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Studies on Feeding Biology of Endemic Arboreal Snail Species *Acavus Haemastoma*

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Abstract- Endemic arboreal snail *Acavus haemastoma* in nature goes for encrusted plant materials such as lichens and mosses even soft tissues of the plants itself. However, it prefers any succulent plant materials as its alternative food indicating that raising them in the laboratory culture for study purposes and conservation practices.

Index Terms- Acavids, Food preference, acceptability index, Food materials

I. INTRODUCTION

Acavids are generally considered to be lichen feeders although no detailed reports to this effect are available. Analyzing the gut contents in the gut of an animal is indicative of the food materials consumed by it. The food may also determine choice of a particular habitat where the preferred food is available in adequate amounts. Thus, a study of diet in analyzing the gut contents is useful in examining habitat preference. In a study of animal population biology, food is one of the important factors affecting the distribution and abundance of a species. Food may influence a population's chance to survive or multiply by modifying the fecundity, longevity, or development of individual members in that population.

II. MATERIALS AND METHODS

1. Analysis of gut contents of *Acavus haemastoma*

The adult snails of almost same size (seven from each site Weligama and Uyanwatte) were collected from different tree species listed below (Figure 1),

1. Jak (*Artocarpus heterophyllus*)
2. Bread fruit (*Artocarpus altilus*)
3. Arecanut (*Areca catechu* L)
4. Coconut (*Cocus nucifera* L)
5. Kitul (*Caryota urens* L)
6. Kottamba (*Telminalia catappa*)
7. Banana (*Musa sapientum* L)

Figure.1. Localities from where snails were collected

Snails were collected from trees listed above at 7.00 hrs after active feeding had begun. They were immediately drowned in 90% ethanol and 90% ethanol injected into the gut by piercing the shell. In addition to this two more snails moving on the ground in each site were treated in the same way. The specimens were all brought to the laboratory and immediately dissected, and the crop contents of the crop of each snail were placed separately in 70% ethanol and examined under the microscope. Once the observations were made separately, the crop contents of each individual was filtered, dried at the room temperature and the weight of each sample was also measured in order to measure the mean total amount consumed by an individual snail. The composition of the gut contents was identified under the microscope. This was sufficient for study. Composition and abundance of individual components of the gut contents were identified.

2. Food Preference of *Acavus haemostoma* under Laboratory Conditions

Laboratory experiments have shown that different diets result in considerably different growth rates in *Cepaea nemoralis* Linnaeus (Williamson and Cameron, 1976). Although there is no evidence showing an effect of food shortage on density of natural populations of *C. nemoralis,* it has been suggested by Wolda *et al* (1971) that the quality of food might limit this species

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abundance. Furthermore, for many animals, food may also determine choice of a particular habitat (Drickamer and Vessey, 1982; Crawley, 1983). Thus, a study of diet in the snail is essential to the study of its population biology and habitat preference and also in application of conservation practices. Previous studies on certain snails such as *Cepaea nemorals* indicated that it eats a wide range of plant species, both in the laboratory (Grime *et al*, 1968; Grime & Thornton, 1970) and in the field (Wolda *et al* 1971; Richardson, 1975). Nevertheless, the snail has quite specific food preferences. According to Grime *et al* (1968) palatability of the food materials to the snail is important in feeding of snails. Further, Grime *et al* (1968) examined fresh leaves of 52 plant species in the laboratory, and found that only about 20% were palatable to the snail. Also Wolda *et al* (1971) have shown that some plant species fairly common in field areas occupied by snails were never found in the guts of snails. However, according to Richardson (1972) the snails did not discriminate between plant species, but between dead and fresh materials. Thus, the senescent plant materials were preferred to fresh ones (Carter *et al*, 1979).

This preference might well be true of these Acavids feeding mainly on lichens with respect to show co-evolution - plant/primitive animals association. There have been two phases in the evolution of the Class Gastropoda. Firstly, the mega evolutionary phase which led to the emergence of the biological model which we define as " gastropod" and secondly, the elaboration of this model in a variety of ways with the production of innumerable variants each of which is able to function effectively under restricted and specialized circumstance. This second phase of adaptive radiation of the gastropods is heavily based on modifications, development and transformations of the original feeding mechanisms.

The adaptive radiation of gastropods was mainly brought by diversification of feeding methods in which process the following consideration is important, retention of an important primitive feeding organ, the radula and the tendency to retain as a general rule the ancient function of ingesting food in the form of comparatively small particles (Woulda *et al*, 1971).

In terms of diversity of feeding habit the adaptive radiation of the Pulmonata may appear rather restricted, but the Pulmonata have colonized all conceivable habitats in freshwater and on dry land. Morphological adaptations of the feeding apparatus have commonly evolved in dietary specialists (Hughes, 1980; Jensen, 1981a). These adaptations increase handling efficiency, thus increasing food value (Hughes, 1980). This is important because dietary specialists often feed on 'low -value' food items (Hughes, 1980).

The present investigation was undertaken to study food preference in the laboratory situation partly in view of finding a solution for *in situ* breeding of this species as well as the other Acavids.

Furthermore, observations made directly in the field were compared with the results from the laboratory study. The field study was carried out in Uyanwatte located in Matara district (approximately 80° 23′ N, 5° 29′E, elevation 10m) where the population of *Acavus haemastoma* under investigation occupied an abandoned compound 1km long and 10-15 m width, with mixed vegetation comprising mostly Breadfruit, Arecanut, Jak, Papaya, Coconut and Kottamba trees and Kolakaesea plants.

2.1. Materials and Methods

In this study observations were confined to *Acavus haemastoma* alone. Normally, snails feed in the night and in the early morning, and observations were made from 5.00-7.00 hrs on the feeding snails. Records were made as to time of feeding, identification of trees. On the tree trunk the easily available source is lichen such as fruticose type. The lichen samples were collected and identified to some extent according to Hale (1981) who worked on the lichens in Sri Lanka.

Various techniques have been reported to determine the acceptability of food materials for snails (Grime *et al*, 1968; Dirzo, 1980; Chang, 1991).Species, *Acavus haemastoma* rared in large glass tank transferred to small tank, one each of the populations was starved for 36 hrs and then given a single item of food as listed in Table 1.3. Each food items was weighed at the beginning of the experiment and weighed after 24 hrs. This was repeated for 7 times and the seven replicates were taken. Before starting the experiments, the formula for the acceptability index (AI) applied by Chang, (1991) was formulated as the quotient of **Weight of test material consumed**, Weight of the maximum quantity consumed for the standard, the maximum quantity was measured by feeding a starved snail in a small glass cylinder with snake gourd (*Trichosanthes cucumerina* L) were soft tissue for 24 hours in the dark, and measuring weight loss of the food items. Seven replicates were carried out like this and mean standard was taken to obtain the standard. Snake gourd was selected at the trials along with other different food items.

In the present study comparisons have been made by separating the food materials into four categories: highly acceptable (AI >0.5), moderately acceptable (0.5 > AI >0.1), rarely acceptable (0.1 > AI 0), and unacceptable (AI = 0) to determine the mean maximum food material consumed by an adult snail. The amount of food item consumed was calculated by setting feeding experiment with control. i.e.

1 - 10 g of the food item and a snail
2 - 10 g of the food item alone

Both preparations were kept in the dark for 24 hours. After feeding, the left over, and the material in the control were dried in an oven and weighed. The relationship between the weight of the material before and after the experiment is expressed as:

$$X_{before/}\, Y_{before} = (X_{after} + X_{consumed})/Y_{after}$$

In which, X: weight of the test materials in the snail jar
Y: weight of the test materials in the control jar

Then, weight of the consumed material was calculated by,

$$X_{consumed} = X_{before} \text{ x } Y_{after}/Y_{before} - X_{after.}$$

The same procedure was performed for all the material tested.

III. Field Observations

Throughout the field study casual observations on snail feeding were always made. In order to obtain quantitative data, direct observations of feeding were made between 5.00 A.M and 7.00 A.M. These observations were made despite the difficulty of observing snails at nights.

IV. RESULTS AND DISCUSSION

The studies on the diet of other snails indicated that they eat a wide range of plant species, both in the laboratory (Grime *et al.,* 1968; Grime and Thornton, 1970) and in the field (Wolda *et al.,* 1971; Richatdson, 1975). Carter *et al* (1979) examined food preference of the snails, *Cepaea nemoralis*. Apart from this, Wolda *et al* (1971) have shown that some plant species fairly common in field areas occupied by snails were never found in the crops of these snails. Acavid snails, arboreal as well as the terrestrial ones may have their respective food preference. As far as the arboreal snail species, *Acavus haemastoma,* used in this investigation, is concerned; it has its specific food preference in the field (Table.1.1).

These values are applicable to snails from on trees as well as those collected on the ground. It appears that lichens whether intact or broken into their constitution the major part of the crop constituents. Detail identification of the lichens was not possible.

Table. 1.1. The contents in the crop of *Acavus haemastoma* collected in the field in decreasing order of abundance viewed under the microscope.

lichens
moss
plant epithelial tissues
soil particle
bark pieces

Hyman (1967) has made a generalization that terrestrial pulmonates commonly eat the vegetation available in their habitat and are not selective in the choice of their food material. Runham and Hunter (1970) have also observed that slugs feed on leaves, stems, bulbs, tubers, and also consume materials like fungi, lichens, algae and animal materials. The analysis of the gut contents of *Acavus haemastoma* from its natural habitat (Table.1.1) has shown that the major portion on is lichens even though a wide variety of edible materials are available in its locality. This may be due to the adaptation of the radula for scraping and not suitable for cutting any plant tissue like in the *Achatina*.

Table.1.2 and Table.1.3 indicate dietary preferences under laboratory conditions. In the present study it is indicated that this snail is herbivorous and while a variety of acceptable food material was provided this snail exhibited a tendency to relish such vegetable material with higher water content. Further, when given a choice to select among different vegetable material provided *A. haemastoma* invariably gather around the sliced pieces of pumpkin and fed on them voraciously. However, snails kept under forcible longer period of starvation were found to feed on other available soft plant materials even the filter paper, toilet tissue *etc* (Table.1.2 and 1.3). The results of acceptability index also show the food preferences of *A. haemastoma*, the plant materials with rough tissue and were rejected by the snails. This type of food rejection by the snail species was also shown by various workers (Grime *et al*, 1968; Williamson & Cameron, 1976; Carter *et al*, 1979)(AI = 0). Some materials have shown mean acceptability index of which the materials are with low water content (AI = 0.01).

Food preference in the field and laboratory can be compared (see table.1.1, 1.2, and 1.3). In the natural state lichens with lesser water content contribute the major source, whereas in the laboratory, they rank as 4 (Table.1.2 and 1.3). The results are organized in Table.1.2. and 1.3.

This laboratory study indicates that the Acavids could be raised on the plant material supplied in the laboratory.

1. Diet may restrict its distribution
2. Avoid in competing with other snails for resources.

Laboratory studies show feeding plasticity – wide range of food can permit its culture in the laboratory. This may be tested to produce viable egg laying populations, which may then promote i*n situ* conservation.

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Table.1.2 Dietary preference of *Acavus haemostoma* by weight of food consumed.

No	Food material supplied	Moisture content (%)	Dietary preference of *Acavus haemostoma*
1	Papaya fruit	96.00	+++
2	Nutrient Agar	95.25	+++
3	Snake Gourd	94.26	+++
4	Sliced pumpkin	92.75	+++
5	Mushroom	92.74	+
6	Jak fruit	92.56	++
7	Lettuce	90.25	+
8	Banana peel	88.96	+
9	Cabbage	86.48	++++
10	Carrot	85.37	+
11	Green Leaves	82.75	+
12	Bread fruit leaf	82.71	-
13	Onion	82.70	-
14	Chow chow*	80.79	+++
15	Lichen species	80.25	+++
16	Tomato	75.79	-
17	Salad leaves	75.25	+
18	Banana fruit	73.36	++
19	Jak leaf	73.25	-
20	Leeks	72.50	+/-
21	Chicken Sausage	72.50	-
22	Apple	70.69	++
23	Bitter gourd	70.28	+/-
24	Beat root	69.26	+
25	Potato	65.79	++
26	Cucumber	64.25	++
27	Grass species	60.50	-
28	Bread fruit	60.27	+
29	Maliban Marie Biscuit	0.92	++
30	Filter paper	0.00	++

- Sign indicates the negative response for feeding on the material

+ Sign indicates the preference of the snail to, feed on the material and the numbers of signs indicates intensity of feeding on respectively and intense liking.

+/- Sign indicates its liking or reluctance of the snail to for feeding on the material provided

++/+++ Sign indicates the intense liking of the snail to feed (*Mohanadas, 1989)

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Table.1.3. Acceptability/Preference indices of 30 food materials as testing materials to snails

No	Food material	Acceptability Index
1	Snake Gourd	0.524 + 0.125
2	Papaya fruit	0.521 + 0.122
3	Mushroom	0.512 + 0. 215
4	Lichen species	0.498 + 0.225
5	Cucumber	0.438 + 0.952
6	Sliced pumpkin	0.432 + 0.255
7	Nutrient Agar	0.422 + 0.199
8	Chow chow	0.412 + 0.092
9	Banana fruit	0.345 + 0.245
10	Apple	0.325 + 0.012
11	Cabbage	0.252 + 0.189
12	Banana peel	0.235 + 0.091
13	Jak fruit	0.215 + 0.122
14	Tomato	0.210 + 0.045
15	Filter paper	0.189 + 0.121
16	Maliban Marie Biscuit	0.185 + 0.245
17	Carrot	0.174 + 0.290
18	Beat root	0.132 + 0.233
19	Potato	0.130 + 0.119
20	Bread fruit leaf	0.122 + 0.009
21	Bread fruit	0.099 + 0.132
22	Leeks	0.098 + 0.782
23	Salad leaves	0.078 + 0.542
24	Lettuce	0.018 + 0.980
25	Green Leaves	0.009 + 0.136
26	Bitter gourd	0.00
27	Chicken Sausage	0.00
28	Grass species	0.00
29	Onion	0.00
30	Jak leaf	0.00