CHEMICAL QUALITY OF WHOLE, BEHEADED AND PEELED FROZEN SHRIMPS

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ABSTRACT

A total of 75 samples(25 of each) of imported frozen shrimps(whole, beheaded and peeled) were collected from different supermarkets in Alexandria governorate to evaluate their chemical quality .The results showed that peeled frozen shrimps had the highest mean values of acidity (PH) and total volatile nitrogen(T.V.N.) (6.5±0.272, 30.0±0.218 ., respectively). Concerning total protein, indole contents, the whole and peeled frozen shrimps showed the highest levels (23.62±1.348., 25±0.676., respectively) . Our results also indicated that peeled frozen shrimps had the highest mean concentrations of cholesterol.(130±1.832). .In case of fatty acids composition., the whole frozen shrimp had a significant increase in Ecosenoic, palmitic and linoleic fatty acids with a mean values of 1 724±0.143., 18.543±1.069., 10.729±0.486., respectively., The highest mean concentrations of saturated fatty acids (41.802±1.127) and total unsaturated fatty acids (61.485±2.211) were in beheaded,whole frozen shrimps,respectively . At the same time, beheaded frozen shrimp showed the highest mean values of total n3 polyunsaturated fatty acids (5.773±1.452.) .Regarding fat quality changes peeled frozen shrimps showed the highest mean concentrations of acid value.,(2.342± 0.312 and ,free fatty acids (1.171± 0.235). In case of conjugated dienes and thiobarbeturic acid reactive substances, beheaded frozen shrimp had the highest levels (0.04± 0.01 and 0.921±0.092 .,respectively) At the mean time., the highest percent of total fat, was found in whole shrimp(1.58±0.266). Concerning mineral composition , the whole frozen shrimp had the highest levels of manganese,copper ,zinc,and calcium with a mean values of 1.225 p.p.m.,,0.259 p.p.m.,0.129 p.p.m.,76.45 p.p.m.., respectively. In case of iron, the highest level (39.0p.p.m.) was found in beheaded shrimp ,Regarding sodium and potassium, peeled shrimp had the highest mean concentrations of 200p.p.m and 650p.p.m.,respectively. At the same time. cadmium,lead and mercury mean concentrations were within the standard permissible limits (0.1p.p.m., 1.0 p.p.m.,and 0.5p.p.m., respectively), in all the examined shrimp samples. In case of boric acid, the whole frozen shrimp had the highest mean concentrations (66.435± 7.213).

INTRODUCTION

Shrimp has become a major port commodity and its production, processing and marketing has become a major source of income of people in the industry. It is an excellent low calorie choice on the food chain. It is a rich source of protein, vitamins and minerals **(Kavun., 2008)**. Many varieties of shrimp are also low in sodium and cholesterol.It is also low in fat and most of the fat is polyunsaturated. **Undeland., et al., 1999**. Because many fats now specify polyunsaturated fat, rather than saturated fat, some frozen shrimp are relatively high in fat. However the fat is a primary unsaturated. It is also a good source of iron, phosphorus, potassium and zinc. Frozen shrimp are high in protein, low in sodium and are rich in polyunsaturated fats, omega 3 fatty acids, which are believed to actively fight cholesterol build up and reduce the risk of heart disease. **(Abdullah Oksuz., et al., 2009)**. Shell fish particularly, shrimp spoils more rapidly than fish for a number of reasons. Firstly, they are smaller, and small fish spoil more rapidly than larger ones. Secondly and more importantly, the gut is usually not removed immediately after capture, hence postmortem autolytic changes will occur faster. A third reason is that the chemical composition of shellfish tissue is different and it contains a lot of non-protein nitrogenous compounds that encourage more rapid spoilage **(Shamshad., et al. 1990), Botta., (1995) and Zeng Qingzhu (2003)**. Since shrimp is important to human health due to its high nutritional value and it is one of the most perishable products and is susceptible to deterioration during storage and processing .therefore the purpose of this work is to evaluate the chemical quality of frozen shrimps .

MATERIALS AND METHODS

A total of 75 samples of frozen shrimp products, whole shrimp (shell on), beheaded shrimp and peeled shrimp ((25 for each) were selected randomly from Alexandria retail stores. Samples were transferred in an insulated iee box to the laboratory and analyzed for chemical quality parameters.

1- **Hydrogen ion concentration (PH):** The pH of shrimp muscle was determined by using PH meter (Genway 3510 model) according to AOAC (1980).
2- **Total volatile basic nitrogen:** It was determined by steam distillation method using macrokejldhal apparatus (Malle and Pourneyrol 1998) .
3- **Total protein** : According to pearson (1976) using macrokejeldhal apparatus .
4- **Indole** : It was estimated colourimetrically according to Carl ponder 1978.
5- **Cholesterol** : It was determined colourimetrically as described by Bohac., etal .,(1988).
6- **Fatty acids composition:** The methyl esters of extracted fish lipids were prepared according to Radwan, S. S., (1978) and fatty acids composition was determined by using Gas Liquid Chromatography (GLC) Shimadzu model according to Radwan., (1978).
7- **Acid number:** Acid number is defined as the number of milligrams of potassium hydroxide required to neutralize the free acid in 1 gm of the sample. It was determined According to Pearson 1976.
8- **Free fatty acids:** according to Pearson 1976
9- **Conjugated dienes:** It can be determined using ultraviolet (UV) -visible spectrophotometer .(Santiago., etal., 1997).
10- **Thiobarbeturic acid reactive substances:** Fat was extracted using cold

extraction method and thiobarbeturic acid reactive substances (TBARS) was determined colourimetrically according to **Li., et al., 2001**.

11- **Total fat** : using soxhelt apparatus for extraction of fat by petroleum ether (pearson., 1976).

12- **Mineral composition (Mn, Cu, Fe, Zn, Na,, Ca, K)** : The principle of the minerals determination involved the production of acidic solution of the inorganic elements, after removing interferring materials by chelation solvent using ammonium pyrrolidine di-thio carbamate (APDC) and isobutyl methyl ketone (MIBK) After that minerals concentrations were determined by using flame atomie absorption spectrophotometer model perkin Elemer 2380 at wave length's specific to each element **(Richard., 1986).**

13- **Contaminant levels (Cd, Pb, Hg):** Cadmium and lead were determined by Hydrochloric-nitric (HCl-HNO3) acid leaching method using flame atomic absorption spectrophotometer model Perkin Elemer 2380 **(Richard, F., 1986).** The principle of mercury (Hg) determination method depends on the conversion of all the Hg present in the sample into the inorganic form by wet oxidation and it's reduction to the metallic state. Then, the realse of Hg from the solution as vapour using a stream of air followed by it's determination by flameless atomic absorption spectrophotometer (APHA/ AWWA 1992).

14 - **Boric acid:** It was determined colourimetrically according to Shunjiro **Ogawa., et al 1979.**

RESULTS

Chemical quality of the examined frozen shrimps (whole, beheaded and peeled) are showed in Tables 1-7

DISCUSSION

Our results indicated that the highest level of acidity (pH) was found in peeled frozen shrimps (6.5) followed by beheaded (6.4) and whole frozen shrimps (6.2) with no significant difference between them. (Table1)

Zeng Qingzhu., 2003., mentioned that the initial pH of fresh shrimp was 7.41. Results show that the increases of pH value were rapid in samples that had been stored in ice at 1.5C^{o} and in salt- water ice at -1.5C^{o}, and reached 8.26 and 8.20, respectively. **(Zeng Qingzhu., 2003).**

The pH values less than 7.5 recorded by **Shamshad., et al. (1990)** even after the prawns were already spoiled especially at ambient storage eould explain the problem using this parameter to cvaluate the quality of shrimp (Macrobrachium rosenbergii.) Moreover, pH values should be combined with other indicators such as total volatile bases to be indicative of the shrimp quality. Lower pH values might have been caused by the production of lactic acid from glycogen degradation in the prawn meat, **Shamshad., et al. (1990).**

Middlebrooks et al., (1988), reported a maximum pH of 7.54 after only 4 hours of storage at ambient temperature, in farmed black tiger prawns., but thereafter the pH decreased to 7.2 and then tended to be relatively stable **(Gelman et al., 1990).**

Results from table (1) showed that, the highest level of total volatile nitrogen (30.0mg/100g) was in peeled frozen shrimps, while the lowest (28.5mg/100g) was found in whole, with no significant difference between them.

The total volatile nitrogen contents of whole shrimp samples stored at 4°C in a refrigerator were ranged from 22.95 mg/100g to 109.15 mg/100g. **(Candan. et al. 2000)**.

The total volatile bases increased with time and temperature during storage. The initial levels of 17.0 mg/100g prawn sample increased continuously during frozen storage. A level of 30 mg/100g of muscle sample has been considered the upper limit above which fishery products are considered unfit for human consumption **(Cheuk., et al. 1979 and Shamshad., et al., 1990)**.

Iced storage shrimp samples showed that the upper limit of total volatile nitrogen (30 mg / 100 gm)was only reached between 12 to 16 days of storage. Based on chemical analysis. At 17th day of storage, the total volatile nitrogen contents were more than 30 mg/100g. **(Farn and Sims., 1987)**.

It was found that the total volatile nitrogen of shrimp stored at zero degrees for one month showed the highest value of total volatile nitrogen (118.30mg /100g of sample)while the lowest was in fresh shrimp (30.96mg/100g) **(Ibrahim., 2005)**.

The total volatile nitrogen of shrimp samples stored at -10 degrees for one month was 108.18mg/100kg **(Canadan., et al. 2000)**.

Levels of TVBN in severely decomposed shrimp was > 60 mg/kg. **(Rogério Mendes., et al., 2005)**, as well as a rapid increase in TVB at 10 degrees in shrimp(Macrobrachium rosenbergii) was detected due to the increase in total aerobic bacteria at elevated temperatures. **(Abu Bakar., etal.; 2008)**, more over Amine, 2003 found that the total volatile nitrogen of frozen shrimp was 27.16 mg/100g. Also, the TVN for shrimp during cold storage was 39.8 mg/100gm **(Christopher, Ellis and Mary Lousilva, 1997)**.

During automatic boiling, peeling and rinsing processes in shrimp factories, some of the water-soluble and volatile compounds will be extracted by the boiling water and possibly evaporated. In this investigation we have attempted to estimate the loss of TVN in shrimp muscle during this automatic processing. The results show that about 50% of the contents of TVN probably will be lost from the shrimps during automatic processing. Adding approximately 100% TVN to the analyzed contents in boiled, peeled and rinsed shrimps will therefore probably give the same level of these compounds as that found in the raw shrimps used **(Solberg and Nesbakken.,1981)**.

Table (2) presented proximate composition of whole, beheaded and peeled frozen shrimps. It was found that the highest percent of protein was found in whole frozen shrimp (23.62%,) while the lowest was in peeled shrimp (15.43%) respectively. There was a significant difference in percent of protein between the studied frozen shrimp samples at $p \leq 0.05$ (Table 2).

White shrimp meat (Penaeus vannamei)

had higher protein content than had black tiger shrimp meat (Penaeus monodon) **(Pisal Sriket., et al., 2007)**.

The protein content was generally high in the shrimps. This higher protein content in shrimps is important from a dietary point of view since; the quality of fish protein is very high because of its essential amino acid composition. Fish muscle is more digestible than other animal protein due to lower level of connective tissue **(Shamshad., et al 1990)**.

The proximate composition varies depending upon season, age, maturity, sex and availability of food **(Karakoltsidis et al, 1995)**. During long starvation periods, fish and shellfish may utilize the protein in its body to survive. **(Abdullah Oksuz et al., 2009)**.

Shrimps is considered as a high-range protein- containing nutrient like fish, which contain 8-20% protein; also its protein content was ranged between 17-21% depending on Shrimps species **(Yanar and Celik, 2006 and Pisal Sriket., et al., 2007)**.

It was found that the protein content of crustaceans and mollusks were indicated around 20% **(Silva and Chamul, 2000 and Abdullah Oksuz etal., 2009)**.

In the present study, the results of Table (3) indicated that the highest levels of indole was found in peeled shrimp (25microgm/100g) while the lowest was in whole frozen shrimp (20 microgm/100g) with a a significant differenee between them.

Indole detection has long been used as an indicator of shrimp spoilage based on data collected by the food and drug administration (FDA) it defined a maximum allowable indole level of 25 mierogm/100gm for canned precooked frozen shrimps **(Candan., et al., 2000)**.

Increased microbiological contamination induced faster and higher indole production at all temperatures. At higher storage temperatures, indole formation was greatly accelerated resulting in very high indole levels. High indole levels indicate decomposition: however decomposed shrimp may not necessarily contain indole.. **(Fatima., et al, 1984, Candan., et al., 2000, Benner and Otwell., 2003, Snellings., et al 2003, Rogério Mendes., et al., 2005)**.

Shrimps (Pandalus borealis) caught in the Barents Sea and in shrimps caught outside Malaysia, India and Taiwan, stored in an ice and processed (boiled, peeled) showed that only low levels of indole had been formed during ice-storage. Not until an advanced state of spoilage could a distinct increase in the indole content in raw and in boiled, peeled shrimps be discerned.). most of samples of boiled. peeled shrimps from the Far East had high levels of indole which exceeded 25 microgram/100g. **(Solberg and Nesbakken, 1981)**.

It was found that at low temperature storage(4 degrees), final indole levels in severely decomposed shrimp were much lower than the 25 g indole/100g shrimp . At higher storage temperatures, (12^{o} and $22^{o}C$), indole formation was greatly accelerated resulting in very high indole levels.. Frozen storage and cooking had little effect on indole levels. **(Olivia chang., I et al., 1983).**

The data presented in Table (4) revealed that highest mean concentrations of cholesterol was 130mg/100g.

The overall average of cholesterol for several species of shrimp from several different geographical locations was 152 ± 15 mg/100g of edible portion of shrimp. Samples of Pandalus borealis, Gloucester prawns and Canadian prawns, accounted for the low (136 mg/100g) and the high (186 mg/100g) limits, respectively, of the range of cholesterol. **(Judith., et al., 2006).**

Reported values of the cholesterol content in shrimp vary considerably. The possible factors causing this variation were method of analysis, season, diet, size, ovarian development, and species. Species and seasonal differences caused significant variation in the cholesterol content. The reported values of cholesterol in shrimp were ranged from 125 to 200 mg/100 g , **(Kritchevsky and Tepper 1961, Feeley et al 1972, Thompson, 1964 and Kritchevsky et al.,. (1967).**

Results of Table (4) illustrated the fat changes in frozen shrimps(whole, beheaded and peeled). Results of lipid hydrolysis showed that the highest mean values of acid number and free fatty acids (2.342mgkoH/g of fat , 1.171ml/g) were in peeled shrimp., respectively., while the lowest were in whole (4.480mg/gm, 2.24 0ml/gm) with a high significant difference between them. Concerning, lipid oxidation changes (CD, TBA), beheaded had the highest value (0.04nmole/mg, 0.921mg/kg), while the lowest was in whole (0.01n mole/mg,0.789mg/kg) with no significant difference in the levels of CD and TBARS between the examined samples, more over, **Ibrahim., (2005)** reported that fresh shrimp showed the lowest free fatty acids levels (1.03 ml/gm) while the highest (4.467ml/gm) was in shrimp stored at -10 c for 10 months .Concerning acid value, fresh shrimp had the lowest value (2.06mg KOH/gm of fat), while shrimp stored for one month at -10 c showed the highest (5.262mg KOH/gm of fat). Regarding lipid oxidation parameters (CD, TBA) the conjugated dienes decreased with the progress of spoilage during storage at different temperatures (at zero degree in ice, 4 degrees in refrigerator and at -10 degrees in freezer) and the vise versa was true for TBA values. The highest levels of CD and TBARS (0.054nmole/mg 3.980mg malonaldehyde/kg) were found in shrimp stored in ice at zero and in shrimp stored at -10 degrees for one month , also, TBA act as an index for lipid oxidation revealed highly significant changes in farm, marine and frozen shrimps with the highest mean value of 0.801 in frozen shrimp then 0.308 and 0.182 in farm, marine shrimp., respeetively **(Amine., 2003)**, while T.B.A. in food value above 1-2 mg/kgm fat will probably have rancid flavours, **(Connel., et al., 1975).**

Table (5) showed Fatty acids composition of frozen shrimps (whole, beheaded and peeled) (n=25). Gas liquid chromatography identified 28 fatty acids in variable concentrations in whole and beheaded and peeled frozen shrimps. The mean values of total saturated fatty acids were (38.631%, 41.802%, 39.747%) in whole, beheaded and peeled frozen shrimps. respectivcly. At the same time, the total unsaturated fatty acids showed mean values of 61.485%. 58.198%. and 57.492% in whole, beheaded and peeled frozen shrimps. respectively. The highest significant percent of Palmitic (C16:0) (the key of fish metabolism (18.543%), was found in whole frozen shrimp and the lowest (16.402%). was in peeled frozen shrimps, while the highest significant percent of EPA (C20:5) n-3, (C22:5) n-3, were in whole frozen shrimps with mean values of 1.003%, 1.124%,, respectively., while the highest percent of DHA (C22:6) n3 was in beheaded frozen shrimp (4.316%). The increase in saturated fatty acids in may be attributed to the transformation (saturation) of some of the monounsaturated fatty acids and or polyunsaturated. Saturated fatty acids results from direct feeding on the phytoplankton and or feeding on fish that had already fed on phytoplankton **(Gopakumar and Nair 1972)**.

Fatty acids profile of P. longirostris and P. martia showed that Palmitic acid was the dominant fattyacid in total saturated fatty acids in both s species The amount of palmitic acid of P. longirostris (20.27%) was almost the same as P. martia (20.14%) ($p>0.01$) **(Abdullab Oksuzc et al., 2009)**, also they reported that black tiger Shrimps showed palmitic acid s mean concentration of 22.2% and white tiger Shrimps had a level of 21.8% **(Sriket et al., 2007)**, In addition. DHA and EPA, belonging to n-3 fatty acids family, are considered as essential **(Feliz et al, 2002)**. DHA and EPA, two of the major PUFA were found as 18.98 and 13.84% in the P. longirostris' of total fatty acids and 15.59 and 12.84 in P. martia's of total fatty acids, respectivcly **(Abdullah Oksuz e et al., 2009)**, on the other hand , polyunsaturated fatty acids were found as the major fatty acids in shrimp. With the range of 42.2-44.4%. DHA (22:6)/EPA (20:5) ratio in black tiger shrimp (2.15) was higher than that in white shrimp (1.05). Pisal Sriket., etal., (2007).

All shrimps (black tiger shrimp and white shrimp) were low in fat at about 1%. Eicosapentaenoie and docosahexaenoic acids were present at about 30% of the total fatty aeids. providing about 0.20g/100g in the edible portion. **Judith., et al., (2006)**.

Ackman (1989), reported that. the shellfish tend to have EPA greater than DHA.

Lipid contains mostly polyunsaturated fatty acids (essential fatty acids), which includes linoleic acid and alpha-linolenic acid that are parent compounds of Omega-6 and Omega-3 fatty acid series, respectively. These essential fatty acids are available in shrimp provides health benefits for humans e.g., eye (retina) and brain development and functioning, nutrient for growth and development of human body **(Simopolous, 1991, Conner, 1992, Anon, 1994, Osborn and Akoh., 2002, Abdullah Oksuz., et al., 2009)**.

Table (2) presented proximate composition of whole,beheaded and peeled frozen shrimps . Results showed that the highest percent of fat was found in whole frozen shrimp (1.58%..) while the lowest was in beheaded shrimp (0.23%)., respectively. There was a significant difference in percent of fat between the studied frozen shrimp samples at $p< 0.05$.

The lipid content in three marine shrimp species in the Venezuelan internal market, two of them are native species, from fisheries, Farfantapenaeus brasiliensis and Litopenaeus schmitti, and one is an exotic species and farmed, L. vannamei., under different culture conditions (e.g. feed used), are ranged from 4.8 to 10.9%. At the same time, there were detected differences between the lipid eontent and fatty acids composition of the species. Wild L. schmitti had the highest lipid content (10.9%), following by wild F. brasiliensis (9.0%), cultured L. schmitti (4.8% to 7.1%) and cultured L. vannamei (5.1% to 6.2%). **(Cabrera., et al., 2005).**

Crude lipid levels was found as 1.55% in muscle of P. longirostris and as 1.01 % in that of P. martia **(Abdullah Oksuz., et al ., 2009)**.

Our results revealed that the whole frozen shrimp had the highest levels of manganese (Mn), copper (Cu), iron (Fe), zinc (Zn), and calcium(Ca) with mean values of 1.225 p.p.m..., 0.259 p.p.m ... 23.30, p.p.m.., 0.129, 76.45 p.p.m.., respectively., concerning., iron the mean concentration was found in beheaded frozen shrimp (39p.p.m.)., while in ease of sodium (Na) and potassium (K)., peeled shrimp had the highest mean eoncentrations (200p.p.m., 650p.p.m., respectively). At the same time., cadmium,lead and mercury mean concentrations were with in the standard permissible limits (0.1p.p.m., 1.0 p.p.m.,and 0.5p.p.m., respectively) (Table 6).

Concentration levels of toxic heavy metals such as Cd, Hg, As, Pb, Cu, and Zn in edible tissues of fish and shrimp species collected from Manifa and Tarut regions in Gulf of Saudi Arabian were found to lie well within the Saudi Arabian Standards Organization limits. **(Saad Al-Sulami, et al, 2002)**.

Ibrahim.., 2001 reported that the mean values of cadmium, lead and mercury in shrimp collected from Elmex Bay in Alexandria were 0.359 p.p.pm., 0.974 p.p.pm.and 0.024p.p.pm., respeetively while shrimp colleeted from Abukir area showed cadmium,lead and mercury levels of 0.130, 1.248,0.622., respectively. Shrimp from Maruit area (fish farm) cd,pb,Hg were 0.149 p.p.m.,1.055 p.p.m.,0.008., respectively.

Heavy metals are considered the most important form of pollution of the aquatic environment because of their toxicity and accumulation by marine organisms like shrimp **(Khansari et al, 2005)**. Heavy metals are classified as: Potentially toxic (e.g., aluminum, arsenic, eadmium, lead, mereury, cadmium), probably essential (e.g., nickel, vanadium, cobalt) and essential (e.g., copper, zinc, selenium) **(Olivas and Cámara, 2001)**. Some heavy metals, such as arsenic, lead and cadmium, are toxic and even a small amount of availability of these metals in shrimp can be very harmful to human health **(Khansari et al, 2005)**.

Reports on the chemical composition and functional properties of prawns in Nigeria indicate that prawns contain a good amount of sodium. **(Schamschula., et al., 1988 and Beauchamp, Engelman, 1991)**.

Shell fish are relatively good sources of macrominerals, including calcium, phosphorus, magnesium and potassium. **(Erkanand**

Ozden, 2007). The ratio of sodium to potassium ranged from 1:4 to 1:15. they are excellent sources of the trace elements, including copper, iron, zinc and manganese..**(Lovell, 1989 Anon, 2004, and Whithney and Rolfes, 2008 , Abdullah Oksuz et al., 2009)**.

Gokoglu, et al., 2008, reported that high levels of Copper (Cu) (6.19 mg kg^{-1}), cadmium (Cd) (2.36 mg kg^{-1}), zinc (Zn) (30.84 mg kg^{-1}) and iron (Fe) (33.89 mg kg^{-1}), were found in edible tissue of P. semisulcatus and the highest Mn (1.52 mg kg^{-1}) concentrations were found in shrimp (P. longirostris) from the Gulf of Antalya, Turkey while the lowest Cu (1.33mg kg^{-1}), Cd (0.23 mg kg^{-1}), Zn (6.25 mg kg^{-1}), Fe (1.84 mg kg^{-1}) and Mn (0.25 mg kg^{-1}) concentrations were in P. serratu. At the same time., there were significant differences in trace element concentrations among shrimp species, while Abdullah **Oksuz et al., 2009** found that the highest mean values of macroelements (K, P, Na and Ca) of P. longirostris were 996 mg kg^{-1}, 993 mg kg^{-1}, 876 mg kg^{-1}, and 495 mg kg^{-1}, respectively., while those of P. martia were 1344 mg kg^{-1}, 644.96 mg kg^{-1}, 578.8 mg kg^{-1}, and 574.8 mg kg^{-1}, respectively. **(Abdullah Oksuz et al., 2009)**. The highest concentrations of m icroelements (iron, zinc and copper) in P. longirostris were 18, 6.1 and 2.2 mg kg^{-1} respectively. In addition, very small amount of Cd, Mn and Cr were also detected inP. longirostris with values of 0.784 mg kg^{-1}, 0.729 mg kg^{-1}, and 0.098 mg kg^{-1}, correspondingly. On the other hand, similar results were observed for P. martia.

Iron is one of the very important essential trace elements since it has several vital functions in human system. It serves as a carrier of oxygen to tissues from the lungs by red blood cell. Adequate Fe in diet is very important for avoiding some major health problems **(Belitz and Grosch, 2001; Câmara et al., 2005, Kavun., 2008)**. However, according to Institute of Turkish Standard (ITS, 2000). exceeding level of 10 mg kg^{-1} for iron is not permitted. green tiger shrimp, speckled shrimp and Aristeus antennatus had iron mean concentrations of 1.48 mg/100 g, 1.55 mg/100 g and 0.9 mg/100 g respectively. **(Karakolsidis etat, 1995 and Yanar and Celik, 2006)**.

High amounts of copper are present in crustaceans, decapods, gastropods and cephalopods that use copper in their haemocyanins to carry oxygen to their tissues. Despite the high copper concentrations in some molluscan and crustaccan shellfish, copper concentrations in aquatic food present no problem for human health **(White and Rainbow, 1985 and Oehlenschlager, 2002)**. Copper has been known one of the major catalysts for oxidation **(Thanonkaew et al., 2006)**. It was found that Cu, Cd and Zn were found as 2.2, 0.7 and 6.1 mg kg^{-1} for P. longirostris and 2.8, 0.14 and 5.8 for P. martia, respeetively. Except Zinc and Chromium, all the elements were significantly different in both shrimp species. Aecording to **ITS (2000)**, tolerance level of Cu, Cd and Zn in food should not exceed 5, 0.1 and 50 mg kg^{-1} (500 mg/100 g), respectively. The levels of Zn in P. longirostris and P. martia was not exceed the limit. Additionally, **Gokoglu et al. (2008)** reported levels of Cu, Cd andZn for P. longirostris as 1.33, 0.23 and14, 57 mg kg^{-1}. Anon, 2004, **Gokoglu et al., 2008 and Abdullah Oksuz etal., 2009)**.

It is pointed out that the main functions of essential minerals are regulation of acid- base equilibrium. Minerals also constitute important components of enzymes, hormones and enzyme activators (Belitz and Grosch, 2001).

It was reported that the highest boric acid level was in frozen whole shrimp (66.435p.p.m.) while the lowest was in peeled shrimp (48.698p.p.m.) (Table 7).

Boric acid is not allowed as a food additive. However because of its antiseptic effect, it is sometimes used illegally to preserve imported sea food such as frozen shrimp and prawns. Borate in imported shrimp should not exceeded 150 p.p.m.. Levels of boric acid (p.p.m) in frozen shrimp with shells were 67.9p.p.m. at.the same time peeled frozen shrimp had boric acid mean concentration of 60 p.p.m. . (Shunjiro Ogawa.,etal 1979).

CONCLUSION

We can conclude that:

1- From results of this study, it was indicated that the imported frozen shrimp samples were of good chemical quality.

2- It is recommended to evaluate the microbial quality of imported frozen shrimps.

Table (1) : Mean values of hydrogen ion concentration (pH) and total volatile nitrogen content (T.V.N.) of frozen shrimps (whole, beheaded and peeled).

Frozen shrimps	Hydrogen ion conc.(PH)	Total volatile nitrogen (T.V.N.) (mg/100gm)
	Mean± S.D	Mean ±S.D
Whole (shell on)	6.2 ±0.132	28.5±0.145
Beheaded (shell on, head off)	6.4 ±0.131	29.0±0.268
Peeled (shell off)	6.5 ±0.272	30.0±0.218

Table (2) : Mean values of proximate composition (Total proteins % and Total lipids %) of frozen shrimps(whole,beheaded and peeled).

Frozen shrimps	Total proteins (%)	Total lipids (%)
	Mean±S.D	Mean±S.D
W hole frozen	23.62±1.348*	1.58± 0.266*
Beheaded	18.70±1.760 *	0.23±0.194*
Peeled	15.43±1.942*	0.24±0.148*

* Significant at P≤ 0. 05

Table (3): *Mean values of indole levels of frozen shrimps(whole, beheaded and peeled).*

Frozen shrimps	Indole levels (Mean± S.D)
Frozen whole	20±0.643*
Beheaded	23±0.436*
Peeled	25±0.676*

* Significant at P≤ 0.05

Table (4): Mean values of fat quality indicators of frozen shrimps (whole,beheaded and peeled).

Frozen shrimps	Cholesterol (mg/100 gm)	Acid number [mg KOH/g of fat]	Free fatty acids (ml/gm)	Conjugated dienes (n mole/mg)	TBARS [mg malonaldehyde / kg of sample]
whole	125± 2.054 *	2.480± 0.293*	1.240± 0.145	0.01±0.008	0.789± 0.054
Beheaded	128± 1.636 *	2.860± 0.353*	1.430± 0.191	0.04± 0.01	0.921±0.092
Peeled	130± 1.832 *	2.342± 0.312*	1.171± 0.235	0.02± 0.009	0.864± 0.064

* Significant at P≤ 0.05

Table (5): Mean values of fatty acids composition of frozen shrimps (whole, beheaded and peeled) .

Fatty acids	Whole	Beheaded	Peeled
C6	1.305±0.185*	1.086±0.165*	1.850±0.168*
C8	0.059±0.016*	1.044±0.312*	1.078±0.428*
C10	0.239±0.189*	1.311±0.415*	1.559±0.0.542*
C12	0.702±0.231*	1.270±0.510*	2.030±0.493*
C13	0.228±0.165*	1.374±0.562*	1.845±0.601*
Myristic($C_{14:0}$)	3.544±0.196	3.219±0.923	3.306±0.816
C14:1	0.118±0.046*	1.060±0.123*	1.119±0.346*
pentadecanoic ($C_{15:0}$)	0.306±0.102*	1.141±0.131*	1.129±0.161*
C15:1	0.069±0.010	1.075±0.298	1.110±0.184
Palmitic ($C_{16:0}$)	18.543±1.069*	17.835±1.164*	16.402±1.049*
Palmitoleic ($C_{16:1}$)	4.149±0.913*	4.516±0.385*	2.405±0.569*
heptadecanoic ($C_{17:0}$)	0.541±0.176	0.332±0.169	1.256±0.631
C17:1	0.123±0.081	0.091±0.021	1.071±0.641
Stearic ($C_{18:0}$)	4.933±0.536	4.287±0.136	4.225±0.265
Oleic ($C_{18:1}$)	28.735±0.675*	27.525±0.917*	29.234±0.821*
Lenoleie ($C_{18:2}$)	10.729±0.486*	8.171±0.614*	6.634±0.148 *
Lenolenic ($C_{18:3}$)	1.623±0.375	0.508±0.167	1.415±0.167
Arachidic ($C_{20:0}$)	6.114±1.152	5.047±0.345	5.067±0.218
Eicosenoic ($C_{20:1}$)	1.724±0.143	0.903±0.213	1.636±0.148
C20:2	0.124±0.073	0.421±0.115	1.214±0.121
C20:3	0.104±0.021	1.563±0.165	1.376±0.179
C20:4	2.565±0.838	1.365±0.167	0.481±0.287
EPA ($C_{20:5}$) n-3	1.003±0.103	0.923±0.258	0.632±0.216
C22:1	6.143±1.585*	5.094±0.521*	4.049±0.189*
C22:2	0.180±0.048	0.133±0.021	0.059±0.023
($C_{22:5}$) n-3	1.124±0.455	0.810±0.167	0.741±0.198
DHA ($C_{22:6}$) n-3	2.856±0.846 *	4.040±0.651*	4.316±0.238
C24:0	2.1166±0.972*	3.856±0.512*	2.761±0.231
total Saturated fatty acids	38.631±1.123*	41.802±1.127*	39.747±1.214*
total Unsaturated fatty acids	61.485±2.211*	58.198±2.121*	57.492±2.165*
total n3 polyunsaturated fatty acids	4.983±1.832*	5.773±1.452*	5.689±1.518*

* Significant at P≤0.05

Table (6) : Mean concentrations of trace elements (p.p.m) in frozen shrimps (whole,beheaded and peeled).

Frozen shrimps	Trace elements (mean concentrations)									
	Mn	Cu	Fe	Zn	Na	Ca	K	Cd	Pb	Hg
Whole	1.225	0.259	23.30*	0.129	145*	76.45*	550*	0.017	0.225	0.05
Beheaded	0.414	0.243	39.00*	0.061	185*	41.55*	600*	0.007	0.120	0.04
Behpeeled	0.129	0.196	35.50*	0.055	200*	34.60*	650*	0.040	0.100	0.08

* Significant at P≤ 0.05.

Table (7) : Mean concentrations of boric acid in frozen shrimps(whole, beheaded and peeled) .

Boric acid (Mean± SD)	Frozen shrimps
66.435± 7.213*	Frozen whole
59.432± 6.768*	Beheaded shrimp
48.698± 4.943*	Peeled

* Significant at P≤ 0 05.

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الملخص العربى

الجودة الكيميائية للجمبرى المجمد الكامل والمنزوع الراس والمقشر

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لقد تم جمع ٧٥ عينة من الجمبرى المجمد الكامل والمنزوع الراس والمقشر من السوبر ماركت المختلفة بمحافظة الإسكندرية وذلك لتقييم الجودة الكيميائية وتشمل متوسط تركيز الأس الهيدروچينى ومتوسط النتروچين الكلى المتصاعد ومحتوى البروتين الكلى وكذلك محتوى الأندول والكوليسترول وتركيب الأحماض الدهنية والرقم الحمضى والأحماض الدهنية الحرة وكذلك مؤشرات تأكسد الدهون الابتدائية (CD) والثانوية (TBA) ومحتوى الدهون الكلية وكذلك محتوى المعادن مثل المنجنيز والنحاس والكادميوم وغيرها، وكذلك متوسط تركيز حمض البوريك، وقد أوضحت الدراسة النتائج الآتية : أعلى قيمة لمتوسط تركيز الأس الهيدروچينى والنتروچين الكلى المتصاعد والأندول والكوليسترول فى الجمبرى المقشر المجمد بمتوسط تركيز 6.5±0.272 و 30.0±0.218 على التوالى) وفى حالة تركيب الأحماض الدهنية كان أعلى متوسطات تركيزات للأحماض الدهنية الكلية المشبعة والغير مشبعة فى الجمبرى المجمد الكامل 41.802±1.127 و 61.485+2.211 على التوالى). بينما كان أعلى تركيز للأحماض الدهنية الأوميجا ٣ الكلية الغير مشبعة فى الجمبرى المنزوع الراس (5.773±1.452) كما أظهرت الدراسة أن أعلى قيمة لمتوسط تركيز الرقم الحمضى (5.342±0.312) والأحماض الدهنية الحرة (2.671±0.235) كانت فياالجمبرى المقشر والكامل بالراس على التوالى وفى حالة مؤشرات تحلل الدهون الابتدائية (CD) والثانوية (TBA) كان أعلى تركيز فى الجمبرى المنزوع الراس 0.921±0.092 و 0.04±0.832 على التوالى، وقد أوضحت الدراسة أيضاً أن أعلى محتوى للمنجنيز والنحاس والزنك والكالسيوم 1.225 p.p.m.., 0.259 p.p.m... 0.129 p.p.m., 76.45 على التوالى كان فى الجمبرى المجمد الكامل بالراس، وفى حالة الحديد كان أعلى متوسط تركيز (39p.p.m.) فى الجمبرى المنزوع الراس أما بالنسبة للصوديوم والبوتاسيوم فكان أعلى تركيز 200p.p.m. و 650p.p.m. فى الجمبرى المقشر، كما أشارت الدراسة أيضاً إلى أن متوسطات تركيزات المعادن الثقيلة مثل الكادميوم والرصاص والزئبق كانت فى الحدود المسموح بها وكذلك متوسط تركيز حمض البوريك كان فى الحدود المسموح بها فى جميع العينات موضع الدراسة.