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The Use of Recovered Frying oil in Broiler Chicken Diets: Effect on Performance, Meat Quality and Blood Parameters

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Abstract

The present work was achieved in order to evaluate the use of recovered frying oil in broilers diet and its effect on performance, carcass traits, meat quality and blood parameters. A total of 72 (one day old) Ross chicks were used in the experiment and divided into two groups. The chickens in the first group were fed the (control diet) containing fresh oil whereas the chickens in the second group were fed (treatment diet) containing recovered frying oil. The fatty acids profile, peroxide value and acidity value of the recovered oil indicated its suitability to be added to the diets. The experimental results 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. 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.

Keywords: Oil, broilers, fatty acids, peroxide value, performance, carcass, blood, meat quality, economic efficiency.

Introduction

Different types of fats and oils have been used as feed ingredients in broilers diet in order to increase their energetic value. Fats and oils are variable in their nutritive values according to their chemical composition[1]. Fats and oils are complex mixtures of triacylglycerols (TAGs), diacylglycerols, free fatty acids, phospholipids, and other minor components[2].

Energy and protein levels of ration should be high in order to get the optimum productivity from chickens[3]. Broiler's growth performance can be affected by different fat origins supplemented to the diets[4]. Oils are the most important energy source of broiler rations[3].

According to Wiseman et al. 1992[5], the degree of saturation of the constituent fatty acids, their chain length and the proportion of free fatty acids have a pronounced effect upon the dietary energy value of fats and oils.

In view of the increasing cost of feed ingredients, there is a need for finding low cost alternatives to be used in broilers' rations. Approximately 70% of the total cost of poultry diets is related to meeting energy needs[3].

Oils recovered from industrial frying processes could show satisfactory quality to be used in animal feeds [6]. The aim of the present study was to investigate the effect of including recovered frying oils in the diet on broiler chickens' performance, carcass traits and meat quality.

Material and Methods

Experimental oils and diets: Fresh sunflower oil (FO) and recovered frying sunflower oil (RO) were obtained from local restaurants. The two oil samples were subjected to analysis for their fatty acids profile, peroxide value and acidity. Oils analyses were all done according to the Official Method 996.06 (AOAC)[7].

Four experimental diets were formulated according to the nutritional requirements of the chicks in the different stages of age. In each experimental phase one diet contained fresh oil (control) while the other contained recovered frying oil (treatment). The ingredients and chemical compositions of the diets are shown in table-1.

Growth performance experiment: A total number of 72 (one day old) Ross chicks (36 per experimental diet), were housed under controlled environmental conditions. The chickens had free access to their respective experimental diets and live weight gain; feed intake and feed efficiency were recorded from 1 to 14 days, 15 to 28 days, 29 to 42 days and cumulatively.

Carcass characteristics and meat quality: At the end of the experiment, 12 birds from each treatment group were slaughtered for evaluation of carcass characteristics. Carcasses were cleaned thoroughly, feathers, feet and visceral organs were removed. The dressed and edible organs (heart, empty gizzard and liver) weights were then individually recorded. All weights were expressed as percentage of live body weight.

Meat samples (breast and thighs) were minced, homogenized and kept at -25°C until they were analyzed to determine their fat, protein, moisture, abdominal fat and ash percentages.

Blood cholesterol and triglycerides: At the end of the experiment two birds from each pen were bled by cutting the carotid artery and blood was taken from this artery. The blood samples were centrifuged for 15 min at 2500 × g, and the serum was collected. Cholesterol and triglycerides were determined using kits purchased from the agent of DiaSys Diagnostic System GmbH.

Chemical measurements: Crude protein was determined in muscles (N×6.25). Nitrogen was determined according to the Kjeldahl method. The content of crude fat was determined using ANKOM Fat Analyzer. The content of ash was determined gravimetrically after incineration at a temperature of 550°C at pre-defined conditions. All chemicals analyses were done following the official methods of analysis listed in the AOAC (2012)[7].

Economic efficiency: The economic efficiency of the diets was calculated as the percentage of net revenue per feed cost based on the prices of the local markets at the time of the experiment.

Statistical analysis: Data were statistically analyzed using the general linear model for analysis of variance of SAS[8] and the test of significance for the difference between means was computed using Duncan's[9] multiple range tests.

Results and Discussion

Characterization of the experimental oils: Quality of fat has a great contribution to get better poultry growth and feed efficiency which depends upon chemical nature of the constituent fatty acids[10]. The fatty acids profile, peroxide and acid values of fresh and recovered frying oil are shown in table-2. The results indicated that the frying process of fresh oil resulted in increasing its peroxide and acid values. The average peroxide value (meq O_2/kg) of fresh oil was 3.30 and it increased to 6.55 upon using it in the frying process. Peroxide value is one of the most widely used tests for the measurement of oxidative rancidity and or deterioration of oils and fats[11]. And according to Gan et al.[12] good quality oil should have a peroxide value less than 10 units. On the other hand, the acid value (mg KOH/g) was 0.20 for fresh oil and 1.00 for recovered frying oil which is attributed to the hydrolytic alteration that usually occurs when food products containing a certain amount of water (e.g. potatoes) are fried[5]. In agreement with our results, similar results were obtained by Anjum et al.[13] for soyebean oil and Blas et al.[14] for vegetal oil (sunflower oil + olive oil).

Table -1
Starter and finisher diets composition and analysis

Ingredients	Control (starter)	Treatment (starter)	Control (finisher)	Treatment (finisher)
Corn 7.5%	56.665	57.165	62.600	62.600
Soybean (46%)	28.500	27.000	24.000	24.800
Gluten (60%)	8.310	9.310	6.275	5.475
Fresh sunflower oil (9600Kcal)	2.500	-	3.500	-
Recovered frying sunflower oil (8800 Kcal)	-	2.500	-	3.500
Di-Calcium phosphate (24.5%)	2.030	2.030	1.850	1.850
Limestone (39.8%)	0.570	0.570	0.490	0.490
Vitamin	0.400	0.400	0.400	0.400
Salt	0.300	0.300	0.300	0.300
Choline (70%)	0.075	0.075	0.075	0.075
Dl-Methionine	0.190	0.190	0.170	0.170
L-Lysine	0.460	0.460	0.340	0.340
Total	100	100	100	100
Determined analysis (%)				
Crude protein	23.1	23.4	20.0	19.90
Calcium	1.1	0.99	0.88	0.86
Total phosphorus	0.77	0.76	0.67	0.69
Ether extract	2.90	2.95	3.20	3.40
Ash	6.30	6.35	5.90	6.10
Crude fiber	2.53	2.50	2.62	2.58

(*)Premix supplied per Kg of diet: Vit. (A), 12000 I.U., Vit.(D_3), 2000I.U. ; Vit.(E), 10mg ;Vit.(K_3) , 2mg; Vit.(B_1), 1 mg; Vit.(B_2), 5 mg; Vit.(B_6), 1.5 mg; Vit.(B_{12}), 10 ug; Biotin, 50ug; Choline chloride,500mg; Pantothenic acid , 10 mg; Niacin,30mg; Folic,1mg; Manganese, 60mg; Zinc,50mg; Iron,30mg;Copper,10mg;Iodine,1mg;Selenium,0.1mg and Cobalt,0.1mg (According to **NRC**;1994)[7].

The fatty acids profile has a large significance on the quality of oils and fats. The results of the present study showed that heating the fresh oil led to a reduction in linoleic acid content and accordingly caused an increase of saturated and monounsaturated fatty acids in the recovered frying oil. According to Blas et al. 2010[14] the thermal treatment of oil causes a loss of linoleic acid and increases the peroxide value. Our results are in accordance with the results of Tres et al.[5] Blas et al.[14] and Htin et al.[15].

Table-2
Characteristics of the experimental oils

	Fresh oil	Recovered frying oil
Fatty acids profile		
Palmitic acid (%)	6.04	10.31
Stearic acid (%)	3.20	1.37
Oleic acid (%)	24.4	26.47
Linoleic acid (%)	63.0	58.41
Linolenic acid (%)	0.30	0.51
Arachidic acid (%)	0.17	0.27
Other characteristics		
Peroxide value ($meqO_2$/ Kg)	2.30	6.65
Acid value (mg KOH/g)	0.20	1.00

Effect on growth performance: The results of feeding fresh sunflower oil and recovered frying oil on broilers performance during the starter, grower and finisher stages are given in table-3. There were no significant differences in body weight, weight gain, feed intake or feed conversion ratio between the fresh and recovered frying oil during the three experimental periods. Our results are in agreement with the results of Pesti et al.[16] 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. Similar results were also reported by Ahmed et al.[3] who found no significant differences in chickens' performance when fed fresh or fried groundnut oil in their diets. According to Leo[17] there is no evidence for a negative effect of the oil heating process on the quality of fat for feeding to poultry.

The effect of using fresh and recovered frying oils in broilers' diet on their carcass characteristics are presented in table-4. The data analysis of the results in table-4 revealed no significant differences (p >0.05) in dressed, breast, thigh and drumstick weights between the chickens fed the diets containing fresh oil and those fed recovered frying oil. Similarly Anjum[13] reported no significant differences in carcass traits between broilers fed oxidized oil and fresh oil. The results also showed that the edible organs weights (liver, heart and gizzard) were not affected by the type of oil used.

Table-3
Effect of oil type on chickens' performance

	Control group	Treated group	P-value
Starter stage (1-14 days old)			
Live body weight (g)	329.3 ±7.68	320.7 ± 3.28	0.308
Body weight gain (g)	285.3 ± 7.68	276.7 ± 3.28	0.308
Feed intake (g)	378.3 ± 6.98	390.3 ± 11.05	0.570
Feed conversion (feed/gain)	1.32 ±0.008	1.40 ±0.035	0.117
Grower stage (15-28 days old)			
Live body weight (g)	1198.3 ±13.64	1184.3 ±12.66	0.920
Body weight gain (g)	869 ±18.24	863 ±10.58	0.503
Feed intake (g)	1400.3 ±4.91	1437.7 ±16.17	0.168
Feed conversion (feed/gain)	1.61 ±0.029	1.66 ±0.012	0.280
Finisher stage (29-42 days old)			
Live body weight (g)	2271 ±36.11	2249 ±17.78	0.192
Body weight gain (g)	1072 ±38.17	1064.7 ±22.4	0.512
Feed intake (g)	2072.7±15.76	2072±13.71	0.861
Feed conversion (feed/gain)	1.93 ±0.053	1.94±0.03	0.479
Overall experimental period (1-42 days old)			
Live body weight (g)	2271±36	2249±17.78	0.192
Body weight gain (g)	2227±36	2205±11.78	0.192
Feed intake (g)	3851±9.82	3900±17.67	0.471
Feed conversion (feed/gain)	1.73±0.023	1.76±0.017	0.706

The nutritional value of meat can be assessed by evaluating meat quality parameters such as protein, fat, moisture, ash. In the present study, the results of meat quality (table 4) showed that the replacement of fresh oil by frying oil in broilers' diet did not affect significantly (p >0.05) the fat, protein, moisture, ash or abdominal fat percentages of chickens. In line with our findings, Racanicci[18] reported that there was no effect on meat moisture, protein, fat, or ash contents between the chickens fed diets containing fresh or oxidized fat.

Blood parameters are influenced by the dietary components and are usually considered as an important index of physiological, pathological and nutritional status in the organism[19]. The serum total cholesterol and triglyceride level (table-4) did not differ significantly (p>0.05) among the two experimental groups.

Economic efficiency study: The economic efficiency results are presented in table-5. It is evident that the usage of recovered frying oil in broilers' diet instead of fresh vegetable oil reduced the total cost of feed per kg chicken by about 6%. This reduction in the feed cost resulted consequently in an economic efficiency of 104% for the diet supplemented with frying sunflower oil relative to that containing fresh oil.

Table-4
Effect of oil type on chickens' meat quality, carcass traits and blood parameters.

Item	Control group	Treated group	P-value
Meat Quality parameters			
Fat (%)	3.15 ±0.057	3.06 ±0.07	0.800
Protein (%)	22.48 ±0.044	22.38 ±0.044	1.000
Moisture (%)	58.93 ±0.036	58.88 ±0.109	0.196
Ash (%)	12.78 ±0.109	12.9 ±0.057	0.430
Abdominal Fat (%)	1.49 ±0.36	1.64 ±0.068	0.067
Carcass traits			
Body weight (g)	2271 ±36.09	2233 ±27.61	0.738
Dressed weight (%)	81.31 ±1.46	83.03 ±1.70	0.850
Liver weight (%)	2.24 ±0.22	1.93 ±0.14	0.601
Gizzard weight (%)	2.66 ±0.28	3.16 ±0.15	0.483
Heart weight (%)	0.47 ±0.056	0.46 ±0.058	0.960
Breast weight (%)	16.82 ±0.39	17.32 ±0.43	0.900
Drumstick weight (%)	4.56±0.052	4.58 ±0.53	0.107
Thigh weight (%)	4.67 ±0.18	4.82 ±0.30	0.540
Blood parameters			
Blood cholesterol (mg/dL)	189.3 ±4.25	187.3 ±2.14	0.417
Blood triglycerides (mg/dL)	117.0 ±1.15	115.0 ± 0.57	0.400

Conclusion

The results of the present study suggests that the oil resulting from frying process could be used as a source of energy in broilers' diets without showing any negative effects on broilers performance and meat quality. The use of such type of oils is only restricted by their chemical composition and provided that the oil's peroxide value is not higher than allowed.

Table-5
Economic efficiency of the experimental diets

	Control diet	Treatment diet
Fixed Cost (L.E)[a]	3.5	3.5
Final LBW/chicken (g)	2271	2249
Price/Kg feed	2.73	2.51
Feed intake (kg)/ chicken	3.73	3.75
Total cost/ 1Kg chicken (L.E)[b]	13.69	12.90
Total revenue/ chicken (L.E)[c]	31.79	31.49
Net revenue/ chicken (L.E)	18.11	18.58
Economic efficiency (EE), %[d]	56.95	59.02
Relative EE (%)[e]	100	104

(a) Chick price. (b) Including the feed cost. (c) Assuming that the selling price of one Kg live body weight is (14 L.E). (d) Net revenue per unit total cost. (e) Considering the economic efficiency of the control diet is 100%.

References

1. Wiseman J., Edmunds B. K. and Shepperson N., The apparent metabolisable energy of sunflower oil and sunflower acid oil for broiler chickens, *Anim. Feed Sci. Technol.,* **36,** 41–51 **(1992)**

2. Van Ruth S.M., Rozijn M., Koot A., Perez Garcia R., van der Kamp H., and Codony R., Authentication of feeding fats: Classification of animal fats, fish oils and recycled cooking oils, *Anim. Feed Sci. Technol.,* **155,** 65–73 **(2010)**

3. Ahmed A. M., Mohammed K. A. and Shakak M. A. S., Effects of frying oils used in broiler rations on performance, *J. Curr. Res. Sci.,* **1,** 310–315 **(2013)**

4. Tabeidian S. A., Ghafoori M., Bahrami Y., Chekani-Azar S. and Toghyani, M., Effect of Different Levels of Dietary Fat on Broiler Performance and Production Cost with Emphasis on Calcium and Phosphorus Absorption, *Glob. Vet.,* **5,** 54–60 **(2010)**

5. Tres A., Bou R., Guardiola F., Nuchi C. D., Magrinyà N. and Codony R., Use of recovered frying oils in chicken and rabbit feeds: effect on the fatty acid and tocol composition and on the oxidation levels of meat, liver and plasma, *Animal,* **7,** 505–17 **(2013)**

6. AOAC, Official Methods of Analysis of *AOAC* international, 19th Edition **(2012)**

7. NRC, Nutrient requirements of poultry. Ninth Revised Edition, National Academy Press, Washington D.C. **(1994)**

8. Duncan D.B., Multiple range and multiple F-test, *Biometrics,* **11**, 1-42 **(1955)**

9. SAS Institute. SAS User's Guide: Statics, Release 9.1. SAS Institute Inc., Cary, NC **(2004)**

10. Ali M., Sharif M., Sultan J.I., Rehman S., Farooq K. and Khan M. L.. Influence of varying levels of Bergafat on performance of broiler chicks, *J. Anim. Plant Sci.,* **22,** 853–856 **(2012)**

11. Babalola T. and Apata D., Chemical and quality evaluation of some alternative lipid sources for aqua feed production, *Agric. Biol. J. North Am.,* **2,** 935–943 **(2011)**

12. Gan H.L., Man Y.B.C., Tan C.P., NorAini I. and Nazimah S.A.H., Characterisation of vegetable oils by surface acoustic wave sensing electronic nose, *Food Chem.,* **89,** 507–518 **(2005)**

13. Anjum M. I., Mirza I. H., Khan A. G. and Azim A. Effect of fresh versus oxidized soybean oil on growth performance, organs weights and meat quality of broiler chicks, **24,** 173-178 **(2004)**

14. Blas E., Cervera C., Rodenas L., Martínez E. and Pascual J. J., The use of recycled oils from the food industry in growing rabbit feeds in substitution of fresh oil does not affect performance, *Anim. Feed Sci. Technol.,* **161,** 67–74 **(2010)**

15. Htin N.N., Effects of dietary fatty acid saturation on broiler chickens subjected to high ambient temperatures, Ph.D. Dissertation. University of Putra, Malaysia, Selangor Darul Ehsan, Malaysia **(2006)**

16. Pesti G.M., Bakalli R.I., Qiao M. and Sterling K.G., A comparison of eight grades of fat as broiler feed ingredients, *Poult. Sci.,* **81,** 382–90 **(2002)**

17. Leo S.J., Is Kitchen Grease Safe For Poultry. Poultry Science, the University of Georgia, Athens, CA 30602-2772 **(1992)**

18. Racanicci A., Menten J., Regitano-d´Arce M. and Pedroso T., Dietary Oxidized Poultry Offal Fat: Broiler Performance and Oxidative Stability of Thigh Meat During Chilled Storage 1, *Brazilian J. Poult. Sci.,* **10,** 29–35 **(2008)**

19. Odetola M. O., Ewuola E. O. and Adu O. A., Haematology, Serum Biochemistry and Organ Histopathology of Rabbits Fed Graded Levels of Whole Kenaf (Hibiscus canabinus) Seed Meal, *Int. J. Agric. Res.,* **7,** 86–92 **(2012)**