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Lokesh Tak
Department of Livestock Products Technology, College of Veterinary and Animal Science, Rajasthan University of Veterinary and Animal Sciences, Bikaner, Rajasthan, India

Basant Bais
Department of Livestock Products Technology, College of Veterinary and Animal Science, Rajasthan University of Veterinary and Animal Sciences, Bikaner, Rajasthan, India

Sanjay Singh
Department of Livestock Products Technology, College of Veterinary and Animal Science, Rajasthan University of Veterinary and Animal Sciences, Bikaner, Rajasthan, India

Neha Saini
Department of Veterinary Public Health, U.P Pandit Deen Dayal Upadhyaya Pashu Chikitsa Vigyan Vishwavidyalaya Evam Go-Anusandhan Sansthan, Mathura, Uttar Pradesh, India

Parma Ram Gorachiya
Department of Livestock Products Technology, College of Veterinary and Animal Science, Rajasthan University of Veterinary and Animal Sciences, Bikaner, Rajasthan, India

Durga Devi
Department of Livestock Products Technology, College of Veterinary and Animal Science, Rajasthan University of Veterinary and Animal Sciences, Bikaner, Rajasthan, India

Correspondence
Lokesh Tak
Department of Livestock Products Technology, College of Veterinary and Animal Science, Rajasthan University of Veterinary and Animal Sciences, Bikaner, Rajasthan, India

Studies on the physico-chemical properties and accessibility of camel milk using lactobacillus fermentum and phoenix dactylifera

Lokesh Tak, Basant Bais, Sanjay Singh, Neha Saini, Parma Ram Gorachiya and Durga Devi

Abstract
Milk products are greatest blessing for new born mammals and human as it serve as an almost complete food with full of nutrients. Milk fermentation by proteolytic lactic acid bacteria (LAB) is one of the economical and practical methods for the production of fermented dairy products enriched in bioactive peptides. In the present study, Camel milk is used to produce a fermented milk product with the help of *Lactobacillus fermentum*, which is a lactic acid bacteria (LAB). The present study focused on enrichment of dietary fibre in milk product as milk alone is deficient of dietary fibre. For this, Date Palm (*Phoenix dactylifera*) syrup is used due to natural antioxidative agents of Date Palm.

Keywords: Camel milk, fermentation, functional food, lactic acid bacteria, yoghurt

Introduction
Camels live in the vast pastoral areas in Africa and Asia and divided into two different species belonging to the genus Camelus. Dromedary camels (*Camelus dromedaries*; one humped) that mainly live in the desert areas (arid), and Bactrian camel (*Camelus bactrianus*; two-humped) which prefer living in the cooler areas. There are reports on its antibacterial and other therapeutic properties, fresh and fermented camel milk is an important nutritional and functional source. Normal camel milk has a very white colour and is foamy. The one-humped camels (*Camelus dromedarius*) are well-known producers of milk which differs from bovine milk in the composition and structure of its protein content and thus has different functional and medicinal properties. Caseins (CNs) are the major proteins in camel milk, and α-, β- and κ-CN constitutes about 65, 21 and 3.47% respectively, of total caseins (Kappeler *et al.* 2003) [7]. Camel milk shows similarity to human milk as it contains a high amount of β-CN; this could reflect its higher digestibility and lower incidence of allergy in infants, as β-CN is more sensitive to peptic hydrolysis than α-CN (El-Agamy *et al.* 2009) [5]. Camel milk α-lactalbumin was reported to have a molecular weight of 14.6 kDa having 123 residues, which is similar to that of bovine, human and goat milk (Beg *et al.* 1985) [3].
Increased public consciousness of diet related health issues has resulted in a consumer's orientation towards healthy foods. Numerous scientific studies have confirmed that many chronic diseases including osteoporosis, cancer, coronary heart diseases and hypertension are linked to unbalanced diet. Furthermore, some reported that milk and other dairy products have long been recognized as a significant component of a balanced diet.
Lactobacillus fermentum belongs to the genus *Lactobacillus*. Species in this genus are used for a wide variety of applications; these applications include food and feed fermentation. It has been found that some strains for *Lactobacillus fermentum* have natural resistance to certain antibiotics and chemotherapeutics. They are considered potential vectors of antibiotic resistance genes from the environment to humans or animals to humans.
Phoenix dactylifera, commonly known as date or date palm, is a flowering plant species in the palm family, Arecaceae, cultivated for its edible sweet fruit. The species is widely cultivated and is naturalized in many tropical and subtropical regions worldwide. Dates provide a wide range of essential nutrients, and are a very good source of dietary potassium. The high fibre content of the date fruit prevents LDL cholesterol absorption in the gut. Additionally, the fibre works as a bulk laxative. They contain health benefiting flavonoid polyphenolic antioxidants known as tannins. They are moderate sources of vitamin-A (contains 149 IU per 100 g), which

is known to have antioxidant properties and essential for vision. Additionally, it is also required maintaining healthy mucus membranes and skin. Consumption of natural fruits rich in vitamin A is known to help protect from lung and oral cavity cancers. They compose antioxidant flavonoids such as ß-carotene, lutein, and zea-xanthin. These antioxidants found to have the ability to protect cells and other structures in the body from harmful effects of oxygen-free radicals. Thus, eating dates found to offer some protection from colon, prostate, breast, endometrial, lung, and pancreatic cancers.
Limited studies have been done on camel milk proteins and their milk products as sources of bioactive peptides. Keeping in view the aforesaid facts, the present investigation has been planned to make a balanced fermented product using *Lactobacillus fermentum* for promote health benefits.

Material and methods

About 2 liter of fresh camel milk was collected from camel dairy maintained at ICAR-NRC on Camel, Bikaner at weekly interval for period of 2 months to perform the different experiments as mentioned under the study.

Determination of Physico-chemical Properties of Camel Milk

To determine the physico-chemical properties of camel milk, about 10 ml of milk samples from fresh camel milk were collected and were analyzed for pH, SNF, fat, specific gravity, water content, protein, lactose, freezing point depression, salts and conductivity using Milkoscan at camel milk research laboratory, ICAR-NRC on Camel, Bikaner.

Production of fermented camel milk product (yoghurt)

The following experiment done with these sub steps:

Preparation of Date Palm (*Phoenix dactylifera*) extraction

About, 500g of dry dates cleaned and the seeds were removed, then soaked with 1500 ml of warm distilled water overnight, then were good blended with the electrically laboratory blender, Then filtered through very fine sieve (0.5mm), and the extract stored in a refrigerated temperature at 4 °C.

Preparation of Date Syrup dilutions

Date syrup was diluted with distilled water until the total solid been 13-14%, then were taken 5% W/W of yoghurt and placed in the plastic cups for making yoghurt.

Yoghurt Making

The fermented camel milk was taken after 6 hour of fermentation and mixing of sugar and date syrup at a level of 5% W/W of yoghurt take place in a hygienic way. Then the mixture was blended with laboratory blender until all ingredients were dissolved in the fermented camel milk.

Proximate analysis of fermented camel milk yoghurt

Proximate analysis of camel milk product was done according to method described by A.O.A.C. (2000) [1], (Official methods of analysis).

Result and discussion

Physico-chemical properties of camel milk

All samples, collected manually in sterile bottles once per day (usually in the morning), Milk samples were analyzed for pH, SNF, fat, specific gravity, water content, protein, lactose, freezing point depression, salts and conductivity by using Milkoscan at camel milk research laboratory, ICAR-NRC on Camel, Bikaner.
The physico-chemical properties of fresh camel milk (from 10 camels) are shown in Table 1. In general the present study showed a wide variation in the gross composition of camel milk. The results obtained for camel milk were in agreement with studies of Ahmed (1990) [2], Lapsson (1990) [9] and Khaskheli *et al.* (2005) [8]. This variation was concluded to be partly due to the inherited capabilities of the animals and/or attributed due to various seasonal and environmental factors as well as stage of lactation, age and number of calving. In addition, the feed and water quality and quantity available to the animals also play an important role (FAO, 1982) [6].

Table 1: Physico-chemical properties of camel milk

Physico-chemical Property	Camel milk (Mean ± SE)
Fat (%)	3.63±0.080
SNF (%)	7.16±0.120
Density	1.025±0.230
Protein (%)	2.430±0.050
Lactose (%)	3.92±0.050
Water (%)	13.22±1.250
Salts (%)	0.80±0.010
Freezing Point	-0.47±0.008
pH	6.44±0.010
Conductivity	5.28±0.070

Proximate analysis of fermented camel product

Proximate analysis camel milk product was done according to method described by A.O.A.C. (2000) [1], (Official methods of analysis).

Table 2: Proximate analysis (Mean ± SE) of fermented camel milk product

Constituent (%)	Camel milk product (Mean ± SE)
Moisture	84.71±0.07
Dry matter	15.01±0.06
Crude protein	6.93±0.03
Crude fibre	0.95±0.01
Ether extract	4.05±0.02
Total ash	0.75±0.03

Moisture content in camel milk product was higher due to less dry matter content, and higher water percentage in camel milk. The moisture content of the yoghurt was 84.71±0.07 which was almost similar to the camel milk water content. The mean dry matter percentage of camel milk product was 15.01±0.06%. The crude fibre percentage in camel milk yoghurt have average value 0.75±0.03 due to extract of Date Palm (date palm syrup). As milk and milk products does not contain crude fibre, the source of the fibre was date palm syrup which helps to promote the health benefits of the camel milk yoghurt. These findings were in line with result demonstrated by Sulieman *et al.* (2006) [10] and Eissa *et al.* (2010) [4].

Conclusion

The results of the present study illustrate the medicinal properties of camel milk. The yoghurt which is made by fermentation by lactic acid bacteria *Lactobacillus fermentum*, have increased functional properties of camel milk and date palm tends to increase the anti-oxidant nature as well as the dietary fibre in the yoghurt as they were absent in the camel milk alone. So, it may be concluded that fermented camel milk yoghurt, prepared from date palm (*Phoenix dactylifera*)

syrup is acceptable, nutritious and contain various functional properties.

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