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Review

Composition and characteristics of Chinese Bactrian camel milk

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ABSTRACT

A comprehensive review on Chinese Bactrian camel milk composition, properties, nutrition value was provided. The review indicated that the mean values of Bactrian camel milk composition were as follows: protein, 3.96%; lactose, 4.50%; fat, 5.32; ash, 0.83%; total solids, 14.52%. The all essential nutrient for humans needed was found in Bactrian camel milk as well as in bovine milk. The α-lactalbumin was the main component and lack β-lactoglobulin in Bactrian camel whey. The pH, acidity (%), density, viscosity (mPa s) and electrical conductivity (μS/cm) of fresh Bactrian camel regular milk ranged from 6.31 to 6.57, 0.17% to 0.20%, 1.028 to 1.040, 6.79 to 7.16 and 0.380 to 0.547 × 10^4, respectively. The composition of proteins in camel milk was different from the bovine milk in some aspects. Meanwhile, fresh and fermented camel milk were found to provide various potential health benefits on adjunctive therapeutic of type-II diabetes, improving the chornic renal failure, promoting the recovery of the chronic hepatitis B patients, inhibitions of inflammatory and inhibiting the growth of tumor.

1. Introduction

The total population of Bactrian camels in China was estimated to be about 316 thousands (China Statistical Yearbook, 2013), prevalently domesticated in desert and semi-desert areas of northwestern China, including Inner Mongolia, Xinjiang, Qinghai, Gansu, Ningxia and other provinces, and they were mainly used for working and wool production (Dong, 1979; Zhang et al., 2005). Xinjiang, Alxa and Sonid Bactrian camel have been described as three fine breeds of *Camelus bactrianus* in China according to their geographic distribution (Bai et al., 2009).

The current unofficial data in the literature on Chinese Bactrian camel milk production was scarce and was mainly based on estimated value of particular research. An Alxa Bactrian camel was reported to produce 0.25–1.5 kg milk daily in addition to the amount taken by the calf (Zhang et al., 2005). Park and Haenlein (2006) reported that Chinese Bactrian camel may yield 1.7–5.0 kg milk per day and 514–1525 kg milk (calculated yield per 305 day) per lactation. Although, some animals could give as much as 15–20 kg per day, only about 2 kg was milked, the rest was suckled by the calf (Dong, 1979). The milk production was inconsistent which could be explain by the factors. Camels were known to be occupy the arid and desert countries, these pastoralist areas and conditions made it difficult to estimate camel milk production. On the other hand, the

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forage quantity and quality, watering frequency, climate, breeding age, milking frequency, calf nursing, milking method and health which all affected the milk production (Yagil, 1982; Bekele et al., 2002; Alhadrami, 2003).

The highest milk yield was observed in the third month (Zhang et al., 2005) or between the third and fourth month of lactation for the Chinese Bactrian camel (Zhao, 1994). In general, milk yield of Bactrians was lower than that of Dromedaries and belonged to low milk yield category according to the literature (Alhadrami, 2003). Unlike other milk producing animals, the camel can thrive under extreme hostile conditions of hot, drought and lack of pastures and still have the capability to produce more milk because of the longer lactation periods (Yagil and Etzion, 1980; Al haj and Al Kanhal, 2010; Farah et al., 2007; FAO, 2006). Therefore, it was reasonable to believe that the Chinese Bactrian camel had the ability to produce more milk than that of bovine in the hot regions and arid countries. The Chinese Bactrian camel milk can be used to make various dairy products such as butter, shubat, cheese, milk tea, camel milk face mask and camel milk soap, which all successfully be produced (Bai et al., 2009; He et al., 2012; Chen, 2013; Cui, 2013).

Compared with the Dromedary camel and the bovine milk, the Bactrian camel milk had not been given as much attention in research because of the lower yield, especially for Chinese Bactrian camel milk. It was noting that the investigations on the Chinese Bactrian camel milk were performed in recent years, the all essential nutrient found in it as well as in bovine milk (Si et al., 1993; Zhang et al., 2005; Bai et al., 2009; Guo, 2009; Wang et al., 2011), and it played an important role in human nutrition for inhabitants in arid and semiarid areas in China. The some potential health benefits were also observed for Chinese Bactrian camel milk (Pan et al., 2010; Wang et al., 2009a,b; Saltanat et al., 2009; He et al., 2011).

The aim of this paper was to review the currently available information on Chinese Bactrian camel milk properties, composition, nutritive value, and functionality.

2. Chinese Bactrian camel milk properties

2.1. Colostrum

The colostrum was produced for the first 7d of lactation, after which the secretion were considered regular milk (Gorban and Izzeldin, 1997). The titratable acidity (%) and pH of Chinese Bactrian camel colostrum ranged from 0.18 to 0.24% and 6.31 to 6.53, respectively (Bai et al., 2009), which were similar to that of Dromedary camel colostrum (Elagamy, 1994; Gorban and Izzeldin, 1997). The titratable acidity (%) of Chinese Bactrian camel colostrum was slight lower than that of Kazakhstan Dromedary camel milk (Konuspayeva et al., 2010). The highest density of Chinese Bactrian camel colostrum was 1.055 for the first milking, which was consistent with the Dromedary camel milk (1.05) reported by Elagamy (1994), as lactation progressed from 1d to 7d post partum the density ranged from 1.034 to 1.037, which was slight lower than that of Kazakhstan Dromedary camel milk (Konuspayeva et al., 2010). The highest viscosity of Chinese Bactrian camel colostrum obtained from the first milking was 24.66 mPa s, as lactation progressed from 1d to 7d post partum the viscosity of milk ranged from 7.52 to 8.27 mPa s (Zhao, 2006). The electrical conductivity of Chinese Bactrian camel colostrum ranged from 0.380 to 0.450 $\times 10^4$ μS/cm (Zhao, 2006).

2.2. Regular milk

The pH of fresh Chinese Bactrian camel milk ranged from 6.30 to 6.57, and the mean values and standard deviation was 6.40 ± 0.11, which was slight lower than that of Dromedary camel milk (6.60 ± 0.11) as shown in Table 1. The titratable acidity (%) of Chinese Bactrian camel milk ranged from 0.17% to 0.20%, and the mean values and standard deviation was 0.18 ± 0.01, which slightly higher than that of Dromedary camel milk (0.15 ± 0.01) as shown in Table 1. The density of milk ranged from 1.028 to 1.040, which was consistent with that of Dromedary camel milk (Wangoh, 1997; Farah, 1993; Shamsia, 2009) and slight higher than that of Kazakhstan Dromedary camel milk (1.015) reported by Khaskheli et al. (2005). The viscosity and electrical conductivity of milk ranged from 6.79 to 7.16 mPa s and 0.380 to 0.547 $\times 10^4$ μS/cm for Bactrian camel milk (Zhao, 2006; Bai et al., 2009).

The ethanol stability of Chinese Bactrian camel milk was 75% and slightly lower than that of bovine milk (Zhao et al., 2010). The fresh Chinese Bactrian camel milk exhibited a pronounced maximum buffering at approximately pH4.4 and the value of dB/dpH was about 0.073 (Bai and Zhao, 2015). Elagamy (1983) reported that the maximum buffer index of Egyptian Dromedary camel milk between 0.060 and 0.062 at pH 5.2. According to the literature, the maximum buffering index for camel milk higher than that of bovine (0.034), buffalo (0.043), sheep (0.049), and goat milk (0.042) (Mehaia, 1974). The higher buffering capacity of fresh camel milk than that of bovine milk, which contribute to the camel milk had the potential therapeutic properties for the patients with gastric ulcer.

3. Milk composition

The detailed information about the composition of camel milk was mostly focus on the Dromedary camel milk and showed a wide variation. The detailed information about the composition was not available regarding the Chinese Bactrian camel milk, except for the particular literatures.

3.1. Colostrum composition

The lactose content ranged from 4.38 to 4.59% (Zhang et al., 2005; Ji et al., 2007; Zhao, 1994) for Chinese Bactrian camel colostrum and remained relatively stable from the first milking. The fat content of Chinese Bactrian camel colostrum for the first milking were 0.27, 0.28 and 0.35% (Zhang et al., 2005; Ji et al., 2007; Zhao, 1994), and progressively increased to its average levels during the first week, which was also found in Kazakhstan Bactrian camel (0.20%), Dromedary camel (Breed, Majaheem) (0.20%) and Israeli camel (Sestuzheva, 1958; Abu-Lehia et al., 1989; Merin et al., 2001, 1998). The contents of protein and total