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Physico–Chemical Characterization of Camel (*Camelus dromedarius*) Milk as Influenced by Parities and Seasons under Pastoral Production System in Katsina State, Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The study was conducted in order to come-up with the various physico–chemical characterization of camel (*Camelus dromedarius*) milk under pastoral production system in Katsina State, Nigeria. It was conducted using twelve (12) lactating camel cows under three different parity levels (1, 3 and 5). The feeding and watering regimes of the camels were the same and all the animals were managed under pastoral production system. The animals for the study were carefully examined before the selection especially for calving and health status. Milk samples collected were studied under the guide of various prescribed methods using local kits available. Results obtained indicated higher values of acidity (0.35%) and specific gravity (1.008%) both under parity five in hot dry season followed by titerable acidity with higher values (0.015g) in parity three under cold dry season. Vitamin C was higher (4.71 mg/100ml) in parity five under wet season respectively. In conclusion, the study also confirmed that camel milk is full of evenly balanced nutritional constituents that plays a variety of roles despite the level of management, feeding and watering regimes.

Keywords: Physico-chemical; camel; milk; Vitamin C; Katsina.

1. INTRODUCTION

"Camel is used for several purposes for which its role is essential especially in the Arid ans semi Arid Lands (ASALs) of the universe. It is used as a beast of burden for transporting goods and people. Among the mammals domesticated by humans for their needs, camel has a peculiar status which include highly adapted to a specific ecosystem (the desert) and it also served as multipurpose animal used for leisure (racing, sport such as polo, tourism, beauty contests, festivals)" Khan and Al–Bukhari (2004). "Camels are reliable milk producers with a long lactation period and they maintain milk production throughout long dry spells when milk from cattle and goats is scarce. The information on the milk off take of camels varies according to the management of camels in their natural environment or under improved condition" (Werney and Yagil, 2019). "Camel milk constitutes an important part of the diet in pastoral societies in arid and semi-arid regions Yagil "(1982). The composition of the various constituents of camel milk varies greatly between breeds, geographical location and parity levels. Geographical location (Temperature, feed and water and relative humidity) and parity would have a significant effect on the constituents Haddadin et al., (2008). Also, Konuspayeva et al., (2009) reported that geographical location and seasonal variations were found to be the most effective factors in camel milk composition. Various researches were conducted on the camel milk constituents across the world but research conducted on the milk of other livestock species is higher (Sahani et al., 1998 and Al–Ani, 2004). Parity influence milk production in virtually all other species of livestock. Milk yield and composition may be a fluctuating effect on the parity level. Quantity and composition of camel milk produced as reported by various authors (Mehaia et al., 1995; Khaskeli et al., 2005; Haddadin et al., 2008; Shuiep et al., 2008 and Omer and Eltinay, 2009) differ significantly. Relatively, lactating camels in the first parity produce lower quantity of milk and it increases as the parity advance. Variations in the various composition of camel milk under pastoral production system will be linked with quality and availability of feed as well as parity differences (Ghude et al., 2016). "Camel sustains its productivity in difficult conditions and comparatively not affected by feed shortage and quality, water deficit and high ambient temperature. With all these challenges, milk production is still guaranteed. However, some factors such as type of feed, age and parity are expected to affect the quantity and composition of camel milk" (Khaskeli et al., 2005). Despite camel is an important domestic animal in the study area; little work has been done on the physico–chemical characterization of camel milk in general. Therefore, this study was designed to assess the physico–chemical constituents of camel milk across the three seasons of the year.

2. MATERIALS AND METHODS

2.1 Experimental Design

The experiment was conducted using 3 x 3 factorial in a completely randomized design (CRD) to evaluate the effect of parities on milk yield and its nutritive value. The age range of the

camels were between 4 to 8 yers. The parities were one (1), three (3) and five (5) and within each parity four camel cows were used and each camel cow serving as replicate. The seasons were Wet (June–October 2019), Cold Dry (November 2019 – February 2020) and Hot Dry (March – May, 2020).

2.2 Study Area

The study was conducted at 3 different locations (Dan Aunai Grazing area in Dutsi Local Government Area, Gana Jigawa in Mash Local Government Area and Shirinya in Mani Local Government Area of Katsina State – Nigeria) respectively.

2.3 Milking Procedure

In all the camel cows selected for the experiment, the calf was allowed to suckle first to elicit the milk let-down reflex. After a few seconds (5–10) the calf is moved aside and the camel cow were milked by two men standing by opposite sides of the animal. As soon the milking started, a container was used to collect the milk. An average 300ml were collected per animal for the analysis. The milking regime adopted were Once Daily Milking (ODM) in the morning.

2.4 Sample Collection and Handling

Samples of milk collected at the point of milking were preserved in flask containing ice pack.

2.5 Laboratory Analysis

Samples of milk collected from 12 lactating camel cows were collected. Camels were grazed on natural grasses and mineral (potash) supplements periodically. Milk samples (300 ml each) were collected in clean and sterilized bottles and kept with ice bag and transported to the laboratory for analysis. Concentration of Acidity, Specific Gravity, Titerable Acidity and Vitamin C were followed and analyzed in accordance with the standard procedures of Association of Official Analytical Chemists (AOAC, 2000) using the local kits available.

2.6 Data Analysis

Records collected were entered into SPSS version 16.0 thereafter imported into the SAS version 9.1 and analyzed. Duncan multiple range test (DMRT) were used to separate the means.

3. RESULTS

Physico–chemical characterization of camel milk as influenced by parity in wet season: Physico-chemical characterization of camel milk as influenced by parity revealed significant ($P<0.05$) difference from the values (0.32%) of Acidity in parity five followed by values (1.007%) of Specific Gravity also in parity five and Titrable Acidity values (0.012) in parity one respectively. However, values (4.71mg/100ml) of Vitamin C were significant ($P<0.05$) in parity three compared to other parities.

Physico–chemical characterization of camel milk as influenced by parity in cold dry season: Physico-chemical characterization of camel milk as influenced by parity indicated that values of Acidity presented were similar in both parities. Specific Gravity across the parities did not show any significant (($P>0.05$) difference while values (0.015g) of Titrable Acidity were significant ($P<0.05$) at parity three respectively. However, higher values (4.66mg/100ml) of vitamin C were significant ($P<0.05$) in parity five.

Physico-chemical characterization of camel milk as influenced by parity in hot dry season: Physico-chemical characterization of camel milk as influenced by parity indicated significant ($P<0.05$) difference from values of Acidity presented in parity five. Specific Gravity had higher values of 1.008% in parity five which showed a significant ($P<0.05$) difference. Parities one and three had values of 0.012 and 0.011% from Titrable Acidity which showed no significant ($P>0.05$) difference. Values (4.64 mg/100ml) of vitamin C were significant ($P<0.05$) in parity five.

Mean physico-chemical characterization of camel milk as influenced by seasons of the year: Physico-chemical characterization of camel milk as influenced by seasons indicated similar values (0.31%) of acidity in wet and cold dry seasons and 0.33% in hot dry season which indicated no significant ($P>0.05$) difference while Specific gravity was higher (1.007%) in hot dry season while values of Titerable Acidity were the same in cold and hot dry seasons respectively. Vitamin C content differ significantly ($P<0.05$) between seasons with hot dry season having the highest values (4.67mg/100ml).

Table 1. Physico-chemical characterization of camel milk as affected by parity in wet season

Parameters	Parities		
	1	3	5
Acidity (%)	0.30[b]	0.30[b]	0.32[a]
Specific Gravity (%)	1.006a[b]	1.003[ab]	1.007[a]
Titerable Acidity (g)	0.011[b]	0.012[a]	0.012[a]
Vitamin C (mg/100ml)	4.52[c]	4.58[b]	4.71[a]

Means with different letters in the same row are significantly different (P<0.05)

Table 2. Physico-chemical characterization of camel milk as affected by parity in cold dry season

Parameters	Parities		
	1	3	5
Acidity (%)	0.30[c]	0.32[a]	0.31[b]
Specific Gravity (%)	1.004	1.005	1.005
Titerable Acidity (g)	0.013	0.015	0.013
Vitamin C (mg/100ml)	4.12[c]	4.23[a]	4.66[b]

Means with different letters in the same row are significantly different (P<0.05)

Table 3. Physico-chemical characterization of camel milk as affected by parity in hot dry season

Parameters	Parities		
	1	3	5
Acidity (%)	0.33[b]	0.32[c]	0.35[a]
Specific Gravity (%)	1.006[b]	1.003[c]	1.008[a]
Titerable Acidity (g)	0.011[b]	0.012[a]	0.012[a]
Vitamin C (mg/100ml)	4.16[c]	4.52[b]	4.64[a]

Means with different letters in the same row are significantly different (P<0.05)

Table 4. Mean values of physico-chemical characterization of camel milk as affected by seasons of the year

Parameters	Seasons		
	Wet	Cold Dry	Hot Dry
Acidity (%)	0.31[b]	0.31[b]	0.33[a]
Specific Gravity (%)	1.005[b]	1.004[c]	1.007[a]
Titerable Acidity (g)	0.012[b]	0.013[a]	0.013[a]
Vitamin C (mg/100ml)	4.27[c]	4.44[b]	4.67[a]

Means with different letters in the same row are significantly different (P<0.05)

4. DISCUSSION

Physico-chemical characterization of camel milk as influenced by parity across the seasons revealed the highest values (0.33%) of Acidity in parity five under hot dry season while parity one and three follows with similar values. The present report agrees with the reports of Brazel et al. (2013) who reported similar values. This study revealed that as parity advances, Acidity in the milk increases which is an indication that milk from older camels are better for medicinal purposes in curing human minor ailments and infections (Agrawal et al. 2005; Agrawal et al. 2007 and Ajamaluddin et al. 2012). In other contributions on Physico-chemical characterization of camel milk, Yagil (1982) declared that young camel and human livings in dry areas are in need of fluids to maintain homeostasis and Thermo-regulation as well as maintaining the level of milk's chemical contents. However, the pastoralists usually rely on camel milk throughout the year and it may contribute up to 50% of their food despite the decrease in quantity during hot dry season and a little deficiency in some chemical constituents. This result is in harmony with the reports of Iqbal, (2001); Mohammed et al., (2004) and Bakheit et

al., (2009). The Specific Gravity of camel milk obtained was higher in parity five under hot dry season followed by parity one (wet and hot dry seasons) respectively. The results obtained were in agreement with studies of Ahmad (2012) and Hassan et al., (2011) who reported similar values in parity three and five with the highest concentration in hot dry season. However, Dell'Orto et al. (2001) presented higher values of Specific Gravity in parity five during cold dry season under farming system. The variation was partly due to the inherited capabilities of the animals and/or 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 according to which, the hydration status of the animal as well as the type of forage eaten would also affect the specific gravity of the milk. This report is in agreement with the reports of FAO, (2011); Hassan et al. (2011); Ahmad (2012) and Kamoun and Jemmali (2012). This indicated that as the animals advanced in age, the level of feed utilization and absorption also increased. Higher values of Titrable Acidity were observed in parity three during cold dry season. These results were in accordance with other investigators (Abu–Lehia, 1989a and Abu–Lehia et al., 1989b) who observed similar percentage of Titrable Acidity in camel cow milk with respect to parity and season of the year. Taha and El–Leboudy (1991) reported that environmental and physiological factors such as diet, stage of lactation, and genetic difference influenced Titrable Acidity. Vitamin C content was higher in parity five across the three seasons. It is well known fact that camel milk is a rich source of vitamin C especially in dry season period which is 3–5 folds greater compared with cow milk. The availability of a relatively fair amount of vitamin C in camel milk is of significant relevance from the nutritional standpoint in the arid areas where fruits and vegetables containing vitamin C are scarce. Camel Milk that has a higher amount of Vitamin C is essential for the production of energy as well as Iron, Calcium, Magnesium and Potassium and it is lower in lactose compared to other animals. However, the high level of Vitamin C in camel milk is well known and documented, especially when compared to cow milk. The result is in agreement with the reports of Farah et al., (2004); Dell'Orto et al., (2001); El-Hatmi et al., (2004) Khan and Al-Bukhari, (2004); Al-Hashem et al. (2005); Stahl et al., (2006); Abdel Rahman et al., (2009); Brazel et al., (2013) and Hessain et al., (2013). Similarly, from the reports of Galili et al. (2000), camel milk is 3 times richer in vitamin C than cow milk. Banerjee (2007) also reported that vitamin C aids Iron in reduced state, which is very important for the body and it is essential for collagen formation.

5. CONCLUSION

Despite the traditional way of managing the camels with respect to feed, water and health-care, the various physico-chemical characterization falls within the normal range reported by various authors. However, the level of vitamin C is averagely more than twice higher than that of cow milk and the availability of vitamin C in camel milk is of significant importance from the nutritional point of view in the arid and semi-arid zones where there is scarcity of fruits and vegetables containing vitamin C.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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