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Performance and Internal Organ Characteristics of Broiler Chickens Fed Urea-Treated and Untreated Rice Milling Waste

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Abstract

Seventy Five (75) day-old broilers randomly allotted into five treatments with 3 replicate each containing five birds where used to evaluate the effects of urea treated Rice Milling Waste (UTRMW) and untreated Rice Milling Waste (UNTRMW) on the performance and internal organ characteristics of broiler chickens. Five experimental diets T_1, T_2, $T_{3,}$ T_4 and T_5 containing 0% UNTRMW, 10% UNTRMW, 15% UNTRMW, 10% UTRMW and 15% UTRMW respectively were formulated. Complete Randomized Design (CRD) was used and significant means were separated using Duncan Multiple Range Test. The results of the proximate composition of the diets showed an increase in the crude protein in T_4 and T_5 due to non-protein Nitrogen contribution from urea. In the starter phase, weekly weight gain and feed cost per Kg gain were highly significant (p< 0.01). Final weight, total weight gain, daily weight gain and FCR were significant (p< 0.05). At the finisher phase as observed from Table 4, Final weights, weekly weight gain, Total feed intake, FCR and Feed cost/Kg gain were highly significant (p<0.01).Daily feed intake was significant (p<0.05).As for the internal organs, spleen and intestine weights were highly significant (p<0.01) while liver and gizzard weights were significant (p<0.05). T_2 was better in feed cost per kilogram gain (₦) at the starter phase. T_4 (10% UTRMW) had the best live weight apart from T_1. T_3 had the highest gizzard weight. 10% dietary level of inclusion of UTRMW and levels below 10% of UNTRMW is recommended in broilers diet, and 15% level of inclusion of UNTRMW is recommended if the sale of gizzard is priority.

Keywords

Urea-Treated, Untreated, Rice Milling Waste

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1. Introduction

Nigeria has not been able to provide animal protein requirement of her citizenry despite the large variety of animal protein sources: 13.8m cattle, 34.4m goats, 22m sheep, 3.4m pigs, 104.3m local poultry and about 20m exotic poultry, 1.7m domesticated rabbits (RIM, 1992).

Oluyemi and Robert (2000) reported that the basic problem facing any livestock improvement especially in Nigeria is not basically from the genetic code of the animals, but from the nutritive aspect of it. The use of non-conventional feedstuffs that are not demanded by man for food is perhaps one of the approaches to reducing the high feed cost incurred in livestock feeding. The energy component of poultry feed is usually high and any significant reduction in cost of energy would in effect translate to reduced cost of feeding. The biggest constraint to broiler production in Nigeria which is cost of feed that accounts for about 60-80% of the recurrent expenditure in intensive broiler production (Oluyemi and Robert, 2000) can be savaged by exploiting cheaper and reliable sources of feed to replace expensive ones.

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Rice milling waste, the byproduct of a one-step rice milling process which contains the bran, polishing, husk and small quantities of broken gains constitutes 40% of paddy rice and is available in large quantities in the major rice growing areas of Nigeria (Dafwang and Damang, 1995). Ashan, (1994) and Tiemako (1994) reported that the nutrient profile of rice waste could be improved by processing techniques such as chemical treatment with urea.

Urea-ammonia treatment of crop residues has been reported to improve digestibility, milk yield, weight gain and feed efficiency in animals. (Djibrillou *et al*., 1998).

In an experiment conducted by Amaefule *et al.* (2006) to evaluate the effect of various treatment methods of rice milling waste (RMW) on growth performance, nutrient retention and organ characteristics of finisher broilers, Rice milling waste was treated with urea (D_2), poultry droppings (D_3) and water (D_4), while untreated waste (D_1) served as control. Urea treated RMW diet significantly (P<0.05) improved body weight, weight gain and dressed weight of broilers. Organ weights, dry matter intake and nitrogen free extract were not significantly (P>0.05) influenced by the dietary treatments. Broilers fed untreated RMW diet recorded significantly higher feed intake than broilers fed other diets. The results showed that rice milling waste, when treated with urea (fertilizer grade) and included in finisher broiler diets, could enhance their performance. Broilers fed urea treated RMW (D_2) diet had significantly higher (P<0.05) final body weight and daily weight gain than those fed other diets. There were no significant differences (P>0.05) in these two parameters between broilers fed D_1 (untreated RMW), D_3 and D_4 diets. The treatment of RMW with urea increased its nitrogen content due to the addition of non-protein nitrogen (Fontenot *et al.,* 1983). This is in agreement with the reports (Taiwo *et al.,* 1992 and Amaefule *et al.,* 2003) that urea ammunition increases the crude protein content of feed materials including RMW. Urea treated RMW diet improved broiler daily weight gain and final body weight more than other diets in contrast to earlier report (Ameafule *et al.,* 2003) that urea treated RMW had no effect on body weight and daily weight gain of broilers. The untreated RMW (D_1) diet had the highest intake probably due to high crude fiber content (Moran, 1977), which may have caused the broilers to consume more of the diet to meet their nutrient requirement (Isikwenu *et al.,* 2000). The result of nutrient utilization of the treatment diets by broilers did not actually reflect the observed performance of the broilers and also did not follow any regular pattern. This suggests that the effect of the treatments on RMW needs proper investigation. It was expected that urea and poultry droppings would enhance crude protein and fiber utilization of the diets since according to (Taiwo *et al.,* 1992), urea ammoniation increased RMW utilization and fiber fraction degradation. This particular study investigated the effect of untreated and urea treated rice milling waste on performance and internal organ characteristics of broiler chickens. This study is very needful since rice milling waste is free, in abundance and left to constitute environmental pollution in the study area. It is believed that treating this waste with urea will improve its usage as livestock feedstuff.

2. Materials and Methods

2.1. Preparation and Procedure for Treating Rice Milling Waste

The test diet (Rice Milling Waste) was collected free of charge from a rice mill at Itobe town which is about 35 minutes drive from the experimental site within Kogi State. Fifty kilogram (50kg) out of the rice milling waste was soaked in a plastic drum containing 75 litres of water with 1 kg of area (fertilizer grade) dissolved in it after which the drum was made air-tight by sealing it with a polythene sheet and left to ferment for seven days and later sundried for 72 hours. It was then incorporated at varying levels in the experimental diets (Both Starter and Finisher Phase). The water used in this study (both for the preparation of feed and that served to the birds) is free of toxicant.

2.2. Management of Experimental Birds and Duration of the Experiment

The broilers in each replicate were brooded in a deep litter brooding room of the Experimental poultry house for 3 weeks. Heat was provided with kerosene stoves under metal hovers. Feed and water were provided to the broilers *ad libitum* while additional light was sometimes provided at night using electricity. The average initial weight of the experimental birds was 73.21g. The birds were given VITALYTE orally for 5 consecutive days from day-old. Lasota vaccine was administered orally on days 7 and 21, while Gumboro disease vaccine was administered orally on days 24 and 28. Broad-spectrum antibiotics and coccidiostat were administered to the birds orally. The experiment lasted for 9 weeks.

2.3. Data Collection and Statistical Analysis

Data on performance and internal organ characteristic were collected. All the data obtained were subjected to a one way analysis of variance (ANOVA) using SPSS (2010) Inc. 16.0 Evaluation Version for windows in a Complete Randomized Design (CRD). Significant mean levels were separated using Duncan Multiple Range Test.

The proximate analysis of the experimental diet was determined according to AOAC, (2000).

Table 1. Gross % and Proximate Composition of Experimental Diet for Starter.

Ingredients	T_1 (0%UNTRM)	T_2 (10%UNTRMW)	T_3 (15%UNTRMW)	T_4 (10%UTRMW)	T_5 (15%UTRMW)
Maize	32.50	23.30	17.90	23.30	17.90
GNC	28.20	32.00	34.30	32.00	34.30
BNW	17.00	20.00	20.00	20.00	20.00
BDG	15.00	5.00	2.00	5.00	2.00
RMW	0.00	10.00	15.00	10.00	15.00
Fish Meal	3.00	3.00	3.00	3.00	3.00
Bone Meal	2.00	2.00	2.00	2.00	2.00
Palm Oil	2.00	4.00	5.00	4.00	5.00
Premix	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Methionine	0.20	0.20	0.20	0.20	0.20
Lysine	0.10	0.10	0.10	0.10	0.10
Total	100.00	100.10	100.00	100.10	100.00
Calculated Analysis					
ME Kcal/kg	2804.50	2789.60	2748.20	2789.60	2748.20
CP (%)	23.10	23.40	23.20	23.04	23.20
Determined Analysis (%)					
Dry matter	93.84	92.47	91.00	93.10	95.00
Crude Protein	21.57	22.00	22.40	24.80	25.50
Crude fiber	5.80	7.00	7.90	6.5.00	7.00
Ether extract	6.20	8.10	8.50	8.00	8.20
Ash	7.30	7.00	7.10	7.20	7.80
NFE	59.13	55.9	54.10	53.50	51.50

Premix Bio-Mix® supplied per tonne: Vit A 5,000000 I.U., Vit D_3 1,000000 I.U., Vit E 20,000mg, Vit K_3 1000mg; Vit B_1, 1200mg, Vit B_2 2400mg, Vit B_6 2400mg, Niacin 16,000mg; Calcium Pantothenate 4,000mg Biotin 32mg; Vit B_{12} 10mg; Folic Acid 400mg; Chlorine Chloride 120,000mg: Manganese 40,000mg; Iron 20,000mg: Zinc 18,000. Copper 800mg; Cobalt 100mg, Iodine 620mg, Selenium 40mg ME: Metabolisable Energy, NFE: Nitrogen Free Extract, GNC:Groundnut Cake, BNW: Bambaranut Waste, BDG: Brewers Dried Gain, RMW: Rice Milling Waste, UNTRMW: Untreated Rice Milling Waste, UTRMW: Urea Treated Rice Milling Waste.

Table 2. Gross % and Proximate Composition of Experimental Diet for Broiler Finisher.

Ingredients	T_1 (0%UNTRMW)	T_2 (10%UNTRMW)	T_3(15%UNTRMW)	T_4 (10%UTRMW)	T_5 (15%UTRMW)
Maize	36.20	32.00	26.60	32.00	26.60
GNC	20.00	26.20	26.60	26.20	26.60
BNW	20.00	20.00	20.00	20.00	20.00
BDG	17.00	4.00	2.00	4.00	2.00
RMW	0.00	10.00	15.00	10.00	15.00
Fish Meal	2.00	2.00	2.00	2.00	2.00
Bone Meal	2.00	2.00	2.00	2.00	2.00
Palm Oil	2.00	3.00	5.00	3.00	5.00
Premix	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Methionine	0.20	0.20	0.20	0.20	0.20
Lysine	0.10	0.10	0.10	0.10	0.10
Total	100.00	100.00	100.00	100.00	100.00
Calculated Analysis					
ME Kcal/kg	2848.64	2818.74	2830.40	2818.74	2830.40
CP	20.10	20.01	20.02	20.01	20.02
Determined Analysis (%)					
Dry matter	95.00	94.87	93.70	96.00	95.30
Crude Protein	19.78	19.90	20.00	22.10	22.80
Crude fiber	6.00	10.80	11.50	9.00	10.00
Ether extract	5.10	6.00	6.10	5.90	6.00
Ash	8.00	8.80	9.40	9.00	8.90
NFE	61.12	54.50	53.00	54.00	52.30

Premix Bio-Mix® supplied per tonne: Vit A 5,000000 I. U., Vit D_3 1,000000 I. U., Vit E 20,000mg, Vit K_3 1000mg; Vit B_1, 1200mg, Vit B_2 2400mg, Vit B_6 2400mg, Niacin 16,000mg; Calcium Pantothenate 4,000mg Biotin 32mg; Vit B_{12} 10mg; Folic Acid 400mg; Chlorine Chloride 120,000mg: Manganese 40,000mg; Iron 20,000mg: Zinc 18,000. Copper 800mg; Cobalt 100mg, Iodine 620mg, Selenium 40mg. ME: Metabolisable Energy, NFE: Nitrogen Free Extract, GNC:Groundnut Cake, BNW: Bambaranut Waste, BDG: Brewers Dried Gain, RMW: Rice Milling Waste, UNTRMW: Untreated Rice Milling Waste, UTRMW: Urea Treated Rice Milling Waste.

3. Results

3.1. Determined Proximate Composition of Experimental Diets (Starter and Finisher Phase)

Proximate composition of experimental diets is presented in Tables 1 and 2. Dietary crude protein increased with increase in urea treated Rice Milling Waste inclusion. There was slight incline in Ether Extract from the control diets which ranges between 6.1-5.1%. The Crude fibre (CF) and Ash, did not increase in a definite order, while NFE was highest in T1 and did not decrease in a definite order from T2 to T5.

3.2. Performance of Broiler Starter Fed Urea Treated and Untreated Rice Milling Waste

In Table 3, weekly weight gain and feed cost per Kg gain were highly significant (p< 0.01). Final weight, total weight gain, daily weight gain and FCR were significant (p< 0.05) while total feed intake, weekly feed intake and daily feed intake were not significant (p > 0.05). T2 was observed to have the highest feed intake (1316.67g) and the best feed conversion ratio (1.87).

3.3. Performance of Broiler Finisher Fed Urea Treated and Untreated Rice Milling Waste

As shown in Table 4, Final weights, weekly weight gain, Total feed intake, FCR and Feed cost/Kg gain were highly significantly different (P<0.01) while daily feed intake was significantly different (P<0.05). There were no significant difference (P>0.05) in total weight gain, daily weight gain and weekly feed intake.

3.4. Internal Organ Characteristics of Broilers Fed Urea Treated and Untreated Rice Milling Waste

Table 5 presents the various weights of the internal organs of the experimental broilers. All the parameters were expressed as percentage live weight. High significant difference (P<0.01) was observed for spleen and intestine, while liver, and gizzard were significantly different (P<0.05). Heart and crop were not significantly different (P>0.05).

Table 3. Performance of Broiler Starter Fed Urea Treated and Untreated Rice Milling Waste.

Parameters	T$_1$0% UNTRMW	T$_2$10% UNTRMW	T$_3$15% UNTRMW	T$_4$10% UTRMW	T$_5$15% UTRMW	LOS
Initial weight (g)	73.10±0.25^{b}	73.67±0.32^{a}	72.50±0.25^{b}	73.37±0.37^{ab}	73.43±0.28^{ab}	*
Final weight (g)	666.93±33.58^{a}	634.17±39.68^{a}	526.33±37.10^{b}	480.53±24.14^{b}	513.93±22.86^{b}	*
Total weight gain (g)	593.83±33.33^{a}	560.33±40.17^{a}	453.83±37.12^{b}	407.17±24.04^{b}	440.50±23.10^{b}	*
Weekly wt. gain (g)	151.80±80.26^{a}	140.13±10.00^{ab}	113.46±9.28^{bc}	101.80±6.01^{c}	110.13±12.02^{bc}	**
Daily wt. gain (g)	21.210±1.20^{a}	20.02±1.43^{a}	16.21±1.33^{b}	14.54±0.86^{b}	15.73±0.83^{b}	*
Total feed intake (g)	1257.00±34.82	1316.67±16.67	1226.90±14.49	1171.67±14.81	1250.00±28.87	NS
Weekly feed intake (g)	314.25±8.70	329.17±37.50	306.73±7.22	292.92±3.70	312.50±27.32	NS
Daily feed intake (g)	46.08±0.75	47.02±5.36	43.82±1.03	41.85±0.53	44.64±3.90	NS
Feed conversion ratio	2.18±0.10^{ab}	1.87±0.22^{b}	2.84±0.19^{a}	2.90±0.22^{a}	2.57±0.35^{ab}	*
Feed cost/kg gain(₦)	143.69±5.60^{ab}	116.71±13.49^{b}	172.02±11.56^{a}	180.88±13.60^{a}	155.49±21.36^{ab}	**

abc: means in the same row with different superscripts differ significantly (P<0.05),LOS: Level of significant,
NS: Not significant
UNTRMW: Untreated Rice Milling Waste, UTRMW: Urea Treated Rice Milling Waste.

Table 4. Performance of Broiler Finisher (5-9week) Fed Urea Treated and Untreated Rice Milling Waste.

Parameters	T$_1$0% UNTRMW	T$_2$10% UNTRMW	T$_3$15% UNTRMW	T$_4$10% UTRMW	T$_5$15% UTRMW	LOS
Initial weight (g/bird)	1046.67±29.10^{a}	860.00±30.55^{b}	713.33±46.67^{c}	973.33±26.67^{ab}	906.67±74.24^{ab}	**
Final weight(g/bird)	2266.67±88.19^{a}	1760.00±23.10^{c}	1420.00±41.63^{d}	1966.67±88.19^{b}	1646.67±29.10^{c}	**
Total weight gain(g)	1220.00±392.73	900.00±11.55	706.67±6.67	993.34±278.83	740.00±72.11	NS
Weekly weight gain (g)	305.00±18.93^{a}	225.00±2.89^{bc}	176.67±1.67^{d}	248.34±15.90^{b}	185.00±18.03^{cd}	**
Daily weight gain (g)	43.57±7.52	32.14±0.41	25.24±0.24	35.48±2.27	26.43±2.58	NS
Total feed intake (g)	3264.50±32.10^{a}	2950.17±28.87^{bc}	2850.23±10.86^{c}	3166.87±88.34^{ab}	2800.27±12.0^{c}	**
Weekly feed intake (g)	816.13±174.67	737.54±7.22	715.06±23.57	808.38±8.38	700.10±28.93	NS
Daily feed intake (g)	116.59±1.15^{a}	105.36±1.03^{b}	102.15±3.37^{b}	115.49±1.20^{a}	100.01±4.13^{b}	*
F C R	2.68±0.14^{c}	3.28±0.10^{bc}	4.03±0.17^{a}	3.19±0.19^{bc}	3.78±0.28^{ab}	**
Feed cost/kg gain(₦)	173.73±9.30^{c}	203.15±3.94^{bc}	243.00±0.00^{a}	203.36±11.72^{bc}	229.80±17.01^{a}	**

abc: means in the same row with different superscripts differ significantly (P<0.05),LOS: Level of significant,
NS: Not significant
UNTRMW: Untreated Rice Milling Waste,UTRMW: Urea Treated Rice Milling Waste.

Table 5. Internal Organ Characteristics of Broilers Fed Urea Treated and Untreated Rice Milling Waste.

Parameter	$T_1$0% UNTRMW	$T_2$10% UNTRMW	$T_3$15% UNTRMW	$T_4$10% UTRMW	$T_5$15% UTRMW	LOS
Heart (g/bird)	0.44±0.04	0.44±0.10	0.50±0.03	0.55±0.04	0.45±0.02	NS
Liver (g/bird)	3.03±0.41^{ab}	3.42±0.41^{a}	2.49±0.15^{b}	2.26±0.07^{b}	2.91±0.10^{ab}	*
Spleen (g/bird)	0.20±0.03^{a}	0.19±0.01^{ab}	0.10±0.03^{c}	0.15±0.01^{abc}	0.13±0.01^{bc}	**
Crop (g/bird)	0.64±0.01	0.61±0.03	0.57±0.01	0.53±0.06	0.58±0.02	NS
Gizzard (g/bird)	3.51±0.19^{b}	4.00±0.21^{b}	5.48±0.50^{a}	3.49±0.16^{b}	3.87±0.01^{b}	*
Intestine(g/bird)	6.78±0.27^{c}	7.70±0.20^{b}	8.99±0.03^{a}	6.96±0.48^{bc}	7.73±0.13^{b}	**

abc: means in the same row with different superscripts differ significantly (P<0.05) ,LOS : Level of significant,
NS: Not significant
UNTRMW: Untreated Rice Milling Waste,UTRMW: Urea Treated Rice Milling Waste.

4. Discussion

The increase in crude protein in Tables 1 and 2 maybe as a resultant effect of the non-protein nitrogen contribution from urea as reported by Fontenot *et al.* (1983). This agrees with the reports (Amaefule *et al.,* 2003) that urea ammoniation increases the crude protein content of feed materials including RMW. Although there was no complete degradation of fiber fraction of RMW due to urea treatment, the reduction in crude fiber content when compared with the untreated RMW diet (Table 1 and 2) is worthy of note and this agrees with Amaefule, *et al.* (2006). The marked decrease in body weight gain of T_3 in Table 4 with increase in the level of RMW in the diets without urea treatment could be associated with higher fibre content which might have led to dilution of the energy concentration of the diet and a reduction in digestibility and nutrient utilization as reported by Tuleun *et al.* (2009). This means that it is better treating rice milling waste with urea before feeding to broilers. Daily feed intake among treatments at the starter phase showed no statistical difference but a difference was observed at the finisher phase with T_2 and T_4 having the highest daily feed intake. However, this disagrees with the report of Isikwenu *et al*. (2000) which suggested that high crude fibre content of UNTRMW could cause broilers to consume more of the diet to meet their nutrient requirements. The increase in feed intake may be responsible for daily weight gain of broilers fed T_4 and with the increased crude protein and low crude fiber (Table 2) and this is in line with Taiwo *et al.* (1992), which show that urea ammoniation increased RMW utilization and fiber fraction degradation. Birds on T_3 eat more at the starter phase in Table 3 due to high crude fiber content which may have decreased the energy density and diluted other nutrients. In Table 3, T_2 and T_4 had the best feed conversion ratio (FCR) and did show statistical difference among experimental diets at both starter and finisher phase, and this may be the reason for their higher final body weight since broilers on these urea-treated diets converted feed to flesh better than the broilers on the other diets.

Although the result for liver weight showed statistical difference with T_2 having the highest mean, this does not indicate that RMW has toxic effect on broilers because the highest liver weight was recorded by T_2. Spleen weight also differed significantly but there was no difference observed in the heart weight. It also shows that urea treatment is a safe method of reducing the fiber content of RMW because the heart which should work more by pumping much oxygenated blood to help detoxification of toxins in any material thereby causing increase in heart weight did not increase among treatments.

Gizzard weights which showed significant differences among treatment means with T_3 having the highest weight, indicates that there was a proportionate increase in the size of the gizzard with increase in the level of UNTRMW. This observation was reported also by Ibiyo and Atteh (2005) which states that gizzard weight increased with increasing levels of rice bran while addition of fat caused a reduction in gizzard weight. This increase could be as a result of increasing dietary fiber as rice milling waste increased, leading to increased peristaltic movement and muscle tone. Acton and Saterlec (1982) attributed the increase to high fiber content of the rice milling waste which stimulates activity of gizzard resulting in increased musculature.

5. Conclusion and Recommendations

Rice milling waste can be utilized by broilers when properly processed by treating with urea as it does not have any adverse effect on the performance characteristics and internal organs observed. The result of this study suggests that urea treated rice milling waste inclusion to broiler ration at 10 percent inclusion level is well tolerated by broilers and improves feed consumption and body weight of broilers. It also shows that rice milling waste (RMW), which is cheap and readily available, could be utilized in both starter and finisher broiler diets when treated with urea. It establishes the fact that inclusion of untreated RMW upto or above 15% in broiler diet has adverse affect on the performance and internal organ characteristics of birds. Therefore, urea treated rice milling waste (UTRMW) is recommended at 10% dietary level of inclusion in broiler feed. Increase in the length of fermentation during the treatment of RMW could lead to further degradation of the crude fibre content. Levels lower than 10% dietary level of inclusion of UNTRMW is recommended although 10% level as observed in this research did not have adverse effect on the growth of broiler chicken. Further research should be carried out to improve fiber digestibility of this surplus feed ingredient.

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