EVALUATION OF SUBSTITUTING NIGELLA SEED MEAL AS A SOURCE OF PROTEIN FOR SOYBEAN MEAL IN DIETS OF NEW ZEWALAND WHITE RABBITS

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ABSTRACT

The present study aimed to evaluate the effects of a partial or complete replacement of soybean meal (SBM) of the control diet by nigella (*Nigella sativa* L) seed meal (NSM) on growth performance, diet digestibility and blood characteristics in growing New Zealand White (NZW) rabbits. NSM was used at levels 0, 6, 12 and 24% in the diets. Thirty-six 8-weeks old growing NZW rabbits were distributed randomly and equally into four treatments groups, each of 9 animals. Each group of rabbits was fed one of four experimental diets (16.4% crude protein and 12.7% crude fiber on average). The study lasted 6 weeks. The results showed that the group of rabbits fed 12% NSM had significantly ($P<0.05$) better total weight gain than the control (1046 vs. 971 g) Feed conversion ratio improved by 3.7%, but difference was not significant. Digestibility of dry matter (DM), organic matter, crude protein (CP), crude fiber (CF) and nitrogen free extract and metabolizable energy were also better with 12% NSM ($P<0.05$) than with the control diet (DM 78.4 vs. 76.6%; CP 86.6 vs. 84.6% and CF 58.7 vs. 54.5%). Serum total protein and albumin of rabbits fed 12% NSM were significantly ($P<0.05$) higher than those fed the control diet, while serum globulin, total lipids and serum glutamic pyrovic transaminase (GPT) were not significantly affected by the treatments. The lowest ($P<0.05$) values in serum cholesterol were recorded in the control group and followed by those of 6, 12 and 24% NSM in an ascending order (69.6, 74.6, 76.9 and 78.4 mg/dl, respectively). Rabbits fed 24% NSM resulted in a significant deterioration of most traits when compared to the control. It could be recommended to use NSM diets for NZW rabbits as a non-traditional source of plant protein up to 12% without harmful effects on the growth performance, kidney or liver function.

Key words: Nigella seed meal, Performance, Digestibility, Carcass, Blood constituents.

INTRODUCTION

Since the discovery of mad cow disease in the last decade, soybean meal have increased demands and accordingly raised its feeding cost. In Egypt, there is a continuous increase in the prices of traditional plant protein sources such as soybean meal, owing to its universal use. Therefore, search for cheaper alternative vegetable protein sources is urgent. Nigella seed (*Nigella sativa*) frequently referred to as black cumin, serves as an important medical crop in many countries and is primarily consumed as medical oil; second, Nigella seed meal (NSM) after oil removal can be used as a protein-rich meal. NSM contains most of the essential amino acids, with crude protein about 33% (EL-Nattat and EL-Kady, 2007), at adequate amounts for the partial substitution of soybean meal (SBM) in Japanese quail practical diets (Zeweil, 1996). The use of NSM to replace the imported SBM may also reduce the cost of rabbits feeding. However, reports on the use of NSM in practical diets for growing rabbits are not enough.

The objective of the present investigation was to evaluate the effect of using different levels of NSM, (0, 6, 12 and 24%), on growth performance, digestibility and blood characteristics in growing New Zealand White (NZW) rabbits.

MATERIALS AND METHODS

Animals and experimental design

This work was carried out at the Rabbit Research Laboratory, Department of Animal and Fish Production, Faculty of Agriculture (Saba Basha), Alexandria University. Thirty-six males NZW rabbits, 8 weeks old, were distributed randomly and equally into four treatments groups, each of 9 animals. Each group was sub-divided into three replicates with three animals each. Rabbits were housed in wire floor batteries of 45 x 36 x 36 cm and were offered diets for duration of the feeding trial until reaching 14 weeks of age. All animals were kept under similar hygienic conditions. Rabbits were housed in well ventilated block building. Fresh air circulated in the house using exhaust fans. Temperature during the experimental periods varied between 16 and 22°C. The rabbits were kept within a cycle of 16 h light and 8 h dark.

Four pelleted diets were prepared using nigella seed meal (NSM) as a partial or complete replacement of soybean meal (SBM) of the control diet. NSM was used at levels 0, 6, 12 and 24%, respectively. Slight modifications were done in feed ingredients formula to make diets nearly iso-nitrogenous and iso-caloric and also to keep the crude fiber percentages of the experimental diets nearly the same (Table 1).

Table 1: Feed ingredients and chemical composition of the experimental diets

	NSM 0% (Control)	NSM 6%	NSM 12%	NSM 24%
Ingredients (%)				
Soybean meal	18.0	13.5	9.0	-
Nigella seed meal	-	6.1	12.1	24.2
Clover hay	33.0	32.4	31.9	30.8
Yellow corn	15.0	15.0	15.0	15.0
Wheat bran	12.0	12.5	13.0	14.0
Barley grain	11.3	11.3	11.3	11.3
Wheat straw	4.0	3.0	2.0	-
Molasses	3.0	3.0	3.0	3.0
Limestone	1.0	1.0	1.0	1.0
Common salt	0.5	0.5	0.5	0.5
Sunflower oil	2.0	1.5	1.0	-
Mineral and vitamin premix[1]	0.2	0.2	0.2	0.2
Chemical composition (% DM):				
Dry matter (%)	92.3	92.1	91.9	91.5
Organic matter	92.7	93.1	93.4	93.7
Crude protein	16.4	16.5	16.2	16.4
Ether extract	2.9	3.3	3.8	4.1
Crude fiber	12.6	12.7	12.8	12.9
Nitrogen free extract	60.8	60.8	60.5	60.2
DE (kcal/kg feed DM)*	3114	3153	3142	3265

[1]Vitamin and mineral premix (per kg): Vit. A 2 000 000 IU, Vit. D3 150,000 IU, Vit. K 0.33 mg, Vit. B1 0.33 g, Vit. B2 1.0 g, Vit. B6 0.33g, Vit. B12 1.7 mg, Pantothenic acid 3.33 g, Biotin 33 mg, Folic acid 0.83, Choline chloride 200 mg, Zn 11.7 g, Mn 5.0 g, Fe 12.5g, Mg 66.7 mg, Se 16.6 mg, Co 1.33 mg, Cu 0.5 g, I 16.6 mg and Antioxidant 10.0 g
[1]Estimated according to Maertens and de Groote (1987)

Each group of rabbits was fed one of four experimental diets. Fresh water was automatically available at all times through stainless steel nipples for each cage. The experimental diets were offered to rabbits *ad libitum*. Individual body weight and feed consumption were recorded weekly. Body weight gain and feed conversion ratio were also calculated. Blood samples were individually collected at slaughtered time (14 weeks of age) from each rabbit in non heparinized glass tubes to estimate blood parameters. Blood serum was separated by centrifugation at 3000 rpm for 15 minutes. The collected

serum was stored at –18º C until analysis. At 15 weeks of age, a digestibility trial was done using three male animals per group.

Chemical analyses

Total protein, albumin, total lipids, cholesterol, glutamic pyrovic transaminase (GPT) and urea-N concentrations in serum were estimated using commercial kits (Bio Merieux, France) according to the procedure outlined by the manufacturer. Chemical analysis of the tested diets and faeces were carried out according to AOAC (1994). Digestible energy (DE) of the experimental diets was calculated according the equation described by Maertens and De Groote (1987) cited by Fekete (1987).

Statistical analysis

Data were statistically analyzed according to SAS (1994). The significant differences between means were tested by using Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

The effects of different levels of NSM on growth performance are included in Table 2. The results showed that the group of rabbits fed 12% NSM had significantly the best values of total weight gain, feed conversion ratio by 7.7 and 3.7% from control. The highest value of total feed consumption during the whole experimental period was observed also in the group fed 12% NSM diet. It increased by 3.9% as compared to control group. The inclusion of 24% NSM in the diet significantly decreased body weight gain and increased feed conversion ratio in comparison with control. Viability rate was statistically similar for groups fed 0, 6 and 12% NSM: 2 rabbits were lost our of 9 in the 24% NSM vs. 0 to 1 in the 3 other groups. The improvement in total weight gain, feed conversion ratio and increasing feed consumption in favor of the group of rabbits fed on diet containing 12% NSM compared with the control group may be attributed to a beneficial effect exerted by NSM composition. It was reported that *Nigella sativa* control and buffer the condition of the stomach and intestine (Projapati *et al.,* 2003). The black cumin seeds contain thymoquinine that has antibacterial, diuretic and immunopotentiating activities *via* increasing neuterophil of the body against infection (Kanter *et al.,* 2005). Black cumin oil and its derivatives inhibit eicosanoid generation in leukocytes and membrane lipid peroxidation (El-Dakhakhny *et al.,* 2002). Besides, the seeds contain eight essential amino acids that improve natural immune system activity (Omar *et al.,* 1999). On the other hand, Vahdati-Mashhadian *et al.* (2005) reported that the methanol extracts of *Nigella sativa* seeds in all orally doses (0.6, 0.9 and 2.1%) and chloroform extract in the dose of 2.1% only, significantly decreased mice weight. Also, they reported the possibility of hepatic damage of aqueous extract in the daily dose of 0.6% of body weight. May be these toxic factors could be responsible of the lower performance observed with high level of NSM (24%). An amino acids imbalance could be also responsible of the low performance.

Table 2: Effect of different levels of NSM on growth performance

	Experimental diets				Significance
	NSM 0% (Control)	NSM 6%	NSM 12%	NSM 24%	
Initial body weight (g)	896	900	890	902	NS
Total weight gain (g)	971±12^{b}	991±10^{b}	1046±15^{a}	883±19^{c}	0.01
Total feed consumption (g)	3989±14^{c}	4075±22^{b}	4144±20^{a}	3911±18^{d}	0.01
Feed conversion ratio	4.11±0.26^{ab}	4.11±0.08^{ab}	3.96±0.11^{b}	4.43±0.12^{a}	0.05
Viability (n)	8/9	9/9	8/9	7/9	NS

Our results were in agreement with those of Nasr *et al.* (1996) who reported that body weight gain and feed conversion ratio were significantly improved in rabbits fed diets containing 5 or 10% NSM compared to control. Using growing Japanese quail, Zeweil (1996) found that the performance of growing Japanese quail fed diets containing 6.25 or 13.50% NSM were improved ($P \leq 0.01$) as

compared to the control one, however, he found that productive traits were deteriorated with feeding diets containing 27 or 33.4% NSM. On the other hand, El-Nattat and El-Kady (2007) found that rabbits received diet containing 9% black cumin meal showed a significant decrease in daily weight gain by 20%, feed intake by 9.4% and deterioration in feed conversion ratio by 13.4%.

The results in Table 3 showed that digestibility coefficients of dry matter (DM), organic matter (OM), crude protein (CP), crude fiber (CF) and nitrogen free extract (NFE) and metabolizable energy (ME) were higher in the group of rabbits fed 12% NSM diet comparing to the control and the other experimental groups. However, digestibility of DM, OM, CP, CF and NFE and ME were significantly decreased with using 24% NSM-diet. The positive response observed with feeding 12% NSM diet may be due to some compounds present in NSM. Nasr and Attia (1998) reported that the nutritive values of rabbit diets enriched with 10 or 20% *Nigella sativa* seeds were (P≤0.05) better than those of control diet.

Table 3: Effect of different levels of NSM on digestibility coefficients of nutrients and nutritive values

	Experimental diets				Significance
	NSM 0% (Control)	NSM 6%	NSM 12%	NSM 24%	
Apparent digestibility coefficients:					
Dry matter (DM)	76.6±0.29^{b}	76.8±0.49^{b}	78.4±0.42^{a}	73.8±0.39^{c}	0.05
Organic matter (OM)	77.6±0.54^{b}	78.1±1.08^{b}	80.8±0.58^{a}	75.3± 0.25^{c}	0.05
Crude protein (CP)	84.6±0.45^{b}	84.3±0.12^{b}	86.5±0.48^{a}	83.6±0.37^{c}	0.01
Ether extract (EE)	85.9±0.99	87.4±1.82	86.8±1.35	83.6±1.28	NS
Crude fiber (CF)	54.5±1.29^{b}	57.6±0.68^{a}	58.7±1.34^{a}	50.2±1.14^{c}	0.01
Nitrogen free extract (NFE)	79.5±0.25^{b}	81.0±0.30^{ab}	83.1±0.67^{a}	75.4±0.78^{c}	0.01
Nutritive value of diets:					
Digestible protein (%)	13.9±0.19^{ab}	13.9±0.18^{ab}	14.0±0.08^{a}	13.7±0.27^{b}	0.05
Metabolisable energy (kcal/kg DM)*	3142±26^{b}	3152±18^{b}	3212±24^{a}	3034±34^{c}	0.05

[1]According to Maertens and de Groote (1987)

The results in Table 4 showed that serum total protein and albumin of rabbits fed NSM at 12% level were significantly higher than those fed the control diet, while, serum globulin, total lipids and serum glutamic pyrovic transaminase (GPT) were not significantly affected by different treatments. The lowest values in serum cholesterol were recorded in the control group and followed by those fed diets containing 6, 12 and 24% NSM in an ascending order.

Table 4: Effect of different levels of NSM on serum blood constituents

	Experimental diets				Significance
	NSM 0% (Control)	NSM 6%	NSM 12%	NSM 24%	
Total protein (gm/dl)	6.31±0.02^{b}	6.57±0.03^{a}	6.66±0.07^{a}	5.95±0.03^{c}	0.01
Albumen (gm/dl)	4.03±0.04^{b}	4.10±0.03^{b}	4.42±0.05^{a}	3.54±0.10^{c}	0.01
Globulin (gm/dl)	2.28±0.02	2.47±0.02	2.23±0.08	2.41±0.08	NS
Total lipids (mg/dl)	262±0.9	262±0.9	263±1.3	264±0.1	NS
Cholesterol (mg/dl)	69.6±0.24^{d}	74.6±0.24^{c}	76.9±0.07^{b}	78.4±0.34^{a}	0.01
Urea-N (mg/dl)	31.0±0.4^{a}	28.8±0.3^{c}	30.8±0.2^{a}	30.0±0.1^{b}	0.01
GPT (U/ml)	32.5±3.5	34.2±7.2	30.5±2.1	33.5±6.4	NS

[a, c] Means in the same row bearing different letters, differ significantly (P≤0.05)

CONCLUSIONS

It could be recommended to use Nigella seed meal in NZW rabbit diets as a non-traditional source of plant protein up to 12% without harmful effects on the growth performance and blood constituents. Further studies needed from the practical point of view.

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