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Biologic and Economic Effects of Replacing Maize with Maize Sievate/Palm Oil in Broiler Bird Diets

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Abstract

A study aimed at replacing whole maize with maize sievate/palm oil in broiler diets was carried out to evaluate their economic and biological growth performance. Maize Sievate: Palm Oil mixture (40:1) was used to replace whole maize both in the starter and finisher diets at 0, 25, 50, 75 and 100% whole maize replacement levels. The experiment was laid out in a completely randomized design with five treatments; three replicates each comprising of 20 days - old broiler birds at the starter phase. These birds were re-randomized at the finisher phase, with each treatment having 54 birds (18 birds/replicate). The starter and finisher phases lasted 28 days each. The average daily feed intake in both phases were not significantly ($P<0.05$) different. The daily weight gains and the final live weight of birds during the starter phase on diets 1, 2 and 3 where similar but significantly ($P<0.05$) higher than birds on diets 4 and 5 in that order. At the finisher phase the same trend was observed except that the significant depression was only noticed with birds on diet 5. Feed conversion ratio values were similar across the treatment diets during starter and finisher phases except on treatment diet 5 where there was significant ($P<0.05$) depression. Protein efficiency ratio was not significantly affected across the treatments likewise digestibility estimates. Feed cost per kilogram feed consumed in both phases seems to decrease significantly ($P<0.05$) with increasing in the test material. Cost/kilogram weight gain(N) during the starter phase only showed decrease at 75 and 100% diets, while during the finisher phase the decrease only took place in T_5 (100%). It could be concluded that maize sievate/palm oil mixture can replace up to 50% of maize during the starter phase and 75% during the finisher phase in broiler diets.

Keywords: Re-randomization, Digestibility estimates, Cost per kilogram weight gain (N).

Introduction

For sustainable livestock production system in the Tropics, FAO [1] predicted that the future scenarios of resources utilization must be predicted on minimizing waste through recycling which reduces the need for raw materials and helps to protect the environment [2]. In Nigeria, the most popular cereal grain in feed formulation is maize where it supplies more than half of the metabolized energy requirement of poultry [3], also been used to a level of between 40-60% as a conventional energy source of poultry, its price in market has been the most unpredictable, this is partly because it has so many alternative uses and its production has not been able to meet the demands by both man and animals [4]. Maize is of major importance to the livelihood of millions of the relatively poor people in developing countries of the tropics. In Nigeria maize is

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cherished for its grains, which can be made into varieties of dishes. Rural families variously derive food, animal feed and cash from the cultivation and production of this crop.

In the manufacturing of starch and glucose from maize, a number of by-products are obtained, which are suitable for feeding farm animals. The cleaned maize is soaked in a dilute acid solution and is then coarsely ground. The maize germ floats to the surface and is removed for further processing. The de-germ grain is the finely ground and the bran separated by wet screening [5]. The process gives rise to three by-products: the germ, brand and gluten which are collectively referred to as maize sievate. Locally, after maize seeds are ground, they are then soaked for a day before the starch is squeezed out with the use of light cloth or sieve, the chaff that is left out is called maize sievate. According to Nsa et al. [6], maize sievate is lower in energy and higher in protein and crude fibre when compared to maize.

Maize sievate is most often discarded by farmers, where pigs are not raised. Its utilization in poultry nutrition is partly hampered because of lack of knowledge on its nutritional values and poor storage life. The utilization of maize sievate meal in poultry feeding is hampered because of its dustiness, storage difficulty as a result of high water content, reduction in feed intake because of its high fibre content. Several methods have been developed to improve the nutritive quality of the meal and of such is the addition of palm oil and fat to reduce dustiness, palatability, intake and energy level [6].

This research is therefore aimed at investigating the biologic and economic of utilizing maize seivate-palm oil mixture by broiler birds as a replacement for maize in their rations.

Materials and Methods

Experimental diets

The maize sievate used for this study was obtained from local farmers within Calabar environs, the capital of Cross River State, Nigeria. Large quantity of maize sievate was collected and sundried on a concrete floor to a constant moisture level of 8%. The dried sievate was then mixed together and stored in an air tight container prior to compounding the experimental diets. Prior to formulation of feeds, palm oil in the ratio of 1:40 was added to the sievate and mixed thoroughly before being analysed for proximate fractions. The essence was to level the energy level with maize. Some fractions were sent for analysis for proximate composition. Thereafter made to replace maize at 0%, 25%, 50%, 75% and 100% represented as treatment diets T1(control), T2, T3, T4 and T5 respectively in both the starter and finisher diets (Table 1-5).

Experimental animals

Three-hundred-day old broiler birds of 'Fidan' strain were individually weighed and randomly assigned to the five treatment diets in a completely Randomized Design. Each treatment diet had 60 birds with three replicates of 20 birds each. The birds were raised in a deep litter house with wood shavings as litter material. All routine vaccinations and necessary medications were given. At the end of the starter phase that lasted for 28 days, birds were weighed and re-randomized into five treatments of 54 birds each and three replicates of 18 birds each to start the finisher phase which also lasted for another 28 days. Feeds and water were given ad libitum.

Experimental design and digestibility studies

The experiment was a completely randomized design. At 8 weeks of age, 4 birds per replicate were randomly selected

Table 1: Gross composition of starter diets.

Ingredients (%)	T_1	T_2	T_3	T_4	T_5	Maize Sievate Palm o
Maize	54.50	40.86	27.25	13.64	0.00	
Maize sievate palm oil	0.00	13.64	27.25	40.86	54.50	
Wheat offal	1.00	2.00	3.00	4.00	5.00	
Palm kernel cake	5.00	4.00	3.00	2.00	1.00	
Soybean meal	33.00	33.00	33.00	33.00	33.00	
Fish meal	2.50	2.50	2.50	3.00	3.00	
Bone meal	3.00	3.00	3.00	3.00	3.00	
Lysine	0.25	0.25	0.25	0.25	0.25	
Methionine	0.25	0.25	0.25	0.25	0.25	
Vitamin Premix	0.25	0.25	0.25	0.25	0.25	
Salt	0.25	0.25	0.25	0.25	0.25	
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	
Calculated Analysis						
Crude Protein (%)	23.84	23.87	23.90	23.93	23.96	
Crude Fibre (%)	3.94	3.93	3.92	3.91	3.91	
ME Kcal/Kg	2890.15	2890.05	2890.01	2889.00	2886.50	
Determined Analysis						
Crude Protein (%)	23.15	23.19	23.22	23.23	23.24	11.58
Crude Fibre (%)	4.01	4.01	3.98	3.98	3.96	7.32
Ether Extract (%)	4.11	4.18	4.26	4.34	4.47	6.00

*Vitamin/mineral premix containing the following per kg. Vitamin A, 8,000,000 IU; vitamin D3, 1,600000 IU; Vitamin E, 5,000 IU; Vitamin K, 2,000 mg; Thiamine, 1,500 mg; Riboflavin B2, 4,000 mg; Pyridoxine B6, 1,500 mg; Antioxidant, 125 g; Niacin, 1,500 mg; Vitamin B12, 10 mg; Panthotenic acids, 5,000 mg; Folic acid, 500 mg; Biotin, 20 mg; Choline chloride 200 g; Manganese, 80 g; Zinc, 50 g; Iron, 20 g; Copper, 5 g; Iodine 12 g' Selenium, 200 mg; Cobalt, 200 mg.

Table 2: Gross composition of finisher diets.

Ingredients	T_1	T_2	T_3	T_4	T_5
Maize	58.00	43.50	29.00	14.50	0.00
Maize sievate palm oil	0.00	14.50	29.00	43.50	58.00
Wheat offal	2.00	3.00	4.00	5.00	6.00
Palm kernel cake	6.00	5.00	4.00	3.00	2.00
Soybean meal	28.00	28.00	28.00	28.00	28.00
Fish meal	2.00	2.00	2.00	2.00	2.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Lysine	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
Vitamin premix	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated Analysis					
Crude Protein (%)	21.10	21.13	21.16	21.19	21.02
Crude Fibre (%)	4.67	4.66	4.65	4.64	4.63
ME Kcal/Kg	3108.00	3107.35	3107.10	3106.42	3106.05
Determined Analysis					
Crude Protein (%)	20.82	20.86	20.87	20.89	20.93
Crude Fibre (%)	4.91	4.87	4.85	4.81	4.76
Ether Extract (%)	4.31	4.72	4.91	5.01	5.09

*Vitamin/mineral premix containing the following per kg. Vitamin A, 10,000,000 IU; vitamin D3, 2,00000 IU; Vitamin E, 20,000 IU; Vitamin 500 mg; K, 2,250 mg; Thiamine, 1,750 mg; Riboflavin B2, 5,000 mg; Pyridoxine B6, 2,750 mg; Antioxidant, 125 g; Niacin, 27,500 mg; Vitamin B12, 15 mg; Panthotenic acids, 7,500 mg; Biotin, 50 mg; Choline chloride 400 g; Manganese, 80 g; Zinc, 50 g; Iron, 20 g; Copper, 5 g; Iodine 12 g' Selenium, 200 mg; Cobalt, 200 mg.

Table 3: The effect of maize sievate palm oil as replacement for maize (starter).

	Treatments					
Parameters	T_1	T_2	T_3	T_4	T_5	SEM
Initial body weight (g)	92.86	91.92	91.87	92.60	92.11	1.18
Final body weight (g)	786.00^a	782.14^a	765.99^a	610.11^b	516.42^c	0.92
Weight gain g/d	24.42^a	24.32^a	24.06^a	19.28^b	18.06^c	0.86
Feed intake g	63.49	63.36	62.12	60.79	60.14	0.04
Feed Conversion Ratio	2.60^b	2.61^b	2.58^b	3.15^{ab}	3.33^a	0.02
Protein Efficiency Ratio	1.75	1.75	1.76	1.76	1.77	0.01
Cost/Kg feed N	96.52^a	94.16^b	92.05^c	90.29^d	88.16^e	2.22
Cost/Kg WG, N	250.95^c	245.76^c	237.49^c	284.41^b	293.57^a	
Feed cost savings (%)	0.00	2.00	5.00	-1.30	-.1.70	

Table 4: The effect of maize sievate palm oil as replacement for maize (finisher).

	Treatments					
Parameters	T_1	T_2	T_3	T_4	T_5	SEM
Initial body weight (g)	781.44	786.43	778.49	755.22	761.00	11.76
Final body weight (g)	2315.00^a	2306.42^a	2295.62^a	2214.80^a	1874.00^b	16.00
Weight gain g/d	50.66^a	50.34^a	50.12^a	49.67^a	37.44^b	1.23
Feed intake g	118.02	119.41	120.22	117.42	115.77	9.08
Feed Conversion Ratio	2.33^b	2.37^b	2.40^b	2.36^b	3.09^a	0.11
Protein Efficiency Ratio	2.26	2.26	2.18	2.16	2.13	0.03
Cost/Kg feed N	95.90^a	93.16^b	90.92^c	88.07^d	86.23e	3.11
Cost/Kg WG, N	223.45^b	220.79^b	218.21^b	207.85^b	266.45a	8.87
Feed cost savings (%)	0.00	1.00	2.00	7.00	-1.90	0.02

Table 5: Apparent digestibility of nutrient (%) by broiler birds fed diets with maize sievate/ palm oil as replacement for maize.

Parameters	T1	T2	T3	T4	T5	SEM
Dry matter digestibility	59.89	61.08	60.78	58.55	54.73	2.47
Crude protein digestibility	71.45	71.08	70.58	70.47	70.1	5.21
Ash digestibility	55.76	59.05	61.55	61.66	63.32	3.76
Ether extract digestibility	67.22	63.42	61.75	65.72	66.04	7.49
NFE digestibility	68.9	76.43	73.51	69.64	70.55	8.23

and kept in metabolic cages. The birds were fed with the same diets offered during the feeding trial. Records on feed intake and excreta were taken on a daily basis with the use of electronic weighing balance. The daily excreta were dried to a constant weight of 800°C in the oven. The dried samples were ground in a hammer mill and stored at room temperature for proximate analysis. The digestibility trial lasted 10days: 7 days for excreta collection and 3 days for acclimatization.

Data collection

Body weights of birds were collected weekly while feed intake was daily. At the end of the experiment (56 days), six (6) birds per replicate were randomly selected fasted for eighteen hours, weighed and slaughtered by severing the jugular vein. The birds were bled, dipped in hot water for a minute and de feathered. They were cut into retail parts and weighed. The prevailing market prices of the feedstuffs as at the time of the study were used to calculate the cost benefit ratio.

Chemical analysis

Test ingredients, feed and droppings samples were dried at 60°C for 24 hours before analysis. Dry matter (DM), ash, CP (Nx6.25), ether extract (EE) and crude fibre (CF) were determined according to AOAC (1990) methods [7].

Statistical analysis

Data collected were subjected to analysis of Variance. Differences between the treatment means were separated using Duncan's Multiple Range Test. All statistical procedures were according to the methods of Steel and Torrie [8].

Results and Discussion

In the present study, the chemical analysis of the maize sievate/palm oil had relatively higher levels of protein (11.58%) and crude fibre (7.32%) than whole maize; these were in consonance with the reports of Bamgbose et al. (2004) [9] for maize and maize sievate in tropical environment. Apart from ether extract value, the values of crude protein and crude fibre reported in this study were close to the range previously recorded by Nsa et al. [3] for maize sievate. The slide difference in crude fibre value recorded in this study could be attributed to various factors identified by Durunna [10] which include the following: differences in processing methods, soil fertility and the time of harvesting of the analysed maize grains.

However, to have a balanced level of fibre in these diets, inclusion levels of wheat offal and palm kernel cake where adjusted. Also, energy value of maize and that of maize sievate was equally balanced by mixing palm oil with maize sievate at the ratio of 1:40, respectively. This was achieved using the formula of Pauzenga [11].

The average daily feed intake during the starter phase was not significantly different despite the slightly lower values recorded for birds in treatment diets 4 (75%) and diet 5 (100%). The same trend was observed for birds during the finisher phase. The observed similarity could be certified by the iso-caloric and iso-nitrogenou feed across the treatment diets. Palm oil is a good source of energy in broiler diets and seems to really augment low energy agro industrial by products in broilers diets [3].

The daily weight gains of birds in diet 1 (24.42g), 2 (24.32g) and 3 (24.06g) during the starter phase statistically similar but significantly ($P<0.05$) higher than birds on treatment diets 4 (19.28g) and in turn significantly ($P<0.05$) higher than that of birds on treatment diet 5 (18.06g). birds during the finisher phase also showed the same pattern except that the significant depression in average weight gain only occurred at treatment 5 (37.44g), while average daily weight of birds on treatment 1 (50.66g), 2 (50.34g), 3 (50.12g) and 4 (49.67g) were statistically similar ($P<0.05$).

The final live weight showed similar pattern with the average daily weight gain both at the starter and finisher phases. At the starter phase the significant depression ($P<0.05$) only occurred in treatment diets 4(610.11g) and 5 (516.42g), while at the finisher phase, significant depression was only in treatment diet 5 (1874.00g). the observed differences between birds during the starter and finisher phase is an indication that mature birds can tolerate more of fortified maize sievate replacement than young chicks. This is in line with the report of Esonu and Udedibie, Faniyi, Oyawaye and Nelson [12-14], that mature birds can tolerate more agro industrial by product in diets than young chicks without sacrificing growth performance.

The feed conversion ratio for both during the starter phase and finisher phases were not significantly affected by replacement levels of maize with fortified maize sievate except for birds on treatment diet 5 that showed significant poor feed conversion ratio. This is an indication that 100% replacement of maize with the fortified maize sievate though the fibre, crude protein and energy levels are similar; the diet is poorly utilized at this level. In the cause of processing of maize sievate, essential minerals, minerals and amino acids are lost which are directly involved in growth [15]. The addition of oil into the feed could only boast energy level and no other essential mentioned nutrients. This should explain why the lower feed conversion ratio vis a vis daily weight gains and the final body weight.

Protein efficiency ratio did not differ both during the starter and finisher phases. This observation shows that protein utilization was not affected by the birds despite depressing with increased maize sievate- palm oil mixture in the diets. This could be due to adjustment in wheat offal and palm kernel levels in order to balance the fibre level and for the fact that maize sievate is higher protein level than maize.

The digestibility estimates (Table 5) showed that the replacement levels of maize with maize sievate-palm oil mixture in the diets had no significant ($P<0.05$) effect on the nutrient retention by the birds. These findings support findings by Onifade, Oluokun and Olaokun, Oke et al. [15-17], that feeds with balance fibre and other nutrient will have similar nutrient retention.

Feed cost per kilogram feed consumed both at the starter and finisher phases deceased with increasing level of maize sievate-palm oil mixture in the diets, which should be due to the non-demand for maize sievate which is even hazardous to the environment.

Cost/kg weight gain (N) showed significant differences, during the starter phase, the decrease is only significant ($P<0.05$) at 75 % (T4) and 100% (T5) replacement levels of maize with Maize sievate-palm oil mixture. But during the finisher phase significant ($P<0.05$) was only noticed at the 100% (T5) maize sievate/ palm oil in the diet. This observation shows that the cheap feedstuff (Maize sievate did not necessarily transform to better cost of production of birds at 75% and 100% during the starter phase and 100% during the finisher phase. Nworgu et al., McNab and Shannon [18-19] highlighted the need for dietary formulation which can be used as an alternative non-competitive readily available and cheap ingredient which can partly replace the conventional energy and protein feedstuffs in poultry diets.

Conclusion

It could be concluded that maize sievate/palm oil mixture can replace maize as the main energy source up to 50% in starter diet and up to 75% in finisher diet without compromising biologic and economic indices in broiler production.

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