Chopping food PHOTO PAIGNTON ZOO

CHOPPING ZOO FOOD

Should zoo food be chopped?

Amy Plowman, Whitley Wildlife Conservation Trust, Paignton Zoo, Kiri Green and Laura Taylor, School of Biological Sciences, University of Plymouth, United Kingdom

The food provided for many zoo animals is often chopped into small pieces. What are the reasons for chopping food and should zoo food even be chopped?

Abstract

Food provided for zoo animals is often chopped into small pieces even if the animals are capable of processing much larger items. Chopping food takes time and increases the risk of bacterial contamination and nutrient loss. Anecdotally, keepers chop food because: it enables all individuals in a group to obtain enough of each food type and reduces aggression; it prevents wastage caused by animals taking one bite and discarding the rest of a large item; it enables a wider scatter feed to encourage foraging behaviour and prolong feeding time.

We investigated these explanations in a primate and an ungulate species. Food was provided in four conditions: chopped/clumped, chopped/scattered, whole/clumped and whole/scattered. Study subjects were observed individually at feeding time, during which number and type of each food item eaten, instances of aggression and total feeding time were recorded. The behaviour of each subject was also observed for two thirty-minute sessions at other times throughout the day. Neither food size nor distribution significantly affected any of the variables measured for most of the subjects. However, the most subordinate primate was able to obtain significantly more food ($P = 0.008$) when it was whole rather than chopped and the chopped/clumped condition resulted in significantly less foraging throughout the day ($P = 0.013$) by the ungulates in one of three zoos. Chopping food does not appear to have any of the advantages keepers assume, suggesting that if animals are capable of processing it, food should be provided whole to avoid the increased risk of contamination and nutrient loss and to save keeper time.

Why chop food?

Chopping food has several disadvantages: it takes large amounts of keeper-time, the chopped edges increase the risk of bacterial contamination (e.g. Gleeson and O'Beirne, 2005) and the rate of nutrient loss (e.g. Brecht, 1995). Conversely, leaving food whole may allow the animals to express more natural feeding behaviour (e.g. Young, 1997) and increase their food processing time (Smith *et al.*, 1989). So why do keepers chop food? Reasons offered are:

1) It reduces aggression and enables all individuals in a group to obtain enough of each food type.
2) It enables food to be scattered more easily across large areas of the enclosure to encourage foraging behaviour and prolong feeding time.
3) It prevents wastage caused by animals taking one bite and discarding the rest of a large item.

Effects of food item size and food distribution

However, there are inconsistent reports of the above-mentioned effects and it appears that food item size and distribution are often confounded, i.e. chopped food is scattered whereas whole food is presented in clumps, and so their separate effects may not be apparent. In this study we attempt to distinguish between the separate effects of food item size and food distribution and to investigate whether the suggested advantages of chopping food are valid in a primate (Sulawesi crested black macaque *Macaca nigra*) and an ungulate (Brazilian tapir *Tapirus terrestris*) species.

Methods

Study subjects

Three adult female Sulawesi crested black macaques (in a group of 3.5.3) were studied at Paignton Zoo. The subjects, the most dominant female, the most subordinate female and a female of intermediate status, were selected on the basis of their known dominance status. Eight Brazilian tapirs served as study subjects, including 1.2 at Paignton Zoo, 1.1 at Newquay Zoo and 1.2 at Bristol Zoo. The Paignton and Bristol groups consisted of an adult pair and their latest infant (both four months old at the time of study), whilst at Newquay Zoo there was a female and her infant (six months old at the time of study).

Tapir eating whole 'greens' PHOTO PAIGNTON ZOO

CHOPPING ZOO FOOD

Macaque eating whole 'fruits' PHOTO PAIGNTON ZOO

Feeding conditions

The usual diet for all animals in the study included a mixture of dry feed and various fruit and vegetables, with the exact variety and quantity of food items varying between groups. Each group was provided with its normal diet at the usual time during the study, in all cases the produce part of the diet was provided once per day. For the study this produce part of the diet was presented in two size conditions (chopped or whole) and two distribution conditions (clumped or scattered) resulting in four conditions overall: whole/clumped, whole/scattered, chopped/clumped and chopped/scattered. The same weight of each produce type was provided on each study day within each group.

In the chopped condition food items were chopped into four to 12 pieces of as consistent size and shape as possible. In the whole condition similar sized items of each type were selected and left unchopped, except for some very large items such as pineapples and watermelons, which were chopped into two or four pieces. The clumped condition consisted of two or three large clumps of food depending on discussions with keepers; no keepers would allow only one clump of food due to the perceived risk of aggression. In the scattered condition food was scattered over the entire enclosure.

For the macaques each feeding condition was repeated on 15 days in a random sequence, allowing each macaque to be observed five times in each condition. For the tapirs each feeding condition was repeated on 12 (Paignton and Bristol) or eight (Newquay) days in a random sequence, allowing each tapir to be observed once in each condition.

Data collection

The total weight of each fruit or vegetable type offered each day was recorded. The average piece weight of each produce type was determined each day by weighing a subset of pieces. Any uneaten food was retrieved from the enclosure and weighed to determine wastage each day.
Each study subject was observed individually using continuous focal sampling for the first thirty minutes after providing the food. The number and type of each food item eaten was recorded, allowing calculation of the weight of each food type eaten and total weight of food eaten from the known average piece weight. The diversity of food eaten was calculated using Shannon's diversity index. Any instances of aggression were also recorded along with the total time spent feeding during the thirty minutes. Each subject was also observed for two thirty-minute sessions at other times throughout the day and his or her behaviour (Table 1) recorded using instantaneous sampling every minute.

Table 1 Basic ethogram for Brazilian tapirs (*Tapirus terrestris*) and Sulawesi crested black macaques (*Macaca nigra*) for observations outside of feeding times.

Behaviour	Description
Resting	Standing still, sitting or lying with head raised or lowered, not engaging in other activity except sniffing or observing surroundings.
Foraging	Searching for food (not including browse) on ground or in substrate and consuming it if found.
Suckling	Infants and mothers only – recorded when infant being suckled
Active	Any active behaviour not defined above including walking, running or other movement (not foraging), eating browse, drinking, defecating, urinating, social behaviour, investigative behaviour e.g. playing or sniffing environment, sexual behaviour, scent marking.
Not visible	Animal out of sight or otherwise not possible to determine its behaviour

Analysis

The data were analysed using randomisation tests equivalent to two-way ANOVAs (design 7; Todman and Dugard, 2001) to determine the effects of food item size and distribution on the total weight of food consumed, diversity of food items consumed, total feeding time, aggression during feeding, total food wasted and occurrence of other behaviour types throughout the day. Analyses were performed for the three macaques as a group (using group daily means, N = 5 days), for the most subordinate macaque individually (using individual daily values, N = 5 days) and for each tapir group separately (using individual daily values, N = 3 or 2 tapirs). In all tests thousand re-randomisations were used and the resulting P-value is the proportion of re-randomisations that returned a difference between the means of the feeding conditions equal to or greater than that observed.

Results

For the macaques neither food size nor distribution significantly affected any of the variables measured when looking at the whole group. However, the most subordinate individual consumed significantly more food (P = 0.008) when it was left whole rather than chopped, but food distribution had no significant effects (Fig. 1).

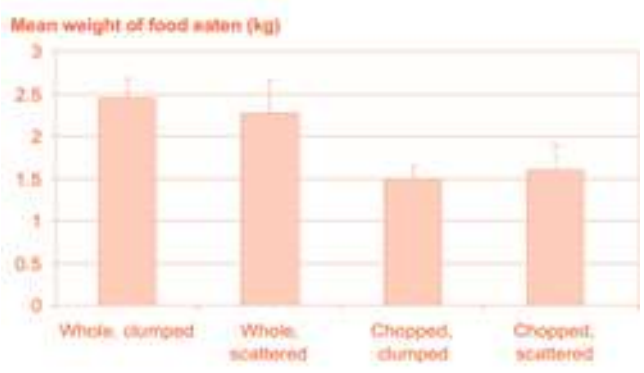

Figure 1 Mean (± SE) total weight of food eaten by the most subordinate adult female macaque in four feeding conditions.

For the tapirs there were no significant effects of food size or distribution on any of the variables measured, except at Paignton Zoo where the chopped/clumped condition resulted in significantly less foraging behaviour throughout the day than the whole/clumped condition ($P = 0.013$) with both the whole/scattered and chopped/scattered conditions being intermediate (Fig. 2). It was not possible to test the effect of food presentation on aggression since only two instances of aggression were observed during the study.

It was not possible to test for differences in food wasted across the four conditions in either species since there were very few days on which any food at all was left uneaten.

Discussion

The reasons offered by keepers for chopping food offered to zoo animals were not supported by the results of this study:

Chopping food allows all animals to obtain a fair share of food and reduces aggression

Contrary to this assumption, the most subordinate female macaque consumed significantly more when the food was left whole. Although unexpected, this result is actually quite intuitive: if access to food is restricted by the presence of other individuals it will be easier to acquire fewer large pieces than many small pieces. The diversity of food consumed did not differ significantly across the four conditions for either species.

Aggression among the tapirs was extremely rare and apparently not affected by feeding condition. In the macaques aggression was more common, but usually not associated with food and it did not differ significantly across the four feeding conditions. This is in contrast to some other studies (e.g. Ganslosser and Brunner, 1997), which found a significant increase in aggression when food was clumped. However these studies often include a single clump condition, which we did not due to keeper concern over potential aggression in this situation.

Chopping food allows a wider scatter feed to promote foraging behaviour and prolong feeding time

Feeding time and foraging behaviour tended to be greater when food was left whole, but in contrast to other studies neither scattering food (e.g. Lutz and Novak, 1995) nor leaving food whole (e.g. Smith *et al.* 1989) resulted in a statistically significant increase in feeding time.

Chopping food prevents wastage

For both species there was very little uneaten food in any condition and neither food size nor distribution appeared to affect the amount of food wasted.

Overall we found no evidence for any advantage to chopping food to the extent that is currently typical in many zoos. The potential for increased nutrient loss and risk of bacterial contamination at cut edges of chopped produce are well documented and chopping food often takes considerable keeper time. Therefore, we suggest that most food should not be chopped as a matter of course for those species that are capable of processing large items. Clearly, there may be some circumstances when food size needs to be small (e.g. young animals, individuals with poor dentition, for a particular enrichment method) but in general there appears to be no benefit to chopping food as the normal routine for many species. •

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