Emir. J. Food Agric. 2014. 26 (4): 354-358
doi: 10.9755/ejfa.v26i4.17277
http://www.ejfa.info/

REGULAR ARTICLE

Some parameters to process camel milk into cheese

Gaukhar Konuspayeva[1,2*], Benedicte Camier[3], Frederic Gaucheron[3] and Bernard Faye[2,4]

[1]Department of Biology and Biotechnology, Al-Farabi Kazakh National University, 71 av. Al-Farabi, 050040 Almaty, Kazakhstan
[2]Al-Kharj FAO Camel Project, Center for Agriculture Project, P. O. Box n°761 Al-Kharj 11942, Saudi Arabia
[3]INRA, UMR Science & Technology of Milk and Egg, 65 rue de Saint Brieuc, 35042 Rennes, France
[4]CIRAD-ES, TA C-Dir/B Campus International de Baillarguet, Cedex, 34398 Montpellier, France

Abstract

Cheese from camel milk was never produced by traditional way. However, Hansen© (Denmark) delivered recently new coagulant agent named “Chy-Max M” containing transgenic camel chymosine. In the present study, impact of calcium, lactation stage and curd acidification were investigated. Camel milk was shared into 6 samples (100g each) submitted to 3 types of treatment (1. calcium chloride solution (500 g/L diluted 1/10 water); 2. powder of calcium phosphate; 3. no calcium) and 2 temperatures (20°C/36°C). Rennet 50 µL/L (Chy-Max) was added in all samples. Milk coagulation was faster at 36°C and renneting pH lower. No difference in clotting time and curd firmness after calcium addition was observed. The curd firmness at 36°C was stronger than at 20°C. For measuring impact of lactation stage, coagulation capacity and curd yield on milk was tested in milk provided by one camel from 12th to 25th day postpartum. Milk was coagulated by Chy-Max (50 µL/L/20°C). No coagulation was observed in the first days of experiment. Then curd start to be formed, but with low yield. The curd was correct and ready to use for cheese making only from the 20th day post-partum. Acidification of camel cheese curd without starters was measured at 20°C and 36°C during 10 hours. Milk pH and curd pH were measured during all cheese processing. At the beginning, milk pH was 6.38 whatever the temperature. Acidification was faster at 36°C than at 20°C. At the time of coagulation, pH of 20°C curd was 5.80 vs 5.08 at 36°C.

Key words: Camel Cheese, Fermentation, Calcium, Lactation stage

Introduction

In the world, camel milk is better known for its fermented products: *shubat* – in Kazakhstan; *chal* – in Turkmenistan; *khoormog* – in Mongolia; *gariss* – in Sudan; *suusac* – in Kenya, *zrig* -in Mauritania, rather than for its types of cheeses: *chuku* – in Niger or *caravan* – in Mauritania, fresh camel cheese – in Morocco (Bengoumi et al., 2002; Konuspayeva and Faye, 2010; Benkerroum et al., 2011). In the literature, there are some data on the use of bovine rennet, or rennet agent coming from vegetal sources for camel cheese making (Ramet, 1989; Boudjenah-Haroun et al., 2011; Boudjenah-Haroun et al., 2012; Ahmed and El Zubeir, 2011). Regarding bovine rennet, a lot of parameters (rennet quantity, time of coagulation, curd description, pH value) for technological production of cheese from camel milk were studied by Ramet (1985).

However, Hansen™ (Denmark) delivered recently new coagulant agent named “Chy-Max M” containing camel chymosine (Sorensen et al., 2011). With such camel rennet, no data about power and time of coagulation, acidification of curd, impact of physiological and environmental factors to coagulation of camel milk, was available. In the present study, impact of calcium and of lactation stage on coagulation to produce cheese, and then curd acidification of coagulated camel milk were investigated.

Material and Methods

Camel milk and early milk were sampled from healthy dromedary camels from Camel and Range Research Center, Al-Jouf, KSA at mid of lactation stage and between 12th to 25th days of lactation respectively. Percentage of fat and total protein was determined by automatic milk analyzer device

Received 26 May 2013; Revised 03 July 2013; Accepted 09 September 2013; Published Online 11 October 2013

*Corresponding Author

Gaukhar Konuspayeva
Camel and Range Research Center, P.O. Box 322, Al-Jouf, Sakaka, Saudi Arabia

Email: konuspayevags@hotmail.fr

(Lactoscan MCC) calibrated for camel milk. The ultrasonic technology used by Lactoscan allowed direct measurement of fat, proteins, lactose and salts. Lactoscan determined also the freezing point of each sample and the quantity of added water. The freezing point was calculated automatically from the components it depends on.

For clotting camel milk, specific liquid chymosin for camel milk – ChyMax M (Hansen©, Denmark) was used. Dose 50 µL/L was added with preliminary dilution 1/20.

Coagulation properties

Camel milk was shared into 6 samples of 100 g each submitted to 3 treatment: (i) calcium chloride solution (500 g/L diluted 1/10 water); (ii) powder of calcium phosphate; and (iii) control with no calcium. Two temperatures 20°C and 36°C were tested. After 30 min of heating or not, 50 µL/L of rennet Chy-Max M (strength 1000 IMCU, international milk coagulating units) was added in all samples. The pH value was measured. Then visual determination of clotting time was done and after 60 min, the curd was cut and filtration through cloth was achieved. The weight of the curd (gross yield) was measured 1h 30 after clotting. Corrected yield was calculated as:

Corrected yield (DM curd=30% and DM whey= 6). Gross yield = [(DM curd- DM whey)/ (30 – 6)], with DM = dry matter.

Impact of lactation period

For measuring impact of lactation stage, coagulation capacity and curd yield on milk was tested in milk provided by one camel from 12th to 27th day *postpartum*. Milk was coagulated by Chy-Max M (50 µL/L/20°C).

Natural acidification of camel cheese curd

The pH value was measured at 20°C and 36°C during 10 hours with Ph-meter Hanna Instruments HI221 pH/mV/ORP

Results

Coagulation properties

Before testing the milk, its gross physico-chemical composition was analyzed (Table 1) and its microbiological status was assessed (total flora and coliforms).

Table 1. Global composition of camel milk (g/100g).

Parameters	Mean and SD
Fat	2.72 ± 0.17
Solid non-fat	9.37 ± 0.12
Protein	2.83 ± 0.04

Milk coagulation was faster at 36°C and pH renneting lower (Table 2). No difference in clotting time and curd firmness between calcium treatments was observed. The curd firmness at 36°C was stronger. The molding was more effective with the curd obtained at 36°C.

The effect of calcium salt quantity was also tested at 36°C (Table 3). There was no effect on type of calcium source and of the dose on the time of coagulation, pH value and on curd yield comparatively to control.

Table 2. Coagulation characteristics as function of type of calcium added.

Parameters	20°C			36°C		
	Control	Ca phosphate (1g/kg)	Ca chloride (0.1mL/kg)	Control	Ca phosphate (1g/kg)	Ca chloride (0.1mL/kg)
pH renneting	6.26 ± 0.05	6.25 ± 0.05	6.25 ± 0.,05	5.78 ± 0.11	5.75 ± 0.11	5.75 ± 0.07
Coagulation time (min)	14 ± 0	14 ± 0	14± 0	6 ± 0	6 ± 0	6 ± 0

Table 3. The dose of different calcium source on coagulation of camel milk at 36°C.

	pH renneting 36°C	Coagulation Time (min)	Yield(g/100g) 1h30after moulding	Dry matter Curd (g/100g)	Corrected yield (g/100g)
Control	6.40	8	14.80	27.46	13.07
Phosphate Ca 2g/L	6.40	8	12.91	31.10	13.45
Phosphate Ca 4 g/L	6.40	8	13.26	31.33	13.97
$CaCl_2$ 0.2mL/L	6.37	8	14.35	28.94	13.65

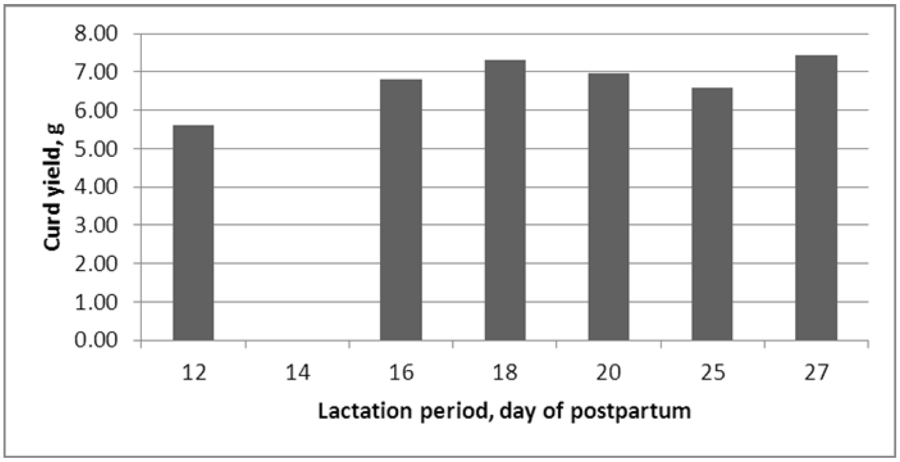

Figure 1. Curd yield according to stage of lactation of camel from 12th *postpartum* day.

Impact of lactation stage on coagulation capacity and curd yield

No coagulation was observed before 12th day of lactation (Figure 1). At 12th *postpartum* day, first coagulation induced the formation of a very weak curd and low yield. At 14th day no coagulation was observed and consequently, and no curd was obtained. Then curd became better, with increase of curd yield. The milk at 25-27th *postpartum* day was acceptable to get curd and was ready to use for cheese making.

Natural acidification of camel cheese curd

At the beginning, milk pH was 6.38 whatever the temperature (Figure 2). Acidification was faster at 36°C. At the end (when coagulation occurred), pH of 20°C milk was 5.80 *vs* 5.08 at 36°C.

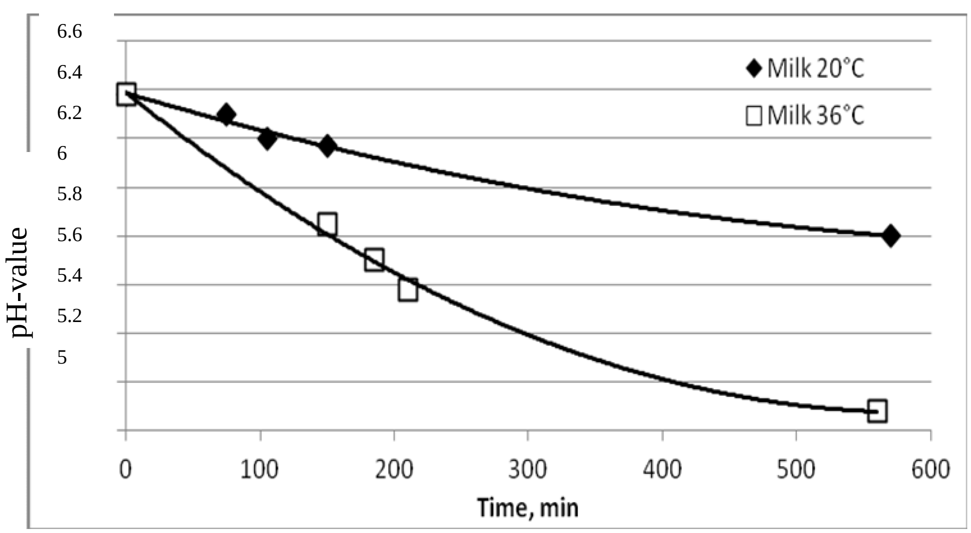

Figure 2. Acidification curves of camel milk at 20°C and 36°C.

Discussion

The physico-chemical composition of camel milk was analyzed before starting the experimentation. The fat and protein contents of our camel milk were in the range of the normal values reported in the literature (Farah, 1993; Konuspayeva et al., 2009).

To transform milk into cheese, the gel obtained after coagulation play important role. For cow milk, calcium ions help to attend this gel stable in all types of milk. Usually calcium phosphate or calcium chloride is used, mainly on milk after heat treatment. It is stated that to get firmness curd of camel milk, 10-15 g of calcium chloride per 100 kg of milk have to be added when bovine rennet is used (Ramet, 1985, Benkerroum et al., 2011). Indeed, in our trial, camel milk was not heated. In such conditions, camel milk showed no effect of adding of calcium ions, whatever the form, phosphate or chloride on clotting time and yield. In all published data, the described trials used heat treated camel milk.

The effect of lactation stage on cheese making is known mainly with cow, goat or ewe milk. With camel milk no data was available in the literature. It is stated that at the first month *post-partum*, the quality of protein in milk undergoes important changes: immunoglobulins and some other whey proteins decreased and proteins from complex casein increased. For cheese making, only casein proteins are of main interest. The optimal time for cheese making will be after 25 days *post-partum*.

In the case of preparation of different types of cheese from camel milk, it is necessary to know the acidification patterns, how many times it takes before attend determined pH value. For coagulation of milk, 3 types of coagulation are described: rennet-coagulation, lactic coagulation and mixed coagulation (Goudedranche et al., 2001). For camel milk, only bovine rennet was tested or extract of young camel stomach (Boudjenah-Haroun et al., 2011). In the literature, no data on coagulation with pure camel rennet is available.

Only one reference using Chymax of Hansen company were used, but it was bovine one (Benkerroum et al., 2011). In our trial, only 50µl was used (Chymax M strength 1000 IMCU) per liter of raw milk instead 170 µl (Chymax–bovine strength 600IMCU) per liter of pasteurized milk by Benkerroum et al. (2011). Also, regarding the type of coagulation, these authors used lactic coagulation for preparing soft cheese from camel milk. Milk acidification in their trial was faster in the presence of *Streptococcus thermophilus* and *Lactobacillus bulgaricus*. The pH value decreased below 5 after 240 minutes in room temperature. In our trial, such decreasing needed more than 500 minutes, because no starter~~s~~ were used and the acidification was natural.

These technological parameters of camel milk processing into cheese by camel rennet represent informative steps for further trials and could be useful for industrial scale cheese processing of camel milk.

Acknowledgment

This study has been achieved within FAO camel project UTF/SAU/021/SAU with the support of Camel and Range Research Center (CRRC). The authors thank Mr. Sallal Issa Al-Mutairi, head of the CRRC for his encouragements and support. We thank also the staff of the camel farm (Mrs. Hassan and Surish) for the monitoring of the camel. Thanks also to FAO team leader at Riyadh, Dr. A. Oihabi and the FAO regional officer, Dr. Bengoumi who supported this project from the beginning.

References

Ahmed, N. A. A. and E. M. El Zubeir. 2011. Effect of salt level on some physical and chemical properties and acceptability of camel milk cheese. J. Camelid Sci. 4:40-48.

Bengoumi, M., A. Kouniba, G. Vias and B. Faye. 2002. Camel milk and traditional cheese in subsaharian Africa. Proc. of workshop Cheese Art. June 4-9, 2002, Raguse, Italy.

Benkerroum, N., M. Dehhaoui, A. El Fayq and R. Tlaiha. 2011. The effect of concentration of chymosin on the yield and sensory properties of camel cheese and on its microbiological quality. Int. J. Dairy Tech. 64(2):232-239.

Boudjenah-Haroun, S., L. Laleye, C. S. Chahra, F. Moulti-Mati, S. Si Ahmed and A. Mati. 2012. Coagulation of camel milk using dromedary gastric enzymes as a substitute of the commercial rennet. Am. J. Food tech. 7(7):409-419.

Boudjenah-Haroun, S., L. Laleye, F. Moulti-Mati, S. Si Ahmed, N. Mahboub, O. E. Siboukeur, and A. Mati. 2011. Comparative study of milk clotting activity of crude gastric enzymes extrated from camels' abomasum at different ages and commercial enzymes (rennet and pepsin) on bovine and camel milk. Emir. J. Food Agric. 23(10):301-310.

Farah, Z. 1993. Composition and characteristics of camel milk. J. Dairy Res. 60:603-626.

Goudedranche, H., B. Camier-Caudron, J. Y. Gassi and P. Schuck. 2002. Procédé de transformation fromagère (partie 1, 2, 3). Techniques de l'ingénieur. F 6 305, Paris.

Konuspayeva, G., B. Faye and G. Loiseau. 2009. The composition of camel milk : A meta-analysis of the literature data. J. Food Compos. Anal. 22:95-101.

Konuspayeva, G. and B. Faye. 2011. Identité, vertus thérapeutiques et allégations santé : les produits laitiers fermentes d'Asie Centrale. Les Cahiers de l'Ocha n°15. Cultures des laits du Monde, pp. 35-145.

Sorensen, J., D. S. Palmer, K. B. Qvist and B. Schiott. 2011. Initial stage of cheese production: A molecular modeling study of bovine and camel chymosin complexed with peptides from the chymosin-sensitive region of kappa-casein. J Agric. Food Chem. 59:5636-5647.

Ramet, J. P. 1985. La technologie des fromages au lait de dromadaire. Rome, Italie, Monographie n° 113, Etude FAO, Production et santé animale, p.118.

Ramet, J. P. 1989. L'aptitude fromagère du lait de dromadaire. Rev. Elev. Med. Vet. Pays Trop. 42(1):105-111.