ANALYSES OF DIETS FED TO BABIRUSA (Babyrousa babyrussa) IN CAPTIVITY WITH RESPECT TO THEIR NUTRITIONAL REQUIREMENTS

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Abstract: Although very little is known about the diet of Babirusa in the wild, they have been successfully kept in captivity in zoos around the world for 200 years. Studies have shown that the anatomy of their digestive tract is quite different from that of the domestic pig and as a consequence their food digestion is also likely to be different. As part of a wider study of the digestion of the Babirusa, the diet fed to animals in 25 zoos worldwide (16 Europe, 7 USA, 2 Indonesia) were analysed for their nutritional content. The results of these analyses will be presented and discussed in the light of the findings of other recent experiments on the food selection, diet digestion and foraging behaviour of Babirusa.

Keywords: Babirusa, *Babyrousa babyrussa,* Suidae, Feeding, Zoo, Diet composition.

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1. Introduction

Studies have shown that the anatomy of the stomach of the Babirusa is more complex than that of the other pigs (Langer, 1988). As a consequence, the composition of the diet they select and the way in which this is digested can be expected to be different. Information on the composition of the diet of Babirusa in the wild is limited to a few general statements, indicating that they eat leaves, roots and fruits as well as invertebrates, meat and fish (Valentijn, 1726; Whitten *et al.*, 1987; Macdonald, 1991). Despite this lack of information on their food habits in the wild, Babirusa have been successfully kept in captivity for at least 200 years. The first Babirusa kept in Europe were housed in "la Ménagerie du Roi", Paris, and were fed on a mixture of grass, herbs, roots, fruits and grains as well as occasional animal matter (Geoffroy-St-Hillaire & Cuvier, 1842). In more recent times Babirusa in zoos around the world are still fed on a mixture of roughly the same items. As part of a wider study of the food selection and digestion of the Babirusa, the diets fed to animals in 19 zoos world-wide were analysed for their nutritional contents. A selection of the results of these analyses (dry matter, protein and digestive energy) are presented here and discussed in the light of the findings of other recent experiments on the food selection, diet digestion and foraging behaviour of the Babirusa.

2. Material and methods

From March 1991 until May 1993 all zoos world-wide housing Babirusa (16 zoos in Europe, 7 in the United States and 2 in Indonesia) were sent a questionnaire. It requested information on the constituents of the diet, the way in which the food is offered, the daily amounts fed and the preferences and dislikes of their animals. Additional information was gathered during personal visits to some of the European zoos. Data of a sufficiently detailed nature to allow analyses of the diet's nutritional contents was received from a total of 19 zoos (13 from Europe and 6 from the United States). Each zoo was allocated a code number and will be referred to by means of this number throughout this paper.

Items fed to the animals were divided into four categories: 1) fruit and vegetables; 2) pellets, grains, bread, nuts and oils; 3) meat, fish and eggs; 4) forage (including grass, hay, alfalfa, hydroponic barley, branches, leaves etc). The amount of dry matter (DM), crude protein and digestible energy (DE) for individual items within these categories was calculated from the data published by Schemmel *et al.* (1969), Jones (1979), ADAS (1986) and Holland *et al* (1991). The nutrient content of commercial pellets was calculated either from the labels sent by the zoos, or in the absence of labels estimated from the information available. The best estimate of DE values for foods fed to the

Babirusa was either derived from values measured in the domestic pig (ADAS, 1986) or calculated from the formula:

$$DE\ (MJ/kgDM) = \frac{\text{crude protein(g/kgDM)} \cdot 18 + \text{Ether extract(g/kgDM)} \cdot 31.5 + \text{carbohydrate(g/kgDM)} \cdot 16.3 - \text{Englyst fibre(g/kgDM)} \cdot 14.9}{0.96}$$

which was adapted from the Provisional Equation published by the EAAP Working Group (Batterham, 1990).

For this presentation, the daily intake of DM, crude protein and DE by the adult male Babirusa was calculated. Information on the amounts of forage ingested was often too vague to allow even rough analyses of its nutritional composition. The effect of forage on the daily intake of protein and other nutrients will be discussed for those zoos that fed a fixed amount of forage daily and all year round.

3. Results

Results are summarised in figure 1(A-D). For each graph, the amount of food and nutrients offered was plotted in ascending order to illustrate the wide range of amounts fed (total amount of food = 1400 - 4770 g; DM = 355.5 - 2108 g; crude protein = 43.1-398.5 g and DE = 5.49-29.12 MJ). Note therefore that the sequence of the zoo code numbers on the x-axis is different in each of the four graphs. This was to demonstrate that the zoos feeding the highest amounts of food (Fig. 1A) are not necessarily those which also feed the highest amounts of DM, protein and DE (Fig. 1B-D) and vice versa. Zoos feeding the highest amounts of DM (Fig. 1B) tended to be those feeding the highest amounts of protein and DE (Fig. 1C-D).

4. Discussion

The wide range of amounts of total food fed, and the lack of a straight relationship between total food fed and DM can be explained by the differences in the proportions of the various food categories (fruit and vegetable; pellets, grains, bread, nuts and oils and meat, fish and eggs) within the diet. Zoos feeding large amounts of fruit and vegetables may seem to be feeding their pigs a large amount of food. However, a lot of the weight fed to these animals is water. Similarly, when a large proportion of the diet is made up of commercial pellets (water content approximately 13%) the zoos may be perceived to be feeding their animals only a small amount of food. But in fact, the animals are receiving a lot more nutrients than when they would be fed an equal weight of fruit and vegetables. Particular caution should be taken in the feeding of pellets and grains since small amounts of these items can represent a large proportion of the total amount of DM, protein and DE that the animal is receiving.

Four zoos provided data which enabled the exact amount of forage consumed per day to be analysed. For example, zoo number 7 feeds 200 g grass daily which raises the values in figure 1 only slightly (from 3617, 788.91, 55.11 and 7.77 to 3817, 818.90, 60.12 and 8.03 for total amount of food, DM, crude protein and DE respectively). In zoo number 22 the animals receive 1.6 kg of alfalfa hay daily. This raises the values for total amount of food, DM and DE (from 3826, 1827.5 and 23.98 to 5425, 3289.9 and 37.73 respectively), but its impact is most important on the amount of protein in the diet which rises from 398.5 to 647.10. Because it is dried, alfalfa hay contains significantly more dry matter per unit weight than fresh grass. In addition alfalfa hay has a higher protein and DE content than other hays. Therefore, caution should again be taken when feeding alfalfa since small amounts will make large contributions to the total DM, protein and DE intake.

Experience with the feeding of domestic pigs suggests that the range of values for the different nutrients in the Babirusa diets is too wide for all the diets to supply the requirements of the animal. The exact nutritional requirements of the Babirusa remain unknown, but a number of estimates can be made from studies carried out on the domestic pigs. The maintenance DE for a 90 kg Large White pig can be calculated to be 13.5 MJ/day from the equation: ME maintenance $=1.75Pt^{0.75}$, with Pt = protein weight in the body (16% of the body weight for a Large White pig) and DE = ME/0.96 (Whittemore, 1993). Taking into account that the Babirusa has a smaller mature size and is a non-developed pig, its Pt can be expected to be lower than that of a Large White pig. If we estimate the Pt of the Babirusa to be 12% of the body weight, its maintenance DE would be 11.0 MJ/day.

The maintenance requirement for crude pro-

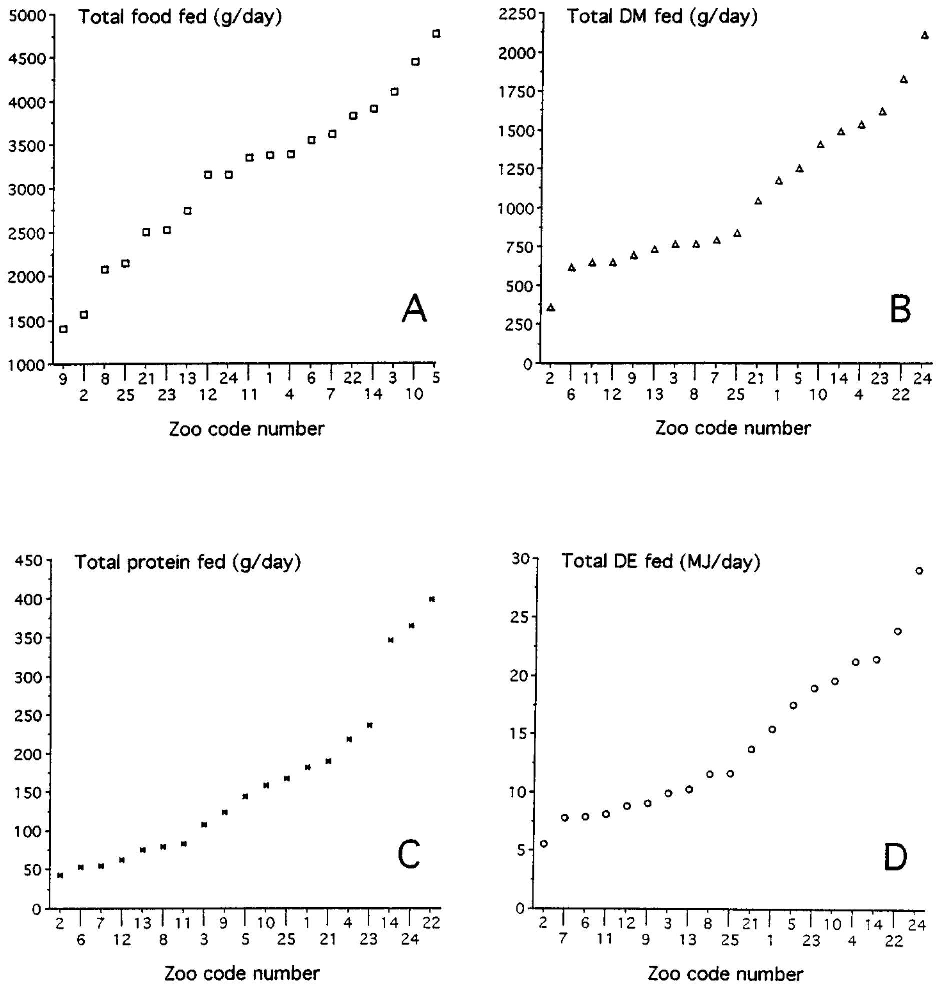

Figure 1 - A: Total amount of food offered daily to an adult male babirusa, not including forage.
B: Total amount of dry matter (DM) offered daily to an adult male babirusa, not including the DM derived from forage.
C: Total amount of crude protein offered daily to an adult male babirusa, not including the crude protein derived from forage.
D: Total amount of digestible energy (DE) offered daily to an adult male babirusa, not including the DE derived from forage.

tein in the diet can be estimated from the formula: Ideal protein maintenance = 0.004 Pt (Whittemore, *op cit.*). Using the same Pt values as above yields 58 g for Large White and 43 g for Babirusa. If we estimate the protein score to be 0.7 and the digestibility 0.75, then the required amount of crude protein in the diet for maintenance of a 90 kg animal is 110 g for Large White and 82 g for Babirusa.
When we apply the estimated values for the Babirusa to figure 1C and 1D, some zoos seem to be feeding their animals up to four times the requirement for protein and up to twice the requirement for DE, which will result in the animals putting on weight. By way of contrast, a number of other zoos seem to be feeding their Babirusa below the maintenance values. These animals should theoretically not be able to survive. This anomaly may be explained either by the feeding of forage (the value of which could

not be calculated into the total), the incomplete reporting of information in the questionnaire, or by the extra food given to the animals by the public; peanuts and bread are two of the favourite items fed to the animals in a zoo, both of which are high in energy. For example, 100 g of peanuts contributes 93.7 g DM, 25.6 g crude protein, and 4.42 MJ DE and 100 g bread contributes 60.5 g DM, 8.5 g crude protein, 0.96 MJ DE. Even small amounts of these items fed by the public can therefore make an important impact on the total daily intake.

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