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Use of Dietary Frying Palm Oil in Broiler Chickens Rations their Growth Performance and Carcass Traits

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Abstract

A study was conducted to investigate the Use of Dietary Frying Palm Oil (FPO) in Broiler Chickens Rations on body weight gain (BWG), feed intake (FI) and feed conversion ratio (FCR) in broiler chicks, haematological values, serum metabolite values and serum electrolytes and enzyme activities values. A total of 96 of the Ross 308 chicks were distributed into 4 treatments with 4 replicates/treatment (6 birds/pen) in floor brooder pens. Four treatment diets were fed from d 0 to 42: T1 (negative control without FPO), diets T2, T3 and T4 (negative control supplemented with 3, 6 and 9% Frying Palm Oil, respectively). Weekly BWG, FI and FCR were evaluated for six weeks. Feed intake per bird did not differ among the treatments during any trial periods. THE lowest BWG in chicks fed T4 and highest BWG in T3 were observed both in wk 6 ($P < 0.05$). FPO treatments significantly influenced FCR in all weeks overall. T3 had the highest FCR ($P < 0.05$), whereas the rest of the treatment diets did not differ from control diets, all levels of FPO had FCR similar to the negative control ($P < 0.05$). Results of the present experiment indicated that the middle level of FPO showed better BWG and the highest level of FPO showed lower BWG. haematological values red blood cell (RBC), white blood cell (WBC) and Packed Cell Volume (PCV). In 6 weeks, there was no significant difference ($P < 0.05$) in serum electrolytes and enzyme activities values in alanine aminotransferase (ALT), aspartate aminotransferase (AST) of chicks treated with vegetable oils compared to the control group. Total protein (TP) and urea in all treated chicks for six weeks were within the normal range were no significant increase ($P < 0.05$) compared to the control groups. Tenderness was affected significantly ($p < 0.05$) economically appraised values were profitability ratio of the test T3 was the higher of the test groups. Recycling of frying oil in poultry feed, especially frying olein oil, after ensuring that it is free from harmful substances. Adding 3 - 6% of the oil improves the carcass, the feed intake, feed conversion efficiency and the profitability margin.

Keywords: *Frying Palm Olein; Tenderness; Total Protein; Serum Metabolites; Profitability Ratio*

Introduction

Plant oils are traditionally used in poultry feed to suffice energy requirement and preserve space for other ingredients especially protein. Many different grades of fat have been used as an energy source in poultry feeding. Regarding the economical demands of broiler farm, especially feed ingredient cost, cheaper high energy sources are favourable selects, when corn is a major proportion of the diet. The alternative low-cost energy sources such as restaurant waste oil (Ketels and De Groote) and vegetable oil refining wastes [1]. In poultry production, the advantages of using oils in diets involve a reduction of feed dust and improvement in hydrolysis and absorption of the lipoproteins that supply fatty acids [2]. Also, oils are the main source of energy for birds and have the highest caloric value among all dietary nutrients. They can also enhance the absorption of fat-soluble vitamins, increase diet palatability and improve the utilization of the consumed energy. Moreover, the rate of food passage through the gastrointestinal tract can be reduced, with subsequent better absorption of all dietary nutrients [3]. Palm oil contains approximately an equal amount of saturated and unsaturated fatty acids. Amongst the former, palmitic and stearic acid account for 45% and 5% of the total fatty acids, respectively and has a wide range of applications. Palm oil commonly fractionated into olein and stearin by Peng and Stanley (2001) [4]. Palm oil is rich in oleic acid (42.7% - 43.9%), α, β, γ and δ-carotene and vitamin E (tocopherols and tocotrienols) [5,6]. Palm oil had the highest percentage of palmitic acid (42.06%) and oleic acid (30.9%) [7]. Edible oils consist of about 96% triacylglycerides, composed of different fatty acids and some other compounds or groups of compounds, such as free fatty acids, phospholipids, phytosterols, tocopherols, other antioxidants or waxes, can be found [8]. Whereas the small increase in polymer and free fatty acids content of oil used under normal heating in restaurants or kitchens has no adverse effect on the quality of the fat feeding to poultry [9-11]. Vitamin E is a natural inhibitor of cholesterol synthesis [12,13]. The total polyunsaturated fatty acids (PUFAs) in the palm oil increases with length of usages, Increased use of palm oil in deep fat frying decreases the quality of oil in term of stability against lipid oxidation, palm oil throughout the frying duration has a lower total poly-saturated fatty acids (TSFAs) shows an increase in TPUFA, has higher MUFA and TUFA, increase in the C18:2/C16:0 ratio and absent of trans FAs. It is therefore the best choice for deep-fat frying [7]. The use of recovered oil instead of fresh oil in the chickens' diet did not cause any significant ($P > 0.05$) alteration in their body weight, weight gain as well as their feed intake and feed conversion ratios. The meat quality, carcass characteristics and blood cholesterol and triglycerides were not affected significantly ($p > 0.05$) by the use of recovered oil in the diets. The use of recovered oil in replacement of the fresh oil in broilers feed was shown to be more economically [14]. Palm olein (PO) is often known as heavy duty frying oil which normally used in fast food outlets due to its oxidative stability and presence of tools and carotenoids composition [15]. The unsaturated and saturated fatty acid content of PO was found contributing to good flavour stability [16].

Aim of the Study

The present study aimed to investigate the effect of including recovered frying palm olein (FPO) in the diet on broiler chickens' performance, carcass traits and meat quality.

Materials and Methods

Birds and housing

Ninety-six (7days-old) commercial broilers Ross-308 were obtained from Arab Poultry Breeder Company (*Ommat* "Mothers") and transported to Student Poultry Premises, Faculty of Agricultural Studies, Sudan University of Sciences and Technology, *Shambat*. Each weighing between 72.9g approximately placed randomly in (3 ft × 4 ft) floor pens at a density of approximately 0.305 m^2 (1.0 ft2) of available floor space per broiler; new pine shavings with a minimal amount of sawdust was provided as litter. Pens were separated by a wire partition and did not touch other pens from any side to minimise the potential for cross-contamination. A continuous 24-h lighting program was followed. Birds were observed three (3) times daily for overall health, behaviour and evidence of toxicity and environmental conditions. No type of medication was administered during the entire feeding period. Mortalities recorded, drinking water provided for *ad libitum* consumption.

Experimental design

The experimental design for this study was a completely randomised design with four dietary treatments (control and three (3) trade references). There were six (6) broilers per pen and four pens (replicates) 4 per treatment for a total of 96 broilers per treatment. Broilers were fed with their respective dietary treatments from the time of (trial seven days) to 42d of age.

Diets

Diet was fed in one phase (7th d to 50) to minimize the possibility of cross-contamination between 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 [17,18] as a guideline of Central animal nutrition research laboratory animal production research centre, Kuku, Khartoum North Sudan. Diets were prepared at the mill of the animal department. Control, test, or reference FOO was added to the indicated diets in equal amounts; requirements for protein, lysine, methionine, cystine, calcium and phosphorus met recommendation ingredients. Also, the diet was formulated to the same ME level 3,100 kcal of ME/kg. Table 1 shows the composition of diets. The feeds were subjected to analysis for crude protein (N x6.25) and found to agree with calculated values feed analyses According to A.O.A.C (2003) [19,20] the experimental diets and meat samples were proximately analyses, diets were fed in mash form, the diets were divided into four groups. Zero supplemented with frying olein oil (0%) reference diet; B, C and D supplemented with frying olein oil (3%, 6% and 9%), respectively.

Ingredients	**Diets**			
	T1 (0%)	**T2 (3%)**	**T3 (6%)**	**T4 (9%)**
Fetarita (white sorghum)	48.50	45.00	43.00	40.00
Ground nut cake	15.00	15.50	15.00	15.00
Sesame cake	14.50	14.50	14.00	14.00
Wheat bran	15.00	15.00	15.00	15.00
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

Table 1: *Percent inclusion rates (as fed basis) and calculated analyses (dry-matter basis) of experimental diets fed to broiler chicks for 42 days.*

**Crude protein: 40.00; crude fat: 4.00; crude fiber: 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: 420 mg/Kg; vit. B1: 15 mg/Kg; vit.B2: 100 mg/kg; vit. B6: 20 vit. B12: 300 mcg/Kg; Biotin: 1.000 mcg/Kg; Nicotinic acid: 600 mg/Kg; Folic acid: 10 mg/Kg; vit. K3: 30 mg/Kg; pantothenic acid: 142 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: 1.200 mg; zinc: 800 mg/Kg; iron: 1.000 mg/Kg; B.H.T.: 900 mg/Kg; Salinomycin-Na: 1.200.*

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. The health of the experimental stock and mortalities were strictly observed.

Chemical methods

Feed analyses According to A.O.A.C (2003) [20]. Meat cholesterol determination, according to Dinh., *et al*. (2012) [21].

Serum determinations

Alkaline phosphatase determined, according to Hassan., *et al.* (2009) [22]. Glucose level was measured according to the method described by Samer (2009) [23]. Total serum protein was measured according to Ankita., *et al.* (2017) [24]. Urea serum concentration was estimated according to Tietz (1996) [25], Calcium Serum concentration was determined according to Fujita (2006) [26]. Fatty acids composition was determined according to A.O.C.S. (2000) [27]. Phosphorus determined, according to the AOAC (2003) [20].

Determination of oils contents

Fatty acids composition was determined according to A.O.C.S. (2000). The viscosity of the oil samples was recorded according to Longfei Li (2017) [28]. Packed Cell Volume (PCV) and the haemoglobin (Hb) value determined according to the McINROY (1954) [29]. Free Fatty Acids % (FFAs) run according to the AOAC (2003) [20].

Slaughtering and processing

At the end of the 6th week, the birds have fasted overnight with only water allowed before terminally slaughtered. The carcass divided into right and left sides by mid-sawing along the vertebral column and each side weighed [30]. Each cut weighed separately. The breast, drumstick and thigh cuts of the right side skinned and deboned. The meat and bone also 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) [31] the means were compared using the method on Least Significant Difference (LSD) that proposed by Smith, (1978) [32].

Results and Discussion

The performance values are shown in table 2 initially, all groups started at similar ($p > 0.05$) body weight. There were no significant differences in body weight, weight gain, feed intake or feed conversion ratio frying oil during the experimental periods. The treatment effect in all performance parameters was not significant ($p > 0.05$). The highest ($p > 0.05$) final body weight was recorded in T1. Weight gain was highest ($p > 0.05$) in T3. Both daily feed and energy intake showed the highest ($p > 0.05$) values in T4. T1 and T3 recorded equal ($p > 0.05$) values of feed conversion ratio, having the best ($p > 0.05$). The lowest ($p > 0.05$) mortality (%) occurred in T1; the results are in agreement with the results of many studies that have demonstrated that Olein oil supplementation has beneficial effects on performance values [27,33,34] who reported no differences in weight gain or FCR of broiler chicken fed various dietary oils. Dorra., *et al*. (2014) [14] indicated that the use of recovered oil instead of fresh oil in the chickens' diet did not cause any significant ($P > 0.05$) alteration in their body weight, weight gain as well as their feed intake and feed conversion ratios.

Items	F† value	Frying Olein Levels			
		T1 (0%)	T2 (3%)	T3 (6%)	T4 (9%)
Initial weight	0.13^{NS}	074.60 ± 08.40	0077.70 ± 07.60	0082.73 ± 03.90	0081.04 ± 05.42
Final weight	0.60^{NS}	2327.60 ± 41.9	2342.42 ± 396.5	2384.05 ± 107.0	2067.10 ± 141.0
Weight gain	1.80^{NS}	2253.02 ± 40.0	2272.80 ± 395.5	2301.30 ± 103.8	1986.04 ± 137.0
Daily feed intake	0.20^{NS}	090.93 ± 06.98	0091.80 ± 09.16	0094.10 ± 06.40	0094.40 ± 08.40
Daily energy intake (kcal/g)	1.53^{NS}	276.42 ± 21.21	0286.43 ± 28.56	0296.37 ± 20.18	0299.36 ± 26.67
Feed conversion ratio %	2.10^{NS}	02.02 ± 00.20	02.02 ± 00.40	02.04 ± 00.10	02.38 ± 00.20
Mortality %	0.27^{NS}	04.20 ± 00.35	03.33 ± 00.65	2.42 ± 00.95	05.33 ± 02.17

Table 2: *Analysis of variance and average (mean ± st. dev) performance values (g) of broiler chicks fed different percentage levels of frying Olein oil for 42 days.*

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

The effects of the FPO on the haematological of broiler are shown in table 3 had no significant effect (p > 0.05) on the PV, Hb, RBC and WBC values. The percentage (%) of PV and Hb values were highest (p > 0.05) in T3. The highest (p > 0.05) RBC and WBC values are shown in T1 and T2. May the addition of oil increasing the immunity of birds to produce more RBC and WBC this was in line with Maxwell., *et al.* (1990) [35] in poultry were PV (30.6%); RBC (2.5 - 3.2) millions/mm^3 and Awotwi (1990) [36] 32.9 - 33.2% and 31.3 - 35.6%; Hb (6.5 - 9.0 g/100 ml); WBC (20 - 30 thousand/mm^3). Results in the same trend were reported by Iheukwumene and Herbert (2003) [37] in Hb (6-13%) and PCV (29 - 38%). The frying quality and stability rate of the free fatty acid (FFA) formation of PO was from 0.079% to 0.93%. The peroxide value (PCV) of PO with an initial value at 3.4 meq/kg increased to 34.6 meq/kg on the fifth day [38].

Items	F† - value	Frying Olein Levels			
		T1 (0%)	T2 (3%)	T3 (6%)	T4 (9%)
PCV%	00.70^{NS}	22.70 ± 03.20	24.10 ± 01.30	25.00 ± 02.20	23.10 ± 01.90
Hb%	00.70^{NS}	08.90 ± 01.70	09.70 ± 01.20	10.60 ± 02.20	09.00 ± 01.30
RBC (×10^6)	00.42^{NS}	02.30 ± 00.40	02.20 ± 00.40	02.00 ± 00.20	02.00 ± 00.40
WBC (×10^3)	00.40^{NS}	07.58 ± 01.37	07.83 ± 01.10	07.56 ± 00.26	06.96 ± 00.92

Table 3: *Analysis of variance and average (mean ± st. dev) haematological values of broiler chicks fed different percentage levels of frying olein oil for 42 days.*

*†: At (3, 12) d.f. NS = not significantly different (p > 0.05). *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 parameters are not significant (p > 0.05) by the dietary components and are usually considered as an important index of physiological, pathological and nutritional status. The serum total cholesterol and triglyceride level (Table 4) did not differ significantly (p > 0.05) among the experimental groups. T1 and T2 were highest (p > 0.05) for cholesterol and glucose values, respectively. Total protein and urea values were highest (p > 0.05) in T4. The cholesterol content of raw and cooked meat and poultry products ranges from 40 to 90 mg/100g [12,39-41]. The reasons for the increase in weight can be traced in variations of cholesterol could be attributed to the breed of chicken, nutritional pattern, type of feed and environmental factors, studies have cited that Aderemi (2004) and others [42-44]. The high-density lipoprotein cholesterol (HDL-C) values increased in chicks when they added palm oil to the dietary [45] showed that decreased in cholesterol (HDL-C) than those reported in this study. Crespo., *et al*. (2001) and Nworgu., *et al*. (2007) [46,47] 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.

Items	F† - value	Frying Olein Levels			
		T1 (0%)	T2 (3%)	T3 (6%)	T4 (9%)
Cholesterol (mg/dl)	00.10^{NS}	141.80 ± 12.50	131.40 ± 05.70	134.40 ± 40.80	139.30 ± 08.10
Glucose (mg/dl)	00.10^{NS}	192.90 ± 105.8	220.60 ± 165.0	161.90 ± 71.40	199.00 ± 107.7
Total protein (g/dl)	00.30^{NS}	003.20 ± 00.80	003.20 ± 00.80	002.90 ± 00.60	003.60 ± 01.20
Urea (mg/dl)	00.30^{NS}	014.30 ± 05.00	012.80 ± 09.10	010.50 ± 03.20	014.60 ± 03.70

Table 4: *Analysis of variance and average (mean ± st. dev) serum metabolite values of broiler chicks fed different percentage levels of frying olein oil for 42 days.*

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

The serum electrolytes and enzyme activity values are shown in table 5. 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 T3. T4 recorded the highest (p > 0.05) value for inorganic phosphorus but within the normal range. The increased serum ALT and AST levels may be attributed to liver function caused by hepatocyte necrosis or by changes in cell membrane permeability (ALT, AST) [48]. Results of Nworgu (2004) [45] in typical 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. The 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 an imbalance of amino acids in the diet which caused elevated blood urea concentration Crespo and Esteve-Garcia (2003) [49]. The use of FOO in activities of ALP and AST enzyme recorded no significant differences between all groups, this result agrees with Iheukwumere and Herber (2003) [37] 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 reflect the integrity of most vital organs [50].

Items	**F† - value**	**Frying Olein Levels**			
		T1 (0%)	**T2 (3%)**	**T3 (6%)**	**T4 (9%)**
Calcium (mg/dl)	00.10^{NS}	09.40 ± 01.60	09.10 ± 01.30	09.60 ± 01.30	09.10 ± 01.40
Phosphorus (mg/dl)	00.30^{NS}	01.20 ± 00.42	01.20 ± 00.30	01.30 ± 00.40	01.40 ± 00.30
ALP (IU/l)	00.20^{NS}	180.20 ± 61.80	256.70 ± 93.5	263.80 ± 91.1	252.70 ± 58.0
AST (IU/l)	00.80^{NS}	18.30 ± 02.30	18.80 ± 01.42	21.40 ± 02.00	19.90 ± 04.10

Table 5: *Analysis of variance and average (mean ± st. dev) serum electrolytes and enzyme activities values of broiler chicks fed different percentage levels of frying olein oil for 42 days.*

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

Slaughter values are shown in table 6. The treatment effect in all slaughter values was not significant (p > 0.05). Slaughter weight, abdominal fat and liver values were highest (p > 0.05) in T4. Empty body weight, hot carcass weight, heart and intestine values were highest in T3. Gizzard value was highest (p > 0.05) in T1. May in taking large amounts of energy and daily nutrition increases fat absorption or to individual animal differences, In addition to Gyenis., *et al*. (2006) [51] attributed such disparity to breed and genetic line. Anitha., *et al.* (2006) [34] recorded no significant differences in total weights of gizzard, heart and liver on feeding broilers rice bran oil. Our results are in agreement with the results of Pesti., *et al*. (2002) [10] who evaluated the use of eight different sources of fat including waste recovered frying oil and reported no significant differences (P > 0.05) in chickens' performance parameters.

Items	**F† value**	**Frying Olein Levels**			
		T1 (0%)	**T2 (3%)**	**T3 (6%)**	**T4 (9%)**
Slaughter weight	0.65^{NS}	2155.0 ± 214.13	2155.0 ± 335.1	2332.42 ± 194.4	2362.42 ± 332.1
Empty body weight	0.65^{NS}	2141.28 ± 214.9	2140.53 ± 334	2317.65 ± 194.7	2348.23 ± 331.7
Hot carcass weight	0.80^{NS}	1649.6 ± 257.8	1721.1 ± 231.6	1865.90 ± 169.4	1861.60 ± 266.2
Heart	1.20^{NS}	16.60 ± 01.90	18.20 ± 04.90	21.60 ± 03.42	20.90 ± 05.90
Liver	0.20^{NS}	40.00 ± 04.10	41.30 ± 11.80	43.80 ± 04.80	43.80 ± 10.30
Gizzard	1.04^{NS}	40.00 ± 04.10	38.80 ± 08.42	36.30 ± 04.80	33.80 ± 02.42
Intestine	0.18^{NS}	77.53 ± 06.39	81.78 ± 11.19	83.90 ± 12.71	80.73 ± 17.35
Abdominal fat	0.20^{NS}	31.30 ± 10.30	32.42 ± 19.40	32.42 ± 17.01	38.80 ± 13.20

Table 6: *Analysis of variance and average (mean ± st. dev) slaughter values (g) of broiler chicks fed different percentage levels of frying olein oil for 42 days.*

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

The percentage (%) slaughter values are shown in table 7. Treatment effect in all % 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 T2. The heart showed the highest (p > 0.05) percentage value in T3. T2 and was similar (p > 0.05) for liver % values. Gizzard % value was highest (p < 0.05) in T1. The abdominal fat value was highest (p > 0.05) in T4. Saleh., *et al.* (2004) [52] who fed poultry oil recorded no significant effect on breast yield, leg quarter and abdominal fat percentage when expressed as a percentage or quantitative yield, but % dressing was affected significantly by treatments. Tabeidian and Sadeghi (2006) [53] observed no significant effect on the % of dressing broiler carcass, abdominal fat, liver, pancreas, intestine and heart when adding fatty acids.

Items	F† - value	Frying Olein Levels			
		T1 (0%)	T2 (3%)	T3 (6%)	T4 (9%)
Carcass	0.87^{NS}	76.84 ± 06.38	80.64 ± 02.13	80.48 ± 00.98	79.30 ± 03.19
Heart	0.42^{NS}	00.78 ± 00.12	00.84 ± 00.12	00.94 ± 00.22	00.91 ± 00.29
Liver	0.00^{NS}	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 ± 00.3	01.56ab ± 00.1	01.45b ± 00.19
Intestine	0.23^{NS}	03.67 ± 00.63	03.86 ± 00.51	03.65 ± 00.65	03.48 ± 00.78
Abdominal fat	0.16^{NS}	01.49 ± 00.54	01.45 ± 00.82	01.35 ± 00.83	01.70 ± 00.68

Table 7: *Analysis of variance and average (mean ± st. dev) percentage slaughter values out of EBW of broiler chicks fed different percentage levels of frying olein oil for 42 days.*

†: At (3, 12) d.f. NS = Not Significantly Different (p > 0.05).

**: 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).*

Items	F† - value	Frying Olein Levels			
		T1 (0%)	T2 (3%)	T3 (6%)	T4 (9%)
Thigh	01.05^{NS}	255.00 ± 33.20	285.00 ± 53.20	292.42 ± 48.60	245.00 ± 42.03
Thighbone	00.20^{NS}	042.42 ± 05.00	042.42 ± 09.60	040.00 ± 08.20	040.00 ± 00.00
Thigh muscle	00.30^{NS}	212.42 ± 33.04	240.00 ± 49.00	227.42 ± 98.40	205.00 ± 42.03
Drum	01.10^{NS}	205.00 ± 17.30	202.42 ± 26.30	227.42 ± 15.00	205.00 ± 28.90
Drum bone	01.40^{NS}	055.00 ± 12.90	055.00 ± 05.80	065.00 ± 05.80	057.42 ± 05.00
Drum muscle	00.42^{NS}	142.00 ± 08.20	147.42 ± 20.60	162.42 ± 15.00	147.42 ± 29.90
Breast	00.20^{NS}	487.42 ± 108.7	485.00 ± 82.30	490.00 ± 96.30	440.00 ± 109.2
Breast bone	00.70^{NS}	060.00 ± 21.60	090.00 ± 53.42	077.42 ± 09.60	082.42 ± 15.00
Breast muscle	00.40^{NS}	427.42 ± 92.42	395.00 ± 91.10	412.42 ± 89.60	357.42 ± 97.10

Table 8: *Analysis of variance and average (mean ± st. dev) of carcass cuts and tissue values (g) of broiler chicks fed different percentage levels of frying olein oil for 42 days.*

Carcass yield is shown in table 8. Treatment effect in all carcass cuts and tissue values was not significant (p > 0.05) feeding of broilers with specific mixtures of fatty acids may substantially alter the fatty acid composition of the carcass [27]. The increased weights of the carcass cut parts may be as a result of the highest of feed intake and this is in line with the findings of Ayman (2006) [54] thigh weight and percentage; average wing weight and percentage; and average carcass weight loss percentage were not significantly ($P \geq 0.05$) affected by strain. Birds fed with rations containing oil present better performance than birds fed no oil [55]. Evaluation of carcass and meat quality parameters in table 9 was not significant ($p > 0.05$) in all the dietary treatment in line with the findings of Ayman (2006) [54]. The results of the primal cut up parts on breast, thigh and drumstick, though no significantly different fell within the levels reported Ayman (2006) [54]. Nutrition and age had a significant influence on the slaughter yield. Cut's bone characteristics significantly may affect by the strain ($P \leq 0.05$) [56]. Mean values of drum bone showed the highest ($p > 0.05$) value in T3 the use of oil or fat in diets for broilers may change both the composition and the quality of the carcass [55]. The crude protein content, moisture, ash and cholesterol in the meat of the same experiment are shown in table 9.

Items	F† - value	Frying Olein Levels			
		T1 (0%)	T2 (3%)	T3 (6%)	T4 (9%)
Moisture	01.80^{NS}	69.90 ± 03.20	70.70 ± 01.90	67.20 ± 02.80	71.70 ± 03.40
C.P	01.00^{NS}	19.90 ± 01.80	18.90 ± 00.80	20.42 ± 01.30	18.80 ± 02.20
E.E	00.60^{NS}	06.40 ± 03.10	07.40 ± 00.70	08.40 ± 02.20	06.10 ± 03.90
Ash	00.80^{NS}	00.70 ± 00.40	00.60 ± 00.42	00.30 ± 00.20	00.70 ± 00.42
Cholesterol (mg)	01.20^{NS}	07.83 ± 01.86	09.37 ± 05.37	05.33 ± 00.65	07.66 ± 02.04

Table 9: *Analysis of variance and average (mean ± st. dev) percentage meat chemical values of broiler chicks fed different percentage levels of frying olein oil for 42 days.*

†: At (3, 12) d.f. NS = Not Significantly Different (p > 0.05). Means in a row do not differ significantly (p > 0.05).

The percentage of subjective meat values are shown in table 10. The treatment effect was not significant in all meat subjective values except for tenderness ($p < 0.05$). The mean value of tenderness was highest ($p < 0.05$) in T1. Organoleptic characteristics, colour, flavour and juiciness of the meat, Colour mainly influenced by the myoglobin content and nature, the composition and physical state of muscle Joo., *et al.* (2013) [57] and the meat structure. These because shear force values of aged fillets also changed significantly. Tenderness was confirmed by the sensory evaluations [58].

Items	F† - value	Frying Olein Levels			
		T1 (0%)	T2 (3%)	T3 (6%)	T4 (9%)
Tenderness	05.42*	05.70^{a} ± 00.30	05.00^{b} ± 00.30	05.60^{a} ± 00.70	05.60^{a} ± 00.40
Flavor	02.42^{NS}	05.30 ± 00.20	04.80 ± 00.60	05.60 ± 00.70	05.60 ± 00.20
Color	02.00^{NS}	05.42 ± 00.42	04.70 ± 00.90	05.60 ± 00.30	05.40 ± 00.40
Juiciness	01.10^{NS}	05.30 ± 00.10	04.90 ± 00.30	05.10 ± 00.70	05.40 ± 00.30

Table 10: *Analysis of variance and average (mean ± st. dev) percentage meat subjective values of broiler chicks fed different percentage levels of frying olein oil for 42 days.*

†: At (3, 12) d.f. NS = Not Significantly Different (p > 0.05). Means in a row do not differ significantly (p > 0.05).

Flavour and juiciness values were equal and highest ($p > 0.05$) in T3 and T4. The use of olein oil in broiler diets is attractive because it is a saturated source that may be associated with a positive influence on meat firmness [46,47]. The unsaturated and saturated fatty acid of palm olein was contributing to excellent flavour stability [16]. Fan., *et al*. (2013) [38] reported that palm olein performed satisfactorily and produced fried foods with acceptable cooking qualities.

Economic appraisal showed in table 11. Chick purchase and feed cost values (SDG) were the significant inputs considered.

Items	Frying Olein Levels			
	T1 (0%)	T2 (3%)	T3 (6%)	T4 (9%)
Meat sales (SDG)	11.42	12.00	13.10	13.00
Chick purchase (SDG)	02.242	02.242	02.242	02.242
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	03.97	04.45	05.45	05.35
Profitability	34.76	37.08	41.60	41.15
Profitability ratio	01.28	01.39	01.65	01.62

Table 11: *Major inputs and margin over primary inputs per head of broiler chicks fed different levels of frying olein oil for 42 days.*
**: At current (March' 2018) prices of meat 7.00 SDG/kg.*
***: At current (March' 2018) price of mash 900 SDG/kg.*
SDG = Sudanese Geneh (Pound).

Conclusion

The Major cost of production values of meat is the total income obtained, that the profitability ratio of the test T3 was the higher of the test groups the fluctuations in the price of chickens and the unpredictable supply of broiler chicks encouraged broiler farmers, also Production inputs for feed materials that were agreed by Akinyodoye and Pingpoh (1992) in Mahama., *et al*. (2013) [59] concluded that poultry production in Nigeria is financially but not economically profitable given the prevailing high cost of imported feed and also reported that the cost of production was the major problem.

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Volume 16 Issue 5 May 2021