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CHEMICAL COMPOSITION OF FRESHWATER CRAYFISH (*PROCAMBARUS CLARKII*) AND ITS NUTRITIVE VALUE

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ABSTRACT

The chemical composition of flesh and carapace of the freshwater crayfish (*Procambarus clarkii*) was determined. The relationship between body weight, total length, yield of meat and carapace was established.Average chemical composition of the flesh of male was determined to be 7% moisture, 3.1% fat, 10.2% ash, 17.5% carbohydrate, 62.2% protein, calcium 2843 mg/100g, phosphorus 343.6 mg/100g; iron 11.7mg/100g, zinc 15.1mg/100g, Selenium 0.9 mg/ loog. The present study reveals that the higher protein content in muscle of males may be due to its faster growth rate than females. Moreover, it was indicated that the present investigated crayfish contains more phosphorus than fish and the carapace contains a higher values of iron, fat and carbohydrate than muscles.

Thus, it is safely to conclude that the flesh of *P. clarkii* is recommended to stand as a source of animal protein for Egyptian citizens and its carapace can be used as a forage for animals.

INTRODUCTION

Recently, there is a growing awareness of the value of biochemical estimation of marine organisms for two purposes, the first is for understanding the process of its metabolism and physiological adaptations, while the second is for determining the possibility of using it as an alternative source of food.

Earlier investigations have shown the high nutritive and caloric value of shrimps as compared with other crustaceans and leanfish (Geng, 1925; Jones, 1926; Lanham & Lemon, 1938; Schmidt, 1950; Varela, 1955; Dabrowski *et al.*, 1969 and Bernice, 1972).

There are many investigations dealing with chemical composition of sea shellfish meat, an excellent review of which has been made by Börgstrom (1962). On the other hand, studies on chemical composition of meat of freshwater shellfish (*Astacus leptodactylus*) and (*Astacus astacus*) were conducted by Dabrowski *et al.* (1966).

The chemical composition of the crayfish *Procambarus clarkii* was investigated by many authors (Torreblance *et al.*, 1991and 1992; Ishii *et al.*, 1996 and 1998; Nagasawa *et al.*, 1996; Foa & Cooke, 1998; and Gradwell *et al.*, 1998).

The present work deals with the chemical composition of muscles and carapace of the freshwater crayfish *Procambarus clarkii* which has lately invaded our waters and has become a substantial member of the aquatic fauna in Egypt particularly Nile Delta.

MATERIAL AND METHODS

Investigated specimens were collected using a 0.7 cm diagonal net size from El-Agezy drain at Tanta city, Gharbia Governorate Collected specimens were kept in fibre glass containers, 43 x 23 x 15.5 cm

containing small pieces of rocks. Water was maintained at a depth of 12-14 cm. These containers were exposed to atmospheric air, natural light and at the room temperature, and specimens were fed with detritus, algae and some vegetation from the natural habitat. Investigated samples were catched by forceps then dried at room temperature for 12 hr and then killed with chloroform vapor. The meat was secured from the tails and claws of the samples.

Morphometric analysis of the samples:

The crayfish were divided according to sex and the following measurements made: total length (the total length was considered as the distance from the rostrum to the end of the caudal plates), total weight, carapace weight and the meat yield of edible parts.

Preparation of samples for chemical analysis:

The carapace and meat yield of 20 male and 20 female samples were dried at 105 °C to a constant weight.

Samples were crushed and finely ground in a porcelain mortar. Analyses were made on freshly ground meat samples immediately after preparation, without storing them at low temperature. Protein and fat were determined by the kjeldahl. All salts, Moisture, Ash and Carbohydrate were determined by atomic adsorption spectrophotometer.

RESULTS

Morphometric analysis:

Table (1) Shows that female crayfish *P. clarkii* of 8.5 – 11.5 cm in length and mean weight of 24.34, yield from 16.7 to 23.49% of flesh (mean 20.5%), while the male of the same length and mean weight of 29.41, yielded from 17.2 to 23.7% of flesh (mean 21%). It appears from figs (1 & 2) that there is a direct relationship between the total weight and

carapace weight and meat yield weight. Bigger individuals generally have higher percentage of meat yield. The males are some what more efficient in meat than the females.

Chemical analysis:-

- **Moisture.**
- Moisture in both sexes of the investigated samples were nearly similar (Tables 2 & 3). The moisture of muscle and carapace in male are 7 and 6.2 g/100g and the moisture of muscle and carapace in the female are 5.6 and 5.5 g/100g respectively.

- Protein.

Proteins are more concentrated in the muscle of both sexes than in the carapace (Tables 2 &3).

The muscle proteins of male is higher (62.2 g/100g) than the female (58.6 g/100g). On the contrary, the carapace protein of female is 23.5 g/100g and in the male is 15.6 g/100g.

- Fat.

It is evident from the estimated values (Tables 2 & 3) that the fat level in both samples (muscle and carapace) of male crayfish is higher than that of female. The fat level in muscle of the male is 3.1 g/100g and 4.1 g/100g in the carapace. The fat content in muscle and carapace of the female is 1.7 g/100g and 1.8 g/100g respectively.

- Ash.

The total quantity of ash which gives an index of various inorganic elements in the body, does not show any marked difference in the values in the carapace of both sexes, while the ash in the muscle of male (10.2 g/100g) is higher than the female (8.6 g/100g).

- Carbohydrate.

A perusal of Table 3 shows that carbohydrate in carapace is slightly less in the female (64 g/100g) than the male (68.7g/100g). But, carbohydrate in the muscle is considerably higher in the female (25.5 g/100g) of investigated sample than the male (17.5 g/100g) (Table 2).

- Total energy.

Calorific values of muscle in both sexs of crayfish (Table 2) are found to be higher in the female (352 kcal) than in the male (347 kcal). The values of total energy for carapace are 366 kcal for female and 374 kcal for male (Table 3).

Minerals:

- Calcium.

Calcium is considered the most important of the principal mineral element (macronutrients) which constitutes 60-80% of all the inorganic material in the body. It is obvious from Tables (4 & 5) that the amount of calcium in muscle and carapace varies with sex. Large amount of calcium was found in the muscle of male (2843 mg/100g) and the female has low value of calcium (1474 mg/100g) in its muscle. Also, carapace of male and female of investigated sample contains 1766 and 1627 mg/100g of calcium respectively.

- Phosphorus.

Obtained results demonstrate that the highest value of phosphorus is found in the muscle of both sexes. Table (4) indicates that the phosphorus values in muscle of male and female are 343.6 and 327.2 mg/100g, while the level of phosphorus in carapace of male and female are 39.5 and 45 mg/100g (Table 5) respectively.

- Iron, Zinc and Selenium.

Tables (4 & 5) show that the value of iron is the highest and selenium is the lowest in muscle and carapace of both sex. Table (5) shows that the highest value of iron in carapace of female and male are 19.9 mg/100g and 18.1 mg/100g respectively, while the muscle contains low value of iron (11.7 mg/100g for male and 8.9 mg/100g for female).

Conversely, the highest value of Zn was found in muscles of both sexes. The value of Zn in muscles of male and female are 15.1 mg/100g and 9.5 mg/100g, while carapace of the male and female have low and nearly the same value of Zn (3.8 mg/100g).

The males of investigated sample have 0.9 and 1.2 mg/100g of selenium in muscle and carapace respectively. While muscle and carapace of the female have 1.4 mg/100g and 0.8 mg/100g of selenium respectively

DISCUSSION

The present study reveals that muscle proteins of the crayfish have been observed to be more concentrated than carapace proteins. This may be due to the fact that proteins are the main components of contractile elements of striated muscles. This agrees with the previous finding of Sinha & Ahmed (1978) who showed that muscle proteins were concentrated than hepatopancreatic proteins in crabs. In view of the fact that some males of decapod crustaceans grow faster than females (Orton, 1936) and show a greater oxygen consumption as well as a higher SDH activity (Ramamurthi, 1966) it may be concluded that the higher protein content in muscle of the male indicates a faster growth rate in males as compared to the females.

The availability of such high protein in investigated species indicates their high nutritive value. This confirms the findings of Brige & Juday (1922); Orr (1934a & b) and Dabrowski *et al.* (1966).

The high values of phosphorus in muscle of crayfish *Procambarus clarkii* are in close agreement with values reported for American crayfish meat and shrimp flesh reported by Dabrowski *et al.* (1966, 1969). These values are higher than that found in the freshwater fishes such as tench and bream (Dabrowski *et al.*, 1966).

The values of ash were similar with that reported in *Streptocephalus dichotomus* and *Branchinella kugenumaensis* shrimps by Bernice (1972) and higher than that reported in the crustacean *Neomysis integer* by Raymont *et al.* (1964).

The fairly high amount of fat and the moderate amount of carbohydrate present in muscle of the male probably indicate the demand of these materials for their various active metabalic processes for the rapid completion of their life cycle.

The obtained data indicate that carapace of the male contains moisture, fat, carbohydrate, selenium and calcium higher than female, but that of female contains high value of iron, phosphorus and protein. This indicates a slight difference in the values obtained for male and female, and the carapace contains a higher values of iron, fat and carbohydrates than the muscle.

In conclusion, the present work declares that the muscle of *P. clarkii* can stand as a source of animal protein for Egyptian people, many of them suffering from malnutrition, while the dried carapace can also act as a rich constituent of poultry food. This agrees with the previous findings of Huner & Barr (1991) and Soliman, *et al.* (1998).

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Table 1. Relationship between overall length of the carapace of crayfish (*P. clarkii*) and its weight, carapace and meat yield weights.

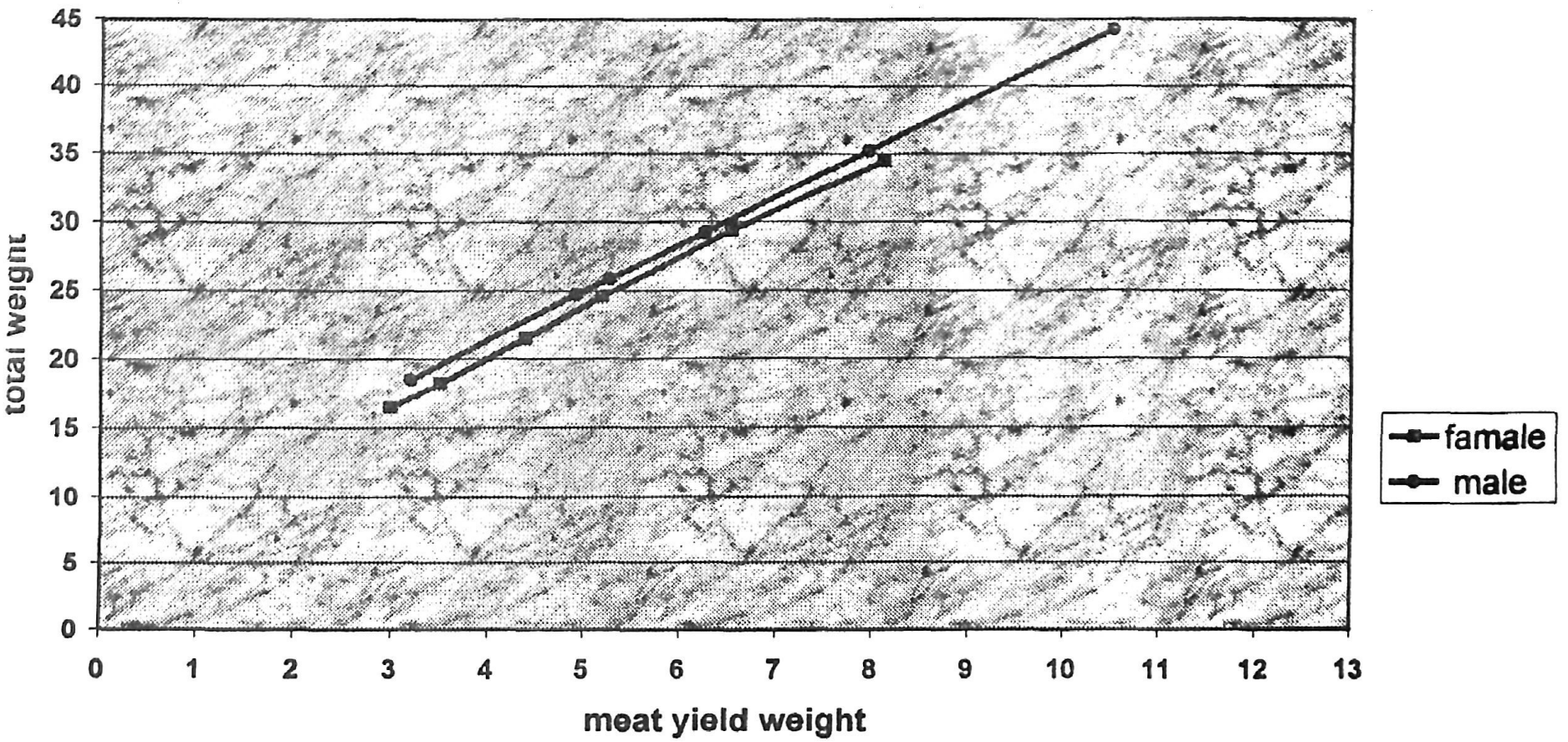
Overall length (cm)	Total weight (g)	Carapace weight (g)	Meat yield weight	
			(g)	(%)
Female				
8.5 - 8.9	17.778	1.672	2.972	16.72
9.0 – 9.4	18.242	1.728	3.487	19.12
9.5 – 9.9	21.534	1.904	4.376	20.32
10.0 – 10.4	24.571	2.238	5.173	21.05
10.5 – 10.9	29.422	2.754	6.530	22.19
11.0 – 11.4	34.513	3.395	8.108	23.49
Mean	**24.34**			**20.48**
Male				
8.5 - 8.9	18.497	1.742	3.182	17.20
9.0 – 9.4	24.731	2.063	4.896	19.80
9.5 – 9.9	25.343	2.472	5.253	20.73
10.0 – 10.4	28.400	2.928	6.246	21.99
10.5 – 10.9	35.272	3.950	7.944	22.52
11.0 – 11.4	44.263	4.688	10.488	23.69
Mean	**29.41**			**20.99**

Table 2. Chemical Composition of the meat yield and carapace of crayfish (*P. clarkii*) g/100g.

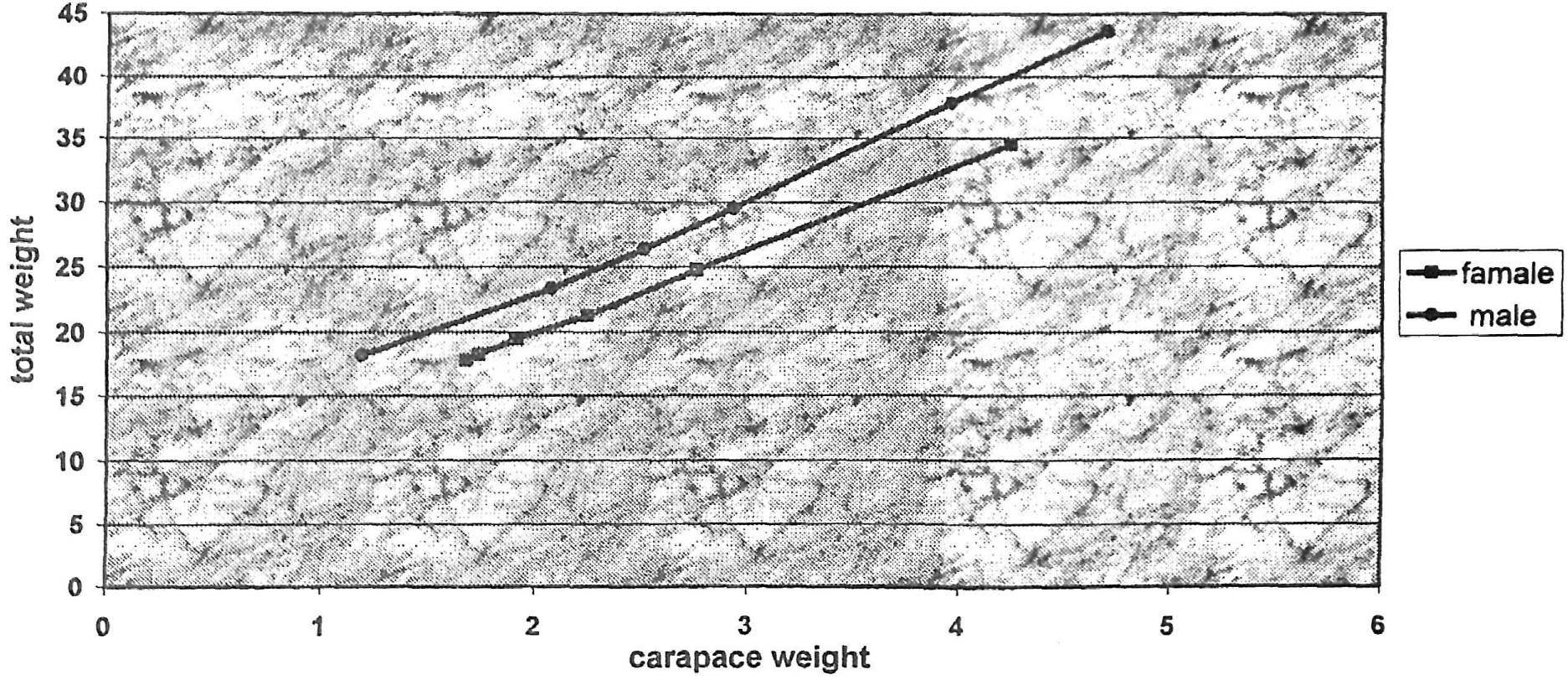
Chemical Composition	Female		Male	
	Meat yield	Carapace	Meat yield	Carapace
Moisture	5.6	5.5	7	6.2
Protein	58.6	23.5	62.6	15.6
Fat	1.7	1.8	3.1	4.1
Ash	8.6	5.2	10.2	5.4
Carbohydrate	25.5	64	17.5	68.7
Kcal (energy)	352	366	347	374

Table 3. Chemical Composition of the carapace of crayfish (*P. clarkii*) g/100g.

Chemical Composition	Female	Male
Moisture	5.5	6.2
Protein	23.5	15.6
Fat	1.8	4.1
Ash	5.2	5.4
Carbohydrate	64	68.7
Kcal (energy)	366	374



Fig(1):- Relationship between the total weight and meat yield weight in both sexes of freshwater crayfish *Procambarus clarkii*



Fig(2):- Relationship between the total weight and carapace weight in both sexes of freshwater crayfish *Procambarus clarkii*