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Preliminary investigation of the composition of alpaca (*Vicugna pacos*) milk in California

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ABSTRACT

The objective of this preliminary investigation was to study the composition of alpaca milk. To define the nutritional requirements of growing alpaca crias, information is needed on the composition of the milk from their dams. Information on milk composition will also contribute to the development of milk formula for alpaca crias. However, there is a paucity of data for the composition of alpaca milk in the literature. The aim of this research was to obtain information on the composition of alpaca milk. Milk samples ($n = 168$) were collected from 11 alpacas on two farms. Average milk concentrations were 3.68% for fat, 4.53% for protein, 6.00% for lactose, and 15.05% for total solids. Milk urea nitrogen averaged 31.4 mg/dl of milk. Concentrations of selected minerals ($n = 22$) varied between animals. Concentration of individual milk components, including selected minerals, showed considerable variability. Milk lipids ($n = 11$) had appreciable amounts of fatty acids of 14 carbon chain-length and greater including high amounts of C16:0 (35.04 g/100 g fatty acids), but there were few fatty acids of 12 carbons and less.

1. Introduction

Alpaca (*Vicugna pacos*) crias double their weight in the first 60 d of life when largely dependent on their dam's milk to meet nutritional needs. However, cria nutritional physiology is not well elucidated (Van Saun, 2006). To understand the nutritional requirements of crias it is critical to establish solid data on the nutrient composition of alpaca milk. However, there are limited data on alpaca milk.

Jimenez et al. (1987) reported that alpaca milk contained 4.4% fat and 5.67% protein. More recently, Parraguez et al. (2003) measured the composition of milk from 42 alpacas. Milk from alpacas on the Andean High Planes contained 3.8% fat, 6.9% protein, 4.4% lactose, and 16.8% dry matter while milk from alpacas in Patagonia averaged 2.6% fat, 6.5% protein, 5.2% lactose, and 18.8% dry matter. However, these researchers composited milk samples with three dams per composite so individual animal data were not established.

There are data for other animals of the family Camelidae. Morin et al. (1995) reported that llama milk contained 2.7% fat, 3.4% protein, 6.5% lactose, and 13.1% total solids. Riek and Gerken (2006) followed 11 llama dams over 26 weeks of their lactation. Mean concentrations of milk constituents were 4.70% fat, 4.23% protein, 5.93% lactose, and 15.61% total solids, considerably different from the composition reported earlier (Morin et al., 1995). More data on milk composition exist for camels. Arabian camels (*Camelus dromedaries*) over a 12-month period averaged 2.95% fat, 2.69% protein, 3.92% lactose, and 12.3% total

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solids (Haddadin et al., 2008) with differences is total solids and fat with season. In dromedary camels (Konuspayeva et al., 2010) there were noted effects of lactation stage on milk fat ranging from 4.34% to 7.81% and protein ranging from 2.58% to 3.64% while lactose content was fairly constant (3.46%). Barlowska et al. (2011) summarized the literature for camel milk and reported milk fat averaged 3.80% (range: 2.35–6.67%), protein averaged 3.26% (range: 2.06–5.23%) and lactose averaged 4.30% (range: 2.77–5.85%). The fatty acid (FA) composition of the milk lipids is not well characterized (Haddadin et al., 2008), but approximately 82% of the fatty acid were 16 carbons and greater with 26.6% C16:0, 11.9% C16:1, 16.0% C18:0, 25.0% C18:1, 0.8% C18:2, and 1.5% C18:3. Similar results for dromedary camels were reported (Barlowska et al., 2011) with approximately 81% of the fatty acids 16 carbons and greater. These authors also reported that both bactrian and dromedary camels had low concentrations of fatty acids from C4:0 to C12:0 inclusive.

The aim of this preliminary investigation was to determine the nutrient composition of alpaca milk including the determination of FA and selected minerals.

2. Materials and methods

Lactating alpacas on two farms in California used to collect milk samples.

2.1. Animals

A total of 11 Hhuacaya alpaca dams were studied from early October 2009 through mid-May 2010 at two farms (37°13′47″ N and 119°30′34″ W). Animals were sampled weekly during the first 25-weeks of lactation creating a total of 168 milk samples; first milk samples were taken approximately one week post-partum. Not all animals lactated for 25 weeks; beyond week 20 of lactation the number of animals sampled decreased. Both farms fed a diet consisting of predominately orchard grass hay that was supplemented with concentrate pellets. Water was free choice. Dams were caught individually, and duct tape was placed on the teats to allow the dam and cria to remain together while waiting approximately 2 h to allow for milk let-down. After 2 h the tape was removed, teats cleaned, and the dams were hand milked to obtain approximately 15 ml of milk per animal. Milk was subsampled with a portion frozen for subsequent fatty acid (10 ml) and mineral (0.5 ml) analyses and the remainder was transported fresh to a commercial laboratory for analysis using an infrared milk analyzer.

2.2. Analytical methods

Fresh milk samples were analyzed for fat, protein, lactose, urea nitrogen, and solids using an infrared milk analyzer (Fossomatic 4000/5000, Foss North America, Eden Prairie, Minnesota). The infrared milk analyzer was calibrated for cow milk. Lipids from each animal ($n = 11$) were extracted from the 10 ml of frozen milk for fatty acid analyses according to (DePeters et al., 2001). For mineral analyses, approximately two per animal ($n = 21$), milk samples were lyophilized and analyzed by inductively coupled plasma atomic emission spectroscopy (DePeters et al., 2013).

2.3. Statistical methods

Statistical evaluation involved calculation of means and variation since there were no treatment effects. The data are a preliminary characterization of milk from alpaca in California, U.S.

3. Results and discussion

Alpaca milk averaged 3.68% fat, 4.53% protein, 6.00% lactose, 11.39% solids-not-fat, 31.40 mg/dl urea nitrogen, and 15.05% total solids (Table 1). There was considerable variation for all individual milk constituents. Milk concentration of lactose (Fig. 1), fat (Fig. 2), and protein (Fig. 3) changed little over the lactation period. Urea nitrogen was high compared with cow milk which can contain 12–16 mg/100 ml. While it is known that camelid metabolism differs substantially from metabolism in ruminants, the exact underlying mechanism for elevated urea nitrogen is not known. Camelid metabolism differs from ruminants. Cebra et al. (2006) found consistently high blood glucose levels in adult alpacas. If amino acids are utilized for gluconeogenesis to support the high blood glucose, higher urea nitrogen in plasma (Van Saun, 2006) and milk would be expected although this is not known to be the mechanism.

It is well known that concentrations of certain milk components change during a single milking session. For

Table 1
Gross composition ($n = 168$) of alpaca milk (wet-weight basis).

	Mean	SD[a]	Minimum	Maximum
Lactose (%)	6.00	0.48	4.21	6.86
Fat (%)	3.68	1.32	1.35	9.90
Protein (%)	4.53	0.78	3.30	10.55
Total solids (%)	15.06	1.70	10.61	25.59
MUN[b] (mg/100 ml)	31.40	9.84	7.80	59.90

[a] SD – standard deviation.
[b] MUN – milk urea nitrogen.

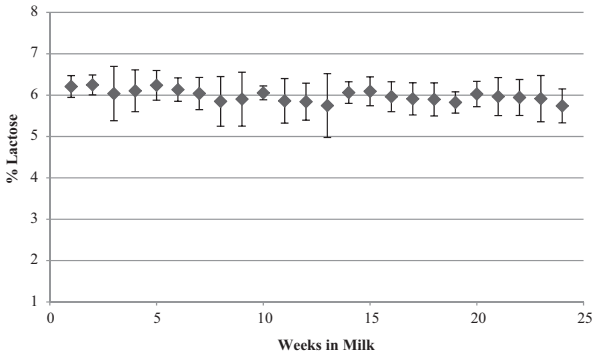

Fig. 1. Lactose concentration (%) in alpaca milk ($n = 168$) for average (±standard deviation) across weeks postpartum.

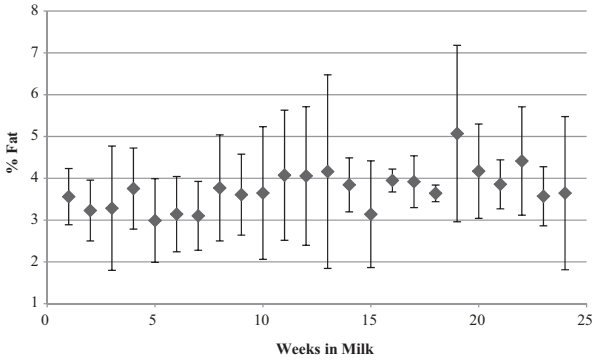

Fig. 2. Fat concentration (%) in alpaca milk ($n = 168$) for average (±standard deviation) across weeks postpartum.