GROWTH PERFORMANCE OF *Clarias gariepinus* FED GRADED LEVELS OF PLANTAIN PEELS AS REPLACEMENT FOR MAIZE.

BY

OMISANMI, OLUWATOSIN VICTORIA

(FAQ/12/0470)

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A PROJECT SUBMITTED TO THE DEPARTMENT OF FISHERIES AND AQUACULTURE, FACULTY OF AGRICULTURE, FEDERAL UNIVERSITY OYE EKITI, EKITI STATE, NIGERIA

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE BACHELOR OF FISHERIES AND AQUACUTURE

DECLARATION

I declare this work entitled "**GROWTH PERFORMANCE OF *CLARIASGARIEPINUS* FED GRADED LEVELS OF PLANTAIN PEELS AS REPLACEMENT FOR MAIZE**' has been carried out by me in the department of fisheries and aquaculture under the supervision of Dr. J. B Olasunkanmi.

Omisanmi oluwatosin V.	____________	19 - 12 - 2017
	Signature	Date

CERTIFICATION

This is to certify that the experiment reported was conducted by **OMISANMI, OLUWATOSIN VICTORIA** with Matric No **FAQ/12/0470** of the Department of Fisheries and Aquaculture, Faculty of Agriculture, Federal University Oye Ekiti.

10/01/2018

DR. J.B OLASUNKANMI (B.Sc; M.Sc, PGDE, PhD (Ibadan)
Supervisor

Date

DR. T.O. BABALOLA
Head of department

Date

DEDICATION

This Project is dedicated to God Almighty, my dear parents, my wonderful brother and sister and my lovely friends for their support financially, morally and materially. Thank you all and God bless.

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My sincere appreciation goes to Almighty God, the Source of my strength, the only Source of Authority that renders all other forms of authority impotent. My LORD and KING, the blessed and only potent, the KING of kings and LORD of lords, dwelling in the light which no man hath seen or can see. To him alone all the glory is.

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To the Head of Department Dr. T.O Babalola, the authorities of the Federal University Oye-Ekiti especially those in the Department of Fisheries and Aquaculture as well as the lecturers of the great department, who have taken pains to impart knowledge into me and also guiding me on the path of excellence in academic and career

To all Departmental mates in this great institution, I appreciate you all for your moral support for making my stay a memorable one.

My sincere gratitude also goes to my fiancé Mr Vincent Segbuwa for his financial and moral support towards the completion of this project work. God will lift you high above your expectation and may God grant you all your heart's desire.

My gratitude also goes to my loving, caring, ever ready and always active parents Mr and Mrs OMISANMI, my wonderful siblings Bamidele Omisanmi, Temitope Omisanmi, Oluwaseun Omisanmi, and Omowumi Omisanmi for their financial, spiritual and moral support towards my academic pursuit in this great institution, the blessing of God will continue to abide with you.

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ABSTRACT

High cost of feed is a major constraint to fish farming in Nigeria. This study investigated the growth performance of African catfish (*Clarias gariepinus)* fed graded levels of plantain peels (PPM). PPM was used to replace maize at 0% (T1) 25% (T2) 50% (T3), 75% (T4) and 100% (T5) for 56 days level. Data collected were analyzed using One-way ANOVA test. Results showed that control diet (0% PPM) recorded the highest average weight gain (7.34 ± 0.09) which was significantly different ($p<0.05$) from the other treatments. However, there was no significant difference ($p>0.05$) in the weight gain for T2 (25%) and T3 (50%). A Similar trend was observed in specific growth rate (SGR), feed conversion ratio (FCR) and protein efficiency ratio (PER). Packed cell volume (PCV), Haemoglobin (HB).Red blood cell (RBC).Mean corpuscular haemoglobin cell (MCHC). Lymphocytes were significantly higher ($p<0.05$)in treatment 4 than any other.MCV was highest in treatment 1 and lowest in treatment 4. MCH was significantly higher ($p<0.05$) in treatment 1 and lowest in treatment 3. WBC was significantly higher ($p<0.05$) in treatment 3 and Neutrophils was significantly higher ($p<0.05$) in treatment 5. From the results of this study. PPM compares favorably with maize: with the optimum inclusion level obtained in this study is 50% PPM.

CHAPTER ONE

1.0 INTRODUCTION

Fish is the cheapest and direct source of animal protein and micro nutrients for several millions of Africans (Bene and Heck, 2005). Fish is generally accepted as protein source in diets of average Nigerians (Agbabiaka, 2010a). In Nigeria, fish is widely accepted by the populace, thereby making the demand for it to be on the increase. In recent time, a good amount of fish consumed by Nigerians is from aquaculture because the conventional fish catch from ocean and rivers are continually declining due to over fishing and environmental hazards (Changadeya *et al.*, 2003). According to FAO (2006), fish supplies from capture fisheries will, therefore, not be able to meet the growing global demand for aquatic food.

Fish has continued to be the source of the hope toward solving global problem of the malnutrition due to its richness in nutritive value above other animal sources of protein (Delgade *et al.*, 2003 and Fasakin, 2008).

Fish feed accounts for at least 60% of the total cost of production (Fagbenro and Adeparusi, 2003; Gabriel *et al.*, 2007). Fish feed consist of a range of ingredients nutritionally formulated to provide fish all the correct nutrients in the form of protein, fat, carbohydrate, vitamins, and minerals. It has been emphasized in the formulation of least cost fish feed towards ensuring profitable fish business. Feed is one of the major inputs in aquaculture production and fish feed technology is one of the least developed sectors of aquaculture particularly in Africa and other developing countries of the world (Gabriel *et al.*,2007). Thus, incapacitating the expansion of farms to increase production and consequently, low yield in terms of quality and quantity of fish. However, problem of high cost of feeding in aquaculture is further exacerbated due to the scarce and expensive nature of ingredients used in the formulation of fish feeds. Towards solving the problem of scarce and expensive feed ingredients, a number of unconventional feedstuffs have been investigated most of which are alternative protein sources since this nutrient is considered as the most expensive nutrient (Sogbesan and Ugwumba, 2008). However, it is equally important that researches are focused on other alternative energy sources to maize in fish diet (Sogbesan *et al.*, 2012).

For the purpose of nutritional and economic benefits, previous researchers have made attempts at increasing the use of unconventional plants and animal materials to replace conventional feed ingredients like maize and fishmeal in fish feed ration (Eyo,2004;Agbabiaka *et al.*,2012;)

Maize is the most important cereal grain in the world after wheat and rice (Abdulrahaman and kolawole, 2006). Maize has been a traditional energy source in formulated feeds, is a major source of metabolized energy in most compounded diets for catfish species. In production of cereals, serious issue has been coming up in many countries including Nigeria; Which have leads to reporting the use of cereals products, especially maize in fish feed as becoming increasingly unjustified in economic terms (Tewe,2004). There is therefore need to exploit cheaper energy sources to replace expensive cereals in fish feed formulation to relieve the food/feed competition between man and animal for profit maximization.

Plantain peels are by-products of the plantain processing industry, which are normally dumped in landfills, rivers or regulated grounds (Osma *et al.*, 2007).Plantain peels constitute an important source of energy, it is quite abundant and readily available and since it is of no direct importance to man, can be fully harnessed in the production of feed for animals (Omole *et al.*, 2004).Omole *et al.*, (2008) reported that the peel has the potential of replacing maize in the diet of fish. The abundance of plantain peel could serve as huge benefit for the sustainability of the aquaculture industry, if properly harnessed.

1.1 Statement of Problem

Despite the ability of fish farming, its impact to fish production is low due to certain problems. Part of these problems includes:

Human beings and livestock compete for the same feed ingredient which is causing high cost of these conventional energy sources. Another problem is high cost of production input most especially cost of fish feed. The solution to the problem must be procured through a combination of all resources available.

1.2. Justification

Quality fish production can be accomplished by creating balanced and low cost allocation of fish. The competition for the available resources, especially maize, by the feed millers and human consumption combined with limited resources for production has created serious pressure on all fish and livestock in the country. Another way round to increase supply will be to make more energy source available for human consumption and to sought for alternative energy feed for fish and livestock feed. This could reduce the cost of livestock and fish production without compromising fish quality and its uses for human consumption.

Plantain is one of the most important crops of the tropical plants, it belong to the family of Musaceae and the genus Musa. The plantain peel is discarded as waste after the edible portion is eaten thereby constituting a menace to the environment. It is reported that plantain peel contains sufficient carbohydrate to substitute as energy source in the feed industry and was prescribed as a potent food source (Adeniji T A 2006). However, the peel is a predominant waste. Therefore, there is need to explore ways by which it could be put into efficient use. This calls for research, hence, the need for this work.

1.3 Objectives of the study

The main objective of the study is to evaluate the use of plantain peel in the diet of African catfish, *Clarias gariepinus.*

The specific objectives of this research are to determine: -

- its best inclusion level in the diet of *Clarias gariepinus*
- Haematology in the diet of African catfish (*Clarias gariepinus)*

CHAPTER TWO

LITERATURE REVIEW

2.1. FISH FEED DEVELOPMENT

Fish feed technology is one of the least developed sectors of aquaculture particularly in Africa and other developing countries of the world (FAO, 2003). Feed is one of the major inputs in aquaculture production and it is one of the fundamental challenges facing the development and growth of aquaculture in the African continent. Fish feed development in Sub-Saharan Africa has not made a significant progress (Gabriel *et al.*, 2007). In Nigeria the bulk of feed used in fish production, especially for catfish are imported and this has led to high production cost of farmed fish (Aniebo *et al.*, 2009). Development and management of fish feed, play vital role in aquaculture growth and expansion, and it is a major factor that determines the profitability of aquaculture venture.

Hence, research in fish nutrition that will utilize locally available ingredients and fabricated equipment without reducing the quality of the feed is urgent and crucial to the overall success of aquaculture development, growth and expansion in Africa. Aquaculture production in Africa involves both the intensive and semi-intensive system of production, which is daily gaining ground in the continent. For any aquaculture venture to be viable and profitable, it must have a regular and adequate supply of balanced artificial diets for the cultured fishes. This is so because the dissolved nutrients that promote primary and secondary production in the natural environment are seasonal and might be insufficient or may not occur in required proportions to meet the nutritional demand of cultured fishes (Ugwumba and Ugwumba, 2007).

2.2. AQUACULTURE DEVELOPMENT AND FEEDING OF FISH

Fish has long been valued as a source of protein for human nutrition. Consumption of fish generally cuts across ecological, socio-economic, cultural and religious boundaries, leading to its predominant role as an animal protein. Presently, fish accounts for over 50% of total animal protein consumed in most developing countries and global estimate stands at 15.5% in 2003 (FAO, 2007). Fish feed accounts for at least 60% of the total cost of production (Fagbenro and Adeparusi, 2003; Gabriel *et al.*, 2007).

2.3. AQUACULTURE PRODUCTION IN NIGERIA

Despite its long history, aquaculture in Nigeria has only emerged as an industry, and has experienced tremendous growth in production during the last two decades. In 2007, production figures from aquaculture indicated a total (excluding aquatic plants) of 85,087 metric tons (FDF, 2007). Fish farming is the sub-set of aquaculture that focuses on rearing of fish under controlled or semi controlled conditions for economic and social benefits (Anthonio and Akinwumi, 2002). *Clariasgariepinus*is a highly esteemed fish in Nigeria because it commands high commercial value (Ugwumba and Ugwumba, 2007).The story of aquaculture in Nigeria is essentially the story of catfish culture and the hope of fish supply in Nigeria hangs on its development and culture (Okoye and Sule, 2001).

Food and Agriculture Organization (2002) stated that fisheries products represented a major source of export revenue for developing countries, amounting to over US $ 20 billion per annum in late 1990s. This exceeded the values obtained from the exports of meat, dairy, cereals, vegetables, fruit, sugar, coffee, and tobacco and oil seeds in 1997 from developing countries (I.T.C. 2002). Food and Agriculture Organization in 2008 reported that out of total fish produced in Sub-saharan Africa, 40% was in Nigeria and *Clarias gariepinus* contributed substantially to the total fish produced.

Catfish production is important to the Nigerian economy. It serves as a source of income, reduces the rate of unemployment in the economy and increases the Gross Domestic Product (GDP) (Adebayo *et al.*, 2013). In most countries it earn a higher price than Tilapia as it can be sold live at the market and they have a market value two to three times that of Tilapia (Emokaro *et al.*, 2010). According to Olagunju *et al.*, 2007), it requires less space, time, money and has a higher feed conserving rate. The importance of catfish itself cannot be overemphasized.

According to Anoop *et al* (2009), it provides food for the populace, it allows for improved protein nutrition because it has a high biological value in terms of high protein retention in the body, higher protein assimilation as compared to other protein sources, low cholesterol content and one of the safest sources of animal protein (Adebayo *et al.*, 2013). Many species of fish are farm produced all over the world, but Catfish is taking the lead because of its uniqueness. The demand for Catfish in Nigeria is unprecedented so much so that no matter the quantity supplied into the market, it would be consumed by ready buyers.

2.4. FOOD AND FEEDING HABITS OF *CLARIAS GARIEPINUS*

*C. gariepinus*is equipped to feed on a wide variety of food items, from minute crustaceans to fish. Predation is more efficient on invertebrate prey. Most feeding takes place at night on active benthic organisms, but they may also feed during the day and at the water surface. Individual bottom foraging is the normal mode of feeding, although catfish may also feed in groups at the water surface (Bruton, 2010).

2.5. UNCONVENTIONAL FEED STUFF

Unconventional feedstuffs are potential feed ingredients, which have hitherto not been used in fish feed production for some reasons: They are not well known or understood, no effective study of the method of production with a view to commercializing them, they are not readily available and they can be toxic or poisonous (Moel and Harwart, 2005). They could contain high quality feed nutrients that can compare favorably with conventional feed stuffs. They are expected to be cheaper by virtue of less competition for human consumption. The feedstuffs can be of animal or plant source (Jamu and Ayinla, 2003).

They are locally available feed stuffs that are not standardized. The usage is not widely-spread and they are not consumed by man in most cases. Utilization in aqua feed is very common especially in the rural area of Sub-Saharan Africa, among low income group that are actively engaged in fish farming. Gabreal*et al.* (2007) reported that these feeds normally come from kitchen wastes, plants and animal by-products.

2.6. DESCRIPTION OF PLANTAIN PEEL

Plantain peels are by-products of the plantain processing industry, which are normally dumped in landfills, rivers or regulated grounds (Osma et al., 2007). Plantain peels constitute an important source of energy. The peel is being discarded as waste after the inner fleshy portion has been consumed thereby constituting menace in environment. Omole et al (2008) reported that the peel has the potentials of replacing corn starch in diet of fish.

2.7. PROXIMATE COMPOSITION OF PLANTAIN PEEL

According to Arislem O. *et.al* ,(2012), proximate composition of plantain peel ranges between 7% to 12.71% of protein, 6.71% to 6.86% of ash, 10.57% to 15.48% of fibre, 3.75% to 3.94% of fat, 57.58% to 61.11% of carbohydrate and 4.78% to 5.19% of sugar (Adegboyega O.K(2006), Agbini, (2012).

2.8 ANTI-NUTRITIONAL SUBSTANCE IN PLANTAIN PEELS MEAL

Anti-nutritional substance in plantain peels meal as highlighted by Agbabiaka *et., al.* (2013).

Anti-nutrients	Concentration (mg/g)
Tannic acid	2.78
Phytate	35.02
Phytin phosphorus	9.87
Oxalate	1.04
Saponin	0.38
Alkaloids	0.24

2.9. **Proximate composition of the Plantain peels**

Carbohydrate	57.59
Protein	7
Lipid	6.96
Ash	10.9
Crude Fibre	6.93
Moisture	10.7
Nitrogen free extract	57.5

Plate1: *Clarias gariepinus*
Source: (Burchell, 1822)

CHAPTER THREE

MATERIALS AND METHODS

3.0. Experimental Site

The research was conducted in the wet Laboratory, Department of Fisheries and Aquaculture, Federal University Oye- Ekiti, Ikole Campus, Ekiti State, Nigeria.

3.1. Collection and processing of Plantain peels

Peels of unripe plantain were gotten from Ikole Ekiti, Ekiti State at different locations. It was sundried until a constant weight is obtained after which it was grounded and sieved into powdered form and stored in air tight free container. The resulting meal was analyzed for proximate and mineral composition using AOAC (2000).

3.2. Experimental design

There were five (5) treatment groups with three (3) replicates each. Fifteen (15) rectangular plastic aquaria were used. The fish was acclimatized for ten (10) days after which the fish were fed for eight weeks with unconventional feedstuff and the weight and other growth parameters was taken weekly.

3.3. Feed formulation

Feedstuffs were prepared and formulated into feeds, using the Pearson square method to attain 40% crude protein. Five (5) experimental feeds were formulated at varying percentage inclusions of plantain peel of 0, 25, 50, 75 and 100% replacing maize. Equal proportions of Vitamin premix, Methionine, Starch, vitamin C and NaCl (common salt) were added to the formulated diets. All other feed ingredients except Plantain peels and maize were adjusted to accommodate varying inclusion levels of plantain peel meal (Table 1).

Table 1: Percentage Composition (%) of the Experimental Diets

Ingredients	Treatment 1 (0%)	Treatment 2 (25%)	Treatment 3 (50%)	Treatment 4 (75%)	Treatment 5 (100%)
Fishmeal	30	30	30	30	30
Maize	10.64	7.98	5.32	2.66	0
Plantain peel	0	2.66	5.32	7.98	10.64
Soybean meal	30.53	29.73	29.73	29.97	29.87
Groundnut cake	15.99	16.79	16.97	16.87	17.17
W Offal	4.32	4.32	4.14	4.00	3.8
Methonine	1	1	1	1	1
Vit/min premix	2	2	2	2	2
Salt	0.5	0.5	0.5	0.5	0.5
Vitamin C	0.015	0.015	0.015	0.015	0.015
Chromic oxide	0.005	0.005	0.005	0.005	0.005
Starch	2	2	2	2	2
Veg.oil	3	3	3	3	3
Total	100	100	100	100	100

Key:

T1 (0%) = Treatment 1

T2 (25%) = Treatment 2

T3 (50%) = Treatment 3

T4 (75%) = Treatment 4

T5 (100%) = Treatment 5

3.4. Growth performance and nutrients utilization parameters

Growth performance parameters

Fish response to treatments were measured using mean weight gain, average daily growth, specific growth rate, percentage weight gain, survival rate (falayi, 2009)

- Mean weight gain (MWG) = W1 – W0

Where W1 = Finial Weight

W0 = Initial Weight

- Specific growth rate (SGR) $= \frac{\log \text{ of } W1 - \log \text{ of } w0}{T1 - TO} \times 100$

Where: -

W1 and w0 = final and initial weights of fish respectively

T1 and T0 = final and initial time of the experiment respectively

- Average daily growth (ADG) $= \frac{\text{Mean weight gain}}{\text{Experimental period (in days)}}$
- % Weight gain $= \frac{\text{Mean weight gain}}{\text{Initial Mean weight}} \times 100$
- Mortality $= \frac{\text{Number of fish dead at the end of the experiment}}{\text{Initial number of fish stocked}} \times 100$
- Survival Rate (SR) $= \frac{\text{Initial number of fish stocked} - \text{Mortality}}{\text{Initial number of fish stocked}} \times 100$

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

Nutrients utilization parameters

Nutrient utilization were measured using food conversion ratio, protein efficiency ratio and productive protein valve as described by Adepoju OT (2008)

- Feed conversion efficiency (FCE) = $\frac{\text{Weight gain}}{\text{Feed intake}} \times 100$

- Protein efficiency ratio (PER) = $\frac{\text{Mean weight gain (g)}}{\text{Crude protein intake (g)}}$

3.5. Water quality assessment

Water quality parameters such as: Temperature, pH, Dissolved oxygen, Ammonia and Nitrite were monitored throughout the period of the experiment.

3.6. Sample collection

At the end of feeding trial, fish blood samples were collected with heparinised bottle. Blood samples were obtained from the caudal vein of fish from each tank. Blood serum analysis were collected into bottles (EDTA Bottle)

3.6.1. Haematological Assessment

Haematological examination of the fish was carried out at the end of the experiment using standard haematological techniques in order to investigate the possible effect(s) of the feed on fish. Haematological parameters investigated include: Haemoglobin, Red blood Cell (RBC), White blood Cell (WBC), Packed Cell Volume (PCV), neutrophils and lymphocytes. The blood indices including mean corpuscular volume (MCV in femtoliters), mean corpuscular haemoglobin (MCH in pictograms per cell), and mean corpuscular haemoglobin concentration (MCHC in grams per decilitre) were calculated according to the below formulars (lewis 2001): -

$$MCV\ (fl) = \frac{PCV\ (\%)}{RBC\ (10^{\wedge}\text{-}6\mu l\ ^{\wedge}\text{-}1)}$$

$$MCH\ (pg) = \frac{[Hb\ (gdl^{-1})]}{RBC\ (10^{-6}\mu l^{-1})}$$

$$MCHC\ (gdl^{-1}) = \frac{[Hb\ (gbl^{-1})]}{PCV\ (\%)}$$

3.7. Statistical Analysis

The data collected were subjected to using one way statistical analysis of variance (ANOVA) and the significant differences in means were determined by applying Duncan's Multiple Range test. The tests will use SPSS Software, version 20 (2011). Statistical significance effect on the parameters to be measured was set at $p \leq 0.05$.

CHAPTER FOUR

RESULTS AND DISSCUSSION

4.0 RESULTS

4. 1 Proximate Composition of African Catfish Fingerlings Fed Plantain Peel Meal

Proximate composition of experimental African catfish fed plantain peel meal is presented in Table 2. It shows that moisture content was highest in T4 and lowest inT1. Crude protein was highest in T2 and lowest in T5, Lipid was highest in T5 and lowest in T3. Ash was significantly higher ($p<0.05$) in T1 and lowest in T5. Nitrogen free extract T3 was significantly higher ($p<0.05$) inT3 and lowest in T2 in catfish fed all dietary treatments.

Table 2: Proximate Composition of African Catfish Fingerlings Fed Plantain Peel Meal

Parameters	Treatment 1 (0%)	Treatment 2 (25%)	Treatment3 (50%)	Treatment4 (75%)	Treatment5 (100%)
Moisture Content (%)	8.96 ± 0.00^{a}	9.16 ± 0.00^{b}	10.30 ± 0.06^{c}	11.60 ± 0.06^{d}	11.67 ± 0.03^{e}
Crude Protein (%)	57.53 ± 0.07^{e}	57.07 ± 0.24^{d}	56.33 ± 0.15^{c}	55.57 ± 0.07^{b}	55.07 ± 0.03^{a}
Lipid (%)	11.60 ± 0.50^{a}	12.43 ± 0.62^{a}	11.43 ± 0.78^{a}	11.73 ± 0.62^{a}	12.47 ± 0.03^{a}
Ash (%)	11.13 ± 0.37^{a}	10.83 ± 0.48^{a}	10.67 ± 0.23^{a}	10.43 ± 0.19^{a}	10.20 ± 0.06^{a}
NFE (%)	10.77 ± 0.19^{a}	10.51 ± 0.12^{a}	11.27 ± 0.69^{a}	10.67 ± 0.37^{a}	10.60 ± 0.11^{a}

*** NFE = nitrogen free extract**

Mean ± S.E with different superscripts are significantly different at $p < 0.05$

4. 2 Growth and Nutritional Performance of African Catfish fed Plantain Peel Meal

Growth and nutritional performance of *Clarias gariepinus* fed plantain peel meal is presented on Table 3, while the growth pattern of fish is shown on figure 1. Fish fed control diet had the highest feed intake (8.37 ± 0.06) while the lowest was recorded in fish fed T5. Feed intake was statistically different ($p < 0.05$) among all the treatments. However, there was no significant difference ($p > 0.05$) between the feed intake of African catfish fed 25% and 50% plantain peel meal respectively. The result indicated that fish fed T2 and T3 consumed more diets among the treatments with plantain peel meal. Fish fed inT1 had the highest final weight (10.64 ± 0.09); weight gained, final weight were significantly higher ($p<0.05$) in T1than any other. Furthermore, the result also indicated that fish fed diet containing 75% plantain peel meal had the highest feed conversion ratio (1.64 ± 0.04) while the lowest was recorded in the control (1.14 ± 0.01).Specific growth rate was significantly higher ($p<0.05$) in T1 and lowest in T5. Protein efficiency ratio had highest in T1 While there was similarity ($p > 0.05$) between the PER recorded in T2 and T3 and T4 and T5.

Table 3: Growth and Nutritional Performance of African Catfish fed Plantain peel meal

Parameters	Treatment 1 (0%)	Treatment 2 (25%)	Treatment 3 (50%)	Treatment4 (75%)	Treatment5 (100%)
Initial Weight (g)	3.30 ± 0.01^{a}	3.33 ± 0.01^{a}	3.32 ± 0.02^{a}	3.32 ± 0.01^{a}	3.32 ± 0.02^{a}
Final Weight (g)	10.64 ± 0.09^{c}	8.70 ± 0.05^{b}	8.44 ± 0.05^{b}	7.34 ± 0.07^{a}	7.31 ± 0.15^{a}
Feed Intake (g)	8.37 ± 0.06^{d}	7.21 ± 0.05^{c}	7.18 ± 0.10^{c}	6.58 ± 0.05^{b}	6.19 ± 0.08^{a}
Weight Gained (g)	7.34 ± 0.09^{c}	5.38 ± 0.06^{b}	$5.12 + 0.04^{b}$	4.02 ± 0.06^{a}	3.93 ± 0.15^{a}
Feed Conversion Ratio	1.14 ± 0.01^{a}	1.34 ± 0.01^{b}	1.40 ± 0.03^{b}	1.64 ± 0.04^{d}	1.55 ± 0.04^{c}
Specific Growth Rate	2.09 ± 0.02^{c}	1.72 ± 0.02^{b}	$1.67 + 0.01^{b}$	1.42 ± 0.01^{a}	1.41 ± 0.03^{a}
Protein Efficiency Ratio	0.18 ± 0.02^{c}	0.13 ± 0.01^{b}	0.13 ± 0.01^{b}	0.10 ± 0.01^{a}	0.10 ± 0.04^{a}

Mean + S.E with different superscripts are significantly different at $p < 0.05$

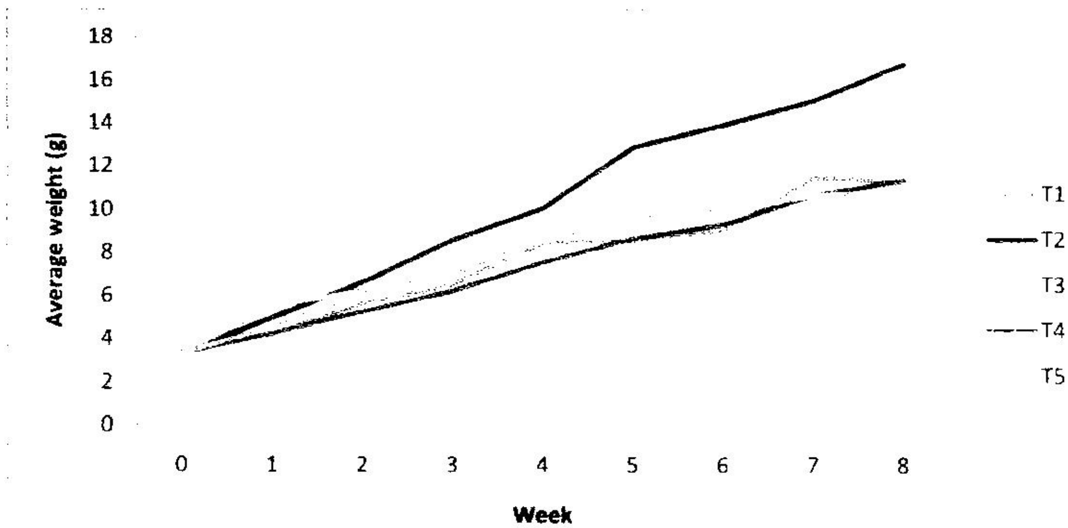

Figure 1: Graph showing growth pattern of*C. gariepinus fed graded level of PPM*

4. 3 Haematological Parameters of African Catfish fed Plantain Peel Meal

Haematological parameter of *C. gariepinus* fed diets containing different levels of plantain peel meal is presented on Table 4. Packed cell volume (PCV), Haemoglobin (HB).Red blood cell (RBC), Mean corpuscular haemoglobin cell (MCHC). Lymphocytes were significantly higher ($p<0.05$) in treatment 4 than any other. Mean Corpuscular Volume (MCV) was highest T1 and lowest in T4.

Results further reveal that the Mean corpuscular haemoglobin (MCH) was significantly higher ($p > 0.05$) in T1and lowest in T3. White blood cell showed significant differences ($p < 0.05$) in all the dietary treatments. *C. gariepinus* fed T3 had the highest while the least was recorded in T4. Blood count differentials (neutrophils and lymphocytes) showed significant differences ($p < 0.05$) in all the dietary treatments.

Table 4: Haematological Parameters of African Catfish fed Plantain Peel Meal

Parameters	Treatment 1 (0%)	Treatment 2 (25%)	Treatment 3 (50%)	Treatment 4 (75%)	Treatment5 (100%)
PCV	18.00 ± 0.58^{a}	17.67 ± 0.33^{a}	18.67 ± 0.33^{a}	20.67 ± 0.33^{b}	18.00 ± 0.58^{a}
HB (G/DL)	5.80 ± 0.06^{a}	5.67 ± 0.03^{a}	6.60 ± 0.06^{b}	$7.77 + 0.03^{c}$	6.60 ± 0.06^{b}
RBC (*10^12/L)	1.13 ± 0.03^{a}	1.33 ± 0.03^{b}	1.60 ± 0.06^{c}	1.80 ± 0.06^{d}	1.33 ± 0.03^{b}
MCV (Fl)	159.10 ± 6.93^{d}	132.80 ± 5.70^{bc}	116.87 ± 2.56^{ab}	114.96 ± 2.25^{a}	135.37 ± 7.33^{c}
MCH (Pg)	51.23 ± 1.56^{b}	42.50 ± 1.25^{a}	41.33 ± 1.38^{a}	$43.23 + 1.21^{a}$	49.57 ± 0.86^{b}
MCHC (G/Dl)	32.30 ± 1.36^{ab}	32.10 ± 0.40^{a}	35.40 ± 0.72^{bc}	$35.57 + 0.47^{c}$	36.77 ± 1.50^{c}
WBC (*10^9/L)	$30.90 + 0.06^{b}$	34.43 ± 0.09^{c}	$41.20 + 0.17^{e}$	$29.53 + 0.19^{a}$	$35.80 + 0.12^{d}$
Neutrophils (%)	21.00 ± 0.58^{c}	26.00 ± 0.58^{d}	18.00 ± 0.58^{b}	16.00 ± 0.58^{a}	28.00 ± 0.58^{c}
Lymphocytes (%)	$79.00 + 0.58^{c}$	$74.00 + 0.58^{b}$	82.00 ± 0.58^{d}	$84.00 + 0.58^{e}$	$72.00 + 0.58^{a}$

Mean + S.E with different superscripts are significantly different at $p < 0.05$

4.4 DISCUSSION

Proximate compositions of experimental diets were within the requirements for catfish juvenile as recommended by FAO (2006). The reduction in the feed intake and average weight gain between the fish in control and other experimental diets could be attributed to the increased crude fibre and palatability of the feed since this is identify as a common difficulty observed when alternative feedstuffs are tried in fish nutrition (Domingues et al., 2003). The result obtained in this study is similar to the reports of Ajasin et al. (2006) and Omole et al. (2008) who reported that there was reduction in fed intake and weight gain, when maize was substituted with plantain peel. Possible reason for the reduction in weight gain across graded levels of test ingredients were associated with the presence of the following anti-nutritional factors :Tannic acid, phytate, phytic phosphorous, oxalate and saponin in plantain peels as highlighted by Agbabiaka et al. (2013).

The proximate composition of the plantain peels has moisture content of 10.7%, Ash 10.9%, crude fibre 6.93%, crude protein 7%, lipid 6.96% and nitrogen free extract 57.5%. The proximate composition of the experimented diets showed that CTRL had the highest crude protein (41.77%) with high crude fibre (4.03%) while the PPM100 had the lowest crude protein (39.40%) and PPM75 had the low crude fibre (4.02%). PPM75 was found to contained the highest ash (11.73%) with PPM50 having the lowest.

Ash is 10.9% and crude fiber of 6.93% which was is similar to the work of Agbabiaka (2013) but the moisture content was lower a bit but there was significant difference in the protein of the peel, while the nitrogen free extract was also in contrast to the work of Agbabiaka (2013) and the work of Sogbesan *et.,al.* (2012), and the moisture of 10.7% which has no much significant difference from the work of Agbabiaka. However thee crude protein values of (7.15 – 9.70%) reported for tiger nut meal and maize (Aduku, 1993; Oladele and Aina, 2007).

The significant reduction in the feed intake in the diet with 100% plantain peel compared with other plantain peel diets conforms to the report of Ajasin *et.,al.* (2006) who reported a decrease in feed intake with increasing plantain peels; resulting to change in the taste of the diet (Omole *et.,al.*, 2008). Cost per kg feed and total cost of feed consumed reduced as the level of plantain peels in the diet increased. The lowest profit index in the control diet confirmed the gain recorded at inclusion level of unconventional feed support the observation of Omole *et.,al.* (2013) that the use of alternative feed resources could lead to profitable non-ruminant production in developing countries.

Furthermore, nutritional indices indicated that fish fed diet containing 75% plantain peel meal had the highest feed conversion ratio (1.64 ± 0.04) while the lowest was recorded in the control (1.14 ± 0.01) Agbabiaka, L.A (2013) reported the lowest feed conversion ratio was reported in the control group (0%) with the value of 0.32 while the highest value of 0.55 was obtained from fish fed 75% plantain peel diet. There was no significant difference (p>0.05) among the treatment groups. Specific growth rate was highest (2.09 ± 0.02) in the control while the lowest (1.41 ± 0.03) was recorded in PPM100. Similar (p > 0.05) SGR was recorded in PPM25 and PPM50; PPM75 and PPM100 respectively. Protein efficiency ratio was highest (1.84 ± 0.02) in control while there was similarity (p > 0.05) between the PER recorded in PPM25 and PPM50 and PPM75 and PPM100 respectively.

Haematological characteristics helps fish biologist to interpret physiological response by fish and division from normal response may indicate a disturbance in the physiological process (dienye and olumuuji 2014). The haematological parameters of the fish fed graded levels of unripe plantain peels were similar in all indices. This shows that the plantain peel inclusion did not cause any undue stress to the fish because blood composition is usually altered during diseases or malnutrition conditions as documented by Maheswaran *et. al.* (2008), which is also similar to the report of Aderolu *et.,al*(2016)

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATION

From the result of this study, it is reveal that PPM contain sufficient energy to compares favorably with maize, however, the optimum inclusion level obtained in this study is 50% plantain peel meal.

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Appendix
Descriptive

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
IW	ctrl	3	3.3000	.00000	.00000	3.3000	3.3000	3.30	3.30
	PPM25	3	3.3267	.02309	.01333	3.2693	3.3840	3.30	3.34
	PPM50	3	3.3167	.02887	.01667	3.2450	3.3884	3.30	3.35
	PPM75	3	3.3200	.01732	.01000	3.2770	3.3630	3.30	3.33
	PPM100	3	3.3167	.02887	.01667	3.2450	3.3884	3.30	3.35
	Total	15	3.3160	.02098	.00542	3.3044	3.3276	3.30	3.35
TFI	ctrl	3	8.3733	.10263	.05925	8.1184	8.6283	8.26	8.46
	PPM25	3	7.2133	.09452	.05457	6.9785	7.4481	7.14	7.32
	PPM50	3	7.1767	.17954	.10366	6.7307	7.6227	7.04	7.38
	PPM75	3	6.5833	.08622	.04978	6.3692	6.7975	6.49	6.66
	PPM100	3	6.1933	.14189	.08192	5.8409	6.5458	6.04	6.32
	Total	15	7.1080	.77205	.19934	6.6805	7.5355	6.04	8.46
FWVIII	ctrl	3	10.6400	.16371	.09452	10.2333	11.0467	10.46	10.78
	PPM25	3	8.7033	.08021	.04631	8.5041	8.9026	8.62	8.78
	PPM50	3	8.4367	.09074	.05239	8.2113	8.6621	8.34	8.52
	PPM75	3	7.3367	.12503	.07219	7.0261	7.6473	7.21	7.46
	PPM100	3	7.3100	.25865	.14933	6.6675	7.9525	7.03	7.54
	Total	15	8.4853	1.26570	.32680	7.7844	9.1863	7.03	10.78
TWG	ctrl	3	7.3400	.16371	.09452	6.9333	7.7467	7.16	7.48
	PPM25	3	5.3767	.10017	.05783	5.1278	5.6255	5.28	5.48

	PPM50	3	5.1200	.07000	.04041	4.9461	5.2939	5.04	5.17
	PPM75	3	4.0167	.11015	.06360	3.7430	4.2903	3.91	4.13
	PPM100	3	3.9933	.25541	.14746	3.3589	4.6278	3.73	4.24
	Total	15	5.1693	1.27180	.32838	4.4650	5.8736	3.73	7.48
TFCR	ctrl	3	1.1400	.01000	.00577	1.1152	1.1648	1.13	1.15
	PPM25	3	1.3433	.00577	.00333	1.3290	1.3577	1.34	1.35
	PPM50	3	1.4033	.04933	.02848	1.2808	1.5259	1.37	1.46
	PPM75	3	1.6400	.06245	.03606	1.4849	1.7951	1.57	1.69
	PPM100	3	1.5533	.06506	.03756	1.3917	1.7150	1.49	1.62
	Total	15	1.4160	.18388	.04748	1.3142	1.5178	1.13	1.69
TSGR	ctrl	3	2.0900	.02646	.01528	2.0243	2.1557	2.06	2.11
	PPM25	3	1.7167	.03055	.01764	1.6408	1.7926	1.69	1.75
	PPM50	3	1.6700	.01000	.00577	1.6452	1.6948	1.66	1.68
	PPM75	3	1.4167	.02082	.01202	1.3650	1.4684	1.40	1.44
	PPM100	3	1.4100	.06000	.03464	1.2610	1.5590	1.35	1.47
	Total	15	1.6607	.25930	.06695	1.5171	1.8043	1.35	2.11
TPER	ctrl	3	1.8367	.04163	.02404	1.7332	1.9401	1.79	1.87
	PPM25	3	1.3500	.03000	.01732	1.2755	1.4245	1.32	1.38
	PPM50	3	1.3033	.02082	.01202	1.2516	1.3550	1.28	1.32
	PPM75	3	1.0233	.02517	.01453	.9608	1.0858	1.00	1.05
	PPM100	3	1.0100	.06557	.03786	.8471	1.1729	.94	1.07
	Total	15	1.3047	.31273	.08075	1.1315	1.4778	.94	1.87
PCV	ctrl	3	18.0000	1.00000	.57735	15.5159	20.4841	17.00	19.00
	PPM25	3	17.6667	.57735	.33333	16.2324	19.1009	17.00	18.00
	PPM50	3	18.6667	.57735	.33333	17.2324	20.1009	18.00	19.00

	PPM75	3	20.6667	.57735	.33333	19.2324	22.1009	20.00	21.00
	PPM100	3	18.0000	1.00000	.57735	15.5159	20.4841	17.00	19.00
	Total	15	18.6000	1.29835	.33523	17.8810	19.3190	17.00	21.00
Hb	ctrl	3	5.8000	.10000	.05774	5.5516	6.0484	5.70	5.90
	PPM25	3	5.6667	.05774	.03333	5.5232	5.8101	5.60	5.70
	PPM50	3	6.6000	.10000	.05774	6.3516	6.8484	6.50	6.70
	PPM75	3	7.7667	.05774	.03333	7.6232	7.9101	7.70	7.80
	PPM100	3	6.6000	.10000	.05774	6.3516	6.8484	6.50	6.70
	Total	15	6.4867	.77907	.20116	6.0552	6.9181	5.60	7.80
RBC	ctrl	3	1.1333	.05774	.03333	.9899	1.2768	1.10	1.20
	PPM25	3	1.3333	.05774	.03333	1.1899	1.4768	1.30	1.40
	PPM50	3	1.6000	.10000	.05774	1.3516	1.8484	1.50	1.70
	PPM75	3	1.8000	.10000	.05774	1.5516	2.0484	1.70	1.90
	PPM100	3	1.3333	.05774	.03333	1.1899	1.4768	1.30	1.40
	Total	15	1.4400	.25014	.06459	1.3015	1.5785	1.10	1.90
MCV	ctrl	3	1.5910E2	12.00042	6.92844	129.2893	188.9107	150.00	172.70
	PPM25	3	1.3280E2	9.87269	5.70000	108.2749	157.3251	121.40	138.50
	PPM50	3	1.1687E2	4.42869	2.55691	105.8652	127.8682	111.80	120.00
	PPM75	3	1.1497E2	3.90043	2.25191	105.2775	124.6559	110.50	117.70
	PPM100	3	1.3537E2	12.69344	7.32856	103.8344	166.8989	121.40	146.20
	Total	15	1.3182E2	18.26586	4.71623	121.7047	141.9353	110.50	172.70
MCH	ctrl	3	51.2333	2.69506	1.55599	44.5384	57.9282	48.30	53.60
	PPM25	3	42.5000	2.17025	1.25300	37.1088	47.8912	40.00	43.90
	PPM50	3	41.3333	2.38607	1.37760	35.4060	47.2607	39.40	44.00
	PPM75	3	43.2333	2.10079	1.21289	38.0147	48.4520	41.10	45.30

	PPM100	3	49.5667	1.49778	.86474	45.8460	53.2873	47.90	50.80
	Total	15	45.5733	4.56140	1.17775	43.0473	48.0994	39.40	53.60
MCHC	ctrl	3	32.3000	2.35160	1.35769	26.4583	38.1417	30.00	34.70
	PPM25	3	32.1000	.69282	.40000	30.3789	33.8211	31.70	32.90
	PPM50	3	35.4000	1.25300	.72342	32.2874	38.5126	34.20	36.70
	PPM75	3	37.5667	.80829	.46667	35.5588	39.5746	37.10	38.50
	PPM100	3	36.7667	2.60064	1.50148	30.3063	43.2270	34.20	39.40
	Total	15	34.8267	2.75486	.71130	33.3011	36.3523	30.00	39.40
WBC	ctrl	3	30.9000	.10000	.05774	30.6516	31.1484	30.80	31.00
	PPM25	3	34.4333	.15275	.08819	34.0539	34.8128	34.30	34.60
	PPM50	3	41.2000	.30000	.17321	40.4548	41.9452	40.90	41.50
	PPM75	3	29.5333	.32146	.18559	28.7348	30.3319	29.30	29.90
	PPM100	3	35.8000	.20000	.11547	35.3032	36.2968	35.60	36.00
	Total	15	34.3733	4.25046	1.09746	32.0195	36.7272	29.30	41.50
NEUTRO	ctrl	3	21.0000	1.00000	.57735	18.5159	23.4841	20.00	22.00
	PPM25	3	26.0000	1.00000	.57735	23.5159	28.4841	25.00	27.00
	PPM50	3	18.0000	1.00000	.57735	15.5159	20.4841	17.00	19.00
	PPM75	3	16.0000	1.00000	.57735	13.5159	18.4841	15.00	17.00
	PPM100	3	28.0000	1.00000	.57735	25.5159	30.4841	27.00	29.00
	Total	15	21.8000	4.81367	1.24288	19.1343	24.4657	15.00	29.00

LYMPHO	ctrl	3	79.0000	1.00000	.57735	76.5159	81.4841	78.00	80.00
	PPM25	3	74.0000	1.00000	.57735	71.5159	76.4841	73.00	75.00
	PPM50	3	82.0000	1.00000	.57735	79.5159	84.4841	81.00	83.00
	PPM75	3	84.0000	1.00000	.57735	81.5159	86.4841	83.00	85.00
	PPM100	3	72.0000	1.00000	.57735	69.5159	74.4841	71.00	73.00
	Total	15	78.2000	4.81367	1.24288	75.5343	80.8657	71.00	85.00

ANOVA

		Sum of Squares	Df	Mean Square	F	Sig.
IW	Between Groups	.001	4	.000	.580	.684
	Within Groups	.005	10	.001		
	Total	.006	14			
TFI	Between Groups	8.186	4	2.047	129.094	.000
	Within Groups	.159	10	.016		
	Total	8.345	14			
Final Weight	Between Groups	22.180	4	5.545	223.588	.000
	Within Groups	.248	10	.025		
	Total	22.428	14			
TWG	Between Groups	22.406	4	5.602	235.165	.000
	Within Groups	.238	10	.024		
	Total	22.645	14			
TFCR	Between Groups	.452	4	.113	52.799	.000
	Within Groups	.021	10	.002		
	Total	.473	14			
TSGR	Between Groups	.930	4	.232	201.538	.000
	Within Groups	.012	10	.001		
	Total	.941	14			
TPER	Between Groups	1.353	4	.338	211.433	.000
	Within Groups	.016	10	.002		
	Total	1.369	14			
PCV	Between Groups	17.600	4	4.400	7.333	.005
	Within Groups	6.000	10	.600		
	Total	23.600	14			
Hb	Between Groups	8.424	4	2.106	287.182	.000
	Within Groups	.073	10	.007		
	Total	8.497	14			
RBC	Between Groups	.816	4	.204	34.000	.000
	Within Groups	.060	10	.006		
	Total	.876	14			
MCV	Between Groups	3796.124	4	949.031	10.848	.001
	Within Groups	874.860	10	87.486		
	Total	4670.984	14			

MCH	Between Groups	242.643	4	60.661	12.470	.001
	Within Groups	48.647	10	4.865		
	Total	291.289	14			
MCHC	Between Groups	76.256	4	19.064	6.356	.008
	Within Groups	29.993	10	2.999		
	Total	106.249	14			
WBC	Between Groups	252.396	4	63.099	1.183E3	.000
	Within Groups	.533	10	.053		
	Total	252.929	14			
NEUTRO	Between Groups	314.400	4	78.600	78.600	.000
	Within Groups	10.000	10	1.000		
	Total	324.400	14			
LYMPHO	Between Groups	314.400	4	78.600	78.600	.000
	Within Groups	10.000	10	1.000		
	Total	324.400	14			

Post Hoc Tests

Homogeneous Subsets

Initial Weight

Duncan

Trt	N	Subset for alpha = 0.05
		1
Ctrl	3	3.3000
PPM50	3	3.3167
PPM100	3	3.3167
PPM75	3	3.3200
PPM25	3	3.3267
Sig.		.208

Means for groups in homogeneous subsets are displayed.

Feed Intake

Duncan

Trt	N	Subset for alpha = 0.05			
		1	2	3	4
PPM100	3	6.1933			
PPM75	3		6.5833		
PPM50	3			7.1767	
PPM25	3			7.2133	
Ctrl	3				8.3733
Sig.		1.000	1.000	.729	1.000

Means for groups in homogeneous subsets are displayed.

Final Weight

Duncan

Trt	N	Subset for alpha = 0.05		
		1	2	3
PPM100	3	7.3100		
PPM75	3	7.3367		
PPM50	3		8.4367	
PPM25	3		8.7033	
ctrl	3			10.6400
Sig.		.840	.065	1.000

Means for groups in homogeneous subsets are displayed.

Weight Gained

Duncan

Trt	N	Subset for alpha = 0.05		
		1	2	3
PPM100	3	3.9933		
PPM75	3	4.0167		
PPM50	3		5.1200	
PPM25	3		5.3767	
ctrl	3			7.3400
Sig.		.857	.069	1.000

Means for groups in homogeneous subsets are displayed.

Feed Conversion Ratio

Duncan

Trt	N	Subset for alpha = 0.05			
		1	2	3	4
ctrl	3	1.1400			
PPM25	3		1.3433		
PPM50	3		1.4033		
PPM100	3			1.5533	
PPM75	3				1.6400
Sig.		1.000	.143	1.000	1.000

Means for groups in homogeneous subsets are displayed.

Specific Growth Rate

Duncan

Trt	N	Subset for alpha = 0.05		
		1	2	3
PPM100	3	1.4100		
PPM75	3	1.4167		
PPM50	3		1.6700	
PPM25	3		1.7167	
Ctrl	3			2.0900
Sig.		.815	.123	1.000

Means for groups in homogeneous subsets are displayed.

Protein Efficiency Ratio

Duncan

Trt	N	Subset for alpha = 0.05		
		1	2	3
PPM100	3	1.0100		
PPM75	3	1.0233		
PPM50	3		1.3033	
PPM25	3		1.3500	
Ctrl	3			1.8367
Sig.		.692	.184	1.000

Protein Efficiency Ratio

Duncan

Trt	N	Subset for alpha = 0.05		
		1	2	3
PPM100	3	1.0100		
PPM175	3	1.0233		
PPM50	3		1.3033	
PPM25	3		1.3500	
Ctrl	3			1.8367
Sig.		.692	.184	1.000

Means for groups in homogeneous subsets are displayed.

PCV

Duncan

Trt	N	Subset for alpha = 0.05	
		1	2
PPM25	3	17.6667	
Ctrl	3	18.0000	
PPM100	3	18.0000	
PPM50	3	18.6667	
PPM175	3		20.6667
Sig.		.171	1.000

Means for groups in homogeneous subsets are displayed.

Hb

Duncan

Trt	N	Subset for alpha = 0.05		
		1	2	3
PPM25	3	5.6667		
Ctrl	3	5.8000		
PPM150	3		6.6000	
PPM100	3		6.6000	
PPM175	3			7.7667
Sig.		.086	1.000	1.000

Means for groups in homogeneous subsets are displayed.

RBC

Duncan

Trt	N	Subset for alpha = 0.05			
		1	2	3	4
ctrl	3	1.1333			
PPM25	3		1.3333		
PPM100	3		1.3333		
PPM150	3			1.6000	
PPM175	3				1.8000
Sig.		1.000	1.000	1.000	1.000

Means for groups in homogeneous subsets are displayed.

MCV

Duncan

Trt	N	Subset for alpha = 0.05			
		1	2	3	4
PPM175	3	1.1497E2			
PPM150	3	1.1687E2	1.1687E2		
PPM125	3		1.3280E2	1.3280E2	
PPM100	3			1.3537E2	
Ctrl	3				1.5910E2
Sig.		.809	.064	.744	1.000

Means for groups in homogeneous subsets are displayed.

MCH

Duncan

Trt	N	Subset for alpha = 0.05	
		1	2
PPM150	3	41.3333	
PPM125	3	42.5000	
PPM175	3	43.2333	
PPM100	3		49.5667
Ctrl	3		51.2333
Sig.		.338	.377

Means for groups in homogeneous subsets are displayed.

MCHC

Duncan

Trt	N	Subset for alpha = 0.05		
		1	2	3
PPM25	3	32.1000		
Ctrl	3	32.3000	32.3000	
PPM50	3		35.4000	35.4000
PPM100	3			36.7667
PPM75	3			37.5667
Sig.		.890	.053	.174

Means for groups in homogeneous subsets are displayed.

WBC

Duncan

Trt	N	Subset for alpha = 0.05				
		1	2	3	4	5
PPM75	3	29.5333				
ctrl	3		30.9000			
PPM25	3			34.4333		
PPM100	3				35.8000	
PPM150	3					41.2000
Sig.		1.000	1.000	1.000	1.000	1.000

Means for groups in homogeneous subsets are displayed.

NEUTRO

Duncan

Trt	N	Subset for alpha = 0.05				
		1	2	3	4	5
PPM75	3	16.0000				
PPM150	3		18.0000			
ctrl	3			21.0000		
PPM25	3				26.0000	
PPM100	3					28.0000
Sig.		1.000	1.000	1.000	1.000	1.000

Means for groups in homogeneous subsets are displayed

LYMPHO

Duncan

Trt	N	Subset for alpha = 0.05				
		1	2	3	4	5
PPM100	3	72.0000				
PPM25	3		74.0000			
ctrl	3			79.0000		
PPM50	3				82.0000	
PPM75	3					84.0000
Sig.		1.000	1.000	1.000	1.000	1.000

Means for groups in homogeneous subsets are displayed.

Proximate Analysis of Experimental Diets and Fish

Oneway

Diets

Descriptives

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
MC	CTRL	3	9.2533	.02517	.01453	9.1908	9.3158	9.23	9.28
	PPM25	3	10.3000	.10000	.05774	10.0516	[illegible]	10.20	10.40
	PPM50	3	9.4933	.00577	.00333	9.4790	[illegible]	9.49	9.50
	PPM75	3	10.0667	.05774	.03333	9.9232	[illegible]	10.00	10.10
	PPM100	3	10.0667	.05774	.03333	9.9232	[illegible]	10.00	10.10
	Total	15	9.8360	.41149	.10625	9.6081	[illegible]	9.23	10.40
Protein	CTRL	3	41.7667	.05774	.03333	41.6232	[illegible]	41.70	41.80
	PPM25	3	41.3000	.26458	.15275	40.6428	[illegible]	41.10	41.60
	PPM50	3	40.9667	.05774	.03333	40.8232	[illegible]	40.90	41.00
	PPM75	3	40.3333	.11547	.06667	40.0465	[illegible]	40.20	40.40
	PPM100	3	39.4000	.20000	.11547	38.9032	39.8968	39.20	39.60
	Total	15	40.7533	.86178	.22251	40.2761	[illegible]	39.20	41.80

Lipid	CTRL	3	9.8333	.25166	.14530	9.2082	10.4585	9.60	10.10
	PPM25	3	8.4267	.37005	.21365	7.5074	9.3459	8.00	8.66
	PPM50	3	13.0333	.05774	.03333	12.8899	13.1768	13.00	13.10
	PPM75	3	11.7333	.11547	.06667	11.4465	12.0202	11.60	11.80
	PPM100	3	13.5000	.20000	.11547	13.0032	13.9968	13.30	13.70
	Total	15	11.3053	1.99699	.51562	10.1994	12.4112	8.00	13.70
Ash	CTRL	3	11.5333	.30551	.17638	10.7744	12.2922	11.20	11.80
	PPM25	3	10.8667	.05774	.03333	10.7232	11.0101	10.80	10.90
	PPM50	3	10.0667	.05774	.03333	9.9232	10.2101	10.00	10.10
	PPM75	3	11.7333	.11547	.06667	11.4465	12.0202	11.60	11.80
	PPM100	3	10.6000	.20000	.11547	10.1032	11.0968	10.40	10.80
	Total	15	10.9600	.64896	.16756	10.6006	11.3194	10.00	11.80
Fibre	CTRL	3	4.0267	.06429	.03712	3.8670	4.1864	3.98	4.10
	PPM25	3	6.8667	.05774	.03333	6.7232	7.0101	6.80	6.90
	PPM50	3	6.0100	.01000	.00577	5.9852	6.0348	6.00	6.02
	PPM75	3	4.0200	.02000	.01155	3.9703	4.0697	4.00	4.04
	PPM100	3	4.6500	.01000	.00577	4.6252	4.6748	4.64	4.66
	Total	15	5.1147	1.17787	.30413	4.4621	5.7670	3.98	6.90
NFE	CTRL	3	23.5867	.13868	.08007	23.2422	[illegible]	23.47	[illegible]
	PPM25	3	22.2400	.75604	.43650	20.3619	24.1181	21.68	23.10
	PPM50	3	20.4300	.07000	.04041	20.2561	20.6039	20.38	20.51
	PPM75	3	22.1133	.34020	.19641	21.2682	22.9584	21.86	22.50
	PPM100	3	21.7833	.15948	.09207	21.3872	22.1795	21.65	21.96
	Total	15	22.0307	1.09411	.28250	21.4248	22.6366	20.38	23.74

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Mc	Between Groups	2.336	4	.584	168.254	.000
	Within Groups	.035	10	.003		
	Total	2.371	14			
[illegible]	Between Groups	10.137	4	2.534	97.471	.000
	Within Groups	.260	10	.026		
	Total	10.397	14			

Lipid	Between Groups	55.318	4	13.829	269.125	.000
	Within Groups	.514	10	.051		
	Total	55.832	14			
Ash	Between Groups	5.589	4	1.397	45.565	.000
	Within Groups	.307	10	.031		
	Total	5.896	14			
Fibre	Between Groups	19.407	4	4.852	[illegible]	.000
	Within Groups	.016	10	.002		
	Total	19.423	14			
NFE	Between Groups	15.285	4	3.821	25.928	.000
	Within Groups	1.474	10	.147		
	Total	16.759	14			

Post Hoc Tests

Homogeneous Subsets

Moisture

Duncan

TRT	N	Subset for alpha = 0.05			
		1	2	3	4
CTRL	3	9.2533			
PPM150	3		9.4933		
PPM175	3			10.0667	
PPM100	3			10.0667	
PPM125	3				10.3900
Sig.		1.000	1.000	1.000	1.000

Means for groups in homogeneous subsets are displayed.

Protein

Duncan

TRT	N	Subset for alpha = 0.05				
		1	2	3	4	5
PPM100	3	39.4000				
PPM75	3		40.3333			
PPM50	3			40.9667		
PPM25	3				41.3000	
CTRL	3					41.7667
Sig.		1.000	1.000	1.000	1.000	1.000

Means for groups in homogeneous subsets are displayed.

Lipid

Duncan

TRT	N	Subset for alpha = 0.05				
		1	2	3	4	5
PPM25	3	8.4267				
CTRL	3		9.8333			
PPM75	3			11.7333		
PPM50	3				13.0333	
PPM100	3					13.5000
Sig.		1.000	1.000	1.000	1.000	1.000

Means for groups in homogeneous subsets are displayed.

Ash

Duncan

TRT	N	Subset for alpha = 0.05		
		1	2	3
PPM50	3	10.0667		
PPM100	3		10.6000	
PPM25	3		10.8667	
CTRL	3			11.5333
PPM75	3			11.7333
Sig.		1.000	.092	.192

Means for groups in homogeneous subsets are displayed.

Fibre

Duncan

TRT	N	Subset for alpha = 0.05			
		1	2	3	4
PPM75	3	4.0200			
CTRL	3	4.0267			
PPM100	3		4.6500		
PPM50	3			6.0100	
PPM25	3				6.8667
Sig.		.843	1.000	1.000	1.000

Means for groups in homogeneous subsets are displayed.

NFE

Duncan

TRT	N	Subset for alpha = 0.05		
		1	2	3
PPM50	3	20.4300		
PPM100	3		21.7833	
PPM75	3		22.1133	
PPM25	3		22.2400	
CTRL	3			23.5867
Sig.		1.000	.194	1.000

Means for groups in homogeneous subsets are displayed.

Fish

Descriptives

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean: Lower Bound	95% Confidence Interval for Mean: Upper Bound	Minimum	Maximum
MC	CTRL	3	8.9633	.00577	.00333	8.9490	8.9777	8.96	8.97
	PPM25	3	9.1567	.00577	.00333	9.1423	9.1710	9.15	9.16
	PPM50	3	10.3000	.10000	.05774	10.0516	10.5484	10.20	10.40
	PPM75	3	11.6000	.10000	.05774	11.3516	11.8484	11.50	11.70
	PPM100	3	11.6667	.05774	.03333	11.5232	11.8101	11.60	11.70
	Total	15	10.3373	1.19466	.30846	9.6758	10.9989	8.96	11.70
[illegible]	CTRL	3	57.5333	.11547	.06667	57.2465	57.8202	57.40	57.60
	PPM25	3	57.0667	.41633	.24037	56.0324	58.1009	56.60	57.40
	PPM50	3	56.3333	.25166	.14530	55.7082	56.9585	56.10	56.60
	PPM75	3	55.5667	.11547	.06667	55.2798	55.8535	55.50	55.70
	PPM100	3	55.0667	.05774	.03333	54.9232	55.2101	55.00	55.10
	Total	15	56.3133	.96501	.24916	55.7789	56.8477	55.00	57.60
Lipid	CTRL	3	11.6000	.86603	.50000	9.4487	13.7513	11.10	12.60
	PPM25	3	12.4333	1.06927	.61734	9.7771	15.0895	11.20	13.10
	PPM50	3	11.4333	1.35769	.78387	8.0606	14.8060	10.60	13.00
	PPM75	3	11.7333	1.06927	.61734	9.0771	14.3895	10.50	12.40
	PPM100	3	12.4667	.05774	.03333	12.3232	12.6101	12.40	12.50
	Total	15	11.9333	.94768	.24469	11.4085	12.4581	10.50	13.10
Ash	CTRL	3	11.1333	.64291	.37118	9.5363	12.7303	10.40	11.60
	PPM25	3	10.8333	.83865	.48119	8.7500	12.9166	[illegible]	11.80
	PPM50	3	10.6667	.40415	.23333	9.6627	11.6706	[illegible]	10.90
	PPM75	3	10.4333	.32146	.18559	9.6348	11.2319	10.20	10.80
	PPM100	3	10.2000	.10000	.05774	9.9516	10.4484	10.10	10.30
	Total	15	10.6533	.55661	.14371	10.3451	10.9616	10.10	11.80
NFE	CTRL	3	10.7700	.34598	.19975	9.9105	11.6295	10.44	11.13
	PPM25	3	10.5100	.21378	.12342	9.9790	11.0410	10.34	10.75
	PPM50	3	11.2667	1.19304	.68880	8.3030	11.2303	9.90	12.10

	PPM75	3	10.6667	.64291	.37118	9.0696	12.2637	10.20	11.40
	PPM100	3	10.6000	.20000	.11547	10.1032	11.0968	10.40	10.80
	Total	15	10.7627	.60621	.15652	10.4270	11.0984	9.90	12.10

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Moisture	Between Groups	19.934	4	4.984	1065.13	.000
	Within Groups	.047	10	.005		
	Total	19.981	14			
[illegible]	Between Groups	12.504	4	3.126	58.613	.000
	Within Groups	.533	10	.053		
	Total	13.037	14			
Lipid	Between Groups	2.807	4	.702	.718	.598
	Within Groups	9.767	10	[illegible]		
	Total	12.573	14			
[illegible]	Between Groups	1.551	4	.388	1.391	.305
	Within Groups	2.787	10	.279		
	Total	4.337	14			
NFE	Between Groups	1.061	4	.265	.649	.640
	Within Groups	4.084	10	.408		
	Total	5.145	14			

Post Hoc Tests

Homogeneous Subsets

Moisture

Duncan

TRT	N	Subset for alpha = 0.05			
		1	2	3	4
CTRL	3	8.9633			
PPM25	3		9.1567		
PPM50	3			10.3000	
PPM75	3				11.6000
PPM100	3				11.6667
Sig.		1.000	1.000	1.000	.260

Means for groups in homogeneous subsets are displayed.

Protein

Duncan

TRT	N	Subset for alpha = 0.05				
		1	2	3	4	5
PPM100	3	55.0667				
PPM75	3		55.5667			
[illegible]	3			56.3333		
[illegible]	3				57.0667	
[illegible]	3					[illegible]
Sig.		1.000	1.000	1.000	1.000	1.000

Means for groups in homogeneous subsets are displayed.

Lipid

Duncan

TRT	N	Subset for alpha = 0.05
		1
PPM50	3	11.4333
CTRL	3	11.6000
PPM75	3	11.7333
PPM25	3	12.4333
PPM100	3	12.4667
Sig.		.265

Means for groups in homogeneous subsets are displayed.

Ash

Duncan

TRT	N	Subset for alpha = 0.05
		1
PPM100	3	10.2000
PPM75	3	10.4333
PPM50	3	10.6667
PPM25	3	10.8333
[illegible]	3	11.1333
Sig.		.075

[illegible] homogeneous subsets are displayed

NFE

Duncan

TRT	N	Subset for alpha = 0.05
		1
PPM25	3	10.5100
[illegible]	3	10.6000
PPM75	3	10.6667
CTRL	3	[illegible]
PPM150	3	[illegible]
Sig.		.211

Means for groups in homogeneous subsets are displayed.