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

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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 NorthernWest Arabian gulf; Acanthopagrus arabicus. Otoliths ruber, Mugil cephalus. 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. cephalus 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.
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 of 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 al. (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 cephalus. Tenualosa ilisha. Pampus argenteus). to assess their chemical composition and nutritional value.

MATERIALS 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. cephalus. 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 ≤ 0.05 is found to be significantly different.

RESULTS AND DISCUSSION
Chemical composition
tested. (P>0.05) in caloric value of chemical contents have been considerably and ash) and the caloric value of fish. All biochemical contents (moisture, protein, fat. 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 cephus              | 14.77±0.712         | 94.8±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±69.08        | 6                       |
| Cyprinus carpio           | 27.19±1.473         | 782.8±67.91        | 13                      |
| Hypophthalmichthys        | 39.08±2.423         | 605.4±23.1         | 8                       |
| vorax                     |                      |                    |                         |
| 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.

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        | 18.8± 0.507        | 3.327± 0.036   | 1.076± 0.132   | 135.0065±3.1305        |
| M. cephus        | 65.65± 1.81          | 19.05± 0.933       | 11.63± 0.658   | 2.127± 0.279   | 215.26±11.3828         |
| T. ilisha        | 73.12± 1.374        | 18.89± 0.26        | 5.79± 0.525    | 1.144± 0.039   | 158.9± 6.1475          |
| P. argenteus     | 76.96± 0.8           | 18.63± 0.754       | 2.147± 0.283   | 1.125± 0.047   | 122.8615±6.8355        |
| O. ruber         | 76.96± 0.297         | 19.44±0.418        | 0.974±0.049    | 1.048±0.044    | 116.1732±7.7645        |
| C. carpio        | 76.73± 0.255         | 15.92±0.255        | 5.43±0.463     | 0.886±0.03     | 139.145±5.801          |
| H. molitrix      | 77.94± 0.799         | 15.81±0.893        | 3.39±0.523     | 1.008±0.033    | 119.16±9.88            |
| C. idella        | 76.98± 0.357         | 16.12±0.207        | 4.369±0.437    | 1.01±0.014     | 130.1655±5.22          |
| L. vorax         | 73.52± 0.294         | 17.84±0.457        | 6.461±0.489    | 1.01±0.056     | 159.4995±7.15935       |
| M. sharpeyi      | 74.83± 0.917         | 17.49±0.466        | 5.025±0.846    | 1.111±0.092    | 143.9325±10.6000       |

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.

*Means with different small letters in the same column are significantly different (p≤0.05)
Figure 1. 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 0.97±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. cephalus 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 0.88±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. cephalus (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/100 g (Fig. 5). Most fish had caloric values less than 200 kcal. Only M. cephalus 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%).

This is in compliant Mahdi et al. (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. cephalus 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. cephalus >L. vorax > T. ilisha >M. sharpeyi > C. carpio > A. arabicus > C. Idella > Pampus argenteus> H. molitrix > O. ruber

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

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

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

*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±1.15 mg/100 g. while marine species had the highest value of 411.52 ±4.56 to 839.92± 6.33 mg/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).

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±6.11 mg/100 g. O. ruber had the lowest value 249.36 mg/100 g while the C. carpio had the highest value 686.61 mg/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).

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).

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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