

CHANGES OF THE HEPATOPANCREAS ORGANIC COMPONENTS DURING MOULTING OF THE TERRESTRIAL ISOPOD *Porcellionides Pruinosus* (BRANDT) IN EL-MINOUEFIYA PROVINCE, EGYPT.

Key words: Terrestrial Isopoda, moulting, hepatopancreas, organic components, biochemistry, physiology.

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Abstract

The hepatopancreas organic components of the terrestrial isopod *Porcellionides pruinosus* (Brandt) were determined and the effect of moulting on them was studied. It was showed that the organic components of these terrestrial isopods hepatopancreas were lipids, proteins and carbohydrates. The lipid level was over 53% in dry weight, while those of protein and carbohydrate were under 7.35 and 1.23 in dry weight, respectively.

The hepatopancreatic indices, lipid and carbohydrate levels in specimens with new-exoskeletons were higher than those in the corresponding with old – exoskeletons, while protein levels in the former specimens were less than those in the latter ones.

Introduction

The terrestrial isopods play an important role in leaf litter decomposition (Schaefer, 1990; David *et al.*, 1991).

Some isopod species are a suitable bioindicator for metal contaminated soil (Dallinger *et al.*, 1992; Hopkin, 1993; Farkas *et al.*, 1996; Pokarzhevskii and Van Straalen, 2001 and Loureiro *et al.*, 2002).

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The hepatopancreas of crustaceans playing an important role in storage of organic components (Warner, 1977; Varadorajian and Subramonian, 1982). In isopods, the hepatopancreas has three major functions: (1) secretion of digestive enzymes, (2) main site of food absorption, and (3) main deposit of metabolic reserves (Clifford and Witkus, 1971; Hopkin & Martin, 1982; Guarino *et al.*, 1994).

Moulting cycle in crustaceans causes internal and external changes (Warner, 1977; Highnam and Hill, 1979; Hagedorn and Ziegler, 2002). Minerals are reabsorbed before moulting from the old-exoskeleton and stored either in haemolymph or hepatopancreas, then redeposited again in the exocuticle at the metecdysis (Brown *et al.*, 1991). The aim of this work is to study the changes of the hepatopancreas's organic components of terrestrial isopod *Porcellionides pruinosus* (Brandt) during moulting.

Material and Methods

Sixty specimens of the isopod *Porcellionides pruinosus* (Brandt) were collected in November 2001, from manure heaps near to an orchard located approximately 15 km south of Shebin El-Kom City, Menofeia Governorate, Egypt, (each sex was represented by 15 specimens for each exoskeleton case). The specimens were weighted, dissected out and the hepatopancreas was removed.

From them and weighted, its index was calculated according to Lawrence (1976).

$$\text{Hepatopancreatic index} = \frac{\text{Wet hepatopancreas weight} \times 100}{\text{Wet whole body weight}}$$

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The total soft body protein was determined as described by Lowery *et al.*, (1951) and by Ansell & Travallion (1967). Total carbohydrate was determined using the Strichland and Parsons (1968) method, while total lipid was measured by the method described by Marsh and Weinstein (1966).

The results were expressed as mean \pm standard deviation of the specimens. The obtained data were compared using student's t-test, the values of $P < 0.05$ and $P < 0.01$ were considered significant and highly significant, respectively.

Results

With regard to table 1, it shows that the mean and standard deviation values of the hepatopancreas' indices in both sexes of new - exoskeletons amounted to 10.48 ± 2.38 and 10.88 ± 3.44 for males and females, respectively. They were higher than those in the corresponding that have old - exoskeleton (9.23 ± 2.27 and 10.11 ± 2.39).

Regarding to specimens with new - exoskeletons, the mean standard deviation values of the total Lipid level in their hepatopancreas (59.82 ± 13.12 and 63.00 ± 16.62 for males and females, respectively). Were higher than those in the corresponding with old - exoskeletons (53.18 ± 16.24 and 55.93 ± 10.26 for males and females, respectively), (Fig.1). The total Lipid levels in hepatopancreas of females were higher than that of males in each exoskeleton case alone. Except males and

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females with new – exoskeletons, all statistical analyses were highly significant ($P < 0.01$), (Table 2).

In contrast to the level of the total Lipid in the studied hepatopancreas, the level of the total protein in the same specimens was higher in the individuals with old – exoskeletons of both sexes (6.39 ± 2.32 and 7.35 ± 2.30 for males and females, respectively) than those of the corresponding ones with new – exoskeletons (4.26 ± 2.58 and 5.30 ± 1.94) fig.1.A. Also, protein levels in female's hepatopancreas of each with the exoskeleton cases were higher than those in male's hepatopancreas with the same exoskeleton (fig.1.B & C). The differences in protein levels are statistically highly significant between sexes and exoskeleton cases (Table 2). On the other hand, the carbohydrate level of the measured hepatopancreas in individuals with new – exoskeletons of both sexes was approximately equal, being 1.23 ± 0.38 and 1.22 ± 0.42 for males and females, respectively. While its level in specimens with old – exoskeletons, was higher in females than males (0.83 ± 0.46 and 0.64 ± 0.32 , respectively). Also its level in individuals with new – exoskeletons was higher than those with old – exoskeletons (Table 1 & fig. 1). The differences in total carbohydrate levels between males with new and old – exoskeleton are significant ($P < 0.05$), while those between males and females with old – exoskeleton are highly significant ($P < 0.01$), Table 2.

Discussion

The hepatopancreas in crustaceans acts as the primary reserve organ for use as a source of material and energy during moulting (Gilbert

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and Oconnor, 1970; Schoffeniels and Gilles, 1970; Yamaoka and Scheer, 1970). This agrees with the present findings that the increasing values of hepatopancreatic indices in both sexes with new-exoskeletons are due to high rate of reabsorption for most materials from old-exoskeletons during moulting and stored in hepatopancreas, which lead to increase its wet weight.

The high level of total lipid in both sexes with new-exoskeletons is due to high rate of reabsorption for most constituents from old-exoskeletons during premoulting and remain high in hepatopancreas until redeposition again in the new-exoskeletons and other tissues (Highnam and Hill, 1979 and Akpan, 1997).

The lower level of protein in hepatopancreas of both sexes with new-exoskeletons than that with old-exoskeletons show the role of protein in new tissue formation after moulting and redeposition in chitin formation of the new-exoskeletons (Highnam and Hill, 1979).

The higher levels of lipid and protein in females than males may due to their necessity for ovarian development and egg formation before releasing ova (Subramoniam, 1982).

The higher level of carbohydrate in specimens with new-exoskeletons than that with old-exoskeletons ones indicates the role of carbohydrate and reflects the activity pattern of enzymes of glycogen phosphorylases and accumulation of carbohydrate in the new tissues of moulted isopod. This agrees with Reddy *et al.*, (1991) and Siuming *et al.*, (1988). While the lower level of carbohydrate in males with old-exoskeletons than females, may be due to the lower activity of females than males.

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Table 1: Mean and standard deviation of hepatopancreas' indices and levels of total lipid, protein and carbohydrate (L% DW) in hepatopancreas of the terrestrial isopod *Porcellionides pruinosus* (Brandt).

Parameters		WB	WH	HPI	Lipid	Protein	Carbohydrate	
Exoskeleton case & sex								
Old exoskeleton	Male	$\bar{X} \pm SD$	166.79 ± 34.27	15.39 ± 4.25	9.23 ± 2.27	53.18 ± 16.24	6.39 ± 2.32	0.64 ± 0.32
		Range	134.12-197.14	11.25-19.61	6.62-13.12	42.32-69.13	4.26-8.91	0.31-0.98
	Female	$\bar{X} \pm SD$	154.82 ± 28.64	15.64 ± 3.89	10.11 ± 2.39	55.93 ± 10.26	7.35 ± 2.30	0.83 ± 0.46
		Range	129.73-182.16	10.95-18.93	6.35-11.54	41.12-63.54	5.00-9.49	0.68-1.63
New exoskeleton	Male	$\bar{X} \pm SD$	157.75 ± 35.28	16.72 ± 5.21	10.48 ± 2.38	59.82 ± 13.12	4.26 ± 2.58	1.23 ± 0.38
		Range	131.18-188.64	12.18-20.03	7.34-13.28	40.20-64.02	2.06-7.79	0.73-1.59
	Female	$\bar{X} \pm SD$	149.75 ± 39.55	16.21 ± 4.98	10.88 ± 3.44	63.00 ± 16.62	5.30 ± 1.94	1.22 ± 0.42
		Range	121.11-191.12	11.14-21.10	6.98-13.42	44.05-68.00	2.96-8.35	0.82-1.68

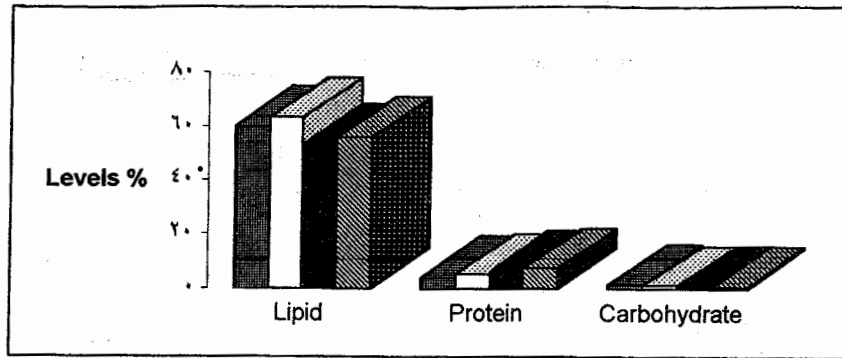
X = Mean, SD = standard deviation, WB = dry body weight, WH = dry hepatopancreas weight, HPI = Hepatopancreas indices, L% DW = level % dry weight.

Table 2. Values of student's t-test for organic components in hepatopancreas of the terrestrial isopod *Porcellionides pruinosus* (Brandt).

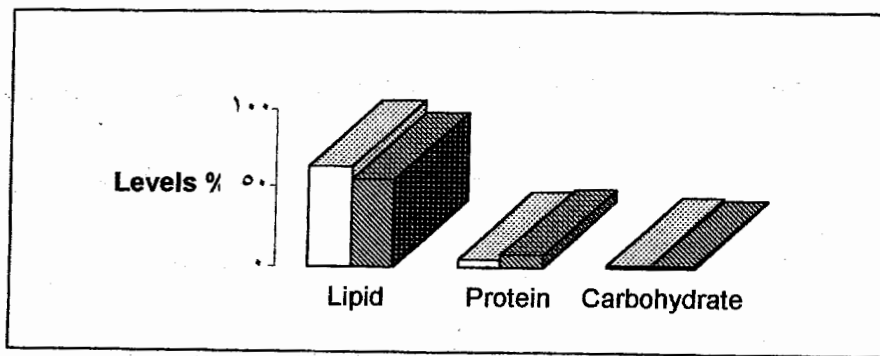
Stages parameters	Old exoskeleton ♂ & ♀	New exoskeleton ♂ & ♀	New and old exoskeleton ♂	New and old exoskeleton ♀
Total lipid	4.11 **	1.16 NS	2.88 **	2.66 **
Total protein	6.23 **	7.96 **	4.13 **	2.93 **
Total carbohydrate	3.19 **	0.83 NS	2.20 *	0.24 NS

** = Highly significant at P < .01, * = significant at P < 0.05, NS = Non significant.

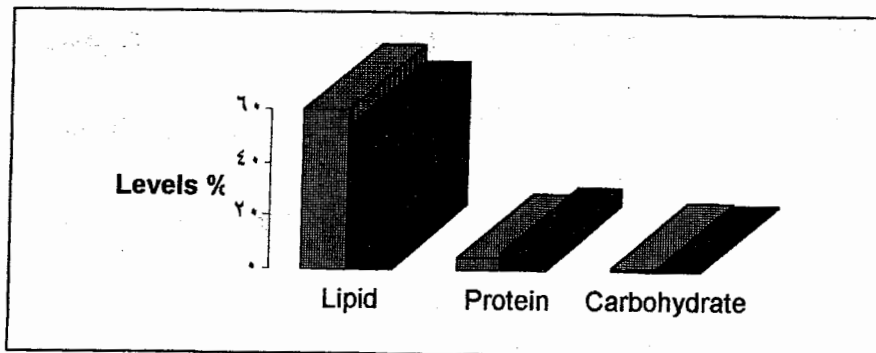
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A



B



C

Figure 1. Relationship between levels of organic components in the hepatopancreas of new and old-exoskeleton of the terrestrial isopod *Porcellionides pruinosus* (Brandt). A= Males and females, B= Females, C= Males.

التغيرات في المكونات العضوية للكبد البنكرياسية أثناء الإسلاخ في متشابهات الأرجل

الأرضية بورسيلونيدز برينوزوز في محافظة المنوفية . مصر

خالد عبداللطيف الدهوجي

الملخص العربي

تم في هذه الدراسة تحديد المكونات العضوية للكبد البنكرياسية في متشابهة الأرجل الأرضية بورسيلونيدز برينوزوز ، وكذلك تأثير الإسلاخ علي هذه المكونات ، تبين أن هذه المكونات عبارة عن دهون وبروتين وكربوهيدرات . أوضحت نتائج هذه الدراسة أن مستوى الدهون يزيد عن ٥٣ % من الوزن الجاف ، بينما انخفض مستوى البروتين والكربوهيدرات إلي أقل من ٧,٣٥ % و ١,٢٣ % من الوزن الجاف علي الترتيب . بينت هذه الدراسة أن معاملات الكبد البنكرياسية وكذلك مستوى الدهون والكربوهيدرات في العينات بعد الإسلاخ (ذات الهيكل الجديد) تكون أكبر منها في العينات قبل الإسلاخ (ذات الهيكل القديم) ، بينما مستوى البروتين في العينات الأولى كان أقل منها في العينات الأخيرة