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Proximate, Minerals and Anti-Nutritional Composition of Water Hyacinth (*Eichhornia crassipes*) Grass

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Abstract

The peels of *Eichhornia crassipes* were evaluated for its proximate and anti-nutritional composition. The results show that the moisture, ash, crude protein, crude lipid, crude fibre, available carbohydrate and energy value were 89.20 ± 0.23% weight wet, 18.20 ± 0.21 %, 8.2 ± 0.18 %, 2.20 ± 0.03 %, 21.56 ± 0.10 %, 49.98 ± 0.48 % and 252.52 ± 0.50 kcal/100g dry weight respectively. The result of minerals analysis showed that the grass is a good source of both macro and micro elements with calcium as predominant. The result shows that the hydrocyanic acid, nitrate, oxalate and phytate were 0.56 ± 0.01 mg/100gDW, 0.38 ± 0.01 mg/100gDW, 0.33 ± 0.05 mg/100gDW and 4.06 ± 1.69 mg/100gDW. The results indicate that if the grass is properly exploited and processed, they could be a high quality and cheap source of carbohydrates and minerals supplement in the formulation of animal feeds.

Introduction

Water hyacinth (*Eichhornia crassipes*) is a cosmopolitan invasive aquatic plant which can tolerate a wide range of environmental conditions such as temperature, humidity, illumination, pH, salinity, wind, current and drought. The plant is

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morphologically plastic with a rapid mode of vegetative propagation that makes it well adapted to a long distance of dispersal and colonization under diverse ecological conditions. It is one of the most prolific aquatic plant which spreads at an alarming rate. It has spikes of light blue flowers and green color roundish leaves with inflated bladder like petioles. The extremely rapid rate of proliferation of *Eichhornia crassipes* results reduced penetration of dissolved oxygen in water body, change in water chemistry, disruption of aquatic flora and increased rate of water loss due to evapotranspiration. Water hyacinth (*Eichhornia crassipes*) is also responsible for drastic changes in the plant and animal communities of freshwater environments and acts as an agent for the spread of serious diseases in tropical countries. Therefore, it is considered as a serious threat to biodiversity and recently massive attention has been given to its harvesting for use as alternative plant protein source for livestock. In some part of the northern Nigeria, animals are fed mainly with low quality roughages including natural grazes and agro-industrial products such as straw, sugarcane by-products and other crop residues. These feeds are sometimes found to be deficient in either 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 and productivity ceases unless supplements are offered to the animals. Availability of livestock feeds are decreasing day by day in the country due to shortage of grazing area. In such cases, plants like water hyacinth, that are more or less available all year round in places where lakes or stagnant water are available may be a good alternative to overcome feed crisis.

This plant however has some positive uses. Studies have shown that the plant serves as industrial raw material for paper making, biogas production, organic manure (compost), potash and fish feed formulation. Also, in its natural form and at low infestation, it serves as fish food, where herbivorous fishes are stocked and cultured in combination with other non-predatory species to promote the growth of fish. In China for example, presence of small quantities of water hyacinth is encouraged in fish ponds because fish find food among the roots. The use of water hyacinth in fish feed will reduce the present dependence on other competitive agricultural crops used in compounding feeds. Fish feed is expensive and can account for 60% of the variable cost in a fish culture operation and this has forced nutritionists to consider alternative sources of plant based protein source such as Soy beans, groundnut cake and others at low cost for fish (Aboaba and Ketiku [1]).

Figure 1. Picture of water hyacinth (*Eichhornia crassipies*) on water body.

Experimental

Sampling

Fresh samples of water hyacinth were obtained from stagnant water within the Usmanu Danfodiyo University, Sokoto student dormitories. The sample was picked at random (Asaolu and Asaolu [2]). The fresh leaves were authenticated at the Herbarium unit of the department of Biological Science of Usmanu Danfodiyo University Sokoto, Nigeria. The sample plant was cleaned with water and rinsed with distilled water to avoid surface contamination (Ahmed and Birnin-Yauri [3]). The sample was dried at room temperature, crushed to a fine powder using mortar and pestle, sieved through 20-mesh and stored in an air tight plastic container for analysis.

Proximate Analysis

Moisture content was determined at 105°C. Ash content was determined at 550°C. Crude protein, lipid and fibre were also determined according to the procedures of (AOAC [4]).

Crude Nitrogen

Crude Nitrogen was determined based on the Kjeldhal procedure and crude protein value was obtained by multiplying the nitrogen value by a factor of 6.25 while estimation of available carbohydrate was done by difference as: CHO = 100 - (%ash+%crude protein+%crude lipid+%fibre) Energy (kcal) =[(%CHO x 4) + (%CP x 4) + (CL x 9)] Where CHO, CP and CL stands for carbohydrate, crude protein and crude lipid respectively (Hassan et al. [5]).

Mineral Analysis

The sample was digested into solution by wet digestion using a mixture of conc. Nitric, perchloric and sulphuric acids in the ratio 9:2:1 respectively. Fe, Zn, Co, Mg, Ca and Mn were determined by AAS, (Alpha 4 model, Buck Scientific Ltd USA). While Na and K were determined using atomic emission spectrometer (200-A model, Buck Scientific Ltd UK), and colorimetric method was used to determined Phosphorus. Other analysis and adopted methods include the determination of oxalate, phytate and hydrocyanic acid (Hassan et al. [5]) and nitrate (IITA [6]).

Result and Discussions

Table 1. Proximate content of water hyacinth (*Eicchornia crassipes*) plant.

Component analyse	Concentration (%)
Moisture	89.20 ± 0.23
Ash	18.20 ± 0.21
Crude protein	8.20 ± 0.18
Crude lipid	2.20 ± 0.03
Crude fibre	21.42 ± 0.10
Carbohydrate	49.98 ± 0.48
Energy value (kcal/100g)	252.52 ± 0.50

The data are mean value ± standard deviation of three replicates

Table 2. Level of some anti nutritional factors in water hyacinth (*Eicchornia crassipes*) grass (mg/100gDW).

Antinutritional factors	Concentration
Tannin	0.56 ± 0.01
Cyanide	0.38 ± 0.01
Phytate	0.33 ± 0.05
Oxalate	4.06 ± 1.69

The data are mean value ± standard deviation of three replicates

Table 3. Mineral composition of the plant of (*Eicchornia crassipies*) (mg/100g dry weight).

Elements	Concentration
Ca	3.25 ± 3.75
Mg	1.35 ± 0.25
Na	2.69 ± 2.81
K	0.47 ± 0.79
P	0.98 ± 2.51
Zn	1.56 ± 1.58
Fe	0.56 ± 2.98

The data are mean value ± standard deviation of three replicates

Proximate Composition

The result shows that Water hyacinth *Eicchornia crassipies* contain large amount of moisture (89.20). The moisture content of any food is an index of its water activity (Frazier and Westhoff [7]) and is used as a measure of stability and the susceptibility to microbial contamination (Scott [8]). This implies that *Eicchornia crassipies* may have a short shelf-life due to its high moisture content. This high moisture content also implies that dehydration would increase the relative concentrations of the other food nutrients and improve the shelf-life/preservation of the *Eicchornia crassipies* meal.

The result revealed that Water hyacinth *Eicchornia crassipies* has crude protein content of (8.2 ± 0.18%). The value is lower than that of *Pennisetum purpureum* grass 27.00 mg/100 g DW as reported by (Okaraonye and Ikewuchi [9]) but it is higher than the wet weight (WW) of *Pennisetum purpureum* (2.97 mg/100 g WW) (Okaraonye and Ikewuchi [9]). It is also higher than what is reported for *Andropogon gayanus* (4.19%DW) as concluded by Waziri et al. [10]).

The lipid content of the sample Water hyacinth (*Eicchornia crassipies*) was found to be 2.2 ± 0.18. The crude lipid level in the present study ranges from 2.02 % to 16.07 % as reported by Kang'ombe et al. [11]). The value obtained is lower than that obtained for *Pennisetum purpureum* grass (14.82 % DW). The value obtained is also higher than (1.0 % DW) for Cassava leaf meal and 0.8% DW for Pawpaw leaf meal as reported by Abowei and Ekubo (2011), and lower (3% DW) for Sweet potato leaf meal as reported by Adewolu [12]).

The result indicate that Water hyacinth (*Eicchornia crassipies*) accumulated more crude fiber (21.42 ± 0.10% DW) in contrast with 14.68 % DW obtained from *Andropogon gayanus* (Waziri et al. [10]). When compared with the value of fibre obtained from dry weight of *Pennisetum purpureum* (9.09 % DW) and that of the wet weight of *Pennisetum purpureum* (1.0 % DW).

Carbohydrate plays a very important role in the body as a source of energy as well as structural materials (Voet et al. [13]). The result shows that Water hyacinth (*Eicchornia crassipies*) has a carbohydrate content of (49.98% DW). This result is higher compared to that of *Sorghum bicolour* (L) stem (44.52 % DW) as reported by Adesuyi et al. [14] but is lower than that obtained from *Tribulus terrestris* (55.67%DW) and in water spinach (54.20 % DW) as reported by Umar et al. [15]) and also lower than that of *Pennisetum purpureum* (37.56 % DW) as reported by Okaraonye and Ikewuchi [9].

The energy value of Water hyacinth (*Eicchornia crassipies*) was found to be 252.52 ± 0.50KJ/100 g DW which is within the range of (84-2500 KJ/100 g) or (20.08-597.51 KCal/100 g) as reported for plant foods (Saka and Msonthi [16]) and is relatively lower than what is obtained from *Pennisetum purpureum* which is found to be 313.45 KJ/100 g.

Mineral Composition

The concentration of sodium in Water hyacinth (*Eicchornia crassipies*) grass was

2.69 mg/100 g which is lower than the value (96.56 mg/100 g) reported by Waziri et al. [10] on the analysis of Andropogon gayanus grass and also what is reported by Falola et al. [17] for Vetiver Grass (*Chrysopogon zizanioides*). On the other hand, the value is lower than what is reported for Cassia hirtsutse (421.05 mg/100 g) as reported by Akpabio et al. [18]. It is an indication that the sample cannot provide the needed sodium.

From what we can see from the Table 3, its indicative that the sample cannot produce the required level of essential minerals that are needed for proper growth and development of the animals and so, there is the need for the proper supplementation of this minerals if the sample is to be used as a source of feed to the animals. In summary, table three3 revealed that the concentration of calcium, magnesium, phosphorus, zinc and iron is way below the recommended diatery allowance (RDA) of the animals, so the sample Water hyacinth (*Eicchornia crassipies*) is a poor source of essential minerals.

Antinutritional Composition

The concentration of oxalate in Water hyacinth (*Eicchornia crassipies*) grass is 4.06 ± 1.69 mg/100 g DW. The value is higher compared to the value obtained for *Pennisetum purpureum* (0.159 ± 0.010 mg/100 g DW) as reported by Okaraonye and Ikewuchi [9]) and also higher than what was obtained for *Vetiver* grass (0.25 ± 0.03 mg/100 g DW) reported by Falola et al. [17]. High oxalate content causes irritation in the mouth and interfere with the absorption of divalent minerals particularly calcium by forming insoluble salts with them leading to kidney stone which may eventually lead to death (Hassan et al. [19]).

The phytate content of Water hyacinth (*Eicchornia crassipies*) (0.33 ± 0.05 mg/100 g DW) is higher than that of *Pennisetum purpureum* (0.006 ± 0.001 mg/100 g DW) as reported by Okaraonye and Ikewuchi [9], the value is lower than (0.56 ± 0.02 mg/100 g DW) obtained for Vetiver grass reported by Falola et al. [17].

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