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THE EFFECTS OF DIFFERENT LEVELS OF DIETARY FRYING OLEIN OIL ON BROILER CHICKENS PERFORMANCE

Mohammad Omer ABDALQADIR[1]; Ahmed Amin MOHAMMED[2]; Kamal Abdalbagi MOHAMMAD[3]; Ahlaam MOHAMMAD[4]; *Sami Ahmed ARABI[5]

[1]Federal Ministry of Animal Sources and Fisheries, General Directorate Development of Animal Production, Development of Genetic Resources Departure-National Centre for animals Reproduction Sudan, Khartoum North.

[2]Department of Medicine, Pharmacology and Toxicology; Faculty of Veterinary Medicine, University of Khartoum

[3]Departments of Animal Production, Faculty of Agricultural Studies, Sudan University of Science and Technology

[4]Food Research Center, Ministry of Sciences and Technology

[5]Faculty of Environmental Science and Natural Resources University of Al-Fashir P O Box 125 Sudan; Head Department of Animal Production Mobile+249912554816 Fax: +249-731-4211[1]

ABSTRACT

The objective of this study was to investigate the effects of different dietary frying olein oil (FOO) on broiler chickens performance. Dietary (FOO) was tested for energy supplementation values in poultry at levels 0, 3, 6 and 9% utilizing isonitrgenous (22.5% CP), semi-isocaloric (3100Kcal/kg) rations run in experiment. Ninety six (96) seven days-old unsexed Ross-308 broiler chicks with initial weight of 75g were used for experiment in a completely randomized design (4×4×6). Chicks were fed for 50 days. Different levels of FOO were incorporated into the broiler diet for performance (with energy retention values determined by the comparative slaughter technique), on blood haemogram, serum metabolites, enzyme activities and electrolytes, slaughter and carcass data and economic appraisal Supplementation with the oils improved performance ($p>0.05$) significantly ($p<0.05$) values in final, weight gain and feed conversion ratio. Results of energy retention showed similar values in initial energy. Hematological values, serum metabolites, serum enzyme activities and serum electrolytes were not seen significantly ($p>0.05$) different. Use of FOO showed significant ($p>0.05$) differences on gizzard percent which is the higher ($p<0.05$) value recorded in group A (01.88±00.10). Supplementation with the FOO treatments had no effect ($p<0.05$) on all absolute and percent carcass cuts values or meat chemical composition. Tenderness was affected significantly ($p<0.05$) by FOO and the higher value gained in group A was (05.70 ±00.30). Economically appraised values were profitability ratio (01.45) of the test group D (9% frying olein oil) was the higher of the test groups.

Key words*:* frying olein oil; blood hemogram; serum metabolites; enzyme activities

INTRODUCTION

Early studies that have been conducted to evaluate the nutritional value of fats fed to poultry showed that the addition of fat to poultry diets improved growth rate and the efficiency of feed utilization (Sunde, 1956). In recent years the composition of the different fat grades has varied more than in the past. Feed fats provide one essential nutrient (Linoleic acid) and dietary ME. The industry that produces oil for human consumption is based on processing palm oil as the predominant local source of oil products, mainly margarine, shortening specifically for food frying (olein). Huyghebaert *et al,* (1988) and Dale (1988) reported that swine and poultry farmers already include those fats in the diets without a clear

[1] Corresponding author Email: samiarabi@ymail.com

knowledge of their real quality, composition, and energy value. The growing world poultry industry requires large amounts of fats as an energy source in poultry diets to yield higher levels of metabolizable energy mainly for broilers at an economically justifiable price. Due to dissimilarities in processes and descriptions, by-products obtained in different regions may not be of the same chemical composition as those reported in the literature. Some of these products have specifications for feed purposes as determined by their content of moisture, impurities (insoluble residues), and unsaponifiable matter, as well as free fatty acids. In many countries there is a need to know more about the composition of those fat products that may be useful for the feed industry. Such knowledge will allow a better understanding of how to produce blends with the highest digestibility and metabolizable energy levels. According to Renner and Hill (1960) and other published research data (Sibbald and Kromev 1978) the best way to use some fats, especially more saturated fats such as tallow and palm fats, is by blending them with more unsaturated oils. Mario *et al.*, (1999) Restaurant greases from soybean oil showed up to 20% more AME_n than restaurant greases from palm olein

MATERIALS AND METHODS

Birds and Housing

Ninety six commercial broilers Ross-308 were obtained at hatch (trial d) from a commercial Coral hatchery and transported to Student Poultry Premises, Faculty of Agricultural Studies, Sudan University of Sciences and Technology, Shambat, in December 2009. Broilers were evaluated upon receipt for signs of disease or other complications that may have affected the outcome of the study. Following examination, broilers were weighed, identified with a wing band, and placed randomly in 0.914 m × 1.219 m (3 ft × 4 ft) floor pens at a density of approximately 0.305 m2 (1.0 ft2) of available floor space per broiler; new pine shavings with a minimal amount of saw dust was provided as litter. Pens were separated by a wire partition and did not touch other pens from any side to minimize potential for cross-contamination. A continuous 24-h lighting program was followed. Birds were observed 3 times daily for overall health, behavior and evidence of toxicity, and environmental conditions. No type of medication was administered during the entire feeding period. Mortalities were recorded, drinking water was provided for *ad libitum* consumption.

Experimental design

The experimental design for this study was a completely randomized design with 4 dietary treatments (control, and 3 commercial references). There were 6 broilers per pen and 4 pens (replicates) 4 per treatment for a total of 96 broilers per treatment. Broilers were fed with their respective dietary treatments from time of (trial seven days) to 50 d of age.

Diets

Diet was fed in one phase (d 1 to 50) to minimize the possibility of cross-contamination between diets. Diet was offered as a mash feed for *ad libitum* consumption, and formulated to meet the nutrient requirements of a typical commercial broiler diet using the NRC Nutrient Requirements for Poultry (1999) as a guideline of Central Animal Nutrition Research Laboratory Animal Production Research Centre, Kuku, Khartoum North Sudan. Diets were prepared at the mill of animal department. Control, test, or reference CSO was added to the indicated diets in equal amounts. Requirements for protein, lysine, methionine, cystine, calcium, and phosphorus were based on recommended ingredients. Also diet was formulated to the same ME level 3,100 kcal of ME/kg. Tables 1, 2 and 3 show the composition of diets. All feeds were subjected to analysis for crude protein (N x6.25) and found to be in agreement with calculated values. Diets were fed in mash form. The diets were divided into four groups A unsupplemented with frying olein oil (0%) reference diet; B,C and D supplemented with frying olein oil (3%).(6%) and (9%) respectively. Fatty acids composition was determined by Gas Liquid Chromatography (GLC) using a Pye–Unicam – GCD model according to A.O.C.S. (2000).

Data collected on performance

Data on average body weight, weight gain and feed consumption (g) for each group were determined weekly throughout the experimental period. Health of the experimental stock and mortalities were closely observed.

Blood and serum profiles

Blood samples drawn from the heart, wing or jugular veins were analyzed for a complete hemogram, Hemoglobin (Hb) concentration, Packed Cell Volume (PCV), a Red Blood Cell (RBC) count RBC and White Blood Cell (WBC) count. Serum prepared from the same sample withdrawn was analyzed for concentrations of metabolites total protein, cholesterol, urea, glucose, enzyme activities Alkaline phosphatase (ALP), Glutamyl oxaloacetic transaminase (Aspartate aminotransferase, L. Aspartate; 2-oxoglutarate amino-transferase, E. C. 6.1.1.; G.O.T, A.S.T) AST and minerals Phosphorous and Calcium.

Slaughtering and processing

At the end of the feeding period, broilers were processed under simulated commercial conditions. Feed was withdrawn for 8 h, and then the birds were transported to the pilot processing plant for slaughter. The birds were slaughtered by cutting the jugular and carotid veins, bled for 3 min, scalded at approximately 62°C for 45 s, defeathered in a rotary drum picker, and manually eviscerated. Carcasses were prechilled for 15 min at 45°C, and then chilled for 45 min in ice water at approximately 0°C. Afterward, they were aged for 5 h at 4°C, hot carcass and each organs, heart, liver, gizzard, intestines with the abdominal fat were separately weighed were collected for preparation of meat. The left side was divided into three commercial cuts, thigh, drumstick and breast according to Mohammed (1996). Each cut was weighed separately. The breast, drumstick and thigh cuts of the right side were skinned and deboned. The meat and bone were weighed separately. The meat was frozen and stored for further analysis.

Statistical analysis

Statistical examination of the data was performed using the analysis of variance, to Snedecor and Cochran (1980) the means were compared using least significant difference (LSD) procedure as out lined by Steel and Torrie (1980).

Table 1. Percent inclusion rates (as fed basis) and calculated analyses (dry-matter basis) of experimental diets fed to broiler chicks for 50 days.

Ingredients	Diets			
	OO (0%)	OO (3%)	OO (6%)	OO (9%)
Fetarita	60.50	53.50	43.00	33.00
Ground nut cake	12.50	14.50	15.00	15.00
Sesame cake	15.00	14.00	14.00	14.00
Wheat bran	05.00	08.00	15.00	22.00
Olein oil	00.00	03.00	06.00	09.00
Salt	00.50	00.50	00.50	00.50
*Concentrate	05.00	05.00	05.00	05.00
Limestone	01.50	01.50	01.50	01.50
Total	100.00	100.00	100.00	100.00
Calculated analysis				
Dry matter	96.22	96.31	96.51	98.18
Crude protein%	22.40	22.50	22.50	22.40
Ether extract%	03.20	03.50	03.30	03.40
Crude fiber%	12.50	11.80	10.70	11.20
N-free extract	54.12	54.31	56.21	56.78
Ash%	04.00	04.20	03.80	04.40
M E, Mcal/Kg	03.04	03.12	03.15	03.17

*crudeprotein:40.00;crudefat:4.00;crudefiber:2.00;Calcium:4.00;Phosphorus(avail):4.00;Lysine:12.00;Methionine:3.00;Meth+Cyst.:3.20;Met.Energy:2100Kcal/Kg;Sodium:2.60, product: vit. A: 200.000 I.U/Kg; vit. D3: 40.000 I.U/Kg; vit. E : 500mg/Kg; vit. B1 : 15mg/Kg;vit.B2:100mg/kg;vit.B6 :20vit.B12:300mcg/Kg; Biotin :1.000mcg/Kg ; Nicotinic acid :600mg/Kg ;Folic acid :10mg/Kg ;vit.K3 :30 mg/Kg ;pantothenic acid: 150 mg/Kg ; choline chloride: 5.000 mg/Kg ; copper: 100 mg/Kg ; iodine: 15 mg/Kg ;Cobalt :3 mg/Kg ; selenium:2 mg/Kg ; manganese: 1.200mg; zinc: 800 mg/Kg ; iron: 1.000 mg/Kg ; B.H.T. :900 mg/Kg ;Salinomycin-Na :1.200.

RESULTS

The performance values of broiler chicks fed different levels of frying olein oil for 50 days are shown in Table (2). Initially all groups started at similar ($p>0.05$) body weight. Treatment effect in all performance parameters was not significant ($p>0.05$).The higher ($p>0.05$) final body weight was recorded in groups A

(2337.00±00.01). Weight gain was higher (p>0.05) in group C (2301.30±103.80). Both daily feed and energy intake showed the higher (p>0.05) values in group D (94.40±08.40and 299.36±26.67 respectively) than the others groups. Groups A (02.03±00.20) and C (02.03±00.10) recorded equal (p>0.05) values of feed conversion ratio, having the best (p>0.05). The lower (p>0.05) mortality (%) occurred in group A (04.20±08.35).

Table 2. Analysis of variance and average (mean ± st.dev) performance values (g) of broiler chicks fed different levels of frying olein oil for 50 days.

Items	F† - value	Frying Olein oil levels			
		A (0%)	B (3%)	C (6%)	D (9%)
Initial weight	00.13NS	74.60±08.40	77.70±07.60	82.73±03.90	81.04±05.50
Final weight	00.60NS	2327.60±41.90	2350.50±396.50	2384.05±107.00	2067.10±141.00
Weight gain	01.80NS	2253.02±40.00	2272.80±395.50	2301.30±103.80	1986.04±137.00
Daily feed intake	00.20NS	90.93±06.98	91.80±09.16	94.10±06.40	94.40±08.40
Daily energy intake (kcal/g)	01.53NS	276.42±21.21	286.43±28.56	296.37±20.18	299.36±26.67
Feed conversion ratio %	02.10NS	02.03±00.20	02.10±00.40	02.03±00.10	02.40±00.20
Mortality %	00.27NS	04.20±08.35	08.33±16.65	12.50±15.95	08.33±12.17

†At (3, 12) d.f. NS = not significantly different (p>o.05). Means in a row do not differ significantly (p>0.05).

Hematological values: The hematological values of broiler chicks fed different levels of frying olein oil for 50 days are shown in Table 4. Treatment effect in all hematological values is not significant (p>0.05). The percent of PCV and Hb values were highest (p>0.05) in group C (25.00±02.20 and 10.60±02.20 respectively). The higher (p>0.05) RBC and WBC values are shown in groups A (02.30±00.40) and B (07.83±01.10). 3

Table 3 Analysis of variance and average (mean ± st.dev) hematological values of broiler chicks fed different levels of Frying olein oil for 50 days.

Items	F† - value	Frying Olein oil levels			
		A (0%)	B (3%)	C (6%)	D (9%)
PCV%	00.70NS	22.70±03.20	24.10±01.30	25.00±02.20	23.10±01.90
Hb%	00.70NS	08.90±01.70	09.70±01.20	10.60±02.20	09.00±01.30
RBC(×106)	00.50NS	02.30±00.40	02.20±00.40	02.00±00.20	02.00±00.40
WBC(×103)	00.40NS	07.58±01.37	07.83±01.10	07.56±00.26	06.96±00.92

†At (3 , 12) d.f. NS = not significantly different (p>o.05). * Denotes f-value significant at p<0.05. Means in a row bearing the same letter or no letter superscript do not differ significantly (p>0.05).

Serum metabolite values of broiler chicks fed different levels of frying olein oil for 50 days are shown in Table 4 The treatment effect in all serum metabolites was not significant (p>0.05). Groups A (141.80±12.50) and B (220.60±165.00) were highest (p>0.05) for cholesterol and glucose values respectively. Total protein and urea values were highest (p>0.05) in group D (03.60±01.20 and 14.60±03.70 respectively).

Table 4. Analysis of variance and average (mean ± st.dev) serum metabolite values of broiler chicks fed different levels of frying olein oil for 50 days.

Items	F† - value	Frying Olein oil levels			
		A (0%)	B (3%)	C (6%)	D (9%)
Cholesterol (mg/dl)	00.10NS	141.80±12.50	131.40±05.70	134.4o±40.8o	139.30±08.10
Glucose (mg/dl)	00.10NS	192.90±105.80	220.6o±165.oo	161.90±71.40	199.00±107.70
Total protein (g/dl)	00.30NS	03.20±00.80	o3.2o±0o.8o	02.90±00.60	03.60±01.20
Urea (mg/dl)	00.30NS	14.30±05.00	12.80±09.10	10.50±03.20	14.60±03.70

†At (3 , 12) d.f. NS = not significantly different (p>o.05). Means in a row do not differ significantly (p>0.05).

The serum electrolytes and enzyme activity values of broiler chicks fed different levels of Frying olein oil for 50 days are shown in Table 6. The treatment effect in all serum electrolytes and enzyme activities was not significant (p>0.05). Mean values for calcium, ALP and AST were highest (p>0.05) in group C. Group D (01.40±00.30) recorded the highest (p>0.05) value for inorganic phosphorus.

Table 5. Analysis of variance and average (mean ± st.dev) serum electrolytes and enzyme activities values of broiler chicks fed different levels of frying olein oil for 50 days

Items	F† - value	Frying Olein oil levels			
		A (0%)	B (3%)	C (6%)	D (9%)
Calcium (mg/dl)	00.10NS	09.40±01.60	09.10±01.30	09.60±01.30	09.10±01.40
Phosphorus (mg/dl)	00.30NS	01.20±00.50	01.20±00.30	01.30±00.40	01.40±00.30
ALP (IU/l)	00.20NS	180.20±61.80	256.70±191.50	263.80±191.10	252.70±158.00
AST (IU/l)	00.80NS	18.30±02.30	18.80±01.50	21.40±02.00	19.90±04.10

†At (3 , 12) d.f. NS = not significantly different (p>o.05). Means in a row do not differ significantly (p>0.05).

Slaughter values: The slaughter values of broiler chicks fed different levels of Frying olein oil for 50 days are shown in Table 6. The treatment effect in all slaughter values was not significant (p>0.05). Slaughter weight and abdominal fat values were highest (p>0.05) in group D. Empty body weight, hot carcass weight, heart and intestine values were highest in group C. Equal and highest (p>0.05) values of liver were recorded in both groups C (43.80±04.80) and D (43.80±10.30). Gizzard value was highest (p>0.05) in group A (40.00±04.10).

Table 6. Analysis of variance and average (mean ± st.dev) slaughter values (g) of broiler chicks fed different levels of frying olein oil for 50 days

Items	F† - value	Frying Olein oil levels			
		A (0%)	B (3%)	C (6%)	D (9%)
Slaughter weight	00.65NS	2155.00±214.13	2155.00±335.14	2332.50±194.36	2362.50±332.10
Empty body weight	00.65 NS	2141.28±214.94	2140.53±333.96	2317.65±194.74	2348.23±331.65
Hot carcass weight	00.80NS	1649.60±257.80	1721.10±231.60	1865.90±169.40	1861.60±266.20
Heart	01.20NS	16.60±01.90	18.20±04.90	21.60±03.50	20.90±05.90
Liver	00.20NS	40.00±04.10	41.30±11.80	43.80±04.80	43.80±10.30
Gizzard	01.04NS	40.00±04.10	38.80±08.50	36.30±04.80	33.80±02.50
Intestine	00.18NS	77.53±06.39	81.78±11.19	83.90±12.71	80.73±17.35
Abdominal fat	00.20NS	31.30±10.30	32.50±19.40	32.50±21.01	38.80±13.20

†At (3 , 12) d.f. NS = not significantly different (p>o.05). Means in a row do not differ significantly (p>0.05).

The percent slaughter values out of empty body weight of broiler chicks fed different levels of Frying olein oil for 50 days are shown in Table 7. Treatment effect in all percent slaughter values was not significant (p>0.05), except for gizzard (p<0.05). Mean values of hot carcass and intestine were highest (p>0.05) in group B (80.64±02.13 and 03.86±00.51 respectively). The heart showed the highest (p>0.05) percent value in group C (00.94±00.22). Groups B (01.90±00.32) and D (01.90±00.58) were equal and highest (p>0.05) for liver percent values. Gizzard percent value was highest (p<0.05) in group A (01.87±06.16). Abdominal fat value was highest (p>0.05) in group D (01.70±00.68).

Table 7. Analysis of variance and average (mean ± st.dev) percent slaughter values out of EBW of broiler chicks fed different levels of frying olein oil for 50 days.

Items	F† - value	Frying Olein oil levels			
		A (0%)	B (3%)	C (6%)	D (9%)
carcass	00.87NS	76.84±06.38	80.64±02.13	80.48±00.98	79.30±03.19
Heart	00.50NS	00.78±00.12	00.84±00.12	00.94±00.22	00.91±00.29
Liver	00.00NS	01.87±00.20	01.90±00.32	01.89±00.12	01.90±00.58
Gizzard	04.55*	01.88a±00.10	01.81ab±00.30	01.56ab±00.10	01.45b±00.19
Intestine	00.23NS	03.67±00.63	03.86±00.51	03.65±00.65	03.48±00.78
Abdominal fat	00.16NS	01.49±00.54	01.45±00.82	01.35±00.83	01.70±00.68

†At (3 , 12) d.f. NS = not significantly different (p>o.05). * Denotes f-value significant at p<0.05. Means in a row bearing the same letter or no letter superscript do not differ significantly (p>0.05).

Carcass yield: The carcass cuts and tissue values of broiler chicks fed different levels of Frying olein oil for 50 days are shown in Table 8. Treatment effect in all carcass cuts and tissue values was not significant (p>0.05). Carcass cuts thigh, drum, drum bone, drum muscle and breast were highest in values (p>0.05)

in group C. Equal and highest (p>0.05) values of the thigh bone are shown in groups A and B, but thigh muscle and Breast bone values were highest (p>0.05) in group B (240.00±49.00 and 90.00±53.50 respectively). Group A recorded the highest (p>0.05) value (427.50±92.50) for breast muscle.

Table 8. Analysis of variance and average (mean ± st.dev) carcass cuts and tissue values (g) of broiler chicks fed different levels of frying olein oil for 50 days.

Items	F† - value	Frying Olein oil levels			
		A (0%)	B (3%)	C (6%)	D (9%)
Thigh	01.05NS	255.00±33.20	285.00±53.20	292.50±48.60	245.00±42.03
Thigh bone	00.20NS	42.50±05.00	42.50±09.60	40.00±08.20	40.00±00.00
Thigh muscle	00.30NS	212.50±33.04	240.00±49.00	227.50±98.40	205.00±42.03
Drum	01.10NS	205.00±17.30	202.50±26.30	227.50±15.00	205.00±28.90
Drum bone	01.40NS	55.00±12.90	55.00±05.80	65.00±05.80	57.50±05.00
Drum muscle	00.50NS	150.00±08.20	147.50±20.60	162.50±15.00	147.50±29.90
Breast	00.20NS	487.50±108.70	485.00±82.30	490.00±96.30	440.00±109.20
Breast bone	00.70NS	60.00±21.60	90.00±53.50	77.50±09.60	82.50±15.00
Breast muscle	00.40NS	427.50±92.50	395.00±91.10	412.50±89.60	357.50±97.10

†At (3 , 12) d.f. NS = not significantly different (p>o.05). Means in a row do not differ significantly (p>0.05).

The percent carcass cuts and tissue values of broiler chicks fed different levels of frying olein oil for 50 days are shown in Table 9. Treatment effect in all percent carcass cuts and tissue values was not significant (p>0.05). Percent carcass cuts and tissue values of thigh, thigh bone, drum, drum muscle, breast and breast muscle were highest (p>0.05) in group A. Group B showed highest (p>0.05) values in thigh muscle and breast bone (13.90±01.20 and 05.10±02.40 respectively). Mean values of drum bone showed highest (p>0.05) value in group C (03.50±00.60).

Table 9. Analysis of variance and average (mean ± st.dev) percent carcass cuts and tissue values of broiler chicks fed different levels of Frying olein oil.

Items	F† - value	Frying Olein oil levels			
		A (0%)	B (3%)	C (6%)	D (9%)
Thigh	00.80NS	15.70±03.20	15.50±01.80	15.60±01.70	13.40±02.80
Thigh bone	01.20NS	02.60±00.30	02.50±00.40	02.20±00.50	02.20±00.30
Thigh muscle	01.10NS	13.10±03.10	13.90±01.20	13.50±01.70	11.20±02.60
Drum	00.60NS	12.60±01.40	11.70±00.90	12.30±01.40	11.20±02.30
Drum bone	00.70NS	03.30±00.40	03.20±00.25	03.50±00.60	03.10±00.30
Drum muscle	00.40NS	09.30±01.50	08.50±00.90	08.80±00.90	08.10±02.10
Breast	01.20NS	29.60±05.90	28.20±03.20	26.10±02.90	23.80±05.60
Breast bone	00.80NS	03.60±00.90	05.10±02.40	04.20±00.40	04.50±01.10
Breast muscle	01.40NS	26.03±05.40	23.20±05.03	21.90±02.90	19.30±04.70

†At (3 , 12) d.f. NS = not significantly different (p>o.05). Means in a row do not differ significantly (p>0.05).

The percent meat chemical values of broiler chicks fed different levels of Frying olein oil for 50 days are shown in Table 10. Treatment effect in all meat chemical component was not significant (p>0.05). (p>0.05) of moisture were highest in group D (71.70±03.40). Group C signaled highest (p>0.05) values of CP and EE. Ash values were equal and highest (p>0.05) in groups A (00.70±00.40) and D (00.70±00.50). Meat cholesterol recorded highest (p>0.05) value in group B (09.37±05.37).

Table 10. Analysis of variance and average (mean ± st.dev) percent meat chemical values of broiler chicks fed different levels of frying olein oil for 50 days

Items	F† - value	Frying Olein oil levels			
		A (0%)	B (3%)	C (6%)	D (9%)
Moisture	01.80NS	69.90±03.20	70.70±01.90	67.20±02.80	71.70±03.40
C.P	01.00NS	19.90±01.80	18.90±00.80	20.50±01.30	18.80±02.20
E.E	00.60NS	06.40±03.10	07.40±00.70	08.40±02.20	06.10±03.90
Ash	00.80NS	00.70±00.40	00.60±00.50	00.30±00.20	00.70±00.50
Cholesterol (mg)	01.20NS	07.83±01.86	09.37±05.37	05.33±00.65	07.66±02.04

†At (3 , 12) d.f. NS = not significantly different (p>o.05). Means in a row do not differ significantly (p >0.05). Mean values

The percent meat subjective values of broiler chicks fed different levels of Frying olein oil for 50 days are shown in Table 11. Treatment effect was not significant in all meat subjective values except for tenderness ($p<0.05$). Mean value of tenderness was highest ($p<0.05$) in group A. Flavor values were equal and highest ($p>0.05$) in groups C and D. Color and juiciness values were highest ($p>0.05$) in groups C and D respectively.

Table 11 Analysis of variance and average (mean± st.dev) percent meat subjective values of broiler chicks fed different levels of frying olein oil for 50 days

Items	F† - value	Frying Olein oil levels			
		A (0%)	B (3%)	C (6%)	D (9%)
Tenderness	05.50*	05.70a ±00.30	05.00 b ±00.30	05.60 a ±00.70	05.60 a ±00.40
Flavor	02.50NS	05.30±00.20	04.80±00.60	05.60±00.70	05.60±00.20
Color	02.00NS	05.50±00.50	04.70±00.90	05.60±00.30	05.40±00.40
juiciness	01.10NS	05.30±00.10	04.90±00.30	05.10±00.70	05.40±00.30

†At (3 , 12) d.f. NS = not significantly different ($p>o.05$). Means in a row do not differ significantly ($p>0.05$).

Economic appraisal: The major inputs and margin over major inputs per head of broiler chicks fed different levels of frying olein oil for 50 days is shown in Table 12. Chick purchase and Feed cost values (SDG) were the major inputs considered. The total selling values of meat is the total income obtained. Profitability ratio (01.45) of the test group D (9% frying olein oil) was the higher of the test groups

Table 12. Major inputs and margin over major inputs per head of broiler chicks fed different levels of frying olein oil for 50 days.

Items	Frying Olein oil levels			
	A (0%)	B (3%)	C (6%)	D (9%)
Meat sales (SDG)	11.50	12.00	13.10	13.00
Chick purchase (SDG)	02.250	02.250	02.250	02.250
Feed cost (SDG)	03.10	03.20	03.30	03.30
Major cost of production	07.45	07.55	07.65	07.65
Margin over major inputs	04.05	05.55	05.45	06.65
Profitability	35.20	46.30	41.60	51.20
Profitability ratio	01.00	01.32	01.18	01.45

*At current (March' 2007) prices of meat 7.00 SDG/ kg.

**At current (March' 2007) price of mash 900 SDG/ kg.

DISCUSSION

Plant oils are traditionally used in poultry feed to supplement energy in small amounts, but can substantially raise energy. Such partial replacement can save more sorghum, decrease feed cost and avail cereals at times of competition for human stable food. There are many researchers conducted to test the use of fats or oils in broiler rations (Eltazi, 2000; Azman *et al.*, 2004 and Waldroup and Waldroup, 2005) as major energy supplement, with benefits of increasing firmness of the ration blend, increasing palatability and efficiency utilization of the consumed energy. The apparent health of the experimental birds was good all through the experimental period and in all treatments. The general behavior of the stock was also good and the levels of feed intake were normal and live weight growth was progressive. Environmental temperature during the experimental period fell within the thermo neutral zone, except in the fifth week when a temperature rise has exerted heat stress on the experimental birds. Hopkins and Nesheim (1967) reported that increasing levels of linoleic acid reduced the incidence of respiratory-related mortality in broilers. It was also consistent with Atteh *et al.*, (1983) who observed that supplementation of an animal / vegetable fat blend had no effect on mortality at 3 weeks of age in male broiler. Similarly, Vanschoubroek *et al.*, (1971) reported that the addition of animal fat or vegetable oils at 4.5 % to the chick ration had no effect on mortality.

Body weight gain, daily feed intake, energy intake and feed conversion ratio records on plant oils fed to broilers at different levels, indicated clearly that the use of (FOO) had improved performance but not

significantly. This agrees with (Fan *et al.*, 1995 ; Mehmet *et al,*. 2005) Anitha *et al*.,(2006) who reported no differences in weight gain or FCR of broiler chicken fed various dietary 0ils. This disagrees with results of (Fan *et al*. 1995; and Anitha *et al*. 2006). Last author found no significant differences between groups fed 1-5% rice bran oil in body weight gain and feed conversion ratio, and that might be explained by nutritional factors.

The comparative slaughter values of FOO revealed positive energy balance i.e. body gain, at all inclusion levels. The technique adopted here assumes initially equal body energy values, though non-significant differences exist. (Kleiber, 1975). Regardless of the energy source or intake, comparative slaughter technique counts indiscriminately total energy gain laid down in different tissues. In all oils, energy gain (tissues laid down) achieved at the 3% level (minimum inclusion) was superior to the control. On further linear increase of dietary oil, the rate of gain increased with the FOO almost constant .Mansoor (2003)founded that fats and oils were known generally to increase peristalsis, hence decrease the retention time of digesta, rendering lower absorption. Increasing dietary oil substantially is expected to further aggravate the condition; these toxins when expressed sub-clinically are considered as anti-nutritional factors. (Mansoor, 2003) exhausted that the FOO was subjected to heat, which was known to induce chemical changes like hydrolysis, oxidation, polymerization or ring compounding. These chemical changes will result in increasing FFAs which are less utilizable some times to the extent of being anti-nutritional. Smink *et al.,* (2008) suggested that the feeding of palm oil significantly raised the palmitic acid content of breast meat and abdominal fat and lowered the ratio of unsaturated to saturated fatty acids. Effect of addition of FOO to the broiler diets at different levels on haemogram (Hb, PCV, RBC and WBC) values in the present study revealed no significant differences between all test groups. The hematological normal values stated by Maxwell *et al.,* (1990) in poultry were PCV (30.6%); RBC (2.5-3.2) millions/mm3; Hb (6.5-9.0 g/100 ml); WBC (20-30 thousands/mm3). Results in the same trend were reported by Iheukwumene and Herbert (2003) in Hb (6-13%) and PCV (29-38%). Islam *et al*. (2004) reported that commercial and local chicken reared in Sylhet region in Bangladesh had Hb values (7.06-9.37%) and PCV values (26.56-34.6%). The values of Hb, PCV and RBC reported as reference by MVM (1986) were 9-13%, 30-40% and 3×106 respectively, but the results in present study were less than the values of Awotwi (1990) who gave PCV in local and commercial chicks in Ghana from 32.9-33.2% and 31.3-35.6% respectively, a variation attributable mostly to the breed. Blood haemogram values on feeding the three vegetable oils to poultry at levels 3, 6 and 9% produce no changes in these values and likewise on the health of birds. (Kral and Suchy, 2000) investigated that comparisons and interpretations in avian medicine of blood profiles are often limited by lack of normal values relevant to the individual avian species and within species breeding lines varied for production types, levels of production etc. Cholesterol in this study agrees with the normal values reported by Sturkie *et al.,* (2000) and Wu *et al,*. (2011) 100-150 mg/dl. They noted a consequent increase in the cholesterol level of the blood when feed cholesterol intake was increased. The values of cholesterol reported by Aderemi (2004) (100.3-108.21 mg/dl) and Nworgu (2004) (93.33-116.67 mg/dl) were lower than those reported in this study. Variations in cholesterol could be attributed to breed of chicken, nutritional pattern, type of feed and environmental factors (Nworgu *et al.,* 2007). Vila and Esteve-Garcia, (1996) founded that the use of palm oil in broiler diets is attractive, because it is a saturated source that may be associated with a positive influence on meat firmness. Saturated fats rich in long-chain fatty acids (>14 C atoms) are less digestible than fats high in medium chain fatty acids or unsaturated fatty acids fatty acids or unsaturated fatty acids Values of cholesterol and total protein agrees with those reported by Talebi (2006) who fed *ad libitum* Arbor-Acres broiler strain to meet the requirements advised by the breeder, but values obtained on glucose were higher than in this study..

The effect of using FOO at different levels on serum metabolic indicators recorded no significant differences between all groups. Results of Nworgu (2004) in normal birds for total protein (6.5-6.77g/dl) and urea (21.01-24 mg/dl) are higher than reported in the present study without affecting the health of the stock. Iyayi and Tewe (1998) reported in pigs (non-ruminating herbivore) that serum urea and total protein depend on both the quality and the quantity of the protein supplied in the diet. Higher level of urea could be attributed to the presence of some anti-nutritional factors which might have lowered the quality

of the protein indicating imbalance of amino acids in diet which caused elevated blood urea concentration Kaneko *et al.*, (1997). Metabolically, under-fed or fasting broilers exhibit higher blood insulin, with higher values of serum glucose due to mobilization of metabolites to suffice for energy. In contrast, well fed broilers with high carbohydrate (cereals) dietary source or glycolipids reveal the opposite Crespo and Esteve-Garcia, (2003). Use of FOO at different levels in broiler diets resulted in no significant differences between all treatment groups in activities of ALP and AST enzyme. This result agrees with Iheukwumere and Herber (2003) who reported no significant differences in ALP and AST activities between treatments of poultry fed a commercial broiler ration. Vital organs lesions, especially the liver were believed to be the source of enzyme leakage to the blood, hence normal peripheral enzyme values reflects the integrity of most vital organs (Kaneko *et al*., 1997).

Adding of FOO at levels (3, 6 and 9%) in broiler rations recorded no significant differences between all treatment groups for calcium values, being similar with those recorded by Talebi (2006), inorganic phosphorus values were higher than that attained in the present study. Gyenis *et al.*, (2006) attributed such disparity to breed and genetic line. The effect of FOO at all inclusion levels on slaughter values; heart, liver, intestine and abdominal fat weights resulted in no significant differences between all treatment groups. Anitha *et al.* (2006) recorded no significant differences in absolute weights of gizzard, heart and liver on feeding broilers 1, 2, 3, 4 and 5% rice bran oil. Though it is well established in ruminants growth studies that similarities in slaughter weight are the key determinant factor (Tulloh, 1963), it was not similarly studied in broilers. The similarity of absolute carcass and non-carcass components and difference in these values are likely to occur due to individual animal differences. Homogeneity of these components is valid when expressed as a percentage of empty body weight.

The percent slaughter values on feeding different dietary FOO at the three levels showed differences between groups on gizzard percent values. Tabeidian and Sadeghi (2006) observed no significant effect on the percent of dressing broiler carcass, abdominal fat, liver, pancreas, intestine and heart when adding calcium salt of fatty acids (fat powder) at levels 0, 2.5, 5 and 7.5%. Saleh *et al.* (2004) who fed poultry oil at levels 3 and 6% recorded no significant effect on breast yield, leg quarter and abdominal fat percentage when expressed as percent/or quantitative yield, but percent dressing was affected significantly by treatments. Anitha *et al.* (2006) reported no significant difference on ready to cook percentage and abdominal fat percent among treatment groups when he fed rice bran oil at levels 1, 2, 3, 4 and 5 percent. Purushothaman *et al.* (2005) reported no significant differences in dressed weight, liver and skin weights among the various groups fed rice bran oil and tallow at levels for starters 0.5 and 1% and finishers 2 and 4% in broiler diets. Selvaraj and Purushothaman (2004) revealed no significant effects on dressing, liver and giblet % for broilers fed full-fat sunflower seeds at levels 0, 5, 10, 15 and 20%. Subuh *et al.*, (2002) demonstrated that feeding full fat Soybean meal to male broilers resulted in no effects on dressing percentage. Raju *et al.*, (2005) also reported the addition of sunflower oil at 30 to 60 g/kg to broilers had little or no effect on the dressing percentage.

Carcass cuts expressed as absolute values or percentage of carcass weight were not affected significantly by the dietary FOO at the three levels fed in the experiment. Saleh *et al.* (2004) recorded that breast yield, expressed as percentage of carcass weight or as absolute value, was not significantly affected by poultry oil fed at 3 and 6% levels in broiler diets. Similarly, yield of leg quarters and wings as well as abdominal fat, both on absolute or percentage basis, were not significantly affected by dietary treatments. The authors attributed these similarities to the fact that energy / protein ratio was maintained relatively constant within each age period treated. These findings agreed with the reports of Marby and Waldroup (1981) on different oil sources at miscellaneous levels when energy / protein ratio was maintained constant. Mehmet *et al*,.(2005) concluded that feeding of broilers with specific mixtures of fatty acids may substantially alter fatty acid composition of the carcass, soybean oil caused marked changes in the fatty acids patterns by significantly increasing polyunsaturated fatty acids (PUFA) mainly linoleic acid in skin, abdominal fat and breast muscle.

Meat chemical composition was not affected by the dietary FOO at different inclusion levels. Crespo and Esteve-Garcia (2001) found that supplementation of sunflower, linseed, tallow and olive oils at levels of 6 and 10% to broilers brought about no significant change in meat chemical composition (fat, protein and

ash). Both meat moisture and ash values in present study agreed with results obtained by Elsaeed (2006) who fed 1% cottonseed oil and 1% tallow in broiler rations. Carew *et al.* (1964) recorded significant differences between broiler groups in meat protein and fat% when fed corn oil at levels 2.5, 12.5 and 22.5 percent. Also, Yau *et al.* (1989) reported variations in breast meat composition (proteins and fats %) on feeding broilers sunflower, olive and coconut oils. Eltazi (2000) found that adding corn oil at levels 2, 4 and 6% affected significantly fat, protein and moisture percent of broiler meats. Similar results on meat composition were reported by Yoshida *et al.* (1969); Pesti and Fletcher (1983); Salmon *et al.*(1983) and Tibin and Mohammed (1990). Meat cholesterol values obtained were not significantly different on feeding FOO at different inclusion levels. Anitha *et al.* (2006) reported similar findings on breast muscle cholesterol when feeding broilers rice bran oil in concentrations 1-5 percent. Crespo and Esteve-Garcia (2001) recorded no significant in breast meat cholesterol of sexed broilers fed four types of oil (sunflower, linseed, tallow and olive) at levels 6 and 10 percent for either oil.

Adding FOO at different levels to the broiler feed brought effects on tenderness. It was shown clearly that sensible meat values on oil supplemented rations cannot be differentiated, especially on tenderness and juiciness, at more than 3% level. Eltazi (2000) in a panel test, agreed to significant differences in tenderness and juiciness when feeding broilers corn oil at 2, 4 and 6%. The deposition of inter and intramuscular fat with other intracellular components in broiler carcasses would bring differences in organoleptic values (Lawrie, 1979). According to Grashorn (1995), 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 the juicy sensation of the meat is greater. Poultry production is of a short cycle, with good profitability that makes it successful as an industry. Supplementation of plant oils improved the performance of broiler chicks and resulted economical benefits. Profitability ratios (01.45) of groups D (9% FOO), were the higher than the test groups. Choice of oil and inclusion level to attain maximum profitability depends on relative current prices.

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