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Full Length Research Paper

Evaluation of the edible muscles of four species of crustaceans from three regions of Egypt and Saudi Arabia

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The edible crustaceans, *Erugosquilla massavensis* (mantis shrimps), *Penaeus semisulcatus*, *Metapenaeus monoceros* (shrimps) and *Portunus pelagicus* (crabs), from different regions are important components of the aquatic fauna that have a small yet growing economic importance in the markets. These edible crustaceans can be beneficial as nutraceutical and pharmaceutical components, if we can use in the treatment of some diseases. So, the purpose of the present work was, therefore, to assess the protein, carbohydrates, and lipids, vitamins (B_1, B_2), minerals (K, Na, Ca, P, S) of these species, which may in the future play an important role in some pharmaceutical industries and may be used as specific health foods (functional supplements). In the present study, analysis of edible muscle of mantis shrimp, shrimps and crab indicated the presence of high level concentration of total proteins (52.11%) in male *E. massavensis;* male and female *E .massavensis* recorded the largest value of carbohydrate concentrations (2.59%, 2.95% respectively). Furthermore male *E. massavensis* recorded the highest values of total lipids (17.66%) in comparison with other studied crustaceans. Also, the results showed that the estimation of Vitamins B_1, B_2 level recorded the highest average concentrations of vitamin B_1 (0.407 mg/100gm) in female *M. monoceros*, while male *M. monoceros* of the Arabian Gulf had the highest value of vitamin B_2 (0.532 mg/100gm). Furthermore, the analysis of 5 elements (K, Na, Ca, P and S) showed the highest average concentration of K (677.05, 600.0 mg/kg) and Na (703, 688 mg/kg) present in male and female *E. massavensis* respectively, also, male and female *E. massavensis* recorded the highest value of Ca, P concentration, while female *P. pelagicus* of Red Sea and Arabian Gulf recorded the highest value of S concentration. Therefore the , mantis shrimp, shrimps and crabs used in this study could be considered as a balanced human diet and may be used in some pharmaceutical industries for the treatment of some diseases.

Keywords: Mantis shrimps (*Erugosquilla massavensis*, *Penaeus semisulcatus*, *Metapenaeus monoceros*), crab (*Portunus pelagicus*), total protein, carbohydrate, lipids, vitamins (B_1, B_2) and minerals (K, Na, Ca, P, S).

INTRODUCTION

The introduction of exotic animals into many areas of the world, among which species of crab, shrimps and mantis shrimps (as *Erugosquilla massavensis*) are also included, became a widespread practice. The mantis shrimp, *E. massavensis* is a potentially important Egyptian constituent

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of the fishery for economic crustaceans both in the area of the Suez Canal and in the Mediterranean Sea at Port Said displacing and dominating the local species *Squilla mantis*. Since landings of these mantis shrimps (Kocatas and Katagan, 1995 and Sa1lam et al, 2006) are incorporated with those of the penaeid prawns, the nature of its fishery is therefore described as a part of the overall fishery of commercial crustaceans. The edible crustaceans can be beneficial as nutraceutical and may be used in some pharmaceutical industries, as reported by Fahmy et al. (2009); Fahmy and Hamdi (2011 a, b); Hamdi (2011) and Abdel Salam (2014).

It is interesting to note that the majority of marine organisms have attracted much attention as potential sources of drugs, recently, that are mainly found in invertebrates such as sponges, tunicates, molluscs, crustaceans and coelenterates. Some species produce very active biochemical compounds which have pharmaceutical value as anticancer drugs and antibiotics (Alonso et al., 2003). Other species have shown clinical antitumor activity in refractory soft tissue sarcoma and ovarian cancer (D'Incalci et al., 2004). Several reports have described aspects of the crustaceans, particularly the edible species that have been intensely investigated and used as model organisms in a number of studies on biochemical composition and nutritive quality (Rosa and Nunes, 2002; Hamdi and Zaghloul, 2006; Hamdi and Abd El-Monem, 2006; Ibrahim and Khalil, 2009; Ehigiator and Oterai, 2012; Abdel Salam, 2013 and Abdel Salam, 2014). Studies on the biochemical components of economic crustacean species in the edible muscles carried out to assess the nutritive quality of this species for human consumption (Sallem *et al*., 2006; Mitra *et al*., 2010).

Vitamins have a nutritional value and play important roles in cell metabolism. The B vitamins often work together to deliver a number of health benefits to the body. Minerals are particularly significant in the different biological functions. Potassium (K) and sodium (Na) regulate the electrolyte and acid-alkali balances, the conductive capacity of the nerves, muscle contractions and the production of adrenaline and amino acids. Calcium (Ca) is considered that most important of the principal mineral element (macronutrients) which constitutes 60-80% of all the inorganic material in the human body. Phosphorus (P) is an essential mineral for cell function and it occupies a key role in all reactions with magnesium (Mg).

So, the purpose of the present work was, therefore, to assess the level of protein, carbohydrates, and lipids, vitamins (B_1, B_2), minerals (K, Na, Ca, P, S) of both sex of mantis shrimps, shrimps and crab *(E. massavensis, Penaeus semisulcatus* , *Metapenaeus monoceros*, and *Portunus pelagicus)* respectively, which may in the future play an important role in some pharmaceutical industries and may be used as specific health foods (functional supplements).

MATERIALS AND METHODS

-Collection of samples:

The edible crustaceans, *Erugosquilla massavensis*, *Penaeus semisulcatus*, *Metapenaeus monoceros* and *Portunus pelagicus* were collected from different sites as follows:

1) Mantis shrimp *(Erugosquilla massavensis*) samples were obtained from the Mediterranean Sea (Port Said).
2) *Penaeus semisulcatus* (shrimp) from Mediterranean Sea (Port Said) and Red Sea (Saudi Arabia).
3) *Metapenaeus monoceros* (shrimp) from Arabian Gulf (Saudi Arabia-Dammam).
4) *Portunus pelagicus* (Crab) from Mediterranian Sea (Port Said), Red Sea (Saudi Arabia) and Arabian Gulf (Saudi Arabia-Dammam).

-Separation of muscle away from exoskeleton:

Fresh whole bodies of mantis shrimps, shrimps and crab samples were stored at -20^{o}C to facilitate heeling process after thawing when needed as most crustaceans.

-Preparation of muscle for biochemical analysis:

After peeling, all the samples were dissected and edible muscles of both the sexes were separated and dried in an oven for 6 hours at 105^{o}C, powdered and then burned in a muffle furnace for 16 hours at 550^{o}C till reduced to ash (Sidwell *et al*., 1970). Powdered samples of muscles were analyzed for total proteins (Lawery *et al.,* 1952), total lipids (Holland and Hannant, 1973) and carbohydrates (Barber and Blake, 1981). All values were expressed on percentage dry weight basis.

-Mineral and vitamin analyses:

1) Mineral analysis: Concentrations of 5 elements (K, Na, Ca, P and S) were measured using Perkin Elmer Atomic Absorption Spectrometer (800) with flow injection analysis system (FIAS) (Larsen and Sandstrom, 1993).
2) Vitamin analysis: vitamins (B_1, B_2) were analyzed using HPLC, the Varian 940- LC (Brubacher et al., 1985).

Statistical analysis

Data are expressed as means $\pm$ S.E. of five separated determinations.
Means with the same letter for each parameters are not significantly different, otherwise they do ($P<0.05$). SPSS, for Windows (Version 15.0) was used for statistical analysis.

Table 1. Biochemical constituents percentage of edible muscles of male and female crustaceans .

Species	Region	Protein %		Carbohydrates%		Lipids%	
		males	females	males	females	males	Females
E. massavensis	Mediterranean Sea	52.11±1.52 ^{a}	38.89±0.59^{e}	2.59±0.01^{b}	2.95±0.02 ^{a}	17.66±0.02 ^{a}	11.55±0.32^{d}
P. semisulcatus	Mediterranean Sea	36.47±1.42^{e}	44.37±2.00^{bc}	2.09±0.03^{d}	1.69±0.04^{h}	13.69±0.29^{c}	12.80±0.01^{d}
P. semisulcatus	Red Sea	41.45±1.99^{cd}	41.84±1.22^{cd}	1.84±0.006^{f}	1.81±0.02^{fg}	9.51±0. 28^{e}	8.41±0.11^{f}
M. monoceros	Arabian Gulf	40.53±0.89^{d}	41.88±0.64^{cd}	1.75±0.04^{gh}	1.85±0.04^{fg}	9.43±0.12^{e}	9.09±0.15^{e}
P. pelagicus	Mediterranean Sea	37.39±0.35^{e}	45.97 ±1.15^{b}	1.95±0.01^{e}	2.30±0.02^{c}	15.49±0.01^{b}	13.82±0.22^{c}
P. pelagicus	Red Sea	44.06±0.88^{bcd}	45.19±1.03^{bc}	2.44±0.02^{c}	2.51±0.01^{bc}	7.91±0.051^{g}	7.45±0.06^{h}
P. pelagicus	Arabian Gulf	44.28±0.98^{bc}	44.88 ±2.31 ^{bc}	2.00±0.12^{e}	2.33±0.01^{d}	6.89±0.05^{hi}	7.22±0.08^{h}
ANOVA◄ (Species effect)		F= 8.854 P<0.001		F=99.863 P<0.001		F=690.270 P<0.001	

Data are expressed as mean ± S.E of five separated determinations; means with the same superscript letters for each parameter are not significantly different, otherwise they do (P<0.05).

RESULTS

Biochemical constituent analysis (Total protein, Carbohydrates, Lipids):

Analysis of edible muscle of both shrimps and crab indicated the presence of high level concentration of total protein (52.11%) of male *E. massavensis* which is followed by male and female *P. pelagicus* of all regions of study except male *P. pelagicus* of Mediterranean Sea, Egypt (which recorded the least value of protein concentrations), followed by *P. semisulcatus* and *M. monoceros* (Table 1).

Male and female *E. massavensis* recorded the largest value of carbohydrate cocenterations (2.59, 2.95%) respectively, where *P. semisulcatus* and *M. monoceros* recorded the smallest values. In between was *P. pelagicus* of all regions of study which recorded the medium values (table 1).

Male *E. massavensis* and male *P. pelagicus* of Mediterranean Sea were recorded the highest values of total lipids (17.66, 15.49%, respectively) while, male *P. pelagicus* of the Arabian Gulf was recorded the smallest values (table 1).

Table 2. Vitamin B_1 and B_2 content (mg/100gm) in edible muscles of males and females crustaceans species .

Species	Region	Vitamin B_1		Vitamin B_2	
		Males	females	males	females
E. massavensis	Mediterranean Sea	0.140 ± 0.01^{h}	0.094 ± 0.07^{j}	0.423 ± 0.02^{bc}	0.400 ± 0.01^{c}
P. semisulcatus	Mediterranean Sea	0.220 ± 0.003^{g}	0.116 ± 0.01^{i}	0.259 ± 0.00^{f}	0.241 ± 0.00^{f}
P. semisulcatus	Red Sea	0.262 ± 0.002^{f}	0.350 ± 0.00^{d}	0.318 ± 0.00^{ef}	0.396 ± 0.05^{d}
M. monoceros	Arabian Gulf	0.304 ± 0.00^{e}	0.407 ± 0.00^{a}	0.429 ± 0.00^{bd}	0.532 ± 0.00^{a}
P. pelagicus	Mediterranean Sea	0.251 ± 0.02^{i}	0.249 ± 0.01^{i}	0.322 ± 0.01^{ef}	0.355 ± 0.01^{d}
P. pelagicus	Red Sea	0.307 ± 0.002^{e}	0.374 ± 0.00^{c}	0.308 ± 0.00^{de}	0.518 ± 0.00^{a}
P. pelagicus	Arabian Gulf	0.385 ± 0.002^{b}	0.376 ± 0.01^{c}	0.365 ± 0.00^{de}	0.358 ± 0.00^{de}
ANOVA◄ (Species effect)		F=2262.236 P<0.0001		F=20.672 P<0.0001	

Data are expressed as mean ± S.E of five separated determinations; means with the same superscript letters for each parameter are not significantly different, otherwise they do($P<0.05$).

Vitamin analysis:

Vitamins B_1, B_2 were analyzed in all types of crustaceans species studied of all regions (table 2). The results recorded the highest average concentrations of vitamin B_1 (0.407, 0.385 mg/100gm) of female *M. monoceros* and male Arabian Gulf strain *P. pelagicus* respectively, while, *E. massavensis*, *P. semisulcatus* and *P. pelagicus* of Mediterranean Sea recorded the smallest values of vitamin B_1 . Male and female *M. monoceros* of the Arabian Gulf recorded the highest value of vitamin B_2 (0.532, 0.429 mg/100gm respectively) followed by both sex of *E. massavensis* (423, 400 mg/100gm for male and female respectively) , where *P. semisulcatus* of Mediterranean Sea recorded the smallest values of vitamin B_2 (259, 241 mg/100gm for male and female respectively). Furthermore, it was observed that the concentrations of vitamin B_2 in edible muscles of all studied crustaceans samples were higher than vitamin B_1 except in both sex of *P. pelagicus* from Arabian Gulf region.

Mineral analysis:

Analysis of 5 elements (K, Na, Ca, P and S) present in edible muscle of mantis shrimps, shrimps and crabs showed the highest average concentration of K (677.05, 600 mg/kg) and Na (703 ,688 mg/kg) present in male and female *E. assavensis* respectively (table 3). The smallest value of K concentration was recorded in edible muscle of male and female *P. semisulcatus* of Mediterranean sea, where male and female *P. pelagicus* of Arabian Gulf recorded the smallest value of Na concentration (table 3).

Also, male and female *E. massavensis* recorded the highest value of Ca, P concentration, while female *P. pelagicus* of Red Sea and Arabian Gulf recorded the highest value of S concentration (table 4). Male and female *P. semisulcatus* of Mediterranian Sea recorded the next highest Ca concentration value and the lowest S concentration value (table4). Furthermore, male and female *M. monoceros* of Arabian Gulf recorded the lowest value of Ca, P concentration (table 4).

Table 3. Potassium and Sodium concentrations in edible muscles of crustaceans species given as mg/kg dry weight

Species	Region	K		Na	
		males	females	males	Females
E. massavensis	Mediterranean Sea	677.05±3.04^{a}	600±1.00^{b}	703±3.44^{a}	688±5.16^{b}
P. semisulcatus	Mediterranean Sea	115±0.08^{g}	117±1.02^{g}	355±1.02^{c}	350±0.09^{c}
P. semisulcatus	Red Sea	359.5±0.31^{c}	204.3±0.30^{f}	309.3±0.61^{de}	261.5±0.45^{f}
M. monoceros	Arabian Gulf	294.1±3.15^{d}	194.4±0.30^{f}	305.3±0.33^{e}	324.4±0.87^{d}
P. pelagicus	Mediterranean Sea	233±0.512^{e}	239±0.32^{e}	262±0.98^{f}	270±0.89^{f}
P. pelagicus	Red Sea	267.8±0.173^{d}	347.7±0.12^{c}	220.6±0.63^{h}	245.87±0.30^{g}
P. pelagicus	Arabian Gulf	255.8±0.20^{e}	274.1±0.32^{d}	209.9±0.61^{h}	226.9±0.65^{h}
ANOVA◄ (Species effect)		F=0. .839 P> 0.05		F=247.131 P<0.0001	

Data are expressed as mean ± S.E of five separated determinations; means with the same superscript letters for each parameter are not significantly different, otherwise they do(P<0.05).

Table 4. Calcium, phosphorus and sulphur concentrations in edible muscles of crustaceans species given as mg/kg dry weight.

Species	Region	Ca		P		S	
		males	females	males	females	males	Females
E. massavensis	Mediterranean Sea	803±2.03^{a}	799±1.06^{a}	2405±4.08^{a}	2389±2.18^{b}	1145±2.07^{c}	1010±1.00^{f}
P. semisulcatus	Mediterranean Sea	708±3.50^{b}	710±1.22^{b}	583.33±0.88^{e}	463.33±1.86^{f}	879±0.88^{k}	907±1.06^{j}
P. semisulcatus	Red Sea	484.3±1.23^{d}	435.0±0.64^{d}	702.6±0.64^{d}	732±1.44^{d}	918.3±1.36^{i}	1031.3±1.63^{e}

Table 4. Continue

M. monoceros	Arabian Gulf	472.7±0.14^{e}	401.4±0.59^{e}	691.5±0.60^{d}	666.8±0.86^{d}	1024.7±1.44^{ef}	913.3±1.45^{i}
P. pelagicus	Mediterranean Sea	655±0.67^{c}	649±1.09^{c}	822±2.33^{c}	811±1.44^{c}	939±0.881^{h}	999±0.98^{g}
P. pelagicus	Red Sea	491.0±0.59^{d}	519.0±1.19^{d}	736.4±1.85^{d}	705.5±1.09^{d}	929.3±0.639^{hi}	1223.8±0.85^{a}
P. pelagicus	Arabian Gulf	537.4±1.15^{d}	546.1±2.60^{d}	715.3±1.07^{d}	713.6±3.18^{d}	1127.1±1.46^{d}	1180±1.16^{b}
ANOVA◄ (Species effect)		F=3.586 P<0.001		F=2.641 P< 0.05		F=1907.278 P<0.0001	

Data are expressed as mean ± S.E of five separated determinations; means with the same superscript letters for each parameter are not significantly different, otherwise they do (P<0.05).

DISCUSSION

Products from marine sources have recently become attractive as nutraceutical and functional foods and as a source material for the development of drugs and specific health foods (functional supplements). Supplements derived from marine foods have been shown to have various functions in animal and clinical experiments. For example, proteins and its functional peptides, saturated and unsaturated fatty acids, minerals and vitamin K are being increasingly used to treat and prevent a wide variety of lifestyle-related diseases and to improve the quality of life. In this study, we analysed the edible muscles of marine crustaceans, mantis shrimps (*Erugosquilla massavensis*), shrimps (*Penaeus semisulcatus*, *Metapenaeus monoceros*) and crabs (*Portunus pelagicus*) from different regions to open the door for production of new products of nutraceutical and healthy food or production of a source material of drugs from unusable marine source. Some edible crustaceans were chosen according to their invading power and spreading activity (canals city; Ismailia, El-Suez and Port Said) and in the eastern Mediterranean at Port Said city for *E. massavensis* and the others because of the biodiversity bower of different regions. The analysis included were the protein, carbohydrates, lipids, vitamins (B_1, B_2), minerals (K, Na, Ca, P, S) which are done in the present study.

Even though much work done on the flesh of *E. massavensis* (Gradwell et al., 1998; Mona et al.2000; Ibrahim and Khalil, 2009 and Hamdi, 2011, Abdel Salam and Hamdi, 2011, Abdel Salam, 2014), study on their extracts was very limited in Egypt (Fahmy et al., 2009; Fahmy and Hamdi, 2011a,b).

Biochemical studies are very important from the nutritional point of view. The biochemical constituents in animals are known to vary with season, size of animal, stage of maturity, temperature and availability of food etc. Protein is essential for the sustenance of life and accordingly exists in the largest quantity of all nutrients as a component of the human body (Okuzumi and Fujii, 2000). An increasing demand for good quality animal protein for the exploding population has led to effective and increasing exploitation of the aquatic resources (Sudhakar et al., 2009) .

In the present analysis, the edible muscles of mantis shrimps, shrimps and crabs indicated the presence of high level concentration of total proteins, especially in male *E. massavensis*. This result agreed with other studies which stated that protein is the most prominent biochemical component of crustaceans (Rosa and Nunes, 2002; Ehigiator, and Oterai,2012; Abdel-Salam, and Hamdi, 2011). In general, the high protein level recorded in the studied crustacean species indicates their high nutritive value. The elevation of protein percentage in the edible muscles may be due to the fact that it is the main component of the contractile elements of the striated muscles (Mona *et al*., 2000) and also can be attributed to omnivorous feeding habit of these crustaceans (Bello-Olusoji et al.,1995). Sallam *et al.* (2006) reported that *E. massavensis* in Suez Canal ranks as the second rich

edible crustacean after the blue crab, *P. pelagicus* which in turn draws the attention to the need of considering this protein rich crustacean as good competitor among its economic counterparts. While, in the present study, the recorded data showed that males *E. massavensis* in Suez Canal ranks as the first rich edible crustacean before *P. pelagicus*.

Carbohydrates constitute only a minor percentage of total biochemical composition. This constituent in fishery products contain no dietary fiber but only glucides, mostly glycogen. They also contain traces of glucose, fructose, sucrose and other mono and disaccharides (Okuzumi and fujii,2000). In the present study male and female *E. massavensis* recorded the largest value of carbohydrate concentrations (2.59, 2.95 %) respectively. The previous studies were suggested that the carbohydrates in the muscle varied from 2.4 to 3.4% in *C. smithii* (Balasubramanian and Suseelan, 2001), 0.16 to 0.55% in *P. pelagicus* and 0.44 to 0.73% in *P. saguinolentus* (Radhakrishnan,1979). Recently Murugesan *et al*.(2008) reported that carbohydrate content of hard shell crabs (1.42 %) of *C. lucifera* was little bit lower than eyestalk ablated crabs (1.45%) .

Lipids are highly efficient as sources of energy and they contain more than twice the energy of carbohydrate and proteins (Okuzumi and Fujii,2000). In the present study, male *E. massavensis* and male *P. pelagicus* of Mediterranean Sea were recorded the highest values of total lipids (17.66,15.49 %) respectively. Balasubramanian and Suseelan (2001) recorded that the lipid values from 6.2 to 7.6% in *Charybdis smithii*. In *P. pelagicus* the lipid value was 3.3 to 5.6 % and *P. sanguinolentus* it was 3.8 to 5.5% -+(Radhakrishnan,1979). In crustaceans, lipids are not only the principal organic reserves and source of metabolic energy, but also indispensable in maintaining cellular integrity. Lipids as a general rule act as major food reserves along with proteins and are subjected to periodic fluctuations influenced by environmental variables like temperature (Nagabhushanam and Farooqui, 1982) .

In the present study, Vitamins B_1, B_2 were analyzed in all types of crustaceans studied of all regions (table 2). The results recorded the highest average concentrations of vitamin B_1 (0.407, 0.385 mg/ 100 gm) of female *M. monoceros* and male *P. pelagicus* respectively. While, male and female *M. monoceros* of the Arabian Gulf recorded the highest value of vitamin B_2 (0.532, 0.429 mg/ 100gm, respectively). Moreover, the recorded data detected that edible muscles of all studied samples had higher concentrations of vitamin B_2 than vitamin B_1 except males and females *P. pelagicus* of Arabian Gulf. In general, the high level of vitamin B1 and vitamin B_2 in edible muscles of these marine organisms indicates its high nutritive value.

Marine organisms form a good source of minerals. The fish and shellfish can absorb minerals directly from the aquatic environmental through gills and body surfaces. Almost all the elements that occur in seawater are found to some extent in aquatic animals and some of these include Na, K, Ca, P, S. The minerals serve as components of bones, soft tissues (sulfur amino acids, metalloproteins), as co-factors and co-activators of various enzymes important in human nutrition. Calcium, phosphorus and the electrolytes (Sodium and potassium) are considered to be as macro elements and iron, copper, zinc, iodine, chromium, cobalt, manganese, molybdenum and selenium are considered as trace elements that are required for normal functioning, for instance the more soluble minerals such as Ca, P, Na, K and Cl are involved in the maintenance of acid-base balance and membrane potential. The calcium and phosphorus together account for 70 to 80% of the minerals in the skeleton of fish (Nair and Mathew, 2000).The phosphorus (adenosine polyphosphate) act as a key substance for energy release and present in phospholipids

In the present study, analysis of 5 elements (K, Na, Ca, P and S) present in edible muscle of mantis shrimps, shrimps and crabs showed the highest average concentration of K (677.05, 600 mg/ kg) and Na (703, 688 mg/ kg) present in male and female *E. massavensis* respectively, Also, male and female *E. massavensis* recorded the highest value of Ca, P concentration, while female *P. pelagicus* of Red Sea and Arabian Gulf recorded the highest value of S concentration. Additionally, the recorded data declared that edible muscles of all studied crustaceans enriched with Ca, P and S as compared with K and Na elements. This variations in mineral contents might be attributed to species and sex variations (Roy et al.,2012) or might be attributed to variations in inhabiting regions.

The muscle and carapace extracts of *P. clarkii* and *E. massavensis* were recorded the highest amount of P (phosphorus) followed by Ca (calcium) and K (potassium) than other minerals analyzed; (than Mg, Fe, Mn, Zn, Cu). Also, that vitamin B_6 was recorded the highest amount values measured followed by vitamin E and then vitamin D than other vitamins analysed; (than vit.B_{12}, vit.B_2, vit. B_p, vit. B_1 and vitamin A). Also analysis of *Trionyx sinensis* indicates that it is a good source of minerals (Calcium and Phosphorus) and vitamins A, B_1, B_2 and D (Yin et al., 2005). Regarding to the applications of these very important rich extracts component in Egypt (Fahmy et al., 2009; Fahmy and Hamdi, 2011a,b) who throw the light for the first time in Egypt on their antioxidant effects as a curative effect of both extracts on kidney and liver dysfunction.

In conclusion mantis shrimps, shrimps and crabs used in this study could be a balanced human diet and could be employed as an alternative dietary supplement of protein, carbohydrate ,lipids ,vitamin and mineral matters in the body(food supplement) or may be used in some pharmaceutical industries if we can use it in the treatment of some diseases. Hence the consumption of these marine

organisms used in this study would help to prevent nutritional deficiencies and some diseases in the future.

REFERENCES

Abdel Salam HA (2013). Evaluation of nutritional quality of commercially cultured Indian white shrimp *Penaeus Indicus*. Inter. J. Nutr and Food Sci. 2(4): 160-166.

Abdel Salam HA (2014). Amino acid Composition in the muscles of male and female Commercially Important crustaceans from Egyptian and Saudi Arabia coasts. Amer. J. Biosci. 2(2): 70-78.

Abdel-Salam HA, Hamdi AHS (2011). Biochemical compositions and heavy metals accumulation capacity of the marine mantis shrimp Erugosquilla massavensis from the Suez canal(El- Suez and Ismailia) Egypt. , " J. Egypt. Germ. Soc. Zoo.,61,199- 214.

Alonso D, Khalil Z, Satkunanathan N, Livett BG (2003). Drugs from the sea: conotoxins as drug leads for neuropathic pain and other neurological conditions. Mini Rev. Med. Chem. 3, 785-787.

Balasubramanian CP, Suseelan C (2001). Biochemical composition of the deep water crab *Charybdis smithii*. Indian J. Fish.,48(3):333-335.

Barber BJ, Blake NJ (1981). Energy storage and utilization in relation to gametogenesis in *Astropecten irradians concntricus*. Exp. Mar. Biol. Ecol.,52:1211-134.

Bello-Olusoji AM, Balogun OA, Fagbenro, Ugbaja N (1995). "Food and feeding studies of the African river prawn. In: Proceedings of Fish and Shellfish Larviculture Symposium. Lavens P., Japan E. and Roelants, I. (Eds.). Europ. Aquac. Soc., Special Publication. 24: 425-427.

Brubacher G, Mullermulot W, Southgate DAT (1985). Methods for determination of vitamins in food Elsevier Applied Science Publishers, London and New York, 166 p.

D'Incalci M, Simone M, Tayecchio M, Damia G, Gorbi A, Erba E (2004). New drugs from the sea. J. Chemother., 16 (Supp1. 4): 86-89. Review.

Ehigiator FAR, Oterai EA (2012). Chemical composition and amino acid profile of a caridean prawns (Macrobra chium vollenhoveanil) from Ovia river and periwinkle (Tympanonus fusctus) from Benin river" , Edo tropical state , Nigeria. JRRAS 11 (1) :162-167.

Fahmy SR, Hamdi SAH (2011a). Antioxidant effect of the Egyptian fresh 63 water *Procambarus clarkii* extract in rat liver and erythrocytes. African J. of pharmacy and pharmacology, 5(6): 776-785.

Fahmy SR, Hamdi SAH (2011b). Curative effect of the Egyptian marine *Erugosquilla massavensis* extract on carbon tetrachloride-induced oxidative stress in rat liver and erythrocytes. Eur. Rev. Med. Pharmacol. Sci., 15(3):303-312.

Fahmy SR, Hamdi SAH, Abdel-Salam HA (2009). Curative Effect of Dietary Freshwater and Marine Crustacean Extracts on Carbon Tetrachloride-induced Nephrotoxicity. Austr. J. Basic and Appl. Sci., 3(3): 2118-2129.

Gradwell MJ, Fan TW, Lanc AN (1998). Analysis of phosphorylated metabolites in crayfish extracts by two-dimensional 1H-3IP NMR hetero nuclear total correlation spectroscopy (hetero Tocsy), 263(2): 139-149.

Hamdi SAH (2011).Muscle and exoskeleton extracts analysis of both fresh and marine crustaceans *Procambarus clarkii* and *Erugosquilla massavensis*. African J. of Pharmacy and Pharmacology, 5(13):1589-1597.

Hamdi SAH, El-Monem SA (2006). Processing, products and marketing of the red swamp crawfish *Procambarus clarkii* (Crustacea, Decapoda). Egypt. J. Exp. Biol. (Zool.), 2: 93-98.

Hamdi SAH, Zaghloul KH (2006). Evaluation of the crawfish *Procambarus clarkii* as a cheaper source of human diet in comparison with two marine shrimps in Egypt. J. Egypt. Ger. Soc. Zool., 50(D): 153-174.

Holland DL, Hannantp J (1973). Addendum to a micro analytical scheme for the biochemical analysis of marine invertebrate larvae. J. Mar. Biol. Ass. U.K. , 51:659-668.

Ibrahim AM, Khalil MT (2009). The Red Swamp Crayfish in Egypt. A (Fast Spreading freshwater invasive crustacean). Center of Research and Studies of Protecturates, Ain Shams University Publisher, Vol. 1, pp. 1-136.

Kocatas AA, Katagan T (1995). On stomatopoda from Turkey with the first record of Rissoides Pallidus fro the Turkish Fauna. Crustaceana, 68(5): 649-652.

Larsen T, Sandstrom B (1993). Effect of dietary calcium level on mineral and trace element utilization from a rapeseed (*Brassica napus* L.) diet ileum-fistulated pigs. Br. J. Nutr., 69: 211-224.

Lawery OH, Daughaday WH, Rosebroughady NJ, FIELD WS (1952). Determination of cerebral protein using Folin phenol reagent. J. lab. Clin Med.,39: 663-665.

Mitra K, Banerjee R, Ghosh R, Ray SK (2010). Bioaccumulation pattern of heavy metals in the shrimps of the lower stretch of the River Ganga. Mesopot. J. Mar. Sci.,25(2): 1 – 14 .

Mona HM, Geasa SN, SN, Sharshar MK, Morsy ME (2000). Chemical composition of freshwater crayfish (*Procambarus clarkii*) and its nutritive value. Egypt. J. Aquat. Biol. And Fish., 4(1): 19-34.

Murugesan R, Soundarapandian P, Manivannan K(2008):Effect of Unilateral Eyestalk Ablation on the Biochemical changes of edible portunid crab *Charybdis lucifera* (Fabricus).J. Fish. Aqua. Sci.,3(1):82-86.

Nagabhushanam R, Faroogii VM (1982).Mobilization of protein, glycogen and lipid during ovarian maturation in marine crab *Scylla serrata* (Forskal), Indian J. Mar. Sci., 11:184-189.

Nair PG, Mthew S (2000).Biochemical composition of fish and shellfish. CIFT technology advisory series,PP:14.

Okuzumi M, Fujii T(2000).Nutritional and functional properties of squid and cuttle fish .35th Anniversary of commemorative publication.PP:223.

Radhakrishnan CK (1979). Studies on Portunid crabs of Porto Novo (Crustacea:Decapoda:Brachyura).Ph.D.Thesis, Annamalai University,India.PP:129.

Rosa R, Nunes M L (2002). Biochemical changes in different tissues of the mantis shrimp, *Oratoasquilla nepa* (stomatopoda) during reproductive cycle. Ind. J. Mar. Sci., 247-249.

Roy E, Martin J, George F, Wiley J, Sons (2012). Composition of the Edible Portion of Raw (Fresh or Frozen) Crustaceans, Finfish, and Mollusks. II Macroelements: Sodium, Potassium, Chlorine Calcium, Phosphorus, and Magnesium. Species, Products, Processing, and Safety. ISBN: 1118229533, 9781118229538.

Sallam WS, Temraz TA, Gabr HR (2006). Biochemical compositions and heavy metals accumulation in some commercial crustaceans from the Mediterranean coast off Port Said, Egypt. J. Egypt. Ger. Soc. Zool., 51(D): 127-141.

Sidwell VD , Stillings B R, Knobl GM (1970). The fish protein concentrations.10- Nutrition quality and use in foods . J. Food Technol., 14(8): 40-46 .

Sudhakar M, Manivannan K, Soundrapandian P (2009).Nutritive value of Hard and Soft Shell Crabs of *Portunus sanguinolentus* (Herbst) . International Journal of Animal and Veterinary Advanced 1(2):44-48.

Yin J, Tezuka Y, Subehan Liying S, Ueda J, Metsushige K, Kadota S (2005). A combination of soft-shell turtle powder and essential oil of a unicellular chorophyte prevents bone loss and decreased bone strength in ovariectomized rats. Biol. Pharm. Bull., 28(2): 275-279.