Journal of Animal and Veterinary Advances 9 (3): 474-477, 2010
ISSN: 1680-5593

Influence of Canola Oil in Broiler Diets and its Effects of MUFAs and PUFAs Contents in Selected Tissues

Ramin Salamatdoustnobar, K. Nazerad,
Habib Aghdam Shahriyar, Abolfazl Ghorbani and Peyman Fouladi
Department of Animal Science, Islamic Azad University, Shabestar Branch, Shabestar, Iran

Abstract: The aim of this research was to evaluate the effect of Canola Oil (CO) on the carcass selected tissues of male broiler chickens. A total of 90 Ross 308 strains were randomly divided into 3 experimental treatments with 3 replicates were arranged in a completely randomized design. The experimental period lasted 6 weeks. Experimental diets include basal diet with 0% CO; basal diet with 2% CO and basal diet with 3% CO. Meat fatty acids profiles with Gas Chromatography technique were determined. According to results the MUFAs content for breast meat in T_2 and T_3 treatment were significantly ($p<0.05$) decreased compared to control group but in thigh meat MUFAs contents compared to control group significantly ($p<0.05$) increased. For PUFAs a similar response was observed in breast and thigh meat and was achieved significant changes in PUFAs contents compared with control group but for breast meat more incorporation of PUFAs than thigh. For increase of nutritional value of broiler meat, 3% of canola oil suitable for enrichment.

Key words: Broiler, canola oil, meat, fatty acid, MUFAs, PUFAs

INTRODUCTION

It is well known that the diet plays an important role in altering meat fatty acid composition (Yaquoob, 2003, 2004; Stulnig, 2003; Salamatdoustnobar *et al*., 2007, 2008). Recently supplementation of diets with lipids from oilseeds for intensive poultry production has been observed. These contain predominantly n-6 Poly-unsaturated Fatty Acids (PUFAs) and consequently, poultry lipids have comprised higher levels of n-6 fatty acids and lower levels of n-3 PUFAs.

Canola oil are one of the few lipid stheces rich in n-3 and their inclusion in poultry diets could contribute to increased the concentrations of PUFAs in poultry lipids (Salamatdoustnobar *et al*., 2007; Lopez-Ferrer *et al*., 1999). Fat inclusion in broiler diets affects carcass fat quality because dietary fatty acids are incorporated with little change into the bird body fats (Salamatdoustnobar *et al*., 2008). The purpose of this experiment was to determine of canola oil effects on the meat fatty acids and compared MUFAs and PUFAs contents in broiler chick's meat.

MATERIALS AND METHODS

A total of 90 male one day old age (ROSS 308) broiler chicks in three treatment and replication for 6 weeks were used as experimental animals. Diets were is caloric and is nitrogenous with the following characteristics:

- T_1 control (Soybean-corn)
- T_2 control + 2% (CO)
- T_3 Control + 4% (CO)

The diets ingredients' are shown in Table 1-3, respectively. In the end of breeding period (42 days), two chicks were randomly taken from each replicate for meat sampling. The meat samples of breast and thigh carefully minced and its oil extract with chloroform. Crude lipids were analyzed by Gas Chromatography (GC). Data's were statistically analyzed using one-way ANOVA and means were compared by Duncan multiple range test.

Statistical analyses: Data were analyzed in a complete randomized design using the GLM procedure of SAS version 8.2 (SAS Inst. Inc., Cary, NC).

$$y_{ij} = \mu + a_i + \varepsilon_{ij}$$

Where:

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

Corresponding Author: Ramin Salamatdoustnobar, Department of Animal Science, Islamic Azad University, Shabestar Branch, Shabestar, Iran

Table 1: Percentage composition of experimental diet in starter period

Ingredients	Percent
Corn	53.5
Soybean	34
Canola oil	0.5
Starch	8
Wheat bran	0
DL-Methionine	0.54
Lysine	0
DCP	1.38
Oyster	1.33
Vitamin[1]	0.25
Mineral[2]	0.25
Salt	0.25
Coccidiostat	0
Sand	0
Total	100
Calculated nutrient content	
ME kcal kg^{-1}	2920
Crude protein (%)	21

[1]Vitamin content of diets provided per kilogram of diet: vitamin A, D, E and K. [2]Composition of mineral premix provided as follows per kilogram of premix: Mn, 120,000 mg; Zn, 80,000 mg; Fe, 90,000 mg; Cu, 15,000 mg; 1,600 mg; Se, 500 mg; Co, 600 mg

Table 2: Percentage composition of experimental diets in growth period

	Experimental diets		
Ingredients	T_1	T_2	T_3
Corn	64	60	55
Soybean	27.4	28	27.1
Canola oil	0	2	4
Starch	3.74	2.06	1.22
Wheat bran	1	2	5.5
DL-Methionine	0	0	0
Lysine	0	0	0
DCP	1.13	1.14	1.16
Oyster	1.5	1.48	1.46
Vitamin[1]	0.25	0.25	0.25
Mineral[2]	0.25	0.25	0.25
Salt	0.25	0.25	0.25
Coccidiostat	0.15	0.15	0.15
Sand	0.33	2.42	3.66
Calculated nutrient content			
ME (kcal kg^{-1})	2920	2920	2920
Crude protein (%)	18.2	18.2	18.2

Table 3: Percentage composition of experimental diets in finisher period

	Experimental diets		
Ingredients	T_1	T_2	T_3
Corn	66.5	57.5	56
Soybean	24.1	25.85	24
Canola oil	0	2	4
Starch	3.81	4.34	1.94
Wheat bran	0	5	6
DL-Methionine	0.44	0.45	0.45
Lysine	0.043	0.015	0.08
DCP	0.89	0.92	0.89
Oyster	1.38	1.36	1.31
Vitamin[1]	0.25	0.25	0.25
Mineral[2]	0.25	0.25	0.25
Salt	0.25	0.25	0.25
Coccidiostat	0.15	0.15	0.15
Sand	1.937	1.665	4.43
Calculated nutrient content			
ME (kcal kg^{-1})	2920	2920	2920
Crude protein (%)	16.5	16.4	16.5

RESULTS AND DISCUSSION

Results show that CO in this experimental could affect fatty acids profiles in whole carcass. The MUFAs found in breast and thigh meat were Myristoleic acid, Palmitoleic acid, Oleic acid, Vaccenic acid and Gondoic acid (Table 4 and 5). The Myristoleic acid (C14:1n5) content for breast meat were significant difference ($p<0.0.5$) between T_3 and T_1 and for thigh meat Myristoleic acid content in T_2 and T_3 treatments was significant compared with control group ($p<0.05$). Results for Palmitoleic acid (C16:1n7) for both breast and thigh meat show that T_2 treatment were higher and in the thigh meat was significant ($p<0.05$).

The incorporation of canola oil in diets was smallest effect on oleic acid (C18:1n9) and that were not significant. Vaccenic acid (C18:1n7) only were significantly affected in breast meat in T_2 but in thigh

Table 4: Least square means for fatty acid profiles in broilers breast meat fed canola oil

	Treatments				
Parameters	T_1	T_2	T_3	SEM	P>F
C14:0	0.59^a	0.51^a	0.54^a	0.016883	0.1101
C14:1n5	0.11^b	0.10^b	0.54^a	0.009156	<0.0001
C16:0	28.50^a	27.01^a	22.71^b	0.765465	0.0262
C16:1n7	6.47^a	6.60^a	5.26^b	0.176499	0.0218
C18:0	6.60^a	6.21^a	6.34^a	0.18724	0.4380
C18:1n9	33.65^a	30.00^a	29.2^a	0.920539	0.1299
C18:1n7	2.40^b	2.93^a	2.73^{ab}	0.078816	0.0379
C18:2n6cis	12.33^b	13.53^{ab}	15.35^a	0.404577	0.0295
C18:3n3	0.72^b	0.75^b	0.87^a	0.02186	0.0295
C20:0	0.75^a	0.24^b	0.23^b	0.013268	0.0002
C20:5n3	0.37^c	1.18^b	2.03^a	0.040638	0.0002
C20:1n9	0.17^c	0.23^b	0.31^a	0.007092	0.0020
C22:6n3	0.61^b	0.62^b	0.75^a	0.01854	0.0228
C22:0	0.93^b	1.96^a	1.93^a	0.050233	0.0011
SFA	37.37^a	35.94^{ab}	31.75^b	0.609	0.0534
MUFAs	42.80^a	39.86^b	38.04^b	0.825	0.1160
PUFAs	14.03^b	16.08^a	19.00^a	0.257	0.2066

Table 5: Least square means for fatty acid profiles in broilers thigh meat fed canola oil

	Treatments				
Parameters	T_1	T_2	T_3	SEM	P>F
C14:0	0.60^a	0.14^c	0.17^b	0.0122	0.0002
C14:1n5	0.19^c	0.87^a	0.47^b	0.0171	0.0002
C16:0	26.21^a	22.37^b	21.88^b	0.6878	0.0370
C16:1n7	6.20^b	7.83^a	6.17^b	0.1973	0.0149
C18:0	8.28^b	8.96^{ab}	10.07^a	0.2667	0.0393
C18:1n9	35.32^a	37.25^a	35.76^a	1.0534	0.4686
C18:1n7	2.52^a	2.48^a	2.27^a	0.0703	0.1453
C18:2n6cis	10.20^b	11.53^a	12.00^a	0.3565	0.1002
C18:3n3	0.52^b	0.66^a	0.74^a	0.0185	0.0085
C20:0	0.81^a	0.54^c	0.63^b	0.0185	0.0041
C20:5n3	0.34^c	1.43^b	2.36^a	0.0461	0.0002
C20:1n9	0.12^b	0.21^a	0.14^b	0.0041	0.0013
C22:6n3	0.25^b	0.50^a	0.47^a	0.0126	0.0016
C22:0	0.76^b	1.94^a	1.96^a	0.04656	0.0005
SFA	36.66^a	33.95^a	34.71^a	0.6700	0.2709
MUFAs	44.35^b	48.64^a	44.81^{ab}	0.9600	0.0761
PUFAs	11.31^b	14.12^a	15.57^a	0.3000	0.1163

meat was not significant. Mean while Gondoic acid (C20:1n9) content in breast meat and thigh meat were significant difference and affected T_2 and T_3 treatment. A number of studies have examined the effects of dietary PUFAs sthece such as vegetable oil, on the fatty acids composition of the broiler carcass.

Many of studies were conducted enhance human dietary intake of long chain n-3, have beneficial effects to human health (Miller and Robisch, 1969; Hulan *et al*., 1988; Phetteplace and Watkins, 1990; Nash *et al*., 1995). The Polyunsaturated fatty acids for T_2 and T_3 breast and thigh meat include Linoleic acid, α-Linolenic acid, Eicosapentaennoic acid and Docosahexaenoic acid were significant difference compared to control group ($p<0.05$). The content of Linoleic acid (c18:2n6cis) in breast meat for T_3 treatment was 15.35 and compared with T_1 with 12.33 g kg^{-1}, respectively was significant ($p<0.05$) and for thigh meat T_2 and T_3 were significant compared to control group and from 10.2 g kg^{-1} reached to 11.53 and 12.00 g kg^{-1} for T_2 and T_3, respectively. Similar results have previously been reported by other researchers, who found a higher deposition of long-chain PUFAs in breast muscle compared with thigh (Hulan *et al*., 1988; Lopez-Ferrer *et al*., 1999; Gonzalez-Esquerra and Leeson, 2000; Crespo and Esteve-Carcua, 2001; Salamatdoustnobar *et al*., 2007). Results show that α-Linolenic acid (C18:3n3) content in breast and thigh meat samples for T_3 treatment with 0.87 and 0.74 g kg^{-1} could significantly increased ($p<0.05$). The fatty acid composition of the broiler carcass lipids is generally a reflection of the fatty acid profile of the diet fed. This is consistent with the results of a number of earlier studies (Hulan *et al*., 1988; Yau *et al*., 1991; Zollistsch *et al*., 1997). According to results Eicosapentaennoic acid (C20:5n3) in breast and thigh meat for T_2 and T_3 in compared to other levels were significant ($p<0.05$). Docosahexaenoic acid (C22:6n3) content for breast meat only in T_3 was significant and for thigh meat both T_2 and T_3 could significantly increased this fatty acid ($p<0.05$).

These data are consistent with those obtained on other studies (Herod and Kinsella, 1986; Phetteplace and Watkins, 1989; Olomu and Baracos, 1991). Since the fatty acid, composition of broiler chicken carcass may be influence considerably by that of the diet (Miller and Robisch, 1969; Hargis and Elswyk, 1993).

It's expected that diets containing oils and fats will influence carcass fatty acid composition affecting their predominant fatty acids. With regards to results total of MUFAs for breast meat, CO could significantly decreased their content, but for thigh meat results show that only 2% of CO compared to control group was higher ($p<0.05$). PUFAs content of breast meat like of thigh meat usage CO in T_2 and T_3 could significantly increase compared to control group and from 14.03 with ascending rate reached to 16.08 and 19 g kg^{-1}, respectively and for thigh meat usage CO in T_2 and T_3 treatment with 14.12 and 15.57 g kg^{-1} significantly increased to control group ($p<0.05$). A similar response was observed in breast and thigh meat and produced significant changes in PUFAs contents but more incorporation of PUFAs than thigh.

ACKNOWLEDGEMENT

Financial support for this study (Islamic Azad University, Shabestar Branch) was provided.

REFERENCES

Crespo, N. and E. Esteve-Garcua, 2001. Dietary fatty acid profile modifies abdominal fat deposition in broiler chickens. Poult. Sci., 80: 71-78.

Gonzalez-Esquerra, R. and S. Leeson, 2000. Effects of menhaden oil and flaxseed in broiler diets on sensory quality and lipid composition of poultry meat. Br. Poult. Sci., 41: 481-488.

Hargis, P.S. and M.E. van Elswyk, 1993. Manipulation of fatty acid composition of poultry meat and eggs for health conscious consumer. J. Worlds Poult. Sci., 49: 251-264.

Herod, P.M. and J.E. Kinsella, 1986. Fish oil consumption and decreased risk of cardiovascular disease: A comparison of findings from animal and human feeding trials. Am. J. Clin. Nutr., 43: 566-598.

Hulan, H.W., R.G. Ackman, W.M.N. Ratnayake and F.G. Proudfoot, 1988. Omega-3 fatty acid levels and performance of broiler chickens fed redfish meal or redfish oil. Can. J. Anim. Sci., 68: 533-547.

Lopez-Ferrer, S., M.D. Baucells, A.C. Barroeta and M.A. Grashorn, 1999. N-3 Enrichment of chicken meat using fish oil: Alternative substitution with rapeseed and linseed oils. Poult. Sci., 78: 356-365.

Miller, D. and P. Robisch, 1969. Comparative effect of herring, menhaden and safflower oils on broiler tissues fatty. Poult. Sci., 48: 2146-2157.

Nash, D.M., R.M.G. Hamilton and H.W. Hulan, 1995. The effect of dietary herring meal on the omega-3 fatty acid content of plasma and egg yolk lipids of laying hens. Can. J. Anim. Sci., 75: 247-253.

Olomu, J.M. and V.E. Baracos, 1991. Influence of dietary flaxseed oil on the performance, muscle protein deposition and fatty acid composition of broiler chicks. Poult. Sci., 70: 1403-1411.

Phetteplace, H.W. and B.A. Watkins, 1989. Effects of various n-3 sources on fatty acid composition in chicken tissues. J. Food Comp. Anal., 2: 104-117.

Phetteplace, H.W. and B.A. Watkins, 1990. Lipid measurements in chickens fed different combinations of chicken fat and menhaden oil. J. Agric. Food Chem., 38: 1848-1853.

Salamatdoustnobar, R., K. Nazeradl, A. Gorbani, H. Aghdamshahriar and J. Gheyasi, 2007. Incorporation of DHA and EPA fatty acids into broiler meat lipids. J. Anim. Vet. Adv., 6: 1199-1203.

Salamatdoustnobar, R., H. Aghdamshahriar and A. Gorbani, 2008. Enrichment of broiler meat with n-3 polyunsaturated fatty acids. Asian J. Anim. Vet. Adv., 3: 70-77.

Stulnig, T.M., 2003. Immunonodulation by polyunsaturated fatty acids: Mechanism and effects. Int. Arch. Allergy Immunol., 132: 310-321.

Yaquoob, P., 2003. Fatty acids as gatekeepers of immune cell regulation. Trends Immunol., 24: 639-645.

Yaquoob, P., 2004. Fatty acids and the immune system: From basic science to clinical applications. Proc. Nutr. Soc., 63: 89-104.

Yau, J.C., J.H. Denton, C.A. Bailey and A.R. Sams, 1991. Customising the fatty acid content of broiler tissue. Poult. Sci., 70: 167-172.

Zollistsch, W., W. Knaus, F. Aichinger and F. Lettner, 1997. Effects of different dietaryfat stheces on performance and carcass characteristics of broilers. Anim. Feed Sci. Technol., 66: 63-73.