Studies on Some Nutritional Values of Water Spinach *Ipomoea aquatica* Forssk

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Abstract

This study has been overviewed to observe the nutrients and mineral contents of water spinach, *Ipomoea aquatica* Forssk. Analyses of the nutritional values of water spinach were carried out by using standard methods of food analysis. The proximate composition as well as mineral elements were also determined. From the results, water spinach was found out that the nutritive values of moisture content (90.63%), ash content (1.13%), protein content (2.90%), fiber content (1.48%), fat content (0.16%) and carbohydrate content (3.70%), respectively. In addition, the energy value 30 kcal/100g was obtained from water spinach. Relative abundance of elements like K (1.364%), Ca (0.233%), Fe (0.012%), Mn (0.004%) and Zn (0.001%) present in water spinach were determined by EDXRF. The elemental contents of water spinach such as Fe (3.217%), Mg (0.123%), Ca (0.122%), K (0.060%), Zn (0.001%) were found to be determined by atomic absorption spectrophotometry and titrimetric method. These elements are vital elements for nutrition role in human metabolism. Hence, water spinach could be used for nutritional purposes due to the amount and diversity of nutrients it contains.

Keywords: water spinach, nutritional values, elemental contents, EDXRF, AAS

Introduction

Ipomoea aquatica Forssk (water spinach) is a vasculas semi-aquatica plant native tropics and subtropics that grows wild and sometime cultivated in Southeast Asia, India and Southern China. Water Spinach is herbaceous peremial plant belonging to the family Convolvulaceae. It has a long, hollow and vine stem, grow prostrate or floating and the roots are produced from the nodes and penetrate into wet soil or mud. Among various types of vegetables, leafy vegetables are most commonly consumed in ancient India daily diet. The importance of leafy vegetables in the developing countries has been recognized only now due to their nutritional values. Green leafy vegetables occupy an important place among food crops as these provide adequate amounts of crude fibre, carotene, a precursor of vitamin A and mineral salts like calcium, iron, potassium etc (Aletor *et al*., 2002). They form cheap and best source of food. Green leafy vegetables are highly seasonal and are available in plenty at a particular season and can be easily cooked. The plants are rich source of a number of micronutrients and phytochemicals and it was the phytochemicals that appeared to provide much of the disease fighting power .Hence, the present study focused on nutritional values and elemental contents of water spinach has been evaluated.

Botanical Aspects of *Ipomoea aquatica* Forssk (Water Spinach)

Kingdom	:	Plantae
Family	:	Convolvulaceae
Genus	:	*Ipomoea*
Botanical name	:	*Ipomoea aquatica*
English name	:	Water spinach
Myanmar name	:	Ye-kazun

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Distributions of Water Spinach

Ipomoea aquatica is supposed to be originated in China. It is distributed throughout India, Sri Lanka, Tropical Asia, Africa and Australia. The plant is grown wildly as weed in India and USA while in South East Asia like Malaysia, China, Hong Kong, Singapore and Indonesia, the plant is grown commercially (Candlish *et al*., 1987).

Medicinal Uses of Water Spinach

Water spinach is an edible plant harvested as leaf vegetables. It is used in herbal medicine for the treatment of fever, liver disease and most importantly diabetes in pregnant women and it is used as a sedative to promote sleep and relaxation (Boyer, 2004).

Materials and Methods

Sample Collection

Water spinach samples were purchased from the Zay- Gyi market (Mawlamyine).

Sample Preparation

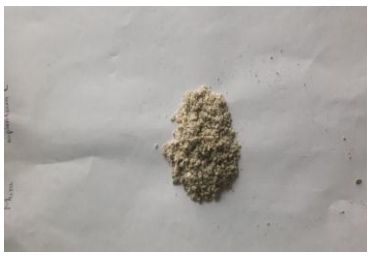
The collected samples were cleaned and air-dried at room temperature. The dried samples were cut into small pieces and ground into powdered by a grinding machine. The dried powdered samples were separately stored in air-tight containers to prevent moisture and other containments. These dried powdered samples were used for the determination of nutritional values by reported methods and relative abundance of elements by EDXRF method.

The cleaned and air dried water spinach samples were weight and then pre-ashing was done by heating on a hotplate until all the combustible materials were burnt. The basins containing pre-ash samples were placed inside the furnace (Electric Heraceus Furnace) and heated, gradually raising the temperature to until 500 °C. The process of heating, cooling and weighing were repeated until constant weight of ash samples were obtained. These ash samples were used for the elemental studies with AAS method.

(a) Water Spinach sample

(b) Air dried water spinach sample

(c) Pre-ash water spinach sample



(d) Ash water spinach sample

Figure 1 Photographs of water spinach sample preparation

Determination of the Contents of Some Nutrients in Water Spinach

In order to find out the nutrients such as moisture, ash, fibre, fat, protein and carbohydrate contents were determined by the following reported methods. Physiological fuel values are used to calculate and balance available energy values in prepared diets.They typically average 4,4 and 9 kcal / g for protein, carbohydrate and fat, respectively (Kala, 2004).

Table 1 Nutritional Parameters, Energy Values and Test Methods

No.	Parameters	Methods
1	moisture content	Dean and Stark's method
2	ash content	ashing method
3	fibre content	acid-base treatment method
4	fat content	Soxhlet extraction method
5	protein content	Macro-kjeldahl method
6	carbohydrate content	by difference method*
7	energy content	literature method

*Fehling's reduction method

Determination of the Contents of Some Elements in Water Spinach

Qualitative determination of some elements by EDXRF method

The content of elements in water spinach were qualitatively determined by EDXRF (Energy Dispersive X-Ray Fluorescence) spectroscopic method at the Universities Research Centre (URC), in Yangon University.

Analysis method

Dried powdered sample (2.5 g) was fabricated into the pellet for EDXRF spectrometry. The sample was placed in the sample chamber of EDX-700 spectrometer that can measure the sixteen samples at a time. The chamber was pumped up to vacuum. The vacuum pressure was about 38 Pa and the detector temperature is about 170 °C. Therefore, liquid nitrogen needs to be added at the time of analysis. Rhodium target was used in EDX-700 spectrometer. Each sample was run for a counting time of about 100 seconds and the spectrum obtained was stored and anlayzed in PC based multichannel analyzer using EDX-700 software.

Quantitative determination of some elements by AAS method

Some elements content in water spinach were quantitatively determined by using Atomic Absorption Spectroscopic (AAS) method at the Universities Research Centre (URC), in Yangon University.

Analysis method

About 0.1 g of ash sample was accurately weighed and dissolved in 5 mL of concentrated hydrochloric acid solution. The resulting solution of ash sample was evaporated to dryness and dissolved in 5 mL of 20 % HCl solution (volume by

volume) following centrifugation. The centrifuged solution was decanted and the clear solution was made up to 100 mL with deionized water. The resultant solution (10 mL) was pipetted accurately and made up to 100 mL with deionized water again. The sample solution prepared was now ready for analysis by AAS.

Results and Discussion

Investigation on Some Nutritional Values of *Ipomoea aquatica* Forssk (Water Spinach)

Moisture content

The moisture content of water spinach was determined by using Dean and Stark's method and the results were shown in Table 2. In this method, the sample was boiled with toluene although its boiling point is higher than that of water, it could control the volatile materials not to release from the sample. From the results, the moisture content of water spinach was found to be 90.63 % which indicates that the sample could not be stored for a long time.

Ash content

The ash content was obtained by ignition of known weight of the dried powdered sample at 600 °C (873 K) until all carbon has been removed. Therefore, the ash value of the sample represents the inorganic residue after all organic matter has been burnt away. The ash content was determined by heating the sample in a crucible. The period of ashing is usually not specified, the ashing being continued until uniformly light grey or white ash of constant weight is obtained. . From the experiment, the ash content was found to be 1.13 % and recorded in Table 2. From the nutritional point of view, the little content of ash indicates the little content of mineral elements.

Fibre content

Crude fibre is defined in the method scope as the amount of fat-free organic substances which after the material had been treated under standardized conditions with petroleum spirit, boiling dilute sulphuric acid, boiling sodium hydroxide, dilute hydrochloric acid, alcohol and ether. A small amount of the fibre content (1.48 %) was observed and recorded in Table 2. The fibre content stimulates the movement of the intestinal muscles, which helps maintain regularity. Thus, it keeps blood sugar levels within the normal range and avoid wide fluctuations.

Fat content

The fat content in water spinach was carried out by Soxhlet extraction method . The fat content can be used for storage and transport forms of metabolic fuel (Nwaogu *et al.,* 2006). From this experiment, the fat content analyzed was found to be 0.16 % which contained a very little amount in water spinach as described in Table 2.

Protein content

In order to know the crude protein content, the total nitrogen content was firstly determined by using Macro-kjeldahl method (Table 2). Then, the crude protein content was obtained by multiplying the nitrogen content with 6.25. The protein content of the sample was found to be 2.90 % which is a fair amount in this selected sample. Protein is one of the important parts of human nutrition: it not only supports growth but is also important for maintenance and repair of body tissues.

Carbohydrate content

The total carbohydrate content of water spinach can be obtained as the difference between 100 and the sum of the percentages of ash, fibre, moisture and protein.The finding result was confirmed by Fehling's reduction method (Table 2). Both results were found to be approximately the same. From this experiment, it was found that the carbohydrate content of water spinach possessed 3.70 % (3.89 % by Fehling's reduction method). The relatively fairly carbohydrate content can be used as energy source and also it is necessary in the digestion and assimilation of other foods (Nwaogu *et al.*, 2006).

Energy content

The energy value of water spinach was calculated by using fat, protein and carbohydrate contents and the result was found to be present as 30 kcal/100 g. Water spinach provides energy to drive our metabolism.The resultant nutritional values of *Ipomoea aquatica* Forssk (water spinach) are summarized in Table 2 and Figure 2 . From these results, water spinach are good sources of plant fibre, carbohydrate consumption and minerals.

Table 2 Some Nutritional Values of *Ipomoea aquatica* Forssk (Water Spinach)

Sample	Nutritional Value (% w/w)						Energy value (kcal/ 100 g)
	Moisture (%)	Ash (%)	Fibre (%)	Fat (%)	Protein (%)	Carbohydrate (%)	
Water spinach	90.63	1.13	1.48	0.16	2.90	3.70 (3.89)*	30

* Fehling's reduction method

Figure 2 A bar graph illustrating some nutritional values of water spinach

Determination of the Contents of Some Elements in Water Spinach

Qualitative determination of some elements by EDXRF method

The EDXRF elemental analysis is a powerful technique for analysis of the various samples. One of the advantages is that it is a multi-elemental analysis, i.e, it can indicate all elements in a given sample by one measurement. According to the results of the related abundances, water spinach can be found out that five elements like K (1.364%), Ca (0.233%), Fe (0.012%), Mn (0.004%) and Zn (0.001%) were detected. These elements are vital elements for human nutrition. The resultant EDXRF spectrum and its spectral data were described in Figure 3 and Table 3.

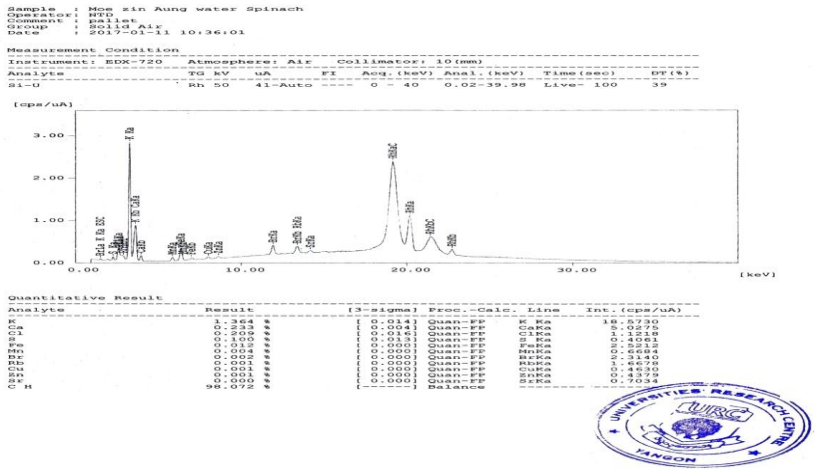


Figure 3 Identification of elements in water spinach by EDXRF method

Table 3 Determination of Elemental Contents in Water Spinach by EDXRF Method

(Based on Air Dried Powdered Water Spinach Sample)

No	Elements	Contents (%)
1	K	1.364
2	Ca	0.233
3	Fe	0.012
4	Mn	0.004
5	Zn	0.001

Quantitative determination of some elements by AAS method

Investigations in the present study showed that elemental contents in water spinach by Atomic Absorption Spectroscopic (AAS) method and titrimetric method. Water spinach contains inorganic trace elements. Atomic Absorption Spectrophotometry (AAS) is widely used techniques for trace metal analysis. It is comparative method and is also capable of complete analysis (Lajunen, 1991). It can be determined the trace elements as low as ppm or ppb level. Some of these elements are currently known or thought to be required for normal biological functions in human. Moreover, Fe can be determined by titrimetric method. In this work, five elements Fe, Mg, Ca, K and Zn present in water spinach samples were determined by AAS method. Iron content wasalso determined by titrimetric method. The results from AAS and titrimetric methods were shown in Table 4 and Figure 4. From these results, water spinach contains Fe (3.217%), Mg (0.123%), Ca (0.122%), K (0.06%) and Zn (0.001%) were found out as nutritive elements.

Table 4 Determination of Elemental Contents in Water Spinach by AAS Method

(Based on Ash Water Spinach Sample)

No	Elements	Contents (%)
1	Iron	3.217
2	Magnesium	0.123
3	Calcium	0.122
4	Potassium	0.060
5	Zinc	0.001

Figure 4 Histogram of elemental contents in water spinach based on 100 g water spinach sample

According to the literature, iron is essential for the proper growth and development of the human body. It is needed for the formation of hemoglobin which carries oxygen cells assisting in oxygen utilization, enzymatic especially for neutral development and overall cell function everywhere in the body.

Magnesium is needed to keep muscle and nerve functions normal and to keep the heart beating rhythmically. It also helps to support a healthy immune system, and keeps bones strong. It is important in terms of regulating blood sugar levels, thereby promoting normal blood pressure. It also supports energy metabolism and protein synthesis.

Potassium is an electrolyte that counteracts the effects of sodium, helping to maintain a healthy blood pressure. It is not the individual vitamin or mineral alone that makes certain foods an important part of our diet, but the food nutrients working together.

Zinc, being an important mineral, plays a vital role in protein synthesis and helps regulate the cell production in the immune system of the human body. It is mostly found in the strongest muscles of the body and is found in especially high concentrations in the white and red blood cells, eye retina, skin, liver, kidneys, bones and pancreas.

Calcium is an essential mineral for healthy bones, gums and teeth. It is found in the human body as deposits in the bones and teeth in high volumes. Traces of the mineral are also present in the circulatory system, which prevent life threatening hemorrhages.

Therefore, a number of studies have demonstrated this green leafy vegetables water spinach are a rich source of minerals and imparting greater benefits to humans.

Conclusion

Some nutritional values of water spinach were determined by using the reported methods for moisture, ash, fibre, fat, protein and carbohydrate contents. In addition, the energy value (30 kcal /100g) was also determined. Relative abundance of elements present in water spinach were determined by EDXRF. The results revealed the minerals included in this study by Fe was titrimetric method and Mg, Ca, K and Zn were AAS method. The iron, magnesium, calcium, potassium and zinc were selected because of these elements are important to access the adequency and safety of human diets. Five elements detected (Fe, Mg, Ca, K and Zn) are important and it might be inferred that water spinach are good for human consumption from the aspect of nutritive values. The results suggest that the plant leaves could contribute greatly human nutritional requirements for normal body growth and adequate protection against diseases arising from malnutrition.

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