Evaluation of Nutritional Quality of Green Tiger Prawn, *Penaeus Semisulcatus* from Land Fisheries (Alexandria) and Market (India)

Ahkam M. El-Gendy, Fatten El-Feky, Neveen H. Mahmoud and Ghada S. A. Elsebakhy
Zoology Department, Faculty of Science (Girls), Al-Azhar University, Cairo, Egypt

ABSTRACT

Seafood in general, shrimps and prawns in particular, are highly nutritious with good source of protein and amino acids. The present study was conducted to evaluate the nutrient value in males and females of green tiger prawn, *P. semisulcatus*. Twenty specimen were collected from land fisheries in Mediterranean Sea (Alexandria) and from markets (India). The results showed that the highest values of lipid contents were measured in the female and male edible muscles (*P. semisulcatus* at Mediterranean Sea (Alexandria) compared to female and male edible muscles of the same species from market (India). The carbohydrate contents in the male edible muscles of *P. semisulcatus* were higher compared to females in the studied regions. Sixteen amino acids have been determined in edible muscle of *P. semisulcatus,* among these, nine essential amino acids (EAAs) and seven non- essential amino acids (NEAAs) were estimated in both sexes from two regions. The quantities of amino acids vary considerably between sexes. The fatty acid contents from the muscles of the *P. semisulcatus* showed the presence of fifteen individual fatty acids, which include seven saturated fatty, three mono and five polyunsaturated fatty acids (MUFA and PUFA). Twelve protein bands were detected in males of *P. semisulcatus* (12 bands); while the females had 13 bands from market (India) compared to 9 bands of both males and females from Mediterranean Sea (Alexandria). Conclusion: The present study clearly indicated that the nutritional value of *P. semisulcatus* is very well as food and health care.

Keywords: proximate composition, Amino acids, Fatty acids, Electrophoresis, *P. semisulcatus*, Egypt, India.

INTRODUCTION

Seafood in general, shrimps and prawns in particular, are highly nutritious with good source of protein and amino acids [1]. Shrimp is one of the most popular species as it is a part of almost every nation's traditional meal rich in protein and mineral. Among seafood, shrimps contribute about 20% by volume of the world seafood market [3]. Shrimps were identified as a rich source of vitamin-B12, Selenium, w-3 highly unsaturated fatty acids (HUFA) and potent natural antioxidants [4].

The nutritive values of edible marine organisms depend upon their biochemical composition, such as protein, amino acids, lipid, fatty acids, carbohydrate, vitamins and minerals. 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 [5]. Protein is essential for normal function, growth and maintenance of body tissues. Its content is considered to be an important tool for the evaluation of physiological standards [6]. However, quantities of these constituents vary considerably within and between species, size, sexual condition, feeding season and physical activity [7]. Biological value of protein is obviously reflected upon its amino acids concentration. Amino acids are the building blocks of proteins and serve as body builders. Amino acids are important in osmoregulation and buffer capacity in the tissues of aquatic animals [8] and some amino acids are involved in neurotransmission [9], it can be an important source of energy producing compounds [10]. Lipid of shrimp contains mostly polyunsaturated fatty acids (EAAs). These EAAs available in shrimp provide health benefits for human e.g., eye (retina) and brain development and function [11]. Among the body organic nutrients, Carbohydrates are considered to be the first substances to be utilized for the synthesis of energy required for physiological activities. Carbohydrates serve as precursors for the synthesis of dispensable amino acids and certain nutrients, which are in free and bound state along with proteins as protein-bound sugars and glycogen [12].

Several studies are available on the nutrient values of shrimps [13] from different regions all over the world. Therefore, the objective of the present work was to evaluate the proximate composition of basic

Received: 25/10/2017
Accepted: 05/11/2017
DOI: 10.12816/0044332

biochemical constituents, such as total protein, lipids, carbohydrates, water content and protein electrophoresis as well as amino acids and fatty acids analysis in the edible muscles in both sexes of green tiger prawn, *P. semisulcatus* in Alexandria, Egypt compared to the same species from market (India).

MATERIAL AND METHODS

1. Specimens collection

Twenty adult shrimps of both males and females (5 for each) from the two studied were collected from Mediterranean Sea (Alexandria) and market (India) during the period from March, 2015 to February, 2016. Samples were put in crushed ice in insulated containers and transported to marine laboratory Department of zoology, Al-Azhar Faculty of Science (boy branch).

for latter examinations. In the laboratory, shrimps were identified according to the method of ***Fischer et al*** .**[14].** For preservation prior to analysis, shrimps were wrapped in aluminum foil and frozen at –20 C°. After defrosting, the shrimps were separated into the exoskeleton (head and the outer body shell, i.e. shell) and edible muscle **[15].**

3. Biochemical analysis

Protein content was determined by using the Folin-Ciocalteu Phenol method of **Lowery *et al*. [16]** with slight modification suggested by **Ansell and Trevallion [17],** lipid content was determined using the method described by **Marsh and Weinstein [18],** carbohydrate content was determined using the anthrone method **of Strickland and Parsons [19].** For water content, the wet muscle tissue was weighed immediately and kept in hot air oven at 60-70°c for about 2-3 days till the moisture was completely evaporated. The percentage of water content was calculated by the following formula.

$$\textbf{Water content } \% = \frac{\textbf{Wet weight} - \textbf{Dry weight}}{\textbf{Wet weight}} \times 100$$

Amino acids were detected by the method of **Pelled and Young [20]** at central lab of Desert Research center (Ministry of Agriculture and Land Reclamation). Fatty acids were detected by gas-liquid chromatography GC /MS **Kitson and Mcewen [26]** at Regional Center for Mycology and Biotechnology, Al-Azhar, Nasr City, Cairo, Egypt.

Both AAs and FAs were measured as triplicates of 3 samples from both sex and locations.

To study electrophoresis, 3 specimens from each species were taken randomly and frozen for separating of protein bands in shrimp muscles. The electrophoresis method; SDS-PAGE and its modification described by **Laemmli [22]**.

4 - Statistical Analysis

All the analyses were performed by using SPSS statistics, for Windows (Version 20.0). The obtained data were used for descriptive statistical analysis consisting of mean ± standard deviation (SD) of 5 separated determinations. In addition, for comparing the different mean values of males and females of the same species and at different locations, one-way ANOVA test were employed. The difference was significant if $P < 0.05$.

RESULTS

I- Biochemical analysis

Protein contents in the female edible muscle of *P. semisulcatus* from Mediterranean Sea (Alexandria) and market (India) were higher than that of males **Table (1)**. The highest values of protein contents were recorded in female samples collected from market (India) (37.99±0.71g/100g wet tissue) compared to the male from the same region (36.93± 0.25g/100g. wet tissue) and both females and males of the same species from Mediterranean Sea (Alexandria) (19.50± 1.59 and 16.00±1.32g/100g. wet tissue) respectively ($P < 0.05$). Lipid contents in the edible muscles were recorded in Table**, 1**. Results showed that the highest values ($P < 0.05$) of lipid contents were measured in the female and male edible muscles (5.91±0.95g/100g and 6.57±0.36g/100g wet tissue) respectively of *P. semisulcatus* from Mediterranean Sea (Alexandria) compared to female and male edible muscles of the same species from market (India) (4.78±0.82 and 4.78± 0.46g/100g wet tissue) respectively. The carbohydrate contents in the male edible muscles of *P. semisulcatus* were higher compared to females in the studied regions. The values of carbohydrate content fluctuated between 2.17±0.55g/100g wet tissues from Mediterranean Sea (Alexandria) to 1.78±0.22g/100g wet tissue from market (India).

Table (1): Protein, lipid, Carbohydrate and water contents of *P. semisulcatus* collected from Mediterranean Sea (Alexandria) and market (India)

Region	**Protein (g/100g)**		**Lipid (g/100g)**		**Carbohydrate(g /100)**		**Water (%)**	
	Male	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**
Mediterranean Sea(Alexandria)	16.00±1.32a*	19.50±1.59a*	6.57±0.36*	5.91±0.95*	2.17±0.55	1.78±0.22	75.54±0.43a*	72.41±0.61a*
Market (India)	36.93±0.25 a*	37.99±0.71a*	4.78±0.46	4.78±0.82	2.01±0.31	1.94±0.43	56.43±0.72a*	55.12±0.27a*

All results represent Mean ±SD of 5 animals.

a: significant at P>0.05 when females compared to males at the same region.

*: Significant at P>0.05 when males by males and females by females compared at the two regions.

Table (2) indicated that nine EAAs (arginine, histidine, lysine, threonine, methionine, leucine, isoleucine, valine, and phenylalanine) were present in the edible muscles of both males and females of *P. semisulcatus* from Mediterranean Sea (Alexandria) and market (India)**.**

The essential amino acids in males of *P. semisulcatus* collected from Mediterranean Sea, (Alexandria) were ordered as the following: Arginine > leucine > lysine > Phenylalanine > Valine > Isoleucine > Threonine > Methionine> Histidine. While, in the females, it was ordered as the following: Leucine > Arginine > lysine > Valine > Isoleucine > Threonine > Phenylalanine > Methionine > Histidine. On the other hand, in males of *P.semisulcatus* from India, the essential amino acid was ordered as the following: Leucine > Arginine > lysine > Valine >Threonine > Isoleucine > Phenylalanine > Histidine> Methionine .While, in the females, it was ordered as the following: Leucine > Arginine > lysine > Methionine > Isoleucine > Threonine Phenylalanine > Histidine> Valine All EAAS in *P. semisulcatus* from Mediterranean Sea, (Alexandria) were higher in males than females. While, EAAS in *P. semisulcatus* from India were higher in females than males with exception of valine **Table (2).**

Data in **Table (3)** indicate the presence of seven NEAAS represented by Proline, Tyrosine, Glycine, Alanine, Serine, Glutamic acid and Aspartic acid. Glutamic acid had the maximum value (10.98 g/100g) of NEAAS in *P. semisulcatus* collected from Mediterranean Sea, (Alexandria) and tyrosine had the minimum value (1.94 g/100g) in males and females of *P. semisulcatus* collected from India**.**

In females of *P. semisulcatus* collected from Mediterranean Sea (Alexandria), and NEAAS was ordered as the following: Glutamic acid > Aspartic acid > Alanine > Glycine > Proline > Tyrosine > Serine. While, in the females, it was ordered as the following: Glutamic acid > Aspartic acid > Alanine > Proline > Glycine >Serine > Tyrosine. On the other hand, in Male of *P. semisculatus* from India, the NEAAS was ordered as the following: Glutamic acid > Proline > Aspartic acid > Alanine > Glycine >Serine > Tyrosine. While, in the females, it was ordered as the following: Glutamic acid > Aspartic acid > Proline > Alanine > Glycine >Serine > Tyrosine. All NEAAS in *P. semisulcatus* from Mediterranean Sea (Alexandria) were higher in males than females with exception of proline which were higher in females than her males .While NEAAS in *P. semisulcatus* from India which was higher in females than males with exception of Tyrosine which was equal in both sexes.

Table (2): Essential amino acids contents (g/100g) of *P. semisulcatus* collected from Mediterranean Sea (Alexandria) and market (India).

Amino acids	*P.P. semisulcatus* (Alexandria)		*P. semisulcatus* (India)	
	Males	Females	Males	Females
Arginine	6.81±0.33	4.03±0.33*	4.15±0.33	4.27±0.33
Histidine	2.03±0.33	1.4±0.33	1.67±0.33	1.66±0.33
Lysine	5.27±0.38	3.66±0.38*	3.61±0.38	3.86±0.38
Threonine	2.59±0.33	2.12±0.33	2.75±0.33	2.95±0.33
Methionine	2.08±0.25	1.33±0.25*	1.35±0.25	3.06±0.25
Leucine	5.88±0.33	4.35±0.33*	4.35±0.33	4.77±0.33
Isoleucine	3.33±0.33	2.67±0.33	2.71±0.33	2.97±0.33
Valine	3.49±0.33	2.86±0.33*	2.81±0.33	1.46±0.33
Phenyl alanine	3.59±0.25	2.02±0.25*	2.23±0.25	2.30±0.25

Table (3): Non-Essential amino acid contents (g/100g) of *Penaeus semisulcatus* collected from Mediterranean Sea (Alexandria) and market (India).

Amino acids	*P.semisulcatus* (Alexandria)		*P.semisulcatus* (India)	
	Males	Females	Males	Females
Proline	2.66±0.33	3.66±0.3*	7.33±0.33	7.49±0.33
Tyrosine	2.44±0.33	1.86±0.33	1.94±0.33	1.94±0.33
Glycine	4.27±0.33	2.56±0.33*	2.72±0.33	3.08±0.33
Alanine	5.59±0.33	3.86±0.33*	4.77±0.33	5.66±0.3*
Serine	2.34±0.33	1.89±0.33	2.19±0.33	2.22±0.33
Glutamic	10.93±0.3	8.64±0.33*	10.05±0.3	10.49±0.3
Aspartic	6.97±0.38	4.19±0.38*	7.04±0.38	7.49±0.38

All results represent Mean ±SD of 3 animals (triplicates for every specimen).
* significant at P >0.05 when females compared to males at the same region.

Table (4): Saturated fatty acids in females and males (g/100g) of *P. semisulcatus* collected from Mediterranean Sea (Alexandria) and market (India).

Fatty	**Name**	***P.semisulcatus* (Alex)**		***p. semisulcatus* (India)**	
		Male	Female	Male	Female
C14:0	Myristic	0.07±0.	0.11±0.0	0.06±0.	0.11±0.02
C15:0	Pentadeca	0.42±0.	0.22±0.0	0.20±0.	0.07±0.01
C16:0	Palmitic	1.40±0.	1.16±0.0	0.99±0.	1.43±0.05
C17:0	Heptadeca	0.13±0.	0.33±0.0	0.53±0.	0.08±0.05
C18:0	Stearic	0.63±0.	0.87±0.1	0.81±0.	0.61±0.03
C20:0	Arachidic	0.03±0.	0.06±0.0	0.03±0.	0.02±0.00
C22:0	Docosanoi	0.21±0.	0.13±0.0	0.19±0.	0.01±0.00
TSF		2.89	2.89	2.81	2.34

Table (5): Monounsaturated fatty acids in females and males (g/100g) of *P. semisulcatus* collected from Mediterranean Sea (Alex) and market.

Fatty acids	**Name**	***P.semisculatus* (Alex)**		***P.semisculatus* (India)**	
		Male	**Female**	**Male**	**Female**
C16:1	Palmitoleic	0.13±0.01	0.42±0.05*	0.31±0.02	0.16±0.01*
C18:1	Oleic	0.70±0.03	0.84±0.19	0.58±0.11	0.77±0.22
C20 :1(n-9)	Eicosenoic	0.00±0.00	0.06±0.1*	0.05±0.01	0.03±0.01
TMUFA		0.83	1.32	0.94	0.96

Table (6): Polyunsaturated fatty acids in females and males (g/100g) of *P. semisulcatus* collected from Mediterra-nean Sea (Alex) and market (India)

Fatty acids	Name	*P. semisulcatus* (Alex)		*P. semisulcatus* (India)	
		Male	Female	Male	Female
C20:2	Eicosadienoic	0.08±001	0.48±0.06*	0.50±0.04	0.41±0.07
C18:2	Linoleic	1.04±0.07	0.50±0.46	0.42±0.06	0.78±0.04*
C20:4(n-6)	Arachidonic	0.50±0.004	0.34±0.41	0.01±0.01	0.48±0.06*
C20:5(n-3)	Eicosapentaenoin	0.04±0.07	0.48±0.06*	0.63±0.94	0.22±0.05*
C22:6 (n-3)	Docosahexaenoin	0.30±0.03	0.00±0.00*	0.32±0.01	0.20±0.04
TPUFA		1.96	1.8	1.88	2.11

All results represent Mean ±SD of 3 animals (triplicates for every specimen).

*: significant at P >0.05 when females compared to males at the same region.

Total fatty acid composition in both sexes of *P. semisulcatus* from Mediterranean Sea (Alexandria) and market (India) were represented in **Table (4 - 6)**. Results in these **tables** showed total saturated fatty acids (SFA) has the highest percentage, followed by monounsaturated fatty acids (MUFA) then polyunsaturated fatty acids (PUFA) in edible muscle of this species. The fatty acid profile from the muscles of the *P. semisulcatus* showed the presence of sixteen individual fatty acids, which include both unsaturated and saturated fatty acids. Seven saturated fatty acids were recorded myristic acid (14:0), Pentadecanoic acid (15:0), palmitic acid (16:0), Heptadecanioc, stearic acid (18:0), arachidic acid (20:0) and docosanoic acid (22:0) **Table (4**). The others were the essential fatty acids, mono and polyunsaturated fatty acids. The mono unsaturated fatty acids detected were palmitoleic acid (16:1), oleic acid (16:1) and docosanic acid (22:1) **Table (5).** The n-3(w-3) series of polyunsaturated fatty acids detected in the muscle of *P. semisulcatus* was linoleic acid (18:2), eicosapentaenoic acid (EPA) (20:5) and docosahexaenoic acid (DHA) (22:5). Similarly, the n-6 (w-6) series of polyunsaturated fatty acids detected was arachidonic acid (20:4) **(Table, 6).**

The contents of fatty acids, especially total (SFA), were found to be higher in both males and females of *P. semisulcatus* collected from Mediterranean Sea (Alexandria), when compared to that of market (India). Total (MUFA) were found to be higher in females than males of *P. semisulcatus* from both Mediterranean Sea (Alexandria) and market (India). Total (PUFA) were higher in females of *P. semisulcatus* from Mediterranean Sea (Alexandria) than males, in contrast to *P. semisulcatus* from market (India) in which males had higher total PUFA than their females **(Table 4 - 6).**

Results in **Table (7)** showed SDS-PAGE muscle protein banding patterns in males and females of *P. semisulcatus* from different regions. It was observed that the total number of protein bands were 9 bands in males of *P. semisulcatus* from Mediterranean Sea (Alexandria) around molecular weight 13.43 to 82.69 KD and 9 bands in their females with molecular weight 12.84 to 81.25 KD. The total number of bands of muscle protein of males *P. semisulcatus* from market (India) were 12 bands with molecular weight 14.344 to 202.84 KD, while their females had 13 bands with molecular weight ranged from 15.77 to 219.89 KD (**Figures, 1&2)**.

Table (7): SDS-PAGE gel electrophoresis of muscles of males and females of *P. semisulcatus* from different regions

Bands	Marker	*Penaeus semisulcatus*			
	MW (KD)	Med. Sea (Alex)		Market (India)	
		Male	Female	Male	Female
1	225	82.69	81.25	202.84	219.89
2	150	69.69	69.69	134.93	145.89
3	100	44.13	44.39	128.08	134.27
4	75	39.57	37.74	62.82	110.25
5	50	33.81	33.51	48.28	73.93
6	35	30.35	29.65	40.90	64.96
7	25	24.21	24.27	30.23	49.02
8	15	17.83	17.83	23.67	31.82
9	10	13.43	12.84	22.20	24.51
10				21.08	22.83
11				18.36	21.43
12				14.44	18.85
13					15.77

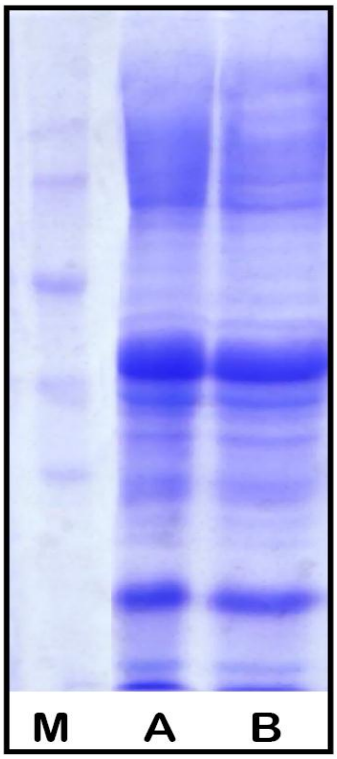

Figure (1): Variations in electrophoretic pattern of muscle proteins of males and females of *P. semisulcatus* from Mediterranean Sea (Alexandria). M: Protein marker; A and B Muscle extract protein of male & female.

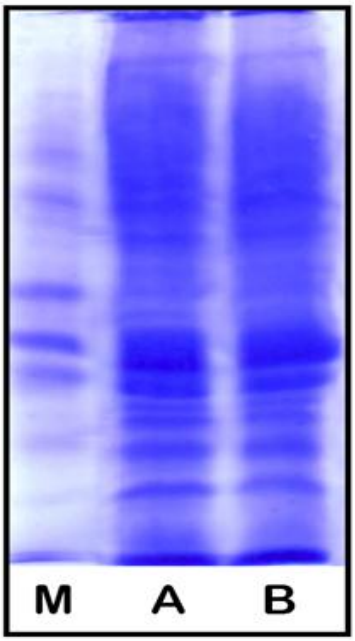

Figure (2): Variations in electrophoretic pattern of muscle proteins of males and females of *P. semisculatus* from market (India). M: Protein marker; A and B Muscle extract protein of male. & female.

DISCUSSION

Marine foods are the very essential food source for many folks due to their great nutrition contents and economically cheap. Marine natural products have drawn the attention of researchers in recent years due to their pharmacological value [23]. The study showed that the values of protein, lipid, carbohydrate and water contents in *P. semisulcatus* were different between males and females from the two locations Mediterranean Sea (Alexandria) and market (India). It may be due to changes in environmental conditions between different locations, life stage, molting of shrimp and differences in nutrient needed for growth of each animal [24]. The recorded data of the present study indicated that the edible muscle of *P. semisulcatus* had high protein with reversible relation to water, low carbohydrate and moderate lipid contents in both males and females. Also, our present research revealed that the protein content is more prominent when compared to the carbohydrate and lipids contents on the studied samples.

Protein contents in both sex from market (India) was higher than that in both sex from Mediterranean Sea (Alexandria). These results may reflect that prawn from Alex, Egypt was wild but that from market (India) were cultured. Several studies have outlined various differences in nutritional composition between wild and cultured fish and shellfish [25]. Shrimp fed with higher quality protein showed higher protein digest ability, better growth and less susceptibility to disease [26]. The high protein content in crustaceans species can be attributed to their omnivorous feeding habit[27] and also may be due to the fact that it is the main component of the contractile elements of the striated muscles[28]. Furthermore, the elevation of protein percentage in the edible muscles in studied crustaceans' samples also indicates their high nutritive quality. The quantities of protein constituents in edible muscle may vary considerably from genera to genera, species to species, size, sex feeding season, physical activity, reproductive stage and different stages of life cycle of marine organisms [29].

This result agreed with other studies which stated that protein is the most prominent biochemical component of crustaceans [30]. Also the protein contents in the female edible muscle of *P. semisulcatus* were higher compared to males. This result was confirmed by [31] for Penaeid shrimp which collected from the Egyptian Mediterranean, coast off Port Said. According to the study of [28], the edible muscles of female marine prawns showed significantly higher protein values than in males. Our data indicated that the highest values of protein content are recorded in females of *P. semisulcatus* from two regions compared to males from the same regions. The results of the present study

disagreed with that of [32] who found protein contents in *M. vollenhovenii*, *M. rosenbergii*, *P. notialis* and *Bachrus niger* less than the protein of our present study.

The lipids are highly well-organized source of energy, in that they contain more than twice the energy of carbohydrate and proteins [33]. The highest values of lipid content were measured in the edible muscles of male *P. semisulcatus* and female *P. semisulcatus* at Mediterranean Sea (Alexandria). The present result are higher than that recorded in *Metapenaeus affinis* [34] and lower than that recorded in *Fenneropenaeus indicus*, *Penaeus monodon* and *Aristeus virilis* [35]. That is due to periodic fluctuations in inviromental factors.

Carbohydrates are a group of organic compounds that includes sugars, starches and fiber, which is a major source of energy for animals. The present study showed that carbohydrate contents in the male edible muscle of *P. semisulcatus* were higher compared to their females. These results are similar to that obtained by other investigators [20,43] who recorded that male of marine prawns had significantly higher carbohydrate values than in females. The variations in the carbohydrate level in edible tissues of different marine crustacean organisms were reported **by Devi *et al.*** [37]. They mentioned that, this variation carbohydrate contents may be attributed to the variation of various factors which change carbohydrates percentage in edible muscles of crustacean animal, such as starvation, rest, exercise, gonad development and other physiological stages.

The whole body moisture content of the shrimps varied when they fed with two different feeds as expected that Indian prawn was cultured. **Nor Faadila *et al.*** [38] reported majority of shrimp usually consists of about moisture within the range of 70 - 80% and it was agreed with our results in relation to samples from Alex, Egypt but dis agree with the total water contents in samples from market (India). **Manivannan *et al*** .[39] reported that moisture content of crab *S. serrata* was affected by quality of feed. The maximum percentage of water content was detected in the edible muscles of male *P. semisulcatus* from Mediterranean Sea (Alexandria). These result is lower than that recorded in *P. monodon* and *P. indicus* and *Acetes indicus*[36] and in *P. monodon* and higher than that recorded in *Fenneropenaeus indicus* and *Aristeus virilis* [35].

All the shrimps had a better amino acid composition with respect to their protein level. Sixteen amino acids have been determined in edible portions of studied crustacean species *(P. semisculatus*). Among these, nine EASS and seven NEAAS. In comparison with the other previous studies, such as in aquaculture prawn, *Macrobrachium rosenbergii*; nineteen amino acids were detected, among these eleven are essential and, eight are non-essential amino acids [3] while nine essential amino acids and nine non-essential were detected in edible muscles of *Procambarus clarkii* and *E. massavensis* [40]. The variation in amino acids content might be attributed to species, sex difference, physiology mechanism, geographical differences and age [8]. In the present study the most abundant EAAS in *P. semisculatus* is arginine, this amino acid found in higher amount because it is the important substance for the regulation of osmotic pressure in crustacean muscles [41]. Arginine followed by lysine and leucine. Moreover, the presence of high content of valine in edible muscles of crustacean organisms which ranged from 1.46 to 3.49 mg/100g was recorded in the present study. Valine is involved in many metabolic pathways and is considered indispensable for protein synthesis and optimal growth [37]. This result is similar to that recorded by **Abdel-Salam** [20].The author recorded the most abundant amino acid in all studied species was arginine except for female *E. massavensis* and male *P. semisulcatus*. Our works confirm that NEAAS in the edible muscles of *P. semisculatus* is enriched in glutamic acid and aspartic acid. This result is similar to the result of **Abdel-Salam** [20]. Glutamic acid and glycine are amino acids component of glutathione; that has been to be an important natural cellular antioxidant against reactive oxygen metabolites in several cells by serving as a substrate for glutathione peroxidase [42]. Therefore, the marine crustaceans can be used as antioxidant agents that play a critical role in body protection by scavenging active oxygen and free radicals and neutralizing lipid peroxides as reported by other reaserches [43]. Also EAAS/ NEAAS ratio in male and female of *P. semisculatus* from Mediterranean Sea (Alexandria) were high. This result is higher than that recorded in giant fresh prawn, *M.*

rosenbergii, green tiger shrimp, *P. semisulcatus*[12], *P. semisulcatus* [2], *P. monodon* and lower than that recorded in *F. indicus* and *A. virilis* [35]. The results of [19], revealed that the ratio of EAAS to NEAAS in *P. monodon* similar to that of male and female of *P. semisculatus* from India in the present study. The total fatty acids composition of *P. semisulcatus* from Mediterranean Sea (Alexandria) and market (India) included total saturated fatty Acids (SFA) and unsaturated fatty Acids (USFA). The highest percentages of fatty acids were recorded for SFA followed by MUFA then PUFA in edible muscle of this species. The fatty acid profile from the muscles showed the presence of sixteen individual fatty acids, which include both unsaturated and saturated fatty acids. The present study agrees with the fatty acid studies on other shrimps [35,44]. The predominant individual SFA was palmic acid (C16:0) while oleic acid (C18:1w-9) represented the most abundant individual MUFA [45]. Also in several shrimp species (*Parapenaeus longirostris, Aristeus antennatus, P. semisulcatus* and *M. monoceros*), it is reported that palmic acid (C16:0), stearic acid (C18:0), DHA and EPA were the most abundant fatty acids [46] which are similar to the present study. The contents of fatty acids, especially total SFA were found to be higher in both males and females of *P. semisulcatus* collected from Mediterranean Sea (Alexandria), when compared to that of market (India). Total MUFA were found to be higher in females than males of *P. semisulcatus* from both Mediterranean Sea (Alexandria) and market (India). PUFA were found as the major fatty acids in several shrimp species followed by MUFA and SFA [47]. Thus our study emphasized that the fatty acid composition is species specific. Fatty acid ratios of shrimp muscle can be affected by diet, size, age, reproductive cycle, salinity, temperature, season and geographical location.

The percent of EPA and DHA was calculated with their total PUFAs and the results full in the range of other shrimps based on the work of **Yanar and Celik** [46] for *P. semisulcatus* and *M. monoceros*, for *P. longirostris* and *P. semisulcatus* [48]for *P. brasiliensis* and *Penaeus schimitti*. PUFA/SFA, w-3/w-6 and EPA/DHA ratios [49] are highly related to the human health since they are used to evaluate the nutritional value of fat and their role in human atherosclerosis. EPA and DHA may have individually potential roles in the function of the human organs, since EPA-enriched supplements significantly improved psychological distress and depressive symptoms during menopausal transitions and have been suggested as an effective anti-cachexia anti-inflammatory agent [50]. On the other hand, DHA is essential for the growth and functional development of the brain in infants and is also required for the maintenance of normal brain function in adults, while it is taken up by the brain in preference to other fatty acids [51]. The deficiency of w-3 fatty acids in the brain is thought to induce memory, learning impairment, as well as psychological disorders[51]. Both EPA and DHA were detected in males from the two regions but DHA could not be detected in females from Mediterranean Sea (Alexandria).

The highest numbers of protein bands estimated in males of *P. semisulcatus* and differences in the banding pattern of the male and female marine crustaceans might be due to sex variation or to physiological factors such as size, molting cycle, season, nutritional state or might be to an increased synthesis of acute phase proteins (new polypeptide chain) which act as buffer or as protective protein against toxicity with heavy metals [40].

In conclusion: *P. semisulcatus* from market (India) have the best nutritive value, because the nutritional analysis of muscle of both sexes indicate the presence of high amount of protein, moderate content of lipids, low level of carbohydrates with reverse water content and contain 12 protein bands in males and 13 protein bands in females which represent a great benefit for man.

REFERENCES

1. Abdel-Salam H (2013): Evaluation of nutritional quality of commercially cultured Indian white shrimp, *Penaeus indicus*. International Journal of Nutrition and Food Science, 2:160-166.

2. Tag El Din H, Habashy M and Sultan H (2009): Residues uses of some heavy metals and hormone in water prawn (*Macrobracuhium rosenbergi* and marine shrimp *Penaeus semisulcatus* with reference to the nutritive value. World J. Zoology, 4: 205 - 215.

3. Bhavan S , Saravana S , Radhakrishnan S , Shanthi R and Poongodi R (2010): Proximate composition and profiles of amino acids and fatty acids in the muscle of adult males and females of commercially viable prawn species, *Macrobrachium*

rosenbergii collected from natural culture environments. Inter. J. Biolog., 2: 107-119.

4. Holthius, L (1980): FAO Species Catalogue.. Shrimps and prawns of the world. An annotated catalogue of species of interest to fisheries. FAO Fisheries Synopsis, 125: 1-271.

5. Sudhakar M, Manivannan K and Soundrapandian P (2009): Nutritive value of hard and soft shell crabs of Portunus sanguinolentus (Herbst). Inter. J. Animal and Veterin.Advan. ,1: 44-48.

6. Diana J (1982): An experimental analysis of the metabolic rate and food utilization of northern pike. Comp. Biochem.Toxicol., 59: 989-993.

7. Nargis R (2006): Seasonal variation in the chemical composition of body flesh of koi fish *Anabas testudineus* (Block) (Anabantidae, Perciformes). Bangladesh J. Sci. Ind. Res., 41: 219-226.

8. Sankar R and yogamoorthi A (2012): Free amino acid composition in haemolymph and muscles of the ghost crab Ocypoda platytarsis. Pakistan J.BIOL. SCI., 15(10): 490- 495.

9. Paulraj R and Sridhar S (2001): Essential amino acid and fatty acids requirements of fish and crustaceans acid. Course manual on advance in fish and crustaceans and aqua feed biotechnology, CMFRI, Kochi.,1: 44-48

10. Anaya J and Aneiello S (2006): Free amino acids in the nervous system of amphioxus, *Branchiostoma lanceolatum.* Int. J. Biol. Sci., 2:87:92.

11. Conner W Neuringer M and Reisbick S (1992): Essential fatty acids: The importance of n-3 fatty acids in the retina and brain. Nutr. Rev., 50:21- 29.

12. Shahina Banu S, Hareesh K and Srinivasulu Reddy M (2016): Evaluation of nutritional status of penaeid prawns through proximate composition studies. Int. J. of Fish. and Aqua. Studies, 4: 13-19.

13. Nandanan S (2017): Compartive study on biochemical composition of some selected shellfishes on nutritive aspects. International Journal of Informative& Futuristic Research, 4:7721- 7725.

14. Fischer W, Schneider M and Bauchot M (1987): FAO fishes for species identification for the needs of fisheries. (Revision1). Mediterranean and Black Sea. Fishing area, 37 (2): 763 - 1529.

15. Abdel-Salam H (2014): Amino acid composition in the muscles of male and female commercially important crustaceans from Egyptian and Saudi Arabia Coast. American Journal of Bioscience, 2(2): 70-78.

16. Lowery O, Rosebrough N, Farr, A Land Randal R (1951): Protein measurement with the Folin phenol reagent. J. Biol. Chem., 193: 265-275.

17. Ansell A and Trevallion A (1967): Studies on *Tellina tenuis* da costal. Seasonal growth and biochemical cycle., J. exp. Mar. Biol. Ecol., 1: 220-235.

18. Marsh J and Weinstein D (1966): Notes on methodology: a sample method for determination of lipid in tissue .J. Lipid Res., 17 :574 – 576. Measurement with the Folin-Phenol reagents. J. Biol. Chem., 193: 265-275.

19. Strickland J and Parsons T (1968): Apartical method for carbohydrate determination in tissue. Bull. Fish Res. Bd. Can., 167: 311.

20. Pelled P and Young V (1980): Nutrional evaluation of protin foods. published by the United Nation Unviresity. World J. ZOO., 4:205-215.

21. Kitson F and Mcewen A (1996): Gas chromatography and specterometry: A practical guide - United kingdom edition by Academic press limited, London. pp: 632.

22. Laemmli U (1970): Cleavage of structural protein during the assembly of the head of bacteriophage T4. Nature, 227: 680 – 685.

23. Eswar A, Nanda R, Ramamoorthy Z, Isha K and Gokulakrishnan S (2016): Biochemical Composition and Preliminary Qualitative Analysis of Marine Clam Gafrarium divaricatum(Gmelin) From Mumbai, West Coast of India. Asian J. Biomed. Pharmaceut. Sci., 6: 01-06.

24. Rosa R and Nunes M (2003): Biochemical composition of deep-sea decapod crustaceans with two different benthic life strategies off the Portug uese south coast. Deep-Sea Res.. 50: 119–130.

25. Zhou L, Han D, Zhu X, Yang Y, Jin J and Xie S (2015): Effects of total replacement of fish oil by pork lard or rapeseed oil and recovery by a fish oil finishing diet on growth, health and fish quality of gibel carp (Carassius auratus gibelio). Aquaculture. Res., 1-15.

26. Venkataramiah A, Lakshmi G, and Gunter G (1975): A review of the effects of some environmental and nutritional factors on brown shrimp Penaeus aztecus Ives in laboratory culture Proc. 9th Eur. mar. Biol. Symp.,55: 523 547.

27. Bello-Olusoji A, Fagbenro B and 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.

28. Abdel-Salam H and Hamdi A (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 - 211.

29. New M (2003): The role freshwater prawns in sustainable aquaculture. Freshwater prawns International symposium. kerala Agriculture University, Kochi, India., Pp 10-13.

30. Ehigiator F and Oterai E (2012): Chemical composition and amino acid profile of a caridean prawns (*Macrobra chium vollenhoveanil*) from Ovia River and tropical periwinkle (*Tympanonus fusctus*) from Benin River, Edo state, Nigeria. IJRRAS., 11 (1):162-167.

31. Sallam W, Temraz T and Gabar H (2006): Biochemical compositions and heavy metals accumulation in some commercial crustaceans from the Mediterranean coast off Sci., 247-249.

32. Fasakin E, Bello-Olusoji O and Oyekanmi F (2000): Nutritional value, flesh and waste composition of some processed commercially important crustaceans in Nigeria. J. Appl. Trop. Agric., 5(2): 148-153.

33. Dempson I, Schwarz C, Sbears M and Furey G (2004): Comparative proximate body composition of Atlantic salmon with emphasis on parr from fluvial and lacustrine habitats. J. Fish Biol., 64: 1257-1271.

34. Dincer M and Aydin I (2014): Proximate composition and mineral and fatty acid profiles of male and female jinga shrimps (*Metapenaeus affinis*, H. Milne Edwards, 1837). Turk J. Vet. Anim. Sci., 38: 445 - 451.

35. Karuppasamy P, Sakthi S, Priyadarshini R, Ramamoorthy N, Sujatha R, Ganga S, Jayalakshmi1 T and Santhanam P (2013): Comparison of proximate, amino and fatty acid composition of *Penaeus monodon* (Fabricius, 1798), *Fenneropenaeus indicus* (H. Milne Edwards, 1837) and *Aristeus virilis* (Bate, 1881) of Nagapattinam landing *kerathurus* (Forskål, 1775). Journal of the Marine Biological Association of India, 55 (2):55 – 60.

36. Rexi P, Manoharam J and Priya P (2015): Comparison of approximate composition of fresh and cooked muscles of some prawn. International Journal Informative Futuristic Researc., 2: 3537-3541.

37. Devi D, Hareesh K and Srinivasulu R (2015): Studies on the Proximate Composition of Tropical Freshwater Prawn, *Macrobrachium rosenbergii.* Int. J. of Fisheries and Aquatic Studies,3(1): 329-336.

38. Nor Faadila M, Harivaindaran K, Tajul A and Yang R (2013): Biochemical and texture property changes during molting process of tiger prawn, Penaeus monodon. International Food Research Journal, 20(2):751-758.

39. Manivannan K, Sudhakar M, Murugesan R, Soundarapandian P (2010): Effect of Feed on the Biochemical Composition of Commercially Important Mud Crab Scylla tranquebarica (Fabricius, 1798). International Journal of Animal and Veterinary Advances, 2(1):16-20.

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

41. Wilson R (2002): Amino acids and protein. In: Fish Nutrition. Halver, J.E. and Hardy, R.W. (Eds.), Academic Press, San Diego. CA, USA. 143-179.

42. Fahmy S, Hamdi S, Abdel-Salam H (2009): Curative effect of dietary freshwater and marine crustacean extracts of carbon tetrachloride-induced nephrotoxicity. Aust. J. Basic. Appl. Sci., 3: 2118-2129**.**

43. Maitraie D, Hung D, Tu H, Liou Y, Wei B, Yang S , Wang J and Lin C (2009): Synthesis, antiinflammatory and antioxidant activities of 18 betaglycyrrhetinic acid derivatives as chemical mediators and xanthine oxidase inhibitors. Bioorg. Med. Chem., 17: 2785-92.

44. Oksuz A, Ozyilmaz A, Aktas M, Gercek G and Motte J (2009): A comparative study on proximate, mineral and fatty acid compositions of deep seawater rose shrimp (*Parapenaeus longirostris*, Lucas 1846) and red shrimp (*Plesionika martia*, A. Milne-Edwards, 1883). J. anim. Vet. Adv., 8(1): 183-189.

45. Li G, Sinclair A and Li D (2011): Comparison of lipid content and fatty acid composition in the edible meat of wild and cultured freshwater and marine fish and shrimps from China. J. Agric. Fd. Chem., 59: 1871-1881.

46. Yanar Y and Celik M (2005): Note. Seasonal variations of fatty acid composition in wild marine shrimps (*Penaeus semisulcatus* De Haan, 1844) and speckled shrimp (*Metapenaeus monoceros* Fabricus, 1789) from the Eastern Mediterranean Sea Food Sci. Tech. Int., 11: 391-395.

47. Bragagnolo N and Rodriguez-Amaya D (2001): Total lipid, cholesterol, and fatty acids of farmed freshwater prawn (*Macrobrachium rosenbergii*) and wild marine shrimp (*Penaeus brasiliensis*, *Penaeus schimitti*, *Xiphopenaeus kroyeri*). Journal of Food Composition and Analysis,14: 359- 369.

48. Saglik S and Imre S (1997): Fatty acid composition and cholesterol content of mussel and shrimp consumed in Turkey. Turk . J. Mar. Sci., 3(3): 179-189.

49. Simopoulos A (2008): The importance of the omega-6/omega-3 fatty acids ratio in cardiovascular disease and other chronic diseases. Exp. Biol. Med., **233**: 674- 688

50. Lucas M , Asselin C, Merette M , Poulin and Dodin S (2009): Ethyleicosapentaenoic acid for the treatment of psychological distress and depressive symptoms in middle-aged women: double-blind, placebo-controlled randomized clinical trial. Am. J. Clin. Nutr., 89: 641-651.

51. Navarro-García, Pacheco-Aguilar R, Bringas-Alvarado L and Ortega-García J (2004): Characterization of the lipid composition and natural antioxidants in the liver oil of *Dasyatis brevis* and *Gymnura marmorata* rays. Food Chemistry, 87: 89-96.