrel	26	51.0
Metal barrel	15	29.4
Plastic + metal barrel	10	19.6
Type of cheese cloth used		
Cotton cloth	41	80.4
Synthetic	7	13.7
None	3	5.9
Cheese storage containers		
Plastic barrel	29	56.9
Metal barrel	17	33.3
Plastic + metal barrel	5	9.8

More than two thirds (68.6%) of the interviewed producers reported that braided cheese had a higher cost of production than white cheese. Most of the respondents (60.78%) used to sell their dairy products at El-Obeid market due to availability of marketing facilities especially the purchasing power. The rest of interviewees (5.88%) who lack the means of transportation used local markets through which marketing of dairy products was done. Although poisoning of milk and milk products could easily happen due to the vulnerability to contamination by germs and bacteria, 94.1% of the interviewed producers reported that there were no poisoning cases in their local processing units. The most important problems mentioned by respondents were marketing problems, shortage of milk and shortage of water which recorded 20.00, 18.57 and 8.56% of the interviewees' answers, respectively.

Other minor constraints reported were difficulty in coagulation, rise in milk prices and unavailability of transportation means to marketing centers and storage especially during the rainy season (Table 3).

Table 3

Relative production cost of different cheese types, markets and production constraints as reported by the interviewed producers (%).

	Frequency	Percent
High production cost		
White	16	31.4
Braided	35	68.6
Markets,		
Local	3	5.9
El-Obeid town	31	60. 8
Out of State	4	7.8
Local + town	10	19.6
Town + out of State	3	5.9
Cheese poisoning		
Yes	3	5.9
No	48	94.1
Constraints to cheese production		
Yes	21	41.2
No	30	58.8
What are the constraints?		
Marketing	14	20.0
Shortage of milk	13	18.6
Shortage of water	6	8. 6
Coagulation difficulties	5	7.1
Prices reduction	3	4.3
Rise in milk prices	5	7.1
Failure of production	2	2.9
Lack of capital	2	2.9
shortage of canning equipment	5	7.1
Veterinary facilities and follow up not enough	1	1.4
Shortage of store in production area	1	1.4
Transportation to stores during high rainfall	5	7.1
Shortage of rennet tablet	3	4.3
Milk adulteration	3	4.3
Mobility of milk producer	2	2.9

3.2. Chemical composition and bacteriological profile of dairy products

Samples of dairy products taken from different locations in the area of study were analyzed for their nutrient contents, chemical composition and bacterial constituents (Table 4). It was shown that, cheese obtained from location 2 had the highest ($P < 0.05$) fat content. Whereas the braided cheese showed higher ($P < 0.05$) fat and protein contents than the white cheese (Table 4).

Table 4
Chemical composition of sampled white and braided cheese produced in the area of study.

Factor	pH	TS1 (%)	Ash (%)	Fat (%)	Protein (%)	Lactose (%)
Location						
1	4.9	49.7	4.1	16.8	12.3	16.4
2	4.3	54.4	5.8	24.5	13.4	9.9
3	5.1	48.5	6.6	20.5	13.2	8.3
± SE	0.28NS	4.3NS	0.33NS	0.80*	0.44NS	3.4NS
Cheese type						
White	4.4	45.3	5.6	19.1	8.5	11. 9
Braided	5.2	56. 5	5.4	22.1	17.4	11.1
±SE	0.13*	2.9NS	0.77NS	0.51*	0.61*	2.1 NS
Location x Cheese type						
±SE (Interaction)	0.22NS	5.2NS	1.3NS	0.88NS	1.0569NS	3.7 NS

NS = not significant (P > 0. 05), * Significant at P < 0.05.
1 total solids

On the other hand, the whey of the braided cheese had higher (P <0.05) fat content than that of the white cheese (Table 5). The bacteriological profile for both white and braided cheese showed no significant differences (Table 6).

Table 5
Chemical composition of white and braid cheese whey samples produced in the area of study

Factor	pH	TS (%)	Ash (%)	Fat (%)	Protein (%)	Lactose (%)
Location						
1	4.9	17.9	10.6	0.33	0.58	6.5
2	5.1	16.7	8.8	0.36	0.65	6.9
3	5. 5	14.8	8.2	0.35	0.50	5.7
± SE	0.50NS	1.1 NS	0.29NS	0.30 NS	0.03NS	0.90NS
Cheese type						
White	5.8	17.1	9.3	0.62	0.52	6.8
Braided	4.6	15.8	9.1	0.08	0.63	5.9
± SE	0.35NS	1.08NS	0.53NS	0.42*	0.049NS	1.5NS
Location x Cheese type						
±SE Interaction	0.60NS	1.8 NS	0.92NS	0.73NS	0.08NS	2.55 NS

NS = not significant (P > 0. 05), NS = not significant (P > 0. 05), * at Significant P < 0.05.

Table 6
The bacteriological profile of samples of white soft and braided cheese obtained from various units in the area of study

Cheese type	Staphylococcus	Bacillus	Corynebacterium	Aerococcus	Coliform	Total Bacterial Count
White Cheese						
Minimum	0	0	0	0	0	1 X 106
Maximum	6.1 X 107	1.5 X 107	7 X 105	8.1 X 105	0	6.4 X 107
Average	2.0 X 107	5.9 X 106	2.3 X 105	2.8 X 106	0	2.9 X 107
Braided Cheese						
Minimum	0	2.1 X 105	0	0	0	2.1 X 105
Maximum	0	1.9 X 106	0	2 X 104	0	2.1 X 106
average	0	1.2 X 106	0	6.7 X 103	0	1.3 X 106

4. Discussion

4.1. Dairy rural products

Most of the rural dairy producers surveyed in this study agreed that there were fluctuations in milk quantities during the rainy season depending on rain amounts and availability of pasture, a situation which led to mixing of milk from different animal species (cows, goats, and sheep). The high cost of braided cheese as reported by the respondents was due to the extra cost needed for heating before milk processing. Other constraints were; shortage of water and marketing.

The variation in fat content in this result were in agreement with the results of Hayaloglu et al. (2005) and in disagreement with the findings of Tarakci and Kucukoner (2006) who found no significant variation in fat content during ripening period of Turkish Kashar cheese and El Owni and Hamid (2008) who found increasing fat content during of Sudanese White cheese.

Variations in protein content might be due to protein degradation leading to formation of soluble compounds (Abdalla et al., 1993). This result is in agreement with the results of Hayaloglu et al. (2005). Differents in total solids content was mainly due to degradation of total protein and decrease in fat content during storage period (Hayaloglu et al., 2005).

However, heat treatment, as well as light or oxygen exposure may adversely affect product quality, safety and nutritional value by means of oxidative damage to food lipids and proteins.

Generally the as this cheese produced traditional therefore might be there is no control to some items that include in manufacturing processes, also the variations in the nutrient contents and chemical composition observed in dairy products obtained from different locations could be contributed to factors such as percentage differences in type of milk mixed and manufacturing conditions.

4.2. Bacterial profile

Bacillus was found in all samples of cheese either made in laboratory or from rural processing units. This was attributed to that the wide range of pH for the growth of Bacillus, 4.9 to 9.3 at salt content of 7.5 to 10% (Buchanon and Gibbons, 1974).

Staphylococcus aureus was found in samples of white cheese obtained from the traditional processing units but not in pasteurized milk. The major factors contributing to the presence of S. aureus in cheese were the use of un-pasteurized milk with high infected starter culture (Santos and Genigeorg, 1981). Santos and Genigeorg (1980) reported that the use of raw milk for manufacture of cheese, if the milk contains high count of Staphylococcus aureus and milk was collected by non-refrigerated truck, brought to the plant after 3-5 hours, the Staphylococci and other organisms will multiply rapidly. Lack of satisfactory sanitary practices in the dairies may contribute to heavy contamination of the milk. High logarithmic counts of microorganisms are indicative of a poor hygiene observed during milk collection and distribution; this justifies the need to pasteurize milk in order to ensure innocuousness and uniformity in quality of cheese derived from it.

Preformed enter toxin can survive milk pasteurization. Therefore, pasteurization can not be substituted for sanitary milk production. Microbes enter milk and milk products via air, handling, equipments, and high environmental temperatures (> 16oC) (O'Mahony, 1988).

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