CHEMICAL AND MINERAL COMPOSITION OF TEN ECOMONICALLY IMPORTANT FISH SPECIES IN THE SATT AL- ARAB RIVER AND IRAQI MARINE WATER NORTHERN WEST ARABIAN GULF

Q. H. Alhamadany A.T.Yaseen A.T.Yasser A.W.Ali
Assist. Prof Assist Prof. Assist. Prof. Assist. Researcher
Dept. Mar. Verteb. University Basrah e-mail : qusayhamid@yahoo.com

ABSTRACT

This study was aimed to determine and compared the chemical composition and some of the main minerals of ten economically important fish species from the Shatt Al-Arab River; *Leuciscus vorax*. *Cyprinus carpio*. *Hypophthalmichthys molitrix*. *Ctenopharyngodon idella* and *Mesopotamichthys sharpeyi*. And Iraqi coastal water to the NorthernWast Arabian gulf; *Acanthopagrus arabicus*. *Otoliths ruber*. *Mugil cephlus*. *Tenualosa ilisha* and *Pampus argenteus*. Moisture ranged from 65.65±1.81 % to 77.94±0.799 %. Protein from 15.81±0.893 to 19.44±0.418 %. Fat from 0.974±0.049 to 6.461±0.489 %. Ash from 0.886±0.03 % to 2.127±0.279 percent and caloric value was ranged from 116.173±2.7645 to 215.26±11.3828 kcal/100g. Main minerals; calcium. Potassium. Phosphorus and Iron ranged from 15.98 to 93.49. 53.34 to 839.92. 249.36 to 686.61and 0.52 to 11.92 mg /100g of the fish muscle. Respectively. *M. cephlus* was the highest in contents of calcium and potassium. While *C. carpio* was highest in phosphorous and Iron. Mineral elements as the following sequence K > P > Ca > Fe. Muscle tissues. The results showed that fishes from Shatt Al-Arab and Iraqi marine waters provide a strong supply of protein. Lipid and metals. These results can be used as useful references for consumers in order to choose fish based on their quality and nutritional contents.

Key words: freshwater fish. Marine water fish, nutritional value. Protein, fat, ash.

مجلة العلوم الزراعية العراقية -2021 :52 (3):632-639 الحمداني وآخرون

التركيب الكيميائي والمعدني لعشر أنواع من الأسماك ذات الأهمية الاقتصادية في نهر شط العرب والمياه البحرية العراقية شمال غرب الخليج العربي

قصي حامد الحمداني علي طه ياسين عبدالكريم طاهر ياسر علي وفيق علي
استاذ مساعد استاذ مساعد استاذ مساعد مساعد باحث
قسم الفقريات البحرية , مركز علوم البحار , جامعة البصرة

المستخلص

تضمنت الدراسة تحديد ومقارنة التركيب الكيميائي وبعض المعادن الرئيسة فضلا عن القيمة الغذائية لعشرة أنواع من الأسماك ذات الأهمية الاقتصادية من نهر شط العرب؛ الشلق ***Leuciscus vorax*** والكارب الشائع ***Cyprinus carpio*** والكارب العشبي ***Ctenopharyngodon Idella*** والكارب الفضي***Hypophthalmichthys molitrix*** واسماك البني***Mesopotamichthys sharpeyi***، والمياه الساحلية العراقية شمال غرب الخليج العربي: الشانك الفضي ***Acanthopagrus arabicus***والنويبي ***Otoliths ruber*** والبياح ***Mugil cephlus*** و الصبور ***Tenualosa ilisha*** والزبيدي ***Pampus argenteus*** ، تراوحت نسبة الرطوبة في عضلات الأسماك بين 65,65± 1,81 و77,94± 0.799 %. البروتين من 15,81 ± 0,893 إلى 19,44 ± 0,418 %، الدهون من 0,974 ± 0,049 إلى 6,461 ± 0,489 %، والرماد من 0,88 ± 0,03 إلى 2,127 ± 0,279%. وتراوحت القيمة الغذائية من 116,173 ± 2,7645 إلى 215,26 ± 11,3828 كيلو سعرة / 100غم. بالنسبة لمحتوى العناصر المعدنية في عضلات الأسماك، تراوح محتوى الكالسيوم بين 15.98 إلى 93,49 ملغم / 100 غم والبوتاسيوم بين 53,34 إلى 839,92 ملغم / 100غم والفوسفور بين 249,36 إلى 686,61 ملغم / 100غم والحديد بين 0,52 إلى 11,هس92 ملغم /100غم. احتوت اسماك البياح على اعلى محتوى من الكالسيوم والبوتاسيوم في حين احتوت اسماك الكارب الشائع على اعلى محتوى من الفسفور والحديد. كان ترتيب العناصر المعدنية في عضلات الأسماك بالشكل التالي: البوتاسيوم > الفسفور > الكالسيوم > الحديد. استنتج من الدراسة أن الأسماك من شط العرب والمياه البحرية العراقية مصادر جيدة للبروتين والدهون والعناصر المعدنية ويمكن استخدام هذه النتائج كمرجع مفيدة للمستهلكين من أجل اختيار الأسماك على أساس جودتها ومحتوياتها الغذائية.

الكلمات المفتاحية: اسماك المياه العذبة، اسماك بحرية، القيمة الغذائية، بروتين، دهن، رماد.

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INTRODUCTION

The fish sector is considered an important component of the economies of many countries in the world including Arab countries, it is also considered an important component of food security (10). Prediction activity in the quantities of red and white meat in Iraq indicates a significant decrease in the quantities available for individual consumption (5). Fish is one of the most important animal protein sources for human nutrition and is known to be one of the lowest cost sources of protein. It is commonly used since it has a higher protein level. lower cholesterol content and often contains essential fatty acids considered to encourage better well-being (17). The biochemical composition of fish is generally composed water content of 70 to 80 %. protein. 20 to 30 % and 2 to 12 % fat. (26). Proximate composition is a useful biological measure necessary for regular fisheries research (14). Moreover. nutritional components of fish differ greatly depending on species. sex. sizes. seasons and locations. (23). Biochemical conditions are closely related to feeding habits. migration and behavioral changes associated with spawning (22). Proportion of minerals in fish is between 1-2 %. and this ratio depends on the fish species as well as the environment where they live (11). Most important minerals in fish are potassium. calcium. and phosphorus that are important for the normal functioning of the nerves and bone formation (28). These minerals are usually specialized for marine fish species compared to freshwater fish (16). Several studies refer to the proximate content of commercially valuable fish from Iraqi freshwater besides marine waters. (8, 9, 11 ,12, 19, 20, 29, 37, 39). seasonal variation of chemical composition (21). effects of the reproductive cycle on chemical composition (22,30,39). Mahdi *et a*l. (27) studied the chemical and mineral composition of some commercially important Iraqi fish. The primary objective of this study was to define and evaluate the chemical constituents and main elements of ten commercially important fish species through Shatt Al-Arab. *Leuciscus vorax*. *Cyprinus carpio*. *Hypophthalmichthys molitrix*. *Ctenopharyngodon idella*. and *Mesopotamichthys sharpeyi*. and Iraqi marine waters northwestern Arabian gulf *Acanthopagrus arabicus*. *Otoliths ruber*. *Mugil cephlus*. *Tenualosa ilisha*. *Pampus argenteus*). to assess their chemical composition and nutritional value.

MATERIAIS AND METHODS

Samples collection

Ten species of commercially important fish of Shatt Al-Arab and Iraqi Marine waters Northwest Arabian Gulf. located on local market in Basrah. southern Iraq. have been studied. Five of these are marine species: *A. arabicus*. *O. ruber*. *M. cephlus*. *T. ilisha*). *P. argenteus*. and five of freshwater fish species. which are: *L. vorax*. *C. carpio*. *H. molitrix*. *C. idella*. and *M. sharpeyi*. Table (1). illustrated the fish species and the size of the fish. Fish specimens was placed in an ice box and transferred to the Fish Nutrition Laboratory. Marine Vertebrate Department.

Chemical content

Moisture. protein (N×6.25). fat and ash content are determined. accordance usual methods suggested by AOAC (2). The caloric value was determined by multiplying protein and fat content by 5.5 and 9.5. respectively. using the methods proposed by Winberg (38).

Major minerals

The preparation of samples for the assessment of these mineral elements was followed by the process mentioned in AOAC (1). Roughly. 5 g of each sample (wet weight) was stored in a Teflon digestion vessel and double acid was digested with nitric acid (HNO3) and perchloric acid (HClO4). Calcium. Potassium. Phosphorus and Iron. were assessed as described by AOAC (2). Atomic Absorption Spectrometer (SAA), has been used for mineral determination.

Statistical analysis

Statistical analysis was performed using the SPSS statistical package (version 22). Values are given in the mean ± standard deviation (SD). The differences were compared by a one-way variance analysis (ANOVA). Samples at $P \leq 0.05$ is found to be significantly different.

RESULTS AND DISCUSSION

Chemical composition

Table 1. Fish species from Shatt Al-Arab and Marine waters

Fish species	Average Length (cm)	Average weight (g)	No. of Ind. fish samples
Acanthopagrus arabicus	17.55±1.031	306.8±32.09	11
Mugil cephlus	14.77±0.712	94.83±19.2	23
Tenualosa ilisha	31.1±1.25	306.8±32.09	7
Pampus argenteus	22.47±2.076	152.2±25.55	6
Otoliths ruber	38.25±1.202	496.5±6.908	6
Cyprinus carpio	27.19±1.473	782.8±67.91	13
Hypophthalmichthys molitrix	39.08±2.423	605.4±23.1	8
Ctenopharyngodon idella	32.5±9.35	1969.2±566.7	6
Leuciscus vorax	58.05±4.21	20.79.1±658.3	7
Mesopotamichthys sharpeyi	29.1±0.995	299.5±17.05	6

Table 2 describes the ratio of the proximate biochemical contents (moisture. protein. fat. and ash) and the caloric value of fish. All chemical contents have been considerably different (P≤0.05) but there are no differences (P>0.05) in caloric value of 10 fish species tested.

Content of moisture

The moisture content was ranged between 65.65±1.81 % to 77.94±0.799 %. Mahdi *et al*. (27) and Hantoush *et al*. (19). also showed a wide difference in moisture content ranged between 65.9% to 79.6% and 73.74 to 78.01% respectively. the fishes of *P. argenteus*. *O. ruber*. *C. Idella*. *C. carpio* and *H. molitrix*. had the highest moisture content fig.1.

Table 2. Average percentage and ±SD of moisture. protein. fat. ash and caloric value of fish species through Shatt Al-Arab and Marine waters

Species	Moisture contents %	Protein contents %	Fat contents %	Ash contents %	Caloric value Kcal/100g
A. arabicus	75.48± 1.247^{d}	18.8± 0.507^{abc}	3.327± 0.036^{f}	1.076± 0.132^{b}	135.0065±3.1305
M. cephlus	65.65± 1.81^{f}	19.05± 0.933 ^{ab}	11.63± 0.658^{a}	2.127± 0.279^{a}	215.26±11.3828
T. ilisha	73.1± 1.374^{d}	18.89± 0.26 ab	5.79± 0.525^{bc}	1.144± 0.039^{b}	158.9± 6.4175
P. argenteus	76.96± 0.8^{ab}	18.63± 0.754^{bcd}	2.147± 0.283^{f}	1.125± 0.047^{b}	122.8615±6.8355
O. ruber	76.96± 0.297^{ab}	19.44±0.418^{a}	0.974± 0.049^{g}	1.048± 0.044^{bc}	116.173±2.7645
C. carpio	76.73± 0.255^{ab}	15.92± 0.255^{e}	5.43± 0.463^{c}	0.886± 0.03^{c}	139.145±5.801
H. molitrix	77.94± 0.799^{a}	15.81± 0.893^{e}	3.39± 0.523^{e}	1.008± 0.033^{bc}	119.16± 9.88
C. idella	76.98± 0.357^{ab}	16.12± 0.207^{e}	4.369± 0.437^{de}	1.01± 0.014^{bc}	130.1655±5.22
L. vorax	73.52± 0.294^{d}	17.84± 0.457 ^{cd}	6.461± 0.489^{b}	1.01± 0.056^{bc}	159.4995±7.15935
M. sharpeyi	74.83± 0.917^{cd}	17.49± 0.466^{d}	5.025± 0.846^{cd}	1.111± 0.092^{b}	143.9325±10.6000
Significance *	*	*	*	*	-

*Means with different small letters in the same column are significantly different (p≤0.05)

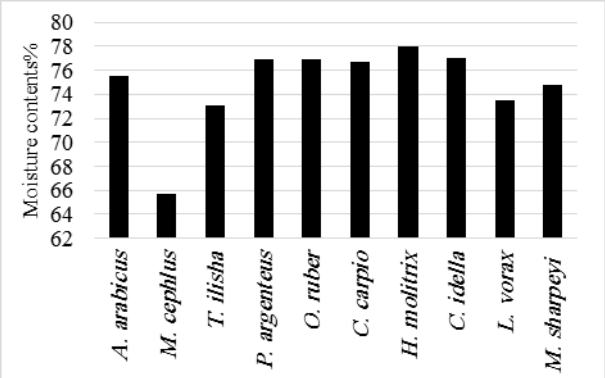

Figure1. Moisture content of fish muscle from Shatt Al-Arab and Marine waters

Content of protein

The average of total protein content for fish varied from 15.81±0.893 to 19.44±0.418 percent (Fig. 2). freshwater species had the lowest protein content ranged 5.81±0.893 to 17.84±0.457 percent. Hindi *et al*. (22) concluded that. for certain important Iraqi fish. the maximum value of muscle protein was found immediately after spawning. Fish muscle protein seem to be the second most valuable component in fish (3) and fish muscle proteins are usually between 15 and 20 %. but are found to be as low as 13.5 % or as high as 28% in special circumstances (31).

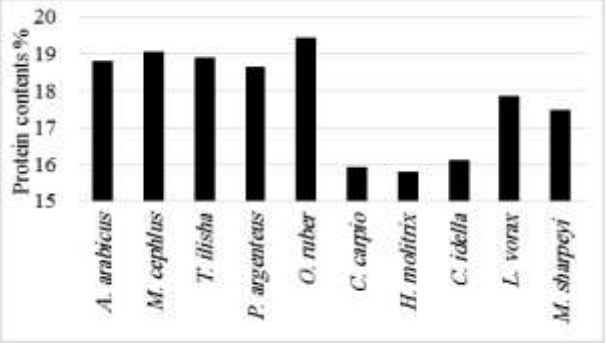

Figure 2. Protein contents of fish muscle from Shatt Al-Arab and Marine waters

Content of fat

The mean fat content varies greatly from 0.974±0.049 to 6.461±0.489 percent (Fig. 3). fish are usually divided into four groups based on their fat content: lean fish (< 2 per cent). low fat (2-4 %). medium fat (4-8 per cent) and high fat (> 8 %) (6). Just *O. ruber* under analysis was described as lean fish. *A. arabicus*. *P. argenteus* and *H. molitrix* was found to be low fat fish. *M. cephlus* was high fat fish while the species of rest fish were considered medium fatty fish. Many species display the same lipid content. while others demonstrate major differences (20, 22, 39). Changes in fat content depending on whether fish are depleting or restoring enough fat to balance the supply of food, spawning cycles and other factors. (22, 39). Several studies have suggested that the fat content could be negatively proportional to the moisture content (19, 33, 40). The variations in the fat content of the fish species are typically higher than other components. This can be due to the inherent variations in the environment. both periodic and regional. Differences in age and maturity of the same species that also lead to differences in fat content. (22. 34).

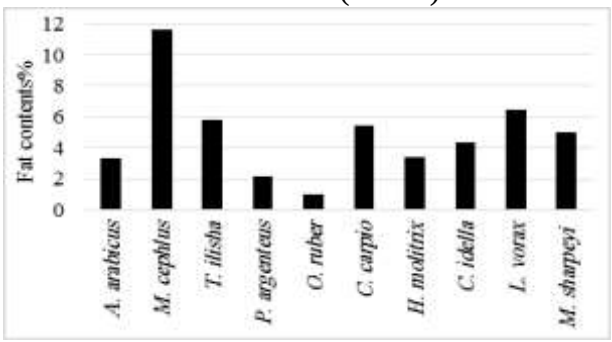

Figure 3. Fat contents of fish muscle from Shatt Al-Arab and Marine waters

Content of ash

Ash is a representation of the mineral content of all organisms. including fish. (32). the estimated ash contents of the fish species ranged from 0.886±0.03 % and 2.127±0.279 % Figure 4. Most of the fishes contained <2 % ash contents. The only species with ash content >2 percent was *M. cephlus* (2.127±0.279 percent). In jack mackerel. such high ash content was recorded earlier (4.10 %) by Pauland and Vivian (33). Total ash content is expected to differ in fish. probably depends on their food intake behavioral patterns (4,11). Yesser (39) and Hindi *et al*. (22) mentioned that perhaps the total amount in ash is independently of maturation and developmental cyclicity.

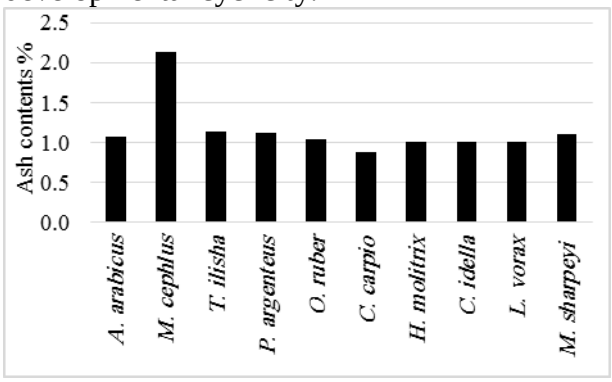

Figure 4. Ash contents of fish muscle through Shatt Al-Arab and Marine waters

Caloric value

Caloric values of fishes ranged widely from 116.173 to 215.26 kcal/ 100g (Fig. 5). Most fish had caloric values less than 200 kcal. Only *M. cephlus* had caloric value of 215 kcal. attributable to high content of fat or protein. The lower caloric value of *O. ruber* was 116.173 kcal due to low fat content (0.974 %).

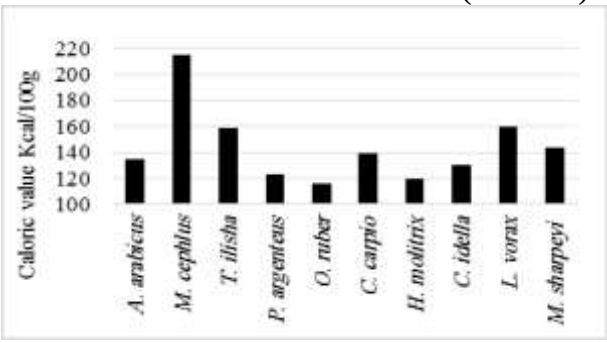

Figure 5. Caloric value Kcal/100 g fish muscle through Shatt Al-Arab and Marine waters

This is in compliant Mahdi *et a*l. (27) for some important Iraqi fish (92.40-184.70 Kcal/ 100gm) in *C. carpio* and *T. ilisha* respectively. The results of highest energy value of 215.26 kcal has been acquired for *M. cephlus* owing to the high content of fat (11.63%) and protein content (19.05%). A wide range of caloric value will represent broad variation in fat content (24). The fish species with high protein content (>17%) also gave maximum caloric contents. Caloric value in fish muscle was as follow:

M. cephlus >L. vorax > T. ilisha >M. sharpeyi > C. carpio > A. arabicus > C. Idella > Pampus argenteus> H. molitrix > O. ruber

Table 3. Mean minerals content (mg/100gm) fish muscle ±SD of fish species from Shatt Al-Arab and Marine waters

Species	Calcium	Potassium	Phosphor	Iron
A. arabicus	**47.08±1.96^{c}**	**411.52±4.56^{d}**	**256.79±3.56^{fg}**	**0.52±0.01^{c}**
M. cephlus	**93.49±2.05^{a}**	**839.92±6.33^{a}**	**506.34±9.32^{d}**	**1.04±0.04^{c}**
T. ilisha	**63.28±1.82^{b}**	**559.54±5.94^{b}**	**354.61±24.45^{e}**	**0.71±0.11^{c}**
P.argenteus	**49.38±2.03^{c}**	**428.35±19.42^{c}**	**267.92±2.65^{f}**	**0.55±0.06^{c}**
O. ruber	**45.79±1.96^{c}**	**404.44±5.86^{d}**	**249.36±1.82^{g}**	**0.54±0.05^{c}**
C. carpio	**21.21±1.48^{d}**	**61.88±1.15^{e}**	**686.61±6.11^{a}**	**11.92±1.14^{a}**
H. molitrix	**18.84±1.07^{d}**	**55.34±2.07^{e}**	**617.41±6.87^{b}**	**10.80±2.01^{ab}**
C.idella	**18.78±1.06^{d}**	**55.44±1.98^{e}**	**619.50±7.96^{b}**	**10.67±2.05^{ab}**
L. vorax	**15.98±1.05e**	**53.26±1.03^{e}**	**523.32±5.95^{c}**	**9.35±1.53^{b}**
M.sharpeyi	**18.49±1.04^{de}**	**57.99±1.50^{e}**	**609.47±6.08^{b}**	**10.54±1.55^{ab}**
Significance*	*	*	*	*

***Means with different small letters in the same column are significantly different (p≤0.05**

Major minerals

Table 3. indicate the occurrence of four principal minerals: calcium. potassium. phosphorus and iron content in fish. All minerals were considerably different (P≤0.05).

Calcium content

Calcium is essential for bone structure. and fish are recognized to have been a useful source of this element. particularly small fishes (28). The total calcium level of fish species in this study ranged from 15.98±1.05mg/100 g to 21.21±1.48 mg/ 100g in fresh water fish. while in marine species ranged from 45.79±1.96 to 93.49±2.05 mg / 100 g (fig. 6) Mahdi *et al*. (27) recorded that the highest Ca contents of marine species ranged from 280 to 340 mg /100g in *Liza dussumeiri* and *T. ilish* respectively compared to fresh water fish *B. sharpeyi*. *B. luteus* and *C. carpio* of average content 58. 41 and 28 mg/ 100 g respectively.

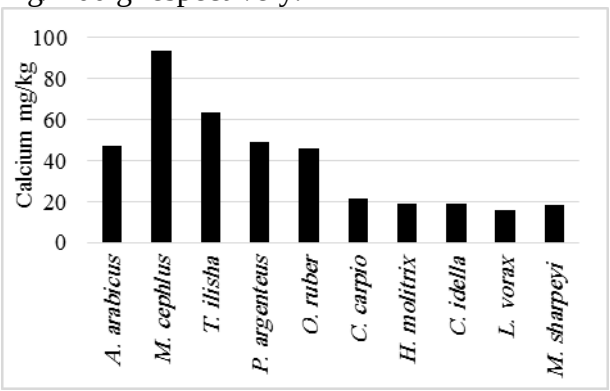

Figure 6. Calcium contents mg/100 gm of fish muscle through Shatt Al-Arab and Marine waters

Potassium content: Potassium is essential in muscle contractions. nerves impulses

transmission and sugar metabolism (28). The fish's total potassium contents ranged widely from 53.26 to 839.92±6.33 mg/100 g. Freshwater fishes. contained 53.26±1.03 to 61.88±1.15mg/100 g. while marine species had the highest value of 411.52 ±4.56 to 839.92± 6.33mg/100 g (Fig. 7). Mahdi *et al*. (27) identified similar trend in K level in Iraqi fresh and marine water fish ranges from 22 to 35 mg/100g and 183 to 195 mg/100 g respectively. Alas *et al*. (7) reported levels of 321-441 mg/100 g that are somewhat similar to this study. Potassium levels in fish muscle may well be owing to the level in which they are found throughout the water and the capabilities of the fish to extract such inorganic elements from their food intake and the living environment (25).

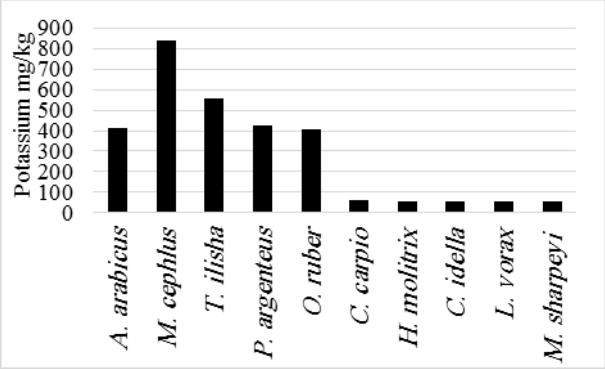

Figure 7. Potassium mg/100mg of fish muscle through Shatt Al-Arab and Marine waters

Phosphorous content:

Phosphorus. along with calcium and magnesium. is a major constituent of bones (28). The average content of phosphorus in fish ranged widely from 249.36±1.82 to 686.61±6.11mg/100 g. *O. ruber* had the lowest value 249.36 mg/100 g while the *C. carpio* had the highest value 686.61mg/100 g (Fig. 8). The P concentration in this study is higher than the FAO range of 68-550 mg/100 (18). and other freshwater fish obtained from Mahdi *et al*. (27) (75- 89 mg/100g). and Ali *et al*. (12) 232 - 426 mg/100 g. The phosphorous abundance in the organism can be due to the fact that phosphorus is indeed a protein component (15).

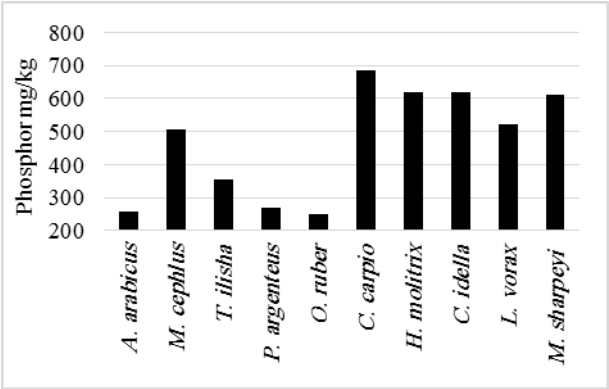

Figure .8 phosphorous contents mg/100 mg of fish muscle through Shatt Al-Arab and Marine waters Northwest Arabian Gulf

Iron content:

Fe is useful for a number of body metabolic processes but primarily for transportation of oxygen through the blood (28). The mean iron content of the fish examined varied widely between 0.52± 0.01 and 11.92± 1.14 mg/100g. The total iron content of freshwater fish was 9.35±1.53 to 11.92±1.14mg/100 g and marine water fish was 0.52±0.01 to 1.04±0.04 mg/100 gm. The species. *A. arabicus* had the minimum iron content 0.52 mg/100gm. The high iron content of 11.92, 10.80, 10.67, 9.35 and 10.54 mg/100 g, were recorded for *C. carpio*, *H. molitrix*, *C. Idella*, *L. voraxhad* and *M. sharpeyi* respectively. that may act as a good dietary iron source (Fig 9). This finding is similar to the iron content of freshwater fish studied by Mahdi *et al*. (27).

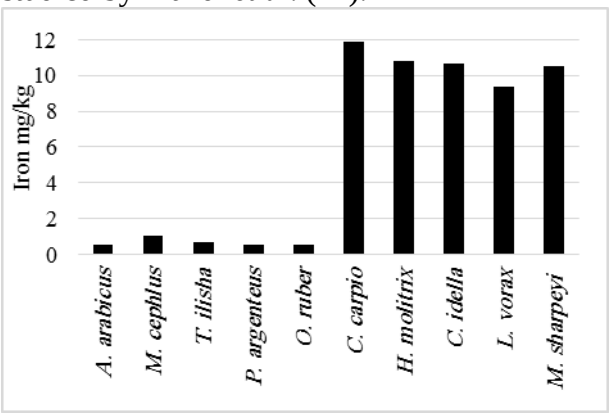

Figure 9. Iron contents mg/100 gm of fish muscle through Shatt Al-Arab and Marine waters

Identified mineral elements were as the following sequence K> P> Ca>Fe. in the muscular tissues of all species studied. The levels of such minerals in fish were considerably different around fish species (25). The variability relates to seasonal and biological variations (36).

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