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Utilization of Two Dietary Plant Oil Sources On Growth, Haematology, Histometry and Carcass Analysis Of Juvenile *Clarias Gariepinus*.

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ABSTRACT
A total of 210 juvenile African catfish (Clarias gariepinus) were used for the experiment. Fish stocked at10/ experimental tank (52.5 X 33.5 X 21cm) and were allowed to acclimatize for two weeks. Feeding of the fish was done ad libitum manually by hand twice daily and the water was changed with borehole water every other day. There was significant (P<0.05) increase in the final weight of fish fed palm-oil and shea-butter from the least inclusion (1.0%) up to 1.5%, but there was decline in growth at the highest inclusion level of 2.0% of both test ingredients. Protein utilization significantly reduced with increase in palm oil inclusion, while the fish on diet containing 1.5% shea-butter inclusion displayed the highest protein intake (47.04). The highest cholesterol level was recorded in fish fed diet with 2.0% shea-butter inclusion (215.00 mg/dl), while the lowest value (135.00 mg/dl) was recorded in fish in the control diet. Triglyceride was highest in diet with 2% palm oil inclusion (262.00) while the lowest value (211.50) was recorded in the control diet. There was significant difference (P<0.05) in the organ analysis across the test diets with liver and kidney showing significant reduction with increased inclusion of the test ingredients, while the opposite was recorded in the spleen. From the experiment both palm oil and shea-butter oil could be used as energy source in the diet of juvenile African catfish up to 1.5% inclusion without any adverse effect to the fish growth and health.

Introduction

Worldwide, natural vegetable oil and fats are increasingly becoming important in nutrition and commerce because they are sources of dietary energy, anti-oxidants, bio-fuels and raw material for the manufacture of industrial products. They are used in food, cosmetic, pharmaceutical and chemical industries (Okullo *et al.,* 2010).

Lipids are a broad group of naturally occurring molecules which include fats, waxes, sterols, fat-soluble vitamins, monoglycerides, diglycerides, phospholipids and others. Lipids are highly digestible source of concentrated energy; it contains about 2.25 times as much energy as equivalent amount of carbohydrates (Robinson *et al.,* 2001), and proteins (Sotolu, 2010).

In aquaculture, dietary lipids play an important role in commercial diets as source of energy, essential fatty acids for growth and development of fish (Pei *et al.,* 2004). Fish oil is the major source of dietary lipids in aquaculture nutrition. Fish oil is produced from small marine pelagic fish and represents a finite fishery resource (Ng *et al.,* 2003).

However, due to several factors including over-fishing resulting in dwindling catch and environmental changes which necessitate tight regulations, future demand for wild-caught fish will exceed supply (Sargent *et al.,* 1999). It has been estimated that aqua feeds currently use about 60% of the global supply of fish oil (Barlow *et al.,* 2000). The predicted use of fish oil for aquaculture is estimated to rise to about 90% of the total available by 2010 (Barlow *et al.,* 2000). Following this trend, there would be increase in the cost of fish oil which would culminate into increase in cost of aquaculture feed. Hence, a growing demand to substitute fish oil with less expensive lipid-rich sources (New and Wijkstrom, 2002).
Lipids supply about twice the energy as proteins and carbohydrates (Sotolu, 2010). According to Jobling (1983), cost effective, practical aquaculture feeds can be produced using vegetable oil in the absence of fish oil with no resulting or apparent loss in fish growth. Hence, there is a growing demand to substitute fish oil with less expensive lipid-rich sources (New and Wijkstrom, 2002).
Plant oil are used as dietary lipid in the diets of fish as a major source of essential fatty acid (EFA) that are needed for the normal growth and structural development. They also aid the absorption of fat soluble vitamins such as vitamins A, D, E and K. Lipids requirement of fish is a function of fish species and their ability to synthesize or utilize the conversions (O'Mara, 1998).

Palm oil, currently the second most available vegetable oil in the world, presents a viable alternative to fish oil in aqua feeds (Ochang *et al.,* 2007) and it is rich in carbon16:0 and 18:1(n-9) fatty acids, but has relatively low levels of 18:2(n-6), as well as carotenes, tocopherols and tocotrienols (Nesaretnam *et al*.,1993). Studies on the use of crude palm oil and refined, bleached and deodorized palm oil as dietary lipid for catfish have shown good results (Legendre *et al.* 1995; Ng *et al.,* 2000; Ng *et al.,* 2003) likewise in the diet of Nile Tilapia (Ochang *et al.,* 2007).
Shea-butter fat, obtained from Shea butter seed is a readily available and cheap cooking ingredient in the Northern part of Nigeria where the tree grows virtually everywhere (Yusuf 2009). Several authors (Hilton, 1982; Lovell, 1989) indicated that the Shea butter lipid is digested with ease and so serve as a butter energy source for protein sparing than carbohydrate as well as sources of essential fatty acids. The high level of un-saturated fats in Shea oil makes it better edible oil. This is because food containing high levels of un-saturated fats can: improve digestibility, easily infiltrate the bile salt and bind to low weight proteins. The fact that the oleic fatty acid values in Shea oil are higher than in soya bean oil (25%) and palm oil (36%) makes Shea oil a good source of poly-unsaturated fatty acids. Anti-oxidants such as [alpha]-tocopherol can be responsible for reducing degenerative diseases and also for mopping up free radicals responsible for oxidative damage of cell membranes, skin and cancer (Olukemi *et al*.,

2005). Since [alpha]-tocopherol is one of the groups of fat soluble vitamin compounds that cannot be synthesized by animal cells; it must be obtained from plant sources through diet (Kornsteiner, *et al*., 2005). Because of their vital roles, the presence of [alpha]-tocopherol in Shea oil and palm oil makes them important oils.

This study was carried out to evaluate the nutritive potential of palm oil and Shea butter in the diet of *Clarias gariepinus*, their influence at graded levels on the growth performance, haematology, organ analysis and carcass proximate composition.

Materials and Methods

Experimental Procedure

The 56 days experiment was carried out at the Nutrition Unit of the Department of Marine Sciences, University of Lagos, Akoka, Nigeria.

Three hundred African catfish (*Clarias gariepinus*) juveniles were purchased (to give room for mortality during transportation) from a fish farm at Ikotun-Egbe, Lagos and transported to the Nutrition Unit of the University of Lagos. The experiment was run in triplicate, a total of 210 juveniles were used for the experiment, spread in ten fish per experimental tank (52.5 X 33.5 X 21cm) and were allowed to acclimatize for two weeks during which the fish were fed with Coppens (2mm-3mm, a commercial feed). After the acclimatization, the fish were randomly re-distributed in the experimental tank based on the average body weight range of 15.00-15.25 g using an electronic digital scale (KERN 770, max. 220 g, d= 0.0001g)

The feeding of the fish was done *ad libitum* by hand twice daily (10.00 and 17.00 hr) with the formulated experimental diets. Through the experimental period, water was changed with borehole water every other day to maintain good water quality, temperature (27.5-29.5ºC) was recorded with a thermometer, dissolved oxygen (4.5-4.8mgL^{-1}) was determined by Winkler's method and pH (7.3-8.0) was determined with a pH meter (Hannah E251).

Procurement and processing of feed ingredients

The feed ingredients (fish meal, soybean meal, groundnut cake, indomie waste, fish premix, dicalcium phosphate, vitamin C and salt) were bought from Soleace Enterprise at Oko-Oba, Agege, Lagos. Palm oil and Shea butter fat were purchased from Oyingbo market at Ebute-metta area of Lagos.

The ingredients were milled, accurately measured and thoroughly mixed with hot water to form homogenized dough; each diet was pelletized to 2mm size using a locally made manual pelletizer.

Experimental diets and Feeding

Seven isonitrogenous (46.5% crude protein) diets were formulated; the control diet was without any of the test ingredients, the other six diets divided into two had palm oil and

Shea butter at 1.0, 1.5 and 2.0% inclusion levels respectively.
The juveniles were fed to satiation twice daily at 10.00h and 17.00h throughout the experiment period. The feed intake and the weight gained were recorded every week for the duration of the experiment.

Laboratory procedures

Haematological Analysis

Blood sample of fish taken at random from each tank were collected in both syringe and heparinized bottles for haematological assay and taken to Bioassay Diagnostic Laboratory Cele-Egbe, Ikotun-Lagos. Haemoglobin (Hb), red blood cells (RBC), white blood cells (WBC) and packed cell volume (PCV) were analyzed using the methods described by Svobodova *et al.* (1991). Cholesterol and Triglycerides was also determined using enzymatic colometric test. Mean Corpuscular Haemoglobin Concentration (MCHC), Mean Corpuscular Haemoglobin (MCH) and Mean Corpuscular Volume (MCV) were calculated according to the formulae given by Dacie and Lewis (2001).

To calculate the MCHC, expressed as gram of haemoglobin per 100ml packed cell

$$\text{MCHC} = \frac{\text{Haemoglobin (g/100ml)} \times 100}{\text{Haemocrit (\%)}}$$

To calculate the MCV, expressed in femtolitres (fl or 10^{-15}L)

$$\text{MCV} = \frac{\text{Haemocrit (\%)} \times 10}{\text{RBC count (millions/L blood)}}$$

To calculate the MCH, expressed in pictograms (pg)

$$\text{MCH} = \frac{\text{Haemoglobin (g/100ml)} \times 10}{\text{RBC count (millions/L blood)}}$$

Carcass Analysis

The proximate composition of fish carcass taken from each treatment tank after the experiment was analyzed at the Department of Animal Sciences, University of Ibadan. The crude protein, ether extract and dry matter were determined according to the Association of Analytical Chemists Method (A.O.A.C., 2004).

Growth, Economic and Nutrient Utilization Parameters

Growth was estimated in terms of mean weight, relative weight and specific growth rate (Bagenal, 1978).

1) Mean Weight Gain (MWG)

MWG =Mean final body weight (g) - Mean initial body weight (g)

2) Relative Weight Gain (RWG)

$$RWG = \frac{\text{Average Weight Gain (g)}}{\text{Number of days (day)}}$$

3) Specific Growth Rate (SGR)

$$SGR = \frac{(\text{Log}_e W_1\ (g) - \text{Log}_e W_2\ (g) \times 100}{T_2 - T_1\ (\text{day})}$$

Where, e = natural logarithm

$T_2 - T_1$ = experimental period

W_1 = initial weight

W_2 = final weight

Nutrient utilization indices were expressed as follows;

4) Feed Conversion Ratio (FCR)

$$FCR = \frac{\text{Feed eaten in dry mass (g)}}{\text{Weight gain (g)}}$$

5) Protein Efficiency Ratio (PER)

$$PER = \frac{\text{Mean weight gain}}{\text{Protein intake}}$$

Where Protein intake = $\frac{\text{Total feed intake}}{\text{Protein content of feed}}$

Economic evaluations were analyzed in terms of Gross profit (GP), Net profit value (NPV), Investment cost analysis (ICA), Profit index (PI) and Incidence cost (IC).

They were calculated according to New (1989), Faturoti and Lawal (1986) and Mazid *et al.* (1997) as follows;

6) Gross Profit (GP)

= Net profit value - Investment cost analysis

7) Net Profit Value (NPV)

= Mean weight gain × Total number of fish (n) × Cost per kilogramme (₦)

8) Investment Cost Analysis (ICA)

= Cost of feeding (₦) + Cost of juvenile stocked (₦)

9) Profit Index (PI)

$$= \frac{\text{Value of fish (₦)}}{\text{Cost of feeding (₦)}}$$

10) Incidence of Cost (IC)

$$= \frac{\text{Cost of fish}(\text{₦})}{\text{kilogramme of fish produced}}$$

The cost was based on current prices of feed ingredient in the experimental locality as at the time of experiment.

Statistical Analysis

All data collected were subjected to analysis of variance (ANOVA). Comparisons among diets means were carried out by Duncan Multiple Range Test (Duncan, 1955) at significant level of 0.05. All computations were performed using Statistical package SPSS15.0 (SPSS Inc., Chicago, IL, USA).

Results

There was significant ($P<0.05$) increase in the final weight of fish fed palm-oil and shea-butter from the least inclusion (1.0%) up to 1.5%, there was however decline in growth at the highest inclusion level of 2.0% of both test ingredients. The highest mean weight gain (117.47g) was recorded in fish fed 1.5% shea-butter while the least was recorded by fish fed 2.0% palm oil (86.50g). The fish fed palm oil containing diet showed significant ($P<0.05$) reduction in feed intake with increased inclusion rate, while those with Shea butter recorded significant ($P<0.05$) increase up to 1.5% inclusion until decline was observed at the highest inclusion of 2.0%. There was significant ($P<0.05$) reduction with increased palm oil inclusion in the protein utilization, while the fish on diet containing 1.5% shea-butter inclusion displayed the highest effective protein intake (47.04). Similar pattern was obvious in the net profit value and gross profit of each diet group.

There was significant difference ($P<0.05$) observed for all haematological parameters analyzed across the diets. The highest cholesterol level was recorded in fish fed diet with 2% shea-butter inclusion (215.00 mg/dl), while the lowest value 135.00 mg/dl was recorded in fish in the control diet. Triglyceride was highest in diet with 2% palm oil inclusion (262.00) while the lowest value 211.50 was recorded in the control diet. (Table 3)
There was significant difference ($P<0.05$) recorded in organ/ fish weight ratio values of the Liver, Spleen, Kidney and Stomach. The highest value for liver was recorded in the control diet while the least value was in 2% shea-butter inclusion. There was no significant difference in fat deposited among diet but the lowest value was recorded in

the control diet. (Table 4). There was a significant difference ($P<0.05$) recorded in proximate composition parameters analyzed among diets. The highest crude protein was recorded for the control diet (75.71%) and the least in diet 5 (68.50%). Result of analysis is shown in Table 5.

Discussion

Use of plant lipid sources in the production of aqua-feed has been a welcome development for the development of the aquaculture industry over decades (Sotolu 2010). Recent studies have revealed that substantial use of vegetable oils as energy sources in fish diets have yielded positive growth response in fish (Babalola and Adebayo 2007; Aderolu and Akinremi 2009). The results gathered from the study have demonstrated that the two vegetable oil sources used are of good nutrient composition.

This observation could imply that there was no palatability problem and that their utilizations were adequate, which is similar to the work of Aderolu and Akinremi (2009) in the utilization of coconut oil and peanut oil in catfish diet. Sotolu (2010) recorded similar observation when he fed diets containing benni seed oil, groundnut oil, soybean oil and palm oil to *Clarias gariepinus* fingerlings. The growth improvement observed agreed with Lim *et al.* (2001) that up to 8% of refined, bleached, deodorized, palm olein (RBDPO) or, crude palm oil CPO can be included in diets for the African catfish with improved performance, protein retention and fillet vitamins E concentration of this fish. Also the work of Pie *et al.* (2004) reported improvement in carp fed dietary lipid. Ng *et al.* (2000) also reported that up to 90% of dietary fish oil could be replaced by crude palm oil without compromising growth or feed utilization efficiency of a tropical catfish, *Mystus nemurus*. The fish on the experimental diets at high inclusion levels (2.0% inclusion level Palm oil and Shea butter oil) showed low growth performance level when compared to 1.5% inclusion level Palm oil and Shea butter oil. The present study showed that increase in dietary lipid level was associated with decline in feed intake. This indicates that there was either palatability problem or feed intake depression. This agreed with earlier report that at high dietary lipid level, growth rate may decrease due to reduced ability to digest and absorb high lipid, reduction in feed intake and or fatty acid imbalance in feed (Ellis and Reigh, 1991). Though, this is not in agreement with the work of Babalola and Adebayo (2007) that reported higher level of plant oil inclusion (12.5%) in the diet of *Heterobranchus longfilis* fingerlings. Bell *et al*., (2002); Ng *et al*., (2003); (2004) reported the use of high levels of palm oil in fish diets will decrease the concentrations of beneficial omega-3 HUFA in fish fillets destined for the human consumer. Apart from not prejudicing the health and welfare of fish, the use of palm oil products in aqua-feed should also not affect the taste and health-promoting benefits to the consumer, especially in terms of its n-3 polyunsaturated fatty acid (PUFA) content.

The improvement in feed conversion ratio FCR with increasing high lipid level in both ingredients tested is in agreement with other studies (Einen and Roem 1997; Weatherup *et al*. 1997; Pie *et al*. 2004). The decrease in protein efficiency ratio PER with increasing high lipid level in both ingredients tested agreed with earlier studies, Peres and Oliva-Teles (1999) did not observe any protein sparing effect of lipid when they fed European *Zea bass* on graded levels of dietary lipid. It could also be inferred that the level of oil being tested is not enough to cause any protein sparing effect. Increased PER could probably be that increased lipid level spared dietary protein conversion into energy (Chou and Shiau, 1996; Regost *et al*., 2001). Lim *et al.* (2001) explained that there is a definite influence of a non protein source of energy (lipid or carbohydrate) on the nitrogen retention and that dietary lipid may also influence the growth performance and protein utilization.

Fish haematology is gaining increasing importance in fish culture because of its importance in monitoring the health status of fish (Hrubec *et al.* 2000). Haematological characteristics of most fish have been studied with the aim of establishing normal value range and any deviation from it may indicate a disturbance in the physiological process (Rainzapaiva *et al*., 2000). The values obtained in this experiment were within the normal ranges recommended for *Clarias gariepinus (*Joshi *et al*., 2002). The values obtained in this experiment for both the PCV and Hb were within the normal ranges recommended for *Clarias gariepinus* (Sunmonu, 2008 and Adedeji, 2009). The Haemaglobin values are much higher than those obtained by Subhadra *et al*. (2006) for the largemouth bass with diets containing canola oil, chicken oil and menhadden fish oil, which ranged between 3.7-3.9 g dl. The cholesterol values recorded in this experiment are below the values obtained by Aderolu and Akinremi (2009) who reported the dietary effects of coconut oil and peanut oil on biochemical characteristics of *Clarias gariepinus* juvenile.

Carcass analysis showed a significant difference (P<0.05) between the control diet and others in terms of the crude protein values; diet 6 (1.5% Shea butter oil) which had crude protein level (73.30%) slightly lower than that of the control diet (75.71%) had better ratios of growth, nutrient utilization and economic conversion than the control diet. Lim *et al*. (2001) found a significantly higher whole body protein in fish fed diets with 12% or 16% refined, bleached deodorized, palm olein (RBDPO) or 16% crude palm oil (CPO).

From the experiment both palm oil and shea-butter oil could be used as energy source in the diet of juvenile African catfish up to 1.5% inclusion without any problem to the fish growth and health.

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Table 1: Composition of Experimental Diets.

Ingredient (%)	**Diet 1**	**Diet 2**	**Diet 3**	**Diet 4**	**Diet 5**	**Diet 6**	**Diet 7**
Groundnut cake	15.13	15.13	15.13	15.13	15.13	15.13	15.13
Soybean meal	45.97	45.97	45.97	45.97	45.97	45.97	45.97
Fish Meal	27.00	27.00	27.00	27.00	27.00	27.00	27.00
DCP	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Vitamins C	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Premix	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Salt	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Indomie waste	10.00	9.00	8.50	8.00	9.00	8.50	8.00
Palm oil	-	1.00	1.50	2.00	-	-	-
Shea butter oil	-	-	-	-	1.00	1.50	2.00
TOTAL	100	100	100	100	100	100	100
Calculated Crude Protein	46.75	46.63	46.57	46.51	46.63	46.57	46.51
Calculated ether extract	2756.03	2800.47	2822.69	2844.91	2776.24	2786.35	2796.45
Calculated Energy	4.13	5.09	5.56	6.04	5.11	5.59	6.08
Calculated Crude Fibre	4.22	4.20	4.19	4.18	4.20	4.19	4.18
Cost of Feed(₦/Kg)	180.48	182.54	183.58	184.61	181.88	182.58	183.28

Diet 1 - Control Diet 2 – 1.0% Palm oil
Diet 3 – 1.5% Palm oil Diet 4 – 2.0% Palm oil
Diet 5 – 1.0% Shea butter oil Diet 6 – 1.5% Shea butter oil
Diet 7 – 2.0% Shea butter oil

Table 2: Growth performance, nutrient utilization and economic indices of *Clarias gariepinus* juvenile fed the different experimental diets

	EXPERIMENTAL TREATMENT						
PARAMETERS	**DIET 1**	**DIET 2**	**DIET 3**	**DIET 4**	**DIET 5**	**DIET 6**	**DIET 7**
Mean final weight (g/fish)	121.73[ab]	118.74[ab]	122.08[ab]	101.58[b]	110.70[ab]	132.63[a]	115.52[ab]
Mean initial weight (g/fish)	15.08	15.17	15.00	15.08	15.25	15.17	15.25
Mean weight gain (g/fish)	106.75[ab]	103.57[ab]	107.08[ab]	86.50[b]	95.45[ab]	117.47[a]	100.27[ab]
Relative growth rate (%/day)	707.85[ab]	682.15[ab]	713.89[ab]	572.85[b]	625.92[ab]	774.30[a]	657.53[ab]
Specific growth rate (%/day)	1.62[ab]	1.58[ab]	1.62[ab]	1.47[b]	1.54[ab]	1.68[a]	1.57[ab]
Feed intake (g/fish)	90.18[ab]	90.09[ab]	88.92[b]	77.31[c]	81.75[bc]	100.09 [a]	91.44[ab]
Voluntary feed intake(g/fish)	17.99	18.64	17.69	18.47	17.85	18.34	19.25
Feed conversion ratio	0.85	0.89	0.83	0.9	0.86	0.85	0.91
Protein intake	42.38[ab]	42.34[ab]	41.79[bc]	36.33[bc]	38.42[c]	47.04[a]	42.97[ab]
Protein efficiency ratio	2.52	2.42	2.56	2.37	2.48	2.58	2.33
Cost of Feed(₦ /Kg)	180.48	182.54	183.58	184.61	181.88	182.58	183.28
Profit index (₦)	0.0311[ab]	0.0302[ab]	0.0308[ab]	0.0225[b]	0.0257[b]	0.0377[a]	0.0299[ab]
Net profit value (₦ /Kg)	1008,09[ab]	998.88[ab]	997.55[ab]	727.39[b]	831.46[b]	1220.61[a]	969.41[ab]
Incidence cost analysis (₦)	78.37[ab]	76.77[ab]	78.27[ab]	65.72[b]	71.17[ab]	85.66[a]	75.38[ab]
Incidence cost	0.1525	0.1602	0.1498	0.1628	0.1543	0.1534	0.1654
Gross profit (₦)	929.73[ab]	922.11[ab]	919.28[ab]	661.66[b]	760.28[b]	1134.95[a]	894.04[ab]

All values on the same row with different superscripts are significantly different (P<0.05)

Table 3: Haematology Analysis

	EXPERIMENTAL TREATMENT						
PARAMETERS	**DIET 1**	**DIET 2**	**DIET 3**	**DIET 4**	**DIET 5**	**DIET 6**	**DIET 7**
Red Blood Cell (10^6 /L)	8.55[ab]	8.90[a]	8.45[ab]	8.75[a]	7.00[b]	8.15[ab]	8.85[a]
Packed Cell Volume (%)	36.00[a]	37.50[a]	36.00[a]	37.00[a]	29.50[b]	34.50[ab]	37.50[a]
White Blood Cell (mm^3)	9000[b]	12500[a]	12000[a]	14000[a]	11500[ab]	12500 [a]	9000[b]
Haemoglobin count (g/dl)	11.65[a]	12.00[a]	11.60[a]	11.90[a]	9.65[b]	11.27[a]	12.00[a]
MCHC(g/dl)	32.36	32.00	32.22	32.16	32.71	32.46	32.00
MCH (pg)	13.63	13.60	13.73	13.66	13.79	13.68	13.67
MCV (fl)	42.11	42.13	42.60	42.29	42.14	42.33	42.37
Cholesterol mg/dl	135.00[d]	180.00[abc]	160.00[bcd]	175.00[abcd]	190.00[ab]	165.00[bcd]	215.00[a]
Triglycerides	211.50[dc]	236.50[abc]	228.50[bc]	262.00[a]	222.00[bcd]	219.00[bcd]	248.00[ab]

All values on the same row with different superscripts are significantly different (P<0.05).

MCHC- Mean Corpuscular Haemaglobin Concentration

MCH- Mean Corpuscular Concentration MCV- Mean Corpuscular Volume

Table 4: Histometry Analysis (% body weight)

	EXPERIMENTAL TREATMENT						
PARAMETERS	**DIET 1**	**DIET 2**	**DIET 3**	**DIET 4**	**DIET 5**	**DIET 6**	**DIET 7**
Liver	1.1690^{a}	1.0817^{abc}	1.1567^{ab}	0.9033^{abc}	0.9703^{abc}	0.9820^{abc}	0.8173^{c}
Spleen	0.0563^{b}	0.0790^{ab}	0.0740^{ab}	0.0960^{ab}	0.1483^{ab}	0.1690^{a}	0.1610^{ab}
Kidney	0.5300^{a}	0.4750^{a}	0.4997^{a}	0.3107^{b}	0.4910^{a}	0.4263^{ab}	0.3977^{ab}
Heart	0.16	0.14	0.34	0.13	0.17	0.26	0.14
Small intestine	0.6233	0.7813	0.5700	0.6313	0.8217	0.7957	0.7643
Large intestine	1.049	1.1403	0.9373	0.5117	1.0237	1.0240	0.9400
Stomach	0.9183^{b}	1.1407^{ab}	1.1177^{ab}	1.077^{ab}	1.2090^{ab}	1.2320^{ab}	1.2140^{ab}

Table 5: Proximate Composition of Carcass (%)

	EXPERIMENTAL TREATMENT						
PARAMETERS	**DIET 1**	**DIET 2**	**DIET 3**	**DIET 4**	**DIET 5**	**DIET 6**	**DIET 7**
Dry Matter	18.60^{bc}	18.96^{bc}	19.96^{a}	20.38^{a}	17.54^{ef}	17.80^{de}	17.17^{f}
Crude protein	75.71^{a}	70.50^{c}	68.87^{d}	70.53^{c}	68.50^{d}	73.30^{b}	69.46^{cd}
Ether Extract	23.33^{bcd}	24.17^{b}	25.50^{a}	25.67^{a}	23.00^{d}	22.00^{e}	23.97^{bc}

All values on the same row with different superscripts are significantly different ($P<0.05$).