

Aspilia spp. Leaves: A Puzzle in the Feeding Behavior of Wild Chimpanzees

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ABSTRACT. Unlike other chimpanzee food items, the leaves of *Aspilia pluriseta*, *A. rudis* and *A. mossambicensis* (Compositae) are eaten without being chewed. Moreover, *A. pluriseta* and *A. rudis* are eaten slowly and singly and particularly in the early morning. This unusual behavior suggests that *Aspilia* leaves offer peculiar stimuli, perhaps with pharmacological effects.

INTRODUCTION

Young leaves of a particular herb genus (*Aspilia*, Compositae) were found to be eaten in an unusual manner by wild chimpanzees. They were usually eaten slowly and singly (at one study site) without being chewed (at both sites). Since feeding efficiency on these leaves is considerably lower than that on other leaves, it is possible that the leaves contain rare nutritive or non-nutritive compounds or elements, which may be attractive to chimpanzees. Nutritional analysis of *Aspilia* leaves are not available, and are unlikely to be rewarding until there are clues as to which class of compounds or elements are relevant. However, we present our observation here, to stimulate further studies of this unusual feeding behavior.

METHOD

Two population of chimpanzees were observed, both at Tanzanian sites on the shore of Lake Tanganyika. R. W. W. studied two social groups in Gombe National Park in 1972 and 1973. The study site was described by GOODALL (1975), WRANGHAM (1977) and CLUTTON-BROCK and GILLET (1979). Individual adult males were observed as focal animals for up to 13 hr continuously. Their behavior was recorded every minute as a point-sample (ALTMANN, 1974); their companions' behavior (i.e., all chimpanzees within 100 m) was recorded every 5 min. Observations were made in all months except February, March and April, and totalled 1,026 hr. Additional data come from the observations of numerous trained assistants working in Gombe between 1964 and 1973.

T. N. studied two social groups in the Mahale Mountains from 1965 to 1979. The study site was described by NISHIDA (1968) and NISHIDA and UEHARA (1981). Observations were made mostly by ad-lib sampling (ALTMANN, 1974), and the data presented here are from recent observations of one group (K-group) totalling 1,242 hr as follows: 95.5 hr (1974), 250.5 hr (1975), 439.8 hr (1976), 149.1 hr (1977) and 307.0 hr (1979).

In both studies chimpanzees were habituated to the presence of observers. Plants were identified by Drs. J. B. GILLET and C. KABUYE of the East African Herbarium, Nairobi. In Gombe it was not always possible to distinguish the two species of *Aspilia* in the field, and they are therefore considered together.

RESULTS

FEEDING TECHNIQUE

Chimpanzees ate young leaves from many different species of herbs, shrubs and trees (Gombe, 54 species, WRANGHAM, 1977; Mahale, 117 species, NISHIDA & UEHARA, 1983). Most of these were eaten quickly and continuously: leaves were picked singly or stripped in numbers off the stem, and added to those already being chewed. Clear exceptions to the normal leaf-eating method occurred in only three cases. These were *Aspilia pluriseta gondensis* (O. HOFFM.) WILD, *A. rudis* OLIV. and HIERN (both found only in Gombe) and *A. mossambicensis* (OLIV.) WILD (found at Mahale). Leaves of all the *Aspilia* species are eaten without being chewed, although those of *A. mossambicensis* are picked off in a usual manner described above (Fig. 1).

All are herbaceous straight-stemmed plants up to 1.5 m tall, occurring in grassland or deciduous woodland. In Mahale, *A. mossambicensis* tended to occur in *Bauhinia petersiana* thicket on valley slopes or near the shore of Lake Tanganyika. Their leaves have a rough surface and no very striking taste to humans. Only young leaves were eaten, between about 2 cm and 10 cm long, and up to about 4 cm broad. At Gombe, feeding was normally preceded



Fig. 1. *Aspilia mossambicensis* (OLIV.) WILD found in Mahale. (Drawn by M. UEHARA)

by a careful visual inspection and sometimes by "tasting" with the lips; chimpanzees closed their lips over a leaf on several occasions, and once did so six times before picking it.

At both sites, either the whole leaf or (more usually) the distal half was selected. At Gombe, it was normally picked only after the previous leaf had been swallowed, and typically one leaf was taken at a time. (On a few occasions, however, a chimpanzee stripped five or six leaves from the stem by a single movement of one hand.) Instead of chewing the leaf, the chimpanzees would take it into its mouth on the tongue, and appeared to rub it against the upper palate, often leaving the jaw slack. Jaw movements observed when the mouth was closed also suggested that the leaves were being rolled around. Once the leaf was seen being folded inside the mouth by the tongue, and on two occasions leaves of *A. rudis* were folded before being put in the mouth. No chewing with the teeth was seen.

The lack of chewing indicated that the leaf was unlikely to be damaged much by being eaten. This was confirmed by faecal analysis. In Mahale, entire leaves or halves of leaf were found regularly in chimpanzee faeces (Table 1) and showed no evidence of having been chewed. Faeces contained up to 50 leaves ($\bar{x} = 9.2$, $N = 17$). In Gombe also the only leaves identified during faecal analysis between 1964 and 1967 were those of *Aspilia* spp., found in 19 months. (Faeces were not examined subsequently.)

Leaves were usually swallowed without any special facial expressions by the chimpanzee. During one eating bout of Gombe, however, an adult male wrinkled his face above the nose as he swallowed. He did this with 3 out of 45 leaves, and the rest were swallowed normally. While wrinkling his nose the male appeared to be inhaling.

Table 1. Monthly variation in the per cent of faeces containing *A. mossambicensis* leaves.*

Month	% faeces with <i>A. rudis</i> leaves	Sample size (No. of faeces)
January	10.5	114
February	12.2	115
March	1.7	235
April	0.0	199
May	1.0	195
June	0.0	235
July	1.6	320
August	2.6	274
September	0.9	218
October	1.0	105
November	0.5	204
December	1.1	95

*Data were collected in the Mahale Mountains from 1975 to 1979 by T. NISHIDA, S. UEHARA, M. HIRAIWA, R. NYUNDO, M. SEIFU, J. KATENSI and A. KASULAMEMBA.

FEEDING RATE

Feeding rate when eating *Aspilia* spp. leaves at Gombe was slow for two reasons. Only one leaf was normally eaten at a time, and each leaf was itself eaten slowly. Ingestion rates in different bouts at Gombe varied from 2.4 per minute for large leaves ($N = 40$ leaves) to 15.4 per minute for small leaves (ca. 2 cm, $N = 16$ leaves). The median rate was 5.0 per minute, i.e., a leaf every 12 sec ($N = 7$ bouts); this was the same rate of leaf-eating as occurred in the only timed bout in Mahale.

The number of minutes spent eating *Aspilia* spp. leaves was recorded at Gombe on ten of the days when it was eaten, and varied from less than 1 min to 25 min per individual (median 15 min or 75 leaves). On most occasions there were many young leaves still available when the chimpanzees left the patch. This contrasts with many species of herbaceous leaf, for which all the young leaves available were commonly consumed in one session.

DIURNAL VARIATION

Most chimpanzee foods were eaten throughout the day. However, although this was true of *Aspilia mossambicensis* in Mahale, the Gombe data showed a striking exception. First, the time of 46 bouts of eating *A. mossambicensis* was recorded in Mahale. Eating occurred from 9:11 to 19:43, and appeared to be evenly distributed across the day, or possibly biased towards the afternoon when the diurnal variation in observation time was taken into account. By contrast, all bouts of eating *Aspilia* spp. at Gombe fell between 6:30 and 7:45 with a median point at 7:15 ($N = 20$). Thus in Gombe feeding on *Aspilia* spp. leaves was virtually restricted to the first hour after dawn. This occurred even when there were no *Aspilia* leaves close to the nest site: on at least five occasions chimpanzees made detours (up to 5-min walking) directly to an *Aspilia* patch, before travelling in a different direction to eat fruits or other foods. No other foods were eaten at such confined times, though diurnal variation occurred in the eating of some other items. For instance, in general leaves were eaten later in the day than fruits (WRANGHAM, 1977). The clearest example was *Ficus exasperata* VAHL (Moraceae) which in 12 bouts at Gombe was eaten between 15:00 and 20:00 with a median midpoint at 17:00. *Aspilia* spp. leaves were the only leaves eaten most in the morning at Gombe.

FREQUENCY OF EATING

In Gombe *Aspilia* spp. leaves were eaten in ten bouts during 1,026 hr, i.e., one feeding bout per 102.6 hr. Direct observation and fecal analysis showed that *Aspilia* spp. leaves were eaten in all months except April and November. In three months of focal observation (July 1972, probably *A. pluriseta*; December 1972 and January 1973, probably *A. rudis*) chimpanzees were observed on 22 mornings, and they ate *Aspilia* spp. leaves on 8 of them, or 36.4%. On 2 of the 14 mornings when they did not eat *Aspilia* spp. leaves, chimpanzees encountered a patch without showing interest in it.

In Mahale *A. mossambicensis* leaves were eaten on 18 occasions in 1,242 hr, i.e., once per 69.0 hr. Feeding was recorded in all months, but was commonest after the beginning of the wet season. This is illustrated in Table 1, which shows a peak in the eating of *A. mossambicensis* in January and February. The frequency and seasonal occurrence of eating *Aspilia* spp. leaves were therefore similar in Gombe and Mahale.

ASSOCIATION WITH FEEDING ON OTHER ITEMS

In Gombe *Aspilia* spp. leaves were eaten both in periods of food abundance (e.g., January 1973) and food scarcity (e.g., July 1972, WRANGHAM, 1977). To find out if *Aspilia* spp. leaves tended to be eaten in conjunction with particular other foods, those eaten immediately before

and after *Aspilia* bouts were recorded. On most days (15 out of 22, i.e., 68%) *Aspilia* spp. leaf was the first food eaten. On the remainder the foods eaten before it were all different, and included fruits of five species and leaves of two species.

Those eaten after *Aspilia* bouts were recorded on ten days. Food selection again appeared to be varied. Nine different foods were eaten, comprising five fruits, two leaves, one seed and one flower. All were typical for the season.

If *Aspilia* spp. leaves provided insignificant calorific value, it might be expected that the total feeding time per day would be greater when they were eaten (*Aspilia*-days) than when they were not eaten (non-*Aspilia*-days). To test this the number of minutes spent feeding before 12:00 was scored on *Aspilia*-days, and matched to the same measure from the non-*Aspilia*-day closest in date (maximum difference was one week). Eight pairs of *Aspilia*-days and non-*Aspilia*-days were obtained. On *Aspilia*-days the median number of minutes spent feeding before 12:00 was 178, of which 15 were spent on *Aspilia* spp. leaf. On non-*Aspilia*-days the median was 129 min. This suggests that more time was spent feeding on *Aspilia*-days (Wilcoxon $T = 4$, $N = 8$, $p < 0.05$, two-tailed). However, in view of the considerable variation in feeding time per day (WRANGHAM, 1977) this result must be treated with caution until a larger sample size is available.

INDIVIDUAL VARIATION

No evidence was obtained of individual variation in the tendency to eat *Aspilia* spp. leaves. In Gombe a total of 21 individuals was recorded eating it, including both sexes from two different social groups (Kasekela and Kahama communities, GOODALL, 1975). The youngest was a 2-year-old female, and the oldest was a senescent male of about 40 years. Differences in the number of *Aspilia* observations per individual were explicable by differences in observation time. The same was true in Mahale, where 12 individuals, of both sexes, were seen to eat *A. mossambicensis*.

Normally all the chimpanzees present at an *Aspilia* spp. patch ate leaves. On two occasions when this was not the case those who did not eat were individuals who ate leaves on other days.

DISCUSSION

The results show that feeding on *Aspilia* spp. leaves was peculiar in two principal ways. First, chimpanzees ate each leaf slowly and individually (but not in Mahale), rolling and pressing them around the mouth, and did not chew them. Second, in Gombe they ate them only in the early morning.

Without chewing, the massaging of plants in the mouths and digestive tracts of vertebrates might release the cell contents, and even if the plant cell walls remain intact, nutrients may be extracted through the stomach by the enzymes and microorganisms of the digestive tract. However, chewing is a powerful and effective way of digestion. Why do chimpanzees refrain from chewing these particular species of leaves and not others? This remains a puzzle. We are not aware of any other animals which eat leaves without chewing them.

However, it seems clear that *Aspilia* leaves could not have provided sufficient calorific value to merit the time taken to find and eat them, given that foods such as ripe fruits were

available on the same days. Probably, the young leaves may contain nutritive or non-nutritive compounds attractive to chimpanzees, the concentration of which could vary with the time of day at least at Gombe, as ROBINSON (1974) found for alkaloids in the leaves of three species (though it is surprising that the Gombe and Mahale populations differed in this respect).

No chemical analysis of *Aspilia* leaves is available, but ethnomedicine suggests that there may be pharmacological agents in *Aspilia* leaves. Thus, WATT and GERDINA (1962) mention the medical use of the root and leaves of *Aspilia* by African people; "The Shambala drink an extract of the root of *Aspilia holstii* O. HOFFM. for the relief of lumbago, sciatica and neuralgia. The Pare use the plant along with *Hymenodictyon parvifolium* as a remedy for threatened eclampsia, the mode of application ensuring free perspiration. In Tanganyika, one of the indigenous galactagogues, for both human and cattle, is made from the leaf and root."

JANZEN (1978) listed many anecdotal but suggestive cases of the use of secondary compounds as a medicine by mammals. HAMILTON, BUSKIRK and BUSKIRK (1978) pointed out one suspected case of drug use by primates (*Papio ursinus* eating *Datura* spp.). In the present case it seems unlikely that *Aspilia* leaves were used as a source of medicine since there was little individual variation in eating it. The possibility that *Aspilia* leaves provided attractive stimulants is supported by the increased feeding time on mornings when chimpanzees ate *Aspilia* leaves at dawn.

More data are needed to elucidate the significance of eating *Aspilia* spp. leaves. The unusual way of eating them, and the geographical difference in the time of days when they were eaten suggest that further investigation would be valuable.

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