

## RESPONSE OF BROILER CHICKENS TO DIETARY LEVELS OF RICE MILLING WASTE

By

*M. Yusuf<sup>1</sup>; A. A. Liman<sup>1</sup>; M. Antyev<sup>1</sup>; A. Faruk<sup>1</sup>, U. D. Doma<sup>2</sup>, K. M. Bello<sup>2</sup>, N. Adamu<sup>2</sup>; and F. Muhammed<sup>3</sup>*<sup>1</sup>Department Animal Production,  
Taraba State College of Agriculture Jalingo,<sup>2</sup>Department of Animal Production  
Abubakar Tafawa Balewa University Bauchi<sup>3</sup>Department Agricultural Technology  
Federal College of Horticulture Dadinkowa  
Gombe State,**ABSTRACT**

*A feeding trial was conducted at the Poultry Research Farm, of the Abubakar Tafawa Balewa University Bauchi to evaluate the effect of dietary levels of rice milling waste (RMW) on the performance of broiler chickens. RMW replaced wheat offal at 0, 25, 50, 75, and 100% levels were designated as diets 1, 2, 3, 4, and 5 respectively. Two hundred and twenty broiler chickens were randomly allotted in to five dietary treatments with forty-four chickens per treatment and replicated four times in a completely randomized design. Feed and water were supplied ad-libitum and the duration of trial lasted for eight weeks. Most of the performance parameters measured at both the starter and finisher phases as well as the overall phase were not affected by the dietary levels of RMW except feed conversion ratio at the finisher (3.19-3.85) and overall phases (3.19-3.56) which were found to be significant at 10% and 5% respectively. Both feed cost (₦/kg) and feed cost in naira per kg gain decreased with increasing levels of RMW with the highest cost saving of ₦52.26 obtained on diet 5 (100%RMW). It can be recommended that RMW can completely (100%) replace wheat offal as dietary fibre source in the diets of broiler chickens with no adverse effects on performance as well as reduction in feed cost.*

**Keywords:** Broiler, Dietary, Rice Milling Waste, ad-libitum

**INTRODUCTION**

Dietary fibre is a component of the diet that affect the development of the gastrointestinal tract and may modify the characteristics of the intestinal content that promote the balanced growth of the native microbiota (Montagne, L., Pluske, J. R. and Hampson, D. J. 2003; Mateos, G. G., Jemenez-moreno, E., Serrano, M. P. and Lazaro, R. 2012). The inclusion of structural dietary fibre increase the size and holding capital of gizzard (Svihus, 2011; Jimenex-moreno, E. M., Frikha, A.

de coca-sinova, R. Lazaro and Mateos, G. G. 2013). Svihus (2011) suggested that the hyper plagia frequently reported in ad-libitum feed birds selected for high growth to rates might be related to under-developed gizzard, a consequence of poor structure of feeds and the lack of sufficient structural component such as dietary fibre. An excess of feed intake as occurs in these birds usually result in pobrer feed efficiency than expected. Consequently, no negative effects of the inclusion of moderate amount of dietary fibre on broiler performance should be expected. Moreover, the

inclusion of an adequate amount of dietary fibre might avoid an excessive feed intake in these birds resulting in better general productivity.

Broiler chickens (*Gallus domesticus*) are a gallinaceous domesticated fowl, bred and raised specifically for meat production (Kruchten 2002). Typical broiler chickens have white feathers and yellowish skin. Most commercial broiler chickens reach slaughter weight at between five to seven weeks of age. Chickens are one of the most common and widespread domestic animals and with a population of 19 billion in 2011 the domestication of chicken is stated in the encyclopedia as "humans first domesticated chicken of Indian" origin (Garrigus, 2007). Another source indicates six to seven weeks as adequate for broiler production (U.S Poultry and Egg Association, 2012).

Broiler mortality in the U.S in 2011 is estimated as 3.8% however the 1925 figure was 18% (U.S Poultry and Egg Association, 2012). Artificial treatments have led to a great change in the speed with which broilers develop. The time required to reach 1.5kg live-weight was reduced from 120 days in 1925 to 30 days in 2005 (Bessei, 2006)

Feeders and drinkers are height adjusted as the birds grow and can be raised on chain or wire to allow out of the barn chicks require warm air temperatures, which reduced as birds mature age brooder temperature 0 days 34-3<sup>0</sup>C, 14days 31-32<sup>0</sup>C. Whole house heating temperature 0 days 31-32<sup>0</sup>C 14 days 24-25<sup>0</sup>C (Hubbard, 2012). Under practical feeding conditions, particle size and solubility of fiber fraction in the digestive environment and the degree of lignification are key characteristic effecting bird productivity because of their effects on rate of feed passage in the upper part of the gastro-intestinal tract (GIT) and fermentative ability in distal part (Hetland, 2003).

Rice milling waste is one of the agro-industrial by-products that is available in large quantities all year round in the rice producing areas of Nigeria. It is obtained at the by-products from the locally.

Rice milling machine produce the polished grain used for human consumption. The rice milling waste contains the husk broken rice grain and the hulls. Dietary fibre has an abrasive effect on the intestinal wall and may result in an increase in endogenous cell losses and nutrients to the lumen (Perez-Bonilla, A., Frikha, M., Miraie S., Garcia J., Mateos G. G. 2011). Dietary fibre decreased pancreatic enzyme activity (Latshaw, 2008). Inclusion of up to 30% high fibre sunflower meal in a pelleted corn basal diet resulted in significant linear increases in apparent ileal digestibility (AID) of fat and crude protein but that dry matter and energy digestibility decreased in broiler chickens (Kalmendal, R., Elwinger, K., Holm L., Tauson R. 2011).

Livestock production is a socio-economic activity that could lead to improved income and quality of life (Alabi and Samuel, 2002). Oluoyemi and Roberts (1982) reported that poultry production has the highest priority rating because it has better energy and protein conversion ratio than other animal species and because the net return on investment is relatively high. In poultry industry, broiler production seems to be faster than egg production in terms of quick return. This is true because of the short generation interval of broilers (Dibner, J. J., Knight, C. D. and Ivey, F. J. 1998).

Adamu, S. B., Waziri, Y. D. and Abbotor, F. I. (2001) evaluated the performance of broilers fed diets containing different energy sources in semi-arid region of Nigeria. They reported that cost of producing a kilogram of broiler finisher mash using maize, sorghum and millet were ₦23.9, ₦21.1 and 21.0 while profit margin per broiler was ₦201, ₦162.4 and ₦209.0 respectively.

They concluded that millet was the most economical of the three main energy sources.

In a comparative cost analysis of meat protein and energy production in Ogun state, Nigeria by Aromolaran and Ashiru (1998), it was observed that the cost of producing a unit of meat (₦/kg) from broiler chicken was ₦ 112.00 while Chumaro (2002) obtained a cost of ₦ 107.72 per kg of meat from broiler when fed diets containing graded levels of wheat offal.

## MATERIALS AND METHODS

The study was conducted at poultry research farm of Abubakar Tafawa Balewa University, Bauchi, Bauchi State. The state occupies a land area of about 66,000 square kilometers. The state lies between longitude 10°10' to 10° 33'N and latitudes 9° 40' to 10° 31E at an altitude of 6902 meter above sea level. The study area has two main season rainy season (June – October) and dry season (November – May). The total mean rainfall is 700 – 900mm for southern zone 690 – 1031mm for central zone and 900 – 1300mm for western zone (BSADP 2003). The temperature range from 19.15°C to 28.5°C, the hottest months being March and April while the coldest months are January and February.

### *Management of the Experimental Birds*

Two hundred and twenty (220) broiler chicks were purchased from Ibadan Oyo state. The chicks were brooded for seven days on deep litter using 200 watts of electricity bulb. Commercial broiler starter (hybrid grade feed) was fed to them during brooded period. After brooding, the chicks were randomly assigned to five dietary treatments replicated four times each with eleven birds per replicate. Feed and water were supplied *adlibitum*. All vaccination schedules were administered to the birds at

appropriate time so also anti stress was given to the birds on arrival and after every week of weighing.

### *Experimental Diets*

Five experimental diets were formulated in which rice milling waste replaced conventional source of fibre i.e. wheat offal at 0, 25, 50, 75 and 100% levels which were designated as dietary treatment 1, 2, 3, 4 and 5 respectively. The diets were formulated to supply 2900 kcal/Kg Metabolizable Energy, 23% and 20% crude protein for both starter and finisher phases respectively. Premix, bone meal, salt limestone methionine and lysine were also used in compounding the feeds. The ingredients, chemical composition and calculated analysis of the experimental diets for both starter and finisher phases were presented in Tables 1 and 2 respectively.

### *Experimental Design*

The experimental design adopted was a Completely Randomized Design (CRD). The five diets formed the treatments and each treatment was replicated four times.

### *Data Collection*

Feed given to the birds were weighed daily each treatment and replication left over were also collected and weighed before offering new feeds in the morning. Daily record of feed supply and feed consumption were obtained for each pen by dividing the total amount of feed consumed by the number of live birds. The feed intake was recorded on daily basis. Initial body weights were first obtained at end of brooding period and their weight gain were also obtained by weekly weighing with help of a weighing balance.

Feed conversion ratio was obtained by dividing the feed intake per bird per day by the total daily weight gain expressed as

$$FCR = \frac{\text{Feed intake}}{\text{Weight gain}}$$

Mortalities were recorded for each group in number. In other to get percentage mortalities for each group, it can be expressed as

$$\% \text{ mortality} = \frac{\text{Number of birds died} \times 100}{\text{Number of birds placed in the pen}}$$

**Table 1:** Ingredients and composition percentage of rice milling waste based diets fed to broilers at the starter phase (1 – 4 Weeks)

Ingredients	Dietary Inclusion Levels				
	1(0%)	2(25%)	3(50%)	4(75%)	5(100%)
Maize	47.13	46.30	45.47	44.63	41.80
Soya Bean	33.47	34.30	35.13	35.93	38.80
Wheat Offal	10	7.7	5.0	2.5	0.00
RMW	0	2.5	5.0	7.5	10.00
FM	5	5	5	5	5
LMS	1.5	1.5	1.5	1.5	1.5
Bone Meal	2.0	2.0	2.0	2.0	2.0
Salt	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
Lysine	0.2	0.2	0.2	0.2	0.2
Methionine	0.2	0.2	0.2	0.2	0.2
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>
<b>Calculated Analysis</b>					
Crude Protein %	23.00	23.00	23.00	23.00	23.00
ME (kcal/Kg)	2922.57	2925.74	2923.4	2919.81	2912.28
Crude Fibre %	4.19	4.49	4.81	5.15	5.49
Calcium %	1.68	1.68	1.68	1.69	1.69
Phosphorous %	0.90	0.89	0.86	0.86	0.85
Ether Extract %	8.48	8.83	9.17	9.50	10.13

RMW: Rice Milling Waste LMS: Limestone ME Kcal/kg: Metabolisable Energy in Kilocal Per kg \*each 2.5kg premix contains the following Vitamin A. 15,000iu, Vit. D<sub>3</sub> 3,000iu, Vit. E. 30,000iu, Vit. K 3000mg; Vit. B<sub>1</sub> 3,000mg; vit. B<sub>2</sub> 6,000mg; Vit B<sub>6</sub> 5,000mg; Vit. B<sub>12</sub> 40mg; Biotin 200mg; Niacin 40,000mg; Pantothenic acid 15,000mg; Folic acid 2,000mg; Choline 30,000mg; Iron 60,000mg; Manganese 80,000mg; Copper 25,000mg; Zinc 80,000mg; Cobalt 150mg; Iodine 500mg; Selenium 310mg; Antioxidant 20,000mg.

**Table 2:** Ingredients and composition percentage of Rice Milling Waste Based Diets Fed to Broilers at the Finisher Phase (5 – 8 weeks)

Ingredients	Dietary Levels of Inclusion				
	1(0%)	2(25%)	3(50%)	4(75%)	5(100%)
Maize	50.53	49.27	48.03	46.77	45.53
Soya Bean	28.07	29.33	30.57	31.83	33.07
Wheat Offal	15	11.25	7.5	3.75	0.00
RMW	0	3.75	7.5	11.25	15
Fish Meal	2	2	2	2	2
LMS	1.5	1.5	1.5	1.5	1.5
Bone Meal	2	2	2	2	2
Salt	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
Lysine	0.2	0.2	0.2	0.2	0.2
Methionine	0.2	0.2	0.2	0.2	0.2
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>
<b>Calculated Analysis</b>					
Crude Protein %	20.00	20.00	20.00	20.00	20.00
ME (kcal/Kg)	2857.00	2853.00	2850.00	2846.00	2843.00
Crude Fibre %	4.27	4.74	5.21	5.67	6.14
Calcium %	1.49	1.49	1.49	1.49	1.49
Phosphorous %	0.85	0.83	0.81	0.78	0.76
Ether Extract %	7.69	8.20	9.71	9.23	9.74

RMW: Rice Milling Waste LMS: Limestone ME Kcal/kg: Metabolisable Energy in Kilocal Per kg \*each 2.5kg premix contains the following Vitamin A. 15,000 IU, Vit. D<sub>3</sub> 3,000 IU, Vit. E. 30,000 IU, Vit. K 3000mg; Vit. B<sub>1</sub> 3,000mg; vit. B<sub>2</sub> 6,000mg; Vit B<sub>6</sub> 5, 000mg; Vit. B<sub>12</sub> 40mg; Biotin 200mg; Niacin 40,000mg; Pantothenic acid 15,000mg; Folic acid 2,000mg; Choline 30,000mg; Iron 60,000mg; Manganese 80,000mg; Copper 25,000mg; Zinc 80,000mg; Cobalt 150mg; Iodine 500mg; Selenium 310mg; Antioxidant 20,000mg.

## RESULTS

The performance of broiler chickens fed rice milling waste based diets. The daily feed intake range from 64.78 to 72.20g in broiler diets fed diet 2 and 3 however, all the feed intake value obtained at starter phase were statistically indifference. Daily weight gain varies from 20-21 and 22.89g in broiler birds fed diets 2 and 1 respectively. Feed conversion ratio varied between 3.09 and 3.47 in broiler birds fed diets 1 and 3. The daily weight gain and

feed conversion ratio at starter phase shown no significant difference. The performance of broiler fed experimented diet at the finisher phase (5-8 weeks) the daily feed intake ranged from 111.58 to 135.63g in broiler chicks fed diets 3 and 1. The daily weight gain varied between 35.34 and 37.12g in broiler birds fed diets 1 and 3 respectively. All the daily feed intake values and the daily weight gain value obtained at finisher phase were similar. While the feed conversion ratio ranged from 3.19 to 3.85 in broiler chicks

fed diets 2 and 1 respectively had the best FCR follow by birds on diets 3 and 4 while birds on diets 1 had the lowest feed conversion ratio. The overall performance of broiler chickens fed rice milling waste based diets is presented in table 7. The overall daily feed intake varied between 89.00 and 103.21g in broiler chicks fed diets 2 and 1 respectively. Daily weight gain ranged from 27.83 to 29.33g in broiler birds fed diets 2 and 3. The observed values in daily feed intake and daily weight gain at overall phase showed no statistical difference feed conversion ratio (FCR) at overall phase ranged from 3.19 to 3.56 in broiler chicks fed diets 2 and 1 were found to be significant at ( $p < 0.1$ ) and ( $p < 0.05$ ) with better FCR obtained in bird fed RMW based diets as compared to wheat offal control diet.

The economics of production of broiler chickens fed diets containing graded dietary levels of RMW is presented in Table 6. For total feed intake, birds on diets 4

and 1 consumed more feed (5.40 kg and 5.78 kg) than those on diets 2, 3 and 3. Feed cost (Naira per kilogramme) decreased with increasing levels of inclusion of RMW. For total feed cost, highest value (₦457.14) was obtained from birds fed diet 1 (control) while values for birds on diets 2, 3, 4 and 5 ranged from ₦386.96 to ₦415.51k. Total weight gain had a ranged of 1.56 kg in diet 2 to 1.64 kg in diet 3. For feed cost (naira per kilogramme gain), birds fed diets 1 and 3 recorded the highest values of ₦ 280.45 and ₦ 53.36 per kilogramme gain respectively. For cost difference the higher the percentage of inclusion the lower the cost difference.

**Table 3:** Performance of broilers fed graded levels of rice milling waste based diets at the starter phase (1 – 4 weeks)

Parameters	Diets					SEM
	1 (0%)	2 (5%)	3 (50%)	4 (75%)	5 (100%)	
DFI (g)	70.78	64.78	72.20	69.13	68.98	5.96 <sup>NS</sup>
DWG (g)	22.89	20.21	21.55	21.54	22.43	1.46 <sup>NS</sup>
FCR	3.09	3.23	3.47	3.22	3.09	0.25 <sup>NS</sup>
Mortality (Number)	2	0	2	0	1	-

NS = Not Significant, SEM = Standard Error of Mean, DFI = Daily Feed Intake, DWG = Daily Weight Gain, FCR = Feed Conversion Ratio

**Table 4:** Performance of broiler chickens fed graded levels of rice milling waste based diets at finisher phase (5 – 8 weeks)

Parameters	Diets					SEM
	1 (0%)	2 (25%)	3 (50%)	4 (75%)	5 (100%)	
DFI (g)	135.63	113.21	111.58	123.37	120.36	7.74 <sup>NS</sup>
DWG (g)	35.34	35.46	37.12	36.63	35.75	2.63 <sup>NS</sup>
FCR	3.85 <sup>a</sup>	3.19 <sup>c</sup>	3.21 <sup>c</sup>	3.41 <sup>b</sup>	3.38 <sup>b</sup>	0.13 <sup>*</sup>
Mortality (Number)	0	0	2	0	0	-

NS = Not Significant, \* = Significant at (P<0.05), SEM = Standard Error of Mean, DFI = Daily Feed Intake,

WDG = Daily Weight Gain, FCR = Feed Conversion Ratio

DFI = Daily Feed Intake, DWG = Daily Weight Gain, FCR = Feed Conversion Ratio

**Table 5:** Overall Performance of broiler chickens fed rice milling waste based diets (1-8weeks)

Parameters	Diets					SEM
	1 (0%)	2 (25%)	3 (50%)	4 (75%)	5 (100%)	
DFI (g)	103.21	89.00	95.68	96.50	94.67	5.67 <sup>NS</sup>
DWG (g)	29.11	27.83	29.33	29.09	29.09	1.64 <sup>NS</sup>
FCR	3.56 <sup>a</sup>	3.19 <sup>b</sup>	3.26 <sup>b</sup>	3.32 <sup>b</sup>	3.26 <sup>b</sup>	0.06*
Mortality (Number)	2	0	4	0	1	-

NS = Not Significant, \* = Significant Difference at (P<0.05), SEM = Standard Error of Mean

DFI = Daily Feed Intake, DWG = Daily Weight Gain, FCR = Feed Conversion Ratio

**Table 6:** Economic analysis of broilers fed graded levels rice milling waste based diets.

Parameters	Diets			
	1(0%)	2(25%)	3(50%)	4(75%)
TFI (Kg)	5.78	4.98	5.36	5.40
FC (₦/Kg)	79.09	78.38	77.52	71.66
TFC (₦)	457.14	390.65	415.51	386.96
TWG (Kg)	1.63	1.56	1.64	1.63
FC (₦/Kg Gain)	280.45	250.42	253.36	237.39
Cost saving(₦)	00.00	30.03	27.09	43.06

TFI (Kg) = Total Feed Intake (Kilogram), FC (₦ /Kg) = Cost (Naira/Kilogram), TFC (₦) = Total Feed Cost (Naira),

TWG (Kg) = Total Weight Gain (Kilogram), FC (₦ /Kg Gain)

## DISCUSSION

The daily feed in take was not significantly influenced by the graded levels of rice milling waste at both starter and finisher phases as well as overall performance. This finding agreed with the report of Duru and Dafwang (2010) in poultry fed 15% rice offal in their diets without any effect on their performance. The finding also tally with the report of Oyawaye and Nelson (1999) who reported that, rice offals can be incorporated at levels up to 40%

for pullets and 25% for layers. But the finding disagree with Saki, A. A., Martin H. R. M., Zamani P., Tabatabai M. M., Vatanchian M. (2011) who observed that, increase in dietary fibre to 3.75% increase the concentration and amount of organic acid excreted as well as Hydrogen gas (H<sub>2</sub>) production resulting from fermentation process which indicates increase in microbial activities and the resulting short chain fatty acid has a bacteriostatic effect on some enteric bacteria including *Salmonella typhimurium*.

The daily weight-gains were statistically similar at starter level. The range values of daily weight gain obtained at the starter varies from 20.21g in diet 2 to 22.89g in diet 1. This finding does not agree with the findings of Mendel (2013) who reported that, the excessive use of such fibre source in the diet may also increase viscosity in the intestinal content with a resulting decrease in bioavailability of vitamin A and Utilization of dietary fat which adversely affects body weight gain and carcass quality.

Feed conversion ratio did not show significant difference at starters phase while significant difference exist ( $P < 0.05$ ) at finisher phase and combined phase. This finding at finisher and combined phases was not in

consonance with the report of Yakubu Yakubu B., Adegbola T.A., Bogoro S. and Yusuf H.B. (2007).

The mortality observed in this study was less than 5% indicating that rice milling waste was not detrimental to broiler chickens as earlier observed by several researchers (Duru and Dafwang 2010, Saki *et al.*, 2011) and Yakubu *et al.*, 2007) who state that, broiler chickens were fed to urea treated rice offal at 12% showed a significantly higher liver weight and carcass yield exhibited by birds on diets.

## CONCLUSION AND RECOMMENDATION

All the experimental diets supported the growth of broiler chickens. It is therefore recommended that RMW is a good substitute for wheat offal in broiler diets.

## REFERENCES

- Adamu, S. B., Waziri, Y. D. and Abbotor, F. I. (2001). The use of different energy sources on the performance of broiler chickens under a semi-arid environment. Proceedings of 6<sup>th</sup> Annual Conference of Animal Science Association of Nigeria 17 – 19<sup>th</sup> September, 2001, Maiduguri, Nigeria
- Alabi, R. A. and Samuel, K. D. (2002). An Economic Analysis of Poultry Production System in Ondo State. Proceeding of the 7<sup>th</sup> Science Association of Nigeria 16<sup>th</sup> – 19<sup>th</sup> September 2002 Abeokuta, Nigeria
- Aromolaran, A. B. and Ashiru, R. A. (1998). Comparative cost analysis of meat protein and energy production in Ogun state-Nigeria Proceedings of the Silver Anniversary Conference of Nigeria Society of Animal Production, 21<sup>st</sup> – 26<sup>th</sup> March, 1998
- Bauchi State Agricultural Development Programme (BSADP) (2003) Annual Report.
- Bessei, W. (2006). "Welfare of Broilers A Review *World's Poultry Science Journal*/62 doi 10.1079/wps2005108
- Chumaro, T. (2002). Performance of Finisher Broiler Fed Varying Levels of Wheat offal Based Diets. Post Graduate Diploma Thesis Animal Production Programme ATBU, Bauchi – Nigeria
- Dibner, J. J., Knight, C. D. and Ivey, F. J. (1998). The Feeding of Neonatal world *poultry science Journal* 14(5):36 – 40
- Duru S. and Dafwang I.I (2010) Effect of mixigrain supplementation of diets with or without rice offal on the performance of broiler chickens *International Journal of Poultry science* 5(1):14 – 16
- Garrigus, N. P. (2007). "Poultry Farming" Encyclopaedia Britannica
- Hetlan, H., Svihus B. (2003) Effect of oat hulls on performance, gut capacity and feed passage time in broiler chickens. *Journal of British Poultry Science* 42:354 – 361



- Hubbard, L. L. C. (2012). "Classic Parent Stock Management Guide"
- Jimenez-moreno, E. M., Frikha, A. de coca-sinova, R. Lazaro and G. G. Mateos. (2013). Oat hulls and Sugar Beet Pulp in diets to broilers 2. Effects on the development of the gastrointestinal tract and on the structure of the Jejuna mucosa. *Journal of Animal Feed Science*. 5(3): 346 – 351
- Kalmendal, R., Elwinger, K., Holm L., Tauson R. (2011). High fibre sunflower cake affects small intestinal digestion and health in broiler chickens. *British Journal of Poultry Science* 52:86 – 96
- Kruchten, T. (2002). "US Broiler industry structure". National Agricultural Statistics Service (NASS), Agricultural Statistics Board, US Department of Agriculture retrieved June 23, 2012
- Latshaw, J. D. (2008). Daily energy intake of broiler chickens is altered by proximate nutrient content and form of the diet. *Journal of Poultry Science* 87:89 – 95
- Mateos, G. G., Jimenez-moreno, E., Serrano, M. P. and Lazaro, R. (2012). Poultry Response to high levels of Dietary Fibre Sources Varying in Physical and Chemical Characteristics. *Journal of Applied Poultry Res* 21: 156 – 174
- Mendel, F., (2013). Western Regional Research centre, Agriculture Research service U.S Department of Agriculture 800 Buchanan Street Albany, California 9470 united states *Journal Of Agriculture and Food Chemistry* 61(45) pp 1062640641
- Montagne, L., Pluske, J. R. and Hampson, D. J. (2003). A Review of Interactions between Dietary Fibre and the Intestinal Mucosa and their Consequences on Digestive Health in Young non ruminant animals. *Animal Feed Science Technology* 108: 95 – 117
- Oluoyemi, J. A and Robert, F. A. (1982). *Poultry Production in Warm-Wet Climate*. Macmillan London Pp 169
- Oyawoye, E.O., and Nelson F.S (1999). Optimum level of inclusion of rice offal in the diet of young cockerel proceedings of the 26<sup>th</sup> Annual Conference of Nigeria Society of Animal Production 21-25<sup>th</sup> March, Ilorin.
- Perez-Bonilla, A., Frikha, M., Miraie S., Garcia J., Mateos G. G. (2011). Effect of the main cereal and type of fat of the diet on productive performance and egg quality of brown-egg laying hens from 22 to 54 weeks of age. *Journal of Poultry Science* 90:2801 - 2810
- Saki, A. A., Martin H. R. M., Zamani P., Tabatabai M. M., Vatanchian M. (2011) Various ratios of pectin to cellulose affect intestinal morphology, DNA quantitation and performance of broiler chicks *Livestock Science*. 139:237-244
- Svihus, B., (2011). The gizzard: function influence of diets structures and effects on nutrients availability. *Journal of Poultry Science*. 67:207-224
- U.S Poultry and eggs Association (2012). "Poultry Industry Frequently Asked Questions Provided by the US Poultry and egg Association".
- Yakubu B., Adegbola T. A., Bogoro S. and Yusuf H.B. (2007) Effect of urea treated and untreated rice offal on the performance of broiler chickens carcass yield and characteristics of internal organs. *Journal of Sustainable Development in Agriculture and Environment*