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THE EFFECT OF ISOPOD FEEDING ACTIVITIES ON LITTER MICROBIOL POPULATION

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ABSTRACT

All levels of grazing reduced fungal standing crop and increased bacterial standing crop. The gut content and faeces of isopod, however represent a more favourable environment for bacterial growth, while fungal growth decreased along the intestinal tract and then increased in the faeces.

INTRODUCTION

Considering the role of litter-feeding soil fauna and microbes in the decomposition of plant litter, there has been an increasing discussion on the interactions between soil fauna and microbes as to how such interactions effect the process of litter decomposition and also of the possible effect of soil fauna on the growth and activities of soil microbes. It is evident that different types of feeding habits might be expected to affect decomposition rates in various ways and an understanding of animal nutrition is important in assessing

the role of soil fauna in the process of litter decomposition (Kayang et al., 1994). In view of this, it was necessary to assess the feeding biology of isopod fauna on microbial population by analysing litter, gut contents and egesta of isopods.

MATERIALS AND METHODS

(a) Preparation of litter samples

Leaf litter of *Alnus nepalensis* D. Don was collected shortly after leaf fall from an alder stand at Upper Shillong, the capital of Meghalaya (alt. 1500 m MSL, lat 25° 34'N, long. 91°56'E), air-dried at room temperature and brushed to remove all

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debris and faeces. Midribs were removed and laminae cut into small pieces (0.5-1.0 cm). Aliquots of 2g were placed in microcosm chambers as described by Anderson & Ineson (1982).

The litter in each chamber was soaked in distilled water for 24h to leach out soluble tannins and the already metabolised materials mobilised drying and wetting. Then the fresh leaf litter was macerated in distilled water to obtain a suspension which was used to inoculate the soaked litter and then incubated at 17°C. Isopods were not introduced to the microcosms for the initial period of three weeks thus permitting the establishment of microbial population.

(b) Feeding experiments

Burmoniscus nova (Isopoda : Philosciidae) were collected from the alder stand and stored at 17°C in plastic sandwich boxes filled with litter until required. Before introduction into the microcosms the isopods were starved for 72 h to void their guts. Subsequently 0, 5, 10 & 15 individuals were introduced in each microcosm and allowed to feed for 40 days. Microbial standing crop estimates were made after 5, 10, 15 & 40 days. Three replicates were destructively sampled on each occasion.

(c) Microbial counts

Microbial standing crop estimates were determined from direct counts of fungi and bacteria using membrane filter

technique as described (Kayang et al., 1994). Subsequent experiments were carried out using groups of ten individuals to determine the distribution of fungi and bacteria in the guts. Litter, gut and faeces were collected for analysis as described by Kayang et al. (1996). Identification of fungi was according to Gilman (1957), Barnett & Hunter (1972) and Domsch et al. (1980). No attempt was made to identify bacteria.

RESULTS AND DISCUSSION

In control microcosms, the fungal and bacterial standing crops remained almost unchanged. All levels of grazing reduced fungal standing crops (Fig. 1) and increased bacterial standing crop (Fig. 2) as observed earlier (Hanlon & Anderson, 1980; Kayang et al., 1994). This phe-

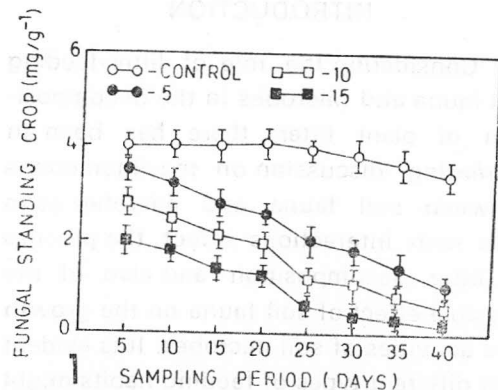


Fig. 1. Variation in fungal standing crops or fragmented leaf litter of *A. nepalensis* grazed by different numbers of isopod. Vertical lines show limits or one SE on either side of mean. Numbers represent 0-15 individuals.

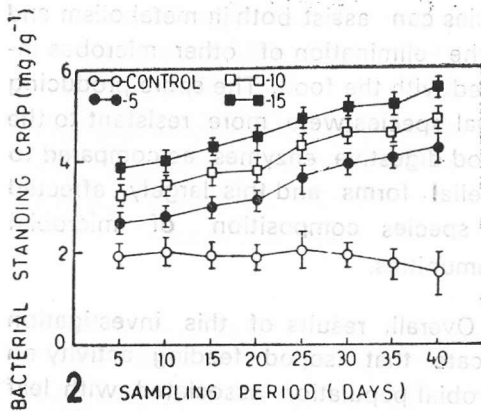


Fig. 2. Variation in bacterial standing crops of fragmented leaf litter of *A. nepalensis* grazed by different numbers of isopod. Vertical lines show limits of one SE on either side of mean. Numbers represent 0-15.

nomenon was regulated by isopod grazing as fungi are sensitive to such feedings thus render favourable environment for bacterial growth (Gunnarsson, 1987). The feeding activity of isopods in such microcosms may be species specific that some fungi or the decomposing litter remained unaffected but there is an overall reduction in the total fungal counts

The microbial population in isopod faeces was higher than the leaf litter (Fig. 3), and may thus form microhabitats of intense microbial activity corroborating the results of Hassal et al. (1987). The increase in the number of bacteria occurring in the guts of isopods (Fig. 3) is in accordance with the observations of Ullrich et al. (1991). The increase in bacterial counts was related to favourable environ-

ment and nutrients provided for the multiplication of bacteria that were ingested alongwith the litter as previously recorded (Hassal et al., 1987; Van Wensem et al., 1993).

A general decrease in the number of fungal species has been observed from litter to midgut then to hind gut (Table 1). Fungal species that subsist in the isopod intestines were *Mucor hiemalis*, *Aspergillus flavus*, *A. niger*, *Cladosporium cladosporioides*, *Penicillium chrysogenum*, *P. citrinum*, *derma viride*, *T. koningii* and *T. harzianum*. All of them were present in the faeces. The faeces of isopods were recolonised by some species that had disappeared during the transit time, such as *Aspergillus fumigatus*, *A. candidus*, *Fusarium oxysporum*, *F. solani*, *Humicola* sp., *Geotrichum candidum* and white sterile mycelia (Table 1). Griffiths & Wood (1985) have shown that the gut of isopods can be highly selective and the proliferation of a single

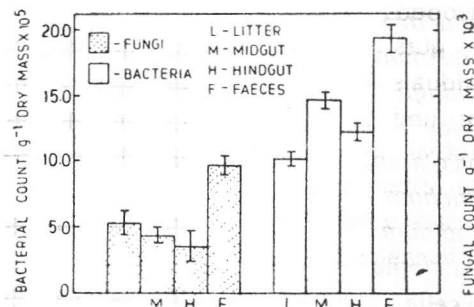


Fig. 3. The population of fungi and bacteria in litter, midgut, hindgut and faeces of isopods. Vertical lines show limits of one SE on either side of mean.

Table 1. Fungi in the litter, gut and faeces of Isopods.

Fungal species	Gut			
	Lit-ter	Mid-gut	Hin-dgut	Fae-ces
<i>Mucor hiemalis</i>	+	+	+	+
<i>Actinomucor</i> sp.	+	-	-	-
<i>Zygorynchus</i> sp.	+	-	-	-
<i>Rhizopus stolonifer</i>	+	-	-	-
<i>Pythium</i> sp.	+	-	-	-
<i>Aspergillus flavus</i>	+	+	+	+
<i>A. fumigatus</i>	+	+	-	+
<i>A. candidus</i>	+	+	-	+
<i>A. niger</i>	+	+	+	+
<i>Cladosporium</i>				
<i>cladosporioides</i>	+	+	+	+
<i>Fusarium oxysporum</i>	+	-	-	+
<i>F. solani</i>	+	-	-	+
<i>Penicillium</i>				
<i>chrysogenum</i>	+	+	+	+
<i>P. citrinum</i>	+	+	+	+
<i>Trichoderma</i>				
<i>harzianum</i>	+	+	+	+
<i>T. koningii</i>	+	+	+	+
<i>T. viride</i>	+	+	+	+
<i>Humicola</i> sp.	+	+	-	-
<i>Geotrichum</i>				
<i>candidum</i>	+	-	-	+
White sterile mycelia	+	-	-	+
Black sterile mycelia	+	-	-	-

+ = Present and - = Absent. *

species can assist both in metabolism and in the elimination of other microbes ingested with the food. The spore producing fungal species were more resistant to the isopod digestive enzymes as compared to mycelial forms and this largely affected the species composition of microbial communities.

Overall, results of this investigation indicate that isopod feeding activity on microbial population associated with leaf litter affects the decomposition of litter indirectly as the isopod egesta is a more suitable substrate for microbial growth than the uneaten litter as observed by Kayang et al. (1996). By altering the fungal species composition of litter either through selective grazing or by changing the nutrient status of the material, this soil isopod may be an important regulator of microbial activity associated with alder litter in the sub-tropical forest ecosystems of North Eastern India.

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