AGRICULTURE AND BIOLOGY JOURNAL OF NORTH AMERICA
ISSN Print: 2151-7517, ISSN Online: 2151-7525, doi:10.5251/abjna.2014.5.1.1.9

Potential of Shea leaves as feed for fingerlings of *Oreochromis niloticus* in earthen ponds

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ABSTRACT

A 5 week study on the performance and economic profitability of *Oreochromis niloticus* when fed on the leaves of Shea tree was carried out in earthen ponds. *Oreochromis niloticus* of average weight 7.74 ± 0.13 g were stocked at 5 per m^3 in triplicate groups in out-door hapas. Fish were fed three times daily at 30 % of their body weight. Upon termination of the experiment, fish fed on the control feed (24.59 g ±4.11) had significantly higher weights than those fed with Shea leaves (12.05 g ± 0.98). Specific growth rate and feed conversion ratio were higher and significantly different for fish fed with control feed than fish fed with the Shea leaves. Water quality parameters such as temperature, pH, and conductivity were not adversely affected by the feed used. The cost of feed per kilogram was higher for fish fed with control feed (GH¢ 2.50) than fish fed with Shea leaves (GH¢ 1.78). Consequently, lower feed cost from Shea leaves, resulted in lower incidence cost and higher profit index and vice versa for the control. The higher energy levels in Shea leaves makes it suitable for it to be used as a cheap source of energy and an economical feed.

Key words: Feed utilization, Feed production, Shea leaves, *Oreochromis niloticus,* profitability, growth performance

INTRODUCTION

Fish is nutritious, serving as a good source of vitamins such as A, B, and D, minerals such as; calcium, phosphorus, iron, copper, selenium and iodine as well as fatty acids such as linoleic and linolenic acids. The increasing demand for fish partly to blame as a result of rapid population growth has led to the decline of fish from the wild. With prospects for higher landings from capture fisheries being limited due to dwindling stocks, a result of over exploitation, the net deficit is expected to worsen over time. According to FAO (2012), fish needs of Ghanaians can be augmented through fish farming. There is therefore the need to intensify fish farming.

Tilapia is the second largest farmed fish group in the world next to carp (FAO, 2012). The expansion of *Oreochromis niloticus* farming is due to its ability to feed on a wide variety of food items and tolerance to a wide range of environmental conditions including factors such as pH, temperature, nitrogen wastes, low dissolved oxygen concentration and its easiness for handling practices (Noor *et al.,* 2010, as cited in Workagegn, 2012). In addition, *Oreochromis niloticus* is a fast growing species and of high economic value.

The most pressing problem faced by fish farmers in developing countries, as Ghana, is the high cost of conventional fish feed (Abarike *et al.,* 2012; 2013). As a result, many farmers though may be interested in rearing fish are unable to venture into the business because of they cannot afford the cost of feed. This situation calls for the unending need to evaluate novel feed sources to substitute completely or partially conventional feedstuff. The need to find good quality, cheaper and readily available alternative feedstuff provides opportunities for innovation and novelty.

The Shea tree (*Vitellaria paradoxa*), a tropical plant, in recent times has gained popularity because of its great usefulness. Abidemi *et al.* (2009) reported that the leaves of the Shea tree are a rich source of

protein (containing four essential amino acid namely; valine, leucine, phenyala- nine and arginine) minerals and carbohydrates with low fat content that falls within the acceptable range for leafy vegetables. Although analysis also revealed that the leaf contains oxalate, tannin and phytate which are anti-nutritional factors, these have not being found to pose any adverse effects.

In Northern Ghana, the Shea tree occupies about 80% of the range and arable lands as land cover trees. As a result, diverse usefulness of the fruits, nuts and branches over the years of the tree has been discovered. Although, the leaves have been discovered to have medicinal and nutritional properties (Abidemi *et al.,* 2009), not great value have been placed on it perhaps because of inadequate documented information. In a few instances, one would see animals such as goats, sheep and cattle browsing on the leaves. Although the Shea tree is resistant (round and conspicuously thick and corky bark) to the effects of wild fire (Abdullahi *et al.,* 2012) it may contribute to the escalation of wild fire as its deciduous nature (leaf fall) adds flammable material to the land it occupies.

In an attempt to reduce the accumulation of combustible materials, research into other usefulness of the leaves of the Shea tree (LST) such as broadening the scope of feedstuff for the fish feed production is needed. This study was carried out to evaluate the growth and economic performance of *Oreochromis niloticus* using the dry leaves of the Shea tree.

MATERIALS AND METHODS

Study area:

The study was carried out in earthen ponds near the Tono reservoir in the Kassena-Nankana West District of Upper East Region located in geographic coordinates 10″ 51′ 21.47″ N, 1″ 07′04.79″ W.

Source of material:

Dry and falling leaves of the Shea tree (LST) were gathered from the UDS Nyankpala campus and further sun-dried to facilitate the removal of sand particles and mouldy leaves. The leaves were then pulverized and stored in an airtight bag. A commercially prepared feed to serve as a control feed was purchased from a market in Ashman and transported alongside with the feed from the LST to the experimental site.

Chemical/proximate analysis

The proximate analyses were carried out in accordance with the procedures on AOAC (1990) cited in Abarike *et al.* (2012) with a little modification.

Determination of percentage moisture

A clean, dry aluminium pan (W grams) was weighed. About 5 g of the sample in the pan were weighed accurately (W1), placed in a hot air oven and kept at 135° C for 2 hours. After the 2 hours period, the pan was removed from the oven and placed inside a desiccator and the lid to the desiccator kept little bit open sidewise. Once the pan was cooled down, the dried sample was weighed accurately and the loss of weight recorded (W2). Percentage of moisture content was then calculated as follows:

$$\text{Percentage of moisture content} = \frac{(W1-W2)}{(W1-W)} * 100$$

Determination of percentage crude fibre (CF)

An amount of fat free sample was weighed into a 500 ml beaker (Tall Form). 200 ml 1.25% H_2SO_4 was added to the sample and heated gently on a hot plate. It was then boiled for exactly30 minutes. When the solution was boiled vigorously, few drops of Octanol were added to avoid frothing. The same was filtered in a filter flask connected to a filter pump/vacuum pump through a muslin cloth held over a Buckner funnel. Residue was washed on cloth with hot water till free from acid and then tested with litmus paper. The material was transferred from muslin cloth back to the same beaker. 200 ml 1.25% of NaOH was added and boiled exactly for 30 minutes. Frothing was avoided by using Octanol. It was then filtered through the same muslin cloth on the filter flask connected to a filter pump. It was then washed with hot water till free from alkaline and tested with litmus paper. The residue was transferred to a clean dry silica crucible. The residue was dried at 105ºC in a hot air oven, cool and weighed. Then, the dried residue was incinerated in a muffle at 600ºC for 30 minutes, cooled and weighed. Percentage crude fibre was calculated as follows:

$$\% \text{ crude fibre} = \frac{\text{wt of contents before ashing} - \text{wt of content after ashing}}{\text{wt of sample}} * 100$$

Where **wt** = weight

Determination of percentage ash: About 5 g of the sample was taken in a silica basin/crucible and weighed accurately. The 3crucible containing the sample was placed on the heating coil kept inside a fume cup-board. While heating, the substance in the silica crucible was not allowed to catch fire. The material was not stirred or disturbed while charring, as this will result in a loss of the substance. The material was allowed to burn progressively from edge to edge. When the entire mass has charred and no more fumes evolved, the silica basin was transferred to an electric muffle furnace at 600ºC ± 50ºC for 30 minutes, when the material turns greyish white and no trace of carbon particles remained, the crucible from the muffle was removed and cooled on an abestes sheet to room temperature. Finally cooled in desiccators and weighed. Weighing was recorded till consecutive weights agree to less than 1ml difference.

Calculation: % of total ash = $\frac{\text{Wt.of basin+ash}-\text{Wt.empty basin}}{\text{Wt.sample taken}} * 100$

Where: **wt** = weight

Determinations of percentage (%) crude lipid (CL), ether extract (EE) and fat:

Extraction thimbles are available which are made of fat-free filter paper. The empty thimble (B) was weighed. About 5g of moisture free ground sample taken into the thimble and re-weighed (A). Cotton plugs was put in the thimble over the sample so that while extraction no sample would come out and dry it in the oven for 15min. at110ºC. A clean dry receiving flask of 150 ml cap was taken and weighed accurately (Y). The thimble was introduced with sample into the soxhlet. The top of the thimble was well below the level of the siphon bend and put the flask in the heating mantle and fill it with 100 ml. petroleum ether. The soxhlet was assembled with the flask. The temperature in the heating mantle was between 60-80ºC Cold water was circulated through the condensers otherwise all ether would be evaporated out. Extraction was done continuously for 8 hours. After the extraction was over, the thimble was removed with the sample inside from the soxhlet. The apparatus assembled again and re-heated to recover all the ether from the receiving flask. The flask now contains only the crude fat. The receiving flask was disconnected and the outside of the flask wiped thoroughly with a clean dry cloth to remove the film of moisture, dust and dried in a hot air oven at 100 ºC for 1 hour. The leftover ether was evaporated out. But the crude fat was checked to make sure that it does not get charred. Cool the flask in desiccators and weigh it (X)

Calculation: % of the ether extract = $\frac{Wt.of\ flask-empty\ flask\ (X-Y)+extract(X-Y)}{Wt.of\ sample\ (A-B)} * 100$

Where: **wt** = weight

Determination of percentage crude protein (CP)

About 1.0 g of the ground sample was weighed on a piece of glazed butter paper and transferred into the Kjeldhal flask. Approximately 10 g of anhydrous sodium sulphate was added and 2g of copper sulphate in (1:5) ratio. 400-cc of conc. H_2SO_4 was poured into the flask along the neck of the flask so as to wash down any particle of sample sticking to the sides. Few drops of glass beads were added into the flask to prevent spurting while boiling. The flask was put on the heating coil to boil the content of the flask till it becomes clear solution. This boiling was done for a minimum of 3 hours. At the end of boiling, the flask was removed from the heater and allowed to cool down to room temperature. A blank experiment was conducted (using all the reagents used in the actual experiment but without the sample) to make a correction for nitrogen present in the reagents used. Anhydrous sodium sulphate was added to raise the boiling point of the content for effective digestion of the matter and $CuSO_4$ act as a catalyst. Selenium was added for clarification of the digesting liquid content in the flask. The digested solution was transferred to a 250 ml volumetric flask and made up the volume with distilled water. The flask was shocked so that the solution would be homogeneous. Once the solution attained a constant temperature, the volume was made up again with water as required. 10 ml of Boric acid solution was taken into a 100 ml conical flask and fixed at the receiving end of the silver condenser. 10 ml of this solution (sample) was taken with a volumetric pipette and pour into distillation unit, 10 ml of 40% NaOH solution added and washed the receiving separating funnel (S) with water. This solution went directly into Kjehhal vacuum mantle. The top of the funnel was closed and filled partly with water. The steam was allowed to agitate above the mixture in the vacuum mantle. All the steam outlet was closed otherwise steam would go waste (except the one used for agitating the sample solution in the mantle). As a result, ammonia gas was liberated which after coming through the silver, condenser burnt the colour of the boric acid solution from blue-violet to green colour. This process was continued till 30-40 ml of distillate was collected. The flask was removed after washing the tip of the condenser with a little water. The distillate was titrated with N/10 or 0.1 (N) H_2SO_4 solutions until the green colour change to blue-violet.

Once the conical flask containing the distillate was taken out, another conical flask (C) was put there containing partly filled distilled water. Then, the knob was turned open for steam out flow and close the inflow knob to create a vacuum inside the condenser. Within few seconds, the solution leftover in vacuum mantle was sucked out and immediately the whole path was clean by fresh distilled water kept in the conical flask (C). The knob was opened of the separating funnel (S) to pass on the already stored water to the vacuum mantle. Water was put again in the conical flask (C). The steam was allowed to agitate the water present in the mantle. Process was repeated 3 times at least.

Calculation: % Crude protein = $\frac{V*O.0014*6.25*100*D}{W*A}$

Where:
V = Volume of N/10 H2SO4 used for back titration
0.0014 N2 factor for l ml. N/10 H2SO4
6.25 Protein factor of N2
D = Volume of Aliquot (Digested) (250 ml)
W = Wt. of sample
A = Aliquot taken to distillation (10 ml.)
100 = for percentage.

Experimental system and fish:

The experiment consisted of two treatments (i.e. one of which was the control and the other feed prepared using Shea leaves) each in triplicates groups. Mosquito nets of dimension (1 m x 1 m x 3 m) were sown in cuboid shapes called hapas and immersed in water such that $^3/_4$ of the nets were submerged in water and the remaining ¼ above the water to prevent the fish from escaping. The nets were fastened to Neem poles (i.e. driven into bed of a pond of about 2 m deep) by means of nylon ropes. Each of the hapas for both treatments were stocked at 5 per m^3 with mixed-sex fingerlings of *Oreochromis niloticus* of average weight 7.74 ± 0.13 g. Replicates for each treatment were randomly assigned to stocked hapas to reduce biasness.

Feeding regime

Fishes were fed three times daily at 0800, 1300 and 1800 GMT and at 30% body weight. After every week, all the fishes from each of the replicates were collected and weighed. Based on the weight measurement, feed was adjusted accordingly. The total quantity of feed used was also recorded.

Water quality parameters

Temperature, conductivity and pH were measured using HANNA pH meter (model HI 83141).This was done by dipping the electrode of the meter to a depth of 30 cm along each respective hapa for 20-30 seconds. The respective values for temperature and displayed on the screen were carefully recorded in a field note book. Similarly, turbidity was measured using a field turbid meter (LaMotte 2020). Water sample from each hapa was collected using a 3 mm glass container and sealed. The sample was fixed in the turbid meter, closed and allowed to analyze. The values displayed on the screen were recorded. This was done for all replicates for each treatment.

Biological parameters measured

Parameters were calculated in accordance to Abarike *et al.* (2012)

1. Mean Weight Gain (MWG): This was computed as: MWG = Mean final weight – mean initial weight
2. Specific Growth Rate (SGR): This was computed as: SGR = $\frac{Lnwt-Lnwo}{t}*100$

Where **wt** is the final weight of fish at the end of the experiment, **w0** is the initial weight of the fish and **t** is the cultured period in days.

3. Feed Conversion Ratio (FCR) = $\frac{\text{Total dry feed fed}}{\text{Total weight gain}}$
4. Feed Conversion Efficiency (FCE) = $\frac{\text{Total weight gained}}{\text{Total dry feed fed}}*100$
5. Survival Rate (SR) as

$$\%SR=\frac{\text{Initial number of fish stocked}-\text{mortality}}{\text{Initial number of fish stocked}}*100$$

Economic parameters calculated

Parameters were calculated in accordance to Abarike *et al.* (2012)

1. Incident Cost(IC) = $\frac{\text{Cost of feed}}{\text{Weight of fish produced}}$
2. Profit Index (PI) = $\frac{\text{Weight or value of fish produced}}{\text{Cost of feed}}$

Data analysis

The chemical parameter, biological parameters and water quality parameters were analyzed using statistical package for social sciences (SPSS) by computing means, standard error of means and analysis of variance (ANOVA). The results were further used to draw bar and line graphs using Microsoft excel. T-test was used in economic analysis of test feed to test for statistical significance.

RESULTS

Chemical composition of feed

Among the two treatments used in this experiment, in figure 1, the crude protein, ash and moisture levels were significantly (P < 0.05) different and higher in the control feed (commercial feed) than the feed prepared using Shea leaves. Shea leaves had higher levels of crude fibre, crude lipids, nitrogen free extract and significantly different (P < 0.00) from those of the control feed.

Growth performance

As shown in Table 1, the initial average weight (IAW) of the fish used in this experiment were the same (P > 0.05) for both treatments, thus with 7.74 g ± 0.13 and 7.67 g ± 0.58 for leaves of the Shea tree (LST)and commercial feed treatments respectively. At the end of the experiment, fish fed the control feed (24.59 g ±4.11) had significantly (P < 0.05) higher weights than those fed with LST (12.05 g ± 0.98). Survival rate (SR) was highest in fish fed with the control feed and significantly (P < 0.05) different from fish fed with the LST. Specific growth rate (SGR), feed conversion ratio (FCR) and feed conversion efficiency (FCE) were higher and significantly (P < 0.05) different for fish fed the commercial feed that for fish feed with the Shea leaves.

Table 1: Growth parameters for fish feed Shea leaves and commercial feed

Growth parameters	Feed types		P –value	Significance
	Shea leaves	Commercial feed		
Initial average weight (g)	7.74 ± 0.13	7.67 ± 0.58	**0.91**	**NS**
Final average weight (g)	12.05 ± 0.98	24.59 ± 4.11	0.04	S
Survival rate (%)	51.11 ± 0.58	73.33 ± 1.15	0.00	S
Specific growth rate	0.7067 ± 0.01	1.26 ± 0.02	0.00	S
Feed conversion ratio	1.57 ± 0.01	1.16 ± 0.02	0.00	S
Feed conversion efficiency (%)	63.81 ± 1.15	86.54 ± 1.15	0.00	S

Where: **NS** = not significant different and **S** = significantly different

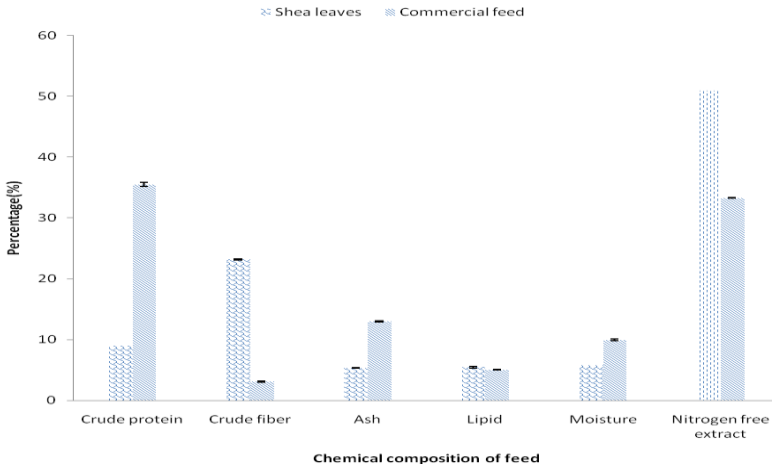

Fig 1: Chemical compositional analysis of feeds used for trial experiment

P-value generated using ANOVA

In figure 2, fish in both treatments started with the same average weights. With the exception of the initial week (W0) and week 4 (W4) where fish samples in both treatments had overlapping standard error bars, the fish fed the control feed attained significantly (P < 0.05) higher average weights than the fish fed Shea leaves throughout the experimental period.

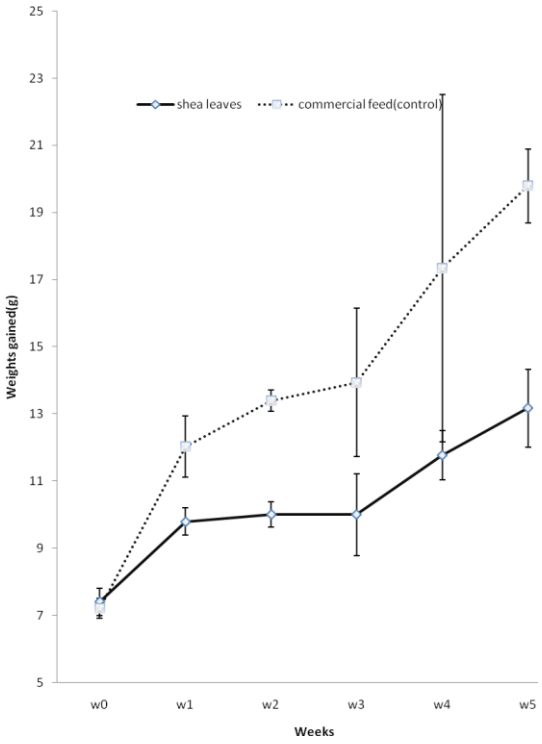

Fig 2: Weekly average weights

Economic analysis

The cost of feed was calculated using market prices, with the assumption that all other operating costs remained constant (e.g. cost of constructing hapa, cost of transportation, cost of fingerlings and labour). In Table 2, significantly ($P < 0.05$), higher feed was administered for fish fed on commercial feed than fish fed with Shea leaves. The cost of feed per kilogram was higher and significantly ($P < 0.05$) different, for fish fedon the control feed than fish fed with LST. The incidence cost of feed prepared using Shea leaves was significantly ($P < 0.05$), lower than the control feed and corresponding with a significantly ($P < 0.05$), higher profit index for fish fed on Shea leaves and lower higher profit index for fish fed on the control feed.

Table 2: Economic analysis of feeds

Parameter	Shea leaves	Commercial feed	p-value	Significance
Feed used (kg)	2.56 ± 0.38	3.41 ± 0.20	0.34	S
Cost per kilograms (GH¢)	1.78 ± 0.00	2.5 ± 0.00	0.00	S
Incident cost (GH¢)	1.33 ± 0.02	1.70 ± 0.03	0.01	S
Profit index (GH¢)	0.75 ± 0.03	0.58 ± 0.02	0.40	S

Where S= means significant difference, T-test used to generate p-values

Water quality parameters measured

Throughout the experimental period, temperature in both treatments range between 20.30 to 32.30^{o}C and no significant ($P > 0.05$) difference among the treatments. Turbidity ranged from 14.30 to 31.70 NTU with no significant ($P > 0.05$) difference among treatments. Conductivity ranged from 16.30 to 81.70 µ/s and similar between treatments. pH ranged

between 6.30 to 8.30 and similar statistically among the treatments.

DISCUSSION

Chemical composition of feed stuff

According to Bahnassary (2009), the optimal crude protein in the diets of fingerling fish should range from 30-36%. Crude protein (CP) levels below and above the optimal bay may not produce the desired results and may be wasteful. In this study, the crude protein in the control feed of 35.51% was ideal for the test fish. Though the CP level of the leaves of the shea tree(LST) of 8.94% was below the optimal requirements for the culture of *Oreochromis niloticus,* growth was enhanced as there was a significant weight gain. This means that Shea leaves has the potential to improve the growth of fingerlings of *Oreochromis niloticus.* That notwithstanding, the leaves need to be combined with other feed items for example pito mash which has higher CP (Abarike *et al.,* 2012; 2013).

The crude fibre (CF) for the control (commercial feed) was 3% and that of the leaves of the Shea tree was 23.16%. Younger fishers can tolerate crude fibre levels in feed between the ranges 8-10%, and excess fibre in fish diets decreases digestibility and consequently contributes to water quality deterioration since fibre is excreted (Ali & Al-Asgall, 2001). Clearly the low fibre levels in the control meant the feed is excellently digested agreeing with Anderson*et al*. (1984) who reported that to attain maximum growth, crude fibre levels in tilapia diets should probably not exceed 5%. That of the fibre level in the leaves of the Shea tree exceeded the tolerable levels for the test fish. This perhaps might have impeded the ability of the test fish to utilize the feed prepared usingLST. However, given this high fibre levels in the Shea leaves, perhaps older/adult fish such as catfish, could be fed on with this diet since that have intestinal micros that can digest higher fibre levels (Stickney, 1979).

The amount of Ash in a feed gives an indication of the mineral content of the feed (Watanabe *et al.,* 1997). The limitation in this research was the inability to analyse the ash obtained after incinerating the test feed for the specific minerals present. However, with the significantly higher levels of ash from the control feed in simple terms may mean that the leaves of the shea tree are lower in minerals. Test fish however, did not show any symptoms suggesting mineral deficiencies.

The lipid levels were 5.6% and 5% for the LST and commercial feed respectively and both were within the acceptable range for the culture of *Oreochromis niloticus,* thistherefore corroborates the findings of Manjappa et al. (2002) who indicated that, lipid in the diets of fish should range between 5-12%.

Carbohydrates are cheaper sources of energy in diets. In a study by Raj (2008), the nitrogen-free extract (NFE) a measure of the carbohydrate level in diets. Gonzalez & Allan (2007) and Audu *et al.* (2008) reported optimal level in the diets of Tilapias to range between 17 – 42 %. The leaves of the Shea tree recorded significantly higher levels of energy thus NFE of 50.94% than in the control with NFE of 33.92%. This higher level of NFE in the leaves of Shea suggests that it could be more regarded as a carbohydrate feed than a protein feed.

Growth performance

With the same ($P > 0.05$) initial average weight (IAW) of test fish for both treatments,there were significant differences in average final weights (AFW), mean weight gain (MWG) and specific growth rate (SGR) among the treatments. Apparently, fish fed on the control diet had significantly ($P < 0.05$) higher AFW, MWG and SGR than recorded in fish fed with LST. Higher weight gains in fish fed on the control can be attributed to higher and utilizable protein (35.6% CP) levels in the feed. With the significant improvement in the weight gained by the fish fed LST is a good sign that LST has the potential to enhance the growth of *O. niloticus*. Though not promising, as that of the control, LST can be improved by combining it with other feed stuff as in the case of Abdelhamid &Solima (2012) who reported higher AFW and AWG for Tilapia when fed with diets prepared with about 2% inclusion of leaves of the guava and Camphar trees.

The feed conversion ratio (FCR) is defined as the amount of dry feed fed per unit live weight gain. It often serves as a measure of efficiency of the diet. The more suitable the diet for growth, the less food is required to produce a unit weight gain, i.e. a lower FCR. The FCR in this study was less and significantly different in the control diet compared to a higher FCR in the diet of LST. Glencross & Allan (2007) indicated that, utilization of diets increases as FCR becomes lower. Applying this to the results in this current study implies that the test fish were able to utilize the control diet than the LST diet. Higher FCR in test fish fed with LST could be attributed to inhibiting characteristics such as lower protein and higher fibre

levels of the LST diet. This corroborates the findings of Attipoe *et al.* (2009) that diets with higher crude protein and energy content would result in better growth than those of lower levels of protein and energy. Ali & Al-Asgall (2001) explicitly explained that when crude fibre in the diets of fish is above the optimal, feed utilization decreases.

Economic analysis

The fore of many fish nutritionist is to develop and promote the use of feed that has an excellent growth, readily available and economical. In Ghana not many people venture into intensive fish farming because they cannot afford the cost of the feed. This is one of the factors that necessitated studies conducted by Attipoe *et al.* (2009) and Abarike *et al*. (2012, 2013) just to mention a few. In this study, it was economical to feed *O. niloticus* with LST than the control, meaning it would be better to develop the LST than to depend on the control diet. This is because the incidence cost of feed prepared LST was significantly ($P < 0.05$), lower than that of the control feed and corresponding with a significantly ($P < 0.05$), higher profit index for fish fed on LST and lower higher profit index for fish fed on the control feed. Given the setting where the study was carried out (Navrongo in the Upper East Region), chances are that farmers may be encouraged to use the readily available resources diligently if better success stories can be realized from the use of LST. In comparison, Abarike *et al*. (2012, 2013) demonstrated that, with the use of non-conventional feed items in diet of *O. niloticus* were economically effective than with conventional feed.

Water quality parameters

Water quality parameters such as temperature, turbidity, conductivity and pH as shown in Table 3 were within the tolerable limits for the growth of *O. niloticus.* This conclusion is drawn from the findings of El-Sherif & El-Feky (2009) that Tilapias generally grow best in temperatures ranging from 21 ^{0}C to 32 ^{0}C. However, temperature values recorded in this research were below the recommended range as reported by Saber *et al.* (2004) that optimal temperature for growth ranged between 26-34°C. Conductivity recorded in this study did not differ significantly among the treatment. No observable effects were recorded in the test fish during the experimental period perhaps because the conductivity range of 16.30 to 81.70 µs/cm and were within the tolerable limits for tilapia. Growth rate decreases significantly at even intermediate turbidity levels of 50 NTU (Ardjosoediro & Ramnarine (2002). In the present study, the range of turbidity levels (Table 3) were far below the intermediate levels and did not pose any challenge to the growth and survival of the test fish as such can be said to be within the acceptable levels as found. The lethal effects of elevated pH are recognized as a potential factor contributing to the variable success of tilapia production. Test fish were not physically observed to be affected by the slightly alkaline water of pH of about 7.17± 0.22 for treatments with LST and 7.47 ± 0.21 for the control.

Table 3: Water quality parameters measure

Parameter	Shea leaves (mean ± standard error)	Commercial feed (mean ± standard error	P -value
Temperature	25.25 ± 1.59	24.25±1.74	0.68
Turbidity	22.13±2.52	22.98±2.49	0.84
Conductivity	33.95±6.02	35.88±9.42	0.87
pH	7.17±0.22	7.47±0.21	0.36

P-value generated using ANOVA.

CONCLUSION

Oreochromis niloticus can be fed with feed leaves of the Shea tree, however, in terms of growth performance test fish fed the control feed gave a better growth i.e. weight gain, feed conversion ratio and specific growth rate than fish fed Shea tree leaves. Test fish fed the Shea tree leaves diet yielded better economic returns than the control. Water quality parameters were observed to be within the acceptable range and were not adversely affected by the use of the test diets.

RECOMMENDATION

The potential for *Oreochromis niloticus* to be grown with diet prepared using leaves of the Shea tree is high. It is therefore recommended that further research should be done on Shea leaves by formulating it with other feed items and used as a trial

feed to feed the *Oreochromis niloticus*.

ACKNOWLEGMENTS

Our appreciation goes toMr. Atuna A. Richard a laboratory technician in the Spanish laboratory of the Faculty of Agriculture, University for Development Studies for assisting the research team in carrying out chemical analysis of the feed times. Our gratitude also goes to Mr. Joseph Ayamga the Director of Jospeb Fish Farms for given us the opportunity to use his fishponds as an experimental site for the study.

REFERENCES

Abarike, E.D., Attipoe F.Y.K. &Alhassan E.H. (2012)Effects of feeding fry of *Oreochromis niloticus* on different agro-industrial by-products.*International Journal of Fisheries and Aquaculture,*Vol. 4(8), pp. 178-185.

Abarike,E.D., Obodai, E.A. &Attipoe, F.Y.K. (2013) Growth and economic performance of fingerlings of*Oreochromis niloticus* fed on different non-conventional feeds in out-door hapas at Akosombo in Ghana. *African Journal of Agricultural Research,*Vol. 8(26), pp. 3384-3391

Abdullahi, I. N., Chuwang, P. Z. &Isah, A. D. (2012) Effect of biofertilizer application on growth of *Vitellariaparadoxa* seedlings. *Journal of Research in Environmental Science and Toxicology,* Vol. 1(11) pp. 294-297

Abidemi, T.A., Adebayo, O.J., Idowu. O. &Agbotoba, M.O. (2009) Nutrient content and anti-nutritional factors in shea butter (*Butryospermumparkii*) leaves . *African Journal of Biotechnology,* Vol. 8 (21), pp. 5888-5890

Ali, A. & Al-Asgall, N. A. (2001) Effect of feeding different carbohydrate to lipid ratios on the growth performance and body composition of Nile tilapia (*Oreochromis niloticus*) fingerlings. *Animal Research*, *50*, 91-100.

Anderson, J. A., A. J. Jackson, A. J. Matty& Capper B.S. (1984) Effect of dietary carbohydrate and fiber on the tilapia *Oreochromis niloticus* (L.). *Aquaculture* 37:303-314.

Ardjosoediro, I. &Ramnarine, I.W. (2002) The influence of turbidity on growth, feed conversion and survivorship of the Jamaica red tilapia strain. *Aquaculture, 212*, 159-165.

Attipoe, F.Y.K., Nelson F.K. &Abbran, E.K. (2009) Evaluation of three diets formulated from local agro-industrial by-products from production of *Oreochromis niloticus* in earthen ponds. *Ghana Journal of Agriculture Science,42*,185-191.

Audu, B.S., Adamu, K.M. &Binga, S.A. (2008) The effect of substituting fishmeal diets with varying quantities of ensiled parboiled Beniseed (*Sesamunindicum*) and raw African locust bean (*Parkiabiglobosa*) on the growth response and food utilization of the Nile tilapia, *Oreochromis niloticus*. *International Journal of Zoological Research,4*(1),42- 47.

Bahnassawy, M. (2009) Effects of dietary protein levels on growth performance and body composition of monosex Nile tilapia (*Oreochromis niloticus* L.) reared in fertilized tanks. *Pakistan Journal of Nutrition, 8* (5), 674-678.

El-SherifM.S.,& El-Feky A.M.I. (2009) Performance of Nile tilapia *(Oreochromis niloticus*) fingerlings. I. Effect of pH., *International Journal of Agriculture and Biology.* Vol (11) 297-300

Food and Agriculture Organization, FAO (2012) The state of the world fisheries and aquaculture part I: World review of fisheres and aquaculture, Rome

Glencross, B.D., Booth, M. & Allan, G.L. (2007) A feed is only as good as its ingredients. A review of ingredient evaluation strategies for aquaculture feeds. *Aquaculture Nutrition*, *13*, 17-34.

Gonzalez, C. & Allan, G. (2007)*Preparing farm-made fish feed*. RetrievedNovember 29th 2011 fromhttp://www.aquaculturewithoutfrontiers.org/wp-content/upload.

Grace S. (2012) Opportunities for Small Scale Suppliers within the Tilapia Value Chain in Ghana: a case study of fish farming in Achavanya. Master's Thesis, Institute of Social Studies, The Hague, Netherlands.

Manjappa, K., Keshavanath, P. &Gangadhara, B. (2002) Growth performance of common carp, *Cyprinuscarpio* fed varying lipid levels through low protein diet, with a note on carcass composition and digestive enzyme activity. *ActaIchthyologica Et Piscatoria*, *32*(2), 145-155.

Raj, A. J. A., Haniffa, M.A., Seetharaman, S. & Appelbaum, S. (2008)Utilization of various dietary carbohydrate levels by the freshwater Catfish, *Mystusmontanus* (Jerdon). *Turkish Journal of Fisheries and Aquatic Science,8*,31-35.

Saber A., El-Shafai, El-Gohary A.F., Fayza A., N., Peter Van Der Steen N., &Huub J.G. (2004) Chronic ammonia toxicity to duckweed-fed tilapia (*Oreochromis niloticus*) *Aquaculture* 232: 117-127

Stickney, R.R. (1979) *Principles of warmwateraquacutlure.* Texas: Wiley-Interscience Press, 361 pp.

Watanabe, T., Kiron, V. & Satoh, S. (1997) Trace mineral for fish nutrition. *Aquaculture, 151*,185-207.

Workagegn, K.B. (2012) Evaluation of Growth Performance, Feed Utilization Efficiency and Survival Rate of Juvenile Nile tilapia, *Oreochromis niloticus* (Linnaeus, 1758) Reared at Different Water Temperature, *International Journal of Aquaculture*, Vol.2 (9) 59-64