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ORIGINAL RESEARCH ARTICLE

Performance, carcass yield and cost benefit ratio of replacing wheat offal with urea-molasses treated maize cob in broiler chickens

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ABSTRACT
An experiment was conducted to investigate the response of broiler chickens to diets containing urea-molasses treated maize cob (UMTMC) as a replacement for wheat offal. Performance, cost benefit ratio and carcass yield were investigated in an experimental period that lasted for eight weeks. One hundred and fifty broilers were allotted to five dietary treatments with three replicates using ten birds per replicate. The five dietary treatments consist of a standard diet (control) and other diets contained UMTMC at 25, 50, 75 and 100% replacement of wheat offal in a maize-soya bean meal based diets formulated for starter and finisher phases Feed consumed, feed conversion ratio (FCR) body weight, cost of feed consumed and Cost of feed/Kg live weight gain were significantly ($P<0.05$) affected by inclusion of UMTMC at starter and finisher phase. Broilers fed diet containing 25% UMTMC had increased ($P<0.05$) feed intake (1285.64 g) with improved FCR (1.66) at starter phase. Cost of feed/Kg live weight gain was reduced ($P<0.05$) for broilers fed diet containing 25% UMTMC at starter phase. Dressing percentage (58.76) was reduced ($P<0.05$) with inclusion of 100 % UMTMC in broiler diet however, thigh weight increased ($P<0.05$) from (9.34) at 0% to (11.83) with 100% inclusion of UMTMC. It was concluded that urea molasses treated maize cob can replace wheat offal up to 50% at starter and finisher phase in broiler diet with improved performance without any adverse effects on the carcass.

Keywords: Broiler, urea-molasses, maize cob, performance, carcass yield, cost benefit.

INTRODUCTION
The quest to broaden the narrow range of feed ingredients available to poultry has prompted the search or use of low cost, unconventional, feedstuffs that are abundant as against the conventional with incessant price increase as well as its high competing demands. The utilization of wheat offal as a major dietary fibre source in most parts of poultry producing areas of Nigeria has escalated its price, thereby necessitating a search for a cheaper and locally available alternative (Lamidi *et al.*, 2008).

Maize cobs are known as the waste products of maize grain shelling and currently being disposed away after processing of maize. It consists of central rachis of the female inflorescence without grains. Maize production in Nigeria is about 10.5 million tons (USDA/FAS, 2019). With these levels of production, cob comes in large volumes (estimated to be about 25% of ear corn) (Hamad, 2010). In Nigeria, large tonnage of maize cob generated from maize production annually are mostly burnt or left in the farm to rot, littering the surroundings, street, markets and constitute nuisance and environmental pollution. However, the cob can be possible cheap feed resource that could be employed in the feeding of livestock to replace wheat offal as conventional fibre source in monogastric feeding to reduce cost of production as well as the negative impact of its indiscriminate disposal.

Maize cob contains mean crude protein ranging between 2.5- 4.71%, crude fibre (10.75-

18.30%), ether extract (3.83-5.79%), ash (0.42-2.88%), carbohydrate (68.70-72.42%) with energy values of 7.60-9.09 MJ/KgDM as reported by Akinfemi *et al.* (2018) and Tona *et al*. (2015). It contains mean fibre components (NDF: 70.25g/100gDM, ADF: 42.15g/100gDM, ADL: 14.05g/100g DM, Hemicellulose: 35.13g/100gDM and Cellulose: 21.08g/100g DM). The calcium, phosphorous and magnesium values are 32.17 mg/kg DM, 334.07 mg/kg DM and 206.49 mg/kg DM respectively (Akinfemi *et al*., 2018). These nutritional compositions of maize cob indicate its usefulness in poultry diet formulation. However, the nutritional content of the cob can be improved with intervention of urea-molasses treatment.

Molasses, derived from sugar-rich crops are rich with constituents such as monosaccharides, disaccharides, minerals and vitamin B5 and it increases palatability of diet and acts as readily available source of energy for microflora for better utilisation (Sheikh *et al*., 2007). while fertilizer grade urea can be used to improve the nutritional value by improving crude protein content and reducing the neutral detergent fibre which is attributed to dissolving effect of urea on the hemicellulose fraction (Ojai *et al*., 2007; Rehrahie, 2001). The use of urea- molasses can amply enhance the utilisation of fibrous feed stuff by providing nitrogen and available energy for poultry utilisation (Sheikh *et al*., 2007). Therefore, the present study was aimed at determining the effect of urea-molasses treated maize cob as replacement for wheat offal on performance, carcass yield, and cost benefit ratio of broiler chickens.

MATERIALS AND METHODS

Experimental Site: The experiment was carried out at the Teaching and Research Farm of the Agricultural Technology Department, Yaba College of Technology, Epe, Lagos State. The farm is located on 3^0 58^0 E and longitude 6^0 47^0 N (Google Earth 2019).

Preparation of Test Material (UMTMC): Maize cobs were collected from maize farm at Ijebu -ode, sun dried and milled using 2 mm size sieve and stored in air tight bags. 2kg of urea were dissolved in 100 litres of water and mixed with10kg of molasses to obtain urea molasses mixture. This mixture was sprayed on 100kg of milled maize cob and sun dried according to Reddy (2001).

Experimental Animals and Management: One hundred and fifty one-day old unsexed broiler chicken (Cobb) were obtained from a reputable commercial hatchery. The broiler chicks were allotted to five dietary treatments of thirty broiler chicks per treatment. Each treatment has three replicates consisting of ten birds per replicate in a completely randomized design (CRD). The brooding was done in a raised rearing cage system with nipple drinkers and feeding troughs. Feed and water were offered *ad libitum* for a trial period of 8 weeks.

Experimental diets: Five experimental diets (Table 1 and 2) were formulated consisting of a maize cob free diet (Control) and the other diets with inclusion of treated maize cob at 25, 50, 75 and 100% as replacement for wheat offal at starter and finisher phases of the study. Diets were formulated to meet the NRC (1994) requirements.

DATA COLLECTION

Determination of proximate composition of the urea molasses treated maize cob: Proximate analysis of the urea molasses treated maize cob was carried out according to the method of AOAC (2000).

Performance characteristics: The performance characteristics of broilers were monitored and determined by measuring the individual weight, Feed intake and Feed conversion ratio (FCR).

Body weight gain (g): The initial body weights of the broiler chicks were taken on arrival and subsequent body weight gain were recorded at the end of every week for a period of 8 weeks of the experiment. Body weight gain was calculated from the differences between the body weights for the given week and previous week. Final weight was taken and recorded at the end of the experiment.

Body weight gain (g) = Final body weight (g) - Initial weight (g)

Feed consumption/intake (g): A known quantity of feed was given to the broiler chicken while the leftover of the feed was weighed to determine weekly feed intake for each treatment. Feed intake for each week will be obtained from differences between the feed given per week and leftover.

Total feed intake (g) = Total feed given (g)- Total feed left over (g)

Feed conversion ratio (FCR): The feed conversion ratio of each of the treatment of broiler chicken were determined by calculating the ratio of feed intake to weight gain

$$\text{FCR} = \frac{\text{Total feed intake (g)}}{\text{Total body weight gain (g)}}$$

Carcass Characteristics: At the end of the 8th week feeding trial, two chickens per replicate (6 birds per treatment) whose weights were similar or close to the average weight of the chickens contained in each replicate were starved of feed for 12 hours and slaughtered for carcass analysis. The slaughtered broiler chickens were plucked and eviscerated to evaluate their carcasses according to Jensen (1984). The carcasses were weighed and weights of cut parts as well as the shank, kidney, heart, lungs were recorded and expressed as percentage of live weight. Dressing percentage was determined by dividing the dress weight by the live weight and expressed in percentage.

$$\text{Dressing percentage} = \frac{\text{Dressed weight}}{\text{Live weight}} \times 100$$

Table 1: Gross composition of experimental diets (Broiler Starter 0-4 weeks) with varying replacement level of UMTMC

Ingredients	0%	25%	50%	75%	100%
Maize	54.00	54.00	54.00	54.00	54.00
Soy bean meal	30.00	30.00	30.00	30.00	30.00
Vegetable oil	1.00	1.00	1.00	1.00	1.00
Wheat offal	6.00	4.50	3.00	1.50	0.00
Maize cob	0.00	1.50	3.00	4.50	6.00
Fishmeal	3.00	3.00	3.00	3.00	3.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Limestone	2.00	2.00	2.00	2.00	2.00
Salt	0.25	0.25	0.25	0.25	0.25
Premix	0.30	0.30	0.30	0.30	0.30
Methionine	0.20	0.20	0.20	0.20	0.20
Lysine	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100
Determined analysis (%)					
Crude protein	22.43	21.68	21.58	21.50	21.42
Crude fibre	2.05	3.95	3.85	3.76	3.66
Ether extract	3.85	3.68	3.63	3.59	3.54
Ash	3.47	3.78	4.11	4.17	3.25
Calculated analysis (%)					
Calcium	1.28	1.28	1.25	1.20	1.20
Available Phosphorus	0.56	0.56	0.56	0.56	0.56
Ca : P	2:1	2:1	2:1	2:1	2:1
Lysine	1.49	1.49	1.49	1.49	1.49
Methionine	0.56	0.56	0.56	0.56	0.56
ME (Kcal/kg)	2838	2838	2838	2838	2838

Starter Premix: Vit. A 10,000,000 (iu), Vit D3, 2,000,000 (iv), Vit. 23,000(mg), Vit.k3 (mg), Vit. B1, 1800 (mg), Vit. B2 5,500 (mg), Niacin 27, 500mg, Pantothenic acid 750mg Vit B6 3,000mg, Vit B12 15mg, folic acid 750mg, biotin H2 60mg, chlorine chloride 300,000 mg, Cobalt 200mg,Copper 300mg, Iodine 1000mg, Iron 20,000mg, Manganese 40,000 (mg), Selenium 200mg, Zinc 30,000mg, Anti-oxidant 1,250mg.

Table 2: Gross composition of experimental diet (Broiler finisher 5-8 weeks) with varying replacement level of UMTMC

Ingredients	**0%**	**25%**	**50%**	**75%**	**100%**
Maize	58.00	58.00	58.00	58.00	58.00
Soybean meal	25.00	25.00	25.00	25.00	25.00
Vegetable oil	2.00	2.00	2.00	2.00	2.00
Wheat offal	7.00	5.25	3.5	1.75	0.00
Maize cob	0.00	1.75	3.5	5.25	7.00
Fishmeal	2.00	2.00	2.00	2.00	2.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Limestone	2.00	2.00	2.00	2.00	2.00
Salt	0.30	0.30	0.30	0.30	0.30
Premix	0.30	0.30	0.30	0.30	0.30
Methionine	0.20	0.20	0.20	0.20	0.20
Lysine	0.20	0.20	0.20	0.20	0.20
Total	100	100	100	100	100
Determined analysis (%)					
Crude protein	20.33	19.62	19.21	19.11	19.01
Crude fibre	4.08	3.79	3.67	3.56	3.45
Ether extract	3.91	3.62	3.57	3.52	3.68
Ash	3.04	2.97	2.91	2.85	2.75
Calculated analysis (%)					
Calcium	1.27	1.27	1.23	1.22	1.20
Available Phosphorus	0.54	0.52	0.52	0.50	0.50
Ca : P	2:1	2:1	2:1	2:1	2:1
Lysine	1.31	1.31	1.31	1.31	1.31
Methionine	0.54	0.54	0.54	0.54	0.54
ME (Kcal/kg)	3100	3100	3100	3100	3100

Finisher premix-vit. a 5,500,000 (iu), vit d3, 1500,000 (iv), vit. 10,000 (mg), vit.k3 1,500 (mg), vit. b1, 1,600 (mg), vit. b2 24,000 (mg), niacin 20,000mg, pantothenic acid 5,000mg vit b6 1,500mg, vit b12 10mg, folic acid 500mg, biotin h2 750mg, chlorine chloride 175,500 mg, cobalt 200mg, copper 300mg, iodine 1,000mg, iron 20,000mg, manganese 40,000 (mg), selenium 200mg, zinc 30,000mg, anti-oxidant 1,250mg.

Feed cost benefit: The feed cost benefit analysis was based on the methods used by Anigbogu and Anosike (2010). The formula used for calculating cost benefit parameters includes:

Cost of feed/kg (₦/kg)= $\frac{\text{Total cost of feed (₦)}}{\text{Quantity of feed (Kg)}}$

Cost of feed consumed/kg weight gain = feed conversion ratio x cost of feed per kg

Cost of feed intake = quantity of feed consumed (kg) x cost of feed per kg (₦)

Statistical analysis:

Data obtained from the study were subjected into one-way analysis of variance (ANOVA) in a completely randomized design using the GLM procedure of statistical analysis software SAS® version 2000. Significant differences among treatment means were determined using Duncan Multiple Range Test (DMRT) as contained in the SAS® software.

RESULTS

The urea molasses treated maize cob used in this study has 90.17% dry matter (DM), 11.06% crude protein (CP), 2.17% ether extract (EE), 3.44% crude fibre (CF) while ash and carbohydrate are 2.64% and 71.31% respectively when compared with the untreated cobs. The performance of broiler chicken fed diets containing varying levels of urea molasses treated maize cob (UMTMC) is shown in Table 4. At starter phase, total feed consumed, FCR, weight gain, cost of feed consumed and cost of feed/kg live weight gain were significantly ($p<0.05$) affected by varying inclusion of (UMTMC) in the diets. Broilers fed diets containing 50% UMTMC had decreased ($p<0.05$) feed intake (1223.13 g). The chicks on 25% replacement showed increased ($p<0.05$) weight (774.17g) and improved feed conversion ratio (1.66) however similar to those fed diet containing 50% replacement of UMTMC. It was observed that feed intake (1285.64 g) above 25% inclusion was inversely related to weight gained (774.17 g) at starter phase. Cost of feed (₦/kg) reduced linearly with increasing inclusion level of (UMTMC) with savings of (₦ 540.00 - ₦ 2,070.00) on tonne of feed produced. There was significant effect ($p<0.05$) of (UMTMC) on cost of feed consumed as well as cost of feed per weight gained. Cost of feed/kg weight gain at 25% inclusion of UMTMC) was reduced from 269.36 ₦/kg - ₦ 239.50 ₦/kg per chick at starter phase.

At the Finisher phase, total feed consumed, FCR, weight gain, cost of feed consumed and cost of feed/kg live weight gain were also significantly affected by the dietary treatments. It was observed that total feed intake was reduced ($P<0.05$) with inclusion of UMTMC at 50% (1223.13 g) inclusion level at starter phase. Broilers fed diet containing 50% UMTMC also had improved FCR (1.94) comparable with that of the control (1.73). Cost of feed per Kg live weight gain (₦255.81) of broilers fed diet containing 50% UMTMC was similar to those fed control diet.

Table 3: Proximate composition of treated and untreated maize cob

Parameters (%)	Untreated	Treated	SEM	P-value
Dry matter	91.1	90.17	0.37	0.24
Crude protein	7.7[b]	11.06[a]	0.76	<.0001
Ether extract	2.35	2.17	0.05	0.09
Crude fibre	3.53	3.44	0.07	0.57
Ash	2.07[b]	2.64[a]	0.13	0.00
CHO	75.36[a]	71.31[b]	0.04	0.02

Means on the same row with different superscript are significantly different ($p<0.05$)

Table 4: Growth performance and feed cost benefits of broiler chickens fed urea-molasses treated maize cob at starting and finishing phases

Parameters	0%	25%	50%	75%	100%	SEM	P. value
Total feed intake /bird(g)							
Starter	1278.30[a]	1285.64[a]	1223.13[b]	1275.36[a]	1279.47[a]	7.89	0.04
Finisher	2278.97[b]	2335.49[b]	2322.29[b]	2649.38[a]	2701.99[a]	54.11	0.00
Feed conversion ratio							
Starter	1.86[ab]	1.66[c]	1.70[bc]	1.89[a]	1.97[a]	0.04	0.01
Finisher	1.73[c]	2.12[b]	1.94[bc]	2.13[b]	2.44[a]	0.07	0.00
Weight gain (g)							
Starter	685.83[b]	774.17[a]	715.00[ab]	671.25[b]	648.33[b]	0.28	0.04
Finisher	1323.22[a]	1191.67[ab]	1190.83[ab]	1244.58[ab]	1104.17[b]	26.95	0.09
Cost of feed (₦/kg)							
Starter	144.82	144.28	143.77	143.25	142.75	0.30	0.17
Finisher	133.09	132.48	131.86	131.86	130.64	0.31	0.11
Cost of feed consumed(₦)							
Starter	185.12[a]	185.49[a]	175.85[b]	182.69[a]	182.64[a]	0.95	0.00
Finisher	303.31[b]	309.41[b]	306.22[b]	347.73[a]	352.99[a]	5.81	0.00
Cost of feed/Kg live weight gain (₦/kg)							
Starter	269.36[ab]	239.50[c]	244.41[bc]	270.74[a]	281.22[a]	4.33	0.00
Finisher	230.25[c]	280.86[b]	255.81[bc]	280.86[b]	318.76[a]	7.88	0.00

[abc]Means on the same row with different superscript are significantly different ($p<0.05$)

Carcass yield of broiler chickens fed urea molasses treated maize cob (UMTMC) is shown in Table 5. The dietary inclusion of urea molasses treated maize cob has no significant (P>0.05) effect on live weight, back, wing and breast weight while plucked weight, dressing percentage, drumstick and thigh weight were significantly (P<0.05) affected. Dressing percentage value (68.45%) was higher at 50% UMTMC inclusion compared to those fed 100% UMTMC inclusion (58.76 %). Broilers fed diet containing 100% UMTMC had higher (P<0.05) drumstick (10.20 g) and thigh weight (11.83 g) compared to those fed control diet.

Table 5: Effect of urea molasses treated maize cob as replacement for wheat offal on carcass yield of broilers at finisher phase

Parameters	0%	25%	50%	75%	100%	SEM	P-value
Live weight (g)	2056.67	2000.00	1953.33	1963.33	1800.00	28.76	0.30
Plucked weight (g)	1895.33^{a}	1923.00^{a}	1839.00^{ab}	1648.67^{bc}	1535.33^{c}	46.79	0.01
Dressing percentage (%)	66.98^{ab}	66.80^{ab}	68.45^{a}	66.65^{ab}	58.76^{b}	1.30	0.02
Drumstick (g)	8.73^{b}	8.450^{b}	8.60^{b}	10.40^{a}	10.20^{a}	0.27	0.01
Back (g)	7.10	7.09	6.93	7.51	7.87	0.17	0.45
Thigh (g)	9.34^{b}	10.35^{ab}	10.04^{ab}	10.48^{ab}	11.83^{a}	0.30	0.01
Wings (g)	11.67	10.70	11.26	11.72	12.49	0.29	0.42
Breast (g)	4.79	5.06	4.91	5.63	6.65	0.22	0.65

^{abc}Means on the same row with different superscript are significantly different (p<0.05)

DISCUSSION

Dry matter content of urea molasses treated maize cob range was a bit lower than the findings of Mohammed and Jamala (2013) who reported 91.4% dry matter (DM), 91.58% dry matter (DM) for cowpea husk and rice straw respectively. The treatment of maize cob with urea increased its nitrogen content due the addition of non-protein nitrogen. This is in agreement with the report of Amaefule *et al*. (2003) that urea ammoniation increases the crude protein content of feed materials including rice milling waste. The insignificant changes in the fibre value could be as a result of incomplete degradation. Amaefule *et al.* (2006) observed no complete degradation of fibre fraction of rice milling waste due to urea treatment as a reduction (41.43%) in crude fibre content when compared with the untreated rice milling waste diet. In addition, the observed differences could be due to the composition of maize cob as it is affected by stage of maturity, cultivar, climate, soils and production method (Szyszkowska *et al.*, 2007).

Performance of broilers at the starting phase fed urea –molasses treated maize cob diet improved feed intake, weight gain and feed conversion ratio up to 25% inclusion. The increase in feed intake may be responsible for weight gain of broilers and this is in line with Taiwo *et al.* (1992) as reported by Okpanachi *et al.* (2015) which show that urea ammoniation increased rice milling waste utilization and fiber fraction degradation. 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 (Okpanachi *et al.*, 2015). The decrease in performance with increase in the inclusion level could be due to age of the broilers (0-4 weeks) as fibre level tends to decrease feed intake as well as depress growth. Decreased feed intake with higher level of inclusion due to high crude fiber content may also have decreased the energy density and diluted other nutrients resulting in poor performance. At finishing phase, appreciable increase in feed intake was observed up to 50% UMTMC inclusion. The improved utilisation capability could be due to physiological maturity of gut system and development of micro flora that could cope with fibre degradation.

Reduction in the cost of feed per kg was due to the prevailing price of UMTMC at (₦25.80/kg) compared to that of wheat offal (₦50.00/kg) as at the time of the experiment. Inclusion of UMTMC at 25% improved feed cost benefit of broiler chickens as a result of reduced cost of feed per kilogram weight gain at starter (₦239.50/kg) and finishing (₦280.86/kg) phase. These findings uphold the report of Nworgwu *et al*. (2000) who stated that there is need for dietary incorporation of unconventional feed ingredient as alternative, non-competitive, readily available and cheap ingredients so as to reduce the cost of production and in the long run increase profit margin.

The result of carcass yield shows that live weight and breast meat weight were not significantly affected by UMTMC inclusion in diet of broilers. This implies that inclusion of UMTMC up to 100% as replacement for wheat offal in the diet of broilers did not adversely affect the live weight and breast meat weight of broilers. The non-significant effect of dietary inclusion of UMTMC on live weight of broilers suggests no detrimental effect of UMTMC. The numerical increase in breast meat weight suggests that the treatment of maize cob has improved its utilisation thereby enhancing nutrient availability. Improved dressing percentage and thigh weight was also observed for broilers fed diet containing 50% UMTMC and 100% UMTMC respectively which is in line with report of Amaefule *et al.* (2006) who also observed improved dressed weight and thigh weight of broilers fed urea treated rice milling waste in an experiment conducted to evaluate the effect of various treatment methods of RMW on finisher broilers. This contradicts the findings of Gholizadeh and Naserian (2010) who found that higher values of dressing percentage and thigh weight was observed for broiler chicken fed the control diet which also decreased significantly with increased level of maize husk. The discrepancy in the reports could be as a result of differences in solubility and digestibility of the fibre source. Therefore, the improved thigh weight in this study could be attributed to increased nutrient availability as a result of urea molasses treatment.

CONCLUSION

The findings from this study revealed that treating maize cob with urea-molasses could improve its nutritive values. It is obvious that urea molasses treated maize cob can replace wheat offal up to 50% at starter and finisher phase in broiler diet with improved performance without any adverse effects on the carcass. However, it will be necessary to carry-out further investigations on other processing strategies that can increase the utilisation of the by-product.

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