EFFECT OF STARVATION ON SOME ASPECTS OF PHYSIOLOGY OF *Zonocerus variegatus*

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ABSTRACT

The effect of starvation on the body weight, fat body, reproductive structures as well as proximate and chemical composition of adults and instars of *Zonocerus variegatus* was investigated. All the insects starved recorded weight loss, however insects starved for 24 hours recorded highest weight loss while those starved for 6 hours recorded the least. However stage of development had no significant ($P<0.05$) effect on weight loss. There was a sort of fluctuations in the fat body scores of the insects starved. Male and Female insects starved for 18 hours had the highest fat body scores while male and female insects starved for 6 and 12 hours respectively recorded the least fat body. Starvation for the different hours 6, 12, 18 and 24 hours did not affect proximate composition and the mineral content of *Zonocerus variegatus*.

Keywords: *Z.variegatus*, starvation, proximate composition.

INTRODUCTION

Zonocerus variegatus (L) is large grasshopper with disagreeable odour and multi coloured markings on its body. It belongs to the order orthoptera and family pyrgomorphidae *Z. variegatus* is a tropical African grasshopper, hence it occurs in areas with warm climate (Youdeowei, 1974). The grasshopper is a polyphagous insect and its feeds include wild range of uncultivated plant (Chapman *et. al.,* 1986). *Z. variegatus* is reported to consume more than 250 plants species among these are many crops (Chiffaud and Mestre, 1990) including citrus, coffee, cocoa, pineapple, banana, vegetables and cassava (Chapman *et. al.*, 1986 and Bernays *et. al.*, 1977)

Z. variegatus begins feeding in the morning when the temperature reaches about 26°C (Okere, 1980 or 23°C with a slowing down at temperature over 35°C (Kaufman, 1965). Modder (1983) found out active feeding to start in the morning at a temperature as low as 17°C and the extreme massive feeding was recorded at 34°C.

Z. variegatus was influenced by type of food plants they consume. Insects feed on leaves of *Manihot esculenta, Acalypha wilkensiana* and mixture of *M.esculenta* and *A. wilkensiana* gave a good volume secretion while *Chromolaena odorata, Elaeis guinesis, Aspilia* africana and *Citrus sinensis* did not favour secretion production (Idowu and Idowu, 2001).

Idowu and Akinsete (2000) reported that starvation had a positive impact on the attraction of *Z.variegatus* nymph to the different lures Idowu and Idowu (2001) also reported that starvation affect the volume of secretion obtained from *Z.variegatus.* The reserves in the fat body is reported to be decreasing as the duration of starvation increases (Chapman, 1980).

Oocytes in the ovarioles is destroyed and their contents resorted during starvation (Chapman, 1980 Marron *et.al.,* (2002) observed that rates of lipid and protein metabolism were several fold higher during desiccation However there is little information on how starvation affects the proximate and chemical composition of *variegatus*. This study is aimed at investigating the effect of starvation on the Proximate and Chemical composition of *Z. variegatus*

MATERIALS AND METHODS

Collection and Maintenance

6th Instars and adults of *Z. variegatus* were collected from different locations on the University Agriculture, Abeokuta Campus. Collection was made with a sweep net in the evening (6 – 7pm) and in the morning (7 – 8am). Collected samples were kept and maintained in wire mesh (47 x 30 x 30 cm) in the insectary under ambient temperature (29 ± 2°C) and normal relative humidity (79 – 85%).

Starvation Treatment

Insects were grouped into different categories based on hours of starvation i.e. 6, 12, 18 and 24 hours before they were preserved.

Measurement of Body Weight

The weights of the *Z. variegatus* were taken before and after each experiment was carried out, using electric balance (Mettler – toledo A. G model number AE 240).

Dissection of Insects

Adult *Z. variegatus* starved for 6 hours. 12 hours, 18 hours and 24 hours were dissected for the examination of fat bodies and their reproductive structure as described by Youdeiowei (1974). The right and left ovarioles and testicular follicles (female and male respectively) of individual insect were counted under a Binocular microscope. The length of ovarioles and testicular follicles were measured with a ruler.

Proximate and Mineral Analyses .

Proximate analysis for crude protein, fat content, crude fibre, moisture content, dry matter, crude ash and carbohydrate content of the starved *Z.variegatus* was determined by standard method as described by AOAC, (1990). Mineral analysis for magnesium, calcium, iron, potassium and sodium content of starved *Z.variegatus* was determined using Atomic Absorption spectophotometry.

Statistical Analysis

The statistical analyses of the results were performed using ANOVA.

RESULTS

Weight Loss

There was no significant difference ($P<0.05$) in weight loss of insects starved for the four periods – 6, 12, 18 and 24 hours except in Adult male starved for 24 hours. Similarly there was no significant difference ($P<0.05$) in weight loss between the male and female.

Fat Body

There was a sort of fluctuation in the fat body, starved male and female insects starved for 18 hours had the highest fat body scores while male and female insects starved for 6 and 12 hours respectively recorded the least fat body, scores.

Table 1: Weight Loss for *Z. variegatus* starved for different hours.

Hour	6 hrs				12 hours				18 hours				24 hours			
	Adult		Instar		Adult		Instar		Adult		Instar		Adult		Instar	
Sex	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Initial Weight	7.4	4.8	8.0	5.0	11.0	5.0	14.0	4.7	7.9	4.8	10.4	4.9	11.5	5.2	10.4	4.5
Final	6.7	4.2	7.4	3.9	9.4	4.8	13.7	3.6	6.9	4.5	8.7	3.1	7.3	3.3	8.4	3.3
Weight	0.7^b	0.6^b	0.6^b	1.0^b	1.6^b	0.2^b	0.7^b	0.9^b	1.0^b	0.3^b	1.4^b	1.8^b	4.2^a	1.9^b	2.0^b	1.2

* Mean values in each row having the different superscript are significantly different ($P<0.05$)

Table 2: Percentage of fat body for adult *Z. variegatus* starved for different hours

Hours	6	12	18	24
Male	83.30^b	88.90^b	94.40^a	88.90^b
Female	88.90^b	77.8^c	100^a	88.90^b

* Mean value in each row having different superscript are significantly different ($P<0.05$)

Reproductive Structure Measurement

The mean count and length of the reproductive structures of adult *Z. variegatus* starved for different hours are presented in Table 3 and 4. There was no significant different in the reproductive structures of insect for different hours ($P<0.05$) except for the length of ovarioles. However insect starved for 6 hours had a higher reproductive measurement while those starved for 24 hours had the least values. Observation showed that ovarioles on the right ovary and right testicular follicle were higher in number than those on the let row regardless of the starvation hours.

Table 3: Male reproductive structure of adult *Z. variegatus* starved for different hours.

Hours	No of testicular follicle		Length of testicular follicle (cm)	
Control	33.20±1.2	32.40±1.1	0.35±0.02	0.35±0.01
6	30.10±0.9	30.00±0.7	0.32±0.02	0.32±0.02
12	29.10±0.9	33.20±1.2	0.29±0.02	0.2±0.01
8	28.80±0.9	29.60±0.7	0.33±0.20	0.30±1.01
24	27.40±0.9	26.20±0.7	0.27±0.20	0.28±0.01

Table 4: Female reproductive structure of adult *Z. variegatus* starved for different hours

Hours	No of ovarioles		Length of ovarioles (cm)	
	Right	Left	Right	Left
Control	35.40±1.3	34.40± 1.3	0.46±0.10a	0.46v±0.02a
6	34.50±0.9	34.80±0.9	0.34±0.01b	0.34±0.02b
12	31.40±0.9	30.70±0.9	0.33±0.01b	0.33±0.02b
8	31.30±0.9	31.10±0.9	0.33±0.01b	0.34±0.02b
24	30.70±0.9	30.70±0.9	0.29±0.10c	0.29±0.02c

* Mean values in each column having different superscript are significantly different ($P<0.05$).

Proximate and Mineral Analysis

Proximate analysis of adult *Z. variegatus* starved for different hours is given in Table 5. There was no significant difference in fat content, crude protein, moisture content, dry matter, ash content, crude fibre and carbohydrate content.

Table 5: Proximate analysis of Adult *Z. variegatus* starved for different hours.

	Control		06 hours		12 hours		18 hours		24 hours	
Hours	M	F	M	F	M	F	M	F	M	F
Moisture Content	65.52	74.47	66.45	67.98	67.09	67.09	65.92	66.18	67.82	65.59
Dry matter	34.48	25.53	33.55	32.02	32.91	34.78	33.82	37.93	32.18	34.41
Fat content	4.14	3.99	3.65	4.37	2.10	2.9	2.61	5.06	2.98	5.55
Crude protein	24.36	25.14	21.02	22.81	23.84	26.11	24.06	28.15	21.76	24.10
Crude fibre	0.47	0.35	0.45	0.43	0.44	0.46	0.46	0.51	0.44	0.47
Ash content1	.29	0.94	1.21	1.31	1.26	1.45	1.21	1.44	1.68	1.34
Carbohydrate	4.22	5.11	7.22	3.28	5.27	4.15	6.40	3.77	5.28	2.95

Mineral Analysis

Mineral analysis of adults *Z. variegatus* starved for different hours showed that calcium and iron were generally low in the insects. There was no significant difference in mineral content of adult *Z. variegatus* starved for different hours.

Table 6: Mineral analysis of adults *Z. variegatus* starved for different hours.

Hours	Control		06 hours		12 hours		18 hours		24 hours	
Sex	M	F	M	F	M	F	M	F	M	F
Mg	0.03	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Ca	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
K	0.04	0.03	0.03	0.02	0.04	0.03	0.02	0.03	0.02	0.02
Na	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

DISCUSSION

This study showed varying effect of starvation on 6th instar and adult *Z. variegatus*. There was no significant different ($P < 0.05$) in the weight loss by the two development stages except in 24 hours starvation period. This may likely be due to similarities in their internal structures. Likewise adult insects starved for 24 hours recorded the highest weight loss. This is in support of Chapman (1980) observation that starvation exhausts the energy reserves of insects.

There was a significant difference in the fat body scores with those insects starved for 18 hours recording the highest fat body scores. This may likely be due to movement of the gut period of starvation between the hours of 1.00 hour to 18.00 hours which had influence the scores of the fat body (Modder, 1984). Reproductive structures measurements revealed no significant differences in the reproduction structures in the insects starved for 6 – 24 hours. This is in contrary to the observation of Chapman (1980) that starvation causes resoption of oocytes.

It was also observed the ovarioles on the right ovary and right testicular follicle were higher in number than those on the left row and this agrees with Idowu and Sonde (2003) findings. The result of proximate analysis showed that there were no significant different in moisture content, dry matter, crude protein, crude fibre, ash content and carbohydrate content of starved insects. Seyon *et. al.,* (2001) reported out that desert locust starved for three days did not show any significant difference in lipids and carbohydrates metabolism. The results of mineral analysis showed that the mineral content in the insects were generally low. This is corroborated by Romosen and Staffaleno (1998) findings that copper, Iron, Zinc, Magnessium and other metallic elements are very low in phytophagous insects.

It can be deducted from the study that short term starvation period does not have significant effect on *Z. variegatus*. Further studies need to be carried out on longer starvation period and its effect on *Z. variegatus*.

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