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Replacement Value of Palm Kernel Meal for Maize on Carcass Characteristic of Broiler Turkeys

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Target Audience: Animal Nutritionists, Turkey Farmers and Feed Millers

Abstract

This study was conducted to evaluate the effect of replacing maize with palm kernel meal on nutrient composition, fatty acid profile and sensory qualities of the meat of turkeys fed the dietary treatments. Six dietary treatments were formulated using palm kernel meal to replace maize at 0, 20, 40, 60, 80 and 100 percent. One hundred and eighty (180) turkeys poults were randomly allotted to the six dietary treatments replicated trice, containing 30 turkeys per treatment and 10 turkeys per replicate making it a completely Randomized Design study which lasted 24 weeks. Proximate and chromatographic analyses were carried out on the samples of meat of turkeys slaughtered at the end of the experiment in order to determine the nutrient and fatty acid composition whereas sensory assessors were employed to conduct the palatability tests on the meat samples. Crude fibre content of the meat of turkeys fed diet 1(2.41%) was not significantly different (P>0.05) from that of diets 3, 4 and 5 (2.80, 2.86 and 2.85%) whereas the crude fibre of turkeys fed diets 1 and 6 were significantly higher (P<0.05) than that of diet 1. The ash content of turkeys fed diet 1 (27.8%) was not significantly different (P>0.05) from that of diets 2, 3, 4 and 6 (3.07, 3.09, 3.23 and 3.21%). That of diet 5 (3.55%) was however significantly greater than that of diet 1. The lauric acid of turkeys fed diets 5 and 6 (42.18 and 45.40%) were not significantly different (P>0.05) from each other but that of diet 6 was significantly higher (P<0.05) than those of diets 1 to 4 (7.63, 26.85, 37.10, 40.61%). The lauric acid values of turkeys fed diets 2 to 6 (20-100 replacement) were significantly higher (P<0.05) than that of diet 1. The myristic acid value of turkeys fed diet 5 (24.67%) was significantly higher (P<0.05) than others followed by those of diets 6 and 4 (21.41 and 20.76%). There was no significant differences (P>0.05) among the myristic acid of turkeys fed diets 1, 2 and 3 (6.24, 7.95 and 8.40%). The oleic stearic and linoleic acid values of turkeys fed diet 1 (oleic =26.86% stearic = 21.13% and linoleic = 29.90%) were respectively significantly higher (P<0.05) than that of those fed diets 2 to 6 (oleic, diets 2 -6 = 21.95, 21.16, 14,71, 9.89, 9.60%; strearic, diets 2 – 6 = 15.06, 12.71, 8.75, 8.21,7.92%, linoleic, diets 2 – 6 = 13.25, 8.85, 3.06, 2.58, 2.15%). Similarly the capric of turkeys fed diet 6 (0.67%) was significantly higher (P<0.05) than others while that of diets 1 (0.22%) was the least. The

caprylic acid values of turkeys fed diets 2-6 (8.56, 7.56, 8.30, 6.33, 7.56%) were significantly higher (P<0.05) than that of diet 1 (3.58%). There was no significant difference in the caproic acid values of turkeys fed diets 1, 3, 4, 5 and 6 (3.02, 2.93, 2.83, 3.08 and 3.75%). The colour of meat of turkeys fed diet 1, 3, 4 and 6 (4.40, 4.84, 5.20 and 4.76) were not significantly different (P>0.05) from one another whereas those of diets 2 and 5 (6.04, 5.72%) were significantly higher (P<0.05) than that of diet 1. The general acceptability of meat of turkeys fed diets 1, 3, 4, 5 and 6 (5.16, 5.48, 5.72, 5.88 and 5.32) were not significantly different from one another (P>0.05) but that of diet 2 (5.96) was statistically higher than that of diet 1. From the foregoing, PKM can replace maize up to 100 percent without any adverse effect on nutrient content, fatty acids and palatability of the meat.

Keywords: *Maize, Palm Kernel Meal, Turkeys, Carcass Characteristics*

Description of Problem

There is a stiff competition between man and livestock for maize as energy feedstuff. This competition as well as the low level of maize production in Nigeria make the cost of available maize and livestock feeds high. Maize therefore is hardly enough to meet the demand of both man and livestock.

Maize constitutes about 50 percent of the total ingredients used in making poultry feeds [1]. Feed accounts for about 60 percent cost of poultry production [2], implying that high cost of maize translates into high cost of poultry products and low profit marging of farmers.

The potentials of agro-industrial by-products such as palm kernel meal (PKM) in poultry nutrition have not been fully exploited even when PKM is relatively cheap and readily available. The aftermath of which is the over-dependence on cereals, especially maize, for feed formulation. However, there has been recent increase in the awareness to use agro-industrial by-products such as PKM (otherwise regarded as wastes) either to supplement or replace out-rightly grains especially maize in livestock rations [3]. This was because researchers have highlighted the nutritive values of agro-industrial by-products including PKM. Palm kernel meal which is a by-product of palm kernel oil extraction is abundantly available in many tropical regions including Nigeria. The use of PKM in poultry nutrition dated back to 1940 [4 and 5]. It was found to be palatable and satisfactory when used in poultry feeds. Palm kernel meal could serve as replacement for maize in poultry diets having a crude protein content of 19-21 percent and metabolizable energy value of 2600-2700 keal/kg feed [5, 6 and 7].

Turkey production in Nigeria has hitherto remained at the subsistence level due to many reasons which include lack of adequate information on their nutritreint requirements especially the local strains,

high cost of feed and inconsistent feeding programmes [8]. The problem of low animal protein intake of Nigerians can be solved by accelerated, poultry production using species such as turkeys that have fast growth rate, large size and excellent meat quality. Emphasis in the past had been on the use of broiler and laying chicken to address the protein of low animal protein intake of Nigerians; but it has proved unsuccessful. Efforts therefore should be geared towards exploiting the potentials available in other species of poultry like turkeys, guinea fowls, ducks and geese to meet the animal protein need of Nigerians.

Materials and Methods

Location and duration of the study

The study was conducted at the Poultry Unit of the Teaching and Research Farm of Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria. Umudike lies in the co-ordinates of 5^0 North and 7^0 East. It is located within the tropical rain forest zone of South Eastern Nigeria.

The study lasted 24 weeks, which according to [9] was the period it takes to mature broiler turkeys. During this period, dietary treatments were fed as turkey starter, grower and finisher rations.

Experimental Diets and Design

Six treatment diets were formulated (tables 1, 2 and 3) in which palm kernel meal replaced maize at 0, 20, 40, 60, 80 and 100 percent using the principle of weight-to-weight (quantitative) replacement adopted by [10, 11, 12, 13 and 14]. The design of the study was a Completely Randomized Design having 6 treatments each replicated trice.

Experimental Animals and Management

One hundred and eighty (180) turkey poults procured from a reputable hatchery at Owerri, Imo State, Nigeria were used in the study. The turkeys were allotted to the six treatment diets having 30 turkey poults per treatment and 10 poults per replicate.

The turkeys were brooded for four weeks and reared on a deep litter. The turkey poults were vaccinated with New Castle Disease vaccine intra-occular ($NDV^1/0$) at a day old and New Castle Disease lasota (NDVL) at 4 weeks of age. Fowl pox vaccine was administered at 12 weeks and booster NDVL was given at 17 weeks of age [15]. Antibiotics, anti-coccidial and vitamin drugs were administered to the birds when necessary [16].

Meat Sample Collection, Analysis and Sensory Evaluation

At the end of the experiment, one bird (weight closest to the mean) from each of the replicates was selected, slaughtered and processed to enable the collection meat samples which were used for the determination of nutrient and fatty acid composition as well as sensory evaluation of the meat. The meat samples were cut from the breast, thigh and drumstick cut-parts at equal ratios.

Nutrient composition of the meat samples was determined using the procedures of [17]. The fatty acid content of the meat was assayed with the aid of gas-liquid chromatography (GLC) model pye 104. The total lipid (fat) in each sample was first extracted. It was subjected to methylation and gas-liquid chromatography analysis. The lipids were refluxed in a methanol concentrated sulphuric acid mixture.

Anhydrous sodium sulphate was added to the mixture and all passed through the gas-liquid chromatography to fractionate the various methylesters present in the mixture. The individual fatty acids present in the meat samples were obtained as peaks in the GLC. Sensory evaluation of the turkey meat was carried out using a 7-point hedonic scale as described by [18]. Twenty five panelists (assessors) were used to assess the meat samples; organoleptic attributes of colour, taste, texture, flavour and general acceptability. These attributes were scored using the hedonic scale categorized into: 1- dislike very much; 2-dislike moderately; 3-dislike slightly; 4-neither like nor dislike. Others were 5-like slightly, 6-like moderately and 7-like very much.

Statistical Analysis

The data generated were subjected to analysis of variance (ANOVA) using the procedures of [19] Duncan Multiple Range Test was adopted to separate the means where significant differences existed [20].

Table 1: Percentage Composition of Experimental Diet -Starter Ration

	Experimental Diets					
Ingredients	1	2	3	4	5	6
Maize	40	32	24	16	8	0
Palm kernel meal	0	8	16	24	32	40
Soya bean meal	51	51	51	51	51	33
Fish meal	5.5	5.5	5.5	5.5	5.5	5.5
Bone meal	3	3	3	3	3	3
Salt	0.25	0.25	0.25	0.25	0.25	0.25
Vit/Min. Premix	0.25	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100	100
Calculated analysis						
Crude Protein (%)	25.59	29.3	30.19	30.99	31.79	32.59
Metabolisable Energy (Kcal/Kg)	2891	2827	2763	2699	2635	2571
Crude Fibre (%)	10.65	11.85	12.00	12.25	12.68	13.00
Ether Extract (%)	1.86	2.15	2.20	2.40	2.45	2.50
Ash (%)	6.92	7.02	7.60	7.80	7.94	8.12
NFE (%)	42.10	36.30	37.00	38.45	38.41	36.92

Table 2: Percent Composition of Experimental Diets Grower Ration

	Experimental Diets					
Ingredients	1	2	3	4	5	6
Maize	58	46.4	34.8	23.2	11.6	0
Palm kernel meal	0	11.6	23.2	34.8	46.4	58
Soya bean meal	33	33	33	33	33	33
Fish meal	5.5	5.5	5.5	5.5	5.5	5.5
Bone meal	3	3	3	3	3	3
Salt	0.25	0.25	0.25	0.25	0.25	0.25
Vit/Min. Premix	0.25	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100	100
Calculated analysis						
Crude Protein (%)	22.63	25.87	24.97	26.12	27.28	28.45
Metabolisable Energy (Kcal/kg)	3019	2924	2831	2738	2645	2553
Cal.Crude Fibre (%)	11.65	12.40	13.00	14.00	14.40	14.5
Ether Extract (%)	2.12	2.20	2.40	2.12	2.40	2.36
Ash (%)	7.41	7.80	8.00	8.14	8.20	8.25
NFE (%)	38.24	36.40	37.20	38.40	38.14	38.00

Table 3: Percentage Composition of Experimental Diets- Finisher Ration Experimental Diets

	Experimental Diets					
Ingredients	1	2	3	4	5	6
Maize	68	54.4	40.8	27.2	13.6	0
Palm kernel meal	0	13.6	27.2	40.8	54.4	56.4
Soya bean meal	24.5	24.5	24.5	24.5	24.5	24.5
Fish meal	4	4	4	4	4	4
Bone meal	3	3	3	3	3	3
Salt	0.25	0.25	0.25	0.25	0.25	0.25
Vit/Min. Premix	0.25	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100	100
Calculated analysis						
Crude Protein (%)	19.01	20.36	21.72	223.08	24.40	25.81
Metabolizable Energy (Kcal/kg)	30.85	2976	2868	2759	2650	2541
Crude Fibre (%)	14.60	15.00	15.20	15.25	15.32	15.50
Ether Extract (%)	1.95	2.00	2.14	1.96	2.03	2.20
Ash (%)	7.95	8.00	8.15	8.30	8.34	8.42

Results and Discussion

The nutrient composition, fatty acid profile and sensory attributes of the turkey meat samples are presented in Table 4. Significant differences occurred only among the values of crude fibre and ash content of turkeys fed the treatment diets. The crude fibre of turkeys fed diets 2 (3.68%) and 6 (3.55%) were significantly higher ($P<0.05$) than others whereas there was no significant difference in the crude fibre values of turkeys fed diets 1, 3, 4 and 5 (2.41, 2.80, 2.86 and 2.85%). The crude fibres values increased with increase in level of replacement which may have been influenced by the dietary crude fibre levels [21] which also increased with increase in level of replacement. The ash content of turkeys fed diet 5 (3.55%) was significantly higher than that of diet 1 (2.78%). However, the ash content of turkeys fed diet 1 was not significantly different ($P>0.05$) from that of diets 1, 2, 3, 4 and 6 (3.07, 3.09, 3.23 and 3.21%). The pattern of this result was similar to what obtained in the crude fibre values. The numerical values of crude protein of turkeys fed diets 2 to 6 (58.73, 59.06, 69.84, 61.00 and 61.50%) were higher than that of diet 1 (58.60). Since protein content is an index for measuring the quality of meat [1] so the quality of meat of turkeys fed diets 2 to 60 (20 to 100%) may be better than that of die 1.

There were significant differences in the values of all the fatty acids examined.

Lauric acid of turkeys fed diet 6 (45.40%) was significantly higher ($P<0.05$) than that of diets 1, , 2, 3 and 4 (7.63, 26.85, 37.10 and 40.61%). The myristic acid content of turkeys fed diets 5 (24.67%) was significantly higher ($P<0.05$) than others whereas there was no significant difference in the myristic values of turkeys fed diets 1, 2 and 3 (6.24, 7.95 and 8.40%). Generally, there was increase in the values of the saturated fatty acids (lauric and myristic acids) and decrease in the values of unsaturated fatty acids (oleic and linoleic) with increase in level of replacement. This could be attributed to the major source of the fatty acids in the diets. Whereas lauric and myristic acids dominate in palm kernel oil oleic and linoleic acids are the predominant fatty acid contained in corn fat [22, 23, 24 and 25]

This result agreed with the repot that fatty acid composition of turkeys carcass was affected by the chicken fat [26, 27 and 28]. The probable implication of this result is that the meat of turkeys fed diet 1 (0% replacement) may be predisposed to oxidation rancidity and spoilage due to the unsaturated fatty acids; whereas consumer of turkeys fed diets 2 to 6 with higher saturated fatty acids lauric and myristic may face heart problem [25 and 29]

Table 4: Nutrient Composition, Fatty Acid Profile and Sensory Attributes of Meat of Turkeys Fed the Treatment Diets.

	Treatment Diets						
Parameters	1	2	3	4	5	6	SEM
Nutrient Composition							
Dry Matter (%)	73.81	73.62	74.60	74.56	75.22	75.60	0.87
Crude Protein (%)	58.60	58.72	59.06	69.84	61.00	61.50	0.71
Crude Fibre(%)	2.41^{c}	3.08^{ab}	2.80^{bc}	2.86^{bc}	2.85^{bc}	3.55^{a}	0.14
Crude Fat (%)	8.30	8.75	9.10	9.78	10.20	10.93	0.78
Ash (%)	27.8^{b}	3.07^{ab}	3.09^{ab}	3.23^{ab}	3.55^{a}	3.21^{ab}	0.15
Nitrogen Free Extract (%)	16.20	15.89	15.95	16.27	16.00	16.25	0.14
Fatty Acid Profile							
Lauric Acid (%)	7.63^{e}	26.85^{d}	37.10^{c}	40.61^{bc}	42.18^{ab}	45.40^{a}	0.91
Myristic acid (%)	6.24^{c}	7.95^{c}	8.40^{c}	20.76^{b}	24.67^{a}	21.41^{b}	0.82
Oleic Acid (%)	26.86^{a}	21.95^{b}	21.16^{b}	14.71^{c}	9.89^{d}	9.60^{d}	0.40
Stearic Acid (%)	21.13^{a}	15.06^{b}	12.71^{b}	8.75^{c}	8.21^{c}	7.92^{c}	0.85
Capric Acid (%)	3.58^{c}	8.56^{a}	7.56^{ab}	8.30^{a}	6.33^{b}	7.56^{ab}	0.35
Caprylic Acid (%)	3.02^{b}	4.50^{a}	2.93^{b}	2.83^{b}	3.08^{b}	3.75^{ab}	0.28
Linoleic Acid (%)	29.90^{a}	13.25^{b}	8.85^{b}	3.06^{c}	2.58^{c}	2.15^{c}	0.70
Caproic Acid (%)	0.22^{e}	0.51^{d}	0.57^{c}	0.58^{bc}	0.61^{b}	0.67^{a}	0.01
Sensory Attributes							
Colour	4.40^{c}	6.04^{a}	4.84^{c}	5.20^{bc}	5.72^{ab}	4.76^{c}	0.27
Taste	5.24	5.40	5.56	5.32	5.36	5.20	0.26
Texture	5.28	5.24	5.32	5.56	5.52	5.20	0.27
Flavour	5.40	5.40	5.16	5.52	5.44	4.76	0.27
General Acceptability	5.16^{b}	5.96^{a}	5.48^{ab}	5.72^{ab}	5.88^{ab}	5.32^{ab}	0.23

a, b, c, d, e, f means in the same row with different superscripts are significantly different from one another ($P<0.05$).

Among the sensory attributed, significant differences existed only in the scores of colour and general acceptability of meat of turkeys fed the treatment diets. The scores for colour of turkeys fed diets 2 and 5 (6.04 and 5.72) were significantly higher ($P<0.05$) than others whereas there was no significant difference ($P>0.05$). The scores for colour of meat of turkeys fed diets 1, 3, 4 and 6 (4.40, 4.84, 5.20 and 4.76) are not significantly different from one another. The general acceptability score of turkeys fed diet 2 (5.96) was significantly higher ($P<0.05$) than that of diet [5.16]. However, the general acceptability of turkeys fed diet 1 was not significantly different ($P>0.05$) than that of diets 3, 4, 5 and 6 (5.48, 5.72, 5.88 and 5.32). The higher fat content of diets 2 to 6 may have influenced the

colour of the meat in accordance with the report of [30 and 31] that fat gives food better colour and general appearance. This result implies that PKM can replace maize up to 100 percent and good sensory attributes of meat of turkeys fed the diets achieved.

Conclusion and Application

Based on the results obtained in the study, it could be concluded that:

1. Palm kernel meal can replace maize up to 100 percent in the diet of turkey without adverse effect on the nutrient composition and quality of the meat.

2. However replacing maize with PKM up to 100 percent will encourage high level of saturated fatty acids and low level of the unsaturated fatty acids which may expose the consumer of the meat to heart disease of predispose the meat to short shelf life due to oxidation.

3. Palm kernel meal can be used to replace maize up to 100 percent in the diet of turkeys and good sensory qualities achieved.

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