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Biochemical Composition of Zooplankton of Khour Al-Zubair Port, Southern Iraq

iD **Shaker G. Ajeel***, iD **Luma J. Al-Anber,** iD **Qusay H. Al-Hamadany,** iD **Abbas A. Hantoush and** iD **Ahmed Sh. Al-Hassoon**
Marine Science Centre, University of Basrah, IRAQ
*Corresponding Author: e-mail *shaker.ajeel@uobasrah.edu.iq*

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Abstract -The study of the biochemical composition of zooplankton, which constitutes an important part of the food chain, is an accurate criterion for the nutritional importance of these organisms, as they constitute the basic food for fish in their various stages of growth and other aquatic organisms of economic value. The present study aims to describe the significance of biochemical composition of marine zooplankton from Khour Al-Zubair. This study investigates the biochemical structure of zooplankton by studying their contents of proteins, lipids, ash, moisture and carbohydrates in the Iraqi marine waters (Khour Al-Zubair Port) during the period from August to December 2016. This has been accompanied by studying the water temperature and salinity. The results showed that the protein content of the zooplankton were 19.23 – 22.31 %, ash amounted to 3.86 – 4.45 %, while the lipids were 6.27 – 7.18 %, moisture were 65.82 –70.12 % and the carbohydrates 0.25 – 0.47 % wet weight

التركيب البيوكيميائي للعوالق الحيوانية في ميناء خور الزبير، جنوب العراق

شاكر غالب عجيل ولمى جاسم العنبر وقصي حامد الحمداني وعباس عادل حنتوش واحمد شهاب الحسون
مركز علوم البحار، جامعة البصرة، العراق

المستخلص - تعد دراسة التركيب الكيميائي الحيوي للعوالق الحيوانية، والتي تشكل جزءًا مهمًا من السلسلة الغذائية، معيارًا دقيقًا للأهمية الغذائية لهذه الكائنات، حيث أنها تشكل، الغذاء الأساسي للأسماك في مراحلها المختلفة من النمو والكائنات المائية الأخرى ذات القيمة الاقتصادية. تهدف الدراسة الحالية إلى وصف أهمية التركيب الكيميائي الحيوي للعوالق الحيوانية البحرية في خور الزبير. تستعرض هذه الدراسة التركيب البيوكيميائي للعوالق الحيوانية وذلك من خلال دراسة محتواها من البروتينات والدهون والرماد والرطوبة في ميناء خور الزبير، وقد ترافق هذا مع قياس درجة حرارة الماء وتركيز الملوحة. تشير النتائج إلى ان محتوى العوالق الحيوانية من البروتين بلغ 19.23 -22.31% والرماد بلغ 3.86-4.45 % ، اما الدهون فقد بلغت 6.27-7.18% ، بينما بلغت الرطوبة 65.82- 70.12 % والكربوهيدرات0.25-0.47% من الوزن الرطب.

الكلمات المفتاحية: تركيب بايوكيميائي، عوالق حيوانية، ميناء خور الزبير، البصرة، العراق.

Introduction

The zooplankton are good source of proteins, amino acids, lipids, fatty acids, minerals (Vaidya, 2021). The study of the biochemical structure (proteins, lipids and carbohydrates) of zooplankton is an accurate measure of the nutritional importance of these organisms as they are the main food for fish in their various stages of growth and other marine organisms of economic importance. Therefore, the nutritional significance of these fish is directly related to the quality of the food on which they feed (Raymont, *et al*. 1971; Donaldson, 1976; Vijverberg and Frank, 1976; Morris and Hopkins, 1983; De la Bigne, 1985; Phleger *et al*., 2000; Ikhtyar *et al*., 2000, 2002; Yousefian and Kideys, 2003).

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These studies have shown that data on the biochemical structure of zooplankton is essential to determine the role of this group of organisms in higher nutrient levels or rather their role in the transmission and speed of energy in the ecosystem (Clarke and Bishop, 1948; Veloza, 2005). The nutritional importance of an ecosystem can be determined by the energy yield of the food consumed, since the biochemical composition of zooplankton is mainly related to the nutritional value of phytoplankton that feeds on it (Giani, 1991).

Each species has its own food and energy requirements, which can vary according to seasons or other environmental changes (McClatchie, 1985; Fukuda and Naganuma, 2001; Thor *et al.,* 2002; Choe *et al*., 2003; Richoux *et al*., 2005 Aleya *et al*., 2006; Jagadeesan *et al*., 2010). The experimental species of zooplankton are boon for fishery (Dube, *et al*. 2017). In the Arabian Gulf, the case of reference studies on the biochemical composition of marine sea grass, in general, are very scarce. This encouraged the initiation of this type of study due to the great scientific and applied importance of this subject. The results of this study will contribute to obtain basic results on the biochemical structure of the Arabian Gulf plankton.

Materials and Methods

Study Area:

The sampling station was selected in the Khour Al-Zubair Port at latitude 30° 11' 17" N and longitude 47°53' 43" E (Fig. 1).

Sample Collection:

Samples were collected during 5 months (August, September, October, November and December 2016) by a zooplankton net of 0.100 mm mesh size with a mouth aperture of 40 cm, a flowmeter was mounted at the mouth of the net to determine the volume of water filtered by the net (De Bernardi, 1984). The net was pulled behind a boat at its lowest speed and lifted after 15 minutes; the contents were then placed in a 750 ml plastic bottle and preserved in a freezer.

Water temperature and salinity were measured in the field immediately by a thermometer and a digital salinometer M.C.5 type.

Biomass of zooplankton, (Wet weight and Dry weight):

Wet weight and dry weight of the zooplankton were estimated by filtering the sample using a vacuum pump through a filter paper of a known weight, and the wet weight was recorded by subtracting the weight of the wet filter paper from the paper with the zooplankton. Then the paper was oven–dried at 60ºC for 24 hours and the dry weight was recorded. The dry weight of the filter paper was subtracted from that of the paper with the sample and the dry weight of the sample was obtained. Then the wet weight and dry weight were converted into mg/m^3 by dividing the weight of the sample by the volume of the sample filtered.

Methods of chemical analyses:

The chemical analyses were carried out according to the methods mentioned in AOAC (1998). Moisture was estimated at 1 g of the sample placed in an electric furnace at 105 °C for 20 hours (overnight). Ash was estimated by taking 0.5 g of the sample placed in the incineration furnace at a temperature of 525 °C, while the protein was estimated by using the Kjeldahl method, where the concentrated sulfuric acid was used to digest the samples, and then distillation and correction followed by the use of hydrochloric acid (N. 0.1). The fat was assessed by the saxolite and the cyclohexane solvent was used in the extraction process.

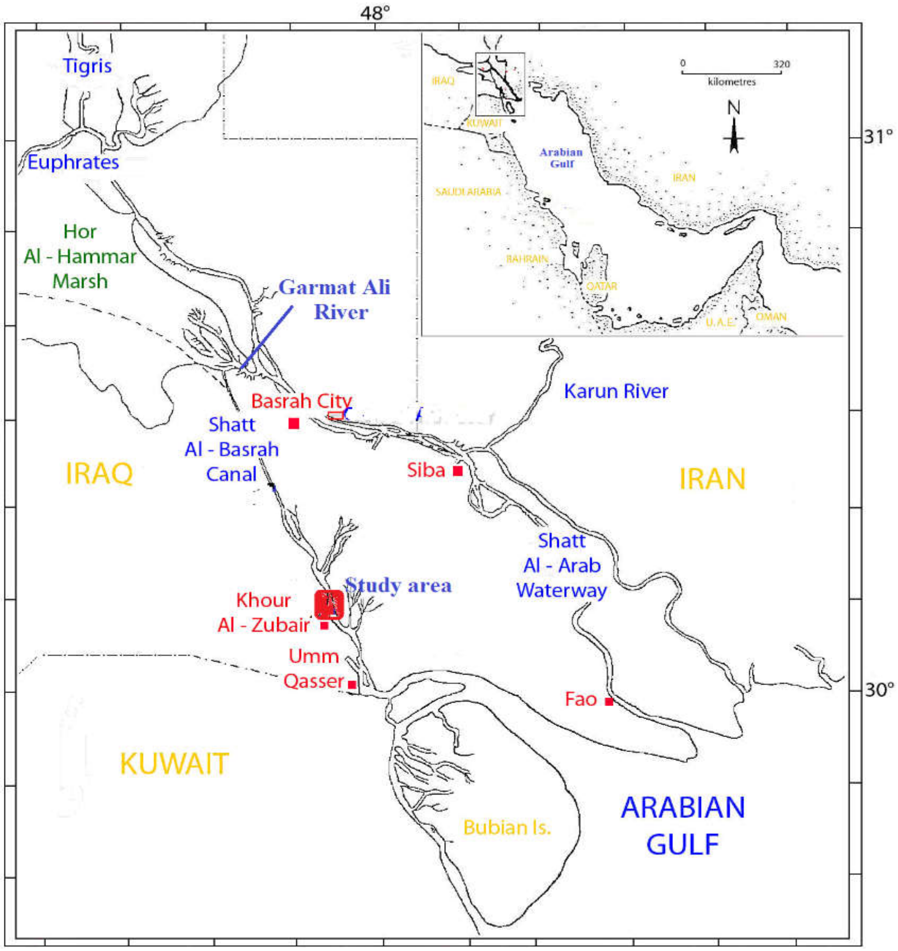

Fig. (1): Map of lower Mesopotamia, showing the study area

Results

Environmental measurements

Table (1) shows the monthly variations of water temperature (°C) and salinity (‰) values at the Khour Al-Zubair Port during August to December 2016

Biomass of the zooplankton

The biomass of zooplankton in terms of wet mass varied from 114.87 - 214.44 mg/m³ in September and October, respectively, and the average was 166.87 mg/m^3, and in terms of dry weight the biomass ranged between 3.25 - 10.61 mg/m³ in November and October, respectively and the average was 7.05 mg/m^3 (Table 2).

Biochemical Composition of Zooplankton

The percentage of biochemical composition was measured for the five samples during the period of collection (August - December 2016) (Table 3). The results showed that the percentage of protein ranged from 19.23%، to 22.31% during August and November, respectively. Lipids varied from 6.27 %, to 7.18% during September and November, respectively. Ash ranged from 3.86%, to 4.54% during September and October, respectively. Moisture was 65.82% and 70.12%, during November and September, respectively. While the carbohydrates changed from 0.25% to 0.47% during August and December, respectively (Fig. 2).

Table 1: Monthly variations of water temperature (°C) and salinity (‰) values at Khour Al-Zubair Port during August to December 2016.

Date of Sampling (Month)	**Water temperature ºC**	**Salinity ‰**
August	26 ±0.2	42±0.1
September	24±0.6	40±0.5
October	22±1.17	40±0.7
November	18±0.8	35±0.6
December	17.5±0.31	34±0.7

Table 2: Monthly fluctuations of zooplankton biomass values (mg/m^3) at Khour Al-Zubair Port during August to December 2016.

Date of Sampling (Month)	**Wet weight (mg/m^3)**	**Dry weight (mg/m^3)**
August	172.76±0.93	3.74±0.78
September	114.87±0.93	10.24±0.92
October	214.44±0.80	10.61±0.91
November	162.34±0.88	3.25±0.56
December	169.96±0.73	7.41±0.56

Table 3: Monthly variations of percentage of biochemical composition of wet weight of zooplankton values at Khour Al-Zubair Port during August to December 2016.

Samples	**Protein %**	**Lipids %**	**Ash%**	**Moisture%**	**Carbohydrates %**
August	19.23±0.21	6.70±0.21	4.09±0.15	69.73±0.13	0.25±0.03
September	19.45±0.35	6.27±0.43	3.86±0.14	70.12±0.36	0.30±0.04
October	21.76±0.10	7.09±0.15	4.54±0.06	66.26±0.08	0.35±0.21
November	22.31±0.39	7.18±0.29	4.22±0.16	65.82±0.76	0.47±0.02
December	22.16±0.11	7.16±0.09	4.25±0.09	65.97±0.15	0.46±0.17

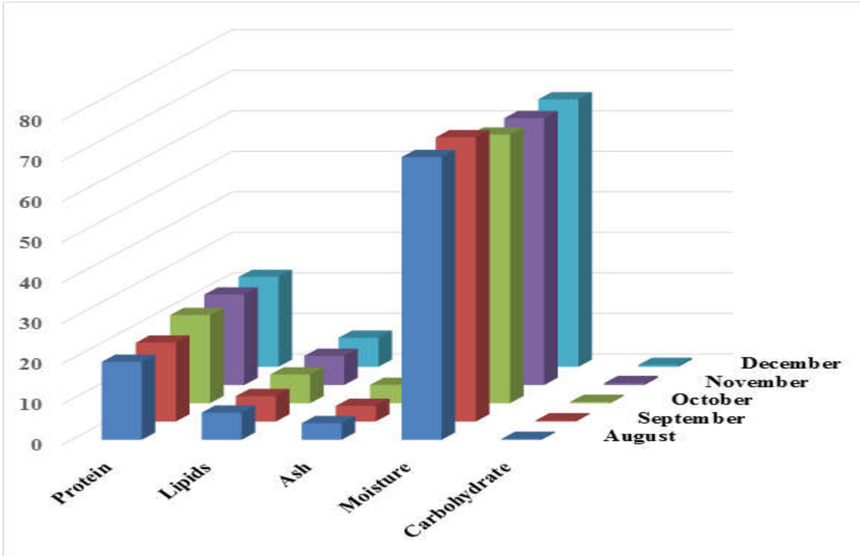

Fig 2: Percentage of biochemical composition of wet weight of zooplankton at Khour Al-Zubair Port during August to December 2016.

Discussion

The biochemical contents of zooplankton varies from one region to another, depending on the environmental conditions and many other variables. It varies during the day and night, as well as with depth and in different seasons. The lipid concentration was high in summer and the protein concentration was high in the spring (Morris and Hopkins, 1983). In addition, the quality of lipids varies with maturity and depth, as the content of lipids and protein decreases in the plankton with increasing water density (Childress *et al.,* 1990). The biochemical contents also varies depending on the sex (male or female) (Richoux *et al*., 2005).

The results showed that the carbohydrate values were very low due to the small size of the plankton indicating that zooplankton may convert a part of their dietary carbohydrates to saturated fatty acids (Taipale, *et al.* 2016). The values also depend on the blooming of phytoplankton and the high concentration of chlorophyll (Bacelar-Nicolou, *et al*. 2003). Freshwater plankton is richer in carbohydrates than marine plankton and close to protein and lipids (Riccardi and Mangoni, 1999). The decrease of concentration of carbohydrates and lipids in the plankton in this study may be due to the method of preserving and drying the samples or due to the nature of the food formed by the phytoplankton (Ohman, 1996). Several studies have recorded significant seasonal changes in the composition of zooplankton. The sequence of zooplankton is associated with the quality of phytoplankton (Richoux *et al*., 2005; Lavaniegos and Lopez-Corts, 1997). The amount of food or feeding conditions can play a role in different chemical composition. Raymont and Conover (1961) indicated that the contents of lipids and proteins in the plankton varies by about 45% between fasting and feeding. Azeiteiro *et al*. (2003) referred to the effect of fasting in the biochemical structure of zooplankton (Euphausiacea). It was found that the process of fasting consumes sugars in larger quantities followed by lipids and proteins. The biochemical structure varies according to the stage of growth of the organism (Clarke, 1977; Ohman, 1988; Vieira *et al*., 2002; Azeiteiro *et al*.,2003; Calado *et al.*, 2005) where the nature of amino acids changes. Yousefian and Kideys (2003) found that the proteins decreased by 13.4% after 5 days of fasting, whereas the lipids decreased by 46.3%, where as, low sugars decreased by 24.5%. As for lipid changes, it is related to metabolism and reproductive strategy (Pastorinho, *et al*. 2003).

The results indicated that the amount of proteins and lipids were inversely proportional to temperature and salinity concentrations. There was a positive correlation between the weight of proteins and lipids and the total weight of the plankton in the studied samples. The relationship was 30% between sugars and dry weight and 86% between lipids and dry weight (-20%). As for ash, its relation to dry weight was very weak and did not exceed + 3.3%. These relationships can be explained by the fact that the level of lipids and sugars are positively correlated with the maturation factor of the bifurcation as opposed to the proteins (Choe *et al*., 2003). Therefore, adult individuals are rich in sugars and lipids while juveniles are rich in proteins, and it has been found that increased levels of sugars and lipids occurred when the total abundance of adult copepods. The quality of food affects more than the quantity at the level of biochemical structure, especially the composition of organic matter and life cycle of zooplankton (Al-Owafeir, *et al*. 2012).

Rosa and Nunes (2003) found that the quality of lipids is related to the maturity and depth of some different types of decapods, as the content of lipids and proteins in the plankton decreases the percentage of wet weight with water density (Childress *et al.,* 1990). Lipid is greatest in summer and protein in the spring. The contents of the zooplankton varies from proteins to lipids with depth and between night and day (Morris and Hopkins, 1983).

Conclusion

1. Zooplankton is of a great importance in the food chain, as it contains proteins, lipids and carbohydrates necessary for the food of fish and other organisms.
2. The amount of proteins, lipids and carbohydrates are inversely proportional with temperature and salinity concentration.

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