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Full Length Research Paper

Effect of diet dilution using rice offal on performance and lipid profile of finisher broilers

Meremikwu, V. N., Bikom, P. M. and Ukorebi, B. A.

Department of Animal Science, Cross River University of Technology, Faculty of Agriculture and forestry Obubra Campus, Cross River State Nigeria.

*Corresponding author: victoriameremikwu@yahoo.com; 08038701890

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ABSTRACT

Finisher diet was diluted with graded levels of rice offal to determine the level(s) of dilution that would lower plasma triglycerides to prevent obesity without comprising performance. Parameters measured were: Performance (body weight, weight gain, feed intake, feed conversion ratio and mortality) and. Blood (total cholesterol, triglycerides, High-density lipoprotein (HDL), Low-density lipoprotein (LDL), and Very low-density (VLDL).Body weight and weight gain were obtained by weighing the birds on weekly basis. Feed intake was recorded as quantity of feed offered minus left over the following day. At the end of the feeding trial, blood was collected into plain bottles by cutting the jugular vein on the throat. Serum was analyzed using standard laboratory procedures. Data were analyzed using statistical package for social sciences. Significant means were separated using Duncan's Multiple Range Test of the same software. Final body weight and weight gain decreased ($p<0.05$) as the levels of dilution increased. Feed intake was high ($p<0.05$) at 20% and 60% levels of dilution. Diet dilution decreased ($p<0.05$) plasma triglycerides, LDL, VLDL and increased ($p<0.05$) HDL. 60% level of dilution had the least level of triglycerides and the birds attained a minimum of 1.8kg weight at eight weeks of age.

Keywords: finisher broilers, diet dilution, lipid profile, triglycerides, obesity.

INTRODUCTION

The negative effects of high density diets on the health of the modern broiler chicken cannot be over emphasized. Broilers are normally fed high density diets of 3000 to 3200 kilocalories of metabolized energy (ME) per kilogram of feed (Ahiwe*et al* 2018).A high ME in broiler diet is associated with increase in fatness and a number of metabolic disorders, increased leg problems, increased incidence of ascites and increased mortality due to heart attacks. Bokkers and koene (2003) reported that the health of the adult broiler is threatened under *ad-lib* feeding condition on high density diets since the birds do not adequately regulate voluntary feed intake to achieve energy balance. According to Bokkers and Koene (2003), the surplus nutrients consumed by the birds are found as hepatic lipids (triglycerides) which are transported into body cells as component of lipoproteins, resulting to obsessed birds with reduced livability and general loss of vigour.

Cheema *et al* (2003) reported that the increased genetic selection of broilers for fast growth have produced birds that have low immune-responsiveness due to a shift from the adaptive arm of the immune response towards a cell –mediated inflammatory response. According to cheema*et al* (2003), this condition has caused *ad lib* fed birds to become lost to aortic rupture, susceptibility to heart/lung insufficiency and most importantly losses due to leg problems. Whitehead (2002) reported that the genetic predispositions to specific metabolic disorders affecting the skeletal and cardiovascular systems of the broiler can be overcome by feed supply aimed at suppressing growth. According to Whitehead (2002), manipulating the metabolizable energy in finisher diets can be used to control body fatness in broilers.

Diet dilution with high fibre feedstuffs had been reported as strategy to reduce the metabolizable energy (ME) content in broiler diets and reduced the health problems associated with feeding high density diets to broilers (Hocking *et al* 2004; Farerell,2005). Farrell (2005) reported that, it was possible to dilute broiler finisher diet with 400g of coconut meal per kilogram without lowering performance. Diet dilution is a method of feed restriction in which broiler diets are mixed with high fibre feedstuffs to reduce the nutrient density. Meremikwu *et al* (2013) described diet dilution with high fibre feedstuffs as a systematic approach to lower nutrient specifications such as Poultry Hub (2020) specifications for broiler which may over-specify nutrients especially for countries in the humid-tropics because of environmental challenges.

Rice offalis one of the agro-industrial by-products that is readily available at no cost in the study area. It is a mixture of husk, bran and small quantities of broken rice obtained from small scale rice processing that is carried out in one -stage mills. The mixture contains approximately 60% hull, 35% bran and 5% polishing (Heuze and Tran 2015). It has a chemical composition of 94.42% dry matter, 5.09% crude protein, 30% crude fibre, 3.40% ether extract, 16.67% ash and 46.1% NFE (Maikano, 2007).

Rice offal is an ultimate waste in rice milling industries in Nigeria where it is seen as mountainous heap that is constantly destroyed by burning. In spite of the abundance of rice offal in Nigeria, it is not considered as a feed ingredient for poultry by Nutritionist because of the high fibre content and the anti-nutritional factor (silica) found in the husk. The fibre in rice offal is an insoluble polysaccharide. Earlier research in poultry revealed that insoluble fibres are inert and therefore act only as nutrient diluents. Unlike soluble fibres such as pectin which can produce high viscosity in the small intestine and thereby inhibit digestion and absorption, the most obvious effects of insoluble fibres include the increased bulk of digesat in the tract and a faster passage through the digestive tract (Hetland and Svihus, 2001).

This research was designed to investigate the effect of diet dilution using graded levels of rice offal on performance and lipid profile of finisher broilers. The objective was to determine the level(s) of dilution that would manifest the potential to prevent obesity and its associated metabolic disorders by lowering plasma triglycerides without compromising performance.

The performance parameters measured were: body weight, weight gain, feed intake, feed conversion ratio and mortality. The blood parameters include. Total cholesterol, triglycerides, HDL, LDL and VLDL. These blood parameters are modifiable factors sensitive to obesity.

MATERIALS AND METHODS

Study area

The research was carried out at the Poultry Unit of Teaching and Research Farm of the Department of Animal Science, Faculty of Agriculture and Forestry, Obubra campus, Cross river State Nigeria.

The area is located at Longitude 8^{o} - 9^{o} E of the Greenwich meridian and Latitude 6o – 7^{o} N of the equator (Mfam, 2002).

Experimental treatments and design

The experimental treatments comprised four levels of rice offal including the control.

Each of the treatments were replicated three times in a complete randomized design (CRD). The treatments includes;

T1 (control) - 0% rice offal dilution

T2 - 20% rice offal dilution (200g of rice offal/ kg of finisher diet).

T3 - 40% rice offal dilution (400g of rice offal/ kg of finisher diet).

T4 - 60% rice offal dilution (600g of rice offal/ kg of finisher diet).

These treatment levels were incorporated into conventional commercial finisher diet of 19% crude protein and available metabolizable energy of 2,900 kcal kg to form the experimental diets. The experimental diets are presented in table (1).

Management of Experimental Birds

A total of one hundred and forty four (144) finisher broilers of four weeks of age were used for the experiment. The birds were randomly selected and assigned to the twelve experimental units with twelve (12) birds per unit. The birds were housed in a deep litter house partitioned into experimental units measuring 8ft x 12ft (width x Length). Management during rearing period was based on standard husbandry practice for broiler production. Feed and water were given *ad-libitum* throughout the duration of the experiment which lasted

Table 1. Experimental Diet

	Treatments			
Diets	**T1 (control) RO (0%)**	**T2 RO (20%)**	**T3 RO (40%)**	**T4 RO (60%)**
FN (100%) RO (0%)	0kg RO/25kgFN			
FN (80%) RO (20%)		5kgRO/25kgFN		
FN 60% RO (40%)			10kgRO/25kgFN	
FN (40%) RO (60%)				15kgRO/25kgFN

FN = Finisher Diet
RO = Rice offal

Table 2. Performance of finisher broilers fed diets diluted with graded levels of rice offal

Parameters	**Treatments**				
	T1 (0% RO)	T2 (20% RO)	T3 (40% RO)	T4 (60%RO)	SEM
Initial body weight (kg)	0.70	0.70	0.70	0.70	0.70
Final body weight (kg)	2.60[a]	2.37[b]	1.96[c]	1.85 [c]	0.133
Body weight gain (g/day)	67.66 [a]	57.66 [b]	45.00 [c]	41.0[c]	4.58
Feed intake (g/bird/day)	153.0 [b]	165.5 [a]	143.3[c]	160.0 [a]	3.33
FCR (g of feed/ g of gain)	2.26 [c]	2.87[b]	2.657[b]	3.90[d]	0.26
Mortality (%)	8.33	0.00	0.00	0.00	

Means followed by the different superscripts are statistically different (P < 0.05)
FCR = Feed conversion ratio.
RO = Rice Offal

for four weeks (28 days).

Data collection

Data were collected on body weight, weight gain and feed intake. Body weight was obtained by weighing the birds using top loading balance on a weekly basis. Feed intake was recorded as quantity of feed offered minus left over the following day. Weight gain was calculated as final live weight minus initial live weight and converted to growth rate (weight gain per day) by dividing weight gain by the number of days of the experiment. Feed conversion ratio (FCR) was calculated as feed intake divided by weight gain.

At the end of the feeding trial, two birds were selected per replicate i.e. Six (6) birds per treatment for blood collection. Blood samples were collected into plain bottles by cutting the jugular vein on the throat. The blood was allowed to coagulate. The coagulated blood was spinned at 2000 rpm (revolution per minutes) for fifteen (15) minutes. The upper layer which is the serum was collected for lipid profile analysis. The serum analysis was carried out using laboratory guide lines by the National Cholesterol Education Programme (NCEP) Expert panel on detection (2002). The serum analysis contained the following items: total cholesterol, triglycerides and high-density lipoprotein-cholesterol, Low-density-lipoprotein cholesterol was calculated by plugging the scores for the measured total cholesterol, triglycerides and HDL in a Mathematical equation as described in Wikipedia (2017). LDL = Total cholesterol – HDL –Triglyceride/5, where triglyceride/5 is used to represent Very low- density lipoprotein cholesterol.

Data analysis

Data obtained were subjected to analysis of variance using statistical package for social sciences (SPSS) Version 16.0 (student's version). Significant means were separated using Duncan's Multiple Range Test of the same software.

RESULTS AND DISCUSSION

The results of this study are presented in tables 2 and 3. Table2 shows result on performance of the experimental birds, while table 3 shows result of the lipid profile test.

Performance

There was significant decrease (P<0.05) in body weight gain and final body weight of the birds as the levels of dilution increased. Feed conversion ratio increased (P<0.05) as the levels of dilution increased. Feed intake was very high at the lowest (20%) and highest (60%) level of dilution (165g and 160g/bird (day) respectively.

Table 3. Summary of Lipid Profile Test for the Experimental Birds

Parameters	Treatments				
	T1 (0% RO)	T2 (20% RO)	T3 (40% RO)	T4 (60%RO)	SEM
Total Cholesterol (mg/dl)	87.62	87.16	86.99	86.63	1.68ns
Triglycerides (mg/dl)	81.57^{a}	75.80^{b}	61.54^{c}	53.94^{d}	6.01
HDL (mg/dl)	61.09^{b}	69.50^{a}	69.52^{a}	69.52^{a}	1.44
LDL (mg/dl)	10.22^{a}	2.5^{b}	5.16^{b}	6.32^{b}	3.58
VLDL (Mg/dl)	16.31^{a}	15.16^{b}	12.31^{c}	10.79^{d}	1.05

Means followed by the different superscripts are statistically different ($P < 0.05$)
Ns = not significant

These values were significantly higher (P<0.05) than the intermediate level of dilution (40%) as well as the control. Mortality was zero percent for the diet diluted bird and 8.33% for control. The relevance of these results are discussed as follows.

The high feed intake of the diet diluted birds could be due to the effect of diet dilution on the energy content of the diets. This is supported by the reports of Farrel (2005) that diet dilution with high fibre feedstuffs reduced the metabolizable energy content of broiler feeds and increased feed intake.This is also in line with the report of Attamankunne (2006) that high fibre feedstuff decreased metabolizable energy content of broiler diets, causing the birds to consume more of the low energy diet to meet their energy needs.

The significant (P<0.05) low body weights and body weight gains of the diet diluted birds could be due to the reduced nutrient content of the diluted diets. This is supported by the report of Mench (2002) that reducing energy or protein content of diet by adding to its extra fibre is one of the methods of reducing fast growth and the associated metabolic disorders in broilers.

The zero percent mortality of the diet diluted birds against the control implied that the anti-nutritional factors (Silica) present in rice offal did not constitute a health hazard; rather diet dilution seemed to improve the health of the birds. This agrees with the report of Hocking *et al* (2002) that, diet dilution with oat hulls and sugar beet pulp resulted in reduction of heterophil: Lymphocyte ratio as well as reduced basophil number and increased antibody titre. Table 2.

Lipid profile

Diet dilution with rice offal decrease (p<0.05) plasma triglycerides, LDL, VLDL and increased (P<0.05) HDL compared to the control. Total cholesterol was not affected by diet dilution with rice offal. Triglycerides and VLDL decreased significantly as the levels of dilution increased. HDL did not differ (P>0.05) between the diet diluted groups. These results are discussed as follows.

The significant (P<0.05) decrease in plasma triglyceride and VLDL as the levels of dilution increased could be due to the reduced energy density of the diets caused by diet dilution with rice offal. This is supported by the report of Moll (2019) that, hypertriglyceridemia can be prevented by decreasing the energy content of diet and increasing the complex carbohydrate and fibre content. This is also supported by the report of Alice and Lichtenstein (2006) that increases in relative proportion of carbohydrate resulted in a dyslipidemia characterized by high triglyceride and VLDL with low concentration of HDL. The low (P<0.05) plasma triglyceride and VLDL of the diet diluted birds is an indication that diet dilution with rice offal can reduce body fatness and the associated metabolic disorders in broilers. Field (2013) reported that attempt to reduce excessive fatness in poultry have involved the control of VLDL because it is the major transporter of triglycerides from intestine and liver to peripheral tissues, resulting to adipose tissue growth and subsequent fattening. The highest level of dilution (60%) tend to manifest the potential to prevent obesity and it's associated with metabolic disorders because plasma concentration of triglycerides and VLDL were lowest (P<0.05) at this level. Although weight gain and final body weight were lowest at this level of dilution (60%) compared to other levels including the control, performance was not compromised because the birds were able to attain the minimum body weight of 1.85kg at eight weeks of age. Whitehead (2002) had reported that, it may be beneficial for a broiler not to reach the maximum growth potential considering the association between fast growth and a number of metabolic disorders.

The significant (P<0.05) high levels of HDL of the diet diluted birds could also be traced to the low calorie intake by the birds caused by diet dilution with rice offal. This is supported by the report of Fogoros (2019), that, low carbohydrate diet is associated with high HDL levels. Research has shown that it is low carbohydrate diet that is associated with higher HDL not low fat diet. Alice and Lichtenstein (2006) reported that replacement of dietary carbohydrate with fat resulted in lower triglycerides and VDL concentration and higher HDL. Fogoros (2019) reported that when energy source is from fat, HDL increased but when the energy source was from carbohydrate, HDL was reduced. The high levels of HDL

(P<0.05) recorded in this research suggest that diet dilution with rice offal may also protect against cardiovascular diseases in broilers. This is also supported by the reports of several authors (Hamilton Cardiology Associates (2019) Fogoros 2019) that high levels of HDL are associated with reduced risk of coronary artery disease (CAD). HDL often called “good cholesterol” is said to “scour” the walls of blood vessels, cleaning out excess cholesterol that might be used to make plaques that cause coronary artery disease. The HDL is then carried to the liver where it is processed into bile and secreted into the intestine and excreted out of the body (Hamilton Cardiology Associates (2019), Fogoros 2019).

The significant (P<0.05) reduction in triglycerides and increase in HDL recorded in this research suggest that diet dilution with rice offal can prevent obesity and protect against cardiovascular diseases in finisher broilers. This statement agrees with the report of Fogoros (2019) that triglycerides and HDL metabolism are closely interrelated and therefore both variables measure the same metabolic disorders. Table 3.

CONCLUSION

1. Diet dilution with rice offal has manifested all the attributes that can prevent obesity and improve the health of broilers. These include low body weight gain, low plasma triglycerides and elevated HDL-C in the diet diluted birds.
2. 60% level of dilution has shown the highest potential to prevent obesity/metabolic disorders without compromising performance because plasma triglycerides and VLDL-C were lowest at this level of dilution and the birds were able to attain a minimum body weight of 1.85 kg at eight weeks of age.

RECOMMENDATION

The health benefits of diets dilution with rice offal are incentives for broilers producers especially breeders to discover more cheap and available fibre feedstuffs for use as diet diluents.

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assistance during blood analysis

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