Comparative evaluation of palm oil and lard as partial replacement for maize in broiler chicken diets

***Essien E. Nsa and Emmanuel E. Archibong**
Department of Animal Science, University of Calabar, Nigeria.
*Corresponding author email: essienkate@gmail.com

Abstract

This study investigated the effect of animal and plant lipids in the diets of broiler finisher birds with respect to their growth performance and abdominal fat deposition. A total of 180 birds of mixed sex were completely randomized into three dietary treatments A, B and C, with 0, 8% animal lipid and 8% plant lipid as replacements for maize respectively. Each treatment was replicated thrice and each replicate had 20 birds. Result showed significant improvement (P<0.05) in feed intake of birds on lard, followed by palm oil and then the control in that order, likewise final live weight, weight gain, feed conversion ratio and protein efficiency ratio. The cost/kg feed intake did not show any significant differences likewise the cost/kg weight gain (N). Among the nutrient retention parameters, only ash and ether extract showed significant (P<0.05) differences, with birds on the control diet having significantly (P<0.05) higher ash content than both lard and palm oil diets. Ether extract was better retained by birds on lard, followed by palm oil. The liver and heart of birds on lard and palm oil were heavier than that of the control. Birds on diet containing lard had the highest (P<0.05) abdominal fat followed by birds on palm oil diet. It was concluded that 4% animal fat (lard) (replacing maize) as an energy source enhances growth performance than palm oil in broiler finisher diets but with attendant abdominal fat deposition.

Keywords: Animal lipid, plant lipid, cost per kg weight gain

Introduction

Fats and oil are the most concentrated sources of energy in feeds but may have an effect upon other feed constituents as well as digestive processes (McDonald *et al*., 1991). Based on volume and nutritional importance, one of the most important ingredients used in poultry and livestock feed formulation is feed grade fat and oil (Zelenka *et al.*,1997). These ingredients are cheaper and more efficient supplements of the conventional energy feed ingredient like maize, barley and wheat.

According to Satabdee (2017), animal lipids have the following characteristics; relatively

rich in saturated fatty acids, iodine number is relatively less (iodine number denotes the degree of un-saturation in fatty acids, animal fats have relatively higher value of Reichert-meisl-number (which is how much volatile acid can be extracted from a fat through saponification), oxidative rancidity is observed more frequently and finally are stored in the liver and beneath the skin, furthermore, plant lipids are comparatively rich in unsaturated fatty acids and due to their high unsaturation tend to stay liquid at room temperature, hence commonly known as oils (Satabdee, 2017). Iodine number of plant fats is more than that of plants; oxidative rancidity is relatively less in plants. Obioha (1992) reported that the fat present in the meat of monogastrics reflects the type of oil contained in the diet fed to the animal as some oils have undesirable taints.

Feed grade fats in animal feed formulation contribute 6-20% of the metabolizable energy. It increases feed efficiency, decreases feed intake, improves feed conversion ratio, increases growth rate, reduces the rate of passage of the digesta in the gastro-intestinal tract (Bryant *et al*., 2005) and according to Finman *et al*.(2008) ensures better absorption of all nutrients.Various sources of feed grade fats include; tallow, poultry fat, lard(pork), yellow grease(restaurant) and vegetable fat like sunflower , soybean , canola and palm oils (Sanz *et al*., 2001).

These various oil and fats however, differ in the type of fatty acids they contain as such differ in their contribution to energy in the feed and abdominal fat deposition (Baino and Lara, 2005).This study was therefore designed to determine the effect of animal lipid (lard) and plant lipid (palm oil) on growth performance and fat deposition of broiler finisher birds.

Materials and methods

Experimental site

The experiment was carried out at the Poultry Unit of the Teaching and Research Farm, University of Calabar, Calabar, Nigeria. The climatic records during the period of the experiment (Dry season, December-February) showed an average temperature and relative humidity of 320C and 72.5%, respectively (Google Earth, 2017)

Experimental birds and management

One hundred and eighty, 28-day old 'Fidan' ,heavy strain birds were used for a 28- day feeding trial. The finisher birds were individually weighed after passing through a common starter diet (Top feed) and assigned to three treatment groups of sixty birds per treatment. Each treatment consisted of three replicates of twenty birds each. Feeds and

water were given to the birds *ad libitum*. At the end of the trial, 4 birds per replicate were sacrificed for organs measurement.

Experimental design and digestibility studies

At the end of the feeding trial, 4 birds per replicate were randomly selected and kept in metabolic cages. The birds were fed 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 80^0C in the oven. The dried samples were ground in a meadows model 35 hammer mill and sieved through a mesh of 5mm and stored at room temperature for proximate analysis. The digestibility trial lasted 10days: 7 days for excreta collection and 3 days for acclimatization.

The following formula was used;

$$\% \text{ Digestibility} = \frac{\text{Amount of nutrient} - \text{amount of nutrient in faeces}}{\text{Amount of nutrient intake}} \times 100$$

Experimental diets

The plant lipid (Palm oil) and animal lipid (Lard) were sourced from within the University of Calabar Community. The lard from the back of pigs was boiled till all the water content removed, while the oil was collected for this experiment. Maize was replaced by 0%, 4% palm oil and 4%lard to form dietary treatments A (Control), B and C, respectively.

Proximate analysis

The proximate composition of experimental diets was determined by the method of AOAC (1990).

Cost- benefits evaluations

The prevailing market prices of the ingredients at the time of the study were used to determine the cost of 1kg feed consumed and the cost of 1kg feed consumed/weight gain.

Data collection and statistical analysis

Data on weight gain feed intake feed conversion ratio, protein efficiency, mortality and abdominal weight were all subjected to one-way analysis of variance for CRD using SPSS (1990). Significant means among variables were separated using the Duncan multiple range test (Duncan, 1995).

Results and discussion

Result of the partial replacement of maize with palm oil and lard is presented in Table 3, it revealed significant ($P<0.05$) differences in all the parameters considered apart from the cost/kg feed consumed, cost per kg weigh(N) and some organs.The result revealed that more feed was significantly consumed ($P<0.05$) by birds fed palm oil and lard diets with similar intake values. The result agrees with the

findings of Nsa *et al.*(2009); Akpan and Nsa (2010), who all attributed it to improvement in palatability as a result of oil inclusion in a diet for broiler birds.

The improved feed consumption by birds on oil palm and lard diets manifested in their final live weight and weight gain, where there was significant (P<0.05) improvement of both parameters in birds fed diets with palm oil and lard over the control diet. More feed intake means more weight gain (Afoyayan, 2012; Nsa *et al*.,2012).

There was significant (P<0.05) improvement in feed utilisation by birds on lard than birds on palm oil which in turn was significantly (P<0.05) better than that of the control diet. The observed better utilisation of feed by birds on lard than palm oil could be due to the fact that lard is an animal lipid that is high in saturated fatty acid than plant lipid. Saturated fat is known to be absorbed and stored directly than unsaturated fat.(Balao and Lara, 2005; Lugas and Riaz, 2005; Nsa *et al*, 2010), also animal fats have relatively higher value of Reichert-Meissl number, which can equally be responsible for the observed better feed utilization (Satabdee,2017).

The cost/kg (₦) feed showed no significant (P>0.05) differences despite the high value recorded for diet with palm oil, and did not translate to any significant improvement in cost/kg weight gain (₦).This means that the partial replacement of palm oil and lard in maize based diets has no cost sparing effect.

The nutrient retention apart from the digestible ether extract and ash indicated no significant differences. The digestible ether extract showed significant improvement with birds on lard and palm oil than the control diet. This could be due to the fact that oil added more energy density to the diets which led to more utilisation. The ash digestibility showed a significant (P>0.05) depression with birds on palm oil and lard when compared to the control diet. Fat and oil in diets are known to affect utilisation of minerals, as they bind some minerals making them unavailable; also rancidity that might set in, in any form can destroy most of the minerals. Some scientists have advocated increase input of minerals and vitamins beyond their recommended levels in feeds that are of high oil content (Sanz *et al.*,2001); Bryant and Rolad, 2005; Nsa *et al*., 2012).

The abdominal fat deposition was significantly (P<0.0) higher in birds on lard, followed by birds on palm oil. The differences in values of birds on the two diets confirmed findings by Sanz *et al.*(2001); Akpan and Nsa (2010), that

fat metabolism and deposition in poultry can be affected by different dietary fats.On carcass characteristics, significant differences were observed only in the liver out of all the organs examined. Percentage weight of liver and heart were significantly ($P<0.05$) enlarged in birds fed lard and palm oil diets. This confirms the fact that liver is where bile is produced, which helps in the emulsification of fat. More fat/oil means more pressure on the liver to produce more bile. This pressure on the liver might cause the liver to enlarge to meets its primary function.

The heart showed significant ($P<0.05$) differences in weight with the highest weight recorded for birds on lard followed by palm oil. The observed higher weight of heart of birds on lard was specifically due to deposition of more fat on the heart tissues. This confirms the reason why people on meat/fat are easily prone to related heart diseases like stroke and heartfailure than people on plant fat oil. Fat from animal origin can easily settled or deposited on sensitive organs, adipose tissues and under the skin because of high content of saturated fatty acids (Satabdee, 2017).

Conclusion

The results of this study have shown that 4% lard (animal lipid from pigs) is a better source of energy than palm oil(plant lipid) in broiler finisher diets in terms of growth performance but with the demerit of encouraging more abdominal fat deposition.

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Table 1: Gross composition of experimental finisher diets

Ingredients (%)	Diet A (Control) (0% lipid)	Diet B(Palm oil)(4% replacement for maize)	Diet C (Lard) (4% replacement for maize)
Maize	59.00	55.00	55.00
Soybean meal	28.00	28.00	28.00
Wheat offal	6.00	6.00	6.00
Palm oil	-	4.00	-
Lard	-	-	4.00
Fish meal	2.50	2.50	2.50
Bone meal	2.50	2.50	2.50
Oyster shell	1.25	1.25	1.25
Lysine	0.25	0.25	0.25
Methionine	0.25	0.25	0.25
*Vit/min premixes	0.25	0.25	0.25
Total	100.00	100.00	100.00
Calculated analysis			
Crude protein(%)	20.92	20.78	20.78
Crude fibre(%)	4.28	4.26	4.26
Calcium(%)	1.23	1.20	1.20
Available phosphorus(%)	0.78	0.75	0.75
Methionine(%)	0.46	0.43	0.43
Lysine (%)	1.18	1.14	1.13
ME (Kcal/Kg)	3,099.12	3,194.00	3,205.00

*Composition per 2kgof mixture contains; Vitamin A- 15,000,000 iu, Vitamin D – 3,000,000 iu,, Vitamin E- 15,000 iu, Vitamin K- 2.5g, Vitamin B_1- 1g, Vitamin B_2- 10g,, Vitamin B_{12}- 4g, Folic acid – 2g, Biotin – 0.1g, Niacin – 70g, BHT – 125g, CalciumD-Pantotenic acid – 20g

Table2. Performance of finisher birds fed diets containing palm oil and lard as replacement for maize

Parameters	Diet A Control	Diet B (4% Palm oil replacement for maize)	Diet C (4% Lard Replacement for maize)	SEM
Initial weight(g/ bird)	785.50	790.00	770.80	1.98
Final live weight(g/bird)	2800.78^{b}	2950.70^{ab}	2988.45^{a}	2.02
Daily weight gain(g/bird)	39.86^{c}	49.73^{b}	53.90^{a}	0.58
Daily feed intake(g/bird)	142.48^{b}	159.64^{ab}	161.71^{a}	3.88
Feed Conversion Ratio	3.58^{a}	3.21^{b}	3.00^{c}	0.06
Protein intake(g/bird)	29.81^{b}	33.17^{a}	34.85^{a}	0.15
Protein efficiency ratio	1.34	1.50	1.55	0.02
Mortality (%)	0.00	0.10	0.00	0.01
Cost/kg feed, (~~₦~~)	118.34	120.00	119.34	1.88
Cost/kg WG, (~~₦~~)	599.13	619.55	607.88	2.81
Abdominal fat deposition(g/bird)	2.17^{c}	5.10^{b}	8.91^{a}	0.08

^{a,b,}Means on the same row with different superscripts differ significantly (P<0.05).

Table 3. Nutrient digestibility (%) 0f the experimental diets fed to finisher broiler chickens.

Parameters	Diet A	Diet B	Diet C	SEM
DM	88.91	85.30	86.09	1.51
CP	68.10	70.00	69.86	1.22
CF	31.08	35.07	38.00	1.08
EE	55.93^{b}	61.17^{ab}	68.03^{a}	1.94
ASH	64.04^{a}	56.00^{b}	55.98^{b}	2.01
NFE	70.89	71.00	70.54	2.80

^{a,b,}Means on the same row with different superscripts differ significantly (P<0.05).

Table 4. Effect of palm oil and lard as partial replacement of maize on the carcass characteristics of finisher chickens

Parameter (g)	Diet A	Diet B	Diet C	SEM
Dressed wt.	54.94(66.96)	57.55(68.57)	59.54(69.53)	1.77
Kidney	5.41(0.89)	7.66(1.19)	8.69(1.44)	0.43
Spleen	2.69 (0.22	2,99(0.25)	3.01(0.23)	0.05
Liver	8.60 (0.24^{b})	10.01(0.88^{a})	10.22(0.98^{a})	0.50
Pancreas	3.29(0.33)	3.31(0.35)	3.40(0.89)	0.04
Heart	4.40(0.59^{c})	6.78(1.45^{a})	6.99(1.19^{b})	0.09
Lungs	4.83(0.71)	4.89(0.69)	4.88(0.65)	0.06

Values in brackets are expressed in percentage of live weight (% LW)