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PhD Dissertation Defense

Entitled

*VARIABILITY IN THE PROXIMATE AND PROTEIN COMPOSITION OF CAMEL MILK
(CAMELUS DROMEDARIUS)*

by

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Date & Venue

1:00 PM

Tuesday, 13 April 2021

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Abstract

Dromedary camel milk (*Camelus dromedarius*) has unique physical, nutritional, and technological properties when compared with other milks. Unlike bovine milk, the processing of camel milk into fermented products and its treatment using ultra-high temperatures is technically challenging. Therefore, this research aimed to determine the variability in the proximate composition and the protein composition of camel milk collected from individual animals that are reared under intensive management in the UAE. To determine the proximate composition of samples (n=217) were analysed by NIR and MIR spectroscopy methods. The results obtained by the two methods were also compared. The results of proximate composition showed a wide variation in the concentration of proteins (2.4-4.0%), fats (1.2 -7.3%), lactose (3.0-5.7%) and total solids (9.1 - 15.2%). Excellent positive correlations between the two methods were obtained ($p < 0.001$); for protein ($r \geq 0.96$), fat ($r \geq 0.99$), lactose ($r = 0.82$) and total solids ($r = 0.90$). The mean of the relative difference ((MIR values – NIR values)/0.5 (MIR values + NIR values) \times 100%) were, for protein (+13.4%), fat (+0.9%), lactose (–0.7%) and total solids (–3.4%). The difference between the two methods may be due to the effects of differences in milk homogeneity, especially with respect to casein micelles and fat globules.

Because proteins confer many of the properties of milk and its products, this research aimed to determine the concentrations of camel milk proteins, their correlations, and relative concentration of the caseins. Raw milk samples were collected from individual dromedary camels (n=206) in the morning and evening. Capillary electrophoresis results showed wide variation in the concentrations (g/L) of proteins between samples as follows: α -lactalbumin, 0.3 to 2.9; α S1-casein, 2.4 to 10.3; α S2-casein, 0.3 to 3.9; β -casein, 5.5 to 29.0; κ -casein, 0.1 to 2.4; unknown casein protein 1, 0.0 to 3.4; and unknown casein protein 2, 0.0 to 4.6. The range of percent composition of the 4 caseins were as follows: α S1-, 12.7 to 35.3; α S2-, 1.8 to 20.8; β -, 42.3 to 77.4; and κ -, 0.6 to 17.4. The relative proportion of α S1-, α S2-, β -, and κ -caseins in camel milk averaged (26:4:67:3, wt/wt) which is different from that of bovine milk (38:10:36:12, wt/wt). This difference might explain the dissimilarity between the two milks with respect to technical and nutritional properties.

Dromedary camel milk includes several bioactive whey proteins with potential health effects. This research also aimed to study the variability in the concentrations of several bioactive whey proteins in milk collected from individual Dromedary camels. Milk samples (n=140) were collected from individual camels reared under intensive management. The concentrations of insulin (IN), insulin-like growth factor-I (IGF1), insulin-like growth factor-II (IGF2), lactoferrin (LF), immunoglobulin G (IgG), peptidoglycan recognition protein-1 (PGRP1), lysozyme (LZ), and lactoperoxidase (LPO), were determined using camel-specific quantitative sandwich enzyme linked immuno-sorbent assay (ELISA) kits. The range of concentration of the studied proteins were: IN (17.8-51.1 mIU/L), IGF1 (1.4-736.1 ng/ml), IGF2 (13.7-82.6 ng/ml), LF (639.4–2,094.9 ug/ml), IgG (7.3-17.9 mg/ml), PGRP1 (1.6-22.3 ng/ml), LZ (23.3-71.4 ug/ml), and LPO (7.1-15.5 ng/ml). Significant Pearson correlations ($p < 0.05$) were observed between IN & LZ ($r = 0.759$), IN & IgG ($r = 0.502$), IN & PGRP1 ($r = 0.6702$), LZ & PGRP1 ($r = 0.641$), IgG & LPO ($r = 0.698$) and IgG & PGRP1 ($r = 0.398$). There is a wide variability in the concentrations of the studied bioactive whey proteins in Dromedary camel milk. IGF1 and IGF2 are present in concentrations much higher than reported values in bovine and human milk shedding a light on possible importance in human nutrition.

Keywords: camel milk, proteins, fat, lactose, total solids, NIR, MIR, α -lactalbumin, casein proteins, whey proteins, capillary electrophoresis, ELISA.