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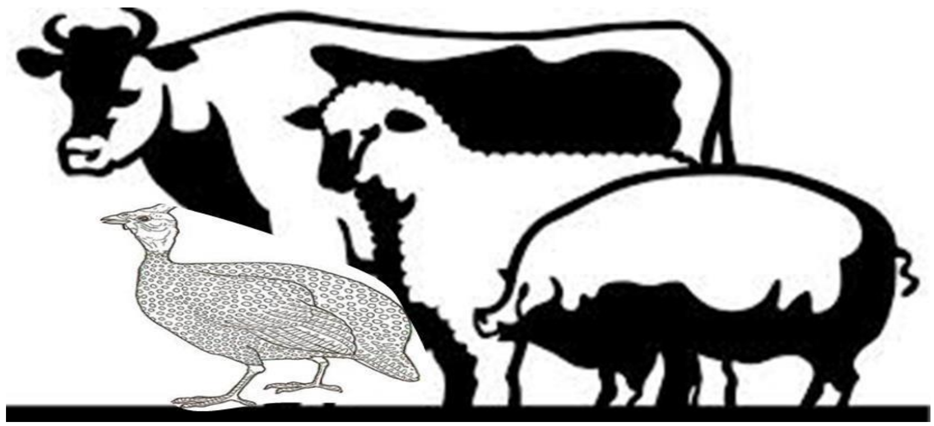

INTENSIFICATION OF DOMESTIC ANIMAL PRODUCTION THROUGH MODERN TECHNIQUES: THE ROLE OF THE YOUTH

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NUTRITIONAL COMPOSITION OF *Thalia dealbata* IN BANKA DAM IN THE TOLON DISTRICT OF THE NORTHERN REGION OF GHANA

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ABSTRACT

The nutritional composition of Thalia dealbata from Banka dam in the Tolon district of the Northern Region of Ghana was evaluated to determine; crude protein, ether extract, crude fibre, ash, nitrogen free extract and some minerals. Samples prepared from leaves, stalk and seeds were subjected to proximate analyses. The crude protein levels were as follows: 5.23 % in the stalk, 16.06 % in the leaves and 15.22 % in the seeds. Crude fibre was as follows: 21.29 % in the stalk, 18.74 %in the leaves and 30.17 % in the seeds. Ash content was 12.30 % in the leaves, 12.25 % in the stalk and in the seed 11.99 %. Ether extract was 1.88 % in the leaves, 1.77 % in the seed, and 1.46 % in the stalk. Nitrogen free extract was 60.09 % in the stalk, 40.64 % and 55 % in the seed. Calcium, zinc and iron were significantly ($P < 0.05$) higher in the leaves; copper and phosphorus in the seed and potassium and sodium in the stalk. The higher levels of nitrogen free extract in Thalia dealbata suggest that jt can be used as an energy feed source for livestock and fish, however, the high crude fibre levels may be a limitation to its utilization as feed for most monogastrics especially fish. Thalia dealbata is a rich source of major minerals especially potassium and sodium, it could be added as a feed ingredient to supplement mineral deficient diets. In subsequent studies, a palatability test could be carried out to ascertain the acceptability of the plant, Thalia dealbata, to various domestic animals.

KEYWORDS*: Thalia dealbata, crude protein, crude fibre, nitrogen free extract, minerals*

INTRODUCTION

Aquatic plants fulfill many natural functions and are vital in aquatic and wetland environments. Some aquatic plants are desirable and serve as food sources i.e. for fish, waterfowls, livestock and wildlife; habitat for fish and a substrate for invertebrates such as insects and snails. However, when aquatic plants become too plentiful in water bodies, they may interfere with fishing, swimming and boating activities. Also, they may clog waterways, trap sediments and as a result cause siltation and organic material to build up thus eventually causing the water body to become shallower (Heffron *et al.,* 1977; Lancar and Krake, 2002).

Though aquatic plants play vital roles in sustaining live, they can be problematic if their growth is not controlled. As a result, efforts in recent times have been directed towards increasing the usefulness of aquatic plants as a measure to control their growth. One of such ways is exploring aquatic plants for use as feed. It has become necessary to use unconventional (e.g. aquatic plants, forage trees) sources of feed to promote and sustain the production of livestock including fish because, most conversional (e.g. fish meal) feed sources are limiting and expensive (Khan *et al.,* 2002; Abarike *et al.,* 2014).

The nutritive value of aquatic plants is of interest from several standpoints as described by Heffron *et al.* (1977) and Bararjee and Matai (1990). Utilization of aquatic plants as food can alleviate feed shortages in livestock production especially in developing countries (Akmal *et al.*, 2014). The Banka dam in the Tolon district of the Northern Region of Ghana was originally constructed for irrigation and domestic purposes, however, in the last five years, the dam has been invaded by aquatic weeds dominant among these are *Thalia dealbata* (Hardy water canna), *Nymphaea alba* (Water lily) and *Vallisneria americana* (Eelgrass). The presence of the weeds has limited fishing as they entangle and destroy fishing gears. Also the weeds have reduced the water holding capacity as a result it is unable to support dry season farming (irrigation farming).

Aquatic plants may have valuable potential as feed for several animals, however, before practical use can be made of these aquatic plants, detailed knowledge must be known about their nutritional composition. There is little or no detailed information of nutrient potential of *Thalia dealbata* for use as an alternative feed for livestock including fish. This study was therefore undertaken to explore the nutritive potential of *Thalia dealbata* for use as feed for likvestock.

MATERIALS AND METHODS

Study area

The study was carried out at Banka dam with a catchment area sharing boundaries with the Kukpehi, Panlebianle communities and that of the eastern boundary of the University for Development Studies, Nyankpala campus in the Northern Region of Ghana. Banka dam is located in the Tolon District and is about 18 km away from Tamale the Regional capital of Northern Region. Its geographical coordinates are 9° 24' 0'' North, 0° 59' 0'' West.

Samples collection and preparation

Samples for the study were collected in the months of October and December 2013. During each sampling time, adequate quantities of the leaves, seed and stalk of *Thalia dealbata,* were collected at random manually from the periphery of the dam at different locations in fresh green conditions. Samples were washed in running tap water to rise off soil particles and dried under the sun.

Chemical analysis of plant samples

Proximate analysis of the plants for the experiment was carried out at the animal nutrition laboratory of the School of Agriculture, University of Cape Coast, following the procedures that broadly adhere to the Association of Official Analytical Chemists [AOAC] (1990). The protocol was used in determining the % crude protein (CP), % ash, % ether extract (EE) and % crude fibre (CF). Nitrogen-free extract was computed using the formula: % NFE = 100 - (% CP + % CF + % EE + % Ash). Minerals such as phosphorus (P) was determined using the colorimetric determination (ascorbic acid method) method, potassium (K) and sodium (Na) were determined using the flame photometer, calcium (Ca) and magnesium (Mg) using the diaminetetra-acetic acid (EDTA) titration method and the atomic absorption spectrophotometer (AAS) was used in determining the iron, copper and zinc levels in *Thalia dealbata.*

Statistical analysis of the plants samples

Data were subjected to one-way analysis of variance (ANOVA) using the SPSS version 16 at 95% confidence level ($P < 0.05$). Where significant differences

occurred, treatment means were compared
0.05) higher in the leaves and lower in the

RESULTS

Chemical composition of the leaves, stalk and seed of *T. dealbata* .

As illustrated in figure 1, among the leaves, stalk and the seed of *Thalia dealbata*, ash levels were highest in the leaves (14.33%) in December and lowest in the leaves (10.27%) in October. Protein was highest (19.17%) and different in the leaves in October and lowest (4.37%) in the stalk in December. Fibre was significantly P < 0.05) different in all plant parts in the two sampling times and followed the order 10.17% < 18.09% < 19.34% < 28.13% < 32.12% < 32.4 % for stalk in December, leaves in December, leaves in October., seed in October., seed in December, and stalk in Oct. respectively. Ether extract, which ranged from 1.27% to 1.97%, was significantly (p < 0.05) different among all plant parts in the two sampling periods thus in October and December. Nitrogen free extract making the highest percentage (35.86% to 70.97%) in the plant under investigation were significantly (P < 0.05) different among all the leaves, stalk and seed.

As illustrated in figure 2, ash levels though not significantly (P > 0.05) different among the plant parts, were high in the leaves and low in the seeds of *Thalia dealbata.* Protein was significantly (P <

using Duncan's multiple range test.

stalk. Fibre was significantly (P < 0.05) higher in the seed and lowest in the leaves but not significantly different from that in the stalk. Ether extract was in the following order 1.88% in the leaves, 1.77% in the seed and 1.46% in the stalk. Nitrogen free extract was highest in the stalk, followed closely by leaves and significantly (P < 0.05) different from the seed.

Mineral compositions of *Thalia dealbata*

Thalia dealbata is rich in minerals (Table 1) in the respective plant parts. In October, the test plant is richer in calcium in the leaves (2.174 % ± 0.032) followed by the seeds (2.049 ± 0.013) and in the stalk (1.989 ± 0.013). Iron levels were higher in the stalk (0.651 ± 0.016), followed by the leaves (0.108 ± 0.004) and in the seeds (0.094 ± 0.007) in December. Potassium (3.099 ± 0.043 and 3.008 ± 0.004) and sodium (1.957 ± 0.012 and 2.047 ± 0.064) levels are higher in the stalk and lower in the leaves and seed in both months thus October and December respectively. Copper, zinc and phosphorus were significantly (P < 0.05) different among the plant parts and lower compared to that of calcium, potassium and sodium.

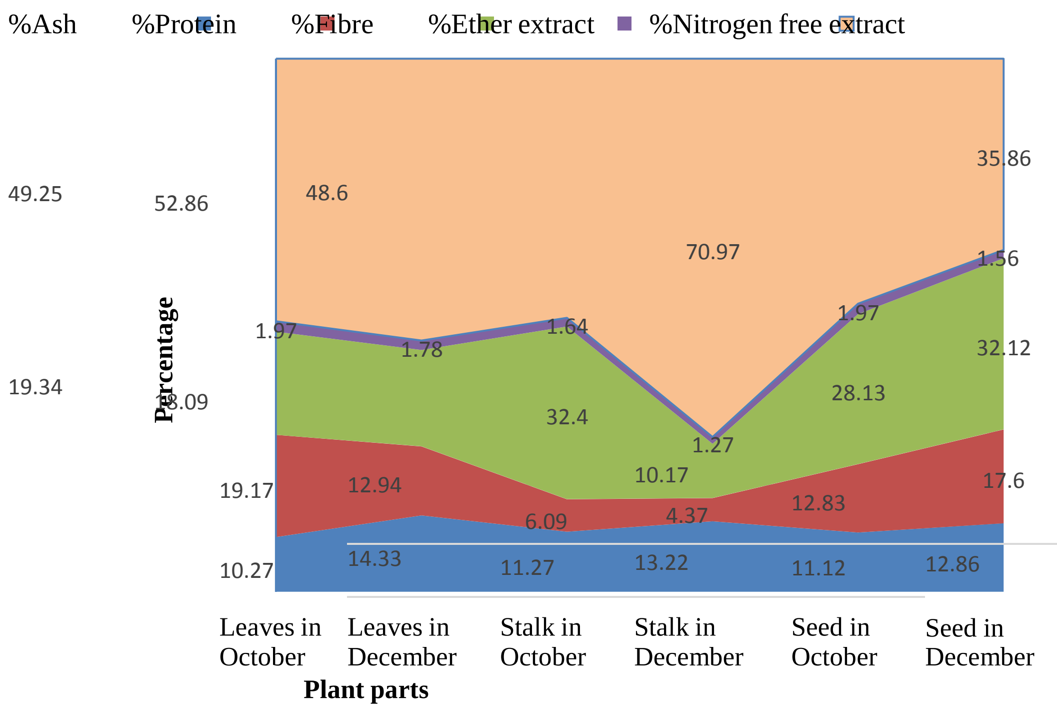


Figure 1: Nutrient composition of *Thalia dealbata* in October and December, 2013

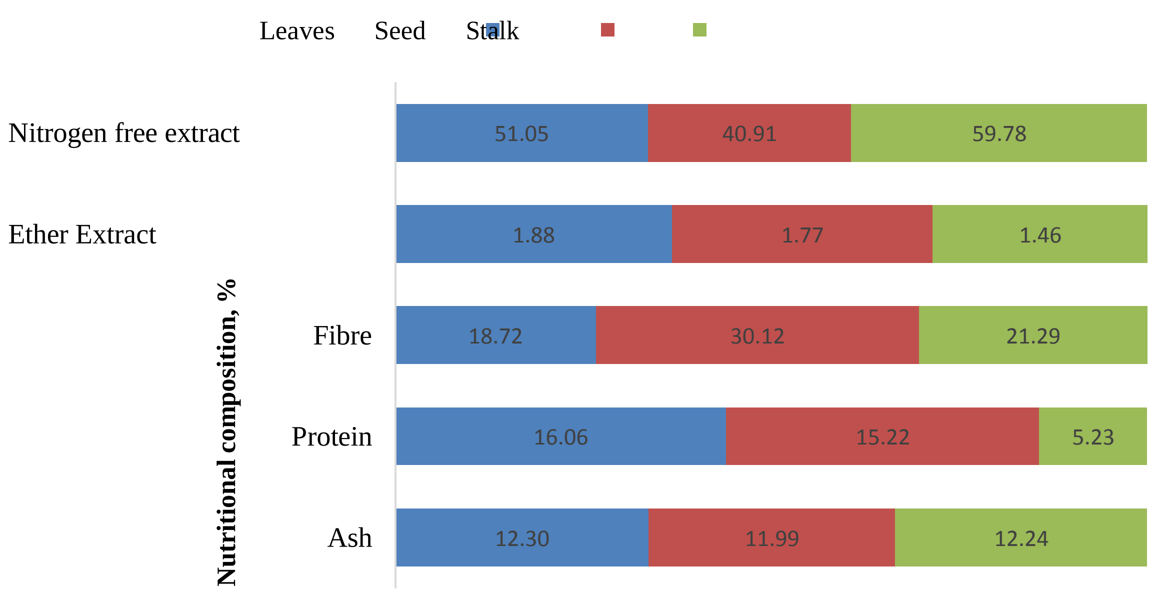
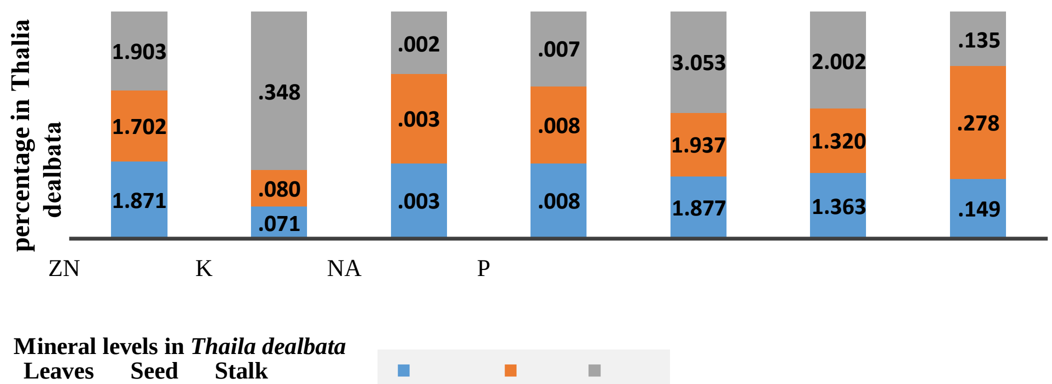


Figure 2: Mean nutritional composition of *Thalia dealbata*

Table 1: Mean minerals composition of *Thalia dealbata* in October and December, 2013

Mineral %	Leaves		Stalk		Seeds	
	Leaves in Oct.	Leaves in Dec.	Stalk in Oct.	Stalk in Dec.	Seeds in Oct.	Seeds in Dec.
Calcium	$2.174^{a} \pm 0.032$	$1.567^{d} \pm 0.032$	$1.989^{b} \pm 0.013$	$1.817^{c} \pm 0.006$	$2.049^{b} \pm 0.013$	$1.356^{e} \pm 0.028$
Iron	$0.034^{d} \pm 0.001$	$0.108^{b} \pm 0.004$	$0.044^{cd} \pm 0.003$	$0.651^{a} \pm 0.016$	$0.066^{c} \pm 0.003$	$0.094^{b} \pm 0.007$
Copper	$0.003^{b} \pm 0.000$	$0.002^{c} \pm 0.000$	$0.002^{c} \pm 0.000$	$0.002^{c} \pm 0.000$	$0.004^{a} \pm 0.000$	$0.003^{b} \pm 0.000$
Zinc	$0.010^{a} \pm 0.000$	$0.005^{e} \pm 0.000$	$0.007^{c} \pm 0.000$	$0.008^{b} \pm 0.000$	$0.006^{d} \pm 0.000$	$0.010^{a} \pm 0.000$
Potassium	$2.220^{d} \pm 0.007$	$1.535^{e} \pm 0.018$	$3.099^{a} \pm 0.043$	$3.008^{b} \pm 0.004$	$2.448^{c} \pm 0.025$	$1.427^{f} \pm 0.038$
Sodium	$1.374^{b} \pm 0.008$	$1.352^{c} \pm 0.022$	$1.957^{a} \pm 0.012$	$2.047^{a} \pm 0.064$	$1.469^{b} \pm 0.032$	$1.170^{d} \pm 0.042$
Phosphorus	$0.172^{c} \pm 0.005$	$0.126^{cd} \pm 0.002$	$0.178^{b} \pm 0.003$	$0.091^{d} \pm 0.034$	$0.224^{b} \pm 0.002$	$0.332^{a} \pm 0.019$

Means with similar superscript alphabets are not significantly different (P > 0.05)



CA FE CU ZN K NA P

Figure 3: Mean nutritional composition of *Thalia dealbata*

Calcium (Ca) was not significantly ($P > 0.05$) different among the plant parts investigated, Iron (Fe) ranged from 1.702 % in the seed to 1.903 in the stalk, Copper (Cu) was significantly ($P < 0.05$) different in all plant parts. There was no significant ($p > 0.05$) difference in the levels of zinc (Zn) in *Thalia dealbata.* Potassium (K) was highest (3.053) in the stalk and significantly different ($P < 0.05$) from that of the seeds (1.937) and the leaves (1.877). Sodium (Na) levels in *Thalia dealbata* was 2.002 > 1.363 > 1.320 in the stalk, leaves and seed respectively. Phosphorus was least in the stalk (0.135) and greatest in the seeds (0.278).

DICUSSIONS

The results from this study have shown that the time and part of the plant, *Thalia dealbata* harvested will result in differences in ash contents. This explains why there were significant difference in ash contents among the various plant parts and the sampling time (Figure 1). However, the level of ash, 11.99 % to 12.30% (Figure 2) as recorded in this study is indicative that, *Thalia dealbata* is a rich source of minerals (Table 1). Ash levels in *Thalia dealbata* as recorded in this study are higher than those reported for emergent plant such as; *Typha latifolia, Polygonum barbatum and Phragmites karka* as 9.5%, 8.0% and 9.4% respectively and lower than those reported for *Hyrdophila spinora* and *Hyrocotyle asiatica* as 18.3% and 17.9% respectively by Bararjee and Matai (1990). The ash levels of *Thalia dealbata* are similar to *Marsilea quadrifolia* (7.5% to 15.8%) but higher than *Enhydra fluctuans* (13.7% to 18.3 %) as reported by Dewanji *et al.* (1993). Although all the above mentioned plants and as in the present investigation are all emergent macrophytes, possible reasons for the variations in ash contents can be attributed to differences in plant families, soil type and media in which they are growing (Kalita *et al.*, 2006).

Crude protein (CP) content for *Thalia dealbata* varied widely between the two sampling times, thus October and December. With higher values (Figure 1) recorded in the leaves and seeds in the two months clearly suggest that for *Thalia dealbata*, protein is greatly stored in these parts of the plants. These parts of the plant should be explored for use as protein supplement feed. However, the range of values (5.23% to 16.06%) for CP as reported in this study is lower than those reported by Dewanji *et al.* (1993) for *Enhydra fluctuans* thus 25.3% in February to 32.6% in April while *Marsilea quadrifolia* had a minimum protein content of 24.5% in June and a maximum of 36.2% in September. The differences in CP could be explained by Boyd and Blackburn (1970) cited in Dewanji *et al.* (1993) that site and state of maturity could account for such variations. In a report by Kalita *et al.* (2006) variation in CP in aquatic plants can be attributed to difference pertaining to the different species of plants and the effects of anthropogenic activities within the catchments of the water body.

The leaves and stalks of *Thalia dealbata* have lower fibre levels than in the seeds. In figure 1, the lower levels of crude fibre recorded in the stalk in December could be due to chance. Animals such as monogastrics who would readily accept *Thalia dealbata* as feed should be fed with the leaves and stalks because of the lower fibre levels in them. On the other hand, ruminants capable of digesting feed with higher fibre contents could be fed rations prepared using the seeds of *Thalia dealbata* of course if acceptable, nevertheless ruminants could be fed rations equally prepared using the whole plant or any part.

Bararjee and Matai (1990) explained that fibre levels in plants could be lower if harvested in the green and lustrous state. This suggests that if the target animal is a monogastric to be fed with *Thalia dealbata,* it would be best to harvest the plant at a time when they are still young and succulent, preferably in October or earlier. This is because as the plant ages (becomes matured), the fibre built up increases. This corroborates Akmal *et al.* (2014) that crude fibre level increases in plants with maturity.

Ether extract values of *Thalia dealbata* (water canna) in figure 2, ranged from 1.46% to 1.88%. These values are slightly higher than those recorded for emergent plants such as *Ludwigia peploides* (water primrose), as 0.12% to 0.21% and lower than those recorded for *Phragmites australis* (Phragmites) as 2.99 – 5.4 % and *Eichhornia crassipes* (water hyacinth) as 1.16 to 4.01% (Akmal *et al.,* 2014). Variation in the ether extract contents may be attributed to differences in species and geographic locations.

Nitrogen free extract (NFE) for *Thalia dealbata* ranged from 40.21 % to 59.78%. The seed seems to be lower in NFE than in the stack and in the leaves because there was a significant difference in the means. Generally, the higher NFE contents (Figure 2) of the test plant is indicative that it is an energy rich plant. However NFE of the plant under investigation is higher compared to other aquatic plants (green roughages) and cereals such as maize as indicated by Bararjee and Matai (1990). This means that *Thalia dealbata* is a much richer source of energy.

Minerals serve as both intra and extracellular components of animals. They are required for normal life processes such as skeletal formation, maintenance of colloidal systems, and regulation of acid - base equilibrium and for biologically important compounds such as hormones and enzymes and all animals, including fish, need these inorganic elements. Mineral deficiencies can cause biochemical, structural and functional pathologies which depend on several factors, including the duration and degree of mineral deprivation (Davis and Galtin 1996; Watanabe *et al.,* 1997).

Rations deficient in calcium and phosphorus can lead to serious fertility problems whereas those deficient in sodium can results in retarded growth (Bararjee and Matai 1990). As shown in Table 1, calcium, potassium, sodium and phosphorus were the minerals scoring very high percentages among other minerals investigated. In figure 3, calcium (Ca), potassium (K) and sodium (Na) levels in *Thalia dealbata* ranging from 1.702% to 1.903%; 1.877% to 3.053%; 1.320 to 2.002% respectively compare favourably to all those of the emergent plants, reported by Bararjee and Matai (1990) where, Ca ranged from 0.28% to 1.17%, K ranged from 0.95% to 4.83% and Na ranged from 0.31% to 1.39%.

Nutritive value of plants often varies largely due to variation in nutrient concentration of the media in which they grow. Khan *et al.* (2002) reported that, *Azolla pinnata* and *Eichhornia crassipes*, are appreciably high in Ca and P contents. Calcium levels in *Thalia dealbata* in this study (Table 1; Figure 3) were slightly lower than those reported for *Azolla pinanata*, 15.3 g/kg = 1.53% and *Eichhorinia crassipes* 18.0 g/kg to 19.5 g/kg = 1.8 % to 1.95%.

The possible causes of mineral variation in plants emanate from factors such as soil, climate, species and stage of maturity (Spears, 1994; Gijzen and Khondker, 1997; Sultana, 1998; cited in Khan *et al.*, 2002). Phosphorus in Thalia dealbata , ranged 0.135 % to 0.278%, was lower than the plants reported by Khan *et al.* (2002), ranged from 0.73% to 1.7%.

Iron has an active part in oxidation/reduction reactions and electron transport associated with cellular respiration. The major factors influencing iron absorption are the proportion of organic and inorganic components of the diet, the amount ingested and the conditions of the digestive tract. Feeds of animal origin such as fish meal and meat meal are rich sources of iron, containing about 400-800 mg/kg (0.04 - 0.08 %) Oil seeds contain 100-200 mg/kg (0.01 – 0.02%) while cereals contain 30-60 mg/kg (0.003 – 0.006%) (Watanabe *et al.*, 1997). In figure 3, the stalks of *Thalia dealbata* are a richer source of iron than that of fish meal, meat meal and cereals which are expensive and highly competed for (Abarike *et al.,* 2012).

According to Watanabe *et al.* (1997) copper (cu) is important for animals as it is involved in the activity of enzymes such as cytochrome oxidase, superoxide dismutase, lysyl oxidase, dopamine hydroxylase and tyrosinase. Higher levels of copper results in depressed growth. The optimal level of copper in diet as determined for several fish ranges from 3 to 5 mg/kg (0.0003 – 0.0005%). In the present study (Figure 3), copper levels in *Thalia dealbata* are higher (0.002 to 0.003%).

Zinc is an important trace element in fish nutrition as it is involved in various metabolic pathways. It serves as a specific co-factor of several enzymes. Zinc and copper have antagonistic behaviour because of the similar nature of the valence shell hybrids. Therefore they compete for binding sites on proteins responsible for mineral absorption and/or synthesis of metalloenzymes (Watanabe *et al.*, 1997). This attempts to explain the higher levels of Zinc in *Thalia dealbata* (Figure 3), however there is the need to investigate more to ascertain the interaction between zinc and copper in aquatic plants to confirm any antagonism.

CONCLUSION AND RECOMMENDATION

In *Thalia dealbata*, ash content was found to be high in the stalks and the leaves, crude protein was high in the leaves and the seeds whilest fibre content was high in the stalk and the seeds as well, nitrogen free extract was found to be high in the stalks. *Thalia dealbata* is a rich source of macrominerals i.e. Ca, Na, P, and K but with higher levels of Na and K and trace minerals i.e. Cu, Fe and Zn.

Exploitation of the nutrient rich aquatic plant *Thalia dealbata* for preparation of feed for livestock including fish would be a useful step in increasing its utilization. However, it would be important to further investigate its digestibility, acceptability and the presence of anti-nutritional factors on potential animals to ascertain its utilization for incorporation in the production of animal feed.

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