Animals' nutritional wisdom

Pros and cons of cafeteria-style feeding

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Most of the factors that determine the foraging ecology and food selection of animals in the wild still remain unknown. It is not clear whether the animals have nutritional wisdom or not. Some authors support the idea that it is the environment that balances the diet of wild animals. The great variability of foods and the seasonal changes condition the composition of the daily diet of the animals (Donoghue and Stahl, 1997). According to Robbins (1993), food habits, foraging patterns, energy and time expenditures, and individual wellbeing depend on the animal's perception of its energy and nutrient requirements relative to the spatial and temporal distribution of its nutritional environment.

In general, it is considered that animals basically consume only to meet their daily needs of water, energy and to a lesser extent, salt. However, it is not clear whether they are able to consume the appropriate levels of each of the other nutrients. When feeding captive wildlife, the most widely used method is Cafeteria Style Feeding (CSF): offer a wide variety of food – usually fresh – to let the animals make their own diet (Allen, 1982). The total amount of food can be ad libitum which will give the animal a great chance of choice feeding, or more adjusted to the intake capacity of the animal that will allow just certain degree of choice feeding to almost none. At the other end of the scale there is Complete Feed Style Feeding, which consists on a homogeneous diet formulated to meet the estimated nutrient requirements of that specific species. In this case, choice feeding is impossible. In general, in captive wildlife feeding practice, the complete feed is one of the ingredients offered in a CSF, and seldom offered as the unique diet choice.

Cafeteria style

There are several studies on animal production that demonstrate and support the idea of 'choice feeding'. It has been observed that pigs and broiler chickens given a choice between two foods with different protein concentration have the ability to eat amounts of the two that give a diet that is close to optimum for growth. There is also evidence that growing chicks and broilers can differentiate from foods with different lysine and methionine concentrations respectively (Forbes and Shariatmadari, 1994). Another example is the strong appetite of laying hens for calcium, which seems to be the determining factor in their food selection. However, it is also accepted that a learning period or adjustment is needed before becoming proficient when given a choice of foods (Forbes and Covasa, 1995).

In wild animals there are also several papers that show a certain degree of nutritional wisdom for a few nutrients. For example, multiparous and reproductive females of common marmosets have a preference for calcium solutions (Power et al. 1999). McNaughton (1990) presented some evidence that the seasonal movement of migratory grazers in the Serengeti ecosystems are related to grass mineral content. There are many studies on primates that also reflect the preference for young plant parts, less fibrous and higher in protein content, which are more digestible and may be better utilised by an animal lacking a specialised gastrointestinal tract (Milton, 1978).

In some cases, there isn't any other better way of feeding a group of animals in captivity, than CSF. For instance, in big groups of animals (of the same or different species), where there may be a strong monopoly of the food source by certain dominant individuals and/or where the nutrient requirements for each species may be completely different and a unique diet is not possible. These cases always require close monitoring.

Discussion

According to all these examples, one might get the idea that CSF is a good feeding method. However, if animals had the ability to balance their diet according to their needs we wouldn't find animals in captivity with nutritional insults, and unfortunately, nutritionists have seen countless cases where the choices made by zoo animals result in nutritionally unbalanced diets (Oftedal and Allen, 1996). Moreover, we find animals that suffer dehydration or obesity, despite the fact that we know animals can regulate their energy and water intake. Dehydration occurs, for example, because water regulation capacity develops with age (as in piglets), or because there are animals that will never be able to completely regulate their water balance (like cats); obesity results when animals fail to regulate their energy intake due to the palatability of the diet or because the diet is not balanced.

In captivity animals don't find the complexity and seasonality of food resources in the wild, and additionally, it has been

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Pheasant pigeon

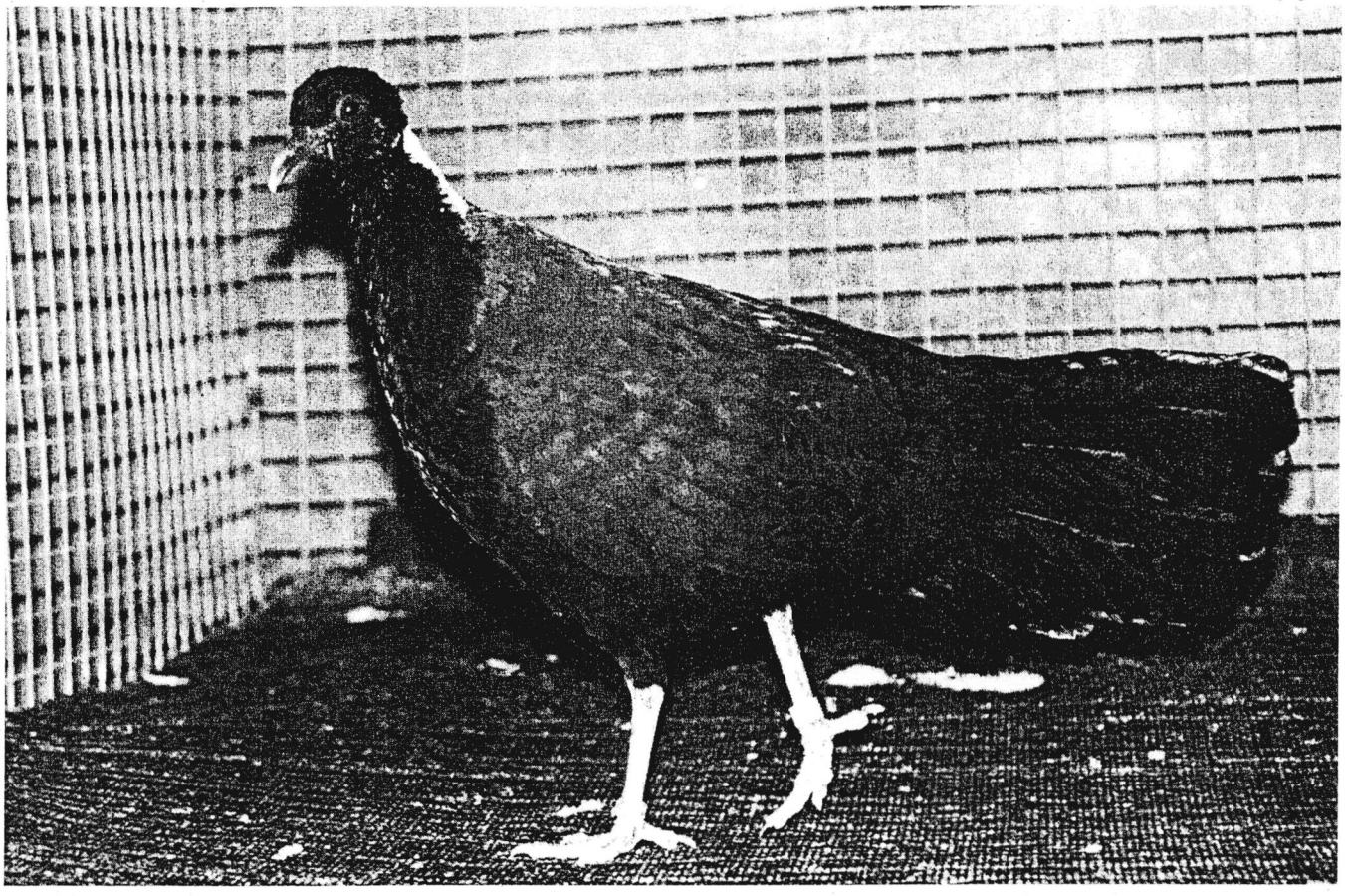

Photo: Helena Marqués

frequently demonstrated that items of importance in human or livestock nutrition are only superficially similar to foods available in the wild. Thus, in captivity animals are faced with choices that they have not evolved to make (Oftedal and Allen, 1996).

Additionally, there are many other factors known to influence food selection, which are not strictly related to the nutrient content of the diet but are also relevant, like the physiology and morphology of the intestinal tract, and the taste, texture, size and colour of the ingredients.

Example: Study on the diet of the white-naped pheasant pigeon in captivity

A study was performed at the Barcelona Zoo to investigate the diet of 11 (8.3) white-naped pheasant pigeons (*Otidiphaps nobilis aruensis*). The diet offered (DO) consisted on 10 different ingredients: 1-wheat, 2-millet, 3-canary seed, 4-Universal insectivorous diet, 5-frugivore supplement, 6-egg-rearing food with hedgerow plants, 7-lettuce, 8-fruit mix, 9-hard boiled egg and 10-mealworms *Zophoba* sp. (Marqués et al, 2000). All of them were offered close to ad libitum (CSF), except for one (*Zophoba* sp.) that was used to encourage animals to go on a weighing scale every day.

Each animal consumed only 23% of the DO, per day. Food preferences were extremely different among individuals, but some ingredients were mostly refused (4 and 6), and others widely preferred (10).

Due to the great variability of food preferences among individuals, and in order to draw some 'population' conclusions, diet ingredients were grouped into 4 categories: grains (1-3), commercial feeds (4-6), fresh vegetables (7-8) and animal protein (9-10).

When looking at the mean diet consumed (DC) of all pigeons on a dry matter basis, grains represented more than 50% of the diet. The supplement for frugivores was consumed in a second place (29%) and third was live prey (6%). The rest of the ingredients were barely consumed. Faunivores in captivity have a propensity for overeating, as they are used to performing hunting behaviours assiduously (Dilger, 1982). This could have happened if *Zophoba* sp. had not been limited.

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According to age, pigeons under 10 months consumed significantly less grain than pigeons over that age, whereas younger pigeons had a tendency to consume more commercial feeds. It has been suggested that the digestive tract of animals with a completely different diet during their early developmental stages (pigeons feed their young with crop milk), tends to adapt as diet habits change. So, the capacity to digest carbohydrates may develop later (Kirk Baer, 1999).

Pigeons were also separated into two separate groups of siblings. There were differences in the consumption of wheat and canary seed between them. This suggested a different pattern of food selection by the parents, which could have influenced the youngsters through the imprinting period.

However, when looking at the nutrients, neither DO nor DC adjusted to the nutrient requirements for pigeons (Vogel et al, 1994). Protein was within the recommended range, although this is quite large, fat was over the requirements and fibre didn't meet the recommendations. The estimated daily Metabolizable Energy intake represented 1.7 x Basal Metabolic Rate (BMR), which was within the range generally accepted for maintenance (1.5 - 2 x BMR).

Conclusion

In general, most wildlife nutritionists agree that there is no evidence to support the idea that captive animals choose their food in relation to its nutritional properties. Additionally, the factors that stimulate an animal to select its diet in the wild are different in captivity. Therefore, CSF it is not widely accepted by zoo nutritionists, and it is the job of the nutritionist to make the choices for the animal under his/her care.

In order to make the right choices, it is necessary to monitor on a regular basis all the aspects related to the feeding and nutrition of the animals (i.e. food preferences, intake, feeding behaviour, body condition, nutritional status, etc.).

To support the decisions taken by the nutritionists, it is essential we learn more about the true requirements of the animals in captivity and in the wild, and the real composition of the natural diet. We shouldn't forget that the feeding behaviour and food selection patterns of both captive and wild animals might provide us with valuable information to improve the diets of animals under our care.

References

Allen, M. E. (1982). Complete feeds or cafeteria style. 2nd Dr. Scholl Conference. T. P. Meehan, B. A. Thomas, K. Bell (eds). Chicago, Lincoln Park Zoological Society. pp. 3-7.

Dilger, W. C. (1982). Behavioural aspects. pp. 220-249.510. In: Diseases of cage and aviary birds. 2nd Ed. M. E. Petrak, Ed. Lea and Febiger, Philadelphia, PA.

Donoghue, S. and Stahl, S. (1997). Clinical nutrition of companion birds. Journal of Avian Medicine Survey 11(4): 228-246.

Kirk Baer, C. (1999). Comparative nutrition and feeding considerations of young columbidae. pp. 269-277. In: Zoo and wild animal medicine: current therapy 4. Fowler et al. Philadelphia, W.B. Saunders Company.

Forbes, J. M. and Covasa, M. (1995). Application of diet selection by poultry with particular reference to whole cereals. World's Poultry Science Journal 51:149-165.

Forbes, J. M. and Shariatmadari, F. (1994). Diet selection for protein by poultry. World's Poultry Science Journal 50:7-24.

Marqués, H., Gonzalo, C., Navidad, G. and Colom, L. (2000). Study of the diet fed to captive white-naped pheasant pigeons (*Otidiphaps nobilis aruensis*) at the Barcelona Zoo. Proc. Comp. Nutr. Soc. pp 132-137.

Milton, K. (1978). Behavioural adaptations to leaf-eating by the mantled howler monkey (*Alouatta palliatta*). pp. 535-549. In: G. G. Montgomery, ed. The ecology of arboreal folivores. Washington D.C., Smithsonian Institution Press.

McNaughton, S. J. (1990). Mineral nutrition and seasonal movements of African migratory ungulates. Nature 345(6276): 613-615.

Oftedal, O. T. and Allen, M. E. (1996). Nutrition and dietary evaluation in zoos. pp 109-116. In: Wild Mammals in Captivity. D.G. Kleimann, M.E. Allen, K.V. Thompson, S. Lumpkin, eds. Chicago, University of Chicago Press.

Power, M. L., Tardif, S. D., Layne, D. G. and Schulkin, J. (1999). Ingestion of calcium solutions by common marmosets (*Callithrix jacchus*). Am. J. of Prim. 47:255-261.

Robbins, C. T. (1993). Wildlife feeding and nutrition. Academic Press. 2nd Edition.

Vogel, C., Gerlach, H. and Löffler, M. (1994). Columbiformes. pp 1200-1217. In: Avian medicine: principles and application. B. W. Ritchie, G. J. Harrison, and L. R. Harrison. Wingers Publishing, Inc.