NUTRITION AND NUTRITIONAL PROBLEMS IN CAPTIVE WILD HERBIVORES

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Introduction

The challenges facing the wild life nutrition are quite different than those for nutrition of domestic animals. There are nearly 50,000 species of vertebrate animals in the world. Zoos may exhibit approximately 3000 of those species (only 6%) and there are about 150 ruminant species. The challenge this reality presents is immense because of the enormous variety of animals, dietary habits, nutritional, and behavioral requirement that the nutritionist should know. Dietary choice of free ranging wild life is complex chemically, temporally and spatially and animals use a wide variety of morphological, physiological and anatomical adaptations to acquire and utilize food stuffs. Proper management of feeding of wild animals in captivity incorporate both husbandry skill and applied nutrition science and more attention has to be paid to free ranging wild life, particularly those of economic value to man.

Reasons for understanding wild life nutrition

- Growth, Production, and Survival are all influenced by nutrition. These are critical parameters for population dynamics.
- Nutrients, especially energy, provide quantifiable limits within which an animal and a population must operate.
- Food selection and foraging can explain other traits, such as habitat use and movements. Nutrients provide a currency which we can use to understand the behaviors of animals.

Problems in feeding of wild animals

No true species–specific nutrient requirement data are available for captive wild animals; domesticated ruminants such as cattle and goat are commonly used as models for ration formulation. But management objectives, natural feeding strategies, digestive anatomy and physiology must be borne in mind while formulating ration for wild animals.

The main objective of feeding the majority of domesticated animals is to produce maximum amount of milk or meat at minimum cost over a period of time. Because of the intensive feeding practice to maximize production of the overall herd, low level of mortality due to digestive upsets is acceptable from economic point of view. But in captive setting, such mortalities are not acceptable, the main objective of feeding captive animals is to enhance longivity and maintain optimum health over many decades. The following point are some of the limitations in the feeding of wild animal

- Appropriate domestic models have not yet been identified.
- Diet composition or digestive physiological adaptation has not been studied in adequate details.
- Lack of experimentally controlled studies in wild life species, results in inadequate qualitative information on natural feeding habits and quantitative data on food-nutrient composition and utilization for optimal diet for captive animal management.
- Guideline have to be developed to make more appropriate captive diets relating nutritional properties of food selected or avoided in nature for some of these species.
- To avoid mineral imbalance and nutritional deficiency related health problems.

Classification of Ruminants Species

Each species have evolved distinctive living and feeding strategies to cope with environmental pressures such as food availability and predators. Although ruminant physiology and eating habit vary widely, we can separate them roughly into three groups.

1. 25% Grazing animals : Eats large amount of grass - eats 3 times per day, eats lots of low nutrition grass, specialize in low digestibility fibers, do not digest sugars and are good at digesting starch.

2. 40% Browsers : Eats leaves from woody plants, eats about 18 times a day. Except in winter, they eat high nutrition sticks, twigs and fat shrubs, specialize in digesting cell solubles, they don't have access to grains in the wild and have trouble digesting them and they digest sugars well. This group is more sensitive to abrupt changes in feed than grazers.

3. 35% intermediates : Mid way between grazers and browsers

The anatomical difference between grazing and browsing ruminants in general, suggest that they process foods differently. The Difference between grazers and browsers is given in Table 1.

Although grazers will eat browse and browsers will eat grass, they will not perform well when forced to shift their diet to these extremes.

Understanding of these differences in feeding types and feeding sources are suitable for successful management of different range of herbivores animals.

A. Feeding programme

Nutritional status plays an integral role in the longevity and propagation of many species. Captive propagation is becoming increasingly important for the survival of many species.

1. Feeding strategy

- *Aim to provide a nutritionally balanced diet.* Diet must be provided in a suitable form and correct proportion based on the most appropriate physiological model or models for the species and provides the animals with all the known nutrients it requires without gross excesses and deficiencies.

- *Provide a diet that reasonably stimulates natural feeding behaviors.* A nutritionally complete diet that stimulates natural feeding behaviors encourages the animals to obtain food in manner similar to that in the wild and should allow a similar amount of time spent on feeding.

- *Provide a nutritionally balanced diet that the animal consumes consistently.* If the intended animal does not consume the diet due to poor palatability or inappropriate form of presentation, the diet is of no value. Diet intake should be periodically monitored.

- *Provide a diet that meets all of the above criteria and is practical and economical to feed.*

2. Diet Formulation

- *Back ground:* A literature review should include information on nutritional, behavioral and functional needs of the species in the captivity. The important information includes: natural diet and feeding habit, gastrointestinal morphology, normal adult weight of males and females, age of maturity, longevity of species and any special physiological needs the animals might have.

Table 1: Difference between grazers and browsers

No.	GRAZERS	BROWSERS
1	Slow fermentation rate	Fast fermentation rate
2	Large rumen	Small rumen
3	Small liver	Large liver
4	Large abomasums	Small abomasums
5	Small papillae in rumen	Large papillae in rumen
6	Large intestine and small intestine ratio is 80:20	Large intestine and small intestine ratio is 70:30
7	Intestine 25-30 times body length	Intestines are 12-15 times body length
8	Small salivary gland	Large salivary gland
9	Hind gut less important to digestion	Hind gut very important to digestion
10	Digest cell wall	Digest cell solubles

- *Diet evaluation*: Diet has to be evaluated regularly to determine the nutrient density and nutritional appropriateness of diet. If there is no known nutritional requirement available for the species in question, an appropriate domestic model can be used.

- *Diet implementation*: Concise diet and feeding instruction should be sent to the animal care takers/ keepers. It is crucial that animal care staff provide feed back to the appropriate person or department regarding animal acceptance of the diet.

- *Diet update*: The nutritional needs of an animal may change throughout its life. Diet should be changed/ adjusted when there is change in life stage, season, or if the animals health status can be aided by a change in diet. Periodically as part of feeding record, the total quantity of the diet consumed by the animal/ or group as well as diet items avoided or consumed only in part should be evaluated. Animal weight change and body condition should be monitored and reported.

3. Dietary Records

Ideally, dietary records should consist of transaction information. Information from daily animal keeper reports like animal weight, abnormal feeding behavior, keeper's comments, evaluations etc. as well as all other information pertinent to the nutritional health of the animals. Dietary records should be available for review by animal care staffs. These records will help document through out the processes regarding diet formulation and presentation that may prevent repeating past mistakes.

4. Recommended Food

All food used for behavioral enrichment must be calculated into the animal's diet. Daily diet should aim to ensure appropriate nutritional content and promote natural feeding behaviors. The natural feeding time of animals should be considered. Use of a nutritionally complete food (commercially available) will help to ensure that the animal is consistently being offered a similar level and quality of nutrients.

B. Nutritional impacts

Animals receiving inadequate diets are more prone to different type of diseases and will fail to reach their genetic potential. Ruminants require carbohydrate or energy, protein, vitamins, minerals, fibers and water. Energy is usually the most limiting factor, where as protein is the most expensive. Fiber is necessary to maintain a healthy rumen environment and prevent digestive upsets. Water is the cheapest feed ingredient, yet often the most neglected.

As a general rule most of the small ruminants will consume 2 to 4 % of their body weight on dry matter basis in feed. The exact percentage varies according to the size (weight) of the animal, with smaller animals needing a higher intake (percentage wise) to maintain their weight. Maintenance requirement increases as the level of the animals' activity increases.

1. Energy

Over nutrition with accompanying obesity is the main health issue for many captive animals. Minor addition of some food items can have a significant impact upon energy balance, so that must be considered critically in developing captive feed programme.

2.Protein

Excess protein can also prove detrimental to animal health. Excessive dietary protein containing more than 20% crude protein (DM basis) can lead to health problems like kidney disease, poor reproduction and growth in some species of animals. Copper deficiency in grazing species may be related to excess dietary protein. Molybdenum and Sulfur are known to chemically bind with dietary copper in vivo - this effect is more prevalent in ruminants. Animals fed quality forages containing high dietary protein appear to dissociate dietary 'S' in the rumen so that it can be bind irreversibly with dietary copper and induce clinical copper deficiency manifesting as bleached hair coat, anemia and ataxia. Supplementing apparently copper adequate diet or low quality forage with lower protein grass hay alleviated these deficiency symptoms.

Low level of dietary protein has been associated with increased feacal egg count (FEC) by breakdown of immune system that will increase

chances of worm infection. Protein quantity is more important than protein quality (amino acid content) in ruminant livestock since the micro organisms in the rumen manufactures their own body protein.

3. Seasonality of diet composition

Seasonal diet changes are neither widely understood nor practically managed in many captive /zoo feeding programmes. The practice of 'flushing' (Maintaining animals on a lower plane of nutrition prior to breeding season, then raising their plane of nutrition immediately before breeding.) is typical in farming operations but less frequently evaluated with captive animals. This practice may be effectively implemented and help in triggering physiologic-health or reproductive-response with seasonality.

4. Fatty acids and health

Imbalanced omega-6 and omega-3 fatty acid ratio have been associated variously with problems of immune system, neurological disorders, carbohydrate metabolisms abnormalities and joint & cardiovascular irregularities. Balanced cellular ratio is feasible for normal cell function and may reduce the risk of many diseases. Omega-3 and omega-6 fatty acids cannot be synthesized in the body and must come from the diet. So the formulated ration for captive animals should include typical ingredients like corn, sunflower, cotton seed, soya bean and sun flower oil etc. which are common source of linoleic acid.

5. Fat soluble vitamins

Vitamin A and E deficiencies are commonly reported in some species of wild animals. Vitamin A is linked with reproduction, both directly and indirectly whereas excess has been associated with teratogenicity.

Vitamin E nutrition has been evaluated in much more detail in zoo species. Vitamin E deficiency in captive population is a disease of longevity, hence frequency of occurrence increase as animals live longer. In addition to dietary inadequacies, many other nutrients interact with Vitamin E metabolism including concentration of other fat soluble vitamins, anti-oxidants and dietary lipids. Clinical signs of deficiency vary with species, but include: skeletal/ cardiac myopathies (particularly in hoof stock) and erythrocyte destruction.

6. Minerals

Mineral imbalance in the diet of captive hoof stock result in the formation of gastroliths, enteroliths, uroliths, hypocalcemia, ruminitis and acidosis syndrome. These problems can be corrected by feeding good quality of forages and mineral blocks.

C. Principles for diet formulations

Ration formulation is the tool for nutritionist to achieve the objectives. Formulations are a combination of food stuffs in definite quantities in such a way that balance and proportion of essential nutrients are respected and animal's requirements are totally met. When animals are out of their natural environment, they are not able to balance their own diets, show dietary preferences and when in a group, they compete for food. Some strategies must be developed in order to overcome these difficulties, other wise food will not be ingested in the proportion it was offered.

The basic principles are:

1. Adequate knowledge of feed to be used - Chemical composition, palatability, digestibility, preservation and storage techniques etc.

2. Determination of actual intake- How much is offered and how much is ingested should be quantified.

3. Knowledge of Nutritional composition of the diet.

4. Determination of nutritional requirements of animal species and its physiological status.

5. Determination of the mechanisms that ensure correct and proportional intake of feed that is offered.

Conclusion

The nutritional need of wild herbivores must be a primary consideration when diet is formulated. Food used to meet the nutritional needs of captive wild animals can and should be offered to the animals in a manner that promotes natural feeding behaviors. Appropriate diets for captive animals can only be achieved through the cooperation and understanding

of all scientific disciplines relating to animals.

Average Nutrient Requirement for Ungulates

NUTRIENT	REQUIREMENT
DM	80-85%
CP	14-16%
ASH	Not more than 8%
Fat	2-5 %
FIBER	12% (min)
FATTY ACIDS	3.1-6.6%
Ca	0.45-1.2%
P	0.33-0.47%.
Mg	0.2-0.33%
S	0.2-0.3%
Na	0.15-0.65%
K	0.6- 3.1%
Cu	10-39 ppm
Mn	40-250 ppm
Zn	40-250 ppm
Se	0.23-0.57 ppm
Fe	200-450 ppm
Co	0.1-1 ppm
TDN	65 %
ME	2.5 kcal/g
Vit A	3900 IU/Kg
Vit E	60 IU/Kg
Vit D	750IU/Kg
Feed intake	Approx. 1.2% of body weight
Enrichment	Should be less than 5% of total diet on as fed basis

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