Chapter 6
Manufacture and Challenges of Camel Milk Cheese

Gaukhar Konuspayeva
Al-Farabi Kazakh National University, Kazakhstan

ABSTRACT

The difficulties in camel milk coagulation due to low concentration in κ-casein was the main obstacle for its processing into cheese. Thus, for 80 years, camel scientists concentrated their efforts on improving coagulation by different methods including use of plant or camel calf abomasum extracts. However, in all cases, poor cheese yield and organoleptic properties were obtained. The recent introduction of the CHY-Max – M1000®, on market solved the problem of clotting. Obtained by genetic engineering, this camel rennet allows high cheese yield. However, other challenges must be met: (1) investigation by fundamental studies of the "behavior" of camel milk during the different steps of cheese processing, (2) to set up final products corresponding to food preferences of local consumers, (3) to ensure transfer of camel cheese technology to camel dairy industry. Based on experiences in different camel countries, the chapter is taking stock of the challenges regarding technological development, cultural satisfaction, and commercialization of camel cheese.

INTRODUCTION

Cow, ewe, goat or buffalo milk was processed into cheese for centuries, or even millennium. At the reverse, despite the popularity of camel milk among pastoralists all over the world, traditional camel cheese has never existed. Camel milk is consumed in raw or fermented form in most of the camel milk producing countries. Especially, fermented milk as *shubat* (Kazakhstan), *khoormog* (Mongolia), *gariss* (Sudan) or *suussac* (Kenya) is the most common form for keeping camel milk beyond a few hours in the absence of a cold chain (see Chapter 3 and 5). Indeed, all along the history, camel milk was not processed into high variable dairy products in comparison to the milk from other dairy species (Faye & Konuspayeva, 2012).

The physio-chemical properties of camel milk make it difficult to coagulate, especially if bovine rennet is used as it has been done with the first trials (Ramet, 1989). Therefore, this difficulty to get a clot led researchers to focus their investigations first in order to find a technological solution, then in a

DOI: 10.4018/978-1-7998-1604-1.ch006

Table 1. Proportion of casein fractions in milk from different species

Species	κ-casein	α_{S1}-casein	α_{S2}-casein	β-casein	References
Bactrian	3.1 ± 1.9	36.1 ± 2.3	7.1 ± 1.5	53.7 ± 2.1	Ryskaliyeva, Henry., Miranda, Faye, Konuspayeva & Martin et al., 2018
Dromedary	3.6 ± 2.1	37.4 ± 3.9	5.8 ± 1.0	53.2 ± 3.5	Ryskaliyeva et al., 2018
Cow	15	40	5	40	McMahon & Brown, 1984
Goat	13	38	11	38	Boulanger, Grosclaude & Mahé, 1984
Ewe	9.1 – 10.8	33.9 – 39.9	12 – 16.4	37 – 42.3	Moatsou, Samolada, Katsabeki & Anifantakis, 2004
Buffalo	10.6	22.8	13.0	53.6	Feligini, Bonizzi, Buffoni, Consenza & Ramunno., 2009

second step, to understand the behavior of the matrix "camel milk" and its evolution under the effect of different starters. However, recent advances were obtained in camel cheese processing in different parts of the world. These recent and significant advances are presented in the present chapter.

Why Camel Milk Does Not Coagulate Traditionally?

Milk clotting is caused by the enzymatic hydrolysis of the protein bonds within the casein micelles causing aggregation of these micelles, then lead to the formation of curd. However, although the types of casein fractions in camel milk is comparable to that of cow's milk (see Chapter 2), the proportions of the different caseins are not similar (Table 1).

The low concentration of κ-casein in camel milk should be the main explanation (3-4% only against 13-15% in cow's milk according to Kappeler, Farah and Puhan, (2003) of its clotting difficulties (see Chapter 2). In addition, bovine chymosin (the main enzyme of the rennet) used in the dairy industry does not allow the optimal clotting of casein micelles of camel milk, leading to a weak curd for a similar time than for bovine milk (also see Chapter 10). Indeed, bovine rennet is cutting camel caseins at different locations than for cow milk leading to a slow reaction of the casein micelles bounds to constitute a clot.

THE FIRST CHALLENGE: GETTING FIRM COAGULUM

The difficulties to get a firm coagulum explain why most of the researches regarding camel cheese making was focused on the clotting step. The first tests achieved in the laboratory used bovine rennet with similar concentrations than that used for cow milk (Farah & Bachmann, 1987). The obtained coagulum was a precipitate in the form of flocks without clot. Moreover, the coagulation time for camel milk was 2-3 times longer than for cow milk and such difference persisted whatever the decreasing pH, increasing temperature or added calcium. The first large-scale work on the cheese-making capacity of camel milk was performed by J.P. Ramet, Professor at ENSAIA-Nancy (Ramet, 1989). To improve the coagulation of camel milk, this author used 3 components: (i) rennet extracted from cow-calf stomach, (ii) a coagulant preparation resulting from a mold classically used in the dairy industry *Rhizomucor miehei*, and (iii) chloride and calcium phosphate. But the amount of the rennet had to be 4 times more important than for the same amount of cow's milk, and the coagulum obtained was fragile and brittle