Oceanography & Fisheries
Open access Journal
ISSN: 2476-0536

Research Article
Volume 7 Issue 5 - June 2018
DOI: 10.19080/OFOAJ.2018.07.555725

Oceanogr Fish Open Access J

Comparative Study of Chemical Composition of Three Species of Commercial Shrimp *Penaeus semisulcatus* (De Haan, 1844), *Metapenaeus affinis* & *Parapenaeopsis stylifera* (H. Milne -Edward) in North West Arabian Gulf

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Submission: December 12, 2017; **Published:** June 21, 2018

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Abstract

In the present study, heavy metal concentrations (Fe, Pb, Zn, and Cu), proximate composition and microbial quality have been measured in edible tissues of the shrimp *Penaeus semisulcatus* (De Haan, 1844), *Metapenaeus affinis* and *Parapenaeopsis stylifera* (H. Milne -Edward) collected from January to December 2016, the samples were collected from the north west Arabian Gulf. These species were morphometrically measured and their tissue were analyzed for their comparative proximate (Protein %, Carbohydrate %, Lipid %, Ash % and Moisture %), on dry weight basis. Three species of shrimps showed a significant increase ($p<0.05$) in protein content and the highest was observed in *Penaeus semisulcatus* (23.57%) followed by *Metapenaeus affinis* and *Parapenaeopsis stylifera* (20.14 and 17.48%) respectively. Also, they showed lower lipid content and other proximate compositions varied significantly. Moisture was 72.26, 74.45 and 76.14% respectively between species.

Variations of heavy metal concentrations at three species of shrimps are compared. Cu, Zn and Pb concentrations in *P. stylifera* were the highest heavy metal concentrations, while Fe concentrations were highest level observed in three species.

Keywords: Proximate composition; Microbial; Heavy metals.

Introduction

Fish can be finfish, shellfish (mollusks and crustaceans), or any other form of marine or freshwater animal life that can be used for human or domestic animal consumption [1]. Nutritional and protein plays an important role in the life of man and nation, fish are known for their high nutritional quality they are relatively low in fat, saturated fat, and cholesterol, and high in polyunsaturated fatty acids, protein and minerals such as calcium, phosphorus, sodium, potassium and magnesium [2].

Shrimps are a group of popular seafoods found worldwide, belonging to the order Decapoda of the class Crustacea. There are about 8,500 species of Decapods [3,4], including 2,000 shrimp species found and approximately 300 species are of commercial importance. Shell fishes are the exoskeleton bearing aquatic invertebrates used as food and feed. Biochemical studies are essential from the nutritional point of view. It is well known that the biochemical composition of the edible tissues of marine invertebrates is influenced by their nutritional habits, age, sex, season and other ecological factors [5,6].

Fish and seafood is a highly perishable commodity compared to other fresh meat commodities and have short lifetimes even at refrigeration temperature [7-9].

The utilization of marine shrimps as bioindicators of heavy metal pollution in environmental monitoring studies has been emphasized by many investigators. Meanwhile, shrimp are widely consumed in many parts of the world by humans, and polluted shrimps may endanger human health. During the last several decades, heavy metals pollution in the aquatic environment has become a serious problem and concentrations in these organisms can be influenced by many environmental and biological factors [10- 12].

Heavy metal contamination may have devastating effects on the ecological balance of the recipient environment and a diversity of aquatic organisms [13-15]. Heavy metals have long been recognized as serious pollutants of the aquatic system. The heavy metals that are toxic to many organisms at very low

concentrations and are never beneficial to living beings are Hg, Cd and Pb [16]. The fish in our water is often exposed to various microorganisms. A number of these microorganisms are naturally present in the aquatic environment, and some of them enter nature water by agricultural runoff, industrial and human wastes [17-19].

Materials and Methods

Collection of samples and preparation of experimental materials

This study was conducted in the laboratories of the marine biology department / University of basrah/ Iraq, for the period from January to December 2016. Three species of shrimps most commercially traded and widespread in Basrah marckets, which were *Penaeus semisulcatus* (De Haan, 1844), *Metapenaeus affinis* (H. Milne Edwards, 1837) and *Parapenaeopsis stylifera* (H. Milne Edwards, 1837). The samples were collected along Iraqi coast in Basrah city, south Iraq (Figure 1). They were transported to the laboratory in ice boxes and were taxonomically identified [20]. Analyses were achieved on a sample of twelve shrimps for each species, 100 gram for each from different parts of the specimens were obtained; exoskeleton, and head were removed and the entire body tissue was dried at 60 °C (constant temperature) for 24 hours in hot air oven. Then the dried meat was powdered and was taken for the estimation of compositional analysis.

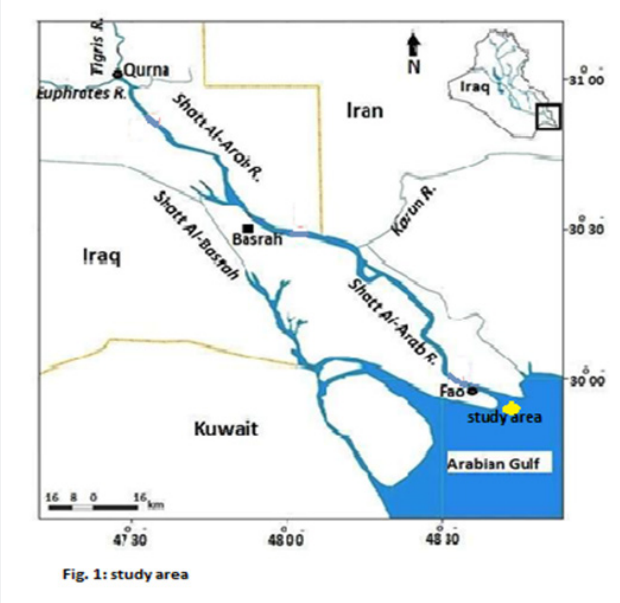

Figure 1: Study area.

Proximate analysis

Moisture (%): The percentage humidity is estimated using the drying oven at 105 °C until the weight is stable according to the method mentioned [21]. The moisture content (%) was estimated by subtracting the dry weight of the sample from the wet weight of the sample.

Ash (%): Ash was calculated by burning samples according to the method listed in AOAC [21]. Pre-dried samples obtained from moisture content analysis were ashed in furnace at 550 °C overnight.

Protein (%): Crude protein content of fish fillets was determined according to the method of AOAC (2000)[21]. Briefly, 1g of sample was weighed into digestion tubes. Two Kjeltabs Cu 3.5 (catalyst salts) were added into each tube. About 20 ml of concentrated sulphuric acid (H2SO4) was carefully added into the tube and then shaken gently. Digestion procedure was carried out. Digested samples were cooled for 10 to 20 min. Distillation procedure was then performed using distillation unit and the distillate was titrated with 0.025N sulphuric acid (H_2SO_4) until the end point changes from green to pink. Volume of acid required in the titration was recorded. Blank was prepared with the exclusion of sample. The percentage of protein content was calculated according to the following equation:

$$\% \text{ Protein} = \%N \times F$$

Where, VD is the Volume of digest; N is the normality of acid; TV is the titre value; AD is the aliquot of digest and F is the conversion factor for nitrogen to protein (6.25).

Fat (%): Crude fat was obtained by exhaustively extracting 2.0g of each sample in a Soxhlet apparatus using petroleum ether (b.p. 40 to 60 °C) as the extractant.

Carbohydrate content analysis (%): Carbohydrate content was calculated based on difference calculation: Carbohydrate = 100% - (%moisture + %ash + %crude protein + %fat).

Microbial analysis: The microbial content of the fish samples were enumerated by standard plate count technique using 0.1ml aliquots of appropriate dilution pour plated onto Nutrients agar, MacConkey, Mannitol salt agar and Salmonella-Shigella agar for

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bacteria. All plates for bacteria isolation were incubated at 37 °C for 24 to 48h. Individual colonies were purified and identified by morphological and biochemical techniques [22].

Statistical analysis: Analysis of the data was carried out by using SPSS (18.0 version) for the mean standard deviation at 5% level of significance.

Results

Proximate analysis

Table 1 shows the mean values for the proximate composition of three Penaeid shrimps. Among these, protein (%), carbohydrate (%), fat (%) and moisture (%) varied significantly ($p < 0.05$) between the species.

Table 1: Proximate composition (%) of shrimp species collected from the Iraqi coast.

Shrimps Species	Protein (%)	Carbohydrate (%)	Lipid (%)	Moisture (%)	Ash (%)
P. semisulcatus	23.57	0.98	2.23	72.26	1.7
M. affinis	20.14	0.76	4.87	74.45	1.3
P. stylifera	17.48	1.04	8.75	76.14	1.6

The highest moisture content was found in *P. stylifera* with value of 76.14% while the lowest was recorded for *P. semisulcatus* with 72.26%. For the concentration of protein content of three shrimps, in *P. semisulcatus* had the highest value (23.57%) while the lowest concentration of protein content in *P. stylifera* (17.48%). Protein was found as the main ratio in the tissues content of shrimps. Also the carbohydrate concentration was lowest in all the species (0.76-1.04%). This study concentrated mainly on the muscular fat content that is highest (2.23-8.57%) between the species. For the carbohydrate content *P. stylifera* recorded the highest value of 1.04% while *M. affinis* had the lowest value of 0.76%.

Heavy metals analysis

Table 2 the mean values for the heavy metals concentration of the three species of shrimps is shown in Table 2. showed that the highest level of iron, lead, zinc and Cu was observed in three shrimps samples, the highest mean values of iron were 2.79, 2.62 and 2.18mg/l, in three species of shrimps respectively. While the highest mean level of lead were 0.06, 0.37 and 0.42mg/l. The highest mean values of zinc concentration were 0.21, 0.098 and 0.31mg/l). While the highest mean values of copper concentration were 0.231, 0.194 and 0.381mg/l). The overall order of heavy metal concentration in all the shrimps species is Fe > Pb >Zn >Cu.

Table 2: Mean of heavy metal composition of shrimp species collected from the Iraqi coast.

Shrimps Species	Fe	Pb	Zn	Cu
P. semisulcatus	2.79	0.06	0.213	0.231
M. affinis	2.62	0.37	0.098	0.194
P. stylifera	2.18	0.42	0.426	0.381

Microbial analysis

Table 3 shows the different microorganisms isolated from each shrimps species. *P. semisulcatus* was found to have *Staphylococcus aureus*, *Escherichia coli* and *Pseudomonas aeruginosa.* From *M. affinis, Enterobacter aerogenes* and *S. aureus* were isolated. While *S. aureus*, *Salmonella* species and *E. coli* were isolated from *P. stylifera.*

Table 3: Isolated bacteria from three shrimp species collected from the Iraqi coast.

Shrimps Species	Bacteria Species
P. semisulcatus	*Staphylococcus aureus, Escherichia coli and Pseudomonas aeruginosa.*
M. affinis	*Enterobacter aerogenes. and S. aureus*
P. stylifera	*S. aureus, Salmonella species and E. coli*

Discussion

The current study investigated the nutritional value of three species of shrimp in the Northwest Arabian Gulf as well as the study of bacterial contamination and heavy metals. The ratios of protein and other ingredients in our study were similar to other studies, especially moisture and protein. The chemical composition, especially the protein ratio in the muscles of *M. affinis* and their differences in other parts of the body of shrimp, as in the study of Abdul-Sahib & Ageel [23].

Similar works on the proximate composition in the edible muscle part was reported in *Fenneropenaeus pennicillatus*, *F. merguiensis, Parapenaeus longirostris* [24], black tiger shrimp and white shrimp [26] were comparable. The average dry weight of the species correspondingly implies its muscle content constituting carbohydrate, protein, lipids and fatty acids exempting the moisture which varies greatly between species. These discussed results shows that the protein was found as the major constituent in the muscle of all the shrimps.

There are highly significant differences among the marine organism organs for the accumulation of heavy metals. In fact, the elements Pb, Cu, Zn, and Fe are expected to vary in a wide range of concentrations cause they reflect the exposure to environmental levels and feeding behaviour [25]. Among the five metals studied in the present study, Zn, Cu, and Fe are essential elements while Pb are non-essential element for most of the living organisms.

Furthermore, different ecological and feeding habits among species can affect the route of uptake of metals, such as in fish [26]. In crustaceans, there is a relationship between the concentration

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of heavy metals and the feeding habits of omnivorous penaeid shrimp [27]. Márquez et al. [26] recorded higher levels of metals in species that feed on lagoon sludge in Unare, Venezuela. According to Frias et al. [10], there is a relationship between the bioaccumulation of metals and their physicochemical properties, as well as with the metabolic needs of the organisms and the availability of food in the water column. Villanueva & Botello [28] associated this bioavailability among others, with the type of sediment and physicochemical characteristics of water. Laws [29] reported that benthic organisms, due to their direct interaction with sediments, are among the most affected by heavy metal concentrations. A fish contaminated with these metals can find its way into man's food chain, resulting in biomagnifications of such heavy metal and this becomes harmful to man's health. Generally, virtually all the heavy metals analyzed were found to exceed National Environmental Standard and Regulation Enforcement Agency [30] and WHO [31] standards [32,33].

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