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Effect of Saturated and Unsaturated Oils on the Growth Performance and Organoleptic Qualities of Broiler Chicken

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Abstract
Ninety day-old Anak strain broiler chicks were used to evaluate the effect of growth performance and sensory/organoleptic qualities of broiler fed diets supplemented with saturated and unsaturated oils at of 5% levels each, in a completely randomized design for 56 days, the birds were grouped into three (3) treatments, each treatment had three (3) replicates and ten (10) chicks in each replicate. Three experimental diets identified as T_1, T_2 and T_3 were formulated, the control diet T_1 had 0% oil, T_2 contained saturated (palm) oil at 5% inclusion and T_3 contained 5% unsaturated (groundnut) oil respectively, feed and water was provided ad-libitum. The results showed that unsaturated fat significantly ($P < 0.05$) improved the final body weight, body weight gain, daily weight gain, total feed intake, daily feed intake and daily water intake. However, there was a superior feed conversion ratio among the birds fed unsaturated oil T_3 which was not statistically significant to the other birds. There was no significant ($P > 0.05$) difference observed in meat tenderness, aroma, juiciness, texture, taste and general acceptability. The best weight gain, feed conversion ratio and organoleptic evaluation was obtained in unsaturated oil (T_3). It is therefore, recommended that 5% inclusion or more of unsaturated fat source (groundnut oil) be used as supplement in broiler diets.
Keywords: Saturated and Unsaturated oils, broiler chiken and organoleptic qualities.

1. Introduction

Fat consists of a wide group of compounds that are generally soluble in inorganic solvents and generally insoluble in water. Fats may be either solid or liquid at room temperature depending in their structure and composition. Oil is usually referred to as fats that are liquid at normal room temperature while “fats” is usually referred to as fats that are solid at normal room temperature. Oil is also used for any substance, that do not mix with water and has a greasy feel such as petroleum (or crude oil) (Maton, Anthea *et al.,* 1993). Saturated fats are derived from animal products such as meat, dairy and eggs but they are also found in some plant based sources such as coconut, palm kernel oils. They are solid at room temperature. Unsaturated fats are derived from plants; they can be further divided as Monounsaturated and Polyunsaturated fats. Monounsaturated fats are liquid at room temperature but begin to solidify at cold temperature. Examples include olives and peanuts. Polyunsaturated fats are also liquid at room temperature. Fats and oil can be used as an alternative energy source in place of prime energy feed ingredients in broiler production. The dietary Metabolizible Energy (ME) increassed through supplementation of fats in broiler ration had significantly increased body weight gain in broiler (Ali Nobakat and Mehmannavaz, 2012). The cholesterol content of the food products especially from animal source becomes the prime area of consumer’s concern because of the increased awareness on higher dietary cholesterol and the incidence of Coronary Heart Diseases (CHD).Similarly, there has been growing interest over recent years in the modification of the fatty acid composition and cholesterol content of poultry products. In poultry and monogastric animals, the fatty acid composition of tissue lipids depends on the dietary fatty acids (Lopez *et al.,* 1999).

Badway (1997) recognized that the supplementation of the rations with 5% sunflower oil resulted in a reduction of triglyceride concentration on blood with about 40% compared to the control. According to Badway 1997, increasing the supplementation levels of sunflower oil to 10% resulted in a significant increase in the triglyceride levels. Abdul Raufe (2007) found that the addition of corn oil to diet rations decreased blood total lipids during the growing and laying period compared with animal fat returns. The decrease was more pronounced by increasing corn oil levels from 3% to 6%. Interest in dietary fat and Coronary Heart Disease (CHD) was centered primarily on saturated and polyunsaturated fatty acids until 1985 when Grundy (1986) reported that monounsaturated fatty acids namely oleic acid were as effective as polyunsaturated fatty acids (PUFA) in reducing plasma total and LDL cholesterol levels. These observations coincided with the relatively low incidence of Coronary Heart Disease (CHD) observed among populations consuming the so-called “mediterranean diet” which is characterized by a high intake of fat but primarily from olive oil. The prevailing theory at the time argued that saturated fatty acids raised blood cholesterol (Abdel-Hakin *et al.,* 1982). The demonstration showed that vegetable oils with high concentration in oleic acid were effective in reducing blood cholesterol (Vilchez *et al.,* 1991). Transfatty acids were produced when fats and oils are hydrogenated (hardened) for use in the manufacture of margarines and derivative. Kinsella *et al.* (1990) reported that high intakes of transfatty acids not only increased Plasma Low Density lipoprotein (LDL) cholesterol levels but lowered Plasma High density lipoprotein (HDL) cholesterol levels triggered an intense debate in the

physiological effects of hydrogenated fats particularly in relation to Coronary Heart Disease (CHD).
The value of fats and oils is based on both safety and their efficacy. The factors affecting the quality of fats and oils can be divided into two principle categories: safety and efficacy.The safety criteria relate to the presence of substances that may have deleterious effects on the health and performance of the animal or the presence of substances that may result in the accumulation of toxic residues related to human health concerns (Pinchaso and Nir, 1992). The efficacy criteria relate primarily to the energy value of the fat product and secondarily to such factors as oxidative stability and palatability. In broiler chickens, the oily fat problem encountered in slaughter-houses causes technological incidents. Today, this problem is exacerbated by the use of vegetable oils and various lipid sources resulting from the recent banning of animal fats and should be taken into account from now when formulating feed. Hofman (1987) and Russo (1988) have broadly classified meat quality characteristics into four (4) main categories: Organoleptic Nutritional value, Technological quality, Hygiene characteristics
The main effect of unsaturated oils is to induce the deposition in body lipids of poly unsaturated fatty acids that are not synthesized by chickens namely lincoleic acid and lincoleic acids in fatty and muscle tissues and long chain polyunsaturated fatty acids muscles (Lessire, 1995).

2. Material and methods

2.1. Experimental Site

The experiment was carried out in the poultry unit of the Department of Animal Science Ebonyi State University, Abakaliki.

2.2. Sources and Processing of Saturated and Unsaturated Oils.

The raw groundnut oil which was used was extracted from the raw groundnut seed that was purchased from Abakaliki foodstuff market and the groundnut seed was made free of dirt, pounded and the oil was extracted. The oil was stored in the bottle to avoid it being contaminated and going rancid. The groundnut oil was used as the unsaturated oil. The palm oil was bought from local traders from Abakaliki food stuff market and was used as the saturated oil.

2.3. Experimental Birds and Management

Ninety day old Anak broiler chicks were purchased from CY farms in Abakaliki Ebonyi State. Before the commencement of the experiment, the chicks were allowed to acclimatize for 7 days. On the 8^{th} day, 90 birds were randomly placed into 3 dietary treatment in a completely randomized design (CRD). Each treatment was replicated 3 times with 10 birds per replicate.
The birds were housed in deep litter system with wire gauze to separate the birds. Ventilation and heat were provided and adjusted as necessary to maintain the birds comfort and body temperature. All the necessary vaccination and other routine poultry management practices were strictly adhered to according to Odoh, (2006)

2.4. Experimental Diet

The dietary treatments were identified as T_1, T_2 andT_3 respectively. The saturated (palm) oil and the unsaturated (groundnut) oil was included in the diets of T_2 and T_3 at levels 0.5% respectively, both at starter and finisher phase of the experiment (Table 1). The proximate composition of experimental diet is presented in Table 2.

2.5. Feeding

The chicks were given ad-libitium access to experimental diets from conica feeding troughs. Water was made available for consumption on rubber and aluminum water troughs

2.6. Data Collection

Data were collected according to the objectives of the experiment on the following parameters.

2.7. Weight

Before the experiment started, the birds were weighed to obtain their initial body weight and subsequently on weekly basis. At the end of the experiments, the body weight gain was determined by subtracting the initial body weight from the final body weight. The daily body weight was determined by dividing the body weight gain by the number of days of the experiment such that:
Body weight gain = final weight – initial body weight
Daily weight gain = total weight gain / number of days of experiment.

2.8. Feed Intake

Weighed quantity of feed was served to the birds per replicate between 7 to 8am daily. The leftover feed was collected the next day, weighed and recorded, from this, the daily feed intake of each replicate was determined

by the difference between the feed served and the leftover feed. The average daily feed intake was determined by dividing total feed intake by the number of days of experiment.
Feed Intake = Total feed served – left over
Daily feed Intake = total feed intake/number of days of experiment.

2.9. Water Intake
Measured quantity of water served to the birds per replicate between 7 to 8am daily. The same quantity of water was kept away from the birds and used to check the quantity lost through evapouration.
Water intake = left over water + evaporated water – water served.
Daily water intake = total water intake/number of days of experiment.

2.10. Feed Conversion Ratio
Feed conversion ratio was obtained by dividing the average daily feed intake by the average daily weight gain. That is feed conversion ratio (FCR) = $\frac{\text{Average Daily Feed Intake}}{\text{Average Daily Weight gain}}$

2.11. Determination of Organoleptic/Sensory Qualities
The procedures for the assessment of organoleptic qualities were as described in Okeudo *et al;* (2005). 6 Birds (2 from each treatment) were selected after the termination of feeding trial. Birds of similar live weight were selected and were starved over night and thereafter slaughtered. One drumstick from each carcass was used for the determination. For sensory evaluation test, drumsticks were cut in cubes packaged individually and heated in a pot on a hotplate for 45 minutes. Thereafter, they were cooled under room temperature and served to a panel of 10 assessors trained in basic organoleptic assessment procedure. Each panelist was required to masticate 3 samples and score each for tenderness, juiciness, appearance, flavour and degree of likeness using the 9 points category rating scale (AMSA, 1978). It was planned that the 3 samples offered to each panelist must come from three different dietary groups.

2.12. Statistical Data Analysis
The data collected were subjected to one way analysis of variance in a completely randomized design (CRD), while significant difference between means were separated using Fishers least significant difference (F-LSD) as outlined by Obi (2002). The experimental linear additive model used was;
$X_{ij} = \mu + T_i + \sum_{ij}$
Where
X_{ij} = Any observation
μ = Population mean
Ti = Treatment effect
$\sum_{ij}$ = Experimental error
i = Number of treatment
j = Number of replicate

3. RESULT
3.1. Growth Performance
The results on the effect of dietary inclusion of saturated and unsaturated oil on the growth performance of broiler chicken are presented in Table 3. The result showed that there were significant differences ($P < 0.05$) in the final body weight, body weight gain, daily weight gain, total feed intake, daily feed intake and daily water intake. There was no significant difference ($P > 0.05$) in feed conversion ratio.

3.2. Sensory/Organoleptic Evaluation of Meat
The organoleptic assessment of broiler birds meat fed diets containing saturated oil and unsaturated oil is presented in Table 5. There were no significant ($P>0.05$) difference in tenderness, aroma, juiciness, texture, taste and general acceptability in all the treatment groups. Though they were numerical increases in some of the parameters measured for sensory/organoleptic test across the treatments, those increases were not statistically different.

4. DISCUSSION
4.1. Growth Performance
The significant ($P<0.05$) improvement observed in the birds fed dietary inclusion of unsaturated (groundnut) oil compared to those birds on saturated (palm) oil and control could be as a result of the fact that unsaturated oil contain high amount of Poly Unsaturated Fatty Acids (PUFA's) which were more soluble and ultimately more

digestible in the intestine than Saturated Fatty Acids. This is in agreement with the findings of Kaman *et al.* (2013), who observed that unsaturated oil has contain higher apparent metabolizable energy (AME) than the saturated oil which reflected in their weight gain. The result of this study confirms the result of earlier reports that addition of fat to poultry diets improved growth rate and the efficiency of feed utilization compared to control (Sunde, 1956). These results also is in accordance with the findings of (Jabar and Ebrahim, 2012) who reported significant difference ($P<0.05$) in the weight gain of broiler fed saturated and unsaturated fatty acids diet. The result is not in agreement with the result of Abdalqadir *et al.(*2014); Anitha *et al.(*2006) and Sanz *et al.(*1999) who reported that dietary inclusion of saturated and unsaturated oil had no significant ($p>0.05$) effect in the performance of commercial broilers. Thacker and Campbell (1994) reported better growth rate in the experimental birds fed unsaturated oil compared to the control, which the author attributed to the higher percentage of long chain fatty acids and higher triglycerides in unsaturated oil.

The significant increase ($P<0.05$) in feed intake observed in birds on T_3 (65.44g) compared to T_2 (63.95g) might be due to the high amount of metabolizable energy in unsaturated oil and their ability to be digested and their unsaturated fatty acids absorbed which is not seen in saturated oils. The result is in line with the report of Jabar and Ebrahim, (2012) who reported significant difference ($P<0.05$) in feed intake of broiler chicken fed saturated and unsaturated fatty acids. The result is again in agreement with the findings of Ali *et al*. (2011) who reported significant difference in feed intake of broilers fed varying sources and levels of vegetable oil. The present result is not in accordance with the result of Kannan *et al. (*2013) who reported that inclusion of saturated and unsaturated fat in broiler diets lowered the feed intake.

The significant ($P<0.05$) difference in daily water intake obtained in unsaturated oil compared to saturated oil and control could be attributed to the chemical contents of unsaturated oil and also due to the quantity of feed consumed in this treatment.

The feed conversion ratio did not differ significantly ($P>0.05$). The comparable feed conversion ratio suggests that dietary inclusion of saturated and unsaturated oil in broiler diet did not affect negatively the feed conversion ratio of broiler chickens. T_3 had superior feed conversion ratio though not statistically different when compared to the other treatment groups. This is in line with the report of Leeson and Summes, (2001); Baiao and Lara,(2005) and Rahim *et al. (*2011) who reported non-significant difference in the feed conversion ratio of birds fed saturated and unsaturated oil, but not in accordance with the findings of Ali *et al. (*2001) who reported significant ($P<0.05$) difference in feed conversion ratio of broilers on different sources and levels of oils.

4.2. Sensory/Organoleptic Evaluation

The numerical increase though not statistically different observed in the tenderness, aroma, juiciness and taste in birds fed dietary inclusion of unsaturated oil T_3 compared to saturated oil T_2 and control T_1; suggest that inclusion of unsaturated oil in broiler diet slightly improves the organoleptic and sensory qualities of broiler meat as perceived by the panelist. This could be because unsaturated oil may have facilitated the deposition of fat in the adipose tissue. This agrees with the report of Botsoglou *et al. (*2002) who reported that essential oils can be deposited in adipose tissues of birds fed unsaturated oils but has not reported negative effect on consumers. Eltazi, (2000) in a panel test, agreed to differences in tenderness and juiciness when feeding broilers with corn oil. According to Grashora, (1995) who reported that the most important criteria for meat quality are juiciness and tenderness. These two attributes are closely related, for more tender meat, juices are released more quickly on chewing and juicy sensation of meat is greater. Birds on T_3 recorded numerical increase in taste compared to other treatment groups which indicates nutritive contents of unsaturated oil against saturated oil. The general acceptance of meat from unsaturated oil supplemented diets gives a good indication of perception, acceptance and preference by the panelist of the meat from birds fed diets containing the test ingredient over control

5. CONCLUSION AND RECOMMENDATION

Inclusion of unsaturated oil at 5% level in broiler diets in this study generally improved body weight gain and feed conversion ratio. Meats from birds fed the unsaturated oil containing diets were generally preferred in terms of juiciness, aroma, taste, tenderness and generally acceptability. It can therefore be recommended that unsaturated oil can be used at 5% level or more in broiler diets to improve the organoleptic properties and of broiler meat and obtain significantly better growth performance.

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Table 1: Percentage Composition of the Experimental Diets

Yellow maize	**50**	**50**	**50**
Soya beans	**22.5**	**22.5**	**22.5**
Wheat offal	**8**	**8**	**8**
Palm kernel cake	**11.5**	**11.5**	**11.5**
Saturated oil	**0**	**0.5**	**0**
Unsaturated oils	**0**	**0**	**0.5**
Fish meals	**3.5**	**3.5**	**3.5**
Limestone	**0.1**	**0.1**	**0.1**
Methionine	**0.1**	**0.1**	**0.1**
Lysine	**0.1**	**0.1**	**0.1**
Bone meal	**3.0**	**3.0**	**3.0**
Starter premix	**0.25**	**0.25**	**0.25**
Common salt	**0.3**	**0.3**	**0.3**
Total	**100**	**100**	**100**

Table 2: Proximate Composition of Experimental Diets

Nutrient	**T_1**	**T_2**	**T_3**
Crude Protein	**19.66**	**19.66**	**19.66**

Crude fibre	**3.54**	**3.54**	**3.54**
Metabolizable energy (Kcal/Kg)	**2209**	**2223**	**2218**

Table 3: Effect of dietary inclusion of saturated and unsaturated oil on performance of broiler chicken

Parameters	T_1	T_2	T_3	SEM
Initial body weight (g)	**55.27**	**55.32**	**55.14**	**0.11**
Final body weight (g)	**1624.70^{b}**	**1646.27^{b}**	**1743.33^{a}**	**15.85**
Body weight gain (g)	**1569.44^{b}**	**1591.33^{b}**	**1688.01^{a}**	**15.85**
Daily weight gain (g)	**28.03^{b}**	**28.42^{b}**	**30.14^{a}**	**0.28**
Total feed intake (g)	**3504.48^{b}**	**3581.01^{b}**	**3664.83^{a}**	**22.50**
Daily feed intake (g)	**62.58^{c}**	**63.95^{b}**	**65.44^{a}**	**0.40**
Daily water intake(ml)	**164.43^{b}**	**166.81^{b}**	**171.40^{a}**	**1.21**
FCR	**2.23**	**2.25**	**2.17**	**0.03**

^{abc} *means on the same row with different superscript are significant (P <0.05)*

Table 4: Sensory evaluation of broiler chicken fed diet containing saturated and unsaturated oil

Parameters	T_1	T_2	T_3	SEM
Tenderness	**7.05**	**7.15**	**7.30**	**0.58**
Aroma	**7.92**	**8.22**	**8.40**	**0.44**
Juiciness	**7.15**	**7.74**	**7.89**	**0.66**
Texture	**7.26**	**7.62**	**7.49**	**0.69**
Taste	**7.11**	**7.51**	**7.55**	**0.65**
General Acceptability	**7.43**	**7.83**	**7.96**	**0.90**