

Milk composition of franciscana dolphin (*Pontoporia blainvillei*) from Rio Grande do Sul, southern Brazil

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Milk is the only external energy source for mammals in their early stages of life. Its composition varies during lactation in baleen whales and pinnipeds, while only descriptive studies are available for odontocetes. The aim of this work was to identify the components of the milk of franciscana, Pontoporia blainvillei, from southern Brazil. Samples were manually collected from lactating females (N = 5) incidentally caught in the gill-net fishery. The amount of fat, protein, carbohydrate, mineral and trace metal content, and caloric value of the samples were estimated. Milk of the franciscana dolphin presented mean fat, protein and carbohydrate concentrations similar to those described for other coastal species. A significant increase in fat concentration was observed in winter months, with a higher energy density. Potassium was the mineral found in higher amounts. Zinc, mercury and copper were detected in low concentrations. Due to different habitat conditions along the species distribution, the presence of a highly seasonal reproductive period and inter-population genetic variability, studies on milk composition in other areas is recommended.

Keywords: milk composition; minerals, contaminants; franciscana; *Pontoporia blainvillei*; Brazil.

Submitted 13 March 2007; accepted 2 November 2007; first published online 17 March 2008

Milk composition has been well described for baleen whales, and variations of fat and protein concentration along the lactation period are reported (Oftedal, 1997). The amount of energy transferred to the offspring during lactation depends directly on the milk composition and on the total amount of milk ingested, and during this period they grow quickly and double in size (Oftedal, 1997). Studies about milk of odontoceti have been merely descriptive and there is no information available concerning variation in milk composition during lactation or lactating strategies (Oftedal, 1997). The difficult access to milk samples may explain this lack of information, since collection of these samples is only possible through accidental catches or strandings of lactating females (e.g. Peddemors *et al.*, 1989; Rosas & Lehti, 1996).

The franciscana, *Pontoporia blainvillei*, is a small cetacean species endemic to the south-western Atlantic Ocean. Its distribution, characteristically coastal, extends from Itaúnas (18°25'S 030°42'W), Espírito Santo, Brazil, to Golfo Nuevo (42°35'S 064°48'W), Patagonia, Argentina (Secchi *et al.*, 2003). Very little is known about the physiology of this species, despite the high number of accidental captures

reported in all major fishing communities along its area of distribution, as this is probably the most threatened cetacean species in the south-western Atlantic (Secchi *et al.*, 2002). In this work the milk composition of *P. blainvillei* was analysed through the identification of its nutritional content, seasonal variation, and mineral and metal content.

Milk samples were collected from five lactant *P. blainvillei* females accidentally caught in fishing nets from Rio Grande (32°05'S 52°08'W) (samples CA05, CA010 and CA338) and Imbé fishing communities (29°58'S 50°07'W) (samples GEMARS0547 and GEMARS0828), southern Brazil. Milk was manually collected about 24 h after death and stored at -20°C. Samples CA05 and CA010 were collected in the summer (January 1993 and February 1993) while samples GEMARS0547, GEMARS0828 and CA338 were collected in the winter (August 1998, August 2000 and June 2004, respectively).

Protein nitrogen was determined by the micro-Kjeldahl method (AOAC, 1990). Fat was determined by the Mojonnier ether extraction procedure (AOAC, 1990). Carbohydrate concentration was determined using the phenol sulphuric acid method (Chaplin, 1986). The caloric value of milk was estimated using fat and protein concentrations (AOAC, 1995). The cryoscopic index was obtained using a digital electronic cryoscope (MV 540, VAPRO® 5520; Wescor) (AOAC, 1975).

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Table 1. Milk composition of the franciscana, *Pontoporia blainvillei*, in Rio Grande do Sul, Brazil.

Composition	Summer samples		Winter samples		
	CA05	CA010	CA338	GEMARSo547	GEMARSo828
Fat (g/100 g)	8.21	8.22	19.00	13.80	14.0
Protein (g/100 g)	13.70	14.43	11.50	9.50	9.80
Carbohydrates (g/100 g)	n.a.	n.a.	2.80	2.20	2.50
pH	6.80	6.70	n.a.	n.a.	n.a.
Cryoscopic index	$\Delta - 0.818^{\circ}\text{C}$	$\Delta - 0.817^{\circ}\text{C}$	n.a.	n.a.	n.a.

n.a., not analysed.

It was possible to determine the composition of heavy metals and minerals in the sample CA338 only. A milk fraction was submitted to digestion with nitric acid (Standard Methods 20TH). The minerals potassium (K), phosphorus (P), sodium (Na), calcium (Ca), magnesium (Mg) and iron (Fe) were quantified by absorption spectrophotometry. In samples CA05 and CA010, only the Ca concentration was determined by oxalate titration. All values were expressed as mg/l. Mercury (Hg), lead (Pb), cadmium (Cd), zinc (Zn) and copper (Cu) were quantified by atomic absorption spectrophotometry and the values were expressed as mg/l, except for Hg ($\mu\text{g/l}$).

To detect seasonal differences in milk composition, samples collected in summer and winter were compared. Fat and protein concentrations, as well as total length (cm) and total weight (kg) were compared using Student's *t*-test with Tukey procedures. Data were considered to be significant at $P \leq 0.05$.

Milk composition of *P. blainvillei* is shown in Table 1. Fat concentrations found in summer (15.60%) were statistically different to those observed in winter (8.21%), with $P = 0.044$. Protein concentration was higher in summer (14.07%) than in winter (10.27%), with $P = 0.021$. The lactant females had similar total lengths in summer and in winter (summer = 154.80 ± 5.94 cm; winter = 155.0 ± 2.18 cm; $P = 0.958$) and similar total weights (summer = 40.30 ± 3.96 cm; winter = 38.13 ± 3.20 cm; $P = 0.543$).

In summer, the mean protein and fat concentrations in franciscana milk corresponded to 56.26 kcal/100 g and 73.85 kcal/100 g, respectively, totalling 130.11 kcal/100 g. The samples collected in winter corresponded to 181.47 kcal/100 g, a caloric value 1.9 folder higher than in summer, due to higher concentration of fat (140.40 kcal/100 g), while protein concentration corresponded to 41.07 kcal/100 g. Carbohydrates, possibly lactose, showed a mean value of 2.5% in franciscana milk during winter. Values for summer were not available for comparison.

The concentrations of minerals and heavy metals analysed in sample CA338 were K = 1521.0 mg/l, P = 1454.0 mg/l, Na = 1054.0 mg/l, Mg = 89.20 mg/l and Fe = 10.20 mg/l. Calcium presented a concentration of 947.0 mg/l, while samples CA05 and CA10 resulted in concentrations of 1460.0 mg/l and 1440.0 mg/l, respectively. The metals found in sample CA338 were Zn = 4.46 mg/l, Cu = 0.63 mg/l and Hg = 0.22 $\mu\text{g/l}$. Lead (Pb) and cadmium (Cd) concentrations were below the detection limits of analytical method (<0.05 and <0.002 mg/l, respectively).

The milk of franciscana presented a low concentration of fat, similar to the Amazon River dolphin (*Inia geoffrensis*) (Rosas & Lehti, 1996), bottlenose dolphin (*Tursiops truncatus*)

and Indo-Pacific humpbacked dolphin (*Souza plumbea*) (Peddemors *et al.*, 1989). Coastal species or populations of the same species generally have a lower fat concentration in milk compared to those of oceanic habits (Peddemors *et al.*, 1989). We observed a variation of fat concentration in milk, being lower in summer (8.21%) and higher in winter (15.60%). The presence of proteins in franciscana milk presented a significant variation throughout lactation, higher in winter and lower in summer. However, the mean concentrations were similar to those of other cetacean species (Ofteidal, 1997). There are no references concerning the variation of composition in other odontoceti. In other species, carbohydrates are present at values close to those found for franciscana (0.0–2.5%) (Ofteidal, 1997).

In spite of the low sample size, the data presented in this study suggested that the milk of *P. blainvillei* presents a variation according to the lactation period. The differences between the beginning and the end of lactation in franciscanas may be under the influence of the sea temperature changes that are regulated by current regimens, with more energy provided to the calves through fat in colder months. Lactation in franciscanas occurs during nine months, and its ending coincides with the presence of the Falkland's current (15–16°C) in Rio Grande do Sul (Danilewicz, 2003). This variation in composition may reflect the pattern of the milk in animals exclusive to the southern range of the species where its reproduction has a well-defined birth period from October to February in southern Brazil. This suggests at least the partial influence of temperature on the water during the time of birth and lactation for the species (Danilewicz, 2003). Variation in milk composition of mysticeti during the lactation period was observed, with fat increasing from 20% to 40% throughout the first six estimated months of lactation (mid-lactation) (Ofteidal, 1997).

The mean concentration of Cu, Fe, Zn, Mg and Ca concentrations were similar to other odontoceti (Ofteidal, 1997). However, the concentrations of Na (1788.0 mg/l) and K (7625.0 mg/l) found by Rosas & Lehti (1996) for the Amazon River dolphin (*I. geoffrensis*) were higher than those found in this study. Zinc concentrations were higher in franciscana than in *T. truncatus* from the Mediterranean Sea (Frodello *et al.*, 2002), and Pb, Cd and Cu concentrations were lower. Franciscana showed Hg concentrations similar to *T. truncatus* (0.22 $\mu\text{g/l}$ vs 0.2 $\mu\text{g/kg}$, respectively), but lower than that found in the Amazon River dolphin (176.0 $\mu\text{g/l}$) (Rosas & Lehti, 1996). This high Hg concentration found in the Amazon River dolphin might be related to gold mining in the Amazon River (Rosas & Lehti, 1996).

The variation in the composition of milk throughout lactation, as well as the evaluation of its nutritional components,

are important information for the understanding of the energy input in the development and growth of *P. blainvillei* calves. Therefore, further studies are recommended with larger sample sizes in other regions.

ACKNOWLEDGEMENTS

The authors thank Dr Fernando C.W. Rosas (INPA), Daniel Danilewicz (GEMARS), Dr Adriano Brandelli (UFRGS) and the unknown referees for providing comments on drafts of this paper. This work received the financial support of CNPq (141315/2003-2), Fundação o Boticário de Proteção à Natureza (FBPN) and Fundo Nacional do Meio Ambiente (FNMA/Brazil).

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