**Nutritive Value of Water Hyacinth (*Eichhornia crassipes*)**



**A Report by**

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| Intern ID | : | D-42 |
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Submitted to the Faculty of Veterinary Medicine, Chittagong Veterinary and Animal Sciences University in partial of the requirement for the fulfillment of the degree of Doctor of Veterinary Medicine (DVM)

Approved as to style and contents by

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November 2014

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**Nutritive Value of Water Hyacinth (*Eichhornia crassipes*)**

**1. Abstract**

The study was undertaken to find out the chemical composition and nutritive value of Water Hyacinth (*Eichhornia crassipes*) available in Chittagong, Bangladesh. Samples were collected from three different places of the study area. Chemical analyses of the samples were carried out in triplicate for dry matter (DM), crude protein (CP), crude fiber (CF), nitrogen free extracts (NFE), ether extracts (EE) and total ash in the animal nutrition laboratory, Chittagong Veterinary and Animal Sciences University, Chittagong, Bangladesh. Results indicated that, there were no marked variations (P>0.05) in the DM, CP, CF, NFE, EE and ash contents of the samples. DM content varied from 81.87 to 83.49%, crude protein content varied from 10.15 to 11.20 %, crude fiber content varied from 26.07 to 27.39 %, ether extract content varied from 1.06 to 1.78%, nitrogen free extracts content varied from 47.21 to 50.17 % and total ash content varied from 12.35 to 12.51 %. It can therefore be inferred that the nutrient contents of Water Hyacinth did not vary due to variation in places. The result indicated that water hyacinth nutritionally was in standard condition, hence, it could provide nutrients and minerals to be utilized as fodder for ruminant especially during the dry season.

Key words: minerals, proximate component, water hyacinth.

**2. Introduction**

Water hyacinth (*Eichhornia crassipes*) is a pleustophytic hydatophyte, a cosmopolitan aquatic weed which can tolerate a wide range of environmental conditions such as temperature, illumination, pH, salinity, wind, current and drought. The plant is morphologically very plastic with a rapid mode of vegetative propagation which makes it well adapted to long distance dispersal and successful colonization of diverse ecological niches. It is one of the most prolific aquatic plants which spreads at an alarming rate having spikes of large blue flowers and roundish leaves with inflated bladder- like petioles.The extremely rapid rate of proliferation of the water usually result in reduction in height penetration and dissolved oxygen in water bodies, change water chemistry, affect flora and faillill, increase rate of water loss due to evapotranspiration and it is now presently being considered as a serious threat to biodiversity. Recently, considerable attention has been given to its harvesting for practical uses, namely, for partially defraying the cost of removing plants from water ways and for use as alternative plant protein source in livestock feed including fish.

Bangladesh mainly subsists on a straw based diet with limited green fodder and little or no concentrate. Out of total dry matter (DM), about 70% constitutes dry roughage, about 90% of which is rice straw. Rice straw is very low digestibility and highly deficient in protein and micronutrients. Animal productivity can be improved by efficient utilization of straw. Nutritive value of straw can be improved by physical, chemical and biological means by supplementation with energy. In Bangladesh cattle feed mainly on low quality roughage including natural grazing and agro-industrial by products such as straw, sugarcane by-products and other similar feeds. These feeds are deficient in protein, energy, minerals and vitamins. At certain time of the year, quality of grazing deteriorates due to seasonal influence. Thus livestock productivity consequently declines and in this case lactation cease unless supplements are offered. Livestock feed decrease in day by day in Bangladesh due to the shortage of grazing area. In such cases any unconventional sources may act as an alternative. The very common and locally available water hyacinth can be the options in livestock feed as an unconventional source to overcome the feed.

Water hyacinth has been widely introduced in North America, Asia, Australia, Africa and New Zealand as well as Kerala Backwaters in India. It was first introduced to North America in 1884, an estimated 50 kilograms per square metre of hyacinth once choked in Florida's waterways, although the problem there has since been mitigated. Directly blamed for starving subsistence farmers in Papua New Guinea, water hyacinth remains a major problem where effective controlprograms are not in place. *Eichhornia crassipes*, the Common water hyacinth, has become aninvasive plant species on Lake Victoria in Africa after it was introduced into the area in the1980. Despite management and control efforts since then, a significant seed bank stillremains across the region. In Bangladesh it is commonly used as forage for cattle which could be used as a supplement to a basal diet of sugarcane, molasses and possibly also cereal straws.

In Bangladesh a large amount of water hyacinth are produced due to large number of rivers and ponds. Due to huge production in some areas (especially in Chittagong district) it is not utilized properly. About 60% or more ponds and rivers are covered by water hyacinth in Chittagong district. Most of them are not used by farmers due to lack of knowledge of farmers on water hyacinth. In addition, most of the farmers are not known about the nutritive value of water hyacinth at all. If the nutritive value and potentiality of water hyacinth discover, farmers of that area can utilize water hyacinth as an unconventional feed in livestock sector to minimize feed cost and maximize production. A very few work has been done on using water hyacinth to cattle, hence, the current study was undertaken with the following objectives:

1. To find out the chemical composition of water hyacinth.
2. To find out the nutritive value of water hyacinth.

**3. Materials and Methods**

The study was conducted at the laboratory of animal science and animal nutrition, Chittagong Veterinary and Animal Sciences University, Khulshi, Chittagong 4225.

**3.1. Study area**

As water hyacinths are available in Bangladesh but the study was done in Chittagong district. The study sample was collected from different ponds at Khulshi, Raozan and Fatikchari in Chittagong district.

**3.2. Collection of sample**

Water hyacinth (*Eichhornia crassipes*) was collected from different ponds of Khulshi, Raozan and Fatikchari. After collection of water hyacinth from water, roots were cut-off and discarded thinking that it is not convenient feed, the stalks and leaves were chopped to 3cm in length and sundried for about 7 days at an environmental temperature (22.8 - 33.8°C) and relative humidity (54.0 - 96.0%). Approximately 500gm of samples were collected by separation from root.

**3.3. Preparation of sample**

Homogenous samples were prepared by chopping and proper mixing. Prepared sample was kept for determination of proximate composition.

**3.4. Chemical analyses**

Chemical analyses of the samples were carried out by using the equations suggested by AOAC (2006) in triplicate for moisture, dry matter (DM), crude protein (CP), crude fiber (CF), nitrogen free extracts (NFE), ether extracts (EE) and total ash in the Animal Nutrition laboratory, Chittagong Veterinary and Animal Sciences University, Chittagong, Bangladesh. The following analyses were performed at that lab.

**3.4.1.** **Estimation of Dry Matter (DM)**

Five grams of raw sample was weighed into a previously weighed petridish and dried in an oven at 105°C till a constant weight was attained. The dry matter content of the sample was calculated as per AOAC (2006).

**3.4.2. Estimation of Crude Protein (CP)**

The nitrogen content of sample was estimated by Kjeldahl method. The crude protein content was calculated by multiplying the determined nitrogen with factor 6.25 as per AOAC (2006).

**3.4.3. Estimation of Crude Fiber (CF)**

Fat free sample was hydrolyzed with dilute sulphuric acid (1.25%) and diluted alkali (1.25%) to estimate crude fibre by employing the methods as per AOAC (2006).

**3.4.4. Estimation of Total Ash (TA)**

Total mineral matter (ash) was determined by igniting samples in muffle furnace at 600°c for 3-4 hours. The total mineral matter was calculated by the following formula as per AOAC (2006).

**3.4.5. Estimation of Ether Extract (EE)**

Moisture free sample was weighed in moisture free thimbles and crude fat was extracted by refluxing in Soxhlet apparatus using petroleum ether as solvent. Per cent crude fat was calculated by difference as per AOAC (2006).

**3.5. Calculation of Nitrogen Free Extract (NFE)**

The NFE content was calculated by deducting the sum of the values for moisture, crude protein, crude fat, crude fibre and total mineral matter in 100 (Raghuramulu et al., 1983).

**3.6. Calculation of ME**

All samples were subjected to proximate analysis in triplicate. Later on, Metabolizable energy (ME) available in all the water hyacinth samples was calculated by using a standard mathematical formula as per Lodhi et al. (1976), by using Microsoft Excel 2007.

**3.7. Data analysis**

Data related to chemical composition and nutritive value of water hyacinth, collected, compiled and analyzed for mean values by using Microsoft Excel 2007.

**5. Results and Discussions**

**Scientific classification of water hyacinth:**

Kingdom: Plantae

Order: Commelinids

Family: Pontederiaceae

Genus: *Eichhoria*

Species: *Eichhornia crassipes*

The **Table 1** shows the proximate composition of water hyacinth. The crude protein of (10.53 g/100g) reported in the present study compares with (10.20 to 12.80 g/100g) reported by **Dada (2002) and Mako and Babayemi (2008)**. However, it is lower than the range value of (14.00 to 26.00 g/100g DM) reported by **Dairo (1997), Aboud et al. (2005), Lareo and Bressani (2009) and Edwards,** (15.8 g/100g DM) reported by **Kamal and Wee (1985),** (12-19.8 g/100g DM) by **Boyd (1968, 1974), Reza (1981)**.The differences in crude protein may have resulted from age variability of water hyacinth. As water hyacinth ages, protein content decreases **(NAS, 1976).** The concentration of most chemicals in aquatic species varies when harvested at similar stages of maturity but from different sites or environment **(Boyd, 1979; cited by Okoye et al., 2002)** and the nutrient content in the environment in which the E. crassipes is cultured influence the nitrogen and phosphorus levels of the water weed **(Gosset (1971) and Boyd al (1975)** . This level of crude protein of water hyacinth can be considered favorable for ruminant feeding and may be considered as a valuable supplement for animals fed on low quality crop residues.

Table 1. Chemical composition and nutritive value of **Water Hyacinth (*Eichhornia crassipes*)**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Parameters | Chemical composition (g/100g Air DM) | | | | | | |
| DM | CP | CF | Ash | EE | NFE | ME (Kcal/kg) |
| Khulshi area | 81.88 | 10.24 | 27.36 | 12.51 | 1.06 | 48.84 | 1995.67 |
| Raozan area | 83.49 | 10.15 | 26.07 | 12.35 | 1.26 | 50.17 | 2051.49 |
| Fatikchori area | 81.87 | 11.20 | 27.39 | 12.43 | 1.78 | 47.21 | 2026.90 |
| Mean | 82.42 | 10.53 | 26.94 | 12.43 | 1.36 | 48.74 | 2024.67 |
| Std. Deviation | 0.76 | 0.48 | 0.62 | 0.06 | 0.30 | 1.21 | 27.97 |
| Sig. | NS | NS | NS | NS | NS | NS | NS |

The crude fibre (26.94 g/100g) obtained in this study is lower than the value of (31.8 g/100g) **Tuan et al. (1994).** However, it is higher than the range value of (18.00 to 24.60 g/100g DM) obtained by **Reza and Khan (1981)**, **Lareo and Bressani (2009)** and **Mako and Akinwande (2010)**, (23 g/100g DM) by **Klinavee, Tansakul and Promkuntong (1990)** and (22.8 g/100g DM) by **Edwards, Kamal and Wee (1985).** This variation could be due to differences in the age of plants from one location to another. The concentration of most chemicals in aquatic species varies when harvested at similar stages of maturity but from different sites or environment **(Boyd, 1979; cited by Okoye et al., 2002).**

The 12.43 g/100g DM ash content is comparable to 12.40 g/100g DM by **Igbinosum et al (1988 )** and closer to the range value of 14.06 to 17.30 g/100g DM reported by **Lareo and Bressani (2009)** for different water hyacinth samples. This is however; lower than 19.01 g/100g DM reported by **Okoye et al. (2002)** and 29.56 g/100g DM reported by **Mako and Akinwande (2012).** This variation could be due to differences in the age of plants from one location to another. Ash content could decline as plants age because of probable increase in cellulose content. Ash represents inorganic matter which mainly includes plant minerals. High content of ash in water hyacinth is probably due to accumulation of minerals absorbed from water. **Boyd (1968)** found that floating aquatic plants contained very large quantities of ash similar to levels in submerged plants. Water hyacinth naturally absorbs pollutants including toxic chemicals like lead and others as well as some organic compounds believed to be carcinogenic in concentrations 10,000 times than in the surrounding water **(National Academy of Science, 1976).** Since the normal ash content of most legume grass forages is about 9.0 g/100g DM **(Hoffman, 2010)** the level in water hyacinth could be said to be high indicating availability of minerals to livestock fed water hyacinth.

The ether extract value of 1.36 g/100g obtained in this study which was almost similar of all available perennial grasses of Bangladesh and is close agreement with 1.8 and 2.3 g/100g DM reported **Aboud et al. (2005) and Dada (2002)** respectively. However, samples used in this study comprised of the leaves and stems mainly. **Gollamudi et al. (1984)** reported that fat in water hyacinth was primarily found in leaves (14.9 g/100g DM) whereas roots and stalks contained 1.6 and 0.9 g/100g DM respectively.

The nitrogen free extract of (48.74 g/100g DM) reported in the present study compares with (49.8 g/100g) reported by Klinavee, Tansakul and **Promkuntong (1990)**.

The calculated metabolizable energy value of 2024.67 Kcl/kg obtained in this study which was almost similar of all available perennial grasses of Bangladesh.

The **Table-1** also showed the difference in proximate composition at Khulshi, Raozan, Fatikchari in Chittagong district. It showed that there were no marked variations in dry matter, crude protein, crude fiber, ether extract, total ash and nitrogen free extract among those places. DM content varied from 81.87 to 83.49%, crude protein content varied from 10.15 to 11.20 %, crude fiber content varied from 26.07 to 27.39 %, ether extract content varied from 1.06 to 1.78%, nitrogen free extracts content varied from 47.21 to 50.17 %,total ash content varied from 12.35 to 12.51 % and metabolizable energy varied from 1995.67 to 2051.49 Kcl/kg.

**6. Conclusion**

Water hyacinth is available all year round and it is rich in nutrients especially CP. Also, the minerals tested revealed that the plant contained adequate mineral content that is within the recommended value as maintenance and production ration. These imply that the plant can be utilized as feed for animals especially ruminants. It was revealed that the proximate composition of water hyacinth was almost similar to other perennial grasses available in Bangladesh. It can assist farmers in ensuring sustainable production of least cost diets for cattle. The sustainability of the least cost diet is expected to eventually translate into successful management of the weed in our water ways and ensure protection of biodiversity. In Chittagong more than 60 % of the water bodies are infested by Water Hyacinth. If these plants can be put to good use, a lot of profitable products can be obtained out of this underutilized product. No strong decision can be done by this sort of short study. Hence, further study would be recommended to make the water hyacinth convenient for cattle to our country though it has a provision in our country to feed water hyacinth as cattle feed during scarce.

**7. References**

Aboud AAO, Kidunda RS and Osarya J (2005). Potential of water hyacinth (E. Crassipes) in ruminant nutrition in Tanzania, Liv. Res. Rural Dev. 17 (8): 23-32.

Ayeni JSO and Daddy F (1994). Control and utilisation of aquatic weeds; Water Hyacinth and Niger grass on Lake Kainji. NIFFR Annual Report.

Boyd CE (1968). Fresh water plants. A potential source of protein. Eco Bot 22: 359-368.

Chalmers MI (1968). Report to World Food Programme on a visit to Sudan. Study on the use of water hyacinth in ruminant animal feeding. Rome, FAO, ACC. No.02787 — 68 -WS.

Dada SA (2002). The utilization of water hyacinth (*Eichhornia crassipes*) by West African dwarf (wad) growing goats. *African Journal of Biomedical Research* 4, 147-149.

Dairo FAS (1997). Evaluation of water hyacinth (*E. crassipes*) as feed ingredient and yolk growing goats, *African Journal of Biomedical Research,* 4: 147-149.

Gollamudi LK, Rao S, Pantulu AJ and Thyagarajan G (1984). Composition of lipids in roots, stalks, leaves and flowers of Eichhornia crassipes, (Mart.) Solms, Aquatic Botany 20: 219-227.

Harley KLS (1990). The role of biological control in the management of water hyacinth, *Eichhorniacrassipe*. Biocontr. News Info. 11: 11-22.

Harris (1993). Effects, constraints and future of weed bio control. Agric. Ecosyst. Environ. 46: 289-303.

Heard TA and Winterton SL (2000). Interactions between nutrient status and weevil herbivory in the biological control of water hyacinth. J. Appl. Ecol. 37: 117-127.

Holm L, Pancho J, Herberger J and Plucknett D (1979). A Geographical Atlas of World Weeds. John Wiley and Sons, New York. Xlix 391.

Hossain W (1959). Investigations on water hyacinth as fodder. Agric. Pakistan 10:513-518.

Jayanth KP (1988). Successful biological control of water hyacinth (*Eichhornia crassipes*) by Neochetinaeichhorniae (Coleoptera: Curculionidae) in Bangalore, India. Trop. Pest Manage. 34: 263-266.

Julien MH and Griffiths MW (1998). Biological Control of Weeds: A World Catalogue of Agents and their Target Weeds (4th ed.), Oxon, UK: CABI Publishing, CAB International.

Lareo L and Bressani R (2009). Possible utilization of the water hyacinth in nutrition and industry, Retrievedfrom, <http://www>.unu.edu/unupress/food/8f044e/8f044EOc.htm.

Little ECS and Henson IE (I967). The water content of some important tropical water weeds. p. 223 -227.

Mako A and Babayemi OJ (2008). Nutritional evaluation of water hyacinth as ruminant feed to curtail its environmental menace in Nigeria, African J. Liv. Extension 6: 35-41.

NAS (1976). Making aquatic weeds useful: Some perspectives for developing countries, National Academy of Sciences, Washington, DC. Retrieved from <http://www.hort.purdue.edu/newcrop/dukeenergy/Eichhorniacrassipes.html>.

Ntiba MJ, Kudoja WM and Mukasa CT (2001). Management issues in Lake Victoria watershed. Lake. Reserve. Manage. 6:211-216.

Okoye FC, Daddy F and Ilesanmi BD (2002). The nutritive value of water hyacinth *(Eichhorniacrassipes)* and its utilisation in fish feed, Annual Report, National Institute for Fresh Water Fisheries Research (NIFFR), New Bussa.

Pemberton RW and Turner CE (1990). Biological control of Seneciojacobaea in northen California, an enduring success. Entomophaga. 35.71-77.

Reza A and Khan J (1981). Water hyacinth as cattle feed, Indian Journal of Animal Science 51: 702 706.

Wolverton BC and McDonald RC (1976). Don’t waste waterweeds, New Sci. 71(1013): 318-320.