Evaluation of Biscuit wafer waste meal as replacement for maize on growth, carcass and economic performance of weaner rabbits.

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Abstract
An experiment was conducted to evaluate the growth responses, carcass characteristics and economy of production of rabbit fed Biscuit wafer waste meal (BWWM) as replacement for maize. Thirty-six grower rabbit were allocated according to randomised completely blocked design (RCBD) to three treatments and were replicated thrice. Each replicate having four (4) rabbits balanced by weight were subjected to feeding trial for the duration of eight (8) weeks. Three (3) experimental grower rabbit rations (diets) were formulated with diet 1 as the control. Diets 1, 2, and 3 were formulated to contain BWWM at 0, 50 and 100 % replacement for maize. Results on the growth performance revealed that live weight, feed intake, and weight gain were not significantly ($p<0.05$) different among the treatments while feed conversion ratio (FCR), cost of feed per kg and cost of feed consumed were significantly influence by the dietary treatments. Also, dietary treatments did not influence ($p>0.05$) the organs (heart, liver, lung and intestine), while diet containing BWWM increased the rib and loin but relatively reduced ($p<0.05$) the hind limb of rabbits. Cost of feed/kg in diets containing 100% BWWM were lowest thus reflecting in the cost of feed consumed. The results suggest that BWWM can replace maize up to 100% inclusion level in broiler diet without ant detriment to health and with good economic returns.
Keywords: Growth, Economy, Biscuit wafer waste meal, Maize

Introduction

The need for animal products will rise consistently in response to the increasing population of the world which in turn is posing so much pressure on the livestock industry (Never Assan, 2018). To meet the growing demand for protein of animal sources, mini livestock production has been identified as alternative animal production strategy that could bridge the gap. However, rabbit is the most common and accessible among other mini livestock class in Nigeria.

Adequate availability and the sustainability of the use of this ingredient in compounding feed for commercial for livestock is in doubt, as the scarcity continues, there are corresponding hike in price of feeds (Smil, 2000). The implication of hike in feed cost is that the total production cost will rise since feed account for more than three quarter of the entire production cost in livestock production, thus reducing farmers profit which may render animal business unlucrative. It therefore become imperative to reduce the cost of feed ingredients for survival the livestock sector. The strategies to be employed in reducing cost of feed should not affect the performance and health status of animal. Nutrients from such alternative feed ingredient should be readily available for growth and development of animals (Adejimi *et. al*, 2007). In some developed nations of the world, wheat forms the bulk energy in feed of monogastric while millet, sorghum, barley and oats are used in other nations, maize is the major source of energy for poultry, rabbits and other monogastric animals. Statistics as at 2008 revealed that maize production was at 7.5 million tons being produced on about 3.8m hectares area at a mean yield

of 1,9metric tonnes per hectare (Aliyu, 2015). Even though Nigeria is rated one of the leading producers of maize in West Africa and the top ten producers in the world (FAO, 2008). Challenges such as climate change, diseases among others continuously reduce output of maize in Nigeria thus the dependent of man and livestock on the maize and other conventional feedstuff required in producing concentrate need to be reviewed.

The use of confectionary waste such as bread, noodles, spaghetti and others waste had been reported by authors as alternative source of reducing feed cost in Nigeria (Adejinmi, *et.al.*, (2007), Adeyemo, *et.al.,* (2013), Anjola. *et.al.,* (2017), Animashahun, *et.al.,* (2017), Santos, *et.al.,* (2017),

Biscuit wafer waste meal is a source of dietary energy with calories apparently close to that of maize. It is less expensive in price when compared to maize. Biscuit waste meal, an agro-industrial waste product found in substantial quantities in biscuit producing industries is palatable, high energy feed produced from wheat flour, skimmed milk powder, vegetable fat, sugar, salt and flavour. Biscuit waste has no anti-nutritional factors and could make a good replacement for maize and other cereal grains in feeding broilers (Omoikhoje, *et., al*. 2017)).

Materials and Methods

Site of the experiment

The experiment was carried out at the experimental section of TETFUND built rabbit Unit of the Teaching and Research Farm, Department of Animal Production, Lagos State Polytechnic, Ikorodu, Lagos State, Nigeria.

Management of the experimental animals

A total of thirty-six (36) growing rabbits of 8 weeks of age with average weight 633.17 ±101.74g) of both sexes were obtained from a reputable farm in Ikorodu, Lagos State, Nigeria for the purpose this study. The rabbits were randomly allotted using randomised completely block design with weights adjusted to the three (3) treatments and replicated three times with four (4) rabbits per replicate. The animals were housed in wooden rabbit hutches. Before the arrival of the animals into the rabbitry, the cages were thoroughly washed, disinfected and allowed to dry. The stands of each cage were placed in bowls of engine oil to prevent ants from climbing the cage. Feed and water troughs were provided in each cage, while feed and water were provided *ad-libitum.* The feeding trial lasted eight weeks. Routine cleaning of water trough, administration of medicine such as anti-stress, antibiotics and anti-coccidiosis were done as necessary to ensure that the rabbits are healthy.

Carcass analysis

At the end of the eight-week feeding trial, one rabbit per replicate was randomly selected, weighed and then starved overnight (12 hr) with water was provided throughout. The weight of the rabbit was recorded in the morning before slaughter. They were then dressed and weighed individually. Carcass traits was measured as described by Blasco, *et, al*, (1993) The animals were thoroughly bled by hanging head down through the hind legs on nail. Furs were removed by roasting to get the dressed weight. Then the carcass was dissected, and the internal organs evacuated (to get the eviscerated weight). The carcass was then dissembled into wholesale cuts as described by Akinmutimi,and Anakebe, (2008). Each prima parts were weighed with a digital scale. The weights of organs such as lungs, heart, kidney, liver and intestine) were also measured. The parts cut, and organs was weighed and record, the weight were expressed as percentage of the dressed weight

Experimental Diet

Three experimental diets were formulated with the inclusion of 0%, 50% and 100% wafer waste meal (WWM) as substitute for maize in rabbit diet. The gross composition of the grower rabbits' diets is presented in Table 1.

Table 1: Gross composition of experimental diets

Ingredients	Diets		
	T1(0% WWM)	T2(50% WWM)	T3(100% WWM)
Maize	45	23.5	0
Wafer	0	23.5	47
Groundnut Cake	14.5	14.5	14.5
Soyabean meal	3	3	3
Fish	1.5	1.5	1.5
Corn offal	10.3	10.3	10.3
Wheatoffal	19.5	19.5	19.5
Palm kernel Cake	3	3	3
Lysine	0.1	0.1	0.1
Meth	0.1	0.1	0.1
Oyster shell	1	1	1
Bonemeal	1.5	1.5	1.5
Premix	0.25	0.25	0.25
Salt	0.25	0.25	0.25
	100	100	100
Calculated Analysis			
Crude Protein	18.28	18.25	18.22
ME (Kcal/kg)	2818.98	2902.866	2986.758

ME = Metabolizable energy (kcal/kg); *Premix contains the following; Vit. A, 10,000,000 lU; D3, 3,000,000 lU; Vit. K, 2.3g; Thiamine-Bi, 1.7g; Riboflavin-B2, 5.0g; Pyridoxine-B,3.1g; Vit. B12,18mg; Biotin, 60mg; Niacin, 31.0g; Pantothenic acid, 8g; Folic acid, 0.8g; Manganese, 85g; Zinc, 50.0g; Iron, 25.0g; Copper, 6.0g; Iodine, l.lg; Selenium, 120.0mg; Cobalt, 220.0mg; B.H.T., 60.0g; Ethoxyquin, 65.0g; Choline chloride, 200.0g.

Table 2: Proximate composition of wafer biscuit wafer waste meal

Nutrient	Composition
Dry Matter	88.46
Moisture	1.54
Gross Energy(kcal/kg)	4102.66
Metabolizable Energy (kcal/kg)	3804.85
Crude Protein (%)	9.87
Ether extract (%)	11.92
Crude Fibre	2.14
Ash Content	2.01

Data collection

Data collected during the eight weeks duration of the experiment include; body weight (initial and final), weight gain, feed intake, and feed conversion ratio. A weighed amount of feed was served to each treatment on replicate basis each week and the left over at the end of the week was weighed to determine the average weekly feed intake. The weights of the rabbits per treatment were taken at the start of the experiment and at weekly interval by use of weighing scale. The differences observed in weight represent weight gain due to the treatment. Average daily feed intake and weight gain were subsequently calculated from the weekly values. The feed conversion ratio was calculated based on feed intake (g) per unit body weight gain (g) of bird produced. The cost of the feed ingredients used in compounding the experimental diets were all recorded and used in estimating the economy of production.

Data analysis

Data obtained in the study were subjected to analysis of variance (ANOVA) using ASSISTAT 7.0 Statistical Package. Duncan multiple range of the same statistical software was used to test significant difference between means.

Table 3: Growth Performance and Economic characteristics of experimental of weaned rabbit fed diets containing biscuit wafer waste meal as replacement for maize

	Diets			
Parameters	T1	T2	T3	SEM
Initial weight(g/rabbit)	646.17	635.50	617.83	0.40
Final weight. (g/rabbit)	991.50	956.67	957.87	0.55
Total Feed Intake(g/rabbit)	2019.00	2338.33	2350.00	5.22
Total weight gain	355.33	321.17	340.04	0.48
Feed Conversion Ratio	6.31 ^{c}	11.06^{a}	7.65^{b}	0.07
Cost/kg (₦)	177.51 ^{a}	151.63 ^{b}	125.76^{c}	0.72
Cost of feed Consumed (₦)	358.57 ^{a}	354.81 ^{a}	295.536 ^{b}	0.98

Table 4: Carcass characteristics of experimental of weaned rabbit fed diets containing biscuit wafer waste meal as replacement for maize

	Diets			
Parameters	T1	T2	T3	SEM
Slaughter weight	972.88	947.23	945.56	1.28
Dressed weight	625.29	622.79	624.42	0.10
Carcass length	25.20	24.26	26.16	0.08
Head	83.50	86.01	86.69	0.14
Fore limbs	97.29	104,20	100.65	0.20
Hind limbs	149.77^{c}	161.56^{a}	153.84^{b}	0.50
Ribs	113 ^{a}	108 ^{b}	112.33 ^{ab}	0.23
Loin	219.67 ^{a}	194.47 ^{c}	205.33 ^{b}	1.05
Pelt	71.22	72.23	70.80	0.06
Heart	5.01	5.05	4.79	0.02
Spleen	1.29	1	1	0.01
Kidney	8	9	7.93	0.07
Liver	34.37	34	33.33	0.04
Lungs	9.11	9.77	9.33	0.03
Caecum	47	49	47.67	0.08

Small intestine	27.56	29	26.83	0..09
Abdominal fat	17.56	18.01	18.00	0.02

Result

The calculated crude protein and metabolizable energy of the diets used for this experiment is presented on table 1. The crude protein and metabolizable energy values of the diet's ranges were 18.18 – 18.24%, and 2857.24 – 2947.88 kcal/kg respectively. The CP, and ME increased as BDW inclusion levels increases in the diets.

The proximate composition and energy value of the test ingredient (BWM) are presented in Table 2. The values were 86.46% DM, 1.54 % Moisture, 9.87% crude protein, 2.14% crude fibre, 11.92% ether extract, 2.01% Ash, and 3804.85 kcal/kg ME.

Table 3 indicate the performance characteristics of the experimental rabbits fed diets containing biscuit wafer waste meal as replacement for maize. There were no vvariations obtained in the final body weight, weight gain, feed intake and feed conversion ratio respectively. Statistical analysis revealed that were no significantly ($P > 0.05$) difference in all the growth parameters, except feed conversion ration with the highest values (11.06) obtained in T2(50% BWWM) while the lowest (6.31) was recorded in the control diet. The economic performance as influenced by diets indicates that cost per kilogram feed produced reduced as the level of BWWM increases in the experimental diets, the highest was recorded in diet 1 (₦177.51) while the lowest cost was recorded in diet 3 (₦125.76). Cost of feed consumed followed the same trend with the control diet (100% maize) having the highest (₦358.57) and the least in diet 4(100% BWWM) was ₦295.54.

The carcass characteristics of of the experimental rabbits fed diets containing biscuit wafer waste meal as replacement for maize is shown on table 4. Results indicated that inclusion of BWWM in the diet of weaner rabbit did not significantly (($P > 0.05$)) affect all carcass parameters except ribs, loins and hind limbs, diets containing maize (100%) has higher ribs and loin weight of 113g and 219.67g respectively while diets containing BMWM were higher in hind limbs (161.56 and 153.84g) with lowest value of 149.77g in the control diet.

Discussion

The increasing population in Africa and other developing continent demands an inevitable and reliable sources of meat protein sources., thus the attention of animal researchers to maximise the potential available in the present animal production scheme (Mermelstein, 2002). The high-quality protein, quick growth, short span generational interval and ability to convert cheap nutrient sources to growth and development are parts of the merits accrued to its production (Hassan et al.2012). The use of agro allied waste is becoming popular in the livestock feed industry. Biscuit wafer waste meal was used to replace meal in this experiment. The experimental diets were formulated to meet the recommended nutritional needs of growing rabbit in the tropical area such as Nigeria (NRC,1977, Adegbola and Akitiwande, 1981, Lang, 1981 and Halls, 2010).

The increasing metabolizable energy with increasing contents of the test ingredient in the diets were due to the differences in amount of the constituents in maize and the substituted ingredient. The energy values of biscuits wafer waste meal obtained in this study was higher than 3300kcal/kg reported by Shahryar, *et.,al,* (2012) but lower than 3,818.92 kcal/kg obtained by Gonzaga, *,et.,al,* (2020). The differences in nutritional values of wafer type biscuits may be due to differences in technological process to which the product was subjected and the type of wheat used for production of the product (Troni, *et.al,* 2016 and Parpinelli, *et.al,* 2018). The

crude protein of the diets containing BWM are close to the control (maize). The crude protein of the biscuit wafer waste meal obtained in this study was higher than 9.37% reported by Gonzaga, et.,*al,* (2020), but lower than 12.6% recorded for mixture of biscuit and wafer by Shahryar,*et.,al,* (2012). Higher crude protein had been reported for other types of biscuit by different authors, 10.8% and 10.82% by Longe, (1987), and Anjola. *et.al.,* (2017), respectively while lower protein of 9.56% was obtained by Ajasin, *et.al*., (2010).

The growth performance indices evaluated in this study includes final weight, feed intake, weight gain and feed conversion ratio. The pattern of weight gain indicates a higher utilization of the control diet than diets containing biscuit wafer waste meal, this is in support of the findings of Ajasin, *et. al*. (2010) who reported a numerically higher feed intake by snails fed varying inclusion levels of biscuit waste while a contrary report that there was higher utilization of diets containing biscuit dough (BD) compared with maize based diet on broiler chicken (Shittu, *et. al*. 2016). Statistical analysis indicated that the dietary treatment had no significant effect on all parameters in this study except a noticeable difference the feed conversion ratio.

Numerically, diets containing BWWM were consumed slightly higher than the control, this is an indicator that the test ingredient was well consumed by the rabbits. This in agreement with significant variation recorded in birds fed BWM, Oduguwa, *et al*., (2004) revealed that higher feed intake in birds fed 50% BWM could be linked to the adequacy of dietary energy which enhanced the palatability of the diet and subsequently led to increase in the amount of feed consumed. Cheeke, (1986) argued that rabbits prefer novel foods that has good flavour, smell, taste and adequate nutrient.

The feed conversion ratio was numerically higher in diets containing BWWM than those in the control diet which indicate that increase in the test ingredient increases the feed conversion ratio of the experimental diets. This higher value obtained in the diets containing BWWM is an indication that the maize may be superior to BWWM in the diet of rabbit. This is contrary to the result of Gonzaga, *et.al*, (2020) that increasing level of wafer type biscuit in the diets of quails decreases the feed conversion ratio.

The economy of production which reflected on the cost of feed produced and consumed respectively showed that the increasing level of BWWM significantly reduced the amount spent on feeding the rabbits used in this study.The finding of this study concurs with that of Wan Zahari and Alimon (2004) the demand for dietary formulation that can be utilised as alternative, less competitive, easily assessable and non-expensive that can partly or fully replace the conventional energy feed stuffs in rabbit diets without adverse effect on health. Report from Adeyemo *et a*l. (2013) confirmed that biscuit type waste does not possess anti-nutritional content and may be a reliable replacement for maize

Carcass characteristics obtained rom the rabbits in this study showed that, dietary treatments affected ($P<0.05$) the hind limbs, loin and the ribs. The other parameters examined for the carcass were not influence by dietary treatments. This is an indication that the diets had no negative effect on the carcass traits of rabbits. Reports has indicated that in the presence of anti-nutritional factors in feed, organs such as liver and heart may be significantly affected (Akinmutimi, *et, al,*2004). The fact that there was no variation in the lung, spleen and kidney among the experimental diets also infer that the diets are safe and do not pose health risk to the rabbit and as such agrees with the finding of Akinmutimi, *et, al,*2008, Haruna & Muhammad (2018) that BMMW can be fed to monogastric without any detrimental effect.

Conclusion

The increase in the number of pastry and other food industries in Nigeria has resulted in the abundant availability of related agro-allied in recent times. BWWM has therefore been further shown from this study as a potential energy source and a cost-effective ingredient in the formulation of compound feed for growing rabbits. The increased use of this agro-allied waste with improved efficiency of utilization represent a potential means of cutting down on the cost of feedingg monogastric.

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