E-ISSN: 2347-5129
P-ISSN: 2394-0506
(ICV-Poland) Impact Value: 76.37
(GIF) Impact Factor: 0.549
IJFAS 2023; 11(2): 91-95

www.fisheriesjournal.com
Received: 01-12-2022
Accepted: 05-01-2023

Oladipupo TM
Department of Fisheries and Aquaculture Technology, The Federal University of Technology Akure, Ondo State, Nigeria

Corresponding Author:
Oladipupo TM
Department of Fisheries and Aquaculture Technology, The Federal University of Technology Akure, Ondo State, Nigeria

Growth performance, haematological parameters and carcass composition of *Clarias gariepinus* fingerlings fed varying inclusion levels of *Asparagus racemosus* Root meal diet

Oladipupo TM

DOI: https://doi.org/10.22271/fish.2023.v11.i2b.2792

Abstract
The current study aimed at evaluate the effect of different inclusion levels of *Asparagus racemosus* root meal on two hundred and twenty five (225) *Clarias gariepinus* juveniles. Five iso-nitrogenous diets of 40% crude protein were formulated to contain different inclusion levels of *A. racemosus* root meal at (0.0, 0.5, 1.0, 1.5 and 2.0 g/kg) labelled as (DI-D5) with a triplicate of each regime at fifteen fish per tank. The fingerlings were fed to visual satiation between 08:00 and 09:00 and 16:00 and 17:00 hours for a period of fifty six (56) days in the Laboratory. Fish were weighed biweekly until the experiment was terminated. Results showed that Temperature ranged between 27.2–27.5 °C, Dissolved oxygen between 6.52-6.79 mg/L and pH between 7.12-7.65. Fish fed diet 3(1.0 g/kg) had the highest weight gain compared to the control and other treatments. A reduction in growth as the *A. racemosus* root meal increased beyond 1.0 g/kg was observed in diet 4 and 5 respectively. Different inclusion levels of *A. racemosus* in the diets improved the blood parameters as there were significant differences (p<0.05) in the parameters tested. There were significant differences in the proximate analysis of the fish. Protein content was highest in fish fed diet 3(66.3%) and lowest in fish fed diet 1(62.4%). The study concludes that the inclusion level of *A. racemosus* root meal in the diet of *C. gariepinus* at 1.0 g/kg is found to be ideal to promote growth and better nutrient utilization.

Keywords: *Asparagus racemosus* root, growth, haematology, carcass, *Clarias gariepinus*

1. Introduction
Clarias gariepinus is one of the most commonly cultured species in Nigeria [1]. It received wide acceptance when it was realized to be a very suitable species for aquaculture and of high economic value. It has been the most widely grow fish in Nigeria and even in Africa. This may be as a result of its hardy nature and ability to grow and reproduce under a wide range of environmental conditions [2, 3]. Aquaculture industry is the major benefactor towards fish supply as production from marine capture fisheries is almost motionless over recent years [4]. The rapid development of aquaculture system and growing demand of fish leads to the intensification of the culture practices, overdrawing stressors for fish and thus magnifying the risk of diseases. Herbs are more compatible with body because of their normal nature and having medicine homologues components together and lack of unwanted side effects, therefore they are most suitable. Borimnejad (2008) [5]. For sustainable and successful freshwater fish culture on scientific basis principally depends upon the use of adequate, economically valuable and environmentally friendly artificial food as well as uses of plants to improve the yield of fish culture.
The plant, *Asparagus racemosus* is one of the most frequently used herb in traditional medicine due to the quality of steroidal saponins and sapogenins in various parts of a plant [6, 7, 8]. According to Choudhary and Kar (1992) [9] *A. racemosus* is rich in minerals and it contains macro minerals. The plant root powder is used as an herbal feed additive which increase the appetite and stimulates the liver function in rat as reported by [10]. The plant root has been used to improved growth performance in broilers chicken at different inclusion levels as reported by [11, 12, 13].

A. racemosus root meal has also been reported to promote growth in *Channa punctatus* at different inclusion levels as reported by [14]. The aim of this study is to evaluate the ability of *A. racemosus* root powder as feed additive in formulated diets of *C. gariepinus* and also to determine its effects on haematological parameters and carcass composition.

2. Materials and Methods

2.1 Collection and Preparation of *Asparagus racemosus* Roots

A. racemosus roots were procured from a local plant market at Akure, Ondo State, Nigeria. The Identification and authentication of the plant roots was done at the Department of Crop, Soil and Pest Management, The Federal University of Technology, Akure. The roots were washed in distilled water and dried at room temperature to prevent loss of volatile compounds. The roots were ground into fine powder using mortar and pestle, sieved through a 0.5 mm mesh screen and stored at 4 °C in a container until used.

2.2 Experimental Fish

Two hundred sixty (260) apparently healthy *C. gariepinus* fingerlings were purchased from the Federal University of Technology fish farm, Akure, Ondo State, Nigeria. The fish were allowed to acclimatize for two weeks, during this period, fish were hand-fed with 40% crude protein of a commercial diet to visual satiation twice daily.

2.3 Experimental diet: Preparation and inclusion

Five iso-nitrogenous diets (40% CP) were formulated for *C. gariepinus* fingerlings to contain *A. racemosus* root meal at different inclusion levels (0.0, 0.5, 1.0, 1.5 and 2.0 g/kg) and designated as D1-D5 respectively. The diet containing 0.0 g/kg of the plant serves as the control without any inclusion of additives. Other ingredients were fish meal, soybean meal, ground nut cake, yellow maize, methionine, lysine, Vitamin–mineral mix, vegetable oil, starch. The constituents of each diet were thoroughly mixed and pelletized using Hobbart A-2007 mixing and pelleting machine (Hobart Ltd London,) with a die hole of 2 mm. The feeds were than sun-dried and packed separately in air tight polythene bags and stored in a cool dry place.

2.4 Experimental Design and Management

The experimental design was a complete randomized design. Prior to the commencement of the experiment, all fish were starved for 24 hours. This practice was to eliminate variation in weight due to residue food in the gut and also to prepare the gastrointestinal tract for the experimental diets, while at the same time to increase the appetite of the fish. The individual weight of each fish was done immediately after acclimatization using an electronic weighing balance (model PB 3002), out of which two hundred and twenty five (225) apparently healthy *C. gariepinus* with mean weight of 6.38 ± 0.01 g were randomly selected and allocated into 15 glass tanks (70litre) each measuring (70cmx45cmx45cm) at the rate of 15 fish per tank representing five treatments in triplicate. During the experimental period, all treatment groups were hand-fed with their respective diets to visual satiation twice daily between (08:00 and 09:00 and 16:00 and 17:00 hours) for 56 days. Fish mortality was monitored daily, dead fish were removed, counted and recorded, total fish weight in each tank was determined at two week-intervals until the experiment was completed. Left over feed and faeces in each tank were siphoned out every morning before feeding. The water in the tank was partially siphoned and replenished every morning while total changing was done every three days to avoid fouling resulting from faeces and uneaten food. Water quality parameters such as (Temperature, dissolve oxygen and hydrogen ion concentration) were monitored throughout the period of the experiment. Calculation of the growth performance was according to (Guo *et al.*, 2012) [15], fish were counted and weighed. The growth parameters and feed utilization indices were calculated. Haematological assessment was carried out on blood of *C. gariepinus.* Three fish specimens were removed from each glass tank for blood analysis. 2 ml of blood from the fish was collected from the cardiac puncture using different 5 ml disposable heparinized syringes, with ethylene diamine tetra acetic acid (10 ml EDTA) as anticoagulant. Haematological values were determined according to adapted method of (Svobodova *et al*., 2006) [16]. Proximate analysis of *A. racemosus* root, experimental feed and fish were carried out according to AOAC (1990) [17] methods.

Table 1: Formulation and chemical composition of the experimental diets (g/kg) for *C. gariepinus*

Ingredients	D1 (0.0)	D2 (0.5)	D3 (1.0)	D4 (1.5)	D5 (2.0)
Fish meal	23.3	23.3	23.3	23.3	23.3
Soybean meal	25.4	25.4	25.4	25.4	25.4
G/cake	28.1	28.1	28.1	28.1	28.1
Yellow maize	13.3	13.3	13.3	13.3	13.3
Methionine	0.30	0.30	0.30	0.30	0.30
Lysine	0.20	0.20	0.20	0.20	0.20
Fish oil	6.00	6.00	6.00	6.00	6.00
Vitamin premix**	2.40	2.40	2.40	2.40	2.40
Starch	1.00	1.00	1.00	1.00	1.00
Asparagus racemosus	0.00	0.5	1.0	1.5	2.0
Proximate composition (%)					
Moisture	9.55	9.32	9.83	9.35	9.52
Ash	4.33	3.81	3.62	4.19	3.75
Protein	40.03	40.11	40.07	40.05	40.12
Fibre	2.03	2.87	2.93	3.01	3.05
Lipid	9.22	9.63	9.75	10.2	10.13
Nitrogen free extract	34.84	34.27	33.8	33.2	33.43

*Vitamin premix- A Pfizer livestock product containing the following per kg of feed: A = 4500 I, U, D = 11252 I.U, E = 71I.U, K3=2 mg, B12=0.015 mg, pantothenic acid = 5 mg, nicotinic acid = 14 mg, folic acid = 0.4 mg, biotin = 0.04 mg. choline = 150 mg, cobalt = 0.2 mg, copper = 4.5 mg, iron = 21 mg, manganese = 20 mg, iodine = 0.6 mg, selenium = 2.2 mg, zinc = 20 mg, antioxidant = 2 mg

2.5 Data Analysis

Data collected were analyzed using a Statistical Package for Social Science (SPSS) Version 21. Test among the treatments were done using One-way Analysis of Variance (ANOVA) as described by Steel and Torrie (1980) [18]. Duncan's New Multiple Range Test Duncan (1955) [19] was used to eployed were differences occurred at a significance level of 0.05.

3 Results and Discussion

The proximate composition of *A. racemosus* root powder is shown in Table 2. The root powder was analysed for percentage moisture, fat, ash, protein, crude fibre and carbohydrate contents. *A. racemosus* root powder used in this study contained 11.8% moisture, 4.27% ash, 4.51% crude protein, crude lipid, 14.6%, crude fibre, 9.83% and 55.99% Nitrogen free extract.

Table 2: Proximate composition of *Asparagus racemosus* root powder

Parameters (%)	Proximate
Moisture	11.8
Ash	3.27
Protein	4.51
Fibre	9.83
Lipid	14.6
NFE	55.99

NFE, Nitrogen free extract.

The result of physico-chemical parameters recorded during the experimental period is shown in Table 3. There was no significant difference (p>0.05) in the dissolved oxygen and temperature values in all the treatments. However, there was significant difference (p<0.05) in the pH. The readings on the physico-chemical parameters in each glass tank were within the recommended ranges for rearing cat fishes, including *C. gariepinus* for optimum growth and survival. These physico-chemical parameters of the water compared favourably with that reported by (Lazo and Davies, 2000) [20] on fresh water fishes, including *C. gariepinus.*

Table 3: Water qualities parameter measured during the experimental period

Parameters	T1 (0.0)	T2 (0.5)	T3 (1.0)	T4 (1.5)	T5 (2.0)
DO (ml/g)	6.33±0.03^{a}	6.79±0.02^{a}	6.31±0.14^{a}	6.52±0.03^{a}	6.35±0.02^{a}
Temperature (^{O}C)	27.16±0.35^{a}	27.22±0.00^{a}	27.05±0.04^{a}	27.20±0.00^{a}	27.17±0.05^{a}
pH	7.12±0.02^{a}	7.51±0.05^{b}	7.65±0.003^{b}	7.36±0.04^{b}	7.42±0.00^{b}

Means in same row with different superscripts are significantly different (p<0.05)

Result of growth performance and nutrient utilization of *C. gariepinus* after the experiment period is presented in Table 4. The results revealed that, fish group fed with diet containing 1.0 g/kg of the plant root powder exhibits a significant (p<0.05) higher final body weight gain as compared with control (0.0 g/kg) and other treated groups (0.5, 1.5 and 2.0 g/kg) which indicate that (1.0 g/kg) inclusion level of *A. racemosus* can be considered as the most optimal level of inclusion in the diet of the fish. There was a declined in growth performance of the fish as the plant root powder increased beyond 1.0 g/kg.

This growth reduction observed at higher inclusion levels of *A. racemosus* root meal in this study compared favourably well with that reported by (Nwanna, 2003; Fagbenro *et al* ., 2010; Ochang *et al* ., 2017) [21, 22, 23] on growth performance of *C. gariepinus* fed different inclusion levels of fermented shrimp head, unprocessed sunflower and sesame seed and *Afzelia africana* seed meal respectively. Although, this observation disagrees with the findings of (Borkar *et* 2014) [24] in which they reported increased in growth performance and nutrient utilization of *Channa punctatus* fed higher inclusion levels of *A. racemosus* root meal diet. This results also disagrees with that reported by (Bhardwaj *et al* . 2008; Sharma *et al* . 2012) [25, 26] in which they observed significant improvement in body weight in broilers chicken fed supplemented *A. racemosus* root powder at different inclusion levels. The highest specific growth rate and feed intake was recorded in D3 while the lowest was recorded in D5. The best result in terms of FCR was recorded in D3 while the poorest value was recorded in D5. There was significant difference (p<0.05) noticed in the FCE and PER. Highest survival percentage was recorded in D2 while the lowest was recorded in D1. Balogun *et al* . (2016) [27] reported that the higher the SGR the smaller the FCR values, the better the feed quality on *C. gariepinus* fed different inclusion levels of soaked *bauhinia monandra* seed meal. This observation compare favourable with the report of this study.

Table 4: Growth performance of *C. gariepinus* fed experimental diets

Parameters	D1 (0.0)	D2 (0.5)	D3 (1.0)	D4 (1.5)	D5 (2.0)
MIW	6.38±0.01^{a}	6.38±0.02^{a}	6.38±0.01^{a}	6.38±0.01^{a}	6.38±0.02^{a}
MFW	22.8±0.24^{b}	26.1±0.26^{d}	27.7±0.09^{e}	24.7±0.12^{c}	21.5±0.27^{a}
MWG	16.5±0.24^{b}	19.7±0.26^{d}	21.4±0.09^{e}	18.3±0.12^{c}	15.2±0.27^{a}
SGR (%/day)	2.28±0.22^{b}	2.51±0.02^{d}	2.62±0.01^{e}	2.42±0.01^{c}	2.17±0.21^{a}
FI	25.5±0.23^{b}	28.3±0.22^{d}	30.2±0.26^{e}	27.5±0.15^{c}	24.4±0.06^{a}
FCR	1.55±0.02^{bc}	1.43±0.01^{a}	1.41±0.01^{a}	1.50±0.02^{b}	1.61±0.03^{c}
FER	0.64±0.01^{ab}	0.70±0.01^{c}	0.71±0.03^{c}	0.67±0.01^{b}	0.62±0.01^{a}
Survival (%)	93.3±6.67^{a}	100.0±0.00^{a}	96.7±3.33^{a}	96.7±3.33^{a}	96.7±3.33^{a}

Mean in the same row with different letter are significantly different at p<0.05

Key: MIW= Mean initial weight, MFW= Mean final weight, MWG= Mean weight gain, SGR= Specific growth rate (%/day), FI= Feed intake, FCR= Feed conversion ratio, FER= Feed efficiency ratio

The results of the effects of *A. racemosus* on haematological parameters of the fish revealed that different inclusion levels of the plant improved the blood profile as there were significant differences (P<0.05) in the parameters tested Table 5. Fish fed experimental diets had significantly higher values (p<0.05) of Hb, PCV, RBC and WBC than those fed control diet. However, there was significant difference (p<0.05) in the MCHC, MCH and MCV values among the treated groups and the control group. Haematological parameters have been described to be reliable as they indicate the nutritional status and overall health indication of the fish (Atamanalp and Yanik, 2003) [28]. The fish on D3 had higher WBC than the other treatment groups. However, RBC, WBC and Hb were within the reference ranges reported by Svobodova *et al* . (2006) [29] in fish but higher than those reported by Dienye and Olumuji (2014) [30] on *Clarias gariepinus* fed different inclusion levels of *Moringa oleifera* leaf meal. The increase in Hb with increasing levels of *A. racemosus* may signal no deterioration condition as a result of *A. racemosus* supplementation. The MCHC, MCH and MCV values recorded in this study were similar to the values reported by Sotolu (2010) [31] in *C. gariepinus* fed *Leuceana leucocephala* seed meal.

Table 5: Haematological parameters of *C. gariepinus*

Parameters	D1 (0.0)	D2 (0.5)	D3 (1.0)	D4 (1.5)	D5 (2.0)
WBC ($x10^3/mm^3$)	6.50±0.12^a	7.02±0.21^{bc}	7.10±0.25^c	6.97±0.07^b	7.05±0.15^{bc}
RBC ($x10^3/mm^3$)	3.40±1.15^a	3.73±012^{ab}	3.77±0.48^{ab}	3.79±0.12^b	3.80±0.44^b
Hb (g/100 ml)	10.1±0.20^a	10.7±0.09^a	11.2±1.68^{ab}	12.7±0.25^{ab}	13.3±1.13^b
PCV (%)	29.3±0.33^a	32.0±1.15^{ab}	35.3±0.33^b	35.8±2.67^b	36.2±1.67^b
MCHC (%)	34.5±0.86^{ab}	33.4±1.60^{ab}	31.7±4.89^a	35.5±4.59^b	36.7±0.88^b
MCH (pg)	29.7±2.07^a	28.7±0.79^a	29.7±8.04^a	33.5±1.50^b	35.0±2.87^c
MCV (fl)	86.2±3.45^a	85.8±4.55^a	93.6±11.5^b	94.5±12.0^b	95.3±11.6^b

Means in same row with different superscript are significantly different (p<005)
Key: WBC- White Blood Cell, RBC- Red Blood Cell, Hb- Haemoglobin, PCV - Pack Cell Volume, MCHC-mean cell haemoglobin concentration, MCH-Mean Cell Haemoglobin, MCV- Mean Corpuscular Volume.

The results of the whole carcass composition of *C. gariepinus* fed different inclusion levels of *A. racemosus* root are presented in Table 6. This table reveals that there were significant differences (p<0.05) in the body composition of the fish. Moisture content was highest in fish fed D4 and lowest in fish fed D3. The least value of Ash was recorded in fish fed D4 while the highest value was observed in fish fed D5. Crude protein ranged between 66.3% in D3 and 62.4% in D1while Lipid content of fish increase with increasing levels of *A. racemosus* in the diets. According to (Adewumi, 2012) [32] data on gross body composition of an animal provides information on its development and physiological state. The differences recorded in proximate composition of the fish carcass within the treatments probably indicated differences in the effectiveness of the utilization of the test diets. The body composition of the fish carcass shows an increase in the value of crude lipid over the control group. This agrees with reports of Ajani *et al* . (2011) [33] who reported increase in the lipid content of *C. gariepinus* carcass when compared with the control group. Sotolu (2010) [34] also recorded higher values of lipid in *C. gariepinus* fed different inclusion levels of *Leucaena leucocephala* seed meal which is not contradictory to the report of this study. Carcass crude protein was generally higher in fish fed *A. racemosus* root meal diet than the fish on control group. The results revealed that the weight gain could be ascribed to protein synthesis of new tissues which eventually resulted to increase in body carcass protein. This observation agrees with that reported by (Fafioye *et al* . 2005; Adewumi, 2012) [35 36] in *C. gariepinus* fed different inclusion levels of soybean meal and bovine blood and rumen digesta than the control group, which agrees with the result of this study.

Table 6: Carcass composition of *C. gariepinus*

Parameters (%)	D1 (0.0)	D2 (0.5)	D3 (1.0)	D4 (1.5)	D5 (2.0)
Moisture	11.0±0.07^b	11.1±0.01^b	10.6±0.04^a	11.6±0.01^c	10.9±0.01^a
Ash	3.43±0.00^d	3.13±0.00^c	2.88±0.07^b	2.16±0.00^a	3.37±0.01^d
Crude protein	62.4±0.22^a	63.2±0.03^b	66.3±0.03^c	65.7±0.06^c	62.9±0.10^a
Crude lipid	11.5±0.02^a	11.9±0.03^b	13.2±0.03^c	13.5±0.00^c	14.0±0.00^d
NFE	11.65±0.23^d	10.67±0.03^c	7.02±0.09^a	7.04±0.04^a	8.83±0.09^b

Mean in the same row with different letters are significantly different at p<0.05
Key: NFE= Nitrogen free extract

Conclusion

In conclusion, results obtained from this investigation showed that 1.0 g/kg level of *A. racemosus* root powder can be incorporated into the diets of the fish without any adverse depression in growth and deleterious effects on the fish health. The present study has clearly shown that *A. racemosus* root improved haematological indices and carcass protein of the experimental fish.

References

1. NSPFS. Inventory of Fish Farms in Nigeria: Aquaculture and Inland Fisheries Project Annex II of the National Special Programme for Food Security with ADPs in all States and Abuja; c2004 Dec.
2. Ajani F. Hormonal and heamatological responses of adult and broodstock *Clarias gariepinus* to amonia and nitrite toxicity under different culture environments. PhD Thesis in University of Ibadan; c2005. p. 180.
3. Olasunkanmi JB. Essential Elements of Fish Production. Christ Gospel 175 Press, Osogbo; c2008. p. 39.
4. DADF. Annual Report 2016. Department of Animal Husbandry, Dairying amd Fisheries, Ministry of Agriculture, Government of India. Krishi Bhavan, New Delhip; c2016. p. 42-45.
5. Borimnejad V. Niche Markets in the Agricultural Sector, case study: Iran, American – Eurasian Journal of Environmental Science. 2008;3:893-899.
6. Thakur M, Chauhan NS, Bhargava S, Dixit VK. A Comparative study on aphrodisiac activity of some ayurvedic herbs in male albino rats. Journal of Arch Sex Behavior. 2009;38:1009-1015.
7. Mishra VK, Sheikh S, Agnihotri V, Chourey N. Effects of *Asparagus racemosus*, (shatavari) on mounting behaviour of male rats. International Journal of Pharmacy and Life Sciences. 2010;1(1):30-34.
8. Alok S, Jain SK, Verma A, Kumar M, Mahor, Sabharwal M. Plant profile, phytochemistry and pharmacology of *Asparagus racemosus* (Shatavari): A review. Asian Journal of Tropical Disease. 2013;3(3):242-251.
9. Choudhary, B.K. and Kar, A. (1992). Mineral contents of *Asparagus racemosus. Indian Drugs*. 29: 623.
10. Kamat JP, Boloor KK, Devasagayam TP, Venkatachalam SR. Antioxdant properties of *Asparagus racemosus* against damaged induced by gamma radiation on rat liver mitochondria. Journal of Ethanopharmacology. 2000;71:425-435.
11. Pedulwar SN, Zanzad AA, Choudhari AJ, Ramteke BN, Deshmukh GB. Effect of dietary supplementation of Shatavari (*Asparagus racemosus*) on broilers. Indian Journal of Field Veterinary. 2007;3:28-29.

12. Rekhate DH, Smita U, Mangle LN, Deshmukh BS. Effect of dietary supplementation of Shatavari (*Asparagus racemosus* Wild) on heamatobiochemical parameters of broilers. Veterinary World. 2010;3:280-281.
13. Sharma V, Verma RB, Sharma S. Preliminary evaluation of the hepatic protection by pharmacological properties of the aqueous extract of A*sparagus racemosus* in lead loaded swiss albino mice. International Journal of Pharmacological. Science. 2012;4:55-62.
14. Borkar SB, Rathod SH, Kulkarni KM, Tantarpale VT. Impact of *Asparagus racemosus* root on average body weight of freshwater fish, *Channa punctatus*. Journal of Global Biosciences. 2014;3(2):582-585.
15. Guo Z, Zhu X, Liu J, Han D, Yang Y, Lan Z, *et al* . Effects of dietary protein level on growth performance, nitrogen and energy budget of juvenile hybrid sturgeon, *Acipenser baerii* ♀×*A. gueldenstaedtii* ♂. Aquaculture. 2012;2:338-341.
16. Svobodova Z, Vykusova B, Modra H, Jarkovsky J, Smutna M. Haematological and biochemical profile of harvest-size carp during harvest and post-harvest storage. Journal of Aquaculture Research. 2006;37:959-965
17. AOAC. Association of Official Analytical Chemist. Official methods of analysis, 15th Edition., Washington DC; c1990. p. 1298.
18. Steel RGD, Torrie JH. Principles and procedures of statistics: A biometrical approach. McGraw Hill Book Company, New York; c1980. p. 101-123.
19. Duncan DB. Multiple range and multiple F-test. Biometrics. 1955;11:1-42.
20. Lazo JP, Davies DA. Ingredients and feed evaluation in Encyclopedia of Aquaculture edited by R.R. Stickney. A Wiley Interscience Publication, John Wiley and Sons incorporation, USA; c2000. p. 1063.
21. Nwanna LC. Nutritional Value and Digestibility of Fermented Shrimp Head Waste Meal by African catfish *Clarias gariepinus*. Pakistan Journal of Nutrition. 2003;2(6):339-345.
22. Fagbenro OA, Adeparusi EO, Jimoh WA. Nutritional evaluation of sunflower and sesame seed meal in *Clarias gariepinus*: An assessment by growth performance and nutrient utilization. African Journal of Agricultural Research. 2010;5(22):3096-3101.
23. Ochang SN, Ugbor ON, Nwiboko CE. Effect of replacement of soybean meal with *Afzilia africana* meal on the growth and intestinal mucosa of *Clarias gariepinus* Fingerlings. Journal of Science. 2017;4(1&2):88-99.
24. Borkar SB, Rathod SH, Kulkarni KM, Tantarpale VT. Impact of *Asparagus racemosus* root on average body weight of freshwater fish, *Channa punctatus*. Journal of Global Biosciences. 2014;3(2):582-585.
25. Bhardwaj RK, Singh SK, Brijesh AK, Singh RK, Shivkumar S. Performance and haemobiochemical profile of quail broilers fed on supplementation of Satawari (*Asparagus racemosus*) root powder. Indian poult. Sci. Asso., Silver Jubilee Annual Conf. and National Symposium held at Anand from; c2008. p. 544.
26. Sharma V, Verma RB, Sharma S. Preliminary evaluation of the hepatic protection by pharmacological properties of the aqueous extract of A*sparagus racemosus* in lead loaded swiss albino mice. International Journal of Pharmacological. Science. 2012;4:55-62.
27. Balogun BI, Oniye SJ, Auta J, Lakpini AM, Abeke FO. Growth performance and feed utilization of C*larias gariepinus* fed different dietary levels of soaked *Bauhinia monandra* seed meal. Journal of Food Research. 2016;5(1):97-106.
28. Atamanalp M, Yanik T. Alterations in Hematological Parameters of Rainbow Trout (*Oncorhynchus mykiss*) Exposed to Mancozeb. Turkish Journal of Veterinary and Animal Science. 2003;27:1213-1217.
29. Svobodova Z, Frada D, Palakova J. Unified methods of haematological examination of fish. Research Institute of Fish Culture and Hydrobiology, Vodnany, Czechoslovakia; c2006 p. 331.
30. Dienye HE, Olumuji OK. Growth performance and haematological responses of African mud catfish *Clarias gariepinus* fed dietary levels of *Moringa oleifera* leaf meal. Journal of Agricultural Science. 2014;2(2):79-88.
31. Sotolu AO. Growth Performance of *Clarias gariepinus* (Burchell, 1822) Fed Varying Inclusions of *Leucaena leucocephala* seed meal. Tropicultura. 2010;28(3):168-172.
32. Adewumi AA. Bovine blood and rumen digesta in catfish, *Clarias gariepinus* (Burchell 1822) diet. European Journal of Scientific Research. 2012;83(2):167-172.
33. Ajani F, Dawodu MO, Bello-Olusoji OA. Effects of feed forms and feeding frequency on growth performance and nutrient utilization of *Clarias gariepinus* fingerlings. African Journal of Agricultural Research. 2011;6(2):318-322.
34. Sotolu AO. Growth Performance of *Clarias gariepinus* (Burchell, 1822) Fed Varying Inclusions of *Leucaena leucocephala* seed meal. Tropicultura. 2010;28(3):168-172.
35. Fafioye OO, Fagade SO, Adebisi AA, Jenyo-Oni, Omoyinmi GAK. Effects of dietary soybeans (*Glycine max* (L.) Merr.) on growth and body composition of African Catfish (*Clarias gariepinus*, Burchell) fingerlings. Turkish Journal of Fisheries and Aquatic Sciences. 2005;5:11-15
36. Adewumi AA. Bovine blood and rumen digesta in catfish, *Clarias gariepinus* (Burchell 1822) diet. European Journal of Scientific Research. 2012;83(2):167-172.