SEASONAL TRENDS IN MAKING DOMIATI CHEESE FROM BUFFALO'S MILK

BY

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ABSTRACT

The present study was undertaken to define the seasonal changes in the efficiency of making Domiati cheese from buffalo's milk collected during summer and winter seasons.

Analysis of cheese milk revealed that summer milk (SM) was significantly differed as compared to winter milk (WM). It characterized by higher values for acidity, TS and fat and lower values for pH and protein as well as lower stability to ethanol and rennin (faster RCT). Values of curd tension and curd syneresis were significantly higher in case of SM.

Yield and recovery of fat and protein in the resultant cheese were insignificantly affected by season of the year but the values were relatively lower in cheese made from SM. SM cheese had lower values for acidity, moisture, protein and SN/TN and higher values for pH and fat than WM cheese.

The sensory evaluation revealed a highly significant improvement in flavour, body and texture as well as appearance of the fresh cheese when made from WM.

INTRODUCTION

Milk must have a desirable chemical composition and must be of satisfactory hygienic quality. This is essential in relation to public health, the quality of the products made from milk, and the suitability of milk for processing. On the other hand, the seasonal differences in raw milk composition derived mainly from changes in diet and stage of lactation of the dairy cows result in significant variation in the quality of manufactured milk products (Banks et al., 1984). Such changes in milk composition especially in fat and casein influence many aspects of cheese making and cheese quality. In this respect, Banks and Tamime (1987) reported that in the UK there is a distinct seasonal trend in the level of these constituents which gives rise to seasonal fluctuations in the yield potential of the milk. They also demonstrated importance of the seasonal changes in the efficiency of conversion of milk constituents to cheese and this by its turn is of significant importance for commercial cheese manufacturing.

Donnelly and Barry (1983) reported that milk used for the manufacture of dairy products in Ireland is produced on a seasonal basis. Production reaches a peak in May-June, with a trough in December-January when most cows have reached the end of lactation. The opposite is well known in Egypt since more than two thirds of the annual milk production are produced during winter and spring months (December-May), where green fodder exceeds the needs of animals. In the dry months of summer less is available and the animals undernourished.

In 1997, Al-Ahwall carried out a comprehensive study on the effect of the seasonal variations on composition and microbiological quality of milk for manufacturing over a period of one year. In this respect, weekly milk samples of unknown type were collected to represent bulk milk supplies ranging from 15-25 tons. Composition and quality of milk and the resultant Domiati cheese were greatly affected by season of the year.

In the present study, we aimed to reveal composition and quality of buffalo's milk produced in summer and winter seasons. Efficiency of making Domiati cheese from such milk was taken in mind with special interest with composition and quality of the resultant cheese.

MATERIALS AND METHODS

Buffalo's milk samples were obtained at weekly intervals during summer and winter seasons from a collecting center near Kafr El-Sheikh city. The samples were analyzed for acidity, pH, TS, fat and TN as described by Ling (1963). Alcohol stability expressed as the weakest ethanol concentration which when added to an equal volume of milk causes clotting was carried out as given by White and Davies (1958). Rennet coagulation time (RCT), curd tension and curd syneresis were done as described by Fahmi and Amer (1962), Chandrasekharra et al. (1957) and Mehanna and Mehanna (1989) respectively.

Domiati cheese was mainly manufactured as described by Fahmi and Sharara (1950). In this respect, cheese milk was heat treated at 70°C/5 min and then cooled to 45°C to be ready for adding calcium chloride (0.01%), sodium chloride (6%) and rennet (The same number of rennet unit).

Yield of fresh cheese expressed as Kg of cheese per 100 Kg of milk was calculated. Recoveries of fat and protein were also calculated according to their actual amounts determined in cheese milk and the resultant cheese (Ling, 1963).

All cheese samples were analyzed for acidity, pH, moisture, fat, SN and TN as given by Ling (1963). The organoleptic properties were assessed as recommended by Naguib et al. (1974).

The obtained data were statistically analyzed as described by Steel and Torrie (1984).

RESULTS AND DISCUSSION

Chemical composition and some properties of cheese milk over two periods of the experimental work are shown in Table (1). Acidity and pH values showed an opposite trend of results. Acidity was significantly higher in summer milk (SM) whereas pH values were lower when compared to those of winter milk (WM) samples. The recorded averages were 0.176 and 0.164% for acidity and 6.58 and 6.73 for pH of SM and WM samples respectively.

Table (1): Chemical composition and some properties of cheese milk collected during summer and winter seasons (Range and average±SE of 12 replicates)

Property	Summer			Winter			F-value	P<
	Min.	Max.	Av.±SE	Min.	Max.	Av.±SE		
Acidity (%)	0.17	0.18	0.176±0.001	0.16	0.17	0.164±0.001	80.0	0.01
PH	6.5	6.7	6.58±0.02	6.63	6.8	6.73±0.01	63.6	0.01
TS (%)	12.85	17.1	15.26±0.31	11.5	16.1	14.05±0.39	7.97	0.01
Fat (%)	5.6	7.1	6.21±0.12	4.1	5.9	5.35±0.19	13.16	0.01
Total protein (%)	2.78	4.29	3.29±0.10	2.95	3.83	3.37±0.06	0.19	NS*
Alcohol stability	68.0	86.0	73.7±0.91	84.0	88.0	84.67±0.45	53.1	0.01
RCT (min)	3.7	8.8	6.27±0.41	6.5	13.0	9.93±0.68	22.6	0.01
Curd tension (g)	55.1	96.4	78.6±3.86	32.3	97.7	49.74±6.1	17.0	0.01
Curd syneresis after (min)								
15	4.85	7.15	6.15±0.17	2.67	6.76	5.29±0.35	5.44	0.05
30	5.86	8.06	7.15±0.15	3.91	7.63	6.27±0.32	6.9	0.05
45	6.25	8.31	7.74±0.15	4.59	7.98	6.77±0.27	10.27	0.01
60	7.48	8.66	8.12±0.14	5.26	8.38	7.15±0.25	12.7	0.01

* NS = Non-significant at P<0.01.

TS and fat contents were significantly higher in SM whereas total protein content was lower. The given corresponding values were 15.26, 6.21 and 3.29% for SM and 14.05, 5.35 and 3.37% for WM respectively.

The data given in Table (1) revealed that SM was less stable to alcohol and rennin. Thus, the weakest concentration of ethanol required to make clotting was 73.7% for SM and 84.67% for WM. The corresponding rennet coagulation time (RCT) was 6.27 and 9.93 min respectively. Such differences were significant (P<0.01).

Curd tension and curd syneresis (Table 1) were also affected by collecting season of milk. Curd tension had much higher value (78.6 g) in SM and much lower value (49.74 g) in WM, whereas curd syneresis at any given syneresis time showed higher values for the amount of exudate in case of SM.

Such trends of results sometimes agree or disagree with the results given by Al-Ahwall (1997). The mentioned author followed chemical composition and some properties of milk collected for manufacturing (15-25 tons). Thus, the present results with respect to acidity, pH and protein agree with those given by Al-Ahwall (1997), whereas those of TS and fat disagree with his results. The mentioned author demonstrated that acidity was higher and pH and protein were lower in SM than in WM. His values of TS and fat were higher in WM (13.74 and 4.4%) than those of SM (12.89 and 4.3% in order).

Different trends of results were given in the literature for cow's milk. Othman et al. (1990) found that TS and fat were higher in winter than in summer, whereas protein content decreased in winter and attributed that to the variation in casein and β-lactoglobulin. Martin et al. (1992) reported that protein content in Jersey milk was higher in autumn than in summer, whereas the opposite was recorded in case of Holstein milk. In all cases, SNF was higher in summer than in winter and autumn.

The reported variability of milk composition is mainly attributed to environmental factors such as season and climate, feeding, stage of lactation... etc. The influence of the mentioned factors is difficult to describe because effects of season and climate are difficult to separate from the nutritional factors. In addition, studies involving herd bulk milk have suffered from the confusing impact of stage of lactation when seasonal calving was practiced. However, Habeeb et al. (1991, 1993) found that exposure to heat during summer season caused a decrease in albumin, globulin, fat and sugar of milk, whereas the protein and its fractions were adversely affected by hot climate. The lower yield of milk in summer should be taken in mind and could be responsible for the higher fat content in SM in the present study.

Such changes in milk composition were greatly reflected on stability of milk to ethanol and rennin as well as the rheological properties of milk. In agreement with the present results, Al-Ahwall (1997) found that SM was less stable to ethanol and was faster in clotting by rennin when compared to WM. However, it is well known that stability of milk to ethanol was mainly affected by acidity and nature of protein, whereas RCT is radically affected by gross chemical composition of milk as well as minerals content and acidity and pH. All the mentioned properties were affected-with different rates- in the present study by season of the year. On the other hand, Hafez (1982) attributed the changes in RCT during the year to the animal feeding systems. Thus, RCT was longer at the beginning of dry feeding in June and shorter in January at the beginning of green feeding.

Fewer studies are available for curd tension and curd syneresis. Our results are in agreement with those given by Al-Ahwall (1997). Hafez (1982) reported that the longer was the RCT, the weaker was the curd. Moreover, Guinee et al. (1997) demonstrated that the renneting properties of milk were enhanced by increasing the levels of milk protein and fat in the range of 0.3-7% (w/w) and 0.1-10% (w/w) respectively which could explain effect of the seasonal changes on the present results.

Cheese yield is an important practical aspect of cheese manufacture. Table (2) reveals that SM gave Domiati cheese at the rate of 28.78 Kg/100 Kg milk, whereas the value for WM was 29.0. Nevertheless, casein and fat are recognized as the most important yield-determining components of milk. Table (2) shows that recovery of fat and protein in the resultant cheese was less in case of SM as compared to those of WM. The differences in values of all mentioned properties were insignificant.

Table (2): Yield, recoveries of fat (FR) and protein (PR) and composition of fresh cheese made from buffalo's milk collected during summer and winter seasons (Range and average±SE of 12 replicates)

Property	Summer			Winter			F-value	P<
	Min.	Max.	Av.±SE	Min.	Max.	Av.±SE		
Yield (%)	25.0	30.9	28.78±0.45	26.7	31.2	29.0±0.5	0.01	NS*
FR (%)	82.6	92.3	88.53±1.10	83.4	93.2	89.2±1.21	0.22	NS
PR (%)	76.2	90.3	86.03±1.21	78.5	90.6	87.1±0.99	0.44	NS
Acidity (%)	0.15	0.25	0.20±0.02	0.20	0.40	0.32±0.01	55.0	0.01
PH	6.2	6.88	6.46±0.07	5.8	6.84	6.3±0.09	2.05	NS
Moisture(%)	58.9	62.7	60.6±0.36	59.4	63.7	61.02±0.4	0.96	NS
Fat (%)	16.5	20.5	18.82±0.32	14.5	18.0	16.42±0.36	29.5	0.01
FDM (%)	41.46	50.99	47.87±0.78	37.8	49.6	42.2±0.96	21.4	0.01
Protein (%)	9.32	12.34	10.29±0.24	9.83	11.7	10.49±0.16	0.48	NS
PDM (%)	23.83	28.56	26.16±0.5	25.29	28.62	26.94±0.37	0.66	NS
SN/TN (%)	7.04	14.72	10.8±0.55	8.74	20.81	13.4±0.86	6.86	0.05

*** NS = Non-significant at P<0.01.**

Much lower values (21.73 and 18.46%) were given by Hafez (1982) and Al-Ahwall (1997) respectively for the yield of Domiati cheese made from SM as compared to those (23.23 and 23.89%) of yield from WM in order. However, the seasonal changes evident in cheese yield could be correlated with the variation in the yield potential of the milk i.e. the sum of the fat and casein content (Banks and Tamime, 1987). In this respect, van den Berg et al. (1996) reported that the most important effect of milk composition on cheese manufacture is the difference in seasonal pattern of various constituents. Other factors affecting yield of Domiati cheese was comprehensively reviewed by Abou-Donia (1986). More recently, Ng-

Kwai-Hang et al. (1989) demonstrated importance of coagulation properties of milk expressed in terms of RCT, rate of firming and curd firmness on cheese yielding capacity and cheese composition.

The present results concerning recovery of fat and protein agree – in part– with those given by Al-Ahwall (1997) who gave always much lower values in summer months than those of winter months. The high values given for protein recovery in the present study could be attributed to effect of the heat treatment applied (70°C/5 min) on denaturation of whey proteins and subsequently on incorporation of such proteins with casein during cheesemaking.

Acidity, pH and composition of the resultant fresh cheese are presented in Table (2). SM cheese was characterized by lower values for acidity, moisture, protein and SN/TN as compared to WM cheese which had lower values for pH and fat. These results agree – in part – with those given by Al-Ahwall (1997) who found that SM cheese had lower values for moisture, TN, SN and SN/TN and higher values for fat and FDM when compared to WM cheese. Such differences could be attributed to that the study of 1997 was carried out using bulk milk for manufacturing (15-25 tons/day) of unkown mixing ratio for cow's and buffalo's milk. Such milk is normally collected from different private farms of different capacities and of different feeding systems for milking animals. The earlier study given by Hafez (1982) showed that SM Domiati cheese made from Friesian milk had lower values for moisture and FDM than WM cheese.

Table (3) shows that SM cheese ranked significantly lower scores for flavour, body and texture and appearance as compared to WM cheese. This could be attributed to the poor quality of SM in Egypt due to the hot climate and insufficient care during milking, collecting and transportation of milk. In this respect, Al-Ahwall (1997) found that SM Domiati cheese contained much higher values for total bacterial counts and counts of proteolytic and lipolytic bacteria as compared to WM cheese.

In conclusion, seasonal impacts should be taken in consideration when buffalo's milk was used for making Domiati cheese. Great efforts should be done to produce milk of a satisfactory hygienic quality to be suitable for making a good quality cheese.

Table (3): Scoring of the o7rganoleptic properties of Domiati cheese made from buffalo's milk collected during summer and winter seasons (Range and average ± SE of 60 evaluations from 12 replicates)

Property	Summer			Winter			F-value	P<
	Min.	Max.	Av.±SE	Min.	Max.	Av.±SE		
Flavour (60)*	40.3	51.6	48.42±0.96	49.1	57.0	52.38±0.81	10.39	0.01
Body & Texture(30)	22.5	27.1	24.73±0.37	25.3	28.8	26.31±0.32	8.6	0.01
Saltiness (5)	3.5	4.2	3.8±0.06	3.4	4.6	3.84±0.12	0.10	NS**
Appearance (5)	3.1	3.9	3.51±0.06	3.3	4.6	4.0±0.12	13.57	0.01
Total (100)	70.1	86.3	80.68±1.29	82.2	93.4	86.48±0.93	12.51	0.01

*** Values in parenthesis represent the maximum attainable scores.**
**** NS = Non significant at P<0.01.**

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الملخص العربى

دراسة تأثير التغيرات الفصلية على كفاءة تصنيع الجبن الدمياطى من اللبن الجاموسى

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اهتمت الدراسة بتحليل عينات اللبن المعدة لصناعة الجبن الدمياطى أسبوعياً وأيضاً بتحليل الجبن الناتج خلال فصلى الصيف والشتاء فقط نظراً للتغيرات المناخية الحالية فى جمهورية مصر العربية وطول فترة الجو الحار التى تقارب نصف العام تقريباً. أوضحت النتائج اختلاف التركيب الكيماوى للبن الصيف جوهرياً عن لبن الشتاء ، فقد اتصف بزيادة حموضته وزيادة محتواه من الجوامد الكلية والدهن وقلة محتواه من البروتين وقلة ثباته للحكول وسرعة تجبنه بإنزيم الرنين عند مقارنته باللبن المجمع فى فصل الشتاء.. كما أن قيم الجذب الخثرى وكمية الشرش المنطلق من الخثرة كانت أعلى فى حالة لبن الصيف. هذا وعند تصنيع الجبن الدمياطى من اللبن أوضحت النتائج أن تصافى الجبن وقيم استرجاع الدهن والبروتين فى الجبن الناتج كانت أقل فى شهور الصيف كما اتصف جبن لبن الصيف بقلة محتواه من الرطوبة والبروتين والنتروجين الذائب منسوباً للنتروجين الكلى وبزيادة محتواه من الدهن مقارنة بجبن لبن الشتاء فى حين تميز جبن لبن الشتاء بنكهته الواضحة وبالقوام والتركيب المتميز وبمظهره العام الجيد.