

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

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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 T₂ and T₃ 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 (Yaquooob, 2003, 2004; Stulnig, 2003; Salamatdoust *et al.*, 2007, 2008). Recently supplementation of diets with lipids from oilseeds for intensive poultry production has been observed. These contain predominantly n-6 Polyunsaturated 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 (Salamatdoust *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 (Salamatdoust *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:

- T₁ Control (Soybean-corn)
- T₂ Control + 2% (CO)
- T₃ 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 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 (2000) version 8.2 (SAS Inst. Inc., Cary, NC).

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

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

Table 1: Percentage composition of experimental diet in starter period

Ingredients	Percentage
Corn	53.50
Soybean	34.00
Canola oil	0.50
Starch	8.00
Wheat bran	0.00
DL-Methionine	0.54
Lysine	0.00
DCP	1.38
Oyster	1.33
Vitamin ¹	0.25
Mineral ²	0.25
Salt	0.25
Coccidiostat	0.00
Sand	0.00
Total	100.00
Calculated nutrient content	
ME kcal kg ⁻¹	2920.00
Crude protein (%)	21.00

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; I, 1,600 mg; Se, 500 mg; Co, 600 mg

Table 2: Percentage composition of experimental diets in growth period

Ingredients	Experimental diets		
	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

Ingredients	Experimental diets		
	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<0.05) between T₃ and T₁ and for thigh meat Myristoleic acid content in T₂ and T₃ treatments was significant compared with control group (p<0.05). Results for Palmitoleic acid (C16:1n7) for both breast and thigh meat show that T₂ 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 was significantly affected in breast meat in T₂ but in thigh

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

Parameters	Treatments				SEM	P>F
	T ₁	T ₂	T ₃			
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	0.002
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

Parameters	Treatments				SEM	P>F
	T ₁	T ₂	T ₃			
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 T₂ and T₃ treatment. A number of studies have examined the effects of dietary PUFAs sthce 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, 1996; Hulan *et al.*, 1988; Phetteplace and Watkins, 1990; Nash *et al.*, 1995). The Polyunsaturated fatty acids for T₂ and T₃ breast and thigh meat include Linoleic acid, α -Linolenic acid, Eicosapentaenoic 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 T₃ treatment was 15.35 and compared with T₁ with 12.33 g kg⁻¹, respectively was significant ($p < 0.05$) and for thigh meat T₂ and T₃ were significant compared to control group and from 10.2 g kg⁻¹ reached to 11.53 and 12.00 g kg⁻¹ for T₂ and T₃, 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-Esquerria and Leeson, 2000; Crespo and Esteve-Garcya, 2001; Salamatdoust *et al.*, 2007). Results show that α -Linolenic acid (C18:3n3) content in breast and thigh meat samples for T₃ 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; Zollitsch *et al.*, 1997). According to results Eicosapentaenoic acid (C20:5n3) in breast and thigh meat for T₂ and T₃ in compared to other levels were significant ($p < 0.05$). Docosahexaenoic acid (C22:6n3) content for breast meat only in T₃ was significant and for thigh meat both T₂ and T₃ could significantly increased this fatty acid ($p < 0.05$).

These data are consistent with those obtained on other studies (Herald 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, 1996; 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 T₂ and T₃ 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 T₂ and T₃ 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.

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