Journal of Animal and Veterinary Advances 8 (10): 2045-2048, 2009
ISSN: 1680-5593

Effect of Residual Oil of Food Manufactories on Cholesterol and Malondialdehyede (MDA) in Muscles of Male Broiler

H. Karamouz
Department of Animal Science, Islamic Azad University,
Shabestar Branch, Shabestar, Iran

Abstract: This experimental was conducted to determine the effect of the Residual Oil (RO) on cholesterol and Malondialdehyede (MDA) as an indicator of lipid oxidation in muscles (breast and thigh) of male broiler chickens. A total of 108 Ross-308 strains were randomly divided into 3 experimental treatments with 3 replicates (12 chicks per pen) and arranged in a Completely Randomized Design (CRD). Experimental diets consisted of: Basal diet with 0% RO; basal diet with 2.5% RO and basal diet with 5% RO. These diets were isonitrogenous and isoenergetic. The feeding continued up to the age of 42 days. Two male birds selected with each pen and slaughtered. Data was analyzed with one way ANOVA and means compared with Duncan test. The results indicated that levels of 5 and 2.5% RO (T_3 and T_2, respectively) caused significant increases in breast and thigh muscles MDA and cholesterol contents as compared with control group ($p<0.05$). These results suggest that usage RO in the broilers diet may raise the susceptibility of tissues to free radical oxidative damage.

Key words: Broiler, cholesterol, food manufactories, malondialdehyede, muscle and residual oil

INTRODUCTION

Poultry meat is susceptible to oxidative deterioration. Oxidative processes are one of the primary mechanisms of quality deterioration in meat and meat products as they cause loss of flavor, colour and nutritive value and consequently limit their shelf-life (Kanner, 1994).

The oxidative stability of meat and meat products depends upon the balance of anti- and peroxidants and the oxidation substrates including Polyunsaturated Fatty Acids (PUFA), cholesterol, proteins and pigments. The changes in meat quality due to lipid oxidation are manifested by adverse changes in production toxic compounds like Malonaldehyde (MDA) and cholesterol oxides (Erikkson, 1982; Gray *et al*., 1999; Onibi and Osho, 2007). MDA as lipid peroxidation index is one of the major causes of quality deterioration in meat and products made from the meat of those birds and high cholesterol content in broiler meat cause to increase risk of cardio vascular diseases in human. Of the components able to add energy value to diets, fats are of significant importance, they have a high caloric value, CA 0.9 kcal g^{-1} and when, applied in feed mixtures, even in small doses, they make it possible to obtain feed with a desirable energy level (Lopez-Bote *et al*., 1997).

One of them, residual oil of food manufactories. The effect of RO of food manufactories have been examined on diet quality and performance of broilers in the previous studies, today, direct or indirect effects of RO on animal and human health are being determined. The safety of administering RO to diets and their impact on live organisms have become controversial and are the subject of research by numerous researchers. One of the reasons of this controversy is the anxiety that the lipid oxidation may decrease the nutritive value of a diet, increase depression and diarrhoea incidence, cause histological changes to tissues and in some cases, even the death of birds (Izaki *et al*., 1984). It may also result in the production of different compounds, including: peroxides, hydro peroxides aldehydes, ketones and others, majority of, which may have toxic potential (Cabel *et al*., 1988).

MATERIALS AND METHODS

Animals and diets: Experiment was conducted of the 108 one-day old male broilers of a commercial strain (Ross-308) were placed in 9 pens of 2×2 m with 12 birds per each pen. Feed and water were provided *ad libitum*. The experimental design consisted in a completely randomized design with 3 treatments (T_1 (0% RO), T_2 (2.5% RO) and T_3 (5% RO)) with 3 replication. The treatment diets of were isonitrogenous and isoenergetic. Diets were formulated by adding 0, 2.5 and 5% RO be based diet that met requirement recommended by the National Research Council (1994). The control diet, which was not enriched with RO and was administered throughout the 10 days of experimental period (adaptation period). The levels of Residual oil of food manufactories were replaced with corn in diets during 2 different periods (starter and grower). Ingredient composition and nutrient

analysis for each treatment is shown in Table 1-3. The chickens were weighted at the start of the experiment and during the experiment, weight gain and total feed consumption per pen were recorded and feed conversation ratio was calculated at experimental periods. Mortality was also, recorded for each treatment. The first, before starting experiment, fatty acids composition and lipid peroxidation value of RO determined (AOAC, 1999). Fatty acid composition in residual oil is shown in Table 4. On day 42, 6 chicks from each treatment group were slaughtered. Thigh and breast muscles without skin were dissected and collected. The samples were vacuum packed and frozen at -20°C until analysis (for 2 months). Also; the muscles were thawed at a temperature of 4±1°C for 6 h prior to consecutive experimental stages. MDA was assessed as thiobarbituric acid reactive substance concentrations in samples (Mihara and Uchiyama, 1978) and meat cholesterol was asssed in autoanalyser system (Maraschiello *et al*., 1998).

Table 1: Percentage composition diet in adaptation period

Ingredients	%
Cron	53.00
Soybean	29.50
Fish meal	4.00
Residual oil	0.50
Starch	7.00
Wheat bran	1.50
DL-methionine	0.00
Lysine	0.00
DCP	1.25
Oyster	1.30
Vitamin[1]	0.25
Mineral[2]	0.25
Salt	0.25
Coccidiostat	0.05
Sand	1.15
Calculated nutrient content	
ME (kcal kg^{-1})	2917.60
Crude protein (%)	20.70
Calcium (%)	1.04
Available P (%)	0.46
ME/CP	140.94
Ca/P	2.26

Table 2: Percentage composition diet in starter period

	Experimental diets		
Ingredients	T_1	T_2	T_3
Cron	54.00	49.700	50.00
Soybean	29.16	29.900	30.00
Fish meal	4.00	3.000	3.00
Residual oil	0.50	2.500	5.00
Starch	7.70	4.950	3.85
Wheat bran	1.50	5.400	4.75
DL-methionine	0.00	0.000	0.00
Lysine	0.00	0.000	0.00
DCP	1.25	1.350	1.30
Oyster	1.30	1.350	1.30
Vitamin[1]	0.25	0.250	0.25
Mineral[2]	0.25	0.250	0.25
Salt	0.25	0.250	0.25
Coccidiostat	0.05	0.050	0.05
Sand	0.22	1.050	0.00
Calculated nutrient content			
ME (kcal kg^{-1})	2933.60	2933.600	2930.35
Crude protein (%)	20.63	20.630	20.60
Calcium (%)	1.03	1.038	1.04
Available P (%)	0.46	0.460	0.46
ME/CP	142.20	142.200	142.20
Ca/P	2.20	2.200	2.20

[1]Vitamin content of diets provided per km of diet: vitamin A, D, E and K; [2]Composition of mineral premix provided as follows km of premix: Mn, 120.000 mg: Zn, 80.000 mg: Fe, 90.000 mg: Cu, 15.000mg: I, 1,600 mg: Se,500 mg: Co, 600 mg; [3]T_1: basal diet, T_2: basal diet + 2.5% RO; T_3: basal diet+5% RO

Statistical analysis: Data were analyzed in a complete randomized design using the GLM procedure of SAS version 6.08 (SAS Inst., Cary, NC).

$$Y_{ij} = \mu + \alpha_i + \varepsilon_{ij}$$

Where:

Y_{ij} = All dependent variable
μ = Overall mean
α_i = The fixed effect of oil levels (i = 1, 2, 3)
ε_{ij} = The random effect of residual

Duncan multiple range tests used to compare means.

Table 3: Percentage composition diet in grower period

	Experimental diets		
Ingredients	T_1	T_2	T_3
Cron	57.00	53.97	54.00
Soybean	27.00	27.00	27.00
Fish meal	1.50	1.50	1.50
Residual oil	0.00	2.50	5.00
Starch	8.48	5.28	0.33
Wheat bran	1.78	3.50	3.43
DL-methionine	0.10	0.10	0.10
Lysine	0.00	0.00	0.00
DCP	1.39	1.35	1.30
Oyster	1.55	1.50	1.40
Vitamin[1]	0.25	0.25	0.25
Mineral[2]	0.25	0.25	0.25
Salt	0.25	0.25	0.25
Coccidiostat	0.05	0.05	0.05
Sand	0.40	2.50	5.14
Calculated nutrient content			
ME (kcal kg^{-1})	2950.40	2950.40	2952.40
Crude protein (%)	18.44	18.44	18.45
Calcium (%)	1.01	1.02	1.01
Available P (%)	0.41	0.41	0.41
ME/CP	160.00	160.00	160.00
Ca/P	2.40	2.40	2.40

[1]Vitamin content of diets provided per kilogram of diet: vitamin A, D, E and K. [2]Composition of mineral premix provided as follows kilogram of premix: Mn, 120.000 mg: Zn, 80.000 mg: Fe, 90.000 mg: Cu, 15.000 mg: I, 1,600 mg: Se,500 mg: Co, 600 mg 3 T_1 = basal diet, T_2 = basal diet + 2.5% RO. T_3 = basal diet + 5% RO

Table 4: Fatty acid composition in residual oil

Ingredients	%
C_{16}:0	20.80
C_{18}:0	11.13
C_{18}:1t	34.50
C_{18}:1	22.00
C_{18}:2t	1.70
C_{18}:2	9.20
C_{18}:3	0.30
C_{20}:2	0.20
PV[1](mEq O_2 kg^{-1})	36.00

[1]Peroxid value

Table 5: Effects of different levels residual oil on some meat metabolites in male broiler (Mean±SD)

	Breast			Thigh		
Treatments	T_1	T_2	T_3	T_1	T_2	T_3
MDA[1] (mg kg^{-1})	1.1±0.10[a]	1.9±0.07[b]	2.1±0.10[b]	1.9±0.03[a]	2.9±0.06[b]	3.2±0.09[b]
Cholesterol (mg/100 g)	50.3±4.09[a]	66.7±5.15[b]	71.8±6.29[b]	98.2±7.01[a]	118±4.10[b]	122±3.05[b]

[1]Lipid peroxides are reported as milligrams of malonaldehyde per km of sample; [a]Values corresponding to a certain factor with different letters differ significantly ($p<0.05$); T_1 = basal diet, T_2 = basal diet + 2.5% RO; T_3 = basal diet + 5% RO

RESULTS AND DISCUSSION

Result for meat (breast and Thigh muscles) chemical analyses show that in Table 5. Result show that with usage 5 and 2.5% RO (T_3 and T_2, respectively) in experimental diet caused significant increases in breast and thigh muscles MDA and cholesterol contents as compared with control group ($p<0.05$). Breast muscle showed lower MDA content than thigh, possibly because of its lower fat content (Igene *et al*., 1979). Also, high cholesterol content in broilers breast and thigh muscles that fed with RO, possibly because of high levels of trans fatty acids in RO. Several reports clearly demonstrate that modest intake of trans fatty acids can deleteriously affect lipoproteins by increasing LDL and decreasing HDL (Abbey and Nestel, 1994). Experimental oil feeding increase MDA significantly and thus, challenges the antioxidant defense system and may raise the susceptibility of tissues to free radical oxidative damage. This result is in agreement to that reported by Lin *et al*. (1989a, b), who found relatively high variation in the susceptibility to lipid oxidation of broiler meat when oxidized oils were used as a dietary fat source in comparison to the marked effect of other oils. Therefore, in industrial practice, generally one does not use fats in animal feed manufacturing with peroxide values above 10-20 meq O^2 kg^{-1} oil (De Rouchey *et al*., 2004).

Studies have shown an increased oxidative status of animals or their meat after feeding highly oxidized fats (Engberg *et al*., 1996: Jensen *et al*., 1997). Jensen *et al*. (1997) also reported that Tocopherols levels were significantly lower in muscles from birds fed the oxidized oil diet, explaining the decreased lipid stability of meat from birds and Thigh meat was more susceptible to lipid oxidation during storage than breast meat, regardless of dietary treatment. Onibi and Osho (2007) reported that MDA concentration of tissues were higher with increase in length of display and/or storage. Dineen *et al*. (2001) also reported that during display or storage of muscle food, ferritin lost iron and this was found to initiate membrane lipid peroxidation. The fatty acid composition of muscle tissue plays a major role in lipid stability and product quality. Lipid oxidation is a major problem in poultry meat due to the high content of Polyunsaturated Fatty Acids (PUFA) thus, methods that are effective, Safe and low cost for controlling poultry product stability are extremely important to the muscle food industry. To increase the storage stability of the processed meat, antioxidant compounds, such as butylated hydroxy toulene, butylated hydmxy anisole and tocopherols, are being used. Recently, the use of natural dietary antioxidants has been advocated (Kang *et al*., 2001) for stabilizing feed and poultry products.

CONCLUSION

Now-a-days, RO usage prevalent for increasing dietary energy in broiler diets, but it is concluded that 5 and 2.5% inclusion levels of RO in broiler diets caused significant increases in breast and thigh muscles MDA and cholesterol contents and may raise the susceptibility of tissues to free radical oxidative damage.

ACKNOWLEDGEMENTS

Financial support for this study (Islamic Azad University, Shabestar Branch) was provided. The authors are also grateful to them valuable support and Tabriz Food and Drug Quality Control lab for their skilled technical assistance throughout the experimental analyses.

REFERENCES

Abbey, M. and P.J. Nestel, 1994. Plasma cholesteryl ester transfer protein is increased when trans-elaidic acid is substituted for cis-oleic acid in the diet. Elsevier. Sci., 106: 99-107. PMID: 8018112.

Association of Official Analytical Chemistst (AOAC), 1999. Official methods of analysis of the AOAC. http://www.eoma. aoac.org/notices.asp.

Cabel, M.C., P.W. Waldroup, W.D. Shermer and D.F. Calabotta, 1988. Effects of ethoxyquin feed preservative and peroxide level on broiler performance. Poult. Sci., 67: 1725-1730. http://www.psa.uiuc.edu.

De Rouchey, J.M., J.D. Hancock, R.H. Hines, C.A. Maloney, D.J. Lee and H. Cao, 2004. Effects of rancidity and free fatty acids in choice white grease on growth performance and nutrient digestibility in weanling pigs. J. Anim. Sci., 82: 2937-2944. PMID: 15484945.

Dineen, N., J.P. Kerry, D.J. Buckley, P.A. Morrissey, E.K. Arendt and P.B. Lynch, 2001. Effect of dietary tocopherol acetate supplementation on the shelf-life stability of reduced nitrite cooked ham products. Int. J. Food. Sci., Technol., 36: 631-639. http://www.blackwell-science.com/products/journals/ijfst.htm.

Engberg, R.M., C. Lauridsen. S.K. Jensen and K. Jakobsen, 1996. Inclusion of oxidized vegetable oil in broiler diets. Its influence on nutrient balance and on the antioxidative status of broilers. Poult. Sci., 75: 1003-1011. PMID: 8829233.

Gray, J.I. and E.A. Gomaa and D.J. Buckley, 1999. Oxidative quality and shelf life of meats. Elsivier. Sci., 43: 111-123. DOI: 10.1016/0309-1740(96)00059-9.

Igene, J.O., A.M. Pearson, R.A. Merkel and T.H. Coleman, 1979. Effect of frozen storage time, cooking and holding temperature upon extractable lipids and TBA values of beef and chicken. J. Anim. Sci., 49: 701-707. http://jas.fass.org.

Izaki, Y., S. Yoshikawa and M. Uchiyama, 1984. Effect of ingestion of thermally oxidized frying oil on peroxidative criteria in rats. Lipids., 19: 324-331. DOI: 10.1007/BF02534782.

Jensen *et al*., 1997. Influence of the oxidative quality of dietary oil on broiler meat storage stability. Elsevier. Sci., 47: 211-222. DOI: 10.1016/S0309-1740(97)00052-1.

Kang, K.R., G. Cherian and J.S. Sim, 2001. Dietary paint oil alters the lipid stability of poiyunsaturated fatty aciddmodified poultry products. Poult. Sci., 80: 228-234. PMID: 11233014 .

Kanner, J., 1994. Oxidative processes in meat products: Quality implications. Meat. Sci., 36: 169-189. http://www.crcpress.com/jour/catalog/foods.htm.

Lin, C.F., A. Ashgar, J.I. Gray, D.J. Buckley, A.M. Boreen, R.L. Crackel and C.J. FIegal, l989a. Effects of oxidized dietary oil and antioxidant supplementation on broiler growth and meat stability. Br. Poult. Sci., 30: 855-864. PMID: 2627665.

Lin, C.F., J.I. Gray, A. Ashgar, D.J. Buckley, A.M. Booren and C.J. Flegal, 1989b. Effect of dietary oils and α tocopherol supplementation on lipid peroxidation in broiler meat. J. Food Sci., 54: 1457-1460. DOI: 10.1111/j.1365-2621.1990.tb06013.x.

Lopez-Bote, C.J., A. Rey. M. Sans, J.I. Gray and D.J. Buckley, 1997. Dietary vegetable oils and tocopherol reduces lipid oxidation in rabbit muscle. J. Nutr., 127: 1176-1182. PMID: 9187633.

Maraschiello, C., E. Esteve and J.A. Garcia-Regueiro, 1998. Cholesterol oxidation in meat from fed tocopherol and S-carotene-supplemented diets with different unsaturation grades. Lipids, 33: 705-713. PMID: 9688174.

Mihara, M. and M. Uchiyama, 1978. Determination of maionaldehyde precursors in tissues by thiobarbituric acid test anal. Elsevier Sci., 86: 271-278. DOI: 10.1016/0003-2697(78)90342-1.

National Research Council, 1994. Nutrient Requirements of Poultry. 9th Rev. Edn. National Academy Press, Washington DC. http://www.nap.edu/openbook.php isbn=0309048923.

Onibi, G.E. and I.B. Osho, 2007. Oxidative stability and bacteriological assessment of meat from broiler chickens fed diets containing Hibiscus sabdariffa calyces. Afr. J. Biotechnol., 6 (23): 2721-2726.

Rogowski, B., 1980. Meat in human nutrition. World Rev. Nutr. Diet., 34: 46-49. PMID: 6986722.