Original Research Article

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

Abstract

The study aimed to characterize the various physico-chemical properties of camel (Camelus dromedarius) milk produced under pastoral systems 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 titratable 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.

Key words: Physico-chemical, Camel, Milk, Vitamin C, Katsina

Introduction

The composition of camel milk constituents varies significantly depending on breed, geographical location, and parity levels. Factors such as temperature, feed and water availability, and relative humidity, along with parity, have a substantial impact on these constituents. Konuspayeva et al. (2009) reported that geographical location and seasonal variations are the

most influential factors affecting camel milk composition Various studies have been conducted on the constituents of camel milk globally. However, research on the milk of other livestock species is more extensive (Sahani et al., 1998; Al-Ani, 2004). Parity influences milk production in virtually all livestock species. Milk yield and composition can fluctuate based on parity levels. Various authors have reported significant differences in the quantity and composition of camel milk (Mehaia et al., 1995; Khaskeli et al., 2005; Haddadin et al., 2008; Shuiep et al., 2008; Omer and Eltinay, 2009. Relatively, lactating camels in the first parity produce lower quantity of milk and it increases as the parity advance. Variations in the composition of camel milk under pastoral production systems are linked to the quality and availability of feed, as well as parity differences (Ghude et al., 2016). Camels sustain their productivity under difficult conditions and are comparatively less affected by feed shortages, water deficits, and high ambient temperatures. Despite these challenges, milk production remains consistent. However, factors such as type of feed, age, and parity are expected to influence the quantity and composition of camel milk (Khaskeli et al., 2005). Although camels are important domestic animals in the study area, little research has been conducted on the physico-chemical characterization of camel milk. Therefore, this study was designed to assess the physico-chemical constituents of camel milk across the three seasons of the year.

Material and methods

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 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), Cold Dry (November–February) and Hot Dry (March – May).

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.

Sample collection and handling

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

Laboratory analysis

Samples of milk collected from 12 lactating camel cows at various stages of lactation 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.

Data analysis

The collected records were entered into SPSS version 16.0 and subsequently imported into SAS version 9.1 for analysis. The Duncan Multiple Range Test (DMRT) was used to separate the means.

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.

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 ($P<0.05$)

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.

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)

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.

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)

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 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)

Discussion

Physico-chemical characterization of camel milk as influenced by parity across the seasons revealed the highest values 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 (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). 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.

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.

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