Journal of Food Technology 8 (3): 102-105, 2010
ISSN: 1684-8462
© Medwell Journals, 2010

Eichhornia crassipes a Suitable Economic Feed: The World's Worst Aquatic Weed

N. Lata and Veenapani Dubey
Department of Botany, C.M.D.P.G. College, Gurughasi Das Vishwavidyalaya, Bilaspur (C.G.), India

Abstract: The present study deals with the feed potential of aquatic macrophyte *Eichhornia crassipes* which is considered as the world's worst aquatic plant by the analysis of minerals. The elemental analysis revealed that the studied plant was characterized by its high value of nitrogen, potassium, iron and manganese. The Ca/P ratio that constitutes an important parameter when plant considered for use as feed source was found to be within range. In addition, the nutritional components i.e., moisture and energy contents of the plant were also determined.

Key words: Aquatic weed, calorific value, *Eichhornia crassipes*, minerals, microelements, macroelements, water hyacinth

INTRODUCTION

It is estimated that there are 2,50, 000-5,00,000 species of plants on earth (Borris, 1996). A relatively small percentage (1-10%) of these is used as food by both humans and other animal species. It is possible that even more are used for medicinal purposes and the roles of plant in maintaining human health is well documented (Moerman, 1996). The plants are rich source of minerals. They are obtained from the earth's crust through the effects of the weather rocks that contain minerals are ground into smaller particles which then become part of the soil. The mineral content in the soil is absorbed by growing plants.

The plants are being eaten by both animals and human beings. In this way minerals become part of the food chain. The plants may absorb so much of the essential elements in the soil in which they are growing that may serve as indicators of the mineralization and are infact used for this purpose (Cannon, 1960). The specific parts of several plants are often used as medicines in the Indian Ayurvedic system.

The high concentration of potassium in the plants could be related to the diuretic action of the drug prepared from the plant materials. The high concentration of calcium ions can explain the absence of side effects as regard stomach lesions (Shailajan *et al.*, 2004; Venketaraman and Krishnan, 2002). A number of metal complexes and ligands have been shown to be chemically useful as antitumor and antiviral agents. Aquatic plants grow profusely in lakes and waterways all over the world and have in recent decades their negative effects magnified by man's intensive use of natural water bodies. Eradication of the weeds has proved almost impossible and even reasonable control is difficult. Turning these weeds to productive use would be desirable if it would partly off set the costs involved in mechanical removal. Among other uses, there has been considerable interest in using aquatic plants as a source of feed. Since aquatic weeds are known to differ widely in their chemical composition depending upon species, season and location (Anonymous, 1984), an insight into their chemical composition is essential if utilization prospects are to be considered.

Eichhornia crassipes (Mart.) Solms commonly known as water hyacinth belonging to the family Pontideraceae is listed as one of the most productive plants on the earth and is considered the world's worst aquatic weed (Holm *et al.*, 1977; Westerdahl and Getsinger, 1988; Grodowitz, 1998; Charudattan, 1996). Its habitat ranges from tropical desert to subtropical or warm temperate desert to rainforest zones. It tolerates annual temperatures ranging from 21.1-27.2°C and its pH tolerance is estimated at 5.0-7.5. The beautiful blue devil water hyacinth, recognized by its lavender flowers and shinning bright leaves is a prolific aquatic plant which spreads at an alarming rate.

The plant is euryhaline, tolerating both fresh and marine water, hence its spread knows no boundaries. Recently considerable attention has been given to

Corresponding Author: N. Lata, Department of Botany, C.M.D.P.G. College, Gurughasi Das Vishwavidyalaya, Bilaspur (C.G.), India

harvesting this aquatic plant for practical uses to partially defray the cost of removal from water ways and use as economical sources in many parts of the world. The present research was designed to evaluate the mineral contents of the aquatic plant *Eichhornia crassipes.* The Ca/P ratio was calculated. In addition, the moisture and energy content was also determined.

The purpose of this study was to supplement existing knowledge on water hyacinth by elemental analysis to examine its economic suitability. Hence, the study deals with the screening and scientific evaluation of plant minerals that may prove beneficial for the mankind along with the management of the aquatic weed.

MATERIALS AND METHODS

Water hyacinth (*Eichhornia crassipes*) plants were collected from the water bodies in Bilaspur district of Chhattisgarh ($21^0$37'-$25^0$7'N latitude and $81^0$12'-$83^0$40'E longitude). Fresh plants were washed several times under running tap water followed by surface sterilization by Mercuric Chloride (0.01%). The plants were shade dried followed by oven-drying at 50°C for 24 h. Then plant materials grinded to powder and used for further phytochemical analysis. Total nitrogen concentration was determined by the standard micro-kjeldahl method (Black, 1965).

To determine phosphorus, plant extract was prepared by dry ashing and triacid digestion (using nitric acid, sulphuric acid and perchloric acid). Then phosphorus was assayed spectrophotometrically (Snell and Snell, 1953).

For potassium and calcium estimation, plant extracts prepared by dry ashing and diacid digestion (using nitric acid and perchloric acid). Potassium and calcium were determined using Atomic Absorption Spectrophotometer (AAS).

Microelements like iron, zinc, copper and manganese were also estimated by AAS. For microelements, plant extracts were prepared by wet ashing and diacid digestion (using nitric acid and perchloric acid).

Moisture content of the water hyacinth plant was determined by standard methods of AOAC (1990). Energy content was estimated using digital Bomb Colorimeter following Leith (1968). All the data were subjected to statistical analysis. Observations are shown in tabular form representing the Mean±SD.

RESULTS AND DISCUSSION

A total of eight elements Nitrogen (N), Phosphorus (P), potassium (K), Calcium (Ca), iron (Fe^{++}), Zinc (Zn^{++}), Copper (Cu^{++}) and manganese (Mn^{++}) were determined. Elemental composition of water hyacinth is shown in Table 1. The values (on dry weight basis) for nitrogen (%), phosphorus (%), potassium (%) and calcium (%) were 5.21, 0.22, 2.3 and 0.36, respectively. Among the macroelements analysed in *Eichhornia crassipes*, nitrogen was found to be highest whereas phosphorus present in less amount. The results of microelements showed a highest value for manganese (332 ppm of dry weight basis). The least value was found for copper (2 ppm of dry weight basis). The Ca/P ratio calculated as 1.63.

The results of the plant analysis for moisture content and energy content were shown in Table 2. The highest moisture percentage value of 88.315 was recorded for whole plant whereas low value was recorded for the rhizome (79.959% of dry weight). The plant has a high calorific value of energy as 333 Kcal/100 g of dry weight.

In the present study the value of nitrogen percentage recorded was higher than the value reported by Sharshar and Haroon (2009) whereas it was lower in case of potassium, phosphorus and calcium. Majid (1983) has also reported N, P and K percentage in the range of 1.50-2.20, 0.37-0.56 and 2.1-3.32%, respectively. The findings support this and suggest that the plant could be used as feed source.

When plants are to be considered for use as a feed source the calcium/phosphorus ratio constitutes an important parameter. This ratio should be within the range of 0.5-2.0 for the healthy growth of animals and should not be >6.0 (Murillo *et al*., 1987). The ratio of calcium/phosphorus in this study found to be 1.63.

It was reported (Alloway, 1990; Al-Shayab, 2002; Borovik, 1990; Ross, 1994) that iron and zinc contents ranged from 0-1642 and 3-4000 ppm, respectively in medicinal plants. Iron is an important trace element for haemoglobin formation, normal functioning of the central nervous system and in the oxidation of carbohydrates, protein and fats (Adeyeye and Otokiti, 1999). Iron can promote disease eliminating polygon and hence the plants can be used as very good diuretic agent and also for strengthening the function of stomach.

Analysis of plant revealed the presence of high energy content as 333 kcal/100 g which is higher value than the value 220 kcal/100 g, reported by Aderibigebe and Brown (1993). It may be suggested that the higher levels of elements could be related to the normal physiology of the plant. K and Ca are bulk

Table 1: Values of macro (% of D.wt.) and micro (ppm)-elements of *Eichhornia crassipes*

		Previously reported values by different workers			
Mineral contents	Observed values	A	B	C	D
Nitrogen (%)	5.21±0.594	1.50-2.20	-	-	2.251
Phosphorus (%)	0.22±0.110	0.37-0.56	0.37	791 (ppm)	0.28
Potassium (%)	2.3±0.557	2.1-3.320	3.68	46060 (ppm)	3.48
Calcium (%)	0.36±0.23	-	1.04	1808 (ppm)	-
Iron (ppm)	280±1.976	-	-	2557 (ppm)	1152
Zinc (ppm)	45±0.856	-	-	-	56.15
Copper (ppm)	2±0.670	-	-	20 (ppm)	44.4
Manganese (ppm)	332±2.450	-	-	222 (ppm)	524
Calcium/Phosphorus	1.63	-	2.81	-	-

Mean±SD (n = 6), A (Majid, 1983), B (Anjana and Matai, 1990), C (Aderibigebe and Brown, 1993), D (Sharshar and Haroon, 2009) reported the values for different elements of *Eichhornia crassipes* plant

Table 2: Biochemical components of *Eichhornia crassipes*

Parameters (%)	Observed values
Moisture content of whole plant	88.315±2.374
Moisture content of the shoot	88.041±2.238
Moisture content of the rhizome	79.959±1.837
Calorific value (Energy content in Kcal/100 g)	333.0±1.85600

Mean±SD (n = 6)

constituents in human body. They are mainly involved in maintaining acid and base balance in body. Ca is essential for the strengthening of bones and teeth.

CONCLUSION

In this study, The *Eichhornia crassipes* is a rich source of mineral contents and can serve as suitable economic feed. Because of the rich diversity of this aquatic plant it is expected that analysis for mineral and scientific evaluation of plant may prove beneficial for the mankind along with the management of the weed.

ACKNOWLEDGEMENTS

The researches are thankful to the Department of Botany, C.M.D.P.G. College, Bilaspur, (C.G.) India for providing laboratory facility. We also thank to Dr. K. Tedia, Sr. Scientist, Dept. of Soil Science, Raipur (C.G.) India for providing help in analysis of microelements.

REFERENCES

AOAC., 1990. Official Methods of Analysis. 14th Edn., Association of Official Analytical Chemists, Washington, DC.

Aderibigebe, A.O. and A.A. Brown, 1993. Nutritive characteristics of two tropical aquatic weeds for ruminants. Ife J. Agric., 16-17: 42-54.

Adeyeye, E.I. and M.K.O. Otokiti, 1999. Proximate composition and some nutritional valuable minerals of two varieties of *Capsicum annum*. Discovery Innovat., 11: 75-81.

Al-Shayab, S.M., 2002. Comparison study of *Phoenix dactylifera* and *Nerium oleander* as biomonitors for lead and other elements. Asian J. Chem., 14: 597-601.

Alloway, B.J., 1990. Heavy Metals in Soils. 1st Edn., John Wiley and Sons, Inc., New York, pp: 339.

Anjana, B. and S. Matai, 1990. Composition of indian aquatic plants in relation of utilization as animal forage. J. Aquat. Plant Manage., 28: 69-73.

Anonymous, 1984. Making Aquatic Weeds Useful: Some Perspectives for Developing Countries. National Academy of Sciences, Washington D.C., pp: 175.

Black, C.A., 1965. Methods of Soil Analysis, Chemical and Microbial Properties. American Society of Agronomy, Madison, WI, pp: 1569.

Borovik, A.J., 1990. Toxic Metals in Soil Plant System. John Wiley and Sons, New York.

Borris, R.P., 1996. Natural productions research: Perspectives from a major pharmaceutical company. J. Ethnopharmacol., 51: 29-38.

Cannon, H.L., 1960. Heavy metals in plants. Science, 132: 591-598.

Charudattan, R., 1996. Pathogens for Biological Control of Water Hyacinth. In: Strategies for Water Hyacinth Control, Carudattan, R., R. Labrada, T.D. Center and C. Kelly-Begazo (Eds.). FAO, Fort Lauderdale, Florida, USA., pp: 90-97.

Grodowitz, M.J., 1998. An active approach to the use of insect biological control for the management of non-native aquatic plants. J. Aquat. Plant Manage., 36: 57-61.

Holm, L.G., D.L. Plucknett, J.V. Pancho and J.P. Herberger, 1977. The Worlds Worst Weeds: Distribution and Biology. University Press Hawaii, Honolulu, USA., pp: 72-77.

Leith, H., 1968. The Measurement of Calorific Value of Biological Material and Determination of Ecological Efficiency. In: Functioning of Terrestrial Ecosystems at the Primary Production Levels, Eckardt, E.F. (Ed.). UNESCO, Paris, pp: 233-242.

Majid, F.Z., 1983. Aquatic Weeds and Algae, the Neglected Natural Resources of Bangladesh. Bangladesh Rice Research Institute, Joydevpur, Bangladesh, pp: 26.

Moerman, D.E., 1996. An analysis of the food plants and drug plants of native North America. J. Ethnopharmacol., 52: 1-22.

Murillo, J.M., M. Barroso, C. Mazuelos and R. Sarmiento, 1987. Nutritional and fertilizer values of *Suaeda vera* J.F. Gmelin. J. Sci. Food Agric., 41: 115-122.

Ross, M.S., 1994. Toxic Metals in Soil Born System. John Wiley and Sons, New York, pp: 63-152.

Shailajan, S., N. Chandra, R.T. Sane and S. Menon, 2004. Chemical analysis of heavy metals in a medicinal plant *Asteracantha longifolia* Nees using ICP-AES Technique. Nat. Environ. Pollut. Technol., 3: 443-445.

Sharshar, K.M. and A.M. Haroon, 2009. Comparative investigations on some biological and biochemical aspects in freshwater crayfish (*Procambarus clarkii*) fed on *Eichhornia crassipes*, *Echinochloa stagnina* L. and *Polygonum tomentosum*. Am.-Eurasian J. Agric. Environ. Sci., 5: 579-589.

Snell, F.D. and C.T. Snell, 1953. Colorimetric Methods of Analysis. D. van Nostrand Co. Inc., Toronto, Canda, pp: 606.

Venketaraman, R. and S.G. Krishnan, 2002. Trace elemental profile in some medicinal plants traditionally used for Jaundice. J. Cur. Sci., 2: 305-308.

Westerdahl, H.E. and K.D. Getsinger, 1988. Aquatic Plant Identification and Herbicide use Guide: Aquatic Plants and Susceptibility to Herbicides. Vol. II, Waterways Experiment Station, Vicksburg, MS.