A Study on Nutrient and Elemental Analysis in *Monopterus albus* (Swamp eel) from Hinthada District, Ayeyarwady Region

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Abstract

The Asian swamp eels (*Monopterus albus*) are widely consumed in many countries including Myanmar. Swamp eel samples (Pa-ni) are also widely consumed in Ayeyarwady Region. Swamp eel samples (Pa-ni) were collected from Padathar Market, Hinthada District. The aim of this paper is to determine the nutrient and elemental analysis in swamp eel (Pa-ni). The nutritional values were conducted during March, 2018 by using advanced technique. Swamp eel contains 74.02 % moisture, 1.37 % ash, 0.66 % fat, 16.33 % protein and 7.58 % carbohydrate and 101.72 kcal / 100 g energy value. In this experiment, fiber content was not found in analyzed sample. The quantitative analysis of some elemental compositions in swamp eel (fresh meal and blood) were also carried out by Atomic Absorption Spectrometric method. The content of elements were found to be sulphur (79.6 ppm and 16.8 ppm), calcium (17.7 ppm and 4.6 ppm), zinc (1.2 ppm and 0.6 ppm), lead (0.58 ppm and 0.58 ppm) and iron (2.3 ppm and 9.2 ppm) in fresh meal and blood of swamp eel. Swamp eel contains the equal amount of cadmium contents. Moreover, the copper and arsenic contents were not detected in sample because of the limitation of AAS method. The potassium contents were found to be 148.7 ppm (fresh meal) and 23.2 ppm (blood). According to above data, swamp eel possess relatively highest amount of potassium contents among the elements. Swamp eel is a type of food that can be beneficial for those who suffer from fish allergies. Nevertheless, swamp eel can provide many nutritional benefits including high protein content along with essential vitamins and minerals making them a great addition into any healthy diet plan.

Keywords : pa-ni, swamp eel, nutritional values, blood, meal, potassium

Introduction

Fish

Fish is very important part of a healthy, well-balanced diet. Fish are dominant animal source of food for many people are living in developing countries, especially those living near coastal and inland waters. Fish is one of the most important sources of animal protein and micronutrients in Myanmar with average consumption levels estimated to be 30 kg/ person / year. The health benefits of fish include that it is high in protein, low in saturated fat, high in unsaturated fat, high in omega oils, other nutrients and important elements of diet.

Swamp eel (*Monopterus albus*)

Fish are one of the most diverse groups of animals on Earth. There are roughly 35,500 different species found in a variety of habitats around the world. One such species is the Asian swamp eel or swamp eel (*Monopterus albus*) that belongs to the family Synbranchidae and can be found in various parts of Asia, including Myanmar, China, India, Japan and Thailand. Pa-ni (Nga shint) is a freshwater eel like fish that was observed from local market in Hinthada District, Ayeyarwady Region during March and June 2018.

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Zoological Description of *Monopterus albus*

Name	:	Asian swamp eel
Kingdom	:	Animalia
Phylum	:	Chordata
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-ni (Nga shint)

Figure 1 Photograph of *Monopterus albus* (Asian Swamp eel), Pa-ni (Nga Shint)

Nutritional Values and Elemental Compositions of Swamp eel

Nowadays, Asian swamp eels are used for special dishes in Asian Countries. Swamp eels are widely consumed by local people in Myanmar because of its delicious meat and nutritional values. Swamp eels are nutritious foods that constitute desirable components of a healthy diet. Today, the major market for the swamp eels are reported from Myanmar to China.

The nutritional compositions of swamp eel varies greatly depending on sizes, age, sex, reproduction cycle and season. The nutritional values of swamp eel include determination of water, ash, fat, protein, fiber, carbohydrates and energy content. Water content is the quantity of water contained in a material such as soil, rock, ceramics, crops and living organism. Water content of a sample include chemical titrations, determining mass loss on heating or after freeze drying. The ash content is a measure of the total amount of minerals present within a food whereas the mineral content is a measure of the amount of specific inorganic components present within a food such as Ca, Na, K and Cl. Ash refers to the inorganic components remaining after either ignition or complete oxidation of organic matter in a foodstuff. Fats are important constituents of a normal diet and the most concentrated of fat sources give as energy by calories. Protein is a source of energy but its main role in the body is growth and repair. Fiber is a type of carbohydrate that the body can't digest. Fiber helps regulate the body's use of sugars, helping to keep hunger and blood sugar in check. Carbohydrates are the main source of energy that fuels our body and everything it does, even thinking. Carbohydrates are sugars and starches. These are found in fruit and some vegetables, dairy food and grain-based food like bread, breakfast cereal rice and pasta. Energy is not a nutrient but, food energy are important

for providing energy for daily activities. Food energy is a chemical energy that animals (including humans) derive from food through the process of cellular respiration

Elemental analyses include the determination of potassium, sulphur, lead, cadmium, zinc, copper, iron, calcium and arsenic. This study revealed the quality of nutritional and elemental values in swamp eel. Copper is an essential elements to life, but in higher concentrations toxic effects clearly have been demonstrated. Copper exerts a wide range of physiological effects in fishes. The human body contains copper at a level of about 1.4 to 2.1 mg per kg of body weight. Copper deficiency can cause anemia a several diseases. Copper is essential for good health but a very high intake can cause adverse health problems, such as liver and kidney damage. Iron is an essential part of haemoglobin; the red colouring agent of the blood that transports oxygen through our bodies. In humans, iron is also essential component of proteins involved in oxygen transport. It is also essential for the regulation of cell growth and differentiation. On the other hand, excess amount of iron can result in toxicity and even death. Iron is an essential trace element in animals. Iron is the most abundant of the heavy metals in nature. The zinc elements were enriched in most organs of swamp eel. Lead is of great public health importance because it commonly causes toxicity. Lead is found in two forms inorganic and organic. Organic lead is more toxic, causes poisoning. Inorganic lead, which is less toxic, can cause anemia. Cadmium compounds can enter the bodies of aquatic animals via the gills, the general body surface and the alimentary canal, following ingestion of contaminated food particle. Cadmium is highly toxic element. It has been described as one of the most dangerous trace elements in food and environment of man. Calcium is known to be an essential element required for numerous functions in the body. Fish bone consists of both organic and inorganic (mineral) parts. Potassium is a mineral that's found in the food. All fish contain potassium. The amount of potassium from fish depends on its variety, but most fish are good sources of the nutrient. Certain conditions can cause potassium deficiencies such as kidney disease, excess sweating, diarrhoe and vomiting. Sulphur is an essential element for all life. Most of the sulphur in the body and diet is in protein molecules.

Materials and Methods

Study area and study sites

This study was carried out in selected Padathar Market, Hinthada District in Ayeyarwady Region.

Sample collection and transportation

The swamp eel samples were purchased from Padathar Market in Hinthada District between March and June, 2018. Plastic containers and plastic bags were used to transport the samples. Samples that could not be processed within 24h were kept in a refrigerator at 4 °C until transportation. The collected samples were then transported in an icebox to the Small Scale Industries Department in Thudama Main Road, North Okkalapa 137 (A), AMTT Co., Ltd and Department of Chemistry in West University Yangon, Myanmar. In the laboratory, samples were measured for their nutritional values, elemental compositions and also measured 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 meal of the swamp eel samples were scrapped off using a steel knife. The collected meal 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

Chemicals

Petroleum ether, anhydrous copper II sulphate, potassium sulphate, sodium carbonates, sodium hydroxide, boric acid, methyl red, hydrochloric acid, sulphuric acid, ethanol.

Apparatus

Round-bottomed flask, graduated pipette, condenser, porcelain crucibles, desiccator, oven (HYSC, Model DO-81, Korea), electric Muffle furnace (Model L 333, Australia), Soxhlet extractor, distillation apparatus, Kjeldahl digestion flask, burette, conical flask.

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

Table 1 Methods for the Determination of Nutritional Values of Swamp eel 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

atoms of that element. Free atoms of any other element will not absorb that radiation. Even through chemical interference are 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.

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 now ready for analysis of mineral elements Atomic Absorption Spectrometry.

Results and Discussion

There are many fish species in Ayeyarwady Region. Among them, swamp eel sample (Pa-ni) was chosen for analysis. This sample was collected from Padathar Market in Hinthada District. Each sample is not the same age, size, length and weight. The nutritional values of swamp eel meal sample and elemental compositions of swamp eel meal and blood samples were carried out for this research by conventional method as well as modern instrumental technique.

Determination of nutritional values and elemental contents of swamp eel sample

During this experiment, the nutritional values of swamp eel meal sample are as follows. The moisture content of the sample was determined by oven dried method and found to be 74.02 %. The total ash in the sample is the inorganic residue remaining after the organic matter has been burnt away. It is obtained by using Muffle furnace (Model L 333, Australia) and found to be 1.37 %. The fat content of the sample was determined by the

Table 2 Percentage of Nutrient Contents in Swamp eel Sample

No.	Nutrients	Content (%) mean ± SD
1.	Moisture	74.02 ± 0.02
2.	Ash	1.37 ± 0.01
3.	Protein	1 ± 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

Soxhlet extraction method and was found to be 0.66 %. In addition, the sample was also studied for fiber content by acid alkali treatment and protein content by Micro-Kjeldahl method. But the fiber content was not detected in swamp eel sample while carbohydrate content and energy value were observed 7.58 % and 101.72 kcal / 100 g. All the results obtained were represented in Table 2.

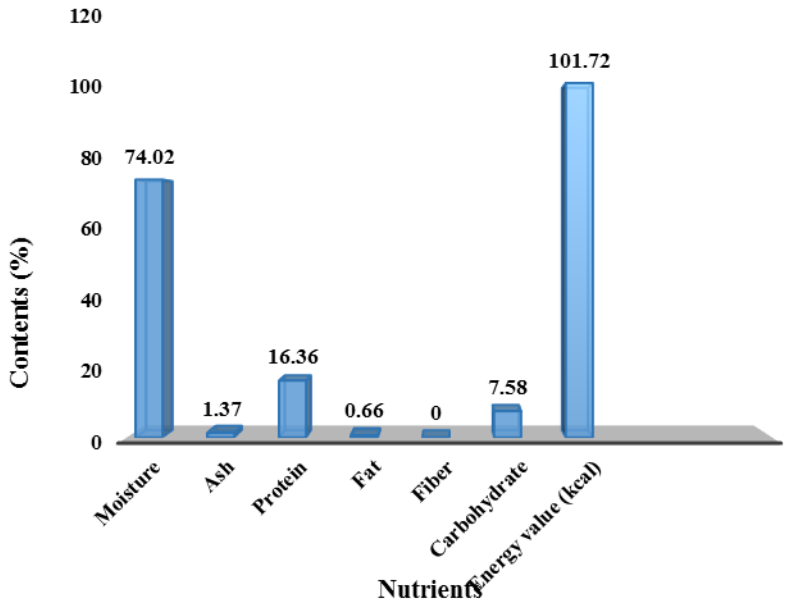

Figure 3 Bar graph of nutritional values in swamp eel meal sample

Moreover, in this experiment, the relative abundance of elements in meal and blood of samples were also examined by EDXRF spectrometer. And then, the quantitative analysis of elemental composition such as K (148.7 ppm and 23.2 ppm), S (79.6 ppm and 16.8 ppm), Ca (17.7 ppm and 4.6 ppm), Zn (1.2 ppm and 0.6 ppm), Pb (0.58 ppm and 0.58 ppm) and Fe (2.3 ppm and 9.2 ppm) respectively in fresh meal and blood of sample were also carried out by Atomic Adsorption Spectrometric method. All the results obtained were represented in Table 3.

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

No	Elements	Elemental contents (ppm)		WHO International Food Standards (Daily Recommended Value)
		Meal	Blood	mg per day
1	K	148.7	23.2	3500
2	S	79.6	16.8	-
3	Ca	17.7	4.6	1000
4	Fe	2.3	9.2	14
5	Zn	1.2	0.6	11
6	Cd	0.08	0.08	0.0002
7	Pb	0.58	0.58	0.0088
8	Cu	ND	ND	-
9	As	ND	ND	-

ND = Not detected because within the limit of AAS method

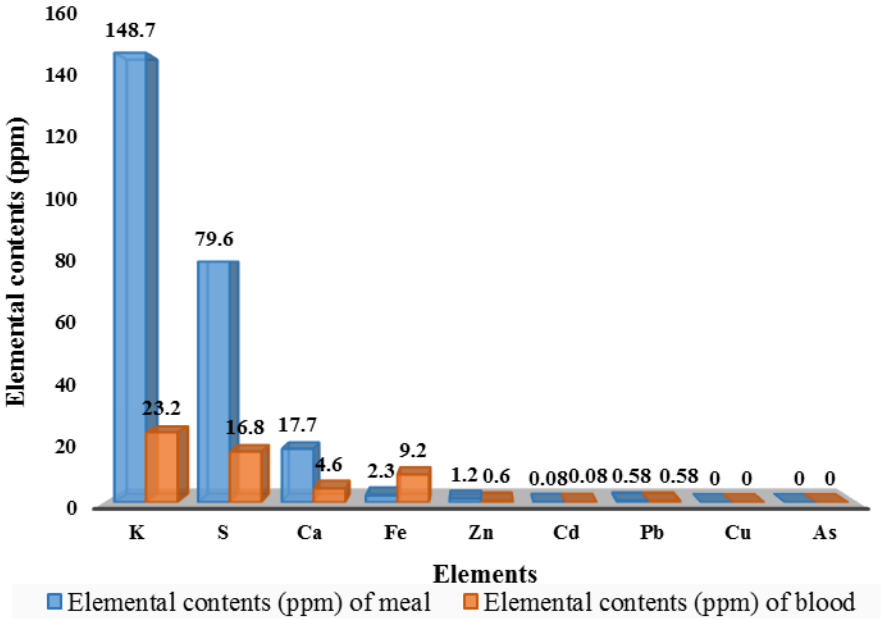

Figure 4 Bar graph of comparison of elemental compositions in fresh meal and blood of swamp eel

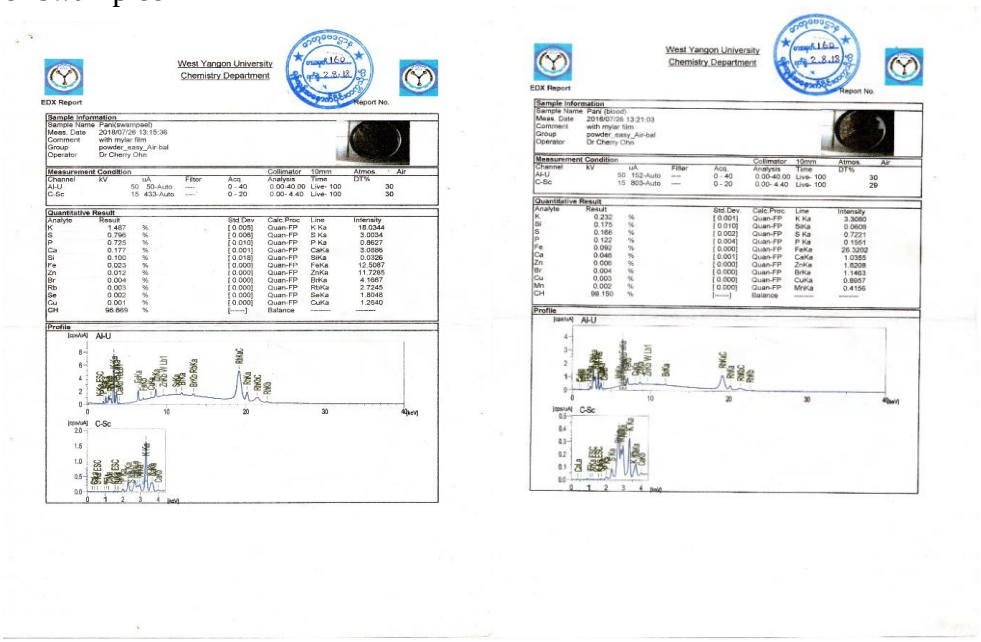

Figure 5 EDXRF spectrum of swamp eel meal and blood samples

Conclusion

Asian swamp eel (*Monopterus albus*) are widely consumed in Asian countries including Myanmar. Quality of swamp eel will be estimated for health in our diet. Nutritional compositions such as water, ash, fat, protein, fiber, carbohydrates and energy values are required for human health benefits. The nutritional values in swamp eels sample have been analyzed.

Although the protein content (16.36 %) and fat content (0.66 %) were observed, fiber content was not found in this sample. According to these data, Pa-ni is suitable to get the fat as a food for human health because fish with high fat content are good source of vitamin A, D and are rich in omega-3 fatty acid. The ash content (1.37 %), carbohydrate content (7.58 %) and energy value (101.72 kcal / 100 g) were found.

As a result of the swamp eel sample contents of the ash were found to be very low level. It can be suggested that the swamp eel cannot caused toxic effect in the diet of the consumer's in local people.

According to Atomic Absorption Spectrometry technique, elemental compositions of swamp eel such as K, S, Ca, Fe, Zn, Cd, Pb, Cu and As were determined by AAS method. Many elements are required in the diet for health. But some elements are toxic effect in the human body. Although the potassium, sulphur, and calcium contents in meal were higher than in blood of sample, the iron and zinc contents in meal were lower than in blood of sample. Cadmium and lead contents were observed that the equal amount in both. They were very low in meal and blood of swamp eel. The contents of copper and arsenic were not found in meal and blood of Pa-ni. In this results, potassium contents were the highest among the elements. These data are in follow with WHO standard. Moreover, cadmium content was higher than WHO standard. Finally, from the nutritional values and elemental compositions it can be concluded that swamp eel are a good source for those looking for healthier dietary options without sacrificing taste or flavor profile. In addition, swamp eel is a good food for nutrients because it contains high amount of protein. This paper will be effective for consumers and their health.

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