ORGANIC AGRICULTURE PROJECT IN TERTIARY INSTITUTIONS IN NIGERIA

Proceedings of the 2nd National Conference on Organic Agriculture in Nigeria

27th November – 1st December, 2006

Venue:

FACULTY OF AGRICULTURE AND FORESTRY

UNIVERSITY OF IBADAN, NIGERIA

Proceedings of the 2nd National Conference on Organic Agriculture in Nigeria. 27th November - 1st December, 2006 at the Faculty of Agriculture and Forestry,University of Ibadan, Ibadan, Nigerian. Okogun J.A., O.O. AdeOluwa and J.A. Adediran (eds), July, 2007.

Materials in this proceedings should be referenced as stated above.

Editors

Dr. J.A. Okogun,
Department of Agronomy, University of Ibadan
a_okogun@yahoo.com

Dr. O.O. AdeOluwa
Department of Agronomy, University of Ibadan
adeoluwaoo@yahoo.com

Professor J.A. Adediran
Institute of Agricultural Research and Training (I.A.R.&T)
jadediran@yahoo.co.uk

Local Organizing Committee

Name	Address
Prof. Adeoye, G.O	Department of Agronomy, University of Ibadan
Prof. Omueti, J.A.I.	Department of Agronomy, University of Ibadan
Prof. Adediran, J.A	Institute for Agric. Research and Training (IAR&T), Ibadan
Dr. A. Omoloye	Department of CPEB, University of Ibadan.
Dr. Adebisi, L .A.	Department of Forestry Res. Mgt, University of Ibadan
Dr. AdeOluwa, O.O.	Department of Agronomy, University of. Ibadan
Dr. Adewole, M.B	OYSADEP
Dr. Akande, M.O	Institute for Agric. Research and Training (IAR&T), Ibadan
Dr. Atungwu, J.J	University of Agriculture (UNAAB), Abeokuta
Dr. Awodoyin, R.O	Department of Crop Protection and Environmental Biology, University of Ibadan
Dr. E.A Akinrinde	Department of Agronomy, University of Ibadan
Dr. Fagbayide, J.A	Department of Agronomy, University of Ibadan
Dr. Fagbenro, J.A	Bowen University, Iwo , Osun State
Dr. Ipinmoroti, R.R	Cocoa Research Institute of Nigeria (CRIN), Ibadan
Dr. L. Babatola	Department of Agronomy, University of Ibadan
Dr. Odebode, A.C	Department of Botany and Microbiology, University of Ibadan
Dr. Okogun, J.A	Department of Agronomy, University of Ibadan
Dr. Olaniyan, A.A	National Horticultural Research Institute (NIHORT)
Dr. Sonibare, M.A	Dept of Pharmacognosy, University of Ibadan
Dr. Taiwo, L.B	Institute for Agric. Research and Training (IAR&T), Ibadan
Dr.E.A Aiyelari	Department of Agronomy, University of Ibadan
Miss Fayemi Folake	Department of Agronomy, University of Ibadan
Mr P. Ogungbe	Department of Agronomy, University of Ibadan
Mr. D.K.A. Shodeke	Forestry Research Institute of Nigeria (FRIN)
Mr. Olayide Olawale	Department of Agric. Economics, University of Ibadan.
Mr. Peter Olanrewaju	Department of Agronomy, University of Ibadan
Mr. S.B. Baye	Fed. Min. of Agric. & Rural Devpt., PRSD, Garki, Abuja
Mrs S.A. Adejumo	Min. of Envir. & Water Resources, Oyo State
Mrs. Alabi, A H	Department of Chemistry, University of Ibadan

Contents Page

THE POTENTIAL OF COW BLOOD MEAL-RUMEN CONTENT BLEND AS PARTIAL OR COMPLETE REPLACEMENT FOR FISH MEAL IN CLARIAS GARIEPINUS DIETS.

Olukunle, O.; V. O. Taiwo; M. C. Okonkwo; and G. O. Agboola,
Department of Wildlife and Fisheries Management, University of Ibadan, Ibadan Nigeria.
Veterinary Department, University of Ibadan, Ibadan Nigeria.

Abstract

A-70-day study investigated the nutritional potential of cow blood rumen content blend, its effect on the growth performance and hematological response of the fingerlings of *Clarias gariepinus*. Triplicate groups of ten *C. gariepinus* fingerlings, average weight 0.79 ± 0.20 g in 8L of water using 20 L- circular plastic tanks was fed with five practical type diets containing 40% crude protein (CP). The diets had their dietary protein sourced from: (1), 100% fish meal (FM) +0% cow blood meal- rumen content blend (CBRB), (2) 25% FM + 75% CBRB; (3) 50% FM + 50% CBRB; (4) 25% FM + 75% CBRB; (5) 0% FM + 100% CBRB respectively. Fish feeding was done daily at 5% body weight but later reduced to 3% after the fifth week. Blood samples were collected from 3 fish per treatment at the beginning and end of the experiment. The water quality was monitored through out the experiment.

The mean weight gain was highest (7.92g) in the fish fed diet of 25% CBRB inclusion and lowest (6.43g) in the 100% CBRB but no significant difference was observed between the MWG of fish fed diet 1(7.26 g) and 2 (7.92 g). The feed conversion (FCR) and Protein Efficiency Ratio (PER) were highest in the fish fed the (0% CBRB), (2.1, 0.85) respectively and lowest in the fish fed diet containing 100% CBRB (1.7, 0.69) respectively. There was no significant difference ($p<0.05$) in the FCR and PER values of fish fed the control and diet 2, (2.0, 0.81). The water quality in all the treatments did not vary excessively from the recommended values nor did the hematological results showed any anaemic conditions.

KEY WORD: Cow blood meal-rumen content blend, *Clarias gariepinus*, growth performance, hematology, nutritional potential.

Introduction

The increasingly high cost of fish production in the tropics demands that alternative cheaper sources of feed ingredients be investigated to reduce the current dependence on costly conventional ingredients like fishmeal. Cow blood meal (CBM) and Cow rumen content (CRC) are animals' by-products, which have great potentials as effective replacement. They are readily available cheap protein sources recommended in fish diet especially for catfish with particular reference to *Clarias gariepinus*. Cow blood and rumen contents are wasted at abattoirs when ruminants like cow are slaughtered. However, raw blood meal has been found to contain 80% water and 20% solids and is very rich in protein. About 90% of its solid materials is protein (Kumor, 1989). The other constituents are small quantities of sugar, cholesterol, lecithin, fat, sodium, potassium, calcium, magnesium, chlorine, and phosphoric acid. Iron however, is present in comparatively large amounts because of blood component.

Conversely, rumen content (semi-digested) food found in the first stomach of herbivorous animals), when dry, contains between 10% - 20% protein, depending on the pasture and diet (FAO, 1989). Apart from proteins, rumen content is rich in vitamins, minerals and carbohydrate. It also has a small percentage of fats. This makes the meal a useful alternate to fishmeal and other protein supplements. However, the quality of blood meal varies greatly due to animals. The healthier the animals, the more the protein content (Bekibele, 1992). Therefore, the use of blood meal as fish feed could be either beneficial or disastrous, but if well processed and incorporated into fish diet in a suitable proportion, dried blood meal will compete favourably with fish meal in aquaculture (Lovell, 1987).

The need to establish feeding standards for fish based on experiments performed in the tropics utilizing animal by-products has been well emphasized (Hastings and Dupree, 1976) and Otubusin and Anachi (1987) and in growing awareness of the nutritive value of animal by-product (regarded a waste) as alternate sources of feed ingredients, studies are needed to provide useful data to complement the scanty information on potentials of local feed materials particularly animal by-products. Faturoti and Ayinla (1998) stated that catfish *C. gariepinus* fingerlings do well with crude protein content of between 37-40% when grown in earthen ponds. Dupree and Huner (1984) reported the protein requirement of different fish species and a linear relationship was established between fish weight gain and dietary protein at a range of 20% - 40%. Shepherd (1992) investigated the optimal protein requirement for different fish species and has shown surprisingly few differences He observed that 35-45% crude protein in fish diets would appear to satisfy most species. The observations of these previous researchers engendered this investigation to examine the potential of cow blood rumen content blend (CBRB) as a partial or complete replacement for fishmeal in the diet of *C. gariepinus*.

Materials and Methods

The cow blood collected from an abattoir was absorbed in wheat bran (v/v), sun-dried for 4 days and subsequently ground to a meal. The rumen content from slaughtered cows was also collected from an abattoir, sun dried for 6 days and ground (Kumor, 1989). Five experimental diets were prepared with diet 1 as the control and containing 0% while diets 2, 3, 4, 5 contained 25%, 50%, 75%, 100% cow blood rumen blend (CBRB) respectively. The Proximate composition of the Cow Rumen Content (CRC), cow blood absorbed in Wheat Bran (CB) and Cow Blood Meal (CBM) is shown in Table 1 while the gross composition of the experimental diets is in Table 2.

The 10 weeks study was conducted in the laboratory of the Department of Wildlife and Fisheries Management, University of Ibadan, Ibadan, Nigeria. One hundred and fifty *C. gariepinus* fingerlings of same percentage were randomly allocated to the treatments with 10 fingerlings/tank in triplicates per treatment. Batch weighing of the fingerlings in each tank was done at the beginning of the experiment and every two weeks till the end of the experiment. The fish were fed at 5% body weight but adjusted to 3% in the fifth week. Weights were taken using a sensitive digital scale. Water quality was routinely monitored throughout the experimental period using the method described by Boyd (1980). Proximate analysis of the fingerlings was done before and after the experiment using the A. O. A. C. (1991) methods. The feed intake of the experimental fish, growth rate and growth performance were later evaluated as shown in (Table 3).

The hematological samples were taken before and immediately after the experiment was terminated. Three fish from each treatment were killed by decapitation and bled into EDTA (anticoagulant) treated bottles for plasma collection and analyzed. Packed Cell Volume (PCV), red blood cell count (RBC), White Blood Cell (WBC) and Hemoglobin (Hb) were determined by Wintrober micro-heamatocrit, improved Neubauer haemmocytometer and cyanometaemoglobin methods respectively. Mean Corpusclar Hemoglobin (MCH) and Mean Corpuscular Hemoglobin Concentration (MCHC) were calculated as described by Jain, (1986).

All data collected were subjected to statistical analysis using analysis of variance (ANOVA) and the treatment means compared the Duncan's multiple range test Daniel (1995).

Results

Table 1 shows the Proximate Composition of Cow Rumen Content (CRC), Cow Blood (CB) mixed with wheat bran (CBR) and Cow Blood Meal (CBM). The CB mixed with wheat bran % Crude Protein (CP) of 88.0 compared favourably with fish meal (72% CP) for the imported fish meal (FM) and 65% CP for the local FM. However, the CRC had a high fiber component (33.21%) compared to CBM's low fiber content (1.0%), but absorbing it in wheat bran lowered the fiber content to 11.64%. The fiber content of CRC is known to vary according to the feedstuff on which the ruminant feeds on (Kumor, 1989). Table 2 shows the gross composition of the experimental diets with Cow Blood Rumen Blend (CBRB) included at graded levels. Diet 1 had its CP sourced from 0% CBRB and 100% FM while diet 5 had 0% FM and 100% CBR while diets 2, 3 and 4 had. 25% CBRB + 75% FM; 50% CBRB + 50% FM and 75% CBRB + 25% FM respectively. Table 3 reveals the effect of the feed intake as elucidated by the growth performance indices. The highest feed intake was recorded in treatment 2 and the lowest in treatment 5 closely followed by the values of the diet 1 which is the control diet.

Supplementation of CBRB significantly ($P=0.05$) improved feed consumption over the control (237.24 g) with the optimum rate at 25% level of CBRB inclusion (271.4 g) and the lowest at 100% CBR inclusion (234.5 g). The result further showed that treatment 2 had the highest mean weight gain (7.92 g) followed by treatments 1 (7.26 g), 3 (6.87g), 4 (6.26g) and 5 (5.82g) respectively. Overall, treatment 5 had the lowest mean weight gain. There was no significant difference in the Feed Conversion Ration (FCR) of the CBRB supplemented diet and the control. This implies that all the diets have similar acceptability and was equally digested.

Treatment 2 had the highest protein intake but in terms of Protein Efficiency Ratio (PER), treatment 2 had the highest PER, which was significantly ($P<0.05$) different from the other treatments. Treatments 2, 3, 4 are not significantly different from each other. However, treatment 5 was significantly ($P<0.05$) different from the rest and had the lowest PER value. The implication of this observation is that 100% CBRB replacement does not encourage optimum growth of *C.gariepinus* fingerlings which corroborates the report of Olukunle (1996), and Olukunle *et al.* (2005) in which 100% solvent extracted sesame seed cake and dried duckweed did not encourage optimum growth in *C. gariepinus*.

The carcass analysis at initial and at the end of the experiment in Table 4 show that fingerlings fed treatment 2 had the highest crude protein stored in the flesh, followed by the fingerlings fed with the control diet while fish on treatments 3, 4, 5 had the lower carcass protein stored. It can be induced that treatment 2 encouraged optimum growth performance over and above the control diet. This observation is similar to the report of Omitoyin and Faturoti (2000) which showed that 25% CBRB inclusion level, were found to perform better than the fish fed the standard diet based on FM.

In Table 5, most of the hematological parameters investigated were similar and unaffected by CBRB supplementation except Corpuscular Volume and Corpuscular hemoglobin counts where fish on treatment 2 had a higher significantly ($P<0.05$) increased value than others. However, white blood cell count was significantly increased in fish fed treatment 4 than the fish on control diet. The lowest white blood cell count was recorded in fish on diet 3 while the value of the fish fed treatment 2 was the same as fish at the initial. This signifies a state of less stress for the fish.

Discussion.

The high fiber content of the rumen content (33.21%) and the blood meal mixed with wheat bran (11.64%) may explain the reduction in the efficiency in the utilization of the feed nutrients. This trend is similar to Recces and Wesley (1975)'s observation in their experiment with channel catfish fed CBRB.

The decreasing trends in fish growth with increasing levels of dietary CBRB observed in Table 3 might be due to the in balance in the amino acid profile in the blood which results in the available amino acids for utilization and growth of experimental fish. Ufodike and Ugwuzor (1985) reported decreasing trends in growth of Tilapia (*Oreochromis niloticus*) when the inclusion of blood meal-algae blend was increased in the diets. Shiau et al (1988) asserted that higher fiber content in feed decreases nutrient utilization by fish by hastening gastric emptying time. NRC (1983) also suggested that increased levels of blood meal in fish feed diets less palatable. Hence, increasing CBRB tend to decrease carcass protein content, increase the fiber and ash content of the experimental fish in all the treatments (Table 4). The increase in moisture content in fish with higher levels of CBRB in the diets can be linked with the decease in fat content of fish because water in the fish tends to beheld at the expense of liquids.

Lovell (1978) observed an inverse relationship between moisture content and fish lipid. Falaye (1988) observed same trend in the increased inclusion of cocoa husk in the diets of Tilapia (*Oreochromis niloticus*).

The erythrocyte (PCV, Hb, RBC) values of *C. gariepinus* fingerlings shown in Table 5 appreciated as the inclusion of CBRB blend increased. This is an indication that the diets improved the fish health and did not have any negative effect on fish health and blood composition neither was an anaemic situation observed in all the fish placed on the experimental diets.

Conclusion

This study suggests that CBRB could be safely incorporated into fish diets up to 100% inclusion level without adverse effects because none of the diets encouraged anemia condition on the fish.

However, from the data presented here, an inclusion level of 25% gives optimum growth performance and optimum hematological conditions.

Table 1: Proximate composition of cow rumen content, cow blood in wheat bran and cow blood meal

Feed Ingredient	CP	CF	EE	NFE	Ash	MC
Cow Rumen Content	5.52^a	33.2^c	1.59^a	1.59^a	8.14^b	3.03^a
Cow Blood in Wheat Bran	40.28^b	11.64^b	3.12^b	24.41^b	4.50^a	16.03^c
Cow Blood Meal	88.00^c	1.00^a	5.00^c	1.00^a	4.40^a	5.75^b

Values across the same row differently superscripted differ significantly ($P<0.05$)
Where CP = Crude Protein CF = Crude Fiber EE = Ether Extract
NFE = Nitrogen Free Extract MC = Moisture Content

Table 2: Gross composition (g) of the experimental diets fed *C. gariepinus* fingerlings

Feed Ingredients	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5
Fish meal	16.73	12.55	8.37	4.19	-
Soya bean meal	33.47	33.47	33.47	33.47	33.47
Yellow maize	16.73	16.73	16.73	16.73	16.73
Wheat bran	18.71	18.71	18.71	18.71	18.71
CBR -	4.18	8.36	12.54	16.73	
Palm Oil	1.00	1.00	1.00	1.00	1.00
Vitamin Premix	2.00	2 00	2.00	2.00	2.00
Salt	0.50	0.50	0.50	0.50	0.50
Bone Meal	1.00	1.00	1.00	1.00	1.00
Oyster Shell	0.50	0:50	0.50	0.50	0.50

Table 3: Growth performance Indices and Nutrient Utilization of *C. gariepinus* fingerlings fed diets supplemented with Cow-blood Rumen Blend (CRB)

Performance Indices	1(0%)	2 (25%)	3 (50%)	4 (75%)	5 (100%)
Experimental days	70	70	70	70	70
Number of fish stocked	30	30	30	30	30
Survival (Number)	21	21	21	22	23
Percentage Survival (%)	70	70	70	73.30	76.70
Initial Mean Weight (g)	0.79	0.79	0.79	0.78	0.80 NS
Final Mean Weight (g)	8.05^{a}	8.71^{b}	7.66^{c}	7.04^{d}	6.62^{c}
Mean Weight gain (g)	7.26^{a}	7.92^{b}	6.87^{c}	6.26^{d}	5.82^{c}
Mean weight gain/fish (g)	0.10	0.11	0.09	0.08	0.08NS
Total feed intake (g)	237.24^{a}	271.46^{c}	238.98^{a}	241.92^{b}	234.5^{a}
Feed intake/ day/ fish (g)	0.12	0.14	0.13	0.13	0.11NS
Food Conversion ration (FCR)	2.10	2.00	2.00	1.80	1.70NS
Protein Intake (g)	95.33^{a}	108.86^{b}	95.60^{a}	96.78^{a}	93.81^{a}
Mean Protein Intake (g)	9.53^{a}	10.86^{b}	9.56^{a}	9.68^{a}	9.38^{a}
Protein Efficiency Ratio (PER)	0.85^{b}	0.81^{a}	0.79^{a}	0.73^{a}	0.69^{c}

. Means across the same row differently superscripted differ significantly ($P<0.05$).NS = no significant ($P<0.05$) difference across the same row

Table 4: Carcass proximate analysis of *C. ariepinus* fingerlings before and after experiment

	CP	CF	EE	NFE	Ash	MC
Initial	59.52	5.78	4.90	6.98	13.10	9.75
End						
1 Control	62.16^{b}	6.37^{a}	4.60^{c}	3.68^{a}	13.68^{a}	9.20^{a}
2	64.14^{c}	6.32^{a}	2.98^{a}	3.50^{a}	13.14^{a}	9.35^{a}
3	61.41^{b}	6.93^{a}	2.71^{a}	3.48^{a}	14.24^{b}	11.23^{b}
4	60.13^{a}	7.28^{a}	3.81^{b}	2.93^{b}	14.25^{b}	11.57^{b}
5	60.07^{a}	6.86^{a}	3.43^{b}	2.86^{b}	14.23^{b}	12.05^{b}
MEAN±SEM	61.58±0.50	6.75±	3.51±	3.29±	13.91±	10.68±

Where CP = Crude Protein CF = Crude Fibre EE = Ether Extract NFE = Nitrogen Free Extract MC = Moisture Content.

Table 5: Hematological Analysis of *C. gariepinus* fingerlings fed graded inclusion levels of Cow blood Rumen blen (CBR)

Hematological Analysis	Initial	1 (0% CBR)	2 (25% CBR)	3 (50% CBR)	4 (75% CBR)	5 (100%CBR)
Hemoglobin (Hb)/100ml	8.4 ± 0.01^{b}	10.40^{c}	11.0 ±0.2	10.0 ± 01	11.5±0.2^{c}	12.0±0.2^{c}
Packed cell volume	26.0V0.05^{a}	32.0±0.6^{b}	34.01±1.2^{c}	30.0±0.5^{c}	36.0±0.5^{c}	38.0±0.6^{c}
Red Blood Cell Count x10^{12}/1	1.20±0.01^{a}	2.60+0.01^{b}	1.72±0.01	2.72±0.01^{b}	2.40±0.10^{c}	2.50±0.01
White Blood Cell Count x109/1	6.40^{a}	7.40^{b}	6.40^{a}	5.40^{c}	8.00^{b}	7.20^{c}
Mean Corpuscular Vol. (MCV) fl	61.90±0.80^{a}	123.08±1.3^{c}	197.67±0.5^{c}	110.29±3.7^{b}	150.00±0.93^{d}	152.00±1.6^{d}
Mean Corpuscular Hemoglobim Conc. g/100 (%0 (MCHC)	33.85^{a}	32.50^{a}	32.35^{a}	33.33^{a}	31.94^{a}	31.58^{a}
Mean Corpscular Hemoglobin MCH)pg)	20.95±0.01^{c}	40.00±0.10^{c}	63.95±0.020^{d}	36.76±0.10^{b}	47.91±0.20^{c}	48.00±0.20^{c}

Values are means ± SE. Means across the same row differently superscripted differ significantly ($P<0.05$).

References

A. O. A. C. 1991. Association of Official Analytical Chemist, 12th Edition, Washington D> C. 1091p.

Ayinla, A. O. and Bekibele, D. O. 1992. Locally available feeding ingredients and nutrition values in Nig. NIOMR Training programme in fish feed formulation and production, Lagos, 1992.

Boyd C. E. (1979). Water quality management in Warm Water fishpond. Alabama Agricultural Expt. Station Research and Development, Series 22, pp 1-11.

Daniel, W. W. 1995. Biostatistics: A foundation of Analysis in the health Sciences 6th ed. Wiley New York.

Dupree, H. K. and Hunter, J. V. 1984. Nutrition feeds and feeding Practices. Third report to fish farmers U. S. Dept. Fish and Wildlife Services pp 141-157.

Falaye A. E. 1988. Utilization of cocoa husk in the nutrition of Tilapia Oreochromis niloticus Trewaves. Ph. D Thesis of the University of Ibadan. Nigeria. 301pp

Faturoti, E. O. and Ayinla, A. O. 1998. Nutrient utilization and growth performance of *C. gariepinus* (Burchell, 18220 fed graded protein diets, Accepted Journal of West Africa.

FAO 1989. FAO Agric. Services Bulletin, FAO of UN, Rome, 1989.

FAO 1995. The state of world Fisheries and Aquaculture Rome, 1995 143pp.

Hasting, W. H. and Dupree, H. K. 1969. Fish Nutrition and fish feed manufacture, in advances in aquaculture. Edited by T. V. R. Pillay and Win, A. O. FAO (1978) Fishing News Books Farham Surrey, England. Pp. 568-574.

Jain, W. C. 1986. Schalm's Veterinary Hematology. 4th Edition. Lea and Febiger. Philadelphia. Pp. 149-162.

Lovell, R. T. 1987. Nutrition and Feeding of fish, Avi book, published by Van Nostrand Reinhold New York 260p.

NRC (National Research Council) 1983. United States Canadian table of feed Composition. Committee on animal nutrition. Washington D. C. National Academy Press 148p.

Kumor, 1989. Processing of Animal by-products in developing countries. A manual of Commonwealth Science Council, London.

Olukunle O. A. 1996 Nutritional Potentials of processed Sesame indium in the diets of *Clarias gariepinus* Burchell 1822. A Ph D thesis of the University of Ibadan. 172p.

Olukunle Oyin and G. O. Agboola 2005. Growth Performance and nutrient Utilization of African Catfish, *Clarias gariepinus* fingerlings fed diets with graded inclusion levels of Duckweed (Lemna sp.)

Omitoyin, B. O. and E. O. Faturoti 2000. Evaluation of chicken offal meal as protein source for African catfish, *Clarias gariepinus* fingerlings raised in earthen pond. J. of W. African Fisheries Vol. IX; 488-495.

Otubusin, S. O. and Anaechi, S. V. 1987. The effect of different combinations of Industrial and Agricultural waste as supplementary feeds in Tilapia *(O. niloticus)* fingerlings. Kainji Lake Research Institute Annual Report 198.

Recces, D. L. and Wesley D. E. 1975. A blood meal/rumen contents blend as partial or complete substitute for fishmeal in channel catfish diets. Fish. Cul: 37:15 -19.

Shepherd, J. And Bromage, N. 1992. Intensive fish farming. Blackwell Scientific Publication pp. 147-154.

Shiau, S. Y; J. L. Chuag and C. L. Sun 1987. Inclusion of soyabean meal in Tilapia (oreochromis niloticus and O. Aureus) diets at two protein levels. Aquaculture 65: 251-261.

Ufodike, E. B. C. and Ugwuzor G. N. 1985. The effect of fishmeal cow blood meal and sorghum diets on food utilization and growth of cultured *Oreochromis niloticus*. Biologia Africana 2 (1): 69-74.