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Physiochemical Properties of Camel Milk Cheese with Added Gum Arabic

Ayat Omer Hassab Elnabi[1], Ahmed Elawad Elfaki[2]

[1]Department of Food Science and Technology, College of Agricultural Studies, Sudan University of Science and Technology, Khartoum North, Sudan

Abstract: ***This study was designed to investigate the effect of added gum Arabic on physicochemical properties of camel milk cheese compared with cow milk cheese. Camel milk cheese was made using calcium phosphate at a level of 0.3%, and gum Arabic was added at level of 0.5%, 1%, 1.5% and 2% Cow milk cheese was manufactured by traditional method. Physiochemical properties and synersis of cheese were determined. Results showed an increase in the moisture content by increasing storage time and decrease in moisture content by increasing the percentage of gum Arabic ,the highest moisture content was 43.42% which was recorded for control sample in the third month, the lowest one was 28.99% which was reported for camel milk cheese with 2% gum Arabic added in zero time. The lowest protein content was in the sample of camel milk cheese without gum Arabic in the third month which was 18.96 % .The highest protein content (25.25%) was in the sample of camel milk cheese with 2% gum Arabic at the first month. The highest percentage of fat content (35.40%) was in the sample of camel milk cheese with 2% gum Arabic at zero time, and the lowest one (29.52%) was in the control sample in the third month. The highest percentage of ash content (10.79%) was in camel milk cheese with 2% gum Arabic at zero time and the lowest percentage (7.99%) was in the control sample in the third month. Addition of gum Arabic in the manufacture of camel milk cheese improved some of the physicochemical properties of camel milk cheese.***

Keywords: Camel milk, cow milk, cheese, physicochemical, gum Arabic, synersis

1. Introduction

According to (FAO, 2013) camel population in the world was 25.89 million. Sudan is the second country in the camel population (Faye, 2013). Female camels can produce milk for several years after giving birth and the maximum production of milk is 20 liters/day (Bannikov, 1976). Increment in human populace of the world has emerged the issue of nourishment security, thus, there is need to investigate new sustenance assets, and camel can serve the best helpful expansion to the sustenance inventory network regarding milk, meat and different items (Ahmad et al., 2010). There is a difficulty in making cheese from camel milk due to very specific casein micelle composition characterized by a low proportion of kappa casein of 5% from total casein compared with 13.6% in cow milk .Camel milk can be treated with gum Arabic to solve the problem of coagulation. *Acacia Senegal* trees are the main source for gum Arabic ,they are cultivated in sudan as a cash crop in agro forestry systems. This gum is nontoxic, odorless, colorless, tasteless for thes reason it used as an emulsifier and stabilizer in food industry (Lelon *et al*., 2010). Camel milk is a completely vital supply of food within the desert .It is a food that contains all the essential nutrients necessary for humans in the desert (Farah and Fischer, 2004). Finding new sources of food production has become important given the continuous increase in human population (Ahmad *et al.*, 2010).Since camel milk is a perishable food, its storage period can be increased by turning it into a fermented product such as cheese (Mustafa, 2011). The present study aimed to determine the physicochemical properties of camel milk and camel milk cheese and Syneresis of camel milk cheese.

2. Materials and Methods

Camel and cow milk was brought from Alkadaru area (Kamal's farm) Khartoum North, Sudan. The source of gum Arabic was Elie group Company. Milk was filtered using a sterile cloth, in sterilized container in ice boxes then transferred to a refrigerator.

Calcium phosphate was added to camel milk at level of 03%, gum Arabic was added at level of 0%, 0.5%, 1%, 1.5% and 2%. Milk was heated to 39°C, starter culture (Freeze dried powder) was added at level of 0.1 mg per 10 liters then 25 ml of water were mixed with rennet powder (0.2 g /10 liter milk) in a beaker, and added to milk and incubated for 2 to 3.30 hrs.to get coagulum , and the traditional method was used for manufacture of cow milk cheese (Ibrahim,1970).The curd was cut into approximately 2 cm^3 after coagulation using stainless steel knife to allow whey separation ,the curd was then pressed in wooden molds(50×50×20 cm) , covered with cheese cloth by using a flat wooden cover (49×49×2 cm) (using about 15 kg weight) , and whey separation took about 6 hrs. then the cloth was removed off the curd . The molded curd was cut into rectangular blocks (400-500 gm.) and placed in containers then salted whey (200 ml) was added. Samples were analyzed at zero time and 1,2 and 3 months intervals .

The moisture content was determined by (AOAC , 2003) method as follows:

A cheese sample of 5 ± 1 mg was weighed into an aluminum dish. Then, the sample was dried in an oven (Kat-NR.2851, Elektrohelios, Sweden) at 105±^{o}C until a constant weight was obtained. The dried sample was transferred to the desiccator until it was cooled and weighed. Triplicate results were obtained for each sample and the

mean value was reported to two decimal points according to the following formula:

The crude protein was determined by the micro-Kjeldahl method according to (AOAC, 2003) as follows:

10 gm sample was accurately weighed and transferred together with 2-3 glass pellets, kjeldahl catalyst (No 33064, BDH, England) and 25 ml concentrated sulphuric acid (No 18474420, Mark AG, Germany) into kjeldahl digestion flask. The flask was placed into a kjeldahl digestion unit (Tecator, Sweden) for about 3 hours, until a colorless digest was obtained then left to cool to room temperature.

The distillate was received in conical flask (100ml) containing ten ml of 2% boric acid (2 %) plus 3 drops of indicator (bromocresol green + phenolphthalein red). The distillation was continued until the volume in the flasks was 75 ml. The content of the flask were titrated against 0.01 N HCL. The titration reading was recorded.

CP = CN % x. 3.38

$$CN\% = T \times 0.10.014 \times 100 / W$$

Where:
CP=crude protein
CN= crude nitrogen
T= Titration reading
N= HCl normality (0.1)
Ws= sample weight
1000= to convert to mg

Fat was determined by Gerber method according to (AOAC ,2003).Ten ml of Sulphuric acid (specific gravity 1.820 at 155^{o}C) were measured into Gerber butyrometers, and mixed well, 10.94 mL of milk sample was slowly added into butyrometers tube. Then one ml of amyl alcohol was added and lock stopper was inserted securely with the stoppers end up .The Gerber tube was grasped and shacked with precaution until the sample was completed digested, the Gerber tubes were centrifuged at 1100 rpm for 4minutes. Butyrometer was then placed in a water bath at 65°C for 3 minutes at least. The fat percent was finally read out directly from the Column.

For determination of lactose content a standard solution was prepared by dissolving 5mg lactose in to 95ml of distilled water to give 5% (w/v) solution of monohydrate. One ml of this solution was diluted with 500 ml in volumetric flask to give 75mg Lactose /ml standard solution. The Anthrone reagent was prepared by dissolving 150mg of Anthrone into 100 ml of 70% (w/v) sulfuric acid. The solution was then cooled and stored overnight.

One ml of sample was pipetted into a 500 ml flask with distilled water. The solution was then mixed thoroughly and 0.5ml was transferred to boiling tube (sample) standard stock solution (0.5ml) was transferred to a second boiling (blank). To each tube 10ml ice cooled Anthrone reagent was added. The tubes were then transferred to boiling water bath for 6 min then transferred to an ice bath and held for 30 min.

The optical density (O.D) was read at 625nm Lactose content (in mg/100ml) was calculated as follows:

$$\text{Lactose g/100ml} = \frac{\text{O.D of sample} - \text{O.D of blank}}{\text{O.D of standard} - \text{O.D of blank}} \times 4.75$$

The ash content was determined by gravimetric method (AOAC ,2003). Five grams of the samples were weighed in crucibles, and then placed in a muffle furnace at 550-600 ^{o}C for 3 hrs until ashes were carbon free. The crucibles were then cooled in desiccators and weighed. The ash content was calculated using the following equation:

$$Ash\% = \frac{W_1}{W_2} x100$$

Where:
W_1= Weight of ash
W_2=Weight of sample before ashing

Total solids (TS) content was determined according (AOAC ,2003). A clean aluminum moisture dishes were dried at 105 ^{o}C for 3 hrs. Five grams of the sample were weighed in dry clean flat bottomed aluminum dish and heated on a steam bath for 15 minutes. The dishes were placed into a forced draft oven at 100^{o}C for 3 hrs. The dishes were transferred to desiccators cooled and weighted. Heating, cooling and weighting were repeated several times until the difference between successive weighting was less than 0.1mg .the total solids (T.S) content were calculated as follows:

$$T.S\% = \frac{W_1}{W_2} \times 100$$

Where:
W_1= Weight of sample after drying
W_2=Weight of sample before drying
Total Solids - fat (S.N.F) content was determined from the Following equation:
SNF (%) = T.S % - Fat %

The pH of cheese was determined according to (AOAC, 2003). Ten grams of cheese were weighed and placed in a conical flask and distilled water at 40 ^{o}C was added until the volume in the flask was 105 ml. The sample was then vigorously agitated and filtered. Then pH of the filtrate was measured by a recalibrated pH meter model (HI 8521 microprocessor bench pH / MV / ^{o}C meter). This has been calibrated with two standard buffers pH 4 and pH 7.0 the pH meter was placed into the sample, and the pH was directly read.

Titrable acidity

The pH of cheese was determined according to (AOAC, 2003). Ten grams of cheese were weighed and placed in a conical flask and distilled water at 40 ^{o}C was added until the volume in the flask was 105 ml. The sample was then vigorously agitated and filtered. 25 ml of the filtrate were pipette into porcelain dish and 5 drops of the indicator of phenolphthalein were added. The sample was titrated against 0.1N NaOH till a faint pink color that lasted for a least 30 second was obtained. The acidity was calculated from the following equation:

$$\text{Acidity \%} = \text{Titre value} \times 4 / \text{Weight of sample}$$

Syneresis was determined by measuring the volume of milk used for cheese making and compared it with the volume of whey which separated by filtration. Whatman paper number 4 (Whatman Corp.,USA)was placed on the funnel, the

cheese sample was put on the filter paper to allow whey separation ,the whey was measured using 100 ml measuring cylinder . The volume of whey was compared with the volume of milk to determine synersis (Smith and McMahon,1996).

Statistical analysis

The data collected were subjected to analysis of Variance and whenever appropriate the mean separation procedure of Duncan was employed (Steel and Torrie, 1980). SAS program (SAS, 2002**),** was used to perform the general liner model (GLM**)** analysis.

3. Results and Discussion

Table (1) shows the effect of addition of gum Arabic and storage period on moisture content of camel milk cheese. It increased by increasing the storage period and decreased by increasing the percentages of added gum Arabic. Significant variation were observed, and the highest moisture content (43.42%) was recorded for ontrol sample in the third month, this result is lower than that reported by Abd EL-Salam *et, al*.,(2004), while, the lowest one was 28.99%, recorded for camel milk cheese with 2% gum Arabic at zero time. The result was lower than that reported by Mehaia,(1993) and Khan *et al.*,(2004). This difference in moisture content may be due to more calcium transferred from the curd into the whey and this transfer has been reported to increase moisture content of cheese and make the cheese softer.

Table 1: Effect of addition of gum Arabic and storage on moisture content (%) of camel milk cheese

Cheese	Storage period (month)			
	0	1	2	3
Control(Without gum Arabic)	37.47 ± 0.25^{fg}	38.39 ± 0.46^{e}	39.68 ± 0.24^{c}	43.42 ± 0.35^{a}
0.5%gum Arabic	33.82 ± 0.23^{m}	34.27 ± 0.25^{l}	35.28 ± 0.17^{j}	37.71 ± 0.21^{f}
1%gum Arabic	31.65 ± 0.19^{p}	32.14 ± 0.27^{o}	33.20 ± 0.15^{n}	36.59 ± 0.22^{h}
1.5% gum Arabic	30.25 ± 0.22^{q}	30.09 ± 0.28^{q}	30.48 ± 0.20^{q}	34.83 ± 0.28^{k}
2% gum Arabic	28.99 ± 0.15^{rs}	28.63 ± 0.21^{s}	29.22 ± 0.24^{r}	32.46 ± 0.19^{o}
Cow milk	36.01 ± 0.31^{i}	37.11 ± 0.26^{g}	36.19 ± 0.27^{d}	41.60 ± 0.24^{b}
$Lsd_{0.05}$	0.4249^{**}			
SE±	0.1494			

Values are mean±SD.

Mean(s) bearing different superscript(s) in columns and rows are significantly different (P≤0.05) according to DMRT.

Table (2) shows effect of addition of gum Arabic and storage period on protein content (%) of camel milk cheese. Crude protein decreased by increasing the storage period and it was increased by increasing percentages of gum Arabic. The lowest protein content was in the sample of camel milk cheese in the third month which was 18.96 %, which is lower than that reported by Khan *et al*.,(2004).The highest protein content was in the sample of camel milk with 2% gum Arabic at the first month which is was 25.25%, this result is lower than that reported by Hassab Elnabi,(2011), ELZubeir and Jabreel (2009). This variation of protein content may be due to the addition of gum Arabic to the cheese, and to decrease in total solid in samples during storage period and breakdown of amino acids by starter culture.

Table 2: Effect of addition of gum Arabic and storage on crude protein (%) of camel milk cheese

Cheese	Storage period (month)			
	0	1	2	3
Control (Without gum Arabic)	21.57 ± 0.18^{k}	21.30 ± 0.24^{l}	21.07 ± 0.21^{m}	18.96 ± 0.25^{o}
0.5%gum Arabic	23.60 ± 0.16^{g}	23.57 ± 0.22^{g}	23.30 ± 0.17^{h}	22.56 ± 0.28^{i}
1%gum Arabic	23.91 ± 0.11^{f}	23.86 ± 0.29^{f}	23.51 ± 0.22^{g}	22.56 ± 0.21^{i}
1.5% gum Arabic	24.62 ± 0.14^{c}	24.43 ± 0.18^{d}	24.13 ± 0.25^{e}	23.18±0.20
2% gum Arabic	24.82 ± 0.20^{b}	25.25 ± 0.14^{a}	25.16 ± 0.21^{a}	23.97 ± 0.26^{f}
Cow milk	21.87 ± 0.15^{j}	21.68 ± 0.26^{k}	21.35 ± 0.23^{l}	20.03 ± 0.27^{n}
$Lsd_{0.05}$	0.1272^{**}			
SE±	0.04472			

Values are mean±SD.

Mean(s) bearing different superscript(s) in columns and rows are significantly different (P≤0.05) according to DMRT

Table (3) shows the effect of addition of gum Arabic and storage period on fat content (%) of camel milk cheese. Fat content decreased by increasing the storage period and it increased by increasing percentages of gum Arabic. The sample of camel milk cheese with 2% gum Arabic at zero time shows the highest percentage of fat content (35.40%) and the lowest one (29.52%) was in the control sample in the third month. This result was higher than those reported by Mehaia (1993), Hassab Elnabi (2011) and Khan *et al* (2004). This variation may be due to decrease in total solid in samples during storage period and may be due to lipolysis of cheese.

Table 3: Effect of addition of gum Arabic and storage on fat content (%) of camel milk cheese

Cheese	Storage period (month)			
	0	1	2	3
Control(Without gum Arabic)	31.71±0.44^{j}	31.61±0.29^{j}	31.02±0.22^{k}	29.52±0.24^{m}
0.5%gum Arabic	33.69±0.41^{f}	33.50±0.33^{f}	33.20±0.20^{g}	31.61±0.30^{j}
1%gum Arabic	34.70±0.38^{cd}	34.59±0.25^{d}	34.22±0.21^{e}	32.22±0.32^{i}
1.5% gum Arabic	34.82±0.31^{bc}	35.02±0.19^{b}	35.33±0.18^{a}	32.58±0.31^{h}
2% gum Arabic	35.40±0.25^{a}	35.36±0.21^{a}	35.41±0.27^{a}	33.54±0.35^{f}
Cow milk	33.13±0.29^{g}	32.78±0.26^{h}	32.02±0.24^{i}	30.59±0.24^{l}
$Lsd_{0.05}$	0.2077**			
SE±	0.07303			

Values are mean± SD. Mean(s) bearing different superscript(s) in columns and rows are significantly different (P≤0.05) according to DMRT.

Table (4) shows the effect of addition of gum Arabic and storage period on ash content (%) of camel milk cheese. The ash content decreased by increasing the storage period and it was increased by increasing added gum Arabic. The highest percentage of ash in camel milk cheese with 2% gum Arabic in at zero time which was 10.79% and the lowest percentage in the control sample in the third month which was7.98%. This result was in good agreement with Ahmed and Ahmed (2017) and lower than the result reported by Khan *et al* (2004). This variation may be due to increase in moisture content that let to dilution of T S. content.

Table 4: Effect of addition of gum Arabic and storage on ash content (%) of camel milk cheese

Cheese	Storage period (month)			
	0	1	2	3
Control(Without gum Arabic)	8.46±0.13^{i}	8.29±0.14^{j}	8.13±0.14^{kl}	7.98±0.10^{m}
0.5%gum Arabic	8.77±0.14^{h}	8.69±0.11^{h}	8.25±0.17^{jkl}	8.12±0.12^{l}
1%gum Arabic	9.70±0.17^{e}	9.45±0.16^{f}	9.07±0.19^{g}	8.73±0.13^{h}
1.5% gum Arabic	10.31±0.20^{c}	10.46±0.21^{b}	10.02±0.24^{d}	9.41±0.16^{f}
2% gum Arabic	10.79±0.22^{a}	10.77±0.23^{a}	10.19±0.22^{c}	10.00±0.20^{d}
Cow milk	8.27±0.18^{jk}	7.89±0.13^{m}	7.30±0.11^{o}	7.70±0.11^{n}
$Lsd_{0.05}$	0.1374**			
SE±	0.0483			

Values are mean±SD.

Mean(s) bearing different superscript(s) in columns and rows are significantly different (P≤0.05) according to DMRT.

Table (5) shows the effect of addition of gum Arabic and storage period on lactose content (%) of camel milk cheese. The lactose appeared only in a control sample and a sample of cow's milk, and all these result were lower than the result reported by Khan *et al* (2004) which was 2.53, this may be due to addition of gum Arabic to cheese which acts as a prebiotics that activates lactic acid bacteria which metabolize lactose.

Table 5: Effect of addition of gum Arabic and storage on lactose (%) of camel milk cheese

Cheese	Storage period (month)			
	0	1	2	3
Control(Without gum Arabic)	0.8000±0.05^{a}	0.4111±0.05^{b}	0.1111±0.03^{c}	0.1000±0.01^{c}
0.5%gum Arabic	ND	ND	ND	ND
1%gum Arabic	ND	ND	ND	ND
1.5% gum Arabic	ND	ND	ND	ND
2% gum Arabic	ND	ND	ND	ND
Cow milk	0.7333±0.0^{4a}	0.5556±0.03^{b}	0.1333±0.0^{2c}	0.1000±0.01^{c}
$Lsd_{0.05}$	0.1548*			
SE±	0.051464			

Values are mean±SD.

Mean(s) bearing different superscript(s) in columns and rows are significantly different (P≤0.05) according to DMRT.

Table (6) shows the effect of addition of gum Arabic and storage period on total soluble solids (%) of camel milk cheese. It decreased by increasing the storage period and increased by increasing the amount of gum Arabic The highest percentage of total soluble solids was in camel milk cheese with 2% gum Arabic at zero time which was71.01% and the lowest percentage in control sample in the third month which was 56.58%. All these result are higher than that reported by Inayat *et al* (2016) which was 29.54 and higher than that reported by Khan *et al* (2004). This difference may be due to the addition of gum Arabic to the cheese and increasing the moisture content of cheese by increasing the storage period.

Table 6: Effect of addition of gum Arabic and storage on total soluble solids (%) of camel milk cheese

Cheese	Storage period (month)			
	0	1	2	3
Control(Without gum Arabic)	62.53 ± 0.41^{lm}	61.61 ± 0.44^{n}	60.32 ± 0.41^{p}	56.58 ± 0.39^{r}
0.5%gum Arabic	66.07 ± 0.48^{g}	65.73 ± 0.40^{g}	64.72 ± 0.46^{i}	62.29 ± 0.47^{m}
1%gum Arabic	68.35 ± 0.51^{d}	67.97 ± 0.39^{d}	66.80 ± 0.47^{f}	63.41 ± 0.41^{k}
1.5% gum Arabic	69.75 ± 0.53^{c}	69.91 ± 0.42^{c}	69.52 ± 0.50^{c}	65.17 ± 0.45^{h}
2% gum Arabic	71.01 ± 0.55^{ab}	71.37 ± 0.54^{a}	70.78 ± 0.53^{b}	67.54 ± 0.40^{e}
Cow milk	63.99 ± 0.42^{j}	62.89 ± 0.41^{l}	60.84 ± 0.52^{o}	58.40 ± 0.38^{q}
$Lsd_{0.05}$	0.4185^{**}			
SE±	0.1472			

Values are mean±SD.

Mean(s) bearing different superscript(s) in columns and rows are significantly different (P≤0.05) according to DMRT

Table (7) shows the effect of addition of gum Arabic and storage period on SNF (%) of camel milk cheese. It decreased by increasing the storage period and increased by increasing the amount of gum Arabic. The lowest percentage of SNF% of cheese was in the third month for the ontrol sample which was 27.38%, this result was similar to the result of Inayat *et al* (2016) which was 28.66%. This difference may be due to the addition of gum Arabic to the cheese. The highest percentage of SNF (%) in camel milk cheese with 2% gum Arabic in the first month which was 36.01% this result was higher than that reported by Inayat *et al* (2016). This difference may be due to the addition of gum Arabic to the cheese and increasing the moisture content of cheese by increasing the storage period.

Table 7: Effect of addition of gum Arabic and storage on SNF (%) of camel milk cheese

Cheese	Storage period (month)			
	0	1	2	3
Control(Without gum Arabic)	30.82 ± 0.25^{g}	29.99 ± 0.21^{i}	29.27 ± 0.21^{j}	27.38 ± 0.26^{k}
0.5%gum Arabic	32.37 ± 0.29^{e}	32.23 ± 0.33^{e}	31.59 ± 0.26^{f}	30.66 ± 0.27^{gh}
1%gum Arabic	33.66 ± 0.30^{cd}	33.38 ± 0.25^{d}	32.61 ± 0.29^{e}	31.19 ± 0.29^{fg}
1.5% gum Arabic	34.93 ± 0.33^{b}	34.91 ± 0.24^{b}	34.19 ± 0.30^{c}	32.54 ± 0.25^{e}
2% gum Arabic	35.61 ± 0.38^{a}	36.01 ± 0.22^{a}	35.61 ± 0.24^{a}	34.05 ± 0.24^{c}
Cow milk	30.87 ± 0.24^{g}	30.11 ± 0.23^{hi}	28.75 ± 0.19^{j}	27.73 ± 0.28^{k}
$Lsd_{0.05}$	0.5987^{**}			
SE±	0.2106			

Values are mean±SD.

Mean(s) bearing different superscript(s) in columns and rows are significantly different (P≤0.05) according to DMRT. Table (8) shows the effect of addition of gum Arabic and storage period on pH-value of camel milk cheese. It decreased by increasing the storage period and also decreased by increasing the amount of gum Arabic. The pH value of control sample at zero time was the highest one (4.69), this result was similar to that reported by Khan *et al* (2004).This variation of pH value may be due to variation in the activity of lactic acid bacteria.

Table 8: Effect of addition of gum Arabic and storage on pH-value of camel milk cheese

Cheese	Storage period (month)			
	0	1	2	3
Control(Without gum Arabic)	4.69 ± 0.13^{ab}	4.60 ± 0.11^{abc}	4.29 ± 0.15^{cde}	3.86 ± 0.19^{fghij}
0.5%gum Arabic	4.58 ± 0.11^{abc}	4.40 ± 0.16^{bcd}	4.21 ± 0.19^{cdef}	3.72 ± 0.11^{hij}
1%gum Arabic	4.47 ± 0.12^{abcd}	4.26 ± 0.19^{cde}	4.08 ± 0.21^{defgh}	3.59 ± 0.10^{ij}
1.5% gum Arabic	4.28 ± 0.10^{cde}	4.14 ± 0.17^{defg}	3.98 ± 0.24^{efghi}	3.66 ± 0.15^{ij}
2% gum Arabic	4.15 ± 0.09^{def}	3.90 ± 0.14^{efghij}	3.81 ± 0.26^{fghij}	3.57 ± 0.17^{j}
Cow milk	4.83 ± 0.15^{a}	4.75 ± 0.18^{ab}	4.43 ± 0.28^{bcd}	3.75 ± 0.18^{ghij}
$Lsd_{0.05}$	0.3444^{*}			
SE±	0.1211			

Values are mean±SD.

Mean(s) bearing different superscript(s) in columns and rows are significantly different (P≤0.05) according to DMRT.

Table (9) shows the effect of addition of gum Arabic and storage period on titratable acidity of camel milk cheese. It increased by increasing the storage period and amount of gum Arabic. The lowest level of titrable acidity of camel milk cheese was in the control sample at zero time which was 0.921 and the highest level of titrable acidity of cheese was in third month in 2% added gum Arabic cheese which was 2.111. All results were lower than that reported by Hailu *et al* (2014). This variation may be due to activity of lactic acid bacteria and addition of gum Arabic.

Table 9: Effect of addition of gum Arabic and storage on titratable acidity (as % lactic acid) of camel milk cheese

Cheese	Storage period (month)			
	0	1	2	3
Control(Without gum Arabic)	0.921 ± 0.05^{n}	0.987 ± 0.06^{mn}	1.089 ± 0.11^{lm}	1.677 ± 0.12^{de}
0.5%gum Arabic	1.133 ± 0.09^{kl}	1.255 ± 0.05^{ij}	1.344 ± 0.10^{hi}	1.833 ± 0.10^{bc}
1%gum Arabic	1.222 ± 0.11^{jk}	1.389 ± 0.08^{gh}	1.489 ± 0.13^{fg}	1.889 ± 0.08^{b}
1.5% gum Arabic	1.266 ± 0.12^{ij}	1.533 ± 0.09^{f}	1.600 ± 0.15^{ef}	1.922 ± 0.06^{b}
2% gum Arabic	1.522 ± 0.08^{f}	1.733 ± 0.10^{cd}	1.710 ± 0.17^{d}	2.111 ± 0.05^{a}
Cow milk	0.916 ± 0.04^{n}	0.968 ± 0.05	0.988 ± 0.06^{n}	1.566 ± 0.09^{f}
$Lsd_{0.05}$	0.1038^{*}			
SE±	0.03651			

Values are mean±SD.

Mean(s) bearing different superscript(s) in columns and rows are significantly different (P≤0.05) according to DMRT. Table (10) shows the effect of addition of gum Arabic on syneresis of cheese. From the result shown in the table the highest ratio of whey was in the control sample which was 56% and the lowest one was in sample with 1% gum Arabic 49.33%). These results were lower than that reported by Mikulce *et al* (2015).This difference may be due to the addition of gum Arabic to the cheese as gum Arabic make bridges which bind the milk casein and acts as a fat replacer and preventing the loss of solid ingredients in whey.

Table 10: Syneresis (ml)

Cheese	Mean±SD
Control(Without gum Arabic)	56.00 ± 0.00^{b}
0.5%gum Arabic	52.67 ± 0.58^{c}
1%gum Arabic	49.33 ± 0.58^{d}
1.5% gum Arabic	50.67 ± 1.53^{cd}
2% gum Arabic	50.33 ± 058^{cd}
Cow milk	88.00 ± 3.00^{a}
$Lsd_{0.05}$	2.551^{*}
SE±	0.8278

Means having different superscripts are significantly different (P≤0.05).

4. Conclusion

Gum Arabic and storage period influenced the physicochemical properties of the camel milk cheese. Addition of gum Arabic in the manufacture of camel milk cheese improved some of the physicochemical properties of camel milk cheese. Moisture content (%) of cheese increased by increasing the storage period and decreased by increasing the percentages of gum Arabic, on the other hand the crude protein, fat content, ash content total soluble solid and TNF decreased by increasing the storage period and increased by increasing the amount of gum Arabic. Lactose appeared only in a blank sample and a sample of cow's milk. pH-value decreased by increasing the storage period and by increasing the amount of gum Arabic. Titratable acidity of cheese increased by increasing the storage period and amount of gum Arabic.

5. Recommendation

Addition of gum Arabic to cheese which acts as a prebiotics that activates lactic acid bacteria which metabolize lactose and improved the physicochemical properties of camel milk cheese. Further research is needed on the manufacture of cheese from camel milk.

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