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STERILIZING EFFECT OF A DIETARY SURPLUS OF BIOTIN IN *TROGODERMA GRANARIUM* EVERTS

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INTRODUCTION

INSECTS in general are known to require biotin in their diet for normal growth and development.[1] Recently, it has been shown in a few insect species that an excess of biotin in the diet causes reduction in their fertility.[2-5] It is of interest to know if biotin will elicit similar reactions in insects in general. Hence, such studies were conducted with Khapra beetle, *Trogoderma granarium* Everts, which is a serious pest of stored cereals.

MATERIALS AND METHODS

T. granarium were normally cultured on broken wheat and 5% brewer's yeast at 35 ± 1° C. and a relative humidity of 65% to 70%. For biotin treatment, a chemically defined diet was used.[6] Biotin was dissolved in 0·1 N sodium hydroxide and the known amounts added to the diet. The diet was allowed to equilibrate for 48 hours with the experimental conditions. One gm. diet was kept in a glass vial of 2·5 × 5·0 cm. In each vial, 20 ten-day-old larvae were introduced. Each treatment was replicated 10 to 12 times. The adults were removed from the diet soon after emergence and the period recorded. The males and females were separated and subsequently used for appropriate crosses. The diet containing only sodium hydroxide solution was used as controls. Additional controls using broken wheat flour and 5% brewer's yeast were also kept. Crosses were made between treated males and treated females, treated males and normal females and normal males and treated females. The eggs were scored at frequent intervals for ten days and allowed to hatch. The number of eggs hatched was also recorded.

RESULTS AND DISCUSSION

Higher doses of biotin, such as 0·5% and 1·0% inhibited further development of the larvae ultimately causing complete mortality. However, there was no mortality at the lower doses of biotin even upto 90 days of treatment. Higher levels of biotin treatment resulted in mortality in house-flies[3] and in *Aedes aegypti*.[5] *Dermestes maculatus*, a closely related species, however, was apparently able to tolerate upto 1% dietary biotin.[4] Comparison of toxicity based on such treatments may be taken with caution as it is possible that the amount of biotin uptake may vary in different cases as it is dependent on the period of treatment and the actual amount of food consumed by the insect. It is evident from Table I that the lower levels of biotin reduced the number of adult emergence. It was observed that this was due to a retarded development of the larvae. In all the treatments, the time taken for adult emergence increased with an increase in the biotin content of the diet (Table I). Such a growth inhibition was not recorded in other insect species studied.[2-5] The treatments in general reduced the fecundity, but the sodium hydroxide controls also showed a similar reduction. This will mean that the fecundity reduction may be due to sodium hydroxide treatment rather than the biotin overdosage. However, sodium hydroxide has been shown to have no effect on fecundity and fertility in house-flies.[3] Biotin did cause a reduction in the number of eggs laid in the insects studied so far.[2-5]

In *T. granarium*, the primary effect of biotin treatment was found to be on the fertility of eggs. A large number of eggs were sterile and

Table I

Effect of dietary biotin on the development, fecundity and fertility of T. granarium

Per cent conc.	No. of larvae treated	No. of adults emerged	No. of days for adult emergence		Sex treated	No. of pairs mated	Total no. of eggs laid	Eggs laid/ female	Total no. of eggs hatched	Per cent hatch
			Average	Range						
0·05	240	187	37·9	29–45	Male	34	332	9·8	238	71·7
					Female	29	275	9·5	99	36·0
					Both	55	396	7·2	149	37·6
0·10	240	162	40·3	30–53	Male	35	397	11·3	262	66·0
					Female	15	70	4·7	14	20·0
					Both	40	245	6·1	54	22·0
0·25	240	59	44·9	31–54	Male	18	314	17·4	169	53·8
					Female	..	..	..	..	..
					Both	11	57	5·2	4	7·0
Control (NaOH)	100	78	33·8	28–43	None	17	87	5·1	66	75·9
Control (Normal diet)	100	96	26·8*	22–32*	None	20	309	15·5	220	71·2

* Agarwal, 1970.

consequently did not hatch. At a biotin level of 0·05%, the sterility was about 62%. This increased to 93% at 0·25% biotin treatment. In the controls, more than 70% of the eggs hatched. This reduced fertility was due to an effect on the female only as can be seen in Table I. The per cent hatch of eggs in crosses between normal females and treated males were almost same as the controls. However, in the reciprocal crosses, the percentage of eggs hatching was identical to the crosses where both the males and females were treated. These results are in conformity with the ones reported so far[2-5] and it appears that induction of sterility may be a general effect of an overdose of biotin in insects. It will be of interest to know the physiological mechanisms involved in such a specific effect on the females.

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COMPARATIVE STUDIES ON THE DIFFERENT METHODS OF ARTIFICIAL RIPENING OF BANANA FRUITS

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Introduction

BANANA fruits do not normally attain the ripening stage on the trees and so they are gathered to be ripened artificially. Various chemicals like ethylene, acetylene, coal gas and some growth-regulating substances are usually employed for artificial ripening of fleshy fruits. Banana fruits do not respond to ethylene treatment if they were previously treated with 2, 4-D.[7] The pulp/peel ratio of banana fruits treated with 2, 4-D and 2, 4, 5-T increased gradually until the ripeness condition is attained.[1-3] According to Abd-El-Wahab *et al.*,[1] the total soluble solids increased steadily during the artificial ripening of banana fruits treated with 2, 4-D and the increase began earlier in the treated than in the untreated fruits. The titrable acidity increased when the fruits reached the ripeness condition.[1,2] Kidd and West,[6] Gane,[4] Wardlow and Leonard,[9] working on the respiration of banana fruits, found that the low steady values of carbon dioxide production in the green stage raised sharply to a peak as, or just before, the