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Asian Journal of Animal and Veterinary Advances

Academic
Journals Inc.

www.academicjournals.com

Asian Journal of Animal and Veterinary Advances 3 (5): 278-285, 2008
ISSN 1683-9919

Replacement of Different Levels of Rapeseed Meal with Soybean Meal on Broilers Performance

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Abstract: This study was conducted to determine the replacement of different levels of rapeseed meal with soybean meal as protein source on broilers performance (7 to 49 day old). Experiment design consisted under completely randomized design of a 5 arrangement of dietary treatments with five replicates, a total of 375 (1-day-old) commercial broiler chicks (Ross-308) were randomly distributed into 25 groups consisting of 15 chicks per group. The treatments were (0.0, 4, 8, 12 and 16%) levels of rapeseed meal. The criteria used to assess were weight gain, feed consumption, feed conversion ratio and internal organs weight. Increasing of body weight between treatment in different levels of rapeseed meal and control group showed significant difference ($p<0.05$). Maximum weight gain belonged to treatment contain 8% and minimum weight gain belonged to treatment contain 16% rapeseed meal. Feed consumption between treatments in different levels of rapeseed meal showed significant difference ($p<0.05$). However, rapeseed meal had positive effect on feed consumption. Maximum feed consumption belonged to control group and minimum feed consumption belonged to treatment contain 16% rapeseed meal. Feed conversion ratio between treatment in different levels of rapeseed meal showed significant difference ($p<0.05$). Minimum feed conversion ratio belonged to treatment contain 16% rapeseed meal and maximum feed conversion ratio belonged to control group. There was significant difference between percentage weights of abdominal fat in different levels of rapeseed meal ($p<0.05$). But there was no significant difference between percentage weights of intestine, liver, pancreas and carcass yield of treatments ($p>0.05$).

Key words: Rapeseed meal, soybean meal, broiler chicks, performance

INTRODUCTION

In recent years, there has been an increase in the area of farmlands allocated for rapeseed in Iran. Moreover, after oil extraction, plenty of rapeseed meal remains. Therefore, rapeseed can be economically justified to be used as plant protein substitute for part of soybean meal's protein. However, because of some anti-nutrient substances, this meal has to be limited in the diets. For this reason, there are few researches which determine the proper level of this meal in the diet for Iranian broilers. Leeson *et al*. (1987) has found that rapeseed oil as the only protein source in diet cause an imbalance between Lysine and Arginine, which is related to the supplements Lysine, Methionine and Arginine. He also reported that when Methionine's availability for both canola and soybean meals in equally met-based on the chickens feedback to increase growth and feed consumption-canola meal's Lysine lick soybean meal's Lysine will enjoy a 90% availability. They also concluded that Leucine and Isoleucine inherent in canola would be limiting for the chicken. Nwokolo and Jeong (1988) regard that canola as a good source of energy and protein only when used at 10% level of diet. They have found

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that Linoleic acid, significantly accumulated in the muscles, subcutaneous fat and abdominal cavity of the chickens which had canola meal in their diet. Oil seed meals are rich in protein and considered as a valuable animal nutrient. They are obtained as a leftover matter after oil is extracted from the oil seeds. Oil is extracted from the seeds through either a mechanical pressure (press) or a solvent, the former of which is more common in Asia (Karunajewa *et al*., 1990). Zuprizal and Chagneau (1991) reported that the true digestibility of canola's amino acids taken from the peeled seeds, are 76.9 and 81.4% in broilers respectively. The relative values in other laboratories are reported 72.8 and 78.3% by the same researchers respectively. Since sunflower and soybean account for the major share in the Iranian oil seeds production, failure to expand farming these two plants as well as the limitation to cultivate them in a few provinces have made some authorities to think of farming alternative oil plants specially rapeseed which is cultivated in fall. When importing soybean meals is indispensable, countries can substitute part of or the whole meal with other domestic protein sources, leading to economize foreign exchange. These resources include oilseed meals, grains, green corn powder and other substances (Modir Sanei, 1993). The rapeseed contains about 42% of oil. Its seed meal has an average of 38% protein, which is widely used in animal nutrition. The English word Rape, used for such oil plants, comes from the Latin word Rapum, meaning Turnip. The rape seeds fall commonly in Brassica, *Brassica napus* and *campestris*. These have formed a meal for humans and cattle since long ago. Nobod knows exactly where and when they came into being, but it seems that they have originated in the Mediterranean regions. The ancient scripts show that Rape grew in India 3000 BC and moved to China and Japan 2000 BC. Historical evidence represent that Asian and European civilizations used the rapeseed oil for lightening. It gradually found usage in human nutrition and in producing industrial oil and soap (Mansouri, 1994). Roth-Maier (2004) with adding up to 25% level of canola's whole seed to the diet of broiler chicks concluded that the added canola to the diet of broiler chicks entails a decrease in their performance and output. The present research aims to determine the proper amount of rapeseed meal in the diet for broiler chicks and to investigate impact of the meal on some of their performance parameters.

MATERIALS AND METHODS

This study was conducted at Shadbad village of Tabriz (Iran) in January 2007. The study included 375 1-day-old (Ross-308) broiler starter. They received the same diet up to 6 days of age. After the pre-experimental period, the chicks were weighed and distributed in to 25 groups consisting of 15 chicks per group. Each floor pen was in to 2×1 m such that the average weight of all the pens were roughly the same and contained one bell shaped waterer, feeder and some dry-wood shaving as a litter. Broiler chicks were fed diet from 7 to 49 days of age. The chicks were maintained in floor pens with feed and water made available for *ad libitum* consumption. The experiment design consisted under completely randomized design of a 5 arrangement of dietary treatments with five replicates. The treatments were (0.0, 4, 8, 12 and 16%) levels of rapeseed meal.

The experimental diet were formulated to meet the requirement of broiler chickens as established by the National Research Council (1994) and based on energy, protein and nutrients content they were all the same (Table 1-3). Factors of this study are as follows: weight gain, food consumption, feed conversion ratio and weight of internal organs (carcass yield, intestine, abdominal fat, liver and pancreas).

Body weight and feed consumption were measured for each pen at were 21, 42 and 49 days of age. Mortality was recorded throughout the experiment and used to adjust feed consumption data. Two birds per pen were identified by having body weight closest to the mean body weight of the pen. Then two birds per pen were killed from these identified birds and their internal organs weights were measured and considered based on body weight percent.

Table 1: Ingredients and nutrient composition (%) of experimental diets in starter period

	Treatments				
Ingredients	Control group	4	8	12	16
Corn	61.00	59.96	59.21	58.51	57.18
Soybean meal (44%)	32.95	29.99	25.12	21.95	18.78
Rapeseed meal	0.00	4.00	8.00	12.00	16.00
Fish meal	2.00	2.00	3.80	3.48	3.68
Soybean oil	0.50	0.82	1.00	1.37	1.80
Milestone	1.72	1.45	1.36	1.31	1.27
Dicalcium phosphate	0.79	0.75	0.52	0.41	0.33
Salt	0.32	0.32	0.31	0.31	0.32
Premix[a]	0.25	0.25	0.25	0.25	0.25
Mineral supplement[b]	0.25	0.25	0.25	0.25	0.25
DL-Methionine	0.22	0.21	0.18	0.16	0.14
Analysis (data on dry matter)					
Calculated					
ME (kcal kg^{-1})	2950.00	2950.00	2950.00	2950.00	2950.00
Crude protein (%)	21.07	21.07	21.07	21.07	21.07
Fiber (%)	3.788	4.038	4.046	4.287	4.516
Calcium (%)	1.04	0.95	0.95	0.95	0.95
Available P (%)	0.40	0.40	0.40	0.40	0.40
Sodium (%)	0.18	0.18	0.18	0.18	0.18
Arginine (%)	1.37	1.36	1.35	1.33	1.32
Lysine (%)	1.18	1.18	1.19	1.20	1.20
Methionine+cystine (%)	0.85	0.85	0.85	0.85	0.85
Tryptophan (%)	0.27	0.27	0.27	0.27	0.27
Threonine (%)	0.86	0.87	0.89	0.91	0.92

[a]: Vitamin supplied kg^{-1} diet: vitamin A, 3600000 IU; vitamin D_3, 800000 IU; vitamin E, 7200 mg; vitamin K_3, 800 mg; pantothenic acid, 4000 mg; vitamin B_1, 1 mg; vitamin B_6, 1200 mg; vitamin biotin, 40 mg; vitamin B_2, 2640 mg; nicotinic acid, 12000 mg; vitamin B_{12}, 6 mg; anti-oxidan, 100000 mg

[b]: Mineral supplied kg^{-1} diet: I, 400 mg; Se, 80 mg; Mn, 40000 mg; Zn, 33800 mg; Fe, 20000 mg; Cu, 4000 mg; Co, 0.1 mg

Table 2: Ingredients and nutrient composition (percent) of experimental diets in grower period

	Treatments				
Ingredients	Control group	4	8	12	16
Corn	66.29	66.23	66.19	65.86	64.13
Soybean meal (44%)	25.89	22.75	19.63	16.56	13.80
Rapeseed meal	0.00	4.00	8.00	12.00	16.00
Fish meal	2.00	2.00	2.00	2.00	2.00
Soybean oil	0.50	0.50	0.50	0.50	1.10
Milestone	1.34	1.16	1.15	1.14	1.09
Dicalcium phosphate	0.88	1.11	1.00	1.02	0.98
Salt	0.26	0.27	0.28	0.28	0.28
Premix[a]	0.25	0.25	0.25	0.25	0.25
Mineral supplement[b]	0.25	0.25	0.25	0.25	0.25
DL-Methionine	0.19	0.16	0.16	0.14	0.12
Sand	2.15	1.32	0.59	0.00	0.00
Analysis (data on dry matter)					
Calculated					
ME (kcal kg^{-1})	2950.00	2950.00	2950.00	2950.00	2950.00
Crude protein (%)	18.40	18.40	18.40	18.40	18.40
Fiber (%)	3.41	4.669	3.93	4.187	4.466
Calcium (%)	0.90	0.90	0.90	0.90	0.90
Available P (%)	0.40	0.45	0.45	0.45	0.45
Sodium (%)	0.16	0.16	0.16	0.16	0.16
Arginine (%)	1.17	1.16	1.14	1.13	1.13
Lysine (%)	0.98	0.98	0.98	0.98	0.98
Methionine+cystine (%)	0.75	0.75	0.75	0.75	0.75
Tryptophan (%)	0.23	0.23	0.23	0.23	0.23
Threonine (%)	0.76	0.77	0.79	0.80	0.82

Table 3: Ingredients and nutrient composition (percent) of experimental diets in finisher period

	Treatments				
Ingredients	Control group	4	8	12	16
Corn	70.29	68.87	67.27	66.25	65.62
Soybean meal	22.89	19.82	16.31	13.43	9.27
Rapeseed meal	0.00	4.00	8.00	12.00	16.00
Fish meal	2.00	2.10	2.80	2.55	3.38
Soybean oil	1.50	2.00	2.50	2.85	3.10
Milestone	1.19	1.15	1.13	1.07	0.99
Dicalcium phosphate	1.19	1.14	1.09	0.97	0.78
Salt	0.27	0.27	0.27	0.27	0.27
Premix[a]	0.25	0.25	0.25	0.25	0.25
Mineral supplement[b]	0.25	0.25	0.25	0.25	0.25
DL-Methionine	0.17	0.15	0.13	0.11	0.09
Analysis (data on dry matter)					
Calculated					
ME (kcal kg^{-1})	3100.00	3100.00	3100.00	3100.00	3100.00
Crude protein (%)	17.40	17.40	17.40	17.40	17.40
Fiber (%)	3.162	4.317	3.44	3.615	3.716
Calcium (%)	0.90	0.90	0.90	0.90	0.90
Available P (%)	0.45	0.45	0.45	0.45	0.45
Sodium (%)	0.16	0.16	0.16	0.16	0.16
Arginine (%)	1.09	1.08	1.07	1.06	1.04
Lysine (%)	0.90	0.91	0.91	0.92	0.93
Methionine+cystine (%)	0.70	0.70	0.70	0.70	0.70
Tryptophan (%)	0.21	0.22	0.22	0.22	0.22
Threonine (%)	0.72	0.74	0.75	0.77	0.79

General Linear Models (GLM) procedures of SAS® (SAS, 1990) software were employed and significant differences between treatments were separated using Duncan's new multiple range test.

RESULTS AND DISCUSSION

Analysis of variance of body weight in different rearing periods revealed that the effect of treatment on body weight during 7-21 days and whole period was significant ($p<0.05$) (Table 4). Comparing means of different treatments of weight gain showed that adding different levels of rapeseed meal to the diet during 7-21 days and the whole period significantly improved body weight, as contrasted to the control group ($p<0.05$). There was no significant difference among different levels of rapeseed meal on the body weight. In this study, adding rapeseed meal at 12 and 16% levels during grower and finisher periods left a numerically negative effect on broilers' weight, which was not statistically significant (Table 5). These results were in agreement with those reported by Blair and Reishert (1984), Fritz *et al*. (1989), Koreleski and Rys (1987) and Leeson *et al*. (1987), but were no consistent with that reported by Chappa *et al*. (1989) and Fenwick and Curtis (1980). It is reported that higher levels of rapeseed meal contain higher levels of glucosinolate and fiber which lead to a weight loss in broilers and decrease food consumption (Ajuyah *et al*., 1991; Kralik *et al*., 2003; Roth-Maier, 2004; Thomas *et al*., 1983).

Analysis of variance of food consumption in different rearing periods revealed that the effect of treatment on food consumption during 7-21, 22-42 and 43-49 days and the whole period was significant ($p<0.05$) (Table 6). Comparing means of different treatments of food consumption showed that with the addition 8, 12 and 16% of rapeseed meal to the diet during 7-21 days, relative to the control group and a treatment contain 4% rapeseed meal led to decrease in food consumption, which was statistically significant ($p<0.05$). There was no significant difference among the treatments contain 8, 12 and 16% of rapeseed meal on food consumption. Comparing means of different treatments of food consumption during 22-43, 43-49 days and the whole period indicated that adding different levels

Table 4: Analysis of variance of effects in different dietary levels of rapeseed meal, on Weight Gain (WG), Feed Consumption (FC) and Feed Conversion Ratio (FCR) in broiler chicks' performance from 1 to 7 weeks of age

		Mean Square (MS)											
		Weight gain (g)				Feed consumption (g)				Feed Conversion Ratio (FCR)			
		7-21	22-42	43-49	7-49	7-21	22-42	43-49	7-49	7-21	22-42	43-49	7-49
SOV	df	days											
CV		4.51	3.24	10.52	1.73	0.83	1.49	2.30	1.38	6.64	1.15	1.83	0.27
Treatment	4	11923.40*	1391.36^{ns}	3286.60^{ns}	10618.05*	3623.55*	8167.50*	2559.28*	33999.17*	1.104*	0.002^{ns}	0.004^{ns}	0.023*
Error	20	1823.14	556.54	1460.71	1246.25	295.50	705.31	416.82	4287.47	0.021	0.0008	0.002	0.00004
Total	24												

NS: Not Significant; *: Significant ($p<0.05$)

Table 5: Comparing means of effects in different dietary levels of rapeseed meal on Weight Gain (WG), Feed Consumption (FC) and Feed Conversion Ratio (FCR) in broiler chicks' performance from 1 to 7 weeks of age

	Weight gain (g)				Feed consumption (g)				Feed Conversion Ratio (FCR)			
	7-21	22-42	43-49	7-49	7-21	22-42	43-49	7-49	7-21	22-42	43-49	7-49
Treatments	days											
Control group	877.00^{b}	742.28	371.14	1990.50^{b}	2098.67^{a}	1813.00^{a}	906.50^{a}	4818.25^{a}	2.39^{a}	2.44	2.44	2.40^{a}
4% rapeseed meal	910.95^{a}	743.00	371.50	2025.45^{a}	2077.08^{a}	1809.00^{a}	904.50^{a}	4790.58^{a}	2.28^{a}	2.43	2.43	2.30^{a}
8% rapeseed meal	976.33^{a}	719.22	359.61	2055.08^{a}	2038.67^{b}	1783.10^{b}	891.55^{b}	4713.08^{b}	2.08^{b}	2.48	2.47	2.29^{b}
12% rapeseed meal	965.67^{a}	723.32	361.65	2050.64^{a}	2040.67^{b}	1782.91^{b}	866.86^{b}	4690.44^{b}	2.11^{b}	2.46	2.39	2.28^{b}
16% rapeseed meal	993.33^{a}	703.50	351.75	2048.58^{a}	2043.17^{b}	1712.27^{c}	856.13^{c}	4611.58^{c}	2.05^{b}	2.43	2.43	2.25^{b}

Values with different superscript letter(s) are significantly different at $p<0.05$

Table 6: Analysis of variance of effects in different dietary levels of rapeseed meal, on carcass yield percentage, intestine percentage, abdominal fat percentage, liver percentage and pancreas percentage in broiler chicks' performance from 1 to 7 weeks of age

		Mean Square (MS)									
		Carcass yield		Intestine		Abdominal fat		Liver		Pancreas	
SOV	df	Weight (g)	Percent (%)	Weight (g)	Percent (%)	Weight (g)	Percent (%)	Weight (g)	Percent (%)	Weight (g)	Percent (%)
CV		3.25	1.46	3.37	2.79	4.93	6.56	7.85	10.83	10.67	11.28
Treatment	4	10423.86^{ns}	74.20^{ns}	32.91^{ns}	0.03^{ns}	22.96^{ns}	0.052*	42.74^{ns}	0.06^{ns}	1.03^{ns}	0.0016^{ns}
Error	20	4169.54	1.16	13.82	0.013	5.02	0.011	17.88	0.05	0.412	0.0006
Total	24										

ns: not significant; *: Significant ($p<0.05$)

Table 7: Comparing means of effects in different dietary levels of rapeseed meal on carcass yield percentage, intestine percentage, abdominal fat percentage, liver percentage and pancreas percentage in broiler chicks' performance from 1 to 7 weeks of age

	Carcass yield		Intestine		Abdominal fat		Liver		Pancreas	
Treatments	Weight (g)	Percent (%)	Weight (g)	Percent (%)	Weight (g)	Percent (%)	Weight (g)	Percent (%)	Weight (g)	Percent (%)
Control group	1970.40	72.68	111.78	4.13	48.85	1.80^{a}	53.66	1.97	6.77	0.245
4% rapeseed meal	1913.02	71.91	105.61	4.06	44.98	1.69^{a}	51.17	1.98	5.56	0.207
8% rapeseed meal	2030.32	73.94	111.88	4.07	43.13	1.56^{b}	51.27	2.08	5.82	0.207
12% rapeseed meal	2011.11	74.11	110.87	4.07	44.37	1.50^{b}	54.77	2.12	5.91	0.212
16% rapeseed meal	1999.91	74.29	109.87	4.08	45.62	1.44^{b}	58.27	2.17	6.01	0.218

Means in columns with no common superscript differ significantly ($p<0.05$)

of rapeseed meal to the diet affects food consumption as a linear decrease ($p<0.05$) (Table 7). It seems that decreased feed intake, by adding the rapeseed meal to the diet, resulting from high glucosinolate and fiber in this meal. Decreased feed intake resulting from adding levels of rapeseed meal has been reported by some researches (Slinger *et al*., 1978; Summers and Leeson, 1977; Thomas *et al*., 1983).

Analysis of variance of Feed Conversion Ratio (FCR) in different rearing periods revealed that the effect of treatment on Feed Conversion Ratio (FCR) during 7-21days and the whole period was significant ($p<0.05$). Comparing means of different levels of FCR revealed that adding 8, 12 and 16% rapeseed meal to the diet during 7-21 days and the whole period, relative to the control group and the treatment contain 4% rapeseed meal, improved FCR ($p<0.05$). There was no significant difference among the treatments contain 8, 12 and 16% rapeseed meal on FCR. However, during the period of 7-21 days, the diet of 16% rapeseed meal left an improved value in FCR, as compared to other treatments. In this study, adding more of rapeseed meal on the diet led to an improved FCR. A possible explanation for better FCR could be: (1) adding rapeseed meal resulted in a decrease feed intake, for this reason, passage time of nutrients from digestive system decrease and nutrients have enough time for digestion and absorption in digestive system, (2) In this study, the added rapeseed meals accompanied soybean oil to balance energy. The soybean oil has some fat which lowers the speed of food transition within the digestive system and creates a subsequent chance of more efficient absorption which improves FCR. This is in line with other researchers' findings (Hulan *et al*., 1980; Slinger *et al*., 1978), while disagreed with the researchers (Blair and Reishert, 1984; Leeson *et al*., 1987; Reddy *et al*., 1982; Sadmann and Schon, 1987).

Analysis of variance of traits in broilers' internal organs weight during the whole period showed that treatment had an insignificant effect on the weight of internal organs except abdominal fat ($p<0.05$). Comparing means of traits pertaining to the internal organs weight in different treatments represented that there was significant difference between 8, 12 and 16% levels of rapeseed meal on the abdominal fat weight as contrasted with the control group treatment and the treatment contain 4% rapeseed meal ($p<0.05$). In this respect, a diet of 16% rapeseed meal had the numerically lowest

abdominal fat weight and a diet of 8% rapeseed meal had the numerically highest abdominal fat weight. In this study the increase in the amount of rapeseed meal in diet corresponded with a linear decrease in the abdominal fat weight, which accorded with some researchers (Crespo and Estve-garsia, 2002; Kralik *et al*., 2003; Leeson *et al*., 1987).

CONCLUSION

The study implies that the treatment contains 8% rapeseed meal can be safely used to feed broilers, without any disturbance on the carcass's performance and properties. Moreover, such a food cost lower in domestic production inter country, making it a substitute for the soybean meal, which in turn helps decrease of production costs with a subsequent decrease of broilers' total cost.

ACKNOWLEDGMENT

The authors gratefully acknowledge the assistant professors of Shabestar Islamic Azad University, Iran.

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