Research Article

Compositional and physical properties of camel milk under nomadic and sedentary production systems

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Abstract

Camel is considered as the best animal for arid and semiarid areas where its milk comprises a significant part of the human dietary habit. In the present study, unique composition of camel milk under nomadic and sedentary production system was investigated. Camel milk samples (n=40) were collected from the nomadic (n=20) and sedentary (n=20) production system and analyzed for physical and chemical properties. The observation shows that the solid not fat content (9.36%), lactose content (4.77%), specific gravity (1.030), viscosity (1.72 cP) and pH (6.60) were significantly ($P<0.05$) higher in the camel milk under sedentary production system in comparison to nomadic production system (i.e. solid not fat content 8.96%, lactose content 4.45%, specific gravity 1.028, viscosity 1.60 cP) and pH 6.53). On the other hand, the fat content (3.84%) and mineral content (0.93%) were significantly ($P<0.05$) greater in the camel milk reared under nomadic production system than that of the sedentary production system (fat content 3.68% and mineral content 0.85%). The total solids and protein content were increased in the milk of camel raised under the sedentary system, however, the variation was non-significant ($P>0.05$). It is concluded that the concentrated supplementation in sedentary production system has positive effects on the composition of camel milk. From a compositional point of views, the camel milk under sedentary production is superior over the camel milk under nomadic production system. It is recommended that farmers should provide the concentrate supplement to the camel under nomadic production system.

Keywords: Nomadic; Physicochemical; Production system; Sedentary

Introduction

Pakistan is the rich source of agriculture and livestock. The livestock component contributed 11.11% to the gross domestic product (GDP) and 58.92% to the agriculture during the year 2017-2018. It is the estimated that approximately 8 million

families involved in livestock which is central to the livelihood of the poor families in the country [1]. In livestock, camel (*Camelus dromedarius*) is the potential animal for the arid, mountainous and desert areas of our country and, therefore it plays the major role in the food

security of these areas [2]. Pakistan is on the 8th position in camel raising in the world population 24 million [3]. Camel has the capability to sustain their production under inclement weather. It is the only animal which can retain the lactation and secrete milk with over 90% water content even under dehydration condition [4].

In our country, the camels are raised under three production systems as nomadic, sedentary and transhumant regarding topography, plant phonology, climatic conditions and water availability. The nomadic production system is well known for roaming of camels place to place because of the shortage of water and forages [2]. The sedentary production system is characterized by limited grazing and supplemented with concentrate ration. In this system, women play an important role by converting byproducts into valuable products and sell them in the market. In the transhumant production system, camel migrates on the basis of seasons especially rainfall. In this system animal sometimes migrates in specific places on scheduled periods of the year [5]. There are various factors which influence the composition of camel milk ultimately cause the wide variation which are the calving number, age, management, sampling technique, lactation stage, feeding regime, and season [6]. The present study was designed to evaluate the effect of sedentary and nomadic production system on camel milk composition and physical properties in Sindh, Pakistan.

Materials and methods

Study population

In the present study, two groups were targeted for the collection of camel milk samples (n=40). The first group was located at Tharparkar, Sindh (n=20) where camel herders adapt the nomadic production system and another group was selected at the pre-urban area of district Hyderabad (n=20) where sedentary production system is being practiced. She-

camel of the first group totally depended on the grazing and browsing available plants and agriculture residue that grown naturally (uncultivated) without any supplements. While she-camels of the second group were allowed limited grazing in some time period on the day and provided cultivated grasses and concentrated supplements on the remaining time period of the day.

Analysis of physical and chemical characteristics

The samples (n=40) were collected and brought (under $4\pm1^{\circ}\text{C}$) to department of Animal Products Technology, Shaheed Benazir Bhutto University of Veterinary and Animal Sciences, Sakrand for physicochemical analysis.

Physical properties

The pH, Viscosity, and Specific gravity were determined according to the standard methods [7, 8]. The following equipments, pH meter (Model-1 Hanna Instruments, Italy), Viscometer (Glass, Germany made) and Pycnometer (Glass, Germany made) were used.

Chemical characteristics

The chemical characteristics include lactose, total solid, solid not fat, protein, fat and mineral contents (%) were determined according to the different standard methods [7-9]. Furthermore, procedures are briefly described below;

Lactose, Total Solid and solid not fat contents (%)

Lactose, total solid and solid not fat contents (%) were determined by the difference formula. Lactose content (%) was obtained by deducting the summation of fat, protein and ash percentage from total solid content (%) while total solid content (%) was evaluated by subtracting moisture percentage from 100. Solid not fat (%) was analyzed by subtracting the fat content (%) from total solid content (%) [7, 8].

Protein content (%)

Camel milk sample (5g), copper sulphate (0.2g), sodium sulphate (2.0g) and concentrated sulfuric acid (30ml) were

taken in kjeldahl flask and digested under micro-kjeldahl digester. The digested samples were diluted (with distal water), distilled (with sodium hydroxide 40%) and titrated (with hydrochloric acid 0.1N) according to the method of British Standards Institution [10].

Fat content (%)

Fat content was analyzed according to the Gerber method. 90% sulfuric acid (10ml), camel milk sample (11ml) and amyl alcohol (1ml) were added in the butyrometer and closed tightly with stopper. The butyrometer placed in the Gerber centrifuge machine and centrifuged for 3 min at 1100 rpm [9].

Mineral or ash contents (%)

Camel milk sample (5g) was taken on the crucible dish and dried in the muffle furnace (550°C) for 4±1 hours and then transferred to desiccator for 1 hour and calculation was made according to the method described in Association of Official Analytical Chemistry (AOAC) [8].

Statistical analysis

The computer program (Statistix SXW, Version 8.1 copyright 2005, Analytical software, USA) was used for the analysis of collected data. The analysis of variance (AOV) and least significant difference (LSD) procedure were used to find the variation in between the data of nomadic and sedentary production system.

Results and discussion

Chemical characteristics

The results of the chemical analysis of nomadic and sedentary production system are presented in table 1. The findings of the present study showed that the lactose and solid not fat contents were significantly ($P<0.05$) higher in comparison to the nomadic production

system. The variation might be due to different feeding and management system. Furthermore, in the sedentary production system, she-camels were offered a supplement of concentration that also altered the composition of milk. These results are supported by the findings of [11, 12]. On the other hand, fat and mineral content observed higher under the nomadic production system than the sedentary system. Statistically, the variation was significant ($P<0.05$) between nomadic and sedentary production system. This significant difference because of she-camel in nomadic production system depends totally on grazing without any concentration supplements that enhance the concentration of fatty acid and minerals as plants are the rich source of these. No doubt, Alwan and Zwaik [13] found the wide range variation in the milk components because of management and feeding difference among various production system. Yagil, [4] reported that the water intake of camel different under different production system which affects the feed intake result in the variation of chemical composition.

The total solids and protein contents of camel milk were slightly higher under sedentary than that of the nomadic production system. The statistical analysis shows that the difference was not significant ($P>0.05$) in between nomadic and sedentary production system. These findings are somewhat different than the findings of [6, 12], who found the significant ($P<0.05$) difference in protein and total solid contents, respectively. However, the results are in a positive relationship with the observation of [11] and within range of camel milk composition reported by [14, 15].

Table 1. Chemical composition of camel milk under nomadic and sedentary production systems

Milk Constituents (%)	Production systems		SE±	LSD (0.05)
	Nomadic	Sedentary		
Fat content	3.84 ^a	3.68 ^b	0.0818	0.1656
Protein content	3.58 ^a	3.73 ^a	0.0860	0.1742
Lactose content	4.45 ^b	4.77 ^a	0.0971	0.1967
Mineral content	0.93 ^a	0.85 ^b	0.0296	0.0598
Solid not fat (SNF)	8.96 ^b	9.36 ^a	0.1284	0.2599
Total solid (TS)	12.81 ^a	13.04 ^a	0.1668	0.3376

Values with different superscripts show significant difference

Physical characteristics

The physical properties of camel milk under different production systems are given in table 2. Like to the chemical characteristics, the physical properties are varied under nomadic and sedentary production systems. The specific gravity, viscosity and pH significantly ($P < 0.05$) higher in the camel milk under sedentary production system that of the nomadic production system. Baloch *et al.*, [16] reported that physical properties vary with the feeding, management and climatic

condition. It is of interest to note that the specific gravity and viscosity are directly related to the total solid that's why they increased in the sedentary production system as total solid increased in the camel milk under sedentary production system. The variation in pH of camel milk under two production systems is because of the difference of mineral contents which alter the hydrogen ion concentration. Furthermore, present findings are within the range of [17, 18].

Table 2. Physical characteristics of camel milk under nomadic and sedentary production systems

Physical characteristics	Production systems		SE	LSD
	Nomadic	Sedentary		
Specific Gravity	1.028 ^b	1.030 ^a	0.0003796	0.0007684
Viscosity (cP)	1.60 ^b	1.72 ^a	0.0373	0.0756
pH	6.53 ^b	6.60 ^a	0.0199	0.0403

Values with different superscripts show significant difference

Conclusion

It could be concluded that the production system influence the chemical and physical properties of camel milk. The composition of camel milk was varied in the camel milk of nomadic production than that of the sedentary production system. Sedentary production system showed a positive effect in constituents of camel milk by improving its total solid contents.

Authors' contributions

Conceived and designed the experiments: AK Lund, TA Khokhar, Q Kalwar & AA Khaskheli, Performed the experiments: AK Lund, Analyzed the data: AK Lund, S Kumbhar, AS Mangsi & AA Junejo,

Contributed materials/ analysis/ tools: MM Rahimoon, ZA Khoso & YM Jalbani, Wrote the paper: AK Lund.

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