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EFFECTS OF FULL-FAT CANOLA SEED WITH AN EXOGENOUS ENZYME SUPPLEMENTATION ON PERFORMANCE, CARCASS CHARACTERISTICS AND THYROID HORMONES OF BROILER CHICKENS

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ABSTRACT

This research was performed to determine the effects of full-fat canola seed with enzyme supplementation on performance, carcass characteristics and thyroid hormones (T_3 and T_4) in broiler chickens. Two hundred and forty one_day-old chicks (ROSS 308) were used in a 2×4 factorial design with three replicates per each treatment. Treatments were 2 levels of enzyme supplementation (0 and 5 g/kg of diet) and 4 inclusion rates of full-fat canola seed (0, 30, 60 and 90 g/kg of diet). The results showed improved ($P<0.05$) broiler performance by inclusion of full-fat canola seed. Linear improvement was noted in feed conversion ratio ($P<0.05$) with an increase in dietary levels of canola seed. However, effect of enzyme supplementation on growth performance was not significant ($P>0.05$). Carcass characteristics, except for liver and pancreas percentage, did not influence by either full-fat canola seed levels or enzyme supplementation. The results of thyroid hormones indicated that use of canola seed, irrespective of enzyme supplementation, in diets changed T_3 and T_4 concentration at 7 and 42 days of age in broilers. In conclusion, use of full-fat canola seed in broiler diets had positive effect on growth performance.

Key words: broiler; full-fat canola seed; performance; thyroid hormones.

INTRODUCTION

Canola is one of the most important oil seeds cultivated in the north part of Iran. The nutritive value of canola seed was reported by Meng *et al.,* (2006). Full-fat canola seed contains approximately 400 g/kg oil and 220 g/kg protein and is, therefore, a suitable source of energy and protein in poultry diets (Salmon *et al.,* 1988). Full-fat canola seed has a valuable amino acid composition, including high content of essential amino acids such as lysine, threonine, tryptophan and sulphur amino acids (Roman *et al.,* 2010). Some reports indicated that the use of canola seed in high amount (175 g/kg of diet) decreased the growth performance of broiler chicks (Summers *et al.,* 1982). The lower energy digestibility of canola seed and subsequent poor growth performance depressing in broilers; is related to the oil covered by the cell wall polysaccharides in seed (Lee *et al.,* 1991). Therefore, the use of exogenous enzyme to extract more energy from full-fat canola seed is a desirable method. However, canola seeds have unfavorable substances including glucosinolates, sinapin and tannins which may negatively affect physiological process such as thyroid hormones production (Roman *et al.,* 2010). Little research has been undertaken on the effects of enzyme supplementation on blood thyroid hormones in broilers. Studies reported that use of full-fat canola seed or rapeseed in broiler diets decreased the level of T_3 and T_4 hormones and changed the activity of the liver enzyme in the blood of poultry (Taraz *et al.,* 2006 & Summers *et al.,* 1988).

Therefore, the present study was designed with the aim to investigate the effects of different levels of canola seed with or without enzyme supplementation on performance, carcass characteristics and thyroid hormones of broiler chicks.

MATERIALS AND METHODS

A corn-soybean meal based diets (for starter and grower periods) with different inclusion rates of full-fat canola seed were prepared and formulated to meet or exceed the nutrient requirement for chickens recommended by the National Research Council (1994). The ingredient and calculated nutrients profile of the experimental diets are presented in Table I. The enzyme preparation used in this experiment was a commercial multi-enzyme complex (Rovabio^{TM}) produced as an extract from the fermentation of the fungal organism *penicilium fummiculosum* and contained 2200, 500, 2200, 1000 and 15 units of Xylanase, β-glucanase, Cellulase, pectinase and protease, respectively. Two hundred and forty male and female chicks were obtained from a commercial hatchery and fed with experimental diets until the age of 42 d. The experiment was carried out in a completely randomized design with 2×4 factorial arrangement, including 2 levels of enzyme (0 or 5 g/kg of diet) and 4 levels of full-fat canola seed (0, 30, 60 and 90

g/kg of diet). Each treatment was represented by three replicates and ten birds were randomly assigned to each pen. Birds consumed experimental diets *ad lib* throughout the experimental period of 42 days.

Feed intake and body weight gain of each pen was measured at the same time intervals. Feed conversion ratio for each pen was calculated by dividing feed intake to body weight gain. No mortality was observed in this experiment. On d 42, eight randomly selected birds from each treatment were killed. The weight of the live bird, intestinal tract, breast, thigh, pancreas and liver were recorded. The carcass data were analyzed base on percentage of live weight of each bird.

To determination of the thyroid hormones concentration two birds per each pen were selected and blood samples were obtained by heart puncture. The concentration of triiodothyronine (T_3) and thyroxine (T_4) were determined using kits (Tabeshyarnoor Company, Iran).

Statistical Analysis: General linear model (GLM Procedure) was used to evaluate the effects of full-fat canola seed inclusion rates and enzyme supplementation on performance, carcass characteristics and thyroid hormones of broilers using SAS (SAS institute, 2001). Statistical significance of differences among treatments was assay using the Duncan multiple range test at (P <0.05).

RESULTS AND DISCUSSION

The use of different levels of full-fat canola seed changed gain and feed intake (P<0.05; Table II). According to these results the birds fed diets with 90 g/kg FFCS had more weight gain. In the other hand, feed intake was greatest in the broilers fed 30 g/kg FFCS diets. Feed conversion ratio did not influence by full-fat canola seed treatments (P>0.05). None of growth traits were affected by enzyme supplementation (P>0.05).

Table III showed the results of carcass analysis and internal organs of broilers fed dietary treatments. Results indicated that use of 30 and 60 g/kg of full-fat canola seed decreased liver and pancreas (P<0.05) in birds. Other carcass characteristics and internal organs remained unchanged in response to both full-fat canola seed and enzyme supplementation treatments (P>0.05). The T_3 and T_4 plasma concentration changed in birds fed full-fat canola seed treatments at 7 and 42 days of age (P<0.05; Table IV). Results indicated that use of full fat canola seed decreased T_4 concentration compared with control group (diet without full fat canola seed). However, effects of dietary full-fat canola seed on thyroid blood concentration were not significant on day 28 (P>0.05). Thyroid hormones concentration were not affected by dietary enzyme supplementation (P>0.05).

Growth performance was affected by feeding full-fat canola seed in the present study. Summer *et al.,* (1982) found that feeding 17.5% full-fat canola seed to broiler chickens resulted in depressed fat use and body weight gain. Such reduced energy use from canola seed may be due to lower oil availability, resulting from the oil-encapsulating effect of the cell wall polysaccharides in canola seed (Lee *et al.,* 1991). These researchers demonstrated that, without further processing, raw ground canola seed could be included in broiler diets at 10% with no adverse effect on live performance of broiler chickens when compared to the soybean meal control. Roman *et al.,* (2010) reported that increasing level of rape seeds added to the diet for broiler chickens leads to the gradual reduction of feed intake and demonstrated that using full-fat rape seeds in broiler chicken feeding are diversified and they mainly depend on the amount of rape seeds incorporated into the diet. High-level oil in canola seed in comparison to its meal will cause dilution of other nutrient and anti-nutrient in the seed and this point can reduce unpleasant effects of inhibitor and anti-nutrient in canola seed (Talebali and Farzinpour 2005).

Increased in gain and numerical improvement in feed conversion ratio in current study may be due to use of multi enzyme supplementation in diets. Josefiak *et al.,* (2010) indicated that the combination of carbohydrase and phytase enzymes may serve as an attractive means of facilitating nutrient availability for digestion and thus enhance the feeding value of wheat-soybean meal-based diets containing full-fat rapeseed. Previous studies have shown that multi-carbohydrase preparation can improve the nutritive value of full-fat canola (Meng *et al.,* 2006) and flaxseed (Slominski *et al.,* 2006 & Jia *et al.,* 2008). Meng *et al.,* (2006) reported that Enzyme supplementation of the canola seed diet resulted in an improvement in feed conversion ratio, total tract dry matter, fat and non starch polysaccharides digestibility; AMEn content; and ileal fat digestibility in broilers. The elimination of the nutrient-encapsulating effect of cell walls with a multi-carbohydrase enzyme could have a positive effect on the efficacy of nutrient utilization (Josefiak *et al.,* 2010).

A dearth of information exists in terms of carcass parameters to full-fat canola seed in poultry; therefore, direct comparisons cannot be made.

Use of full-fat canola seed changed T_3 and T_4 hormones concentration at 7 and 42 days of age in broiler chickens in current study. Thyroid hormones are involved in controlling metabolic rate, and the concentration of circulating T_3 is positively correlated with oxygen consumption in broilers (Bobek *et al.,* 1977; Gabarrou *et al.,* 1997). Canola have some anti nutrients factors, mainly glucosinolates that hydrolyzed by myrosinase iso-enzymes (Shahidi 1990). Glucosinolates and their hydrolytic products are commonly referred to as

goitrogens and presence of glucosinolates in the diets leads to hypothyroidism in animals, reducing the level of thyroid hormones and alters the ratio between triiodothyronine (T_3) and tetraiodothyronine (T_4) in blood (Bell *et al.,* 1991).

Table 1. The ingredients and chemical composition of basal diets.

Ingredients	Starter (1-21 d)					Grower (21-42 d)			
	0	30	60	90		0	30	60	90
					(g/kg)				
Corn grain	550.5	538.8	525.3	511.9		619.0	603.4	591.6	568.4
Soybean meal	364.6	351.2	337.6	324.1		309.7	295.7	282.1	267.3
Soybean oil	26.6	19.0	12.0	5.0		30.0	23.0	15.0	10.0
FFCS[1]	-	30.0	60.0	90.0		-	30.0	60.0	90.0
Wheat bran	20.0	23.0	27.5	32.0		7.0	14.1	18.0	31.0
DCP	13.0	12.7	12.4	12.1		9.8	9.4	9.1	8.6
Limestone	14.5	14.4	14.4	14.4		14.9	14.9	14.8	14.9
Common salt	4.4	4.3	4.3	4.3		3.3	3.3	3.3	3.3
Min- premix[2]	2.5	2.5	2.5	2.5		2.5	2.5	2.5	2.5
Vit- premix[2]	2.5	2.5	2.5	2.5		2.5	2.5	2.5	2.5
DL.Met	1.5	1.5	1.4	1.4		1.2	1.2	1.1	1.1
Calculated analysis (g/kg)									
AME(MJ/kg)	12.56	12.56	12.56	12.56		12.98	12.98	12.98	12.98
Crude protein	216	215	215	215		193	193	193	193

[1] Full-fat canola seed

[2] Provides per kg of diet: 9000 I.U. vitamin A; 2000 I.U. vitamin D3; 18 I.U. vitamin E; 2 mg menadion; 1.8 mg thiamine; 6.6 mg riboflavin; 30 mg niacin; 3 mg pyridoxine; 15 mg vitamin B12; 100 mg D-pantothenic acid; 1 mg folic acid; 0.1 mg biotin; 500 mg choline chloride; 100 mg antioxidant; 100 mg manganese; 84.7 mg zinc; 50 mg iron; 10 mg copper; 1 mg iodine; 0.2 mg selenium.

Table 2. Gain, feed intake and FCR[1] of treated broilers

Treatment		Parameters		
		Gain	Feed intake	FCR
FFCS[2] (g/kg)	Enzyme	(g)	(g)	(g/g)
0		47.81[b]	91.27[b]	1.91
30		51.10[a]	98.23[a]	1.92
60		49.57[ab]	91.04[b]	1.83
90		52.62[a]	96.84[ab]	1.84
SEM		0.99	2.1	0.05
	+	49.51	93.83	1.89
	-	51.03	94.87	1.86
SEM		0.70	1.50	0.03
FFCS× Enzyme		NS[3]	NS	NS

[a,b,c] Columns means with different superscripts differ significantly at P <0.05; [1] Feed conversion ratio; [2] Full-fat canola seed

[3] Non significant

The overall knowledge about the effect of enzyme supplementation to diets on broilers thyroid hormone concentration is limited. Gao *et al.,* (2007) indicated that xylanase supplementation of wheat-based diets increased the concentration of blood thyroxine but had no significant effect on blood triiodothyronine. Some authors reported that ambient temperature and dietary energy level are two factors that are related to the rate of metabolic activity and, hence, to the amount of oxygen required by the animal (Jones, 1994 & Buys *et al.,* 1999). Plasma insulin concentration as a metabolic hormone did not change after enzyme supplementation (Josefiak *et al.,* 2010). A higher metabolic rate is associated with increased deiodinated to triiodothyronine (T3) in the periphery, mainly in the liver and kidneys (Luger *et al.,* 2011). The diets in our experiment were iso energetic and temperature was similar for all bird groups. So, the observed differences among treatments for thyroid hormone concentration may be due to the chemical composition of FFCS in dietary treatments.

It is concluded that use of full-fat canola seed changed weight gain and feed intake in broilers. Thyroid

hormone concentration was affected by different inclusion rate of full-fat canola seed. However enzyme supplementation had no effect on thyroid hormone concentration in broiler chickens. According to the results of this experiment, it is suggested that use of 90 g/kg FFCS in broiler diets improved weight gain.

Table 3. The effect of dietary treatments on relative weight (g/100 g) of carcass traits and internal organs to body weight in broiler chicks

Treatment		Parameters				
FFCS[1] (g/kg)	**Enzyme**	**Breast**	**Thigh**	**Liver**	**Pancreas**	**Intestine**
0		20.83	23.35	3.73[a]	0.63[a]	7.10
30		21.30	22.92	2.70[b]	0.54[ab]	6.90
60		20.89	21.90	2.96[ab]	0.44[b]	6.61
90		20.01	23.03	3.10[ab]	0.60[a]	7.20
SEM		0.76	0.56	0.28	0.05	0.43
	+	20.33	22.83	3.22	0.57	7.04
	-	21.18	22.77	3.02	0.53	6.88
SEM		0.53	0.39	0.20	0.03	0.30
FFCS× Enzyme		NS[2]	NS	NS	NS	NS

[a,b,c] Columns means with different superscripts differ significantly at P <0.05; [1] Full-fat canola seed; [2] Non significant

Table 4. Thyroid hormone concentration (T_3 and T_4) of treated broilers (ng/mL)

Treatment		d 7		d 28		d 42	
FFCS[1] (g/kg)	**Enzyme**	**T_3**	**T_4**	**T_3**	**T_4**	**T_3**	**T_4**
0		3.81[ab]	9.28[a]	3.53	3.80	3.69[b]	2.15[a]
30		3.72[ab]	6.72[b]	3.55	3.14	4.57[a]	1.91[ab]
60		3.32[b]	5.45[b]	3.07	2.86	4.13[ab]	1.66[b]
90		4.14[a]	6.43[b]	3.33	3.58	4.62[a]	2.00[ab]
SEM		0.25	0.76	0.23	0.39	0.27	0.15
	+	3.91	7.41	3.32	3.42	4.18	1.88
	-	3.57	6.54	3.43	3.27	4.33	1.98
SEM		0.18	0.53	0.16	0.28	0.19	0.11
FFCS× Enzyme		S[2]	S	NS[3]	NS	NS	S

[a,b,c] Columns means with different superscripts differ significantly at P <0.05; [1]Full-fat canola seed; [2]Significant; [3]Non significant

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