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Evaluation the Gross Chemical Composition of Camel Milk Collected from Different Regions in Egypt

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ABSTRACT

In this study, the physicochemical characteristics of camel's milk (CM) obtained from different arid and semi-arid regions in Egypt, including Aswan, Luxor, and Shalateen, were investigated. No significant differences were recorded in pH values. Significant differences were recorded in the titratable acidity (%). The milk samples collected from Luxor area had the highest value. Significant differences were recorded in total solids (TS) content between the camel milk samples. The camel milk samples collected from Aswan area have the highest values in fat, protein, and ash content. For the Luxor, Aswan, and Shalateen regions, antioxidant activity (%) and total phenolic compound content were 77.31, 69.14, 73.94%, and 1.48, 1.60, and 1.74 mg/100 g, respectively. In raw camel milk (CM), vitamin C content was recorded at 24.9, 26.03, and 21.92 mg/100g for the Luxor, Aswan, and Shalateen regions, respectively. On the other hand, the results were 13.69, 14.31, and 12.05 for the Luxor, Aswan, and Shalateen regions, respectively, after the pasteurization process. The amounts of K and Na were 1132, 1321, 1217, and 574, 702, and 621 mg/100g for the Luxor, Aswan, and Shalateen regions, respectively.

***Keywords*:** chemical composition; camel milk; physicochemical; characteristics; pasteurization; regions.

INTRODUCTION

Camel's milk has long been regarded as the "desert's white gold" due to its beneficial therapeutic and nutritional characteristics. Camels are members of the Camelidae mammalian family, which belongs to the taxonomic order of Artiodactyla (even-toed ungulates), suborder Tylopoda (pad-footed animals) by Kaurajo *et al.* (2020). Camels are predicted to have a global population of 20 million, with 15 million in Africa and 5 million in Asia. In comparison to other countries, Ethiopia, Niger, Mali, Sudan, Somalia, Saudi Arabia and Kenya have the most camels (FAO, 2014).

Dromedary camels (one hump) can be found in dry and semi-arid regions of Northern and Eastern Africa, as well as Western Asia and Australia Hashim *et al.* (2015). Bactrian camels (two humps) are common in chilly Central Asian regions including East and Northern China, Mongolia, and Southern Russia. The dromedary is thin, long-legged, and short-haired, whereas the Bactrian is stockier, shorter-legged, and has a thicker, longer coat. Both camels have a strong water holding capacity and regulate their body temperature, allowing them to tolerate the harsh circumstances seen in such places. Hashim *et al.* (2015).

Milk is one of the world's most widely produced agricultural products. Lactose, proteins, fat, and minerals are the main components of milk. (FAO, 2012). Camel milk is a key source of milk in arid areas, so it differs from cow milk in various ways (Elkot, 2019). Camel milk proteins have bioactive components of healthier foods, thus expanding market opportunities because it has been demonstrated that fusing milk proteins into other foods can ensure a wide range of functional characteristics (Elkot, 2019). CM is known as the "the white gold of the desert" by certain pastoralists and is at the heart of their culture, existence, and health. Camel milk is distinguished by its opaque white colour and sweet, astringent flavour. It can, however, be salty at times (Alhaj and AlKanhal, 2010). Camel milk composition varies according to geographical region, physiological stage, milk production, feeding conditions, and health status or genetics. The gross composition of camel milk differs from that of other ruminants (Kaskous, 2016).

Daily milk production ranges from 3.5 litres in the desert to 40 litres when thorough treatment is used. Camel milk has a chemical composition of 2.5 to 4.5% protein, 2.9 - 5.5 % fat, 2.9 to 5.8 % lactose, 0.35 to 0.90 % ash, 86.3 - 88.5 % water, and 8.9 - 14.3 % water.% S N F, can be affected by feed and water availability (Hashim *et al*., 2009).

The aim of this study was to evaluating the physicochemical characteristics of camel milk collected from different arid and semi-arid regions in Egypt, including Aswan, Luxor, and Shalateen.

MATERIAL AND METHODS

Material

Fresh camels' milk was collected from three different arid and semi-arid regions (Shallateen, Luxor, and Aswan). Milk samples were immediately stored under refrigerated conditions (4 ^{o}C) until they were transferred to the Laboratory.

Methods:

Chemical analysis:

The samples were mixed and analysed in triplicates

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for total solids (TS), fat, protein, ash, total acidity (as lactic acid), ascorbic acid, and pH (AOAC, 2010). The micro-Kjeldahl method was used to determine total nitrogen content, protein content was obtained by multiplying the percentage of TN by 6.38, fat content was measured by the Gerber method (Kurt *et al*., 1996) and ash by heating a 5g sample in a muffle furnace (Marth, 1978). TS were determined using a drying oven (AOAC, 2010). Titratable acidity was expressed in terms of % lactic acid (Anonymous, 1989). pH was determined by electric pH meter (HANNA HI 2211).Total carbohydrates were calculated by difference, according to Guzman (1999). Sodium and Potassium concentration were determined by flam photometer (JENWAY PFP7). Total volatile free fatty acids Kosikowski, (1982), as ml 0.1 NaOH/10 g beverage. Total phenolic compounds were determined by the Folin-Ciocalteau method following a published procedure (Roy *et al*., 2014). The samples (0.5 ml) were mixed with Folin-Ciocalteau reagent (5 ml, of 1:10 diluted sample with distilled water) for 5 min and aqueous sodium carbonate (4 ml, 1 M) was then added. The absorbance of the reaction mixture was then measured at 765 nm with a UV-Vis spectrophotometer (model – Systronics 2202). Gallic acid was used as standard. The results were expressed as gallic acid equivalents (mg/100gsample). Antioxidant properties were determined according to Li *et al*. (2009). B Complex vitamins were determined according to Batifoulier *et al*., (2005). The concentration of minerals in digested solutions was determined using atomic absorption (Thermo-Tarrell, Ash, Smith-Hieftje (1000) method as recommended by AOAC (2010).

Statistical analysis:

All of experiments were done in triplicates using the Statistical Analysis System and Analysis of Variance (ANOVA). Duncan's test was used to reveal the significant differences at ($P < 0.05$).

RESULTS AND DISCUSSION

Physiochemical properties of camel milk:

Data in Table 1 shows the gross chemical composition of CM samples collected from three regions in Egypt. The obtained results revealed that there were no significant differences in acidity percentage and pH values. The pH values ranged between 6.3-6.42, with the highest grand mean value of pH being 6.54 in the milk samples obtained from Luxor. These results are in agreement with those reported by the Food and Agriculture Organization. The pH value in CM samples ranged between 6.5 and 6.7. FAO (1982). Also, the pH values used in this investigation were similar to those reported by several authors in Egypt, Nasr *et al*. (2013) and Elhosseny *et al*. (2018), with respective values of 6.65, 6.64, 6.6, and 6.6.

The titratable acidity (%) of CM samples varied from 0.17–0.18% as lactic acid. The highest grand mean value of the titratable acidity was determined in the milk that was collected from the Luxor area. These findings were higher than those reported by Shahein (2006).

The fat content ranged from 3.10 to 3.70%, and it was discovered to be proportional to the total solids contents (TS). It should be noted that the protein content of feed, as well as water intake, had a direct impact on the protein quality of milk (FAO, 1982). However, a relatively similar range (2.7 to 3.16%) of protein was observed by Shahein (2006). These results were higher than those reported by Neimat and Salwa (2011) and Khaskheli, *et al*. (2005).

Table 1. Chemical composition, pH and acidity% of the raw camel milk collected from different regions in Egypt.

Parameters	Luxor	Aswan	Shallateen
pH	6.54±0.05^{a}	6.42±0.16^{a}	6.30±0.05^{a}
Acidity (%)	0.18±0.05^{a}	0.18±0.01^{a}	0.17±0.01^{a}
TS (%)	11.62±0.06^{b}	12.43±0.03^{a}	10.54±0.14^{c}
Fat (%)	3.62±0.03^{a}	3.70±0.08^{a}	3.10±0.06^{b}
Protein (%)	2.71±0.06^{b}	3.16±0.03^{a}	2.47±0.08^{c}
Ash (%)	0.64±0.03^{b}	0.70±0.01^{a}	0.64±0.01^{b}
TVFA	1.83 ±0.09^{c}	1.93±0.70^{b}	2.03±0.12^{a}

Average (a, b, c) within the same row with different superscripts differed significantly (P <0.05).

Camel milk samples ranged in ash content from 0.64 to 0.70 percent. The findings are relatively in line with those reported by Khaskheli *et al*. (2005) and Shahien (2006). The findings differed from those reported by Meiloud *et al*. (2011) (1.3%). The higher ash content could be due to the free grazing of camels on bushes or plants established on saline soil.

The data in the same Table (1) showed that TS content was 11.62-12.43 and 10.54% for Luxor, Aswan and Shalateen camel milk samples, respectively. These results were in line with the values reported by Abbas *et al*,. (2013).The findings were consistent with those reported by other researchers (Farag and Kebary, (1992); AlKanhal, (1993); Ahmed (1990) and FAO (1982). The moisture content of CM, which is inversely proportional to TS content, also showed similar oscillations (84 to 93 g per 100 g). One of the explanations they gave was the hot weather, when the cow camel secretes much diluted, low-fat milk. This could be a natural occurrence in which camel young are provided with enough nutritional value and water to allow them to thrive in an arid environment. Second, the amount of water in the feed has an impact on the amount of water in the milk. Table 2 shows minerals and bioactive compounds (antioxidant activity and phenolic compounds contents) of the camel milk samples obtained from different regions in Egypt.

The obtained results showed significant differences between the treatments in antioxidant activity and phenolic compounds. From the same Table (2) showed that antioxidant activity and total phenolic compounds contents were 77.31, 69.14, 73.94% and 1.48,1.60,1.74 mg/100 g for Luxor, Aswan and Shallateen regions, respectively. These findings are in contrast with those reported by Farag *et al*. (2015), who found that the values of antioxidant activity (AOA%) and total phenolic compound content were 88.00% and 7.6 mg/100 g, respectively. The concentrations of K and Na were 1132, 1321, 1217, and 574, 702, and 621 mg/100g for the Luxor, Aswan, and Shallateen regions, respectively.

A great variation in the chemical composition was found in the present research. It becomes clear that the overall milk composition can be influenced by several factors, including feeding strategy, physiological stage, feed and water quality and quantity, seasonal variations, genetics, breed variation (within a species, herd to herd), stage of lactation, and the health status. Konuspayeva *et al*. (2009) reported that the composition of CM differs due to

differences in geographical origin. However, additional elements such as physiological stage, dietary conditions, seasonal or physiological variations must be taken into account, and the camel's genetic or health state are also important.

Table 2. Minerals and bioactive compounds contents of CM samples collected from different regions in Egypt:

Properties	Luxor	Aswan	Shallateen
K	1132±5.21^{c}	1321±7.20^{a}	1217±7.30^{b}
Na	574±9.00^{c}	702±8.00^{a}	621±8.00^{b}
Antioxidant activity (AOA)%:	77.31±1.27^{a}	69.14±1.07^{b}	73.94 ±1.07^{a}
Total phenolic compounds (mg GAE/100 g)	1.48 ±0.06^{b}	1.60±0.12^{ab}	1.74 ±0.14^{a}

Average (a, b, c) within the same row with different superscripts differed significantly (P <0.05).

The obtained results in Figure (1) shows a significant differences between the treatments in vitamin (C) contents, Also, Vitamin C content was recorded at 24.9, 26.03, and 21.92 mg/100g for the Luxor, Aswan, and Shalateen regions, respectively, in raw camel milk. On the other hand, the results were 13.69, 14.31, and 12.05 for the Luxor, Aswan, and Shalateen regions, respectively, after the pasteurization process. The clear decrease in vitamin C content in all the samples may be due to the impact of heat treatment on the vitamin C content; a similar finding was reported by El-Deeb *et al.* (2017).

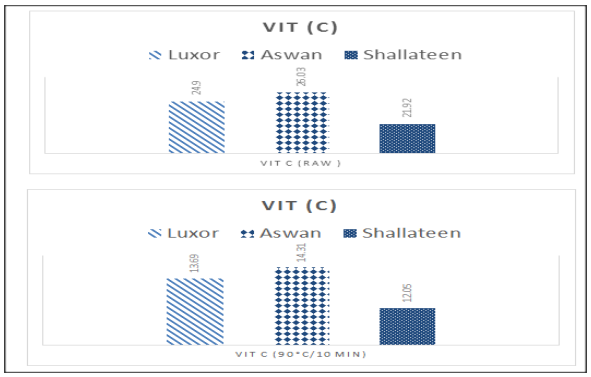

Fig. 1. Impact of pasteurization process on vitamin (C) content of CM samples collected from different regions in Egypt.

CONCLUSION

Camel milk samples which collected from different regions of Egypt had a significant difference in physiochemical composition. Camel milk samples from Aswan had the highest values. Pasteurization process had decreased the vitamin C content.

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تقييم التركيب الكيميائي للبن النوق من مناطق مختلفة في مصر

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هدفت الدراسة إلى تقييم الخصائص الفيزيائية والكيميائية للبن النوق المجمعة من مناطق مختلفة في مصر (الجافة وشبه الجافة) ، بما في ذلك مناطق أسوان والأقصر وشلاتين. لم تسجل فروق معنوية في قيم الرقم الهيدروجيني . وسجلت فروق معنوية في النسبة المئوية للحموضة حيث سجلت عينات اللبن المجمعة من منطقة الأقصر أعلى قيمة. تم تسجيل فروق معنوية في محتوى المواد الصلبة الكلية بين عينات لبن النوق. سجلت عينات لبن النوق المجمعة من منطقة أسوان أعلى القيم في المحتوى من الدهن والبروتين والرماد. سجلت قيم النشاط المضاد للأكسدة (٪) ومحتوى المركبات الفينولية الكلية لعينات لبن النوق المجمع من مناطق الأقصر وأسوان وشلاتين ٧٧,٣١ و ٦٩,١٤ و ٧٣,٩٤٪ و ١,٤٨ و ١,٦٠ و ١,٧٤ مجم / ١٠٠ جم على التوالي. ، تبين من خلال النتائج أن محتوى فيتامين (ج) ٢٤,٩ ، ٢٦,٠٣ ، ٢١,٩٢ ملجم / ١٠٠ جم لعينات اللبن الخام من مناطق الأقصر ، أسوان ، وشلاتين على التوالي. من ناحية أخرى أثرت عملية البسترة على محتوى تلك العينات في محتواها من فيتامين (ج) حيث سجلت النتائج ١٣,٦٩ و ١٤,٣١ و ١٢,٠٥ ملجم/١٠٠ جم لمناطق الأقصر وأسوان وشلاتين على التوالي عقب عملية البسترة. سجل محتوى عينات لبن النوق من عناصر البوتاسيوم والصوديوم ١١٣٢ ، ١٣٢١ ، ١٢١٧ ، ٥٧٤ ، ٧٠٢ ، ٦٢١ ملجم / ١٠٠ جم لمناطق الأقصر ، أسوان ، وشلاتين على التوالي .