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A Review

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Coagulation and Preparation of Soft Unripened Cheese from Camel Milk using Camel Chymosin

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Abstract: Camel milk is known for not being suitable for processing it into different dairy products. Efforts have been made to make cheese from camel milk, but still there is no well accepted manufacturing protocol to be adopted. Hence this experiment was initiated to investigate the effect of different levels of camel chymosin concentrations on camel milk gelation properties and the influence of cooking (at 55°C) on the characteristics of soft un-ripened cheese made from camel milk. Soft unripened cheese was made with 3x2 factorial design with CRD arrangement in which three levels of camel chymosin concentrations (40, 70, and 100 IMCU/L) and two levels of cooking (cooked and uncooked curd) and then cheese quality, yield, texture profile analysis (TPA) hardness and sensory attributes were analyzed. The shortest gelation time was observed for camel chymosin concentration of 100 IMCU/L and 70 IMCU/L whereas the highest maximum gel firmness was observed for camel chymosin level of 40 IMCU/L. Significantly highest ($P<0.001$) cheese yield was observed for uncooked cheese at 100 IMCU/ L coagulant level. Cooked cheese made using 100 IMCU/L had significantly highest values for protein, total solid, ash and hardness. Whereas, the color, texture and appearance scores were significantly higher for 40 IMCU/L cooked cheese. However, the taste, aroma and overall acceptance of cooked cheese made using 70 IMCU/L gave the highest score. It could be concluded that, using medium level chymosin concentration (70 IMCU/L) as well as cooking of camel milk curd could be suitable approaches for making of soft unripened cheese from camel milk.

Keywords: Camel chymosin; Camel milk; Coagulation; Cooking

1. Introduction

Processing of camel milk into cheese is considered to be difficult, even impossible (Wilson, 1984; Yagil, 1994). Most attempts to make cheese from camel milk have been hindered due to major difficulties in getting the milk to coagulate. With the same amount of calf rennet, the coagulation time of camel milk is twice or thrice longer than that of cow milk and the action of rennet on camel milk leads to coagulation in the form of flocks without firm coagulum (El-Agamy, 2000).

The main difference between cow and camel milk is in the variation in physicochemical characteristics of individual components (protein, lipids, ash, etc.). The total protein content of camel milk ranges from 3.0-3.9%, which is similar to cow milk (3.2-3.8%) (Al Haj and Al Kanhal, 2010). Casein accounts for 60% of the total protein in camel milk (Farah, 1993) whereas it reaches 80% in cow milk. Moreover, camel milk is characterized by low amount of kappa casein (5% of the total casein) as compared to about 13.6% in bovine casein (Farah, 1993) and this has been reported as the main factors that impede proper clotting of camel milk. The fat content of camel milk ranges between 2.9-5.4% (Al Haj and Al Kanhal, 2010) with smaller fat globules (3μm) than that for cow milk (D'Urso *et al*., 2008). The total amount of minerals in camel milk ranges between 0.60 to 0.90%. It is rich in chloride and phosphorous, but low in calcium content as compared to that of bovine milk (Konuspayeva *et al*., 2009).

Kappeler *et al.* (2006) indicated that new recombinant camel chymosin has higher clotting activity and lower general proteolytic activity for camel milk. Moreover, Lucey *et al.* (2003) indicated lower proteolysis, higher hardness and chewiness, and less bitter values of cheddar cheese made from bovine milk using camel chymosin. As revealed by Moynihan *et al.* (2014) although camel chymosin used for production of Mozzarella cheese resulted in lower proteolysis as compared to calf rennet, it resulted in significantly higher melting temperature, higher hardness, lower total off-flavor intensity, less sticky (adhesive), and higher strand thickness and thus extended shelf life.

In Ethiopia, different research efforts have been carried out to understand camel milk cheese making properties. A recent study conducted by Yonas *et al.* (2014) on the effect of camel chymosin in comparison to ginger extract, has shown that this novel enzyme showed higher yield, higher protein and total solid, and better consumer acceptance for camel milk soft unripened cheese. Haileeyesus and Shimelis (2016) in their study on optimization of the production process of soft cheese from camel milk using calf rennet observed better yield and better consumer acceptance using high rennet concentration. Lower gelation time and higher gel firmness was also observed using high level of camel

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chymosin concentration (85 IMCU/L) (Yonas *et al.*, 2016). However, there is still a research gap on the functional and coagulation properties of camel milk proteins, as well as on the fragile and weak coagulum and poor yield of camel milk cheese. Moreover, effect of chymosin concentration and cooking of curd and their interaction on cheese yield, texture, and sensory attributes of cheese made from camel milk were not investigated. The present study was, therefore, conducted to investigate the effect of camel chymosin concentration and cooking on cheese made from camel milk with two specific objectives; to evaluate the effect of camel chymosin concentration levels on coagulation properties of camel milk, and to assess the effect of camel chymosin concentration levels and cooking on chemical composition, yield, texture, and sensory attributes of soft unripened camel milk cheese.

2. Materials and Methods

2.1. Materials

Pooled camel milk (from 10-15 lactating camels) was collected early in the morning from camel rearing pastoralists in Ererr valley, eastern Ethiopia. The milk was delivered to Haramaya University Dairy Technology Laboratory using an ice box after collected by directly milking into sterile stainless steel cans (5 L). Liquid camel Chymosin (Chy-Max® M) (Christian Hansen A/S, Denmark) with an activity of 1000 IMCU/ml was used for coagulation of camel milk. A yoghurt starter culture Yoflex Express® 1.0 which contains *Streptococcus thermophiles* and *Lactobacillus bulgaricus sub spp delbrücki* (Christian Hansen A/S, Denmark) were used for acidification of camel milk. All chemicals used for analysis were analytical grade.

2.2. Measurement of Coagulation Parameters

The coagulation properties of milk were performed using a ReoRox G2 rheometer (Medirox, Sweden). The milk samples were incubated in water bath (Clifton, Nickel-Electro Ltd, England) at 40°C for 30 min. Then 100 ml milk was adjusted to pH 6.2 with 1M HCl while stirring. Camel chymosin concentrations of 40, 70 and 100 IMCU/ L were prepared by ten times dilution from a concentrated enzyme preparation (with final concentration of 0.4, 0.7 and 1μl/ml of milk, respectively). All analyses were conducted in triplicate and complete replication of the experiment was done on each of three separate batches of milk.

2.3 Preparation of Soft Unripened Cheese

The cheese samples were produced from whole camel milk according to Mehaia (2006) with some modification as indicated in Figure 1. Six different cheese samples (with different chymosin concentrations and cooking) were prepared with different treatments arrangements as follows;

Treatment 1: 40 IMCU/L with cooking
Treatment 2: 40 IMCU/L without cooking
Treatment 3: 70 IMCU/L with cooking
Treatment 4: 70 IMCU/L without cooking
Treatment 5: 100 IMCU/L with cooking
Treatment 6: 100 IMCU/L without cooking

The cheese samples were made using cheese vat (FH16-D, Armfield Inc, England). Five liters of camel milk samples were pasteurized at 65℃ for 30 minutes in water bath (Clifton, Nickel-Electro Ltd, England) and 0.2 g/L calcium chloride (BLULUX Ltd, India) was added to each sample. Then after the milk samples were cooled to 40±2℃, and inoculated with starter culture (YoFlex Express®1) for acidification (at a rate 0.06g/L) of the milk samples. Then the milk was thoroughly stirred in order to mix it with ingredients ($CaCl_2$ and starter cultures).Then the enzyme (camel chymosin) was added to the milk samples when their pH reached 6.2 and the milk samples were stirred again to mix the enzyme with the milk. Then the stirrer was stopped and the samples were set and covered until the pH reached 4.8.

The pH was followed by digital pH meter and the temperature with thermometer that was fitted with the cheese vat. At pH of 4.8 the cheese samples were cut into smaller cubes and waited for some healing time (10 min) and then those cheese samples which were made without cooking whey were drained immediately (treatment 2, 4, and 6) and those cheese samples which were made with cooking (treatment 1, 3 and 5) were heated to 55℃ and then the whey was drained off. The drainage of both cooked and uncooked cheese samples was done the same way by scooping the curd using big spoon in to hanging mesh cloth (without pressing) and it was continued for 4 hours at refrigerator temperature (4-5℃).Then the cheese was removed from the drainage cloth and packed, and kept in refrigerator for analysis.

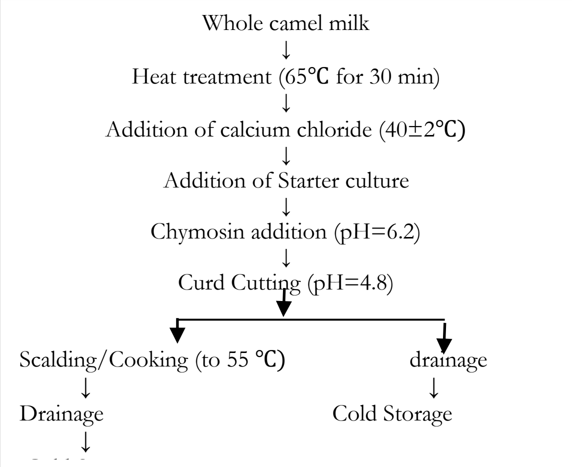

Figure 1. Flow diagram adopted for manufacture of soft unripened cheese from camel milk (Mehaia, 2006).

2.4. Cheese Yield and Physico-Chemical Analysis

The cheese yield was calculated as suggested by Mehaia (2006) and was expressed as g/100 g of milk.

$$\text{Cheese Yield} = \frac{weight\ of\ cheese}{weight\ of\ milk\ sample}$$

The physicochemical properties of raw milk samples used for cheese making were analyzed using milkoscan (Milkoscan™ FT1, Foss, Denmark) whereas the physicochemical properties (pH, titrable acidity, total solids, ash, protein and fat) of soft unripened cheese were analyzed following standard procedures of AOAC (1995). The pH and titrable acidity of the samples were measured on the same day the cheese was manufactured; however, the other parameters were analyzed within 48 hours of manufacture of the cheese.

2.5. Texture Profile Analysis

Texture profile analysis (TPA) of the soft unripened cheese was performed according to Néstor *et al.* (2013) with some modification using a TA.XT. PLUS texture analyzer (Stable Micro Systems, Surrey, UK) with a load cell of 30 kg and a disc-shaped probe (P/25 mm diameter cylinder Aluminum). Textural analyses were performed at room temperature (22-25℃). Prior to analysis the sample was prepared in cylindrical shape with 10mm diameter core borer. The samples were compressed to a single compression to 50% of their original height. The analysis was also performed at a constant test speed of 0.5 mm/s, pre-test speed of 1mm/s and post-test speed of 0.5mm/s. From the force versus time curve hardness (N) (maximum positive force for the first compression) was determined.

2.6. Sensory Evaluation

Sensory quality of the soft cheese was performed by fifteen voluntary panelists who were selected based on the criteria suggested by Hashim (2002): age between 18 and 30 years, and usual consumers of camel milk or fermented camel milk, and cheese from milk of other species. They evaluated acceptability of the cheese based on its color, appearance, aroma, taste, texture and overall acceptability using a 7-point hedonic scale (1 = dislike extremely, 2 = dislike moderately, 3 = dislike slightly, 4 = neither like nor dislike, 5 = like slightly, 6 = like moderately and 7 = like extremely). Sensory terms for taste, aroma and texture of cheeses were introduced to the panelists during training. All samples of similar amount were served to the panels together with water so that panels rinse their mouth between each sample. All cheese samples were presented at the same time in each session. The samples were tested at room temperature (22-25℃). Sensory evaluation of samples in each analysis was carried out twice. Each batch of cheeses was coded with three digit numbers and the samples were presented in a randomized order (Seon-Suk *et al.*, 2012).

2.7 Experimental Design for Milk Coagulation

For milk coagulation experiment, CRD model was used and the experiment was conducted with three replications.

$$yi = \mu + Ci + \varepsilon i,$$

Where: Yi = observation of treatment effect; μ = the overall mean; Ci = the effect of i^{th} chymosin concentration (40, 70, 100 IMCU/L); εij= random error.

Whereas, for Preparation of soft unripened cheese 3x2 factorial with CRD model was used and the experiment was conducted with three replications.

$$Y_{ij} = \mu + C_i + T_j + CT_{ij} + \varepsilon_{ij},$$

Where: Yi = observation of treatment effect; μ = the overall mean; C_i = the effect of i^{th} chymosin concentration (40, 70, 100 IMCU/L); Tj = the effect of cooking (cooking at 55°C and uncooked curd); CT_{ij} = interaction of chymosin concentration and cooking; ε_{ij}= random error

2.8. Statistical Analysis

Data generated from both experiments were analyzed using the General Linear Model (GLM) procedure of SAS software version 9.0. Analysis of variance (ANOVA) was conducted for each set of data. Differences were considered to significant at the level $P<0.05$. Least Significant Difference (LSD) was used for mean separation of significantly different means.

3. Results and Discussion

3.1. Physicochemical Properties of Camel Milk Used for Cheese Making

Whole camel milk used for coagulation experiment had pH 6.65 ± 0.01, titrable acidity 0.14±0.01%, total solids 10.79±0.16, ash 0.81±0.03, fat 2.96±0.03 and protein 2.74±0.21g/100ml whereas, the one used for cheese making had pH 6.61±0.01, titrable acidity 0.13±0.01, total solids 10.65±0.28, ash 0.73±0.02, fat 2.98±0.05, and protein 2.92±0.06g/100ml. These results are in the range of what has been reported by Konuspayeva *et al.* (2009); and Al Haj and Al Kanhal (2010).

3.2. Milk Coagulation Properties

The effect of chymosin concentration on the start of coagulation (tg) of camel milk showed a highly significant difference ($P<0.01$) and shortest gelation time 348 and 433sec were observed with the higher chymosin concentrations of 100 and 70 IMCU/L, respectively than 40 IMCU/L (Fig 2(a)).This means that as the dose of chymosin increases, the time at which milk coagulation starts will be shorter implying that higher chymosin concentration results in the enzymatic reaction being faster and running to a higher degree of ϰ-casein hydrolysis (Lomholt and Qvist, 1997). The present study is in agreement with the report of Yonas *et al.* (2016) that indicated short gelation time (<500 sec) for camel chymosin concentration of 85 IMCU/L at 30°C. Gel firmness is a function of κ-casein proteolysis with initial decrease in viscosity and aggregation of casein resulting in decreased volume fractions of casein micelles, while subsequently entrapment, rearrangement and fusion of casein micelles takes place (Lomholt and Qvist, 1997). In the present study, significantly ($P<0.05$) higher gel firmness (G'max) value was observed for lower camel chymosin concentrations (40 IMCU/L) (Fig 2(b)) but there was no significant difference between 70 and 100IMCU/L as well as between 40 and 100IMCU/L in gel firmness. Similarly, Landfeld *et al.* (2002) found higher G'max (171 pa for 20 ml/l) for lower rennet concentration and lower gel firmness (144 pa for 70 ml/l) for high concentration of rennet for bovine milk.

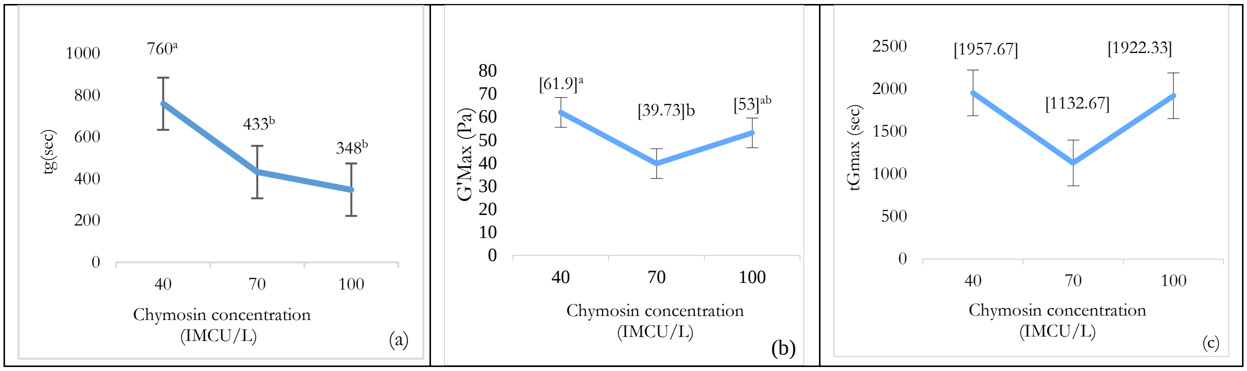

Figure 2. Effect of camel chymosin concentration (a) on the gelation time, (b) on the maximum gel firmness (c) on the time for maximum gel firmness of camel milk. NB: Vertical bars indicate standard errors (SE) of least square means (n = 3). $^{a, b, c}$ Values on the same graph bearing different superscript letters are significantly different ($P<0.01$) for (a) and ($P<0.05$) for (b).

On the other hand, Yonas *et al.* (2016) indicated increased level of gel firmness and ≥50pa at high level of camel chymosin concentration (85 IMCU/L). Studies indicated the effect of coagulants on the kinetics of gel firming is inconsistent. It relates to the amount of caseinomacropeptide (CMP) hairs still to be released after gelation. The percentage of CMP released at the onset of gelation increases with increasing rennet concentration (van Hooydonk and van den Berg, 1988) and it affects the structure of the aggregates and resulting in stronger gel (Lomholt and Qvist, 1997). In the present study, the time needed for maximum gel firmness (tG'max) was dependent of chymosin concentration (Fig 2 (c)) and the shortest time was observed for 70 IMCU/L (1132.67 sec) however, statistically, the result showed non-significant difference

3.3. Cheese Yield and Physicochemical Properties of Cheese

Chymosin concentration and cooking temperature had significant ($P<0.001$) effect on cheese yield (Table 1). The highest cheese yield 12.60g/100ml was obtained with 100IMCU/L uncooked cheese samples. This could be attributed to higher solid recovery and incorporation of more moisture in the curd in uncooked cheese samples which results in the greater amount of cheese (Guo *et al.*, 2004). According to Yun *et al.* (1993) cooking controls the rate of curd syneresis and thus lowers cheese moisture content and higher yield in uncooked cheese samples could be as a result of incorporation of more moisture in the curd. Emmons (1993) indicated that a difference of 1% in the moisture of Cheddar cheese is equivalent to a difference in yield of 1.8%.

Chymosin concentration and cooking had significant ($P<0.001$) effect on pH and titrable acidity (Table 1) and all the uncooked cheese samples showed the highest pH value. According to Fox and McSweeney (2004) cooking reduce the viability of starter cultures as well as its acidification rate (as consequence of thermal stress and moisture reduction) and thus results in higher pH values in the cheese. However, this was not observed in the present study which could be due to the use of thermophilic starter cultures that might have survived the cooking temperature (55℃) and able to produce acids which caused reduction in pH. The titrable acidity had showed inconsistent results in which higher value (0.69%) was observed for 70 IMCU/L uncooked cheese samples. The interaction of chymosin concentration and cooking had significant effect ($P<0.001$) on the total protein content (Table 1) in which the highest total protein content (18.40g/100 ml milk) was obtained at chymosin concentration of 100 IMCU/L with cooking. This could be due to higher chymosin concentration which results in a higher degree of κ-casein hydrolysis and accessibility of κ-casein by chymosin which might explain increased recovery of proteins (Lomholt and Qvist, 1997). When higher concentrations of rennet is added to cheese milk, it is expected that more coagulant will be retained in the curd, which could cause a higher level of proteolysis during ripening and this has been seen for bovine chymosin (Kindstedt *et al*., 1995). This phenomenon was not observed in the present study since the cheese was unripened and camel chymosin has lower level of general proteolysis (Lucey *et al*., 2003). In the present study, chymosin concentration and cooking had no significant ($P<0.01$) effect on the fat content of soft unripened camel milk cheese.

Table 1. The effect of chymosin concentration and cooking on yield and chemical compositions of soft unripened camel milk cheeses.

Cc(IMCU/L) and Cooking	Variables						
	Yield (%)	pH	TA (%)	Fat(g/100g)	Protein (g/100g)	TS (g/100g)	Ash(g/100g)
40 Cooked	9.74 ± 0.30^{c}	4.62 ± 0.04^{d}	0.66 ± 0.35^{ba}	19.75 ± 0.35	14.55 ± 0.35^{c}	40.36 ± 0.67^{cd}	1.98 ± 0.00^{c}
40 Uncooked	10.65 ± 0.07^{c}	4.74 ± 0.07^{a}	0.59 ± 0.00^{c}	18.00 ± 0.00	17.01 ± 0.14^{b}	38.63 ± 0.58^{c}	2.09 ± 0.01^{b}
70 Cooked	9.73 ± 0.03^{b}	4.64 ± 0.03^{c}	0.61 ± 0.00^{c}	18.75 ± 1.06	16.55 ± 0.64^{b}	41.09 ± 0.89^{b}	2.14 ± 0.03^{ba}
70 Uncooked	11.19 ± 0.43^{b}	4.75 ± 0.06^{a}	0.69 ± 0.05^{a}	18.75 ± 0.35	16.43 ± 0.14^{b}	39.99 ± 1.29^{cb}	1.98 ± 0.01^{c}
100 Cooked	11.25 ± 0.35^{b}	4.65 ± 0.01^{b}	0.64 ± 0.01^{bac}	19.25 ± 0.35	18.40 ± 0.28^{a}	42.98 ± 0.23^{a}	2.20 ± 0.03^{a}
100 Uncookd	12.60 ± 0.14^{a}	4.74 ± 0.05^{a}	0.59 ± 0.01^{c}	18.50 ± 0.71	17.05 ± 0.35^{b}	40.28 ± 0.22^{cb}	2.08 ± 0.06^{b}
SL	***	***	*	ns	***	*	***
P<0.05 *,P<0.01 **, and P<0.001 ***							

Note: Values in the same column with different superscripts are significantly different at P < 0.05; each value is the mean of two batch production with six samples analyzed per batch (n=2). Cc = Chymosin concentration. TA = titrable acidity, TS = total solids.

Cooking is used to control the rate of curd syneresis and to lower the moisture content of cheese (Turner *et al*., 1983). In the present study the effect of chymosin concentration and cooking showed a significant ($P<0.05$) effect on the total solid in that the highest value (42.98%) was obtained at chymosin concentration of 100 IMCU/L together with cooking. This could be due to lower level of moisture for cooked cheese. The higher chymosin concentration can also results in faster enzymatic reaction and lower CMP on the surface of the micelle, and which might affect the structure of the aggregates and the resulting gel (Lomholt and Qvist, 1997). Inorganic matter of cheese samples were highly affected by the interaction of chymosin concentration and cooking. The highest ash content (2.20gm/100ml) was observed for highest chymosin concentration (100 IMCU/L) cooked cheese samples. Strong curd due to high chymosin concentration and reduced moisture content due to cooking might have minimized loss of minerals in to whey during drainage.

3.4. Hardness of Soft Unripened Camel Milk Cheese

Hardness is defined as the high resistance to deformation by applied stress (force). In the present study, chymosin concentration along with cooking had highly significant ($P<0.001$) effect on the hardness of soft unripened camel milk cheese. The highest hardness value (6.89N) was observed for the highest chymosin concentration (100 IMCU/L) and cooked cheese samples (Figure 3). This increase in hardness could be attributed to an increase in the level of intact casein which leads to a compact structure of the curd (Guinee, 2003) as result of partial inactivation of chymosin by cooking temperatures (Fox *et al*., 2000). It could also be related to the lower moisture content and to the higher content of protein and, therefore, of micellar calcium retained in the curd which could make the curd stronger. The decrease in moisture is considered to increase hardness and has been attributed to the extent of swelling of casein sub micelles with the decrease in casein to moisture ratio (Olson, 1982).

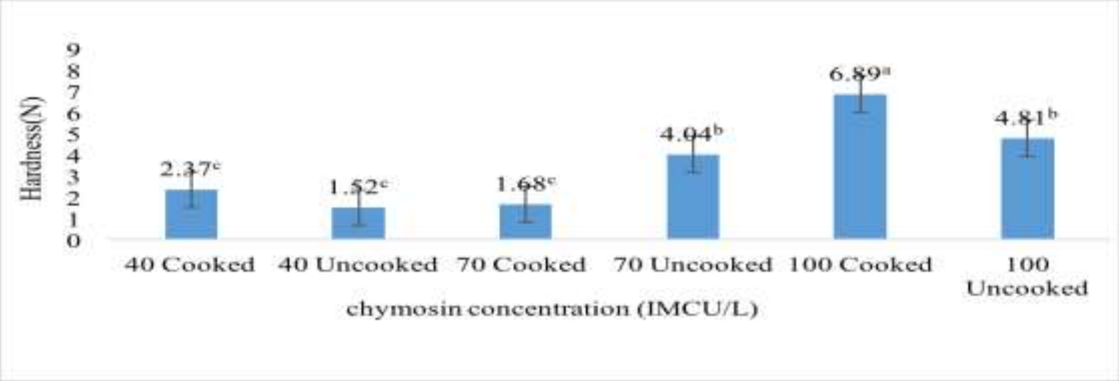

Figure 3. Hardness (N) value of soft unripened cheese made from Camel milk as affected by chymosin concentration and cooking. NB: Vertical bars indicate standard errors (SE) of least square means (n = 2). $^{a, b, c}$ Values in the graph bearing different superscript letters are significantly different at $P<0.001$.

3.5. Sensory Attributes of Soft Unripened Cheese Made from Camel Milk

Chymosin concentration and cooking had significant ($P<0.001$) effect on the sensory attributes (color, taste, aroma, texture and appearance) of cheese made from camel milk (Table 2). The score for color (5.30) and texture (5.50) was observed for cooked cheese at 40 IMCU/L chymosin concentrations. However, higher score (5.10) for appearance was recorded for both 40 IMCU/L cooked and 70 IMCU/L cooked cheese samples. Delahunty and Drake (2004) reported that appearance of cheese as a function of the interaction between cheese colors and texture which support the result of the present study. Moreover, the 70 IMCU/L cooked cheese had higher score for taste (4.90), aroma (5.80) and overall acceptance (5.40). Watery taste was reported for most samples considered which could be attributed to the absence of salt in the present study. Benkerroum (2010) also observed positive correlation of salt and flavor; as the salted cheese sample has received the highest scores for each attributes of cheese made from camel milk using bovine chymosin.

Table 2. Effect of chymosin concentration and cooking on sensory attributes of soft unripened cheese made from camel milk.

Cc (IMCU/L) and Cooking	Variable					
	Color	Taste	Aroma	Texture	Appearance	Overall Acceptance
40 Cooked	5.80 ± 0.45^{a}	4.70 ± 0.57^{b}	5.60 ± 0.96^{b}	5.50 ± 0.61^{a}	5.10 ± 0.65^{a}	4.80 ± 0.84^{b}
40 Uncooked	5.30 ± 0.45^{c}	4.30 ± 1.30^{c}	5.10 ± 0.89^{c}	4.00 ± 0.35^{e}	4.60 ± 0.89^{c}	4.40 ± 0.65^{c}
70 Cooked	5.50 ± 0.50^{b}	4.90 ± 0.65^{a}	5.80 ± 0.45^{a}	5.20 ± 0.45^{b}	5.10 ± 0.65^{a}	5.40 ± 0.55^{a}
70 Uncooked	5.30 ± 0.76^{c}	4.20 ± 0.57^{d}	4.70 ± 0.45^{d}	4.80 ± 0.76^{c}	5.00 ± 0.79^{b}	4.80 ± 0.91^{b}
100 Cooked	5.00 ± 1.87^{d}	4.00 ± 0.71^{e}	5.10 ± 0.96^{c}	4.00 ± 0.50^{e}	4.00 ± 0.35^{d}	4.20 ± 1.15^{d}
100Uncooked	4.80 ± 0.76^{e}	3.90 ± 1.08^{f}	4.60 ± 0.96^{e}	4.20 ± 0.91^{d}	3.90 ± 1.02^{e}	3.80 ± 1.04^{e}
SL	***	***	***	***	***	***

$P<0.05$ *, $P<0.01$ **, and $P<0.001$ ***

Note: Values in the same column with different superscripts are significantly different at $P < 0.05$; each value is the mean of two batch production with six samples analyzed per batch (n=2). Cc=Chymosin concentration.

4. Conclusions

In this study, it was found that a cheese with better yield, quality, hardness and sensory quality could be obtained from camel milk, and that the main parameters that govern the success of the transformation of the milk into cheese were the concentration of camel chymosin, cooking and their interaction. Even though better gel firmness is observed for 40 IMCU/L, it results in longer gelation time. Similarly, higher yield and quality was observed with high chymosin concentration (100 IMCU/L), but it resulted in lower sensory acceptance and judged stiffly texture and unpleasant taste, and appearance. But the medium chymosin concentration (70 IMCU/L) was resulted in better quality in terms sensory attributes. Cooking had effect on soft cheese made from camel milk and higher total solids, higher TPA hardness and higher acceptance was observed for cooked cheeses. The cheese made from camel milk without cooking had high moisture and high pH values, which could affect quality and safety of the product. Moreover, the resulting cheese had lower sensory quality and lower hardness value than cheese made with cooking. Thus cooking was a very applicable practice in camel milk soft unripened cheese making. Therefore, 70 IMCU/L chymosin concentrations with cooking is recommended to make soft unripened cheese from camel milk.

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