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Abstract: Artificial milk formulas manufactured for domestic kittens have traditionally been used as the handrearing milk formula for captive wild felids. This paper will compare the differences between the composition of cheetah (*Acinonyx jubatus*) maternal milk and that of the domestic cat. The differences are significant, especially regarding the carbohydrate (lactose) content. As a result, using a milk formula designed for domestic kittens does not closely match the composition of cheetah milk. However, modifications to kitten milk formulas may provide a more nutritionally balanced diet for cheetah cubs and contribute to increased growth rates and decreased incidence of digestive disorders.

Hand-rearing Cheetah (*Acinonyx jubatus*) Cubs: Milk Formulas

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Artificial milk formulas manufactured for domestic kittens have traditionally been used as the hand-rearing milk formula for captive wild felids. This paper will compare the differences between the composition of cheetah (*Acinonyx jubatus*) maternal milk and that of the domestic cat. The differences are significant, especially regarding the carbohydrate (lactose) content. As a result, using a milk formula designed for domestic kittens does not closely match the composition of cheetah milk. However, modifications to kitten milk formulas may provide a more nutritionally balanced diet for cheetah cubs and contribute to increased growth rates and decreased incidence of digestive disorders.

The maternal milk composition of cheetahs is more concentrated in solids and fat and lower in protein and carbohydrates than the domestic cat (table 1). Kitten milk replacer (KMR®) has been used quite regularly at cheetah breeding facilities that hand-rear cubs. KMR®, in the liquid form, is most commonly used and many times is diluted with water or 5% dextrose for the first several feedings. Anecdotal reports indicate cubs have digestive problems (diarrhea or constipation) when the undiluted formula is used. Facilities have indicated the powder form of KMR®, which can be mixed with water at different dilutions, doesn't mix well and is more prone to cause digestive upset, presumably because the powder stays in a "lump" in the cub's stomach and can't be digested properly. Other facilities have chosen to use Esbilac®, which is a puppy milk replacer. Esbilac® is higher in fat and lower in carbohydrates than KMR®. Taurine, an essential amino acid for felids, is not in the Esbilac® formula, so must be added prior to feeding (250mg/cub/day) (McManamon and Hedberg, 1993). A recent survey on hand-rearing protocols of captive felids indicated there was equal preference for Esbilac® + taurine and KMR® + Multi-Milk® formulas (Hedberg, 2002).

Table 1: Comparison of the maternal milk composition of cheetah and domestic cat. Ben Shaul (1962)[1], Abrams (1950)[2].

	Cheetah[1]		Domestic cat[2]	
	AF	DM	AF	DM
Solids %	23.7		17.7	
Protein %	9.4	39.7	7.2	40.5
Fat %	9.5	40.1	5.0	28.0
Carbohydrate %	3.5	14.8	4.9	27.8
Ash %	1.3	5.4	0.7	3.7
Kcal/ml*	1.4	5.8	0.9	5.3

* Kcals were calculated. AF = as fed basis. DM = dry matter basis

Cheetah milk is higher in dry matter content (total solids), fat and ash (mineral component) and lower in carbohydrates than domestic cat milk. In many of the species that are hand-raised, carbohydrate is the limiting nutrient. Many species are lactose-sensitive and lack the enzyme lactase to break down milk sugars. Because of that, milk formulas manufactured for domestic species must usually be diluted significantly to provide a formula that doesn't exceed the carbohydrate level wild species are able to digest. Such is the case with KMR®. The liquid form (canned) provides 18.2% solids, 42.2% protein, 25.0% fat and 26.1% carbohydrates (DM basis). That formula is comparable to the domestic cat's milk, but is very different from the cheetah's. If the carbohydrate component is the limiting factor, the milk must be diluted enough to make the carbohydrate portion approximately 14-15% of the total solids (on DM basis) or 3.5% (on "as fed" basis). Diluting KMR® liquid to a 2:1 ratio of formula to water gives a carbohydrate content of 3.2%. A ratio of 3:1 provides 3.6% carbohydrates, both of which would be acceptable for cheetahs. However, diluting the formula to reduce the carbohydrates also decreases the amount of protein and fat in the diet. See table 2 for the proximate analysis of KMR® canned formula dilutions.

Table 2: Comparison of nutrient composition of KMR® canned formula dilutions. Values are on an "as fed" basis. Ben Shaul (1962)[1], Pet Ag™ [2]

	Cheetah req.[1]	KMR® canned [2]	KMR® 3:1 dilution	KMR® 2:1dilution
Solids %	23.7	18.2	13.7	12.1
Protein %	9.4	7.7	5.8	5.1
Fat %	9.5	4.6	3.5	3.0
Carb. %	3.5	4.8	3.6	3.2
Kcal/ml	1.4	0.9	0.69	0.6

From the above data, it is apparent that while reducing the level of carbohydrates to the cheetah requirement, it also decreases the amount of protein to 54-62% of cheetah milk and fat provides only one-third the requirement. Felids obtain energy from protein and fat (Bechert, et al., 2002). The main effect that results from a diluted formula is delayed growth rates and/or skin and haircoat problems. Hair loss was noted in snow leopards that consumed an Esbilac® formula deficient in protein. The problem was resolved after adding chicken baby food, which increased the protein level (Hedberg, 2002).

Another issue with diluting the milk formula concerns the amount of calories the cub receives in a 24-hour period. Growing cubs require a minimum amount of calories for basic body functions, development and growth. Many hand-rearing protocols suggest feeding a certain percentage of the body weight (e.g. 15-20%) on a daily basis. However, there can be vast differences in the caloric content of formulas, especially when diluted.

For example: say we have three 600g (20 oz.) cheetah cubs. One is maternally raised, the other two, hand-raised. Of the hand-raised cubs, one is fed formula #1, as described below. The other cub is fed formula #2. Based on the recommendation that formula be offered in the volume equivalent to 15-20% of the body weight, each cub would receive between 90-120 ml (3-4 oz.) of formula/day. Cheetah milk provides 1.37 kcal/ml. At 15-20% body wt., the cub would receive between 123-164 kcal/day. In this example, we'll use that caloric range as the target for the two hand-rearing formulas.

Cheetah milk
Provides 1.37 kcal/ml of formula
Fed at 15-20% body wt: receives 90-120 ml formula/day
90 ml x 1.37 kcal/ml = 123.3 kcal/day
120 ml x 1.37 kcal/ml = 164.4 kcal/day

Formula #1 (canned KMR®, diluted w/ water at ratio of 3:1)
Provides 0.69 kcal/ml of formula
Fed at 20% body wt: receives 120ml formula/day
120 ml x 0.69 kcal/ml = 82.8 kcal/day

Formula #2 (KMR® & Multi-Milk® powders mixed w/ water at ratio 1: 1: 2 1/2) -> in Table 3
Provides 1.26 kcal/ml of formula
Fed at 17-20% body wt: receives 102-120ml formula/day
102ml x 1.26 kcal/ml = 128.5 kcal/day
120 ml x 1.26 kcal/ml = 151.2 kcal/day

The caloric content of formula #1 provides 50-67% of the calories in cheetah milk, when offered at 20% body weight. The caloric content of formula #2 falls within the range of cheetah milk, when fed at 17-20% body wt., and provides 1.8 times more calories than formula #1, when the same amount (20% of the cub's body wt.) is offered. Formula #2 is more nutrient dense than formula #1. In order to provide equivalent calories, formula #1 would have to be fed at 30-40% body wt. to match formula #2 and cheetah milk. Diarrhea has been reported in exotic felids that consume ≥ 25% body wt/day, so no more than 20% should be offered (Hedberg, 2002). As a result, without some type of supplement, formula #1 will likely result in delayed growth rates compared to cubs raised on a more nutrient dense formula, or maternally raised cubs.

The point of the above example is to demonstrate that formulas are not equal when it comes to determining feeding schedules. Offering 15-20% body wt/day is appropriate for formulas that provide adequate nutrient and energy concentrations, but may not insufficient with less nutrient dense formulas.

Many facilities have indicated that chicken or turkey baby food should be added to the formula early on in the hand-rearing process. The addition of baby food will provide supplemental protein and fat. Chicken and turkey are reportedly good sources of taurine (Hedberg, 2002; NRC, 1986). One jar (2.5oz.) of Gerber's® chicken 2nd foods contains 12.9% solids, 11.8% protein, 4.1% fat, 1.47% carbohydrates. 0.6% calcium, 0.09% phosphorus and 15 IU vitamin A and provides 66 kcal (USDA 2004). Taurine was not listed in the analysis. Gerber's® 2nd foods, turkey-flavored, is also a good source of protein and fat, and very low in carbohydrates. However, the calcium: phosphorus ratio is skewed towards phosphorus (1:6.5) so may alter the total Ca:P ratio of the diet to the point of requiring a calcium supplement.

Panthera spp. have benefited from the addition of poultry-based human baby food (e.g. Gerber's® 2nd foods), as early as one to two weeks of age. The baby food provides additional protein and calories, but should be limited to less than 17% (2.5oz baby food to 12.5oz prepared formula) of the diet (Hedberg, 2002). Baby food must be added gradually over one week to prevent digestive upset. This is not considered part of the weaning diet, but as an addition to the formula which increases protein, fat and calories to otherwise dilute formulas. Knox® gelatin has also been added to formulas to increase the protein content (D. Strasser, pers. com.).

It is not advisable to add meat-based baby foods to nutrient-dense formulas such as those presented in Table 3. Laurenson (1995) stated that wild cheetah cubs had physiological limits on growth even when an unlimited food supply was available. However, the addition of protein and calories may promote a faster than optimal growth rate and contribute to potential bone growth abnormalities. Cubs that are consistently growing at >10% body wt/day may need to have their formula diluted to slow their growth. Fast growth promotes bone deformities and fractures because they are not able to support the additional body weight.

Compensatory growth, a phenomenon where young and/or malnourished animals are taken from a low plane of nutrition to a high plane with little or no transition period, has resulted in Degenerative Orthopedic Disease (DOD) in domestic horse foals and dogs (Owen, 1975; Hedhammer, et al, 1974). Factors that predispose animals to DOD include a combination of genetics, high energy intake and an early slow growth followed by a compensatory fast growth spurt (Lewis, 1995). There is a possibility that compensatory growth may contribute to the "ballet" stance that periodically develops in hand-raised cheetah cubs.

Wild cheetah cubs have average growth rates of 37 – 62.4g/day (1.2-2.1 oz.) (Laurenson, 1995, Beekman, et al, 1999; Wack et al, 1991).The recommended average daily weight gain (ADG) goal for hand-reared cheetah cubs is approximately 5% body weight while on milk formula, and 8-10% increase per day after solid foods are introduced (Hedberg, 2002). Formulas and weaning diets that do not match these goals may need to be modified in one or more ways to ensure proper growth rates of cubs.

Calculations associated with feeding schedules

The following calculations are provided to assist the caretaker in determining how much and how often the formula should be fed to provide adequate nutrition, energy and optimal growth rates.

The Basal Metabolic Rate (BMR) or Basal Energy Requirement (BER) is the amount of energy (kcal) an animal needs for basic metabolic function at rest in a thermoneutral zone. In other words, the amount of calories it needs to stay alive, without having to use energy to maintain normal body temperatures. The formula to determine the BER/BMR is: 70 x body wt (in kg.)$^{.75}$ (Kleiber, 1947). For a 600g. (0.6kg) cub, the BER would be: 70 x 0.6$^{.75}$ = 47.72 kcal/day.

Once we have the BER, we can determine the Maintenance Energy Requirement (MER). This determines the amount of calories the animal needs to function in a normal capacity at its life stage. For adults in the maintenance life stage, the BER is multiplied by 2. For infants that have a higher metabolism and are developing and growing, the BER is multiplied by 3 or 4 (Evans, 1987), depending on the species and other factors. The MER factor of 3 is appropriate for cheetahs that grow at a slower rate than small mammals.

The stomach capacity for most placental mammals is 5-7% of the total body weight (Meehan, 1994). Convert the body weight into grams to find the stomach volume in mls (cc's). To calculate the stomach capacity in ounces, convert body weight into the same units (30g ~ 1 oz). The key is to make sure units are the same for body weight and stomach volume. The stomach capacity is the amount of formula a cub can comfortably consume at one feeding. Offering much more than this value may lead to overfilling, which may lead to stomach distension and bloat. It also prevents complete emptying of the stomach between feedings and promotes the overgrowth of potentially pathogenic bacteria, diarrhea and enteritis (Evans, 1987).

The following calculations will determine the total volume and kcal to feed/day, as well as the amount of formula/feeding and the total number of feedings/day.

1. Calculate Maintenance Energy Requirement (MER): 70 x body wt (kg)$^{.75}$ x 3. See Appendix 1 for calculated MER's for various body weights.
2. Determine stomach capacity (amount that can be fed at each meal): Body weight (in grams or ounces) x 0.05.
3. Divide MER (number of calories required per day) by number of kcal/ml in the formula to determine the volume to be consumed per day. This value can be converted into ounces, by dividing it by 30.
4. Divide ml (or oz.) of formula per day by volume to be consumed at each meal (stomach capacity). This gives the number of meals to be offered per day.

Example: 600 gram (0.6 kg) cub

1. MER = 70 x 0.6 kg$^{.75}$ x 3 = 143 kcal/24 hr. period
2. Stomach capacity = 600g. x 0.05 = 30 ml/feeding

   OR: 20oz x 0.05 = 1 oz/feeding

**The following calculations are based on a milk formula that provides 1.26 kcal/ml. Formulas that provide more or less energy will result in different volumes of formula per feeding and number of feedings/day. A formula that provided 0.69 kcal/ml would require 207 ml of formula per day given over seven feeding bouts.

3. $\frac{143 \text{ kcal}}{1.26 \text{ kcal/ml}}$ = 113 ml of formula to be offered in 24 hr. period (approx. 20% bw)

4. $\frac{113 \text{ ml}}{30\text{ml/feeding}}$ = 3.76 feedings (round up to 4)

The cub in the above example would receive 30 ml (1 oz.) of formula at each feeding and would be fed four times over the course of the day. The total amount offered in 24 hrs. is approximately 20% of the cub's body weight. The number of feedings would be split by whatever time period caretakers are able to feed, with a minimum of three hours and maximum of eight hours between feedings. In the above example, if the time frame for feeding was 16 hours, the cub would be fed every four hours with an eight-hour break at night.

It is not unusual for infants to feed well at one meal and consume very little at another. Whatever is not consumed at individual meals can be made up by an additional meal later in the day. It is important to note that if a cub is expected to consume 30 ml at one meal, but only takes in 15 mls, the deficit cannot be made up by offering 45 ml at another feeding. Even if the cub wants to take more than the calculated stomach capacity volume, it must be limited to that amount. Overfeeding may cause bloat and allow for pathogenic bacteria to proliferate in the digestive tract, which will increase the risk of diarrhea, gastric distension and enteritis (Evans, 1987). When cubs are hungry, many times they finish their bottle before the feeling of satiety occurs, but are sound asleep 10-20 minutes later. If the cub is still hungry after it has received its designated volume, shorten the time period to the next feeding by an hour.

With a very young or weak cub, it would be advisable to feed smaller amounts more frequently, although it is generally not necessary to feed more often than every three hours. Frequent feedings that cause the cubs to be repeatedly awakened is actually more stressful than letting them sleep for longer periods (Meehan, 1994). Generally, healthy cubs will start to get restless when they get hungry, which can be used to gage how frequently they need to be fed. In the wild, reports have indicated mother cheetahs may regularly stay away for nine hours between feedings without ill effect to the cubs (Laurenson, 1993).

Formulas

Pet Ag™ manufactures KMR®, Esbilac® and Multi-Milk®. Multi-milk® is a formulated powder with a very low carbohydrate content. Adding it to either KMR® or Esbilac® will maintain high levels of protein and fat while keeping the total carbohydrate content to a minimum. Table 3 provides two formulas using Multi-Milk®. One combines it with KMR®, the other with Esbilac®. The nutrient compositions are very close to cheetah maternal milk.

Table 3a: KMR®-based recipe for a cheetah hand-rearing milk formula

Formula Component		AF basis	DM basis
KMR (42/25): 1 part	Total solids:	22.4%	
Multi-milk (30/55): 1 part	Protein:	8.9%	39.7%
Water: 2 ½ parts	Fat:	9.5%	42.4%
	Carb:	2.5%	11.2%
	Ash:	1.5%	6.7%
	Calcium:	0.3%	1.4%
	Phosphorus:	0.2%	1.0%
	Magnesium:	0.02%	0.08%
	Kcal/ml:	1.26	5.63

AF = as fed, DM = dry matter

Table 3b: Esbilac®-based recipe for a cheetah hand-rearing milk formula

Formula Component		AF basis	DM basis
Esbilac (33/40): 1 ½ parts	Total solids:	23.0%	
Multi-Milk (30/55) : 1 part	Protein:	7.9%	34.2%
Water : 3 parts	Fat :	11.2%	48.8%
Taurine: 250mg/cub/day	Carb:	2.6%	11.2%
	Ash:	0.8%	3.5%
	Kcal/ml	1.4	6.0

As with all milk formulas, the ones described above should be diluted for the initial feedings and gradually increased in concentration until given as a straight stock formula. In an ideal situation, the cub would receive 2-3 feedings of electrolytes only, then a diluted milk formula (1:4 ratio of mixed formula: water) for 2-3 feedings, then 1:3 dilution for 24 hours, then the 1:2 dilution for 24 hrs, 1:1 dilution for 24 hrs, then the full-strength stock formula on the 5th day and from then on. However, in the real world, things don't always work out as planned. Cubs may periodically need to stay on a dilution a little longer, particularly when going from the 1:1 dilution to the full-strength formula. Intermediate steps may need to be added, such as going from 1:1 to 2:1, then full-strength to give the cub more time to adjust. Occasionally cubs need to take a step back if diarrhea occurs. For example, if the cub does well on 1:2 then develops loose stool on the 1:1 dilution, which gets worse at each feeding, delete the next feeding, give electrolytes (at 5-7% body wt) for 1-2 feedings, then go back to the 1:2 dilution step. Offer that formula for 2-3 feedings and progress to 1:1.5 if the stool improves. Healthy infants tend to resolve digestive upset/loose stool pretty quickly when dealt with appropriately. Compromised infants may have other issues that are compounding the problem. They may be stressed and immuno-suppressed. They may have bacterial or viral infections, particularly if they didn't receive colostrum before being removed from the mother. They may have parasites. Or there may be other factors that are adding to the cub's stress level which hampers its ability to adapt and adjust to the hand-rearing process. This is where the "art" of hand-rearing comes in, and the caretaker must make various adjustments to help an individual cub do its best.

Because the carbohydrate content of the full-strength formulas listed in Table 3 is lower than that of cheetah milk, digestive problems should not be an issue. However, our ability to provide appropriate diets is limited by our knowledge at any point in time. Therefore, there is always the potential for new dietary issues to arise. One factor that has been reported is lactobezoars (milk clots in the abdomen) in cheetahs cubs. The cause of this condition is unknown. One facility indicated they thought the milk formula was too concentrated. However, at the time of the lactobezoar incident, they were feeding KMR® liquid as their stock formula, which was high in carbohydrates. Bloating and lactobezoars in two hand-reared polar bears was associated with a milk formula high in carbohydrates (Kenny, et al, 1999). The abdominal distension in the cheetahs may have been caused by fermentation of undigested carbohydrates.

The inability to digest certain types of fatty acids might also contribute to lactobezoars. Prior to 1993, Pet Ag™ used coconut oil as their fat source in the KMR®, Esbilac® and Multi-Milk® recipes. In 1993, the ingredients were changed and they replaced coconut oil with butterfat. The change was made due to research indicating butterfat was more digestible in domestic dogs and cats. However, wildlife rehabilitators and zoo facilities which hand-raised infants noticed that various species were developing digestive problems, even though the caretakers were using the same recipes as before. Lactobezoars were reported in tigers and leopards (Hedberg, 2002). Coconut oil has a high concentration of medium-chain fatty acids, which are generally more digestible than the long-chain fatty acids present in butterfat (Robbins, 1993). Wild felids may not be able to digest butterfat as easily as coconut oil.

Caretakers also reported that the new formula was difficult to mix and had a greasy residue. Pet Ag™ responded to the situation by marketing the Zoologic Milk Matrix® line of milk formulas. It is essentially the pre-1993 version of their milk formulas, and contains coconut oil instead of butterfat as the fat source. Therefore, the Milk-Matrix® version of KMR®, Esbilac® and Multi-Milk® may be preferable products to use in cheetah hand-rearing formulas, especially if lactobezoars are a concern.

The Milk Matrix® line uses formula numbers, which refer to the concentration of protein and fat, as the product names.

KMR® = Milk Matrix® 42/25
Multi-milk® ≈ = Milk Matrix® 30/55
Esbilac® = Milk Matrix® 33/40

From personal experience, the Milk Matrix® line is easy to mix when the powder is added to cold water in equal parts and stirred in a "whisking" fashion. Then the additional water is added to the slurry and mixed completely. There are usually a lot of air bubbles right after mixing, but they dissipate within a few hours. The consistency is much thicker when the formula is cold, and thins out significantly when heated to 100°F (37.77°C). The formula must be refrigerated between feedings.

Many mammalian species lack the enzyme lactase which breaks down milk sugar (lactose) into glucose for absorption into the cells. Gas build-up in the gastrointestinal tract and diarrhea can result as the undigested sugar ferments in the small intestine. Species that have low carbohydrate levels in the maternal milk are generally considered lactose-sensitive or lactose-intolerant. Because commercial milk formulas made for domestic dogs and cats are generally higher in carbohydrates than the maternal milk of the species we're feeding, modifications to the diet are required to prevent digestive distress. Methods used to deal with this issue include:

1. Diluting the formula to reduce the amount of carbohydrates from being consumed
2. Including Multi-Milk® in the recipe to reduce the carbohydrate content
3. Adding lactase enzyme or lactose-eating bacteria (e.g. *Lactobacillus*) to the formula

Growth rates in hand-reared cubs

Hand-reared animals typically have a delayed growth rate compared to maternally-raised cubs. There are many factors which contribute to that.

1. Cubs receive maternal antibodies *in utero* (before birth), in the colostrum and in the milk. Mother-raised cubs receive considerably more passive immunity to a variety of pathogens than the hand-reared cubs.
2. Many times, hand-reared cubs are pulled because they are poor-doers and are nutritionally and/or immunologically compromised from the start, and simply don't have the ability to make up for lost time.
3. The hand-rearing formula, no matter how nutritionally sound it appears, is restricted to the nutrients in the powder mixes. As we learn more about nutritional idiosyncrasies of each species, we find that many times the form of protein, fat or carbohydrate in the artificial formula is not compatible with those in the maternal milk, and may not be as digestible. All we can do is our best with what we know at any given time. Over the years, milk formulas have improved vastly, and will no doubt continue to improve in the future.
4. Formulas given are not nutritionally balanced or are deficient in one or more major nutrients such as protein and fat. An average weight gain of approximately 5% body weight while on milk formula and 8-10% weight gains during the weaning process are the targets (Hedberg, 2002). There will always be some fluctuation where there may be a 2% gain one day and 8% the next. So the key is to see what the average is over a period of 3-5 days. If the cub is consistently maintaining weight for several days or only has slight gains, the formula composition and feeding schedule should be evaluated. Barring any health problems to explain a delayed growth rate in an individual, low weight gains are generally related to a diet that is not meeting the caloric and/or protein requirements.
5. Cubs that are weak may not have the energy to consume the target volume of formula at each feeding. In these cases, small, frequent feedings and the addition of LRS+ 2.5% dextrose given subcutaneously (SQ) may be more appropriate. Weak cubs may also take longer to transition onto the stock formula because of weakened organ function. Close monitoring of these cubs is warranted to ensure they begin gaining weight as soon as feasible, without stressing their immune system any more than necessary. Even in these cases, the cubs should ideally be on a formula at 80-90% full strength concentration within five days and possibly another two days to get to the full-strength stock formula. If diarrhea occurs when these cubs go onto the full-strength formula, they may do better on a 2:1 or 3:1 dilution (full-strength formula: water) as their stock formula.

Hand-rearing wild neonates is part "art" and part science. Over the years, neonate caretakers have given a variety of infant diets, some of which were nutritionally sound, and some were not. As our knowledge increases, so must the quality of the diet we provide. Many times animals "seem" to do fine on a particular milk formula, but when compared to maternally-raised infants are smaller and less robust. Because there are many individual idiosyncrasies of infants that contribute to the "art" of hand-rearing, providing diets that are the most nutritionally sound should contribute to the healthiest cub possible.

Product List
Gerber's® baby food
1-800-4-GERBER (1-800-443-7237) www.gerber.com

Knox® Gelatin
Kraft Foods™ www.kraftfoods.com/knox

Pet Ag™
261 Keyes Ave., Hampshire, IL. 60140
1-800-323-0877/ 1-800-323-6878 www.petag.com

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Appendix 1: Calculated values for Kcal/day and ml/feeding

Weight	ME (Kcal/day) [70 x bw (kg)$^{.75}$ x 3]	ml/feeding (Stomach capacity)
450g. (15 oz.)	115 kcal/day	22.5 ml/feeding
500g.	125	25.0
550g.	134	27.5
600g. (20 oz.)	143	30.0 (1 oz.)
625g.	148	31.25
650g.	152	32.5
675g.	156	33.75
700g.	161	35.0
725g.	165	36.25
750g. (25 oz.)	169	37.5
775g.	173	38.75
800g.	178	40.0
825g.	182	41.25
850g.	186	42.5
900g. (30 oz.)	194	45.0 (1½ oz)
950g.	202	47.5
1.0 kg. (2.2 lb)	210	50.0
1.1 kg.	225	55.0
1.2 kg.	241	60.0 (2 oz.)
1.3 kg.	256	65.0
1.4 kg.	270	70.0
1.5 kg. (3.3 lb)	285	75.0 (2½ oz)
1.6 kg.	299	80.0
1.7 kg.	313	85.0
1.8 kg.	326	90.0 (3 oz.)
1.9 kg.	340	95.0
2.0 kg. (4.4 lb)	353	100
2.1 kg.	366	105 (3½ oz)
2.2 kg.	379	110
2.3 kg.	392	115
2.4 kg.	405	120 (4 oz.)
2.5 kg. (5.5 lb)	418	125
2.6 kg.	430	130
2.7 kg.	442	135 (4½ oz)
2.8 kg.	455	140
2.9 kg.	467	145
3.0 kg. (6.6 lb)	479	150 (5 oz.)

*A complete hand-rearing manual is available by request from the author at zoonutrition@msn.com.

Cheetah Fast Facts

• In the wild Cheetahs don't often drink water as they get the moisture they need from the bodies of their prey.