EFFECTS OF DIETARY ALOE VERA (*ALOEBARBADENSIS*) EXTRACT ON GROWTH AND SOMATIC INDICES OF AFRICAN CATFISH *CLARIAS GARIEPINUS* (BURCHELL, 1822)

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ABSTRACT

Effects of dietary Aloe vera extract on growth performance and somatic indices of Clarias gariepinus was evacuated for 60 days. Five iso-nitrogenous diets were formulated at 35% CP. The experiment consisted of three treatments T2(AE1%), M3(AE2%), T4(AE3%) and one control T1 (AE0%)with three replications each.120 fingerlings (7.00±0.36g) were used, 12 Hapa nets were used with ten fish per Hapa. Highest final weight (107.53g) was recorded in the fish fed diet containing 2% Aloe vera extract followed by 98.40g obtained in the fish fed 3% extract. The least (86.26g) was observed in the fish fed control diet. Highest hepatosomatic index of 2.83was obtained in the fish fed diet containing 2% Aloe vera extract while the least value of 1.30 was recorded in the fish fed 3% Aloe vera extract. This study revealed Aloe vera extract can serve as growth promoter in Clarias gariepinus diet at 2% inclusion level.

KEYWORDS

Growth Promoter, African Catfish, Aloe Vera Extract, Somatic Index, Final Weight

1. INTRODUCTION

Clarias gariepinus is widely considered to be one of the most important tropical catfish species for aquaculture, it has Pan-African distribution, from the Nile to West Africa and from Algeria to Southern Africa. There are over 60 species in the genus Clarias found throughout Africa [1]. *C gariepinus* has high economic importance in many countries of the world. It can tolerate adverse water quality conditions, it grows fast and feeds on a large variety of agricultural by- products, and can be raised in high densities [2].

Medicinal herbs in aquaculture are proved to increase the growth performance of cultured fish[3]. Although they are not a drug, they are raw or extracted products with antimicrobial effects that can limit pathogens and improve fish's immune system resulting in milder diseases with less mortality and economic loss [4]. These herbs being used for the treatment of many infectious diseases since ancient times can be inexpensive biodegradable alternative for disease management and productivity enhancement in aquaculture without any side effects and environmental hazards. A wide range of herbal medicinal plants like ginger, turmeric, garlic, onion, green tea and aloe vera have been tested in aquaculture and have been reported to eliminate pathogenic bacteria, enhance immunity and improve growth in many fin fishes like Nile tilapia, (*Oreochromis niloticus*), Rainbow tout, African catfish, (*Clarias gariepinus*) [5,6,7,8].

Aloe vera (*Aloe barbadensis*) is a tropical or sub-tropical plant with turgid lance-shaped green leaves with jagged edges and sharp points [9]. It is a perennial plant belonging to the Liliaceae or Aloeaceae family and a succulent cactus like plant, which grows in hot and dry climates [9]. Aloe vera is made up of a colourless liquid product, called gel consisting primarily water and polysaccharides, and a yellow latex representing 20-30% by weight of whole leaf with bitter taste. Active compounds present in *A. barbadensis* include the following: polysaccharides, accemannans, anthraquinones, lectins, salicylic acid, urea, nitrogen, amino acids, lipids, sterols, tannins, phenol and enzymes. Accemannan is the main functional component of aloe vera and is made up of long chain acetylated mannose [10].Aloe vera extract has growth enhancing ability as appetizer and has anti-stress properties. Thus this research aimed to evaluate the effects of aloe vera extract on growth and somatic index of *Clarias gariepinus*.

2. MATERIALS AND METHODS

2.1. Study Area

The study was carried out in fish farm of the Department of Fisheries, University of Maiduguri, Borno state, it lies between latitude 11° 05'N and longitude 13°20'E. It has two distinct seasons, a rainy season with annual rainfall of about 500mm from June to October and a hot dry season from March to May. The dry season is preceded by a period of harmattan November to February with very low temperature.

2.2. Experimental Fish Source

A total of one hundred and twenty (120) fingerlings of mean weight of 7g were purchased from Dalhim farm, Gamboru road near Giwa barrack of Maiduguri, Borno state, Nigeria.

2.3. Preparation of Aloe vera Extract

Aloe vera plants were collected from Mairi Bakin Kogi Maiduguri, Borno State. 20 matured Aloe plant leaves of 25-27 cm long and 2-3 Inch width were harvested using a sharp kitchen knife. The harvested Aloe vera plants were washed under a clean running tap using the fingers to clean it from top to bottom, after washing, the Aloe plants were cut on a cutting board and the skin (thin outer green layer) was removed by running a knife between it and the thick, clear gel was scooped with a table spoon and stored in a clean container.

2.4. Feed Formulation

Pearson's square method was used to formulate the experimental diets at 35% crude protein (CP). The ingredients used included: soybean meal (38% CP) as protein source, yellow maize (8.75% CP) as the energy source and fixed ingredients which included: lysine (2%), methionine (2%), salt (0.5%), mineral and vitamin premix (1%), Binder (0.5%), Vegetable oil (2.5%) and Di-calcium phosphate (0.5%) as presented in Table 1.
The experimental diet consist of three treatment diets containing different concentrations of aloe veraextract and the control as listed below;
Treatment 1(Control)-0% Aloe vera extract
Treatment 2(AE 1)----1% Aloe vera extract
Treatment 3(AE 2)----2% Aloe vera extract
Treatment 4(AE 3)----3% Aloe vera extract
The feeds were pelleted at 3mm using the pelletizer, sun-dried, cooled in open air, packed and stored in a labeled opaque nylon according to the treatments.

Table 1. Composition of the Experimental Diets

Ingredients	AE0%	AE1%	AE2%	AE3%
Fish meal	24.6	24.6	24.6	24.6
Soya bean meal	49.2	49.2	49.2	49.2
Yellow maize	16.2	16.2	16.2	16.2
Vitamin premix	2	2	2	2
Salt	0.5	0.5	0.5	0.5
Lysine	2	2	2	2
Methionine	2	2	2	2
Di-calcium phosphate	0.5	0.5	0.5	0.5
Vegetable Oil	2.5	2.5	2.5	2.5
Binder	0.5	0.5	0.5	0.5
Aloe vera extract	0	1	2	3

2.5. Experimental Design and Setup

Completely randomized design (CRD) was employed in this study. The experiment consisted of three treatments *T2(AE1%), T3(AE2%), T4(AE3%) and one control T1 (AE0%) with three replications each. A group of 120 fingerlings of C. gariepinus were acclimatized for 5 da*ys. After the period of acclimatization, 10 fish were randomly assigned to a $1m^2$Hapa net. A total of 12 Hapa nets were used in a polythene-lined earthen pond and four formulated diets were fed to the experimental fish.

Sampling was done once every twentieth (20th) days and during specific sampling, the weight (g) of fish recorded using a weighing scale. For the hepato, gonado and viscero somatic indices (HSI), (GSI) and (VSI), one fish was sacrificed from each treatment and liver, gonads and viscera of fish were collected and weighed on every twentieth (20^{th}) day.

2.6. Proximate Composition of the Diet

The proximate compositions of the experimental diet include in terms of moisture, crude protein, ether extract, ash and crude fibrewere analyzed according to the procedure described by AOAC [11]. While the nitrogen free extract was determined by difference as described by Abdullahi *et al.* [12]

2.7. Determination of Growth Performance and Nutrient Utilization Parameters

The data obtained on the growth performance and nutrient utilization of *Clarias gariepinus* fed with the formulated diet was determined following the method of Abdullahi *et al.*[13].

Mean Weight Gain (MWG)(g)

Mean Weight Gain (MWG) = $W_2 - W_1$

Where: W_1 = Initial Mean Weight (g)

W_2 = Final Mean Weight (g)

Daily Weight Gain (DWG) (g/day)

$$\text{Daily Weight Gain (DWG)} = \frac{\text{FMW} - \text{IMW}}{\text{T}}$$

Where: FMW = Final Mean Weight (g)

IMW = Initial Mean Weight (g)

T = Feeding Trial Period (days)

Percentage Weight Gain (PWG) (%)

$$\text{Percentage Weight Gain (PWG)} = \frac{\text{FMW} - \text{IMW}}{\text{FW}} \times 100$$

Where: FMW = Final Mean Weight (g)
IMW = Initial Mean Weight (g)
FW = Final Weight (g)

Specific Growth Weight (SGR) (%/day)

$$\text{Specific Growth Weight (SGR)\%} = \frac{\text{log of } W_2 - \text{log of } W_1}{T_2 - T_1} \times 100$$

Where: W_1 = Initial Mean Weight (g)
W_2 = Final Mean Weight (g)
T_1 = Initial Time
T_2 = Final Time

Condition Factor (CF)

$$\text{Condition Factor (CF)} = \frac{100(\text{weight gain})(g)}{(\text{final length})^3(\text{cm})}$$

Feed Conversion Ratio (FCR)

$$\text{Feed Conversion Ratio FCR)} = \frac{\text{Total weight of diet fed (g)}}{\text{Total weight of fish (g)}}$$

Protein Efficiency Ratio (PER)

$$\text{Protein Efficiency Ratio (PER)} = \frac{\text{Total Weight Gain (g)}}{\text{Crude Protein Fed (g)}}$$

2.8. Determination of Somatic Indices

Somatic indices were used to know the condition of the experimental fish by determining the viscerosomatic index (VSI) and hepatosomatic index (HSI) according to Kubriza*et al.*[14].

$$\text{Viscerosomatic Index (VSI)} = \frac{\text{FVM}}{\text{FBM}} \times 100$$

Where: FVM = Fish Visceral Mass (g)
FBM = Fish Body Mass (g)

$$\text{Hepatosomatic Index (HSI)} = \frac{\text{LM}}{\text{BM}} \times 100$$

Where: LM = Liver Mass (g)
BM = Body Mass (g)

2.9. Data Analysis

All data collected from the experiment were subjected to one way analysis of variance (ANOVA) to test for significant differences among treatments. Least Significant Difference (LSD) was used to separate the mean where there is significant difference. Confidence interval was set at 95%.

3. RESULT

3.1. Proximate Composition of Experimental Diets

Table 2 shows the proximate composition of the four diets formulated and prepared for the feeding trial. The protein content of the diet ranged between 39.98% to 40.04%, fiber content, ether extract, ash, moisture and nitrogen free extract ranged between 3.1 to 3.42, 4.7 to 5.42, 3.74 to 5.2, 9.56 to 10.98 and 35.77-38.6%, respectively.

3.2. Growth Performance of Fish Fed Aloe Vera Extract

Growth performance of *Clarias gariepinus* fed different inclusion levels of aloe vera extract is shown in Table 3.There was no significant differences (P>0.05) in the initial weight of *C. gariepinus* among all the treatments and the control at the onset of the experiment. Highest value of final weight of 107.53g was recorded in the fish fed diet containing 2% Aloe vera extract followed by 98.40g obtained in the fish fed 3% Aloe vera extract. The lowest value of 86.26g was observed in the fish fed control diet 0%. There was significant difference (P≤0.05) in the mean weight gain, percentage weight gain and specific weight gain among all the treatments and the control. There was no significant difference (P>0.05) in final length of fish fed 1% and 3% Aloe vera extract but differed significantly from other treatments. Mean weight gain ranged from 79.26g to 100.53g, with the highest value 100.53g recorded in the fish fed 2% Aloe vera extract inclusion and differed significantly among the other treatments and the control. Specific growth rate recorded the highest value of 1.96 in fish fed 2% Aloe vera extract and the least (1.73) in control diet. There was no significant difference (P>0.05) in the survival rate among all the treatment groups and the control.

3.3. Nutrient Utilization of Experimental Feeds

Nutrient utilization of experimental diets is shown in Table 4.Protein efficiency ratio ranged from 12.67 in fish fed 2% Aloe vera extract to 10.77 in in the fish fed control diet. There was no significant difference (P>0.05) in T3 (AE2%) and T4 (3%) but varies among T1 (AE0%) and T2 (AE1%).Feed conversion ratio recorded the highest value of 1.99 in AE0%, the lowest 1.82 in T3 (AE2%) and T4 (AE3%).Feed intake ranged from 42.11 to 44.44, with the highest value of 44.44 recorded in T4 (AE3%) and lowest in T1 (AE0%). There was no significant difference in T3 (AE2%) and T4 (3%) but differed significantly with the other treatments.

3.4. Somatic Indices of Fish Fed Experimental Diets

Somatic indices of *C. gariepinus* fed with different inclusion level of Aloe vera extract is presented in Table 5. Hepatosomatic index recorded the highest value of 2.83 in T3 (AE2%)and the least value of 1.30 in T4 (AE3%) Aloe vera extract. There was significant difference (P<0.05) among the other treatment groups. Gonadosomatic index ranges from 2.90 in T3 and 1.60 in T2. There is significant difference (P<0.05) among the treatments. Viscerosomatic index recorded the highest result of 13.16 in T3 (AE2%) and the lowest of 9.16 in T4 (AE3%) Aloe vera extract.

4. DISCUSSION

The protein content of the diet ranged between 39.98 and 40.04, fiber content 3.1-3.42, ether extract 4.7 to 5.42, ash 3.74-5.2, moisture 9.56-10.98 and nitrogen free extract 35.77-38.6. The beneficial effects of Aloe vera extract seem to be dose-dependant, as shown in the results, increasing the Aloe vera extract in the diet up to a specific concentration (2%) causes increasing weight gain, specific growth rate and protein efficiency ratio levels.

There was a general increase in weight gain in the course of the experiment with the highest growth performance observed in fish fed with 2% Aloe vera extract. The superior performance of fish fed with experimental diets in weight gain, percentage weight gain, and specific growth rate over control diet could be due to the presence of growth promoters or constituents in Aloe vera extract (glucomannans and acemannan). This is in accord with the result of Muhammed-Jameel *et al.* [15] who found that inclusion of Aloe vera leaves up to 2% in the diet showed better growth performance of Fayoumi chicks. This was also in line with the work of Heidadieh *et al.*[16],

who demonstrated that high levels 2% of Aloe vera had a positive effect on growth performance in Rainbow trout. However, the feed intake increased as the concentrations level of Aloe vera extract increased. The increased feed intake observed in this experiment in the experimental diet groups could be attributed to change in feed taste and stimulated appetite as reported by Windisch *et al.*[17]. This result is in agreement with Darabighane *et al.*[18].This survival rate of this present experiment agreed with the findings of Farah *et al.* [19] who concluded that survival rate of fish was promoted in diets supplemented with *Melissa officinalis* and Aloe vera.

The nutrient utilization of *Clarias gariepinus* fed diets containing different levels of Aloe vera extract show significant differences ($P<0.05$) in protein efficiency ratio, feed conversion ratio and protein productive value among the experimental diets and the control. The lowest feed conversion ratio (1.82) was obtained in T3 (AE2%) Aloe vera extract and T4 (AE3%) Aloe vera extract. The best feed conversion ratio obtained in this experiment is in line with the findings of Sogbesan *et al.* [20] and Abraham *et al.*[21] who reported best feed conversion ratio of 1.82-1.95, respectively. There was no significant difference ($P>0.05$) in values obtained for protein efficiency ratio in the treatment groups. Fish fed control diet recorded the least protein efficiency ratio value while T4 (AE3%) recorded the highest protein efficiency ratio value. Apparent net protein utilization differed significantly among the experimental fish and the control. The highest apparent net protein utilization was recorded in the fish fed T4 (AE3%) Aloe vera extract while the least apparent net protein utilization value of 34.96 was obtained in the fish fed T1 (AE0%) Aloe vera extract.

The somatic indices commonly used are the viscerosomatic index, gonadosomatic index and hepatosomatic index as cited by Sudaporn*et al*. [22]. Babalola *et al.*, [23] described hepatosomatic and viscerosomatic index as the ratio of organs to body weight measured in relation to body mass which can be used as indices of changes in nutritional and energy status. According to Gumus and Ikiz [24], the assessment of hepatosomatic and viscerosomatic indices plays a significant role in the secretion of digestive enzymes, digestion and absorption of food items as well as metabolism in fishes. There was significant difference ($P<0.05$) in the hepatosomatic index and viscerosomatic index, it ranged from (1.30g-2.83g) and (9.16g-13.16g) respectively.

5. CONCLUSION AND RECOMMENDATION

In conclusion, this study revealed that the fish fed diet containing 2% had the highest value of final weight of 107.53g while the fish fed control had the least.Highest hepatosomatic index of 2.83 was obtained in the fish fed diet containing 2% Aloe vera extract while the least value of 1.30 was recorded in the fish fed diet containing 3% Aloe vera extract. This study revealed that the weight gain, specific growth rate and hepatosomatic index improve as the inclusion level of dietary Aloe vera extract increased to a maximum of 2%. Thus Aloe vera extract can serve as growth promoter in *Clarias gariepinus* diet at 2% inclusion level. It is recommended that catfish farmers should incorporate Aloe vera extract at 2% inclusion level in order to improve the growth performance of the fish.

Table 2. Proximate Composition of Experimental Diets

Parameters	**AE0%**	**AE1%**	**AE2%**	**AE3%**
Moisture	10.5 ± 1.12^{a}	10.98 ± 1.12^{a}	9.86 ± 1.12^{a}	9.56 ± 1.12^{a}
CP	40.01 ± 2.24^{a}	40.17 ± 2.24^{a}	40.04 ± 2.24^{a}	39.98 ± 2.24^{a}
Fibercontent	3.1 ± 0.39^{a}	3.12 ± 0.39^{a}	3.04 ± 0.39^{a}	3.42 ± 0.39^{a}
Ash	5.2 ± 1.10^{a}	4.45 ± 1.10^{b}	3.95 ± 1.10^{c}	3.74 ± 1.10^{c}
EE	5.42 ± 22^{a}	5.2 ± 2.22^{a}	4.98 ± 2.22^{b}	4.7 ± 2.22^{b}
NFE	35.77 ± 3.10^{a}	36.25 ± 3.10^{b}	38.13 ± 3.10^{a}	38.6 ± 3.10^{a}

Means with the same superscripts across rows were not significantly different (P>0.05).
KEY: AE = Aloe vera Extract, CP = Crude Protein, EE = Ether Extract, NFE = Nitrogen Free Extract

Table 3. Growth Performance of Fish Fed Experimental Diets

Parameters	AE0%	AE1%	AE2%	AE3%
IW(g)	7.00±0.36^{a}	7.00±036^{a}	7.00±0.36^{a}	27.10±0.00^{a}
IL(cm)	8.00±0.37^{a}	7.00±0.37^{a}	7.83±0.37^{a}	8.00±0.00^{a}
FW(g)	86.26±0.25^{b}	96.30±0.25^{ab}	107.53±0.25^{a}	98.40±0.00^{ab}
FL(cm)	24.16±0.17^{c}	25.90±0.17^{b}	28.90±0.17^{a}	26.83±0.00^{b}
MWG(g)	79.26±0.25^{b}	89.30±0.25^{ab}	100.53±0.25^{a}	91.40±0.00^{ab}
DWG(g)	0.95±0.23^{b}	1.48±0.23^{a}	1.67±0.23^{a}	1.52±0.00^{a}
PWG(%)	91.70±0.28^{b}	92.60±0.28^{ab}	93.43±0.28^{a}	92.86±0.00^{ab}
SGR(%)	1.73±0.24^{b}	1.83±0.24^{ab}	1.96±0.24^{a}	1.90±0.00^{a}
SR(%)	70.00±0.40^{a}	66.66±0.40^{a}	66.66±0.40^{a}	66.66±0.00^{a}
CF	0.56±0.23^{a}	0.51±0.23^{ab}	0.41±0.23^{c}	0.47±0.00^{bc}

Means with the same superscripts across rows were not significantly different(P>0.05).
KEY**:** AE = Aloe vera Extract, IW = Initial weight, IL=Initial length, FW=Final weight, FL=Final length, MWG=Mean weight gain, DWG=Daily weight gain, PWG=Percentage weight gain, SGR=Specific growth rate, SR=Survival rate, CF=Condition factor

Table 4. Nutrient Utilization of Fish Fed Experimental Diets

Parameters	AE0%	AE1%	AE2%	AE3%
DFI(g)	42.11±4.12^{ab}	42.61±4.12^{ab}	44.17±4.12^{a}	44.44±4.12^{a}
PER	10.77±1.55^{b}	11.76±1.55^{b}	12.57±1.55^{a}	12.67±1.55^{a}
FCR	1.99±0.19^{a}	1.91±0.19^{ab}	1.82±0.19^{b}	1.82±0.19^{b}
ANPU	34.9.6±1.27^{c}	39.08±1.27^{b}	43.14±1.27^{a}	44.23±1.27^{a}
NNR	77.09±1.10^{b}	76.31±1.10^{b}	74.50±1.10^{bc}	73.57±1.10^{c}
PPV	1.53±0.43^{c}	1.65±0.43^{b}	1.69±0.43^{b}	1.66±0.43^{b}

Means with the same superscripts across rows were not significantly different (P>0.O5).
KEY**:** AE = Aloe vera Extract, DFI=Daily feed intake, PER=Protein efficiency ratio, FCR=Feed conversion ratio, ANPU= Apparent Net Protein Utilization, NNR= NetNitrogen Retention, PPV=Protein Productive Value

Table 5. Somatic Indices of Fish Fed Experimental Diets

Parameters	AE0%	AE1%	AE2%	AE3%
HIS(g)	1.90±0.12^{c}	2.33±0.12^{b}	2.83±0.12^{a}	1.30±0.00^{d}
GSI(g)	1.83±0.08^{b}	1.60±0.08^{c}	2.90±0.08^{a}	2.03±0.00^{b}
VSI(g)	10.00±0.32^{a}	9.50±0.32^{a}	13.16±0.32^{a}	9.16±0.00^{a}

Means with the same superscripts across rows were not significantly different (P>0.05).
KEY**:** AE = Aloe vera Extract, HIS=Hepatosomatic index, GSI=Gonadosomatic index, VSI=Viscerosomatic index

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