Changes in nutrient and protein composition of cat milk during lactation

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Objective—To evaluate changes in the nutrient and protein composition of cat milk during lactation.

Animals—12 lactating domestic shorthair cats.

Procedure—Milk samples collected on days 1, 3, 7, 14, 28, and 42 after parturition were analyzed for concentrations of nitrogen, nonprotein nitrogen, casein, whey proteins, amino acids, total lipids, lactose, citrate, minerals, and trace elements. Individual milk proteins (caseins and whey proteins) were analyzed by use of polyacrylamide gradient gel electrophoresis.

Results—True protein concentration ranged from 6.3 to 8.6% and was as high in mature milk as in colostrum. Nonprotein nitrogen as a portion of total N was constant (approx 8%), as was the whey-to-casein ratio (approx 50:50). Total lipid concentration was high (9.3%) in colostrum, rapidly decreased, then increased to 9% in mature milk. Lactose concentration was constant at 4%. Milk calcium, iron, and copper concentrations increased markedly during lactation, and magnesium and zinc values remained constant. Colostrum and early milk had a low Ca-to-P ratio of 0.4:0.9. Although calcium concentration increased with time, phosphate concentration also increased so that the Ca-to-P ratio remained constant in mature milk at 1:1.2. The major whey proteins had molecular weights of approximately 14,000, 19,000, 40,000, and 80,000. The 80,000 protein (possibly lactoferrin) decreased in concentration during lactation. Two major casein subunits of approximately 28,000 and 33,000 were found, and both increased during early lactation.


Domestic cats have become the most popular house pet in the United States.1 Because of their popularity, increased emphasis has been placed on determining the nutrient requirements of adult cats and growing kittens. Although much research has been performed on weaned kittens and adult cats, little information has accrued on the composition of cat milk and how it may meet any unusual metabolic demands of suckling kittens.2

It is generally accepted that optimal nutrition of suckling neonates is provided by milk from the lactating mother.3 Milk replacers have, thus, been formulated to reflect the nutrient composition of that species’ milk. In the case of orphaned kittens, most commercial and home-made formulations are based on antiquated studies by Baines3 and McManamon.4 The resultant rearing of orphan kittens with milk replacers has met with several complications, including cataracts, diarrhea, poor weight gain, and intolerance of the diet.5

Milk from lactating cats is similar in gross composition6 to that of other carnivores, such as dogs,3 but is dissimilar to that of ruminants and human beings.7 However, temporal changes in constituents of cat milk8 differ from those for other species.8 It is likely that, similar to that of other species, cat milk contains several components that actively contribute to development of kittens. These components may interact with nutrients in the milk and facilitate their utilization by kittens. For example, bile salt-activated lipase, which contributes to lipid digestion and was previously thought to be present only in primate milk, has recently been identified in cat milk.9 Results of such studies suggest that cat milk may have many undetermined components that must be further evaluated to better understand how milk nutrients interact with each other and with newborn kittens. With such information, it will be possible to establish nutrient requirements of kittens that are more accurate than those presently used.

Materials and Methods

Cats—The protocol was approved by the Committee for Animal Use and Care at the University of California-Davis and conformed to American Association for Accreditation of Laboratory Animal Care standards. Twelve healthy, lactating domestic shorthair cats in a specific-pathogen-free colony (no vaccines), ranging from 2 to 4 years of age, were studied. The queens were representative of their peers and were given ad libitum access to a diet that exceeded the Association of American Feed Control Officials’ (1995) nutrient profiles for growth and reproduction (Table 1). All kittens were healthy throughout the study and their growth rate was followed and found to be normal. Kittens suckled ad libitum and were weaned at 6 weeks of age (1 day after the final sample was drawn).

Samples—Milk samples were obtained on day 1 (colostrum), and on days 3, 7, 14, 28, and 42 after parturition. Milk was obtained by manual expression of the gland after IM administration of 5 IU of oxytocin. Sample size usually was > 1 ml. All samples were frozen at −20°C until analysis.

Nitrogen analysis—Aliquots of samples from 6 cats were analyzed for total nitrogen and nonprotein nitrogen (NPN) by use of micro-Kjeldahl analysis.10,11 Samples for NPN analysis were subjected to protein precipitation with 24% trichloroacetic acid (TCA) and centrifuged for 15 minutes at 10,000 X g, then the supernatant was analyzed for nitrogen content.11 True protein content was calculated by subtracting NPN from total nitrogen values and multiplying by a 6.25 conversion factor.

Sodium dodecyl sulfate-polyacrylamide gradient gel electrophoresis (SDS-PAGE)—Whole milk samples were diluted to 2 mg of protein/ml in sample buffer (15 mM Tris [pH 8.0], 1% SDS, 10% glycerol, 2.5 mM 2-mercaptoethanol, and 0.5% bromophenol blue). Dilute milk samples were boiled in boiling water for 3 minutes prior to application on the gel. Twenty micrograms of protein was applied to each well of a 10 to 20% minigel.12 Gels were run for 80 minutes at 35 mA in Tris-glycine buffer (0.025M Tris, 0.192M glycine, 1% SDS [wt/vol, pH 8.3]). For detection of proteins, gels were stained overnight with 300 ml of a solution containing acetic acid:ethanol:water (10:25:65 [vol:vol:vol]) and

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