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Effects of Different Substitution Levels of Fish Oil and Poultry Fat on Performance and Parts of Carcass on Male Broiler Chicks

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Abstract: This experiment was conducted to assess the effect of replacing Poultry Fat (PF) with Fish Oil (FO) in broiler diets on performance and different parts of carcass. Three percents oil in 4 diets were altered with replacing PF by FO in completely randomized design at 4 treatments with 4 replicates (T1 = 3%PF, T2 = 2% PF+1% FO, 3 = 1% PF+2% FO and T4 = 3% FO) and were given *ad libitum* to the birds fed throughout the growth period. Performance and carcass parts were determined after withdrawal of FO from the diet (during one week), before slaughtering in 49-d old. Higher live weight, weight gain and lower Feed Conversion Ratio (FCR) were recorded for birds T3 (1% PF+2% FO). The low abdominal fat and highest weight of spleen was observed for treatment of 3% fish oil (T4), ($p<0.01$). Feed intake and other parts of carcass had not significant differences among treatments. In conclusion it seems that inclusion of fish oil in diets including poultry fat could be produce better performance and carcass efficiency.

Key words: Fish oil, poultry fat, performance, carcass, broiler

INTRODUCTION

The supplementation of broiler diets with small quantities of fats and oils is a long standing practice for increasing growth and the utilization of feed and energy and entirely improving the performance (Rand *et al*., 1958; Vermeersch and Vaschoubroek, 1968; Crew *et al*., 1972).

In the recent studies, the performance and difference parts of carcass has been investigated through supplementing diets with marine origins i.e. fish oil, (Dansky, 1962; Hulan, 1988, 1989; Farrel, 1995; Lopez Ferrer *et al*., 1999, 2001) and animals origins i.e. poultry fat (Aloa and Balnave, 1984; Phetteplace and Watkins, 1989; Sklan and Ayal, 1989; Zollistsch *et al*., 1997). Results from these studies indicate that digestibility of fat added, were increased (improve of performance) and abdominal fat decreased as the degree of unsaturation increase.

The marine oils (fish oil and certain marine algae) contain the long chain (C_{20} and longer) omega 3 fatty acids as being an important factor in the diet is for promote of health in man and animals than other origins (Bezard *et al*., 1994; Scaife *et al*., 1994; Cherian *et al*., 1996).

Thus, this study was conducted to evaluate the effect of two type origins (alpha linolenic acid origin, i.e. fish oil and linoleic acid origin, i.e. poultry fat) on performance and carcass parts of male Broiler chicks.

MATERIALS AND METHODS

This experiment was carried$_{out}$ in research farm of Islamic Azad University-Shabestar branch in summer 2006. Six hundred unsexed one-day-old ROSS strain chicks were obtained from a commercial hatchery. The chicks were fed a common basal broiler starter diet from 1 to 20 days (starter period) in completely randomized design at four treatments with 4 replicates. At 21st day, 240 male chickens were sexed and randomly design with (15 bird per pen) and fed experimental diets [diets of containing 3%PF(T1), 2%PF+1%FO(T2), 1% PF+2% FO(T3) and 3% FO(T4)] throughout a 21-d growth period. The experimental diets formulated to be isonitrogenouse (19.5% CP) and isoenergetic (3136 kcal kg^{-1} ME), in accordance with the NRC (1994). The birds were given access to water and diets *ad libitum*. The measured and calculated nutrient composition of the starter and experimental diets were shown in Table 1.

At 42-d, the performance parameters was calculated and the birds were slaughtered at 49-d (two samples per pen) after to exert of withdrawal of FO from diet to determine of parameters.

Statistical analysis: The experiment was based on a completely randomized design. All data were analyzed by ANOVA using the General Linear Model (GLM)

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Table 1: Composition and calculated nutrient content of diets fed to chicks

Ingredients and composition, %	Starter diet[1]	Experimental diet	Withdrawal plan diet[2]
Yellow corn	62.50	61.50	55.50
Wheat	-	-	20.00
Soybean meal	30.50	31.00	20.10
Fish meal	4.00	1.00	1.55
Added fat/oil[3]/PF/FO	-	3.00	-
Monocalcium phosphate	0.80	-	-
Dicalcium phosphate	-	0.90	-
Bone meal	-	-	0.80
Oyster shell	1.20	1.40	1.00
DL-Methionine	0.30	0.20	0.07
Salt	0.20	0.30	0.23
Vitamin/mineral premix[4]	0.45	0.45	0.45
Coccidiostat	0.05	0.10	0.10
Vit E	-	0.10	0.10
Vit A	0.10	0.05	0.10
Total	100.00	100.00	100.00
Calculated nutrient content			
ME (kcal kg^{-1})	2.950	3.136	3.020
Crude protein (%)	21.20	19.50	17.11
Calcium (%)	0.32	0.14	0.15
Available P (%)	0.32	0.21	0.23
Methionine (%)	0.37	0.31	0.28
Methionine+cystine (%)	0.65	0.56	0.52
Lysine (%)	1.22	1.07	0.90

[1]starter diet fed to birds from 0 to 21 d, [2]oil remove for one wk before slaughter (to decreased of unacceptable odors), [3]three percent added fat: T1, control diet = 3% Poultry Fat (PF); T2 = 1% Fish Oil (FO)+2% PF; T3 = 2% FO+1% PF; T4 = 3% FO, [4]provides per kilogram of diet: vitamin A, 9,000,000 IU; vitamin D3, 2,000,000 IU; vitamin B1, 1,800 mg; vitamin B2, 6,600 mg; vitamin B3, 10,000 mg; vitamin B6, 3,000 mg; vitamin B12,15 mg; vitamin E, 18,000 mg; vitamin K3, 2,000 mg; vitamin B9, 1,000 mg; vitamin B5, 30,000 mg; vitamin H2, 100 mg; folic acid, 21 mg; nicotinic acid, 65 mg; biotin, 14 mg; choline chloride, 500,000 mg; Mn, 100,000 mg; Zn, 85,000 mg; Fe, 50,000 mg; Cu, 10,000 mg; I, 1,000 mg; Se, 200 mg

procedures of the SAS Institute (SAS Institute, 2000). The differences between means were determined using the Duncan test. The data are expressed as means and their Standard Error (SE).

RESULTS AND DISCUSSION

Performance parameters: The all of performance parameters showed significant difference with the exception of the feed intake. With the increase of FO contains and decrease of PF levels, improved feed efficiency, weight gain and final weight in male broiler chickens ($p<0.01$). This resulting for T2, T3 and T4 were better that those for T1 (Table 2).

The effect of fat type on efficiency feed could be related to degree of unsaturation, because some others (Aloa and Balnave, 1984; Pinchasov and Nir, 1992; Zolisch *et al*., 1997) who reported that digestibility of fat increased as the degree of unsaturation increases. The inclusion of fish oil in poultry diets has also been reported to have no effect on consumption of feed (Huang *et al*., 1990), but significantly higher weight gain,

Table 2: Performance parameters[1]of chicks according to different amounts of Fish oil in diets (21-42 d)

	Experimental diets[2]					
Variable	T1	T2	T3	T4	SE	Sign
Live weight (kg $bird^{-1}$)	1.92^{d}	1.97^{c}	2.05^{a}	2.02^{b}	0.577	**
Feed intake (g $bird^{-1}$)	122.67	122.80	122.88	122.83	0.191	NS
Weight gain (g $bird^{-1}$)	61.22^{d}	63.45^{c}	66.82^{a}	65.65^{b}	0.217	**
FCR (g: g)	1.97^{a}	1.93^{b}	1.84^{d}	1.87^{c}	0.006	**

[a,b,c,d] Values in the same row and variable with no common superscript differ significantly ($p<0.05$), [1]Values are means of eight observations per treatment and their standard errors, [2]T1 = diet with 3% Poultry Fat (PF); T2 = diet with 2% PF+1% Fish Oil (FO); T3 = diet with 1% PF+2% FO and T4 = diet with 3% FO, [3]NS= $p>0.05$; **= $p<0.01$

Table 3: Carcass yield parameters of birds[1] after withdrawal of fish oil from diets

	Experimental diets[2]					
Variable	T1	T2	T3	T4	SEM	Sign
Carcass yield,	69.32	69.27	68.55	68.32	0.590	NS
Abdominal fat,[4]	2.68^{a}	2.67^{a}	2.55^{a}	2.37^{b}	0.055	**
Breast,[4]	17.55	17.82	18.10	18.05	0.383	NS
Thigh,[4]	19.37	19.55	19.62	19.75	0.224	NS
Liver,[4]	2.00	2.05	2.10	2.16	0.070	NS
Gizzard,[4]	1.45	1.47	1.55	1.60	0.110	NS
Heart,[4]	0.45	0.45	0.46	0.46	0.012	NS
Spleen,[4]	0.08^{c}	0.10^{bc}	0.11^{ab}	0.13^{a}	0.007	**

[a,b,c]Values in the same row and variable with no common superscript differ significantly ($p<0.05$), [1] Values are means of eight observations per treatment and their Standard Errors (Means±SE), [2] T1 = diet with 3% Poultry Fat (PF); T2 = diet with 2% PF+1% Fish Oil (FO); T3 = diet with 1% PF+2% FO and T4 = diet with 3% FO, NS= $p>0.05$; ** =$p<0.01$, [4]Percentage of carcass

final weight and significant improvement in FCR (Farell, 1995) was observed in the chickens fed added dietary fat contain 1% PF+2% FO (T3) compared to other groups (3% PF, 2% PF+1% FO and 3% FO).

This is in agreement with the findings of Huang *et al*. (1990), Newman *et al*. (1998), Crespo and Esteve-Garcia (2001, 2002) and Lopez Ferrer *et al*. (1991, 2001). Fish oil was rich n-3 fatty acids, that reduced the catabolic response induced by immune stimulation and effectively may promot growth (Chin *et al*., 1994).

Carcass yield parameters: The carcass yield values (Table 3) considered on the basis of the carcass weight after feet and head had been removed, were similar among the treatments and ranged from 68-69%. Among parameters of carcass, the low abdominal fat and highest weight of spleen, was observed in T4 and other parts such as breast, thigh, liver and heart were not showed significant differences.

Abdominal fat: In male broiler chickens, abdominal fat deposition showed a significant interaction. With replacing PF by FO, decreased abdominal fat, corresponding with the results of Zolitsch *et al*. (1997) and Lopez Ferrer *et al*. (2001). Therefore, the present results show that in males, diets rich in PUFA do cause

depress abdominal fat deposition. Pinchasove and Nir (1992) reported that n-3 LC PUFA content (1/4 %) in the diet, reduces fat accretion in chickens. Omega-3 fatty acids present in fish oils, mainly Docosahexaenoic (DHA) and Eicosapentaenoic Acids (EPA) reduced fat deposition by reducing the circulating Very Low Density Lipoprotein (VLDL) levels in the blood and effectivness to decrease of fat accretion in arteries, tissues and carcass.

Spleen: Replacing of PF by FO indicated significant difference ($p<0.01$) in weight of spleen that highest percentage of spleen was to male chicks fed 3% FO (T4). This result in agreement with results by Susan *et al.* (1997) from experiment conducted on rat (heavier liver and spleen in fed rats from fish oil rather than pig oil) and observed by Paddy *et al.* (2005) weight gain of spleen in fed chicks from diet contain 3 and 6% fish meal. On the other hand, weight of liver was not significantly increased ($p<0.10$). Halver (2005), with investigate of effect of fish oil on difference animals such as broiler chickens, turkeys, ducks, pigs, rats and rabbits, reported Hypervitaminosis A (above used of FO) has been described in fish oil and in other animals and involved enlargement of liver and spleen, abnormal growth, skin lesions, epithelial keratinization, hyperplasia. He, also observed that affect of deficiency of Vit E (α-Tocopherol) with used fish oil in diet (for stopping per oxidation of lipid), signs is followed by anemia, ascites, exophthalmia, poor growth, poor food conversion, epicarditis and ceroid deposits in spleen and liver.

CONCLUSION

In conclusion it seems that inclusion of fish oil in diets including poultry fat could be produce better performance and carcass efficiency. It may be due to fat substitution from n-6 type (Linoleic Acid, LA) to (alpha Linolenic Acid, LNA) and specially LC n-3 PUFA type such as Eicosapentaenoic Acid (EPA) and Docosa-hexaenoic Acid (DHA) had significant effects on performance improvement and lower abdominal fat in male broiler chickens.

REFERENCES

Aloa, S.J. and D. Balnave, 1984. Growth and carcass composition of broiler fed sunflower oil and olive oil. Br. Poul. Sci., 69: 844-846.

Be´zard, J., J.P. Blond, A. Bernard and P. Clouet, 1994. The metabolism and availability of essential fatty acids in ani-mal and human tissues. Reprod. Nutr. Dev., 34: 539-568.

Cherian, G., F.W.Wolfe and J.S. SIM, 1996. Dietary oils and added tocopherols: Effects on egg or tissue tocopherols, fatty acids and oxidative stability. Poult. Sci., 75: 423-431.

Chin, S.F., J.M. Storkson, K.J. Albright, M.E. Cook and M.W. Pariza, 1994. Conjugated linoleic acid is a growth factor for rats as shown by enhanced weight gain and improved feed efficiency. J. Nutr. 124: 2344-2349.

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

Crespo, N. and E. Esteve-Garcia, 2002. Dietary polyunsaturated fatty acids decrease fat deposition in separable fat depots but not in the remainder carcass. Poult. Sci., 81: 1533-1542.

Crew, L.B., R.H. Machemer, R.W. Sharp and D.C. Foss, 1972. Fat absorption by very young chick. Poult. Sci., 51: 738-742.

Dansky, L.M, 1962. The growth promoting properties of menhaden fish oil as influenced by various fats. Poul. Sci., 41:1352-1354.

Farrell, D.J., 1995. The enrichment of poultry products with the omega (n)-3 polyunsaturated fatty acids: A selected review. Proc. Aus. Poult. Sci. Symp., 7: 16-21.

Halver, J.E., 2005. The Vitamins. Aquaculture development and coordination programme. Fish feed technology. Chapter 6, University of Washington Seattle, Washington.

Huang, Z.B., R.G. Ackman, W.M.N. Ratnayake and F.G. Proudfoot, 1990. Effect of dietary fish oil on n-3 fatty acid levels in chicken eggs and thigh flesh. J. Agric. Food Chem., 38: 743-747.

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 oil. Can. J. Anim. Sci., 68: 533-547.

Hulan, H.W., R.G. Ackman, W.M.N. Ratnayake, F.G. Proudfoot, 1989. Omega-3 fatty acid levels and general performance of broiler chickens fed reddish meal or reddish oil. Poult. Sci, 68: 153-162.

Lo´pez-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.

Lo´pez-Ferrer, S., M.D. Baucells, A.C. Barroeta, J. Galobart and M. A. Grashorn, 2001. N-3 Enrichment of chicken meat. 2. Use of precursors of long-chain polyunsaturated fatty acids: Linseed oil. Poult. Sci., 80: 753-761.

National Research Council (NRC), 1994. Nutrient Requirements of Poultry. 9th Rev. Edn. National Academy Press. Washing-ton, DC.

Newman, R.E., J.A. Downing, W.L. Bryden, E. Fleck, W.A. Buttemer and L.H. Storlien, 1998. Dietary polyunsaturated fatty acids of the n-3 and the n-6 series reduce abdominal fat in the chicken (Gallus domesticus). Proc. Nutr. Soc. Aust., 22: 54.

Paddy, L., U. Wiesenfeld, S. Babu, B.R.. Raybourne, D. Gaines, O. Michael, J.R. Donnell and M.J. Myers, 2005. Effect of Dietary Fish-meal on Chicken Serum, liver and spleen fatty acid metabolism. Int. J. Pul. Sci., 4: 728-733.

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

Pinchasov, Y. and I. Nir, 1992. Effect of dietary polyunsaturated acid concentration on performance, fat deposition and carcass fatty acid composition in broiler chickens. Poult. Sci., 71: 1504-1512.

Rand, N.T., H.M. Scott, F.A. Kummerow, 1958. Dietary fat in the nutrition of the growing chick. Poult. Sci., 37: 1075-1085.

SAS Institute, 2000. SAS_ User's Guide. SAS Institute Inc., Cary, NC.

Susan, O., D. McGuire, W. Alexander and L. Kevin, 1997. Fish Oil source differentially affects rat immune cell α-Tocopherol concentration. J. Nutr., 127: 1388-1394.

Sklan, D. and A. Ayal, 1989. Effects of saturated fatty acids on growth, body fat and carcass quality in chicks. Br. Poult. Sci., 30: 407-411.

Scaife, J.R., J. Moyo, H. Galbraith, W. Michie and V. Campbell, 1994. Effect of different dietary supplemental fats and oils on the tissue fatty acid composition and growth of female broilers. Br. Poult. Sci., 35: 107-118.

Vermeersch, G. and F. Vanschoubroek, 1968. The quantification of the effects of increasing levels of various fats on body weight gain, efficiency of food conversion and food intake of growing chicks. Br. Poult. Sci, 9: 13-30.

Zollitsch, W., W. Knaus, F. Aichinger and F. Lettner, 1997. Effects of different dietary fat sources on performance and carcass characteristics of broilers. Anim. Feed Sci. Technol., 66: 63-73.