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Response of *Acacia sieberiana* containing diet on growth indices and food utilization efficacy of Tilapia *Oreochromis niloticus* fingerlings

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Abstract
This study and for the first time, focused on untapped indigenous wild savannah tree, *Acacia sieberiana* for its nutritional values and benefits may generated for fish aquaculture. The effect of dietary protein from *A. sieberiana* incorporated meal e.g. 10, 15 and 30% inclusions were evaluated in the Nile Tilapia *O. niloticus* fingerlings. Specimens were kept in twelves hapa nets with 500 L capacity installed in concrete tanks for 40 days and the values of growth rate, feeding efficiency and protein efficiency ratio of *O. niloticus* fingerlings (2.30 g) were examined. Every 10 days interval, sampling were conducted with individual weight measurements, and survival were recorded. Interestingly, the highest weight gain was obtained with treatment group fed with 10% *A. sieberiana* inclusion in the diet. The best feed conversion ratio (FCR), specific growth rate (SGR, % day^{-1}), percent weight gain (WG %) and feed efficiency rate (FER) were obtained with the fish fed 10% of *A. sieberiana* inclusion as well. The result of the growth indices on *O. niloticus* fingerlings shows a great effects among experimental groups, and the use of diet containing *A. sieberiana* meal e.g. 10% inclusion is appropriate for optimal growth and efficiency of feed utilization of *O. niloticus* fingerlings. The results obtained in this study may be due to the nutritional values that *A. sieberiana* possessed, where protein and mineral requirements are available in considerable amount.

Keywords: *acacia sieberiana*, tilapia fingerlings, growth indices, proximate composition

Introduction
Concentrated efforts in search of alternative sources of protein has grown due to dearth of animal protein in developing countries, and as food shortage and poverty become more endemic, people increasingly depend on plants rather than animals for proteins in their diets. Throughout history and lately, wild plants are exploited as sources of food and other life supporting commodities and thus provide an adequate level of nutrition to the human beings [1]. These wild plants serve as an indispensable constituent of human diet supplying the body with minerals, vitamins and certain hormone precursors, in addition to protein and energy [2].

Acacia sieberiana a member of the family Fabaceae – Mimosoideae, is a tree that grows up to 15 m high with light-colored bark and often with a flat crown. The leaves, 10-15 cm long have straight white thorns at their base. The seeds are contained in straight pods, 8-12 cm long and 2-3 cm broad, with approximately tested 27.4% available crude protein. *A. sieberiana* grows in the savannah and woodland. It occurs with various botanical characteristics in the entire semi-arid regions in Africa [3]. The tree possessed some botanical and pharmaceutical history; decoction of the root is taken as remedy for stomach-ache. The bark, leaves and gums are used to treat tapeworm, bilharzia, hemorrhage, colds, diarrhea, kidney problems, rheumatism and disorders of the circulatory system. It is also used as an astringent. The pods serve as an emollient as well [3].

For tilapia feeds, varying protein sources were examined including cacao husks [4], legume seed meal, defatted soybean meal [5], full-fat toasted soybean, lupin seed meal and faba bean meal [6], sunflower cakes, wheat bran [7], cottonseed meal, sunflower meal, corn gluten, rapeseed meal, sorghum, barley [8]. Therefore, the present study was designed to evaluate various levels of ***Acacia sieberiana*** meal as feeding regimes in *O. niloticus* whether or not could improve growth, feed efficiency, body composition or any combination of these responses.

Material and Methods
Samples collection and experimental diets
The *A. sieberiana* seeds were collected from uncultivated land in Eldindir Wildlife National Park, Sudan. It is located in South-east of Sudan. The vegetation is semiarid savannah; the area contained the wild tree plants, and the seeds were collected and processed for proximate composition analysis. The high percentage of crude protein content of 27.4% and absence of toxic elements has proven that the *A. sieberiana* seeds are very safe and could serve as an alternative source of protein. Experimental diets were designed to contain 25.15% crude protein. Table 1 presents the constituents and composition of test diets. *A. sieberiana* is incorporated into the diets at levels, 10, 15, and 30%, respectively.

Table 1: Ingredients Composition of the Experimental Diets

Ingredients	Control	Treatment 1	Treatment 2	Treatment 3
Fish meal	30	30	30	30
Ground cake	21	21	21	15
Wheat bran	20	20	13	9
Bread floor	10	6	8	6
Starch	10	4	4	2
Veg.oil	5	5	5	3
Min.mix	4	4	4	4
A. sieberiana	0	10	15	30
Total Sum	100	100	100	100

The control diet contained fish meal as a source of protein and starch as supplement Binder, vitamin and mineral premix were kept constant in all diets. All diets were pelleted and then crumbled before feeding to the fish. Prior to storage, the diet were analyzed for proximate composition according to standard AOAC methods [9] (Table 2).

Table 2: Proximate Composition of the Experimental Diets

Treatment	Moisture	Dry matter	Ash	Crude fiber	Crude fat	Crude protein	NFE
Control	7.6	92.4	10.2	0.6	8.1	25.14	56.05
Feed1	5.6	95.6	14.1	2.84	3.6	25.50	53.93
Feed2	4.5	96.4	15.3	2.81	3.4	25.88	52.84
Feed3	4.3	96.1	14.1	2.80	3.4	25.48	54.21

Experimental Procedure

A total of 180 Nile tilapia fingerlings *O. niloticus* were obtained from a reputable commercial fish farm in Elsilit province, Khartoum State, Sudan. The obtained fish were apparently healthy and free from any infection and deformities. Fish with an average body weight of (2.3g/fish±0.3g), were placed in a hapa net installed in concrete tank, and fed on control diet for two weeks during acclimatization period. The fingerlings were divided into 12 equal groups and transferred into small experimental concrete tanks, measured (75 X 75 X 100 cm) and it was supplied with dechlorinated aerated fresh water.

The hapas were cleaned and water was changed weekly. Water quality were monitored and maintained as dissolved oxygen, water temperature, and water pH. Each experimental group tested were assigned to three replicates and each replicate has contained 10 fingerlings. *O. niloticus* fingerlings fed at 6% of body weight three times a day on experimental diets for 40 days. All fish per replicate were weighed and counted every ten days intervals to determine growth rates, mortalities and further to adjust the feeding rations.

Growth performance and nutrient utilization indices were determined as final fish weight gain (g), survival (%), specific growth rate (SGR, % day^{-1}), food conversion ratio (FCR) and protein efficiency ratio (PER). At the end of the experiment, fish in each tank were counted and weighed individually; growth and feed utilization parameters were calculated as follows:

% weight gain (% $fish^{-1}$) =

[(final wt – initial wt)/initial wt.)] X 100

Weight gain (g) = (final wt – initial wt)

Specific growth rate (% day^{-1}) =

[(ln final wt – ln initial wt)/initial wt] X 100

Food conversion ratio = feed intake (g)/body weight gain (g)

Statistical analysis

The data obtained in the present study were analyzed statistically. Data were tested for uniformity in variance and normality of distribution before they were analyzed using Analysis of Variance (ANOVA) at $P \leq 0.05$ to determine significant differences among treatments. Once significance was detected, data were subjected to post hoc analysis, specifically, Turkey's Test.

Results

After 40 days of the feeding trial, *O. niloticus* fingerlings in the control group significantly exhibited the lowest mean weight gain and consistently sustained the lowest values until the termination of the experiment (figure 1). In contrast, *O. niloticus* fed with diets containing 10, 15, and 30% *A. sieberiana* exhibited statistically the highest mean weight gain against control group, under environmental conditions monitored as temperature, 28-30^{o}C; pH, 7.3; alkalinity, 80 - 100ppm; and dissolved oxygen, 7.6-7.9 mg/L, respectively.

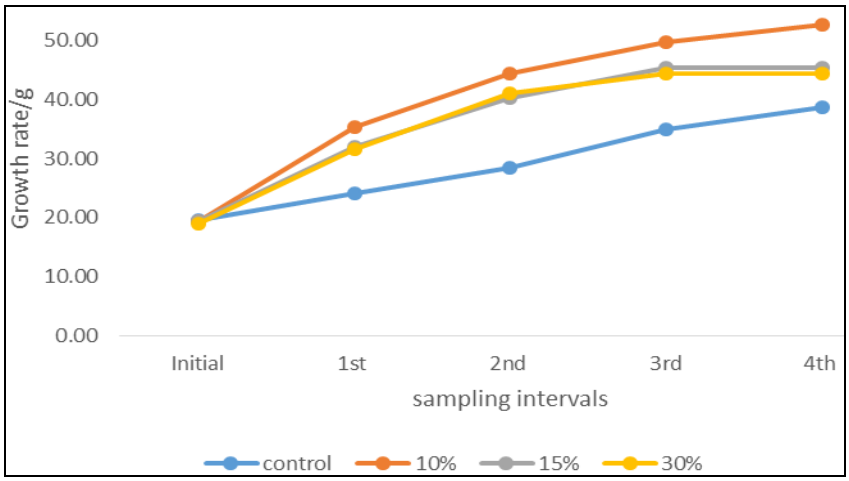

Fig 1: Trends of feeding *O. niloticus* fingerlings diets containing different levels of *A. sieberiana* meal

Growth performance (final body weight, total weight gain, daily weight gain, protein efficiency ratio and specific growth rate) were nearly varied in all treatments after 2 weeks, and there were significant differences observed in all growth parameters among all treatments.

Growth performance after feeding period (40 days) was slightly differed as the level of *A. sieberiana* meal decreased to 10% of the diet's inclusion Figure 1. However, at 30% *A. sieberiana* diet (T4), growth performance was slightly decreased. Yet, significant differences were observed in growth parameters ($P<0.05$) among the tilapia fed with diets containing 10, 15, and 30% *A. sieberiana* meal against the control group.

In respect to survival rate Figure 2, the obtained results revealed that, survival rates ranging from 40 to 93.33%, did differ significantly among treatments. These results may be due to *A. sieberiana* meal available protein (Proximately 25.27%). It is rich in almost all essential amino acids, vitamin A, vitamin B complex, beta-carotene and minerals such as calcium, phosphorus, potassium iron, copper and magnesium.

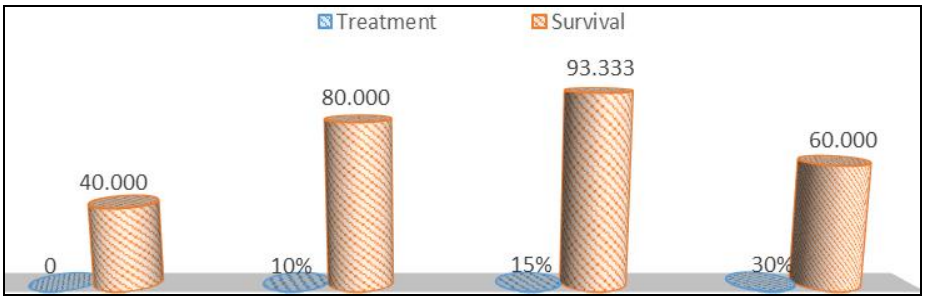

Fig 2: Survival of tilapia *O. niloticus* fingerlings fed varying levels of *A. siebreiana* meal

The results of the effect of feeding Nile tilapia fingerlings diets containing different levels of *A. sieberiana* meal on growth performance are shown in Table 3. It could be noticed that, the initial body weight of tilapia in all treatments were approximately similar and the differences were insignificant.

Table 3. The effect of feeding *O. niloticus* fingerlings diets containing different levels of *A. sieberiana* meal on their growth performance indices

Parameter	Treatments			
	Control	10%	15%	30%
Initial weight (g)	19.50±0.01	19.33±0.21	19.33±0.21	19.00±0.00
Final weight (g)	38.67±0.10	52.67±0.22	45.33±0.13	44.33±0.06
Weight gain (g)	$19.17±0.01^{c}$	$33.33±0.03^{a}$	$26.00±0.08^{b}$	$25.33±0.02^{b}$
Daily weight gain (g)	0.48±0.00	0.83±0.00	0.65±0.10	0.63±0.11
% Weight gain	$98.29±1.05^{c}$	$172.41±12.52^{a}$	$134.48±2.14^{b}$	$133.33±0.96^{b}$
SGR (% day)	$0.74±5.09^{c}$	$1.09±4.65^{a}$	$0.93±2.08^{b}$	$0.92±2.55^{b}$
FCR	$1.29±0.20^{b}$	$1.08±1.05^{a}$	$1.22±0.66^{b}$	$1.29±1.97^{b}$
FER	$0.21±0.20^{b}$	$0.27±0.20^{a}$	$0.24±0.20^{b}$	$0.23±0.20^{b}$
Survival rate %	40.00^{c}	80.00^{a}	93.30^{a}	60.00^{b}
PER	$0.76±0.22^{b}$	$1.36±0.42^{a}$	$1.09±0.12^{a}$	$1.13±0.35^{a}$

Mean values (± SEM) with different letters in the same row are significantly different ($p \leq 0.05$).

However, values of efficiencies of food conversion ratio (i.e. FCR, FER) were significantly the best in *O. niloticus* offered the 10% feeding regime with *A. sieberiana* meal while those of fish offered the control regime and the rest of the *A. sieberiana* groups, and yet were tested statistically similar with each other with no significant differences observed (Figure 3).

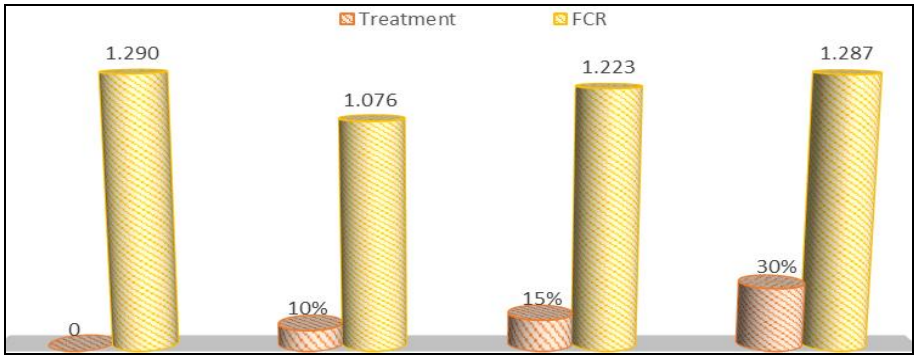

Fig 3: FCR of tilapia *O. niloticus* fingerlings fed varying levels of *A. siebreiana* meal

Furthermore, SGR of *O. niloticus* fed continuously with 10% application of *A. siebreiana* meal exhibited significantly higher specific growth rate (SGR%) than those fed with 15%, 30% and control groups with *A. siebreiana* and without *A. siebreiana* inclusion feeding regimes (Table 3) (Figure 5).

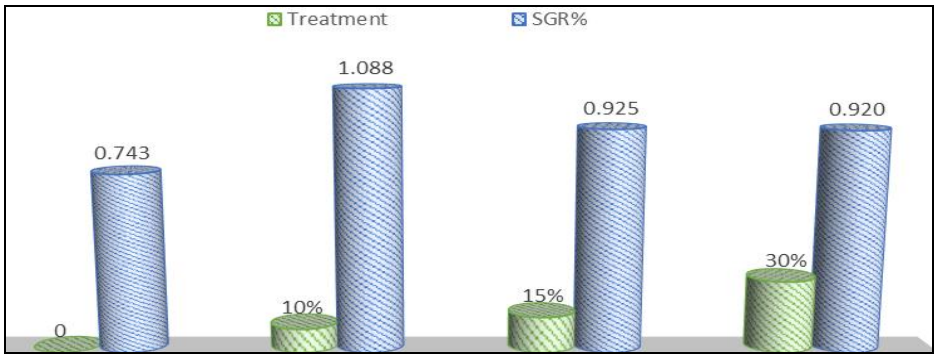

Fig 5: SGR% of tilapia *O. niloticus* fingerlings fed varying levels of *A. siebreiana* meal

After 40 days of feeding trial, the efficiencies of utilizing protein contents of *A. siebreiana* meal were greatly appeared in term of PER by which related to the growth performances of the fish that treated with *A. siebreiana* meal. The lowest PER in *O. niloticus* fingerlings fed under a control group while those fed with *A. siebreiana* meal groups exhibited the highest e.g. treatment with 10% followed by 30% and 15% inclusions, respectively (Table 3).

Polynomial relatioship between Protien effecincy and growth response of Tilapia *O. niloticus* fingerlings fed varying level of *A. siebreiana* showed closed relations among the treatment groups, but higher with the group of 10% *A. siebreiana* meal feeding scheme **(**Figure 4).

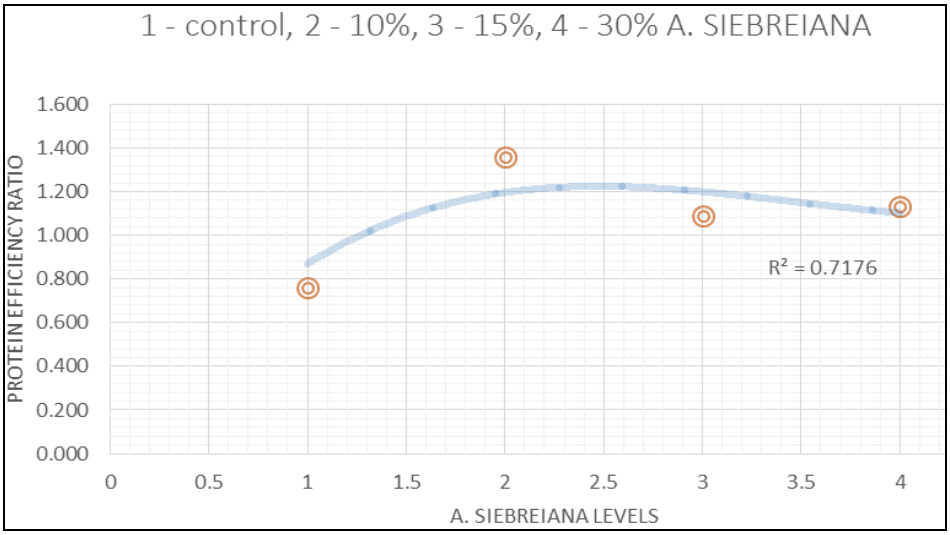

Fig 4: PER of tilapia *O. niloticus* fingerlings fed varying levels of *A. siebreiana* meal

Discussion

The results suggest that *A. sieberiana* meal added feed promoted the growth of *O. niloticus* fingerlings. These results showed improvement in term of nutrient utilization, which reflected in improved weight gain, FCR, PER and SGR. Generally, better feed conversion ratio as well as food efficency ratio values were obtained in all treatments, but the poorest occurred in control treatment toegther with 30% *A. sieberiana* inclusion (Table III). The growth data are in agreement with those suggested that, *azolla meal* is a suitable component of diets for Nile tilapia fry since growth performance and feed conversion ratios were improved as the level of the dietary *azolla meal* increased beyond 8.5% of the diets [10]; and survival rates, were not affected significantly. The findings of this study, agreed upon by which the diets were nearly similar in protein, energy, P/E ratio, and fiber content. Further, reported that, *azolla* can be mixed up to 10% of the purchased animal feed [11]. Furthermore, report mentioned that, *macadamia presscake* was suitable as dietary protein supplement for tilapia when incorporated up to 50% replacement for soybean protein [12].

On the other hand, study found that, *alfalfa leaf* protein could be included at levels of up to 35% of the dietary protein in feeds for tilapia [13]. [14] suggested that, *moringa leaf* meal can be used to substitute up to 10% of dietary protein in Nile tilapia without significant reduction in growth. Nevertheless, [15] found that, fermented *lemma leaf meal* can be incorporated into carp diets up to 30% level compared to 10% level of raw meal. [16] Showed, no significant differences observed in weight gain when replaced 25 and 33% of fish meal protein by soybean meal or concentrates made from *narrowleafed lupine* or *field peas* in extruded feeds for Atlantic salmon. [17] showed that, the possibility of including crude *lupine seed* meal in trout diets at levels as high as 30% of dietary protein. Moreover, [18] found no significant differences observed in weight gain and specific growth rate between shrimp juvenile *Penaeus indicus* fed on diets containing *leguminous seeds* meals from *white cowpea* and leaf meals from *papaya and cassava* comparing with control diet. Interestingly, with food conversion ratio obtained, It was noticed that, FCR significantly affected by increasing *A. siebreiana* meal in the diets (1.08 to 1.29). Values of FCR and FER were nearly similar to those figures when Nile tilapia fry fed on a diet containing *azolla* meal [10].

In conclusion, and for the first time in fish, it was evident that, *A. siebreiana* meal at a maximum level of 10% (dried pellet form) considered as suitable as a dietary protein supplement for tilapia as plant protein source alternative, with no any adverse effect on growth performance parameters, survival rate, and feed utilization efficacy.

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