

POLAR BEARS: ASPECTS OF HANDREARING

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Abstract

Zoos faced with the issue of handrearing polar bear cubs have found success with various formulas. Despite many common ingredients in zoos' polar bear milk replacers, adjustments were made to accommodate specific medical or nutritional needs of the cub(s), and consequently there were differences in solids/energy offered and weaning age. Cubs from three institutions (San Francisco, Brookfield, and San Diego Zoos) were successfully raised to weaning using different formulas; this paper briefly compares the formulas themselves and methods for weaning.

Introduction

Polar bear cubs weigh 600-700 grams at birth. Twins are most common, but as many as four cubs can be born². Mother bears can care for their cubs for up to 28 months, however this depends on weather conditions and age of the female in the wild². However, due to lack of maternal care or medical issues, some institutions may choose to handraise polar bear cubs. In captivity, medical problems have been noted in some cubs associated with formula composition including rickets/vitamin D deficiency⁸, thiamin deficiency⁶, lactobezors, constipation, dehydration, and bloating^{6,8}.

Milk Composition

In general, polar bear milk tends to be higher in total solids, fat and protein, but lower in carbohydrates compared to other carnivores⁴ and more closely resembles that of marine mammals⁷. Milk composition changes over the course of lactation. The fat content of wild polar bear milk is highest (35.8%) when emerging from the den in spring, gradually decreasing to 20.6% one year later while still on land. Lactating bears on sea ice showed no changes in the fat content of the milk as the age of the cubs increased³. Table 1 provides data on milk samples from polar bears.

Formula Selection

If the cubs have not had the opportunity to nurse, then polar bear serum should be administered. It is recommended to supplement at 3-5 mL per pound of body weight in two doses spaced 5-10 days apart⁵. Most institutions that have hand-reared polar bear cubs have used either a combination of milk products (cream or half and half) with Esbilac, various dilutions of Esbilac or a combination of Esbilac and another milk replacer (such as Multi Milk or Enfamil). Pediatric vitamins were added by most institutions, but may not be necessary if a nutritionally complete milk replacer is used. Polar bear milk is low in lactose¹⁰, however most milk replacers are bovine

based and contain significant amounts of lactose. The ability of polar bear cubs to digest lactose has not been determined. For this reason, formula predigested with a lactase enzyme preparation has been employed by some institutions. Cod liver oil was frequently added to formulas, however a number of cubs have been raised successfully without it. Ursids can form indigestible lumps of casein called lactobezoars which can have serious health implications. Reducing casein (a milk protein) and increasing whey in the formula can help prevent this problem. Table 2 lists the nutrient composition of the formulas used successfully by San Francisco, Brookfield and San Diego Zoos. It should be noted that Brookfield Zoo's cub had a host of medical issues in the first weeks of life including a high white count, thrush (possibly antibiotic induced) and dehydration. The formulas listed were used for this cub and may not all be appropriate for a healthy cub. Final formula is presumed to be appropriate for a healthy cub, but has not been tested.

Feeding and Intake

As a guideline, cubs should be fed 15-25% of their body weight per day not to exceed 5% per feeding. It is important to weigh the cub at the same time each day. Quantities can gradually taper off to 10-20% of body weight by 90 days of age.

Initially, feedings should be offered around the clock, evenly spaced 2-3 hours apart. The feeding regime should be reflective of the cub's health status. By 1 month of age feedings may be reduced to 5-7 times per day. Number of feedings should be gradually reduced until weaning.

A variety of human infant bottles have been used for hand-rearing polar bears including preemie and orthodontic "Nuk" nipples. Playtex nipples may prevent chafing of the cub's nose. Elongated nipples and those designed for human infants with cleft palates have also been utilized. A hole in the nipple may need to be opened and this must be done very carefully to prevent aspiration of formula flowing too quickly. If necessary, a nasogastric tube can be used to provide nourishment for an ill cub. However close monitoring is essential to prevent infection at suture sites. Beginning at 90 days syringes have been used successfully to offer formula.

Figure 1 shows average weekly energy intake (kcal ME/day) from formula from weeks 1-40. At 8 weeks of age San Francisco Zoo's cub and Brookfield Zoo's cub were consuming 608 and 501 kcal ME/day, respectively. At 16 weeks of age San Francisco's cub had already been weaned onto solid food. Brookfield's cub was consuming 1673 kcal ME/day while the male and female from San Diego were consuming 3030 and 2517 kcal ME/day, respectively from formula. Brookfield's cub had a number of health issues that contributed to her reduced intake compared to San Diego's cubs, which up until that point had been with the sow. Brookfield's cub consumed a high of 3463 kcal ME/day at week 24 at which point weaning began and formula consumption decreased. San Diego's 1.1 cubs consumed a high of 10,271 and 8848 respectively at week 31.

Weaning

Polar bear cubs nurse for up to 2-3 years in the wild. The age at which the contribution of nursing transitions from nutritional dependence to social bonding with the sow is unclear.

Weaning in the wild involves both nutritional and behavioral processes, while captive weaning typically refers to cessation of bottle-feeding. The captive weaning off the bottle process (i.e. introduction to solids) can begin as early as 60 days, though 70-85 days is more common. Baby cereal, canned cat or dog food and ground cat or dog food have been mixed with formula to introduce solid foods. At 3 months, most cubs can be offered dog kibble or omnivore biscuit, ground or soaked foods can be added, then progressing to dry. Fish or fresh meats have been offered as early as 100-110 days. For cubs in this section, formula was discontinued between 3-11 months of age. The process should be gradual, with only one variable changing at a time so as to track cause/effect for any change.

Figure 2 provides growth curves for San Francisco (1-16 weeks), Brookfield (1-40 weeks) and San Diego (14-40 weeks) polar bear cubs.

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Products:

Esbilac - Pet-Ag, 30W 432 Route 20 Elgin, IL 60120

Multi-milk – Pet-Ag, 30W 432 Route 20 Elgin, IL 60120

Enfamil – Meade Johnson Nutritional Division, Meade Johnson and Co., 2404 W. Pennsylvania St., Evansville, IN 47721

Lacteeze - http://www.gelda.com/web_pages/pharma_products_lacteeze.html

Table 1a. Composition of polar bear milk (as fed basis) ('nd' = not determined); numbers in parenthesis represent number of samples.

Nutrient	Jenness ⁷ (7)	Ben Shaul ¹ (1)	Derocher ³ (128)	Kenny ⁹ Captive (1)	Kenny ⁹ Captive (1)	Kenny ⁹ Free-ranging (10)
Stage of Lactation	^a	unk	^b	80 days	191 days	3-4 mos est.
Total Solids, %	47.6	24	41.6	34.7	45.9	52.5
Fat, %	33.1	9.5	28.5	23.4	30.1	35.8
Carbohydrate, %	0.3	3.0	2.5	1.7	0.6	4.7
Casein, %	7.1	nd	nd	nd	nd	nd
Whey Protein, %	3.8	nd	nd	nd	nd	nd
Total Protein, %	10.9	9.6	11.4	8.5	13.7	10.5
Ash, %	1.4	1.2	nd	1.1	1.5	nd
Calcium, %	0.29	nd	nd	0.23	0.37	nd
Phosphorus, %	0.23	nd	nd	0.18	0.25	nd
Vitamin D, ng/g	Nd	nd	nd	28.7	nd	1.6±2.8

^a Stage of lactation: 4 cubs 7-8 months old, 1 10 mos old, 1 18-19 mos old, 1 unk

^b Stage of lactation : see table 1b.

Table 1b. Composition of polar bear milk (from Derocher et al. 1993)

Cub Age (months)	Fat (%)	Protein (%)	Carbohydrate (%)	Gross Energy (kJ/g)	Gravimetric total solids	Calculated total solids
3 (n=31)	35.8	10.5	4.7	16.9	32.3	52.4
4* (n=8)	33.9	9.1	3.6	15.2	40.1	47.0
10 (n=51)	27.5	12.1	1.8	14.0	40.2	43.8
16* (n=7)	32.0	10.9	1.5	16.1	45.3	49.4
22 (n=15)	20.6	13.2	2.1	11.7	34.5	38.3
28* (n=1)	33.2	11.3	1.3	15.5	48.7	47.3
34 (n=1)	16.8	12.5	2.3	9.7	29.5	33.0
average	28.54	11.37	2.47	14.16	38.66	44.46

* Bears on sea ice (all other values are for bears on land)

Table 2. Comparison of composition of handrearing formulas used to bottle-raise orphaned cubs (As fed basis). (c) indicates value was calculated using Atwater factors

Formula	Total solids, %	Fat, %	Carb, %	Protein, %	Ash, %	Ca, %	P, %	Na, %	K, %	Calculated Energy, kcal/100g
San Francisco Day 1-5	13.72	4.80	4.49	3.84	0.60	0.12	0.085	0.068	0.078	76.5 (c)
San Francisco Day 6-7	17.25	7.46	4.69	4.41	0.69	0.13	0.098	0.077	0.090	103.6 (c)
San Francisco Day 8-14	20.28	9.10	5.07	5.29	0.83	0.16	0.12	0.092	0.108	123.3 (c)
San Francisco Day 15-28	24.32	10.9	5.69	6.71	1.05	0.20	0.15	0.115	0.137	147.4 (c)
San Francisco Day 29+	30.90	13.59	6.76	9.13	1.42	0.27	0.20	0.154	0.186	185.9 (c)
Brookfield Day 5-7	14.62	7.35	1.51	4.83	0.93	0.15	0.12	0.11	0.076	91.5 (c)
Brookfield Day 8-17	29.2	14.5	3.0	9.6	2.1	0.32	0.25	0.15	0.21	181.0 (c)
Brookfield Day 18-24	23.86	12.76	2.57	7.23	1.30	0.22	0.17	0.115	0.15	154.0 (c)
Brookfield Day 25+	18.4	9.8	1.94	5.56	0.99	0.17	0.13	0.088	0.118	118.5 det by bomb cal
San Diego day 90-100	26.3	12.03	8.08	5.18	ua	0.16	0.12	ua	ua	161.3 (c)
San Diego Day 101-222	30.5	13.57	9.60	6.13	ua	0.19	0.14	ua	ua	183.9 (c)
San Diego day 223-343	30.5	12.32	10.3	6.62	ua	0.21	0.15	ua	ua	177.5 (c)

ua = unvariable.

Figure 1. Energy intakes for four hand-raised polar bear cubs

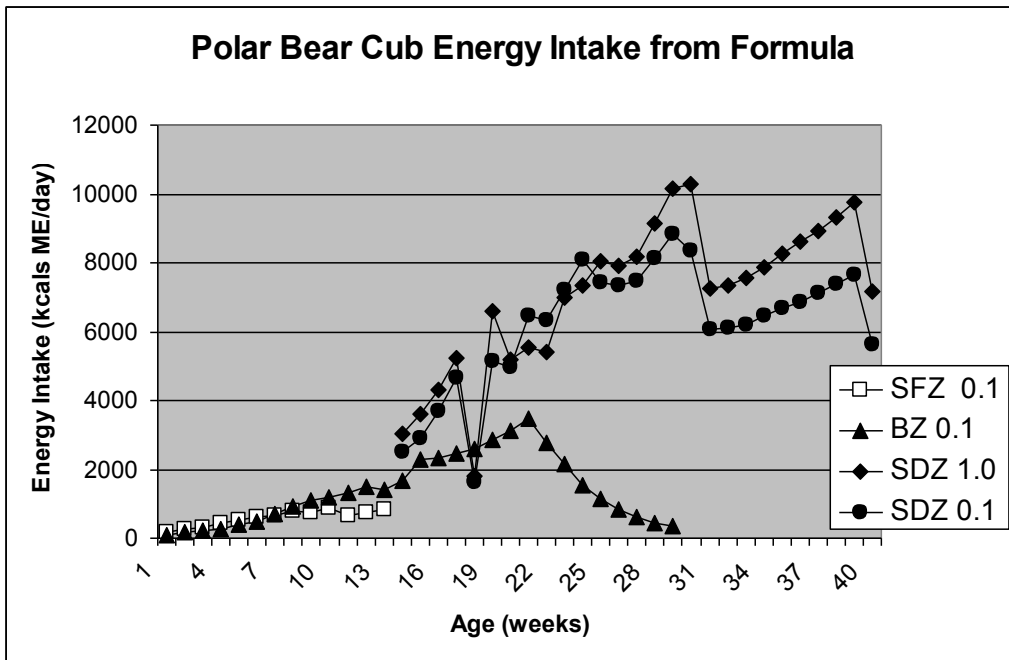


Figure 2. Growth curves for four hand-raised polar bear cubs.

