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Evaluation of Adding Canola Meal to Diet on Growth Performance of Male Wistar Rats

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Abstract: The aim of the present study was to determine how the effect of adding different amounts of canola meal, as a well known protein supplement in animal nutrition, on growth parameters and performance of male Wistar rats. Daily Weight Gain (DWG), Daily Feed Intake (DFI) and Feed Conversion Ratio (FCR) were registered. Forty eight male Wistar rats were divided into four groups of 12, each in 2 separate cages of 6. Three experimental groups were fed diets containing 10, 20 and 30% canola meal (E10, E20 and E30, respectively) and the fourth one (control) was with no canola meal added. In a 6 weeks period trial, adding canola meal did not change ADWG but reduced ADFI. Partial substitution of soybean meal (SBM) by Canola Meal (CM) caused an increase in FCR. Results showed that independently of percentage of SBM substitution, adding canola meal, especially in E20 diet, slightly improved the animal performance and therefore can be used in laboratory animals feeding.

Key words: Canola meal, wistar rat, growth parameters, performance, protein supplementation

INTRODUCTION

Canola is developed through conventional plant breeding from rapeseed, an oilseed plant with roots in ancient civilization. The word rape in rapeseed comes from the Latin word rapum meaning turnip. Turnip, rutabaga, cabbage, Brussels sprouts, mustard and many other vegetables are related to the two canola species commonly grown: *Brassica napus* and *Brassica rapa*. Edible rapeseed oil extracts were first put on the market in 1956-1957, but these suffered from several unacceptable characteristics. Rapeseed oil had a distinctive taste and a disagreeable greenish colour due to the presence of chlorophyll. Feed meal from the rapeseed plant was not particularly appealing to livestock, due to high levels of sharp-tasting compounds called glucosinolates. Cruciferous vegetables (e.g., rape, turnip, cabbage) contain glucosinolates (GLS) that are not toxic *per se* but when broken down by intestinal microflora (Nugon-Baudon *et al*., 1988) lead to well-known toxic effects. Growth depression dramatically reduced feed intake, enlargement of target organs (liver, kidneys, thyroid) and depletion of thyroid hormones plasma levels are the main side-effects observed among different animal species (Bourdon *et al*., 1981; Martland *et al*., 1984; Vermorel *et al*., 1987). A glucosinolate content 0.5 μ mol g^{-1} diet is the upper limit in rat diets without adverse effect (Tripathi and Mishra, 2007). Some researchers have worked on improvement of canola

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meal for using in animal diets (Bell, 1975; Slominski *et al.*, 1999; Jensen, 1999). Plant breeders in Canada, where rapeseed had been grown (mainly in Saskatchewan) since 1936, worked to improve the quality of the plant. In 1968, researchers in the University of Manitoba used selective breeding to develop a variety of rapeseed low in erucic acid. In 1974, another variety was produced low in both erucic acid and glucosinolates; it was named Canola, from Canadian oil (Bell, 1984). This and other recent varieties have been produced by gene splicing techniques. Canola was originally a trademark but is now a generic term for this variety of oil. The present study conducted for the first time in Iran and its main purpose was to evaluate the effect of adding canola meal (produced by Iranian varieties of canola) on performance and growth parameters of male Wistar rats.

MATERIALS AND METHODS

The present study has been conducted from July to September 2009. The diets were formulated as pellet by Pars Animal Feed Company-Tehran according NRC (1995) and were analyzed in laboratory of Techno Azma Co., by specific analytical methods according to AOAC (1990). Used canola meal was analyzed to determine amino acid composition by HPLC method (Table 1). Chemical composition of the control (C) and experimental diets is shown in Table 2. Forty-eight male Wistar rats (*Rattus norvegicus*) with average 230±14 g body weight and 50 days old, divided to 4 treatment group of twelve rats with similar average body weight. The animals of each group were housed in two separate 40×33×17 inches stainless steel cages (length, width, height), 6 rat in each cage. Three experimental groups were fed diets containing 10, 20 and 30% canola meal as E10, E20 and E30, respectively and one was fed standard rat diet (with no canola meal) as control group or C (Table 3). The diets were formulated isoproteinous and isoenergetically. All groups received drinking water *ad libitum* and were kept in a room with established 12/12 h photo period and average of 20±2°C

Table 1: Amino acids composition of the used canola meal (based on 35% protein)

Amino acids	Used CM	Reference	Amino acids	Used CM	Reference*
	---------------(%)-----------------			----------------(%)------------------	
Pro	2.04	2.23	Phe	1.37	1.54
Ser	1.58	1.64	Ala	1.28	1.53
Thr	1.63	1.50	Arg	2.00	2.14
Try	1.29	0.46	Asp	2.50	2.55
Tyr	0.84	1.05	Cys	0.88	0.94
Val	1.67	1.71	Glu	5.78	6.43
His	1.02	1.13	Gly	1.75	1.75
Iso	2.05	1.41	Met	0.75	0.77
Leu	2.46	2.39	Met+Cys	1.88	1.71
Lys	2.67	2.02			

*Bell (1984)

Table 2: Chemical composition of the standard and experimental diets

Nutrients	C	E10	E20	E30
Crude protein (%)	30.62	30.62	30.62	30.62
Crude fiber (%)	10.18	10.07	10.15	10.27
Calcium (%)	0.92	0.92	0.92	0.92
Ash (%)	6.76	6.31	6.33	6.29
Phosphorus (%)	0.87	0.87	0.87	0.87
Glucosinolate (μmol g^{-1})	0.04	3.76	4.33	5.08
Met+Cys (%)	0.67	0.67	0.67	0.67
Lysine (%)	1.98	1.98	1.98	1.98
Gross energy (kcal kg^{-1})	3976.00	3976.00	3976.00	3976.00

Table 3: Control and experimental diets ingredients

Ingredient(%)	C	E10	E20	E30
Canola meal (CM)	-	10.00	20.00	30.00
Soybean meal (SBM)	35.00	25.10	15.20	5.31
Corn	25.00	25.00	25.00	25.00
Wheat	21.75	21.75	21.75	21.75
Alfalfa hay	15.33	15.33	15.33	15.33
Salt	0.40	0.40	0.40	0.40
Limestone	1.00	1.00	1.00	1.00
DL methionine	0.11	0.074	0.03	0.01
Vegetable oil	0.23	0.15	0.08	-
Lysine	-	0.016	0.03	0.02
Vit. and minerals ¥	1.18	1.18	1.18	1.18

¥Provided per kg of diet; mg: Fe, 160; Cu, 13; Co, 2; Mn, 45; Zn, 60; I, 1.0; Se, 1.0; Vit. E, 80; Vit. K, 3.0; thiamine, 12; riboflavin, 12; pyridoxine, 10; niacin, 40; folic acid, 4; biotine, 150 mcg; vit. B_{12}, 80 mcg; Vit. A, 15000 IU; Vit. D, 1000 IU

temperature and 50-60% humidity. The animals were housed in ORDC (Oilseed Research and Development Co.) animal room. Feeds offered and left over were recorded regularly for each cage.

The rats were weighed at the first day of exam (day zero) and 2, 4 and 6 weeks after. The experiments were performed according to procedures approved by the appropriate ethical commission. During the trial (6 weeks), the total feed intake and total growth rate were measured and Average Daily Feed Intake (ADFI) and Average Daily Weight Gain (ADWG) were calculated. Food Conversion Ratio (FCR) was measured by dividing ADFI to ADWG. The results of experiments subjected to the Analysis of Variance (ANOVA) using SPSS. Some differences in the ADWG, ADFI and FCR in rats fed on treatment diets were determined within each period of the trial. The mean differences were considered significant at a probability $p<0.05$.

RESULTS

During 6 weeks-course of feeding, monitoring the performance characteristics of rats fed on E10, E20 and E30 diets there was a reduction in FCR values, probably due to higher growth rate than the feed intake one. In the first 2 weeks-period, control group had higher ADWG and E30 group had lower ADFI and FCR than the others (Table 4). Also, in the second and third 2 weeks-periods, control group had higher ADWG and E30 group had lower ADFI and FCR than the others, but in E20 group, a slight increase in ADWG was observed compared to E10 and E30 (Table 4). ADWG in control group (C) was the highest and ADFI of E30 was the lowest one during the trial. The diet with 20% inclusion of canola meal (E20) had more promotional effects on rat growth performance than other experimental groups. As shown in Table 5, some differences in total body weight between group C and the experimental groups were found but the ADFI in E30 was slightly lower than the others, probably because of lesser palatability of canola meal and physiological adverse effects of its anti-nutritional factors (e.g., glucosinolates or phenolic compounds) and reducing appetite of rats that led to less feed intake. Rats fed on 30% of canola meal in their daily feed (E30) manifest a better FCR than others (C, E10 and E20). Relation between changes in ADWG or ADFI and some physiological parameters of the animal (e.g., liver weight or thyroid hormones level) must be examined by additional researches.

Table 4: Average live weight (ALW) and main 3 characteristics in each 2-weeks period of the trial

	Diet groups				
Characteristics	C	E10	E20	E30	SEM
1st period (from 50 to 64 days of age)					
ALW (g)	310	305	308	301	2.40
ADWG (g)	5.71	5.63	5.61	5.60	0.06
ADFI (g)	22.3	21.3	22.4	20.6	1.10
FCR	3.90	3.78	3.99	3.68	0.18
2nd period (from 64 to 78 days of age)					
ALW (g)	400	400	403	395	1.90
ADWG (g)	6.42	6.38	6.39	6.38	0.04
ADFI (g)	23.6	22.6	23.1	21.3	0.90
FCR	3.68	3.54	3.62	3.34	0.21
3rd period (from 78 to 92 days of age)					
ALW (g)	495	490	494	488	2.10
ADWG (g)	6.76	6.67	6.73	6.72	0.06
ADFI (g)	24.1	23.1	24.9	23	1.20
FCR	3.56	3.46	3.70	3.42	0.20

Table 5: Total amounts of 3 characteristics for all diet groups, from the first to the last day of trial

	Diet groups			
Characteristics	C	E10	E20	E30
ATWG (g)*	265	260	264	258
ADWG (g)	6.31	6.19	6.29	6.14
ADFI (g)	23.3	22.3	23.5	21.6
FCR	3.69	3.60	3.74	3.52

*Average total weight gain (during the trial)

DISCUSSION

Because of more availability and lower cost of canola meal than the other protein supplements such as soybean meal (SBM), diets used in this study had lower price (about 60-70%) and were economically advisable and beneficial for research laboratories. However, adding CM did not significantly increase nutritional value of the diets compared to SBM. Thus, canola meal can be used widely in laboratory animals, especially Wistar rat, as a proper protein source, if available. Many studies are carried out in the recent years to evaluate using canola meal in animal nutrition that have shown different results (Sauer *et al.*, 1982; Rabot *et al.*, 1993; Jørgensen and Lindberg, 2006; Pastuszewska *et al.*, 2008). In a survey, average weight gain of rats fed *B. napus* containing diet were less than those of fed casein-based diet (Lo and Hill, 1971). Results of experimental study by Smith and Bray (1992) showed that weight gain was decreased with increasing dietary levels of canola meal, however, there was no difference between Manitoba and Alberta canola meals. Feed intake was reduced and FCR improved by increasing levels of canola meal. Increased liver weight due to feeding canola meal was partly responsible for a fraction of body weight gain. Garcia de Faria *et al.* (2004) showed that there is a reduction in the digestive use of the gross energy of autoclaving diet containing canola meal in growing rats in period up to 42 days. Scapinello *et al.* (2001) did not find any negative effect of performance of rabbits fed on canola meal but trials with swine during growing and finishing periods showed that animals performance was lower for those fed with 75% or more of canola meal as substitute for SBM (Baidoo and Aherne, 1987). The results of the study of Jensen *et al.* (1995) showed up to 30 min heating the canola meal will enhance its protein solubility and nutritional value. In an experiment by Vermorel and Evrard (1987), treatment of diet with rapeseed meal in rats led only to a reduced thyroid mass without beneficial effect on growth. Under the conditions of the experiment conducted by Drouliscos and Bowland (1969) solvent-extracted rapeseed meal was superior to prepress-solvent meal on the basis of rat growth response and of results for nutritional indices. Both rapeseed meals were inferior to soya-bean meal and casein.

CONCLUSIONS

At all, reviewing the results of this study and other related surveys showed that, regardless of percentage of SBM substitution, CM slightly changed the performance of the male Wistar rats but 30% substitution of SBM by CM can decrease FCR, by decreasing feed intake or reducing weight gain and consequently, decrease the total cost of animal husbandry. In addition, lower price, widely cultivation and availability of CM in Iran, led us to its partial replacement for SBM.

On the basis of achieved body weights, it is concluded that 30% inclusion of CM can improve quality of diet and can be used as an alternative protein supplement in rat feeding in all experimental sites.

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