# Determination of Nutritional Values and Elemental Compositions in *Monopterus albus* (Swamp eel) from Hinthada District

Wah Wah Paing[1], Kay Khaing Myint[2]

## Abstract

*Monopterus albus* (swamp eels) are widely consumed in many countries including Myanmar. Swamp eel samples (Pa-mawe) are widely consumed in Ayeyawady Region. Swamp eel samples (Pa-mawe) were collected from Kantharyar Market, Hinthada District. The aim of this study was conducted to determine the (contents) of nutritional values and elemental compositions in swamp eel (Pa-mawe). The nutritional values, such as moisture (77.05 %), ash (1.83 %), fat (0.84 %), protein (14.44 %) and carbohydrate (5.74 %) and energy values (88.28 kcal / 100 g) of swamp eel (Pa-mawe) were determined by using AOAC method. In this experiment, fiber content was not found in the sample swamp eel. The quantitative analysis of some elemental compositions in swamp eel (fresh flesh and blood) were also carried out by Atomic Absorption Spectrometric method. The contents of elements were found to be sulphur (67.60 ppm and 13.00 ppm), calcium (18.20 ppm and 6.10 ppm), zinc (1.10 ppm and 0.60 ppm), lead (0.55 ppm and 0.56 ppm), iron (2.00 ppm and 7.90 ppm) in fresh flesh and blood of swamp eel. Swamp eel contains the equal amount of cadmium. Moreover, the copper and arsenic contents were not detected in samples because of the limitation of AAS method. The potassium contents were found to be 157.40 ppm (fresh flesh) and 17.80 ppm (blood). According to these data, swamp eel contains a large amount of potassium contents than other elements. It is a noticeable food for fish allergies. Nevertheless, swamp eel is a good source of healthy diet.

**Keywords**: pa-mawe, swamp eel, nutritional values, blood, flesh, elemental compositions

## INTRODUCTION

Fish are popular traditional foods for diet, especially in Myanmar. Fish and other seafoods are the major sources of healthful long-chain omega-3 fat and are also rich in other nutrients such as vitamin D and selenium, high in protein and low in saturated fat. Nowadays, many people are living in developing countries. Fish are dominant animal source of food especially for people who are living in near coastal and inland waters. The Asian swamp eel (*Monopterus albus*), also known as rice eel, ricefield eel or rice paddy eel is a commercially important, air breathing species of fish in the family of Synbranchidae. The Asian swamp eel is a high protein content (approximately 81.25%) fish with delicious taste that can. Last for 6 to 8 months. Swamp eels are nutritious food that constitute desirable components of a healthy diet. Nutritional values of swamp eels include determination of moisture, ash, fat, protein, fiber, carbohydrates and energy. The elemental determination of lead, cadmium, zinc, copper, iron, calcium and arsenic were analysed. This study revealed the contents of nutritional and elemental values in swamp eel.

### Swamp eel (*Monopterus albus*)

The Asian swamp eel or swamp eel (*Monopterus albus*) is a freshwater eel like fish belong to the family Synbranchidae. Pa-mawe (Nga shint) are purchased from Kantharyar Market, Hinthada District.

| | | |
|---|---|---|
| Name | : | Asian swamp eel |
| Kingdom | : | Animalia |
| Phylum | : | Chordata |

[1] Demonstrator, Department of Chemistry, Hinthada University
[2] Demonstrator, Department of Chemistry, Hinthada University

| | | |
|---|---|---|
| Class | : | Actinopterygii |
| Order | : | Synbranchiformes |
| Family | : | Synbranchidae |
| Genus | : | *Monopterus* |
| Species | : | *albus* |
| Binomial Name | : | *Monopterus albus* (Z.) |
| Other Names | : | Also known by some other names such as rice eel, swamp eel, rice field eel, belut, rice paddy eel |
| Common Name | : | Swamp eel |
| Local Name | : | Pa-mawe (Nga shint) |

(a) Dorsal (b)Ventral

Figure 1. Photograph of *Monopterus albus* (swamp eel)

**Characteristics**

The Asian swamp eel has a scaleless, snake like body that is long to a meter or less, typically 25 to 40 cm as an adult. It has a tapering tail and blunt snout, and lacks pectoral and pelvic fins. Its body and head are dark or dark olive, brown dorsal colouring and light orange ventral colouring. Some are brightly colour with yellow, black and gold spots. (Guan et al.,1996)

The mouth is large and protractile and both upper and lower jaws have tiny teeth. Swamp eel eat fishes, worms, crustaceans and other small aquatic animals at night. (Khanh *et al.,* 2010). M.*albus* is native to the tropical and subtropical areas of northern India and Myanmar, China, Russia and Japan. Swamp eels live in ditches, ponds, streams and paddy fields. In Asia, the swamp eel is wide-ranging, occurred in both tropical and temperature climates. It can be found in muddy ponds, canals, medium to large rivers, rice fields and swamps. (Hamillton, 2006). The preferred environment for the Asian swamp eel includes a wide variety of freshwater-like shallow wetlands, stagnant waters, marshes, streams, rivers, ditches, canals, lakes, reservoirs, and ponds. The swamp eel (*Monopterus albus*) has a relatively high tolerance for temperature changes. If someone consumes swamp eel, he can survive for a week without food. (Fuller *et al.,* 2010). Reproduction can occur throughout the year. Eggs are laid in bubble nests located in shallow waters. These bubble nests float at water's surface and are not attached to aquatic vegetation. Females produce up to 1000 eggs, each per spawning event, since all individuals begin as females before maturation, it would be best to implement removal of the species at the juvenile stage of the life cycle so as to affect the largest number of the reproductive population. (Khanh *et al.,* 2010). Asian swamp eels eat

a wide range of prey including fish, shrimp, crayfish, frogs, turtle eggs and aquatic invertibrates. (Nunes *et al.*, 2003)

**Nutritional Values of Swamp eel**

Swamp eels are nutritious foods that constitute desirable components of a healthy diet. Fresh water swamp eels are widely consumed in many countries including Myanmar. Today, a large amount of swamp eels are reported from Myanmar to China. (Julian et al., 2013). The major market place for swamp eel is China.

The nutritional composition of swamp eel varies greatly depending on sizes, age, sex, reproduction cycle and season. The body composition of the swamp eel includes water, ash, fat, protein, fiber, carbohydrates and energy content. (Jenkms et al., 1980)

**Elemental Compositions of Swamp eel**

Fish are widely consumed in many parts of the world by humans and polluted fish may endanger human health. Thus, various factors would suggest less correlation between growth and metal accumulation in the freshwater swamp eel.

Fish has been considered as good indicators for heavy metal contamination in aquatic system because they occupy different trophic levels with different size and ages. Heavy metals like copper, zinc and iron are essential for fish metabolism while some others such as cadmium and lead have no known role in biological system. Iron is an essential part of haemoglobin; the red colouring agent of the blood that transports oxygen through our bodies. Iron is the most abundant of the heavy metals in nature. Potassium is a mineral that's found in the food. All fish contain potassium. The amount of potassium in fish depends on its variety, but most fish are good sources of the nutrition. Almost all foods contain potassium, but most meats and fish are not generally considered to be high potassium food sources. Certain conditions can cause potassium deficiencies such as kidney disease, excess sweating, diarrhoe and vomiting (Eisler et al., 1988).

## MATERIALS AND METHODS

**Sample Collection**

The swamp eels were collected between March and June, 2018, from Kantharyar Market in Hinthada District. Collected swamp eel samples were placed in the plastic bags and transported back to laboratory on the same day and kept in a freezer until analysis. In the laboratory, each sample was measured for their body weight and body length. The average body weight and body length of swamp eel are (800-850) g and (240-250) cm.

**Sample Preparation**

The flesh of the swamp eel samples were scrapped off using a steel spoon. The collected flesh was dried in an oven and the dried course sample was stored in a polythene bag. The nutritional values of collected swamp eel samples were determined by the following methods.

Figure 2. Photograph of sample preparation for analysis

Table 1. Methods for the determination of nutritional values of collected sample

| Nutritional Parameters | Methods |
|---|---|
| Moisture | Oven drying method (HYSC, Model DO-81, Korea) |
| Ash | Ashing method (Model L 333, Australia) |
| Protein | Macro-Kjeldahl method |
| Fiber | Alkali treatment method |
| Fat | Soxhlet extraction method |
| Carbohydrate | Difference method |
| Energy Value | A.O.A.C method |

## Quantitative Elemental Analysis of *Monopterus albus* (Swamp eel) by Atomic Absorption Spectrometry

Atomic absorption spectrometry is the most widely used technique for trace metal analysis (Evans, 1969). It is particularly applicable where the sample is in solution or readily solubilized. Atomic absorption spectrometry in a comparative method and is also capable of complete analysis. One of the greatest advantages of atomic absorption spectrometer is that almost free of spectral interference effects. Since the absorption process is due to a physical property of the matter in the stable of free atomic vapor, a radiation characteristic of the element to be determined will be absorbed only by the atoms of that element. Free atoms of any other element will not absorb that radiation.

Even through chemical interference probably present, the formation of atomic vapor from another component is prevented because a compound first formed with analyze is more resistant to vaporization in the flame. A further advantage of this method is its high sensitivity. Several elements are easily analyzed and measured in the range between ppm and ppb.

### Sample

Ash samples of swamp eel

### Chemicals

Concentrated hydrochloric acid, 25% hydrochloric acid, deionized water

### Apparatus

Absorption Spectrophotometer (Perkin Elmer AAalyst-800)

### Procedure

About 5 g of ash sample was accurately weighed and dissolved in 2 mL of concentrated hydrochloric acid solution. The resulting solution of ash sample was evaporated to dryness and dissolved in 6 mL of 25% hydrochloric acid solution (volume by volume) followed by centrifugation. The centrifuged solution was decanted and the clear solution was made up with deionized water. The resultant solution (10 mL) was pipetted accurately and made up to 100 mL with deionized water again. The sample solution was prepared to be ready for analysis of mineral elements Atomic Absorption Spectrometry.

## RESULTS AND DISCUSSION

There are many fish species in Ayeyawady Region. In this research, swamp eel sample (Pa-Mawe) was chosen for analysis. The sample was collected from Kantharyar Market in Hinthada District. The nutritional values of swamp eel flesh sample and elemental compositions of swamp eel flesh and blood samples were carried out for this research by conventional method as well as modern instrumental technique.

### Nutritional Values and Elemental Contents of Swamp eel Sample

During this experiment, in the swamp eel flesh sample, the nutritional values of moisture content was highest 77.05% and fat content 0.87% was the lowest. But the fiber content was not detected in swamp eel sample while carbohydrate content was observed 5.74%. The protein content 14.44% was found as a second highest value in flesh sample. Ash of mineral content was found 1.83% in swamp eel flesh sample.

Moreover, in this experiment, mineral components of swamp eel flesh and blood were also examined. Potassium content was found to be highest in both. Increasing potassium intake can help decrease blood pressure. By lowering blood pressure, increasing potassium intake can also reduce the risk for heart disease and stroke. The copper and arsenic contents were not detected in flesh and blood of sample. The iron content in the swamp eel blood sample was high 7.90 ppm, the content of iron in flesh sample was also found out. Zn, Cd and Pb contents were found to be acceptable limit in both sample. It cannot be risky for human health.

Table 2. Percentage of nutrient contents in swamp eel sample

| No. | Nutrients | Content (%) mean ± SD |
|---|---|---|
| 1. | Moisture | 77.05 ± 0.02 |
| 2. | Ash | 1.832 ± 0.01 |
| 3. | Protein | 14.44 ± 0.01 |
| 4. | Fat | 0.84 ± 0.03 |
| 5. | Fiber | ND |
| 6. | Carbohydrate | 5.74 ± 0.02 |
| 7. | Energy Value | 88.28 kcal / 100 g |

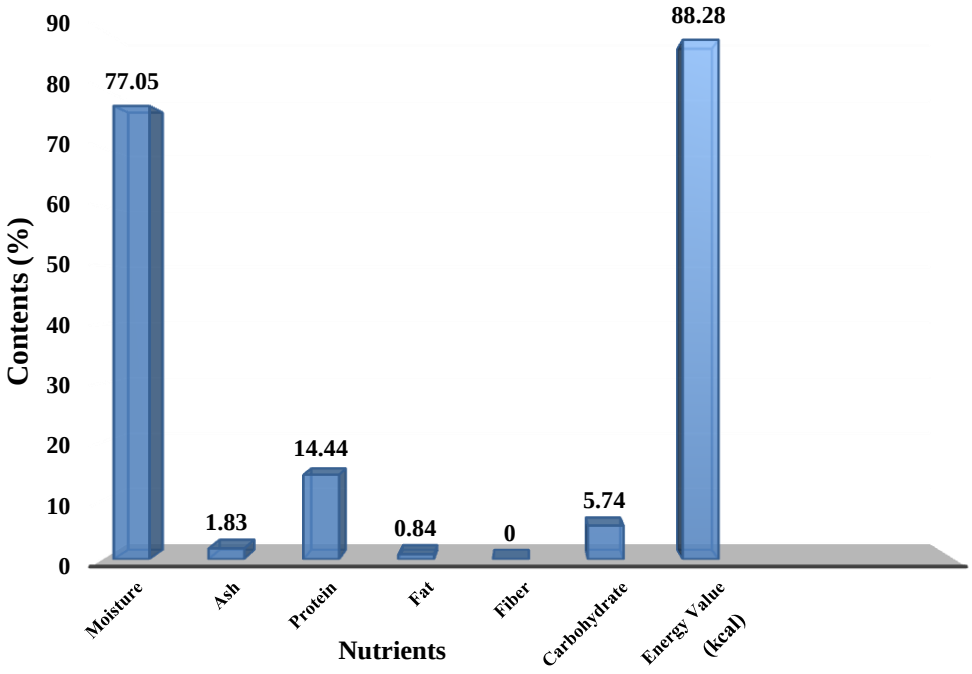


Figure 3. Bar graph of nutritional values in swamp eel flesh sample

Table 3. Comparison of elemental compositions in flesh and blood of of swamp eel sample

| No | Elements | Elemental contents (ppm) | | WHO International Food Standards (Daily Recommended Value) |
|---|---|---|---|---|
| | | Flesh | Blood | mg per day |
| 1 | K | 157.40 | 17.80 | 3500 |
| 2 | S | 67.60 | 13.00 | - |
| 3 | Ca | 18.20 | 6.10 | 1000 |
| 4 | Fe | 2.00 | 7.90 | 14 |
| 5 | Zn | 1.10 | 0.60 | 11 |
| 6 | Cd | 0.07 | 0.07 | 0.0002 |
| 7 | Pb | 0.55 | 0.56 | 0.0088 |
| 8 | Cu | ND | ND | - |
| 9 | As | ND | ND | - |

ND = Not detected because within the limit of AAS method

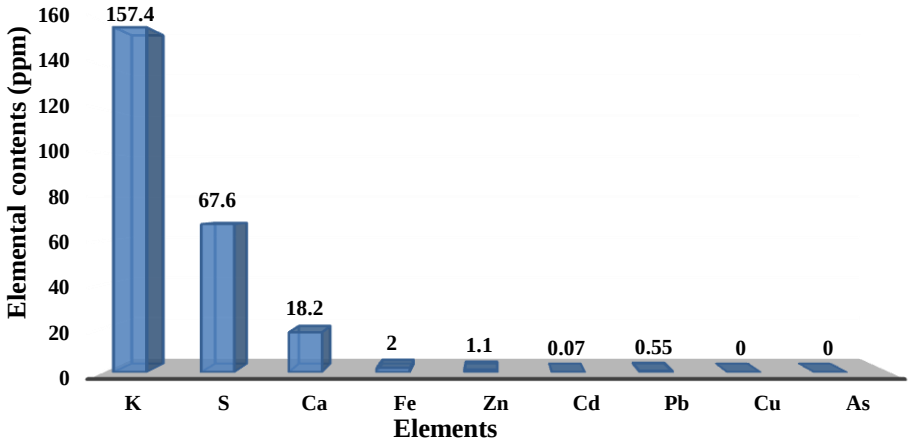


Figure 4. Bar graph of elemental compositions in flesh of swamp eel sample

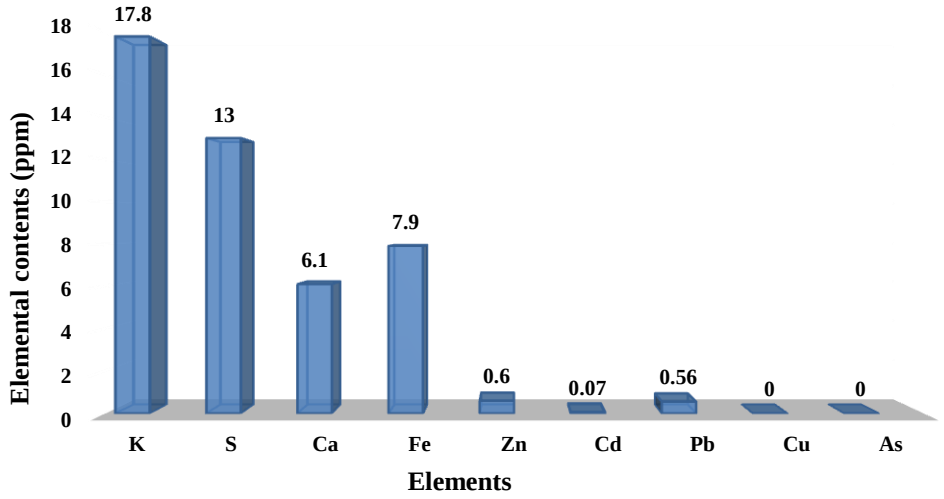


Figure 5. Bar graph of elemental compositions in blood of swamp eel sample

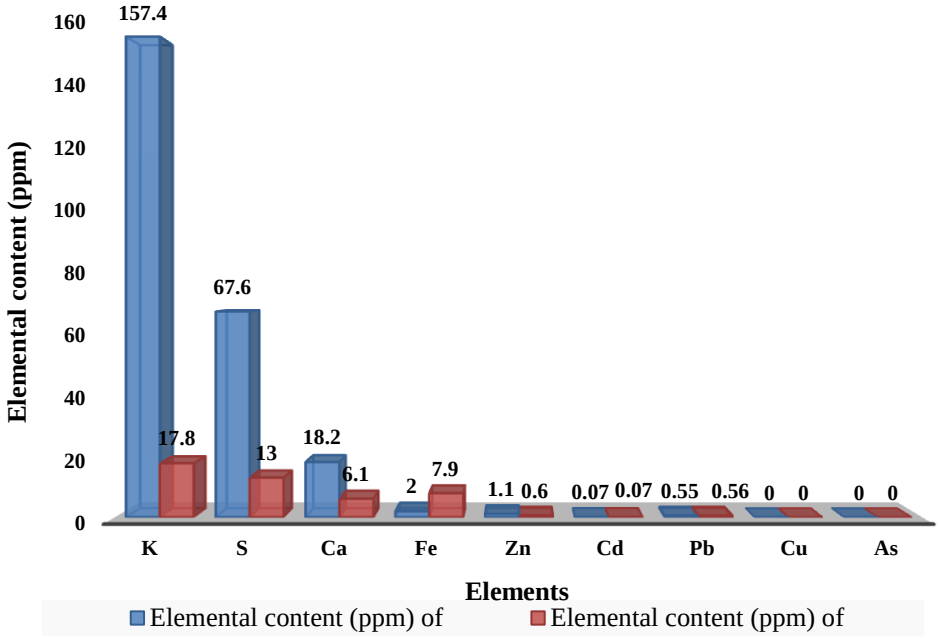


Figure 6. Bar graph of comparison of elemental compositions in fresh flesh and blood of swamp eel

## CONCLUSION

Although the protein and fat contents of sample were observed, fiber content was not found in this sample. The carbohydrate content 5.74 % and energy values 88.28 kcal / 100 g were found. According to these samples, carbohydrate contents are low and energy values are high. The assessment on the quality of it has proved that swamp eels are good food for human health.

Many elements are required in the diets for health. But some elements can have toxic effects in human body. Potassium, Sulphur and calcium contents in flesh of Pa-mawe were higher than in blood of Pa-mawe. But the concentration of iron in Pa-mawe flesh were lower than in Pa-mawe blood. Cadmium and lead contents were very low in flesh and blood of swamp eel. The contents of copper and arsenic were not found in flesh and blood of Pa-mawe.

It was also found that potassium contents were the highest than other the elements. The data for this research are in follow with WHO standard. Moreover, cadmium content was higher than WHO standard. Amount of unbeneficial element like cadmium can vary with environmental surrounding and the migratory behavior of swamp eels. Finally, it is also hoped that the point of nutritional values and elemental compositions of swamp eels is good for health although it should be careful because of unnecessary elements for good health. This research will be effective for consumers and their health.

**Acknowledgements**

We would like to express our profound thank to Rector, Dr. Theingi Shwe and Pro-Rector Dr. Yee Yee Than and Dr. Cho Kyi Than, Hinthada University for their kind permission to carry of this research. Special thanks are also due to Dr. Tin Hway Mu, Professor and Head, Dr. Moe Ohmmar, Professor and Dr. Yin Yin Myint, Professor of Chemistry Department, Hinthada University, for their encouragement, guidance and criticism to this research.

**References**

Anderson, J. (1988). "Structural equation modeling in practice: A review and recommended two-step approach". Physiological Bulletin., **3**, 411-423

Canli, M and G. Atli. (2003). "The Relationships between Heavy Metal (Cd, Cr, Cu, Fe, Pb and Zn) Levels and the Size of Six Mediterranean Fish Species". *Environ, Pollut*., 121(**1**): 129-136.

Eisler, R. (1988). "Zinc Hazards to Fish, Wildlife and Invertibrates: A Synoptic Review US Depertment of the Interior". *Fish and Wildlife Service.*Washington, DC: 13th Ed., 668-780

Evans, E. H. (1969). *An Introduction to Analytical Atomic Spectroscopy*.New York: 5th Edition, John Wiley&Sons Co.Ltd., 23-24

Fuller, P.L., L.G. Nico and M. Cannister. (2010). "Asian Swamp Eel." NonindigenousAquatic Species, United States Geological Survey *http://www.nas.er.sugs.gov/quries/Factsheet.aspx*.com (Accessed 12 July 2016)

Ganderton. (2012). Fiber: Its Importance In Your Diet-What Is Fiber? *http://www.mmm.com* (Accessed 18 August 2017)

Guan, R.Z., L.H. Zhou, G.H. Cui and X.H. Feng. (1996). "Studies on the Artificial Propagation of *Monopterus albus*". *Journal of Aquaculture Research*; **27**, 587-596

Hamillton, H. (2006). "Frequently Asked Questions about the Asian Swamp Eel: Florida Integrated Science Centre USGS" http://www.cars.er.usgs.gov nonindigenous-species.com (Accessed 23 August 2016)

Hlihor, R.M. and M. Gavrilescu. (2009). "Removal of Some Environmentally Relevant Heavy Metals using Low-cost Natural Sorbent".*Environ. Eng. Man.*, **5**, 353-358

Ikem, A. and N.O. Egiebor. (2005). "Assessment of Trace Elements in Canned Fishes (Mackerel, Tuna,Salmon, Sardines and Herrings) Marketed in Georgia and Alabama (United State of America)". *Journal of Food Comp. Anal*, **18**, 771-78

Jenkms, D.W. (1980). *Biological Monitoring of Toxic Trace Metals*. Washington D.C: Environmental Protecting Agency, 1371-1402 Julian, M. (2013). 'Analysis of Ash and Minerals'. *http://www.livestrong-foundation.com* (Accessed 20August 2015)

Khanh, N.H., P.T.T. Van, N.H. Thuy, and D.T.T. Huong. (2008). "Study on Feeding Habital and Reproductive Biology of Rice Eel (*Monopterus albus*)". *Journal of Can The University*, **1**, 100-111

Khanh, N.H. and H.T.B. Ngan. (2010) *Current Practices of Rice Field eel Monopterus albus Culture in Vietnam*. **15**(3), 26-27

Murthy,L.N., S.K. Panda and B.A. Shamasundars. (2011)"Physiochemical and Functional Properties of Protein of Tilapia (*Oreochomismossmbicus*)". *Journal of Food Process Engineering*, **34**, 83-107

Nunes, M.L. (2003). "Fish Products: Contribution for a Healthy Food". *Journal of Environmental, Agricultural and Food Chemistry*,**2** (4), 453-457

Pearson, D. (1976). *The Chemical Analysis of Foods*. New York: 7th Ed., Churchill Living stone, 141-142

Roos, N., H. Thorseng, C. Charman, T. Larsen, U.H. Gondolf, K. Bukhave and S.H.Thilsted.(2007). *"*Iron Content in Common Cambodian Fish Species;Perspectives for Dietary Iron Intake in Poor, Rural Houscholds*". Journal of Food Chemistry, **104**, 1226-1235*

Standsby, M.E and A.S. Hall. (1967). *Chemical Composition of Commercially Important Fish*. New York: Fish. Ind.Res.,**3**,29-34

Stansby, M.E. (1962). *Proximate Composition of Fish: In Fish in Nutrition.* New York: *Fishing News* (Books), 55-60

Trease, G.E. and W.C. Evans. (1954). The Pharmaceutical Journal. London: Longmans, Green and Co.Ltd., 172-351

Vali, T and A.Z. Naser. (2011). "Determination of Trace Elements in Muscle Tissue of Caspian Roaches (Rutilus rutiluscapicus) Collected in Iranian Coastal Waters of the Caspin Sea". *Iranica:Journal of Energy and Environ*; **2**, 47- 551