

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 is 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 six with two repetition; three experimental groups were fed diets containing 10, 20 and 30% canola meal (E1, E2 and E3, respectively) and the fourth one (control) was with no canola meal added. In a 6 weeks period trial, adding canola meal did not change DWG but reduced DFI. Partial substitution of SBM by canola meal caused an increase in FCR. Independently of level of inclusion as a substitute for SBM, results showed that canola meal, especially E2 diet, slightly improved the animal performance and can be used in laboratory animal 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 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 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, researched 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. A variety developed in 1998 is considered to be the most disease and drought-resistant variety of Canola to date. 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. In Canada, an official definition of canola is codified in Canadian law (Bell, 1984). The present study, for the first time in Iran evaluates the effect of canola meal (produced by Iranian varieties of canola) on performance and growth parameters of male Wistar rats.

MATERIALS AND METHODS

The present study is conducted from July-September 2009. The diets were formulated by Pars Animal Feed Company-Tehran according NRC (1995) and were analyzed in Techno Azma laboratory by specific

Table 1: AminoAcids 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	E1	E2	E3
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 ($\mu\text{mol g}^{-1}$)	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	3976	3976	3976

*The analysis were carried out at Techno Azma Co.-Reference laboratory (2009)

analytical methods according to AOAC (1990). Used canola meal was analyzed to determine amino acid profile (Table 1). Chemical composition of the standard 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 $40 \times 33 \times 17$ 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 E1, E2 and E3, 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 food and drinking water *ad libitum* and were kept in a room with established 12/12 h photo period and average of $20 \pm 2^\circ\text{C}$ temperature and 50-60% humidity. The animals were housed in ORDC (Oilseed Research and Development Co.) animal room.

The rats were weighed at the first day of exam (day zero) and 2, 4 and 6 weeks after it. 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 Daily Feed Intake (DFI) and Daily Weight Gain (DWG) were calculated. Food Conversion Ratio (FCR) was measured by dividing DWG to DFI. The results of experiments subjected to the Analysis of Variance

Table 3: Control and experimental diets ingredients**

Ingredient (%)	C	E1	E2	E3
Canola Meal (CM)	-	10.000	20.00	30.00
SoyBean Meal (SBM)	35.00	25.100	15.20	5.31
Corn	25.00	25.000	25.00	25.00
Wheat	21.75	21.750	21.75	21.75
Alfalfa hay	15.33	15.330	15.33	15.33
Salt	0.40	0.400	0.40	0.40
Limestone	1.00	1.000	1.00	1.00
DL Methionine	0.11	0.074	0.03	0.01
Vegetable oil	0.23	0.150	0.08	-
Lysine	-	0.016	0.03	0.02
Vit. and minerals ^y	1.18	1.180	1.18	1.18

^yProvided 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. B₁₂, 80 mcg; Vit. A, 15000 IU; Vit. D, 1000 IU

(ANOVA) using SPSS. Some differences in the DWG, DFI and FCR in rats fed on treatment diets were determined within each period of the trial.

RESULTS AND DISCUSSION

After 6 weeks-course of feeding, the performance characteristics of rats fed on E1, E2 and E3 diets during 6 weeks did not differ in terms of the growth rate (DWG) but was increased in terms of FCR, probably due to decrease in DFI rate (Table 4-6). DWG in control group was the highest and DFI of E3 was lowest in all periods of the trial. The diet with 20% inclusion of canola meal (E2) had more promotional effects on rat growth performance than other experimental groups. As shown in Table 7, significant differences in total body weight between group C and the experimental groups were found but the DFI in E3 was slightly lower than the others, probably because of lesser palatability of canola meal. Rats fed on 30% of canola meal in their daily feed (E3) manifest a better FCR than others (C, E1 and E2) but it is predicted to be due to adverse effect of glucosinolate content of canola meal on thyroid function and reducing appetite of rats that led to less feed intake. Finally, it is concluded that 20% inclusion of canola meal improves its quality and can be used as an alternate protein supplement in rat diet.

The main purpose of the present study was to determine effectiveness of using canola meal in male Wistar rat diet and its nutritional effect on performance of rats. Because of more availability and lower cost of canola meal than the other protein supplements such as soybean meal, diets used in this study had lower price and were economically advisable and beneficial for research laboratories, however, adding canola meal did not significantly increase nutritional value of the diets. Thus, canola meal can be used widely in laboratory animals, especially Wistar rat as a proper protein source. Many studies are carried out in the recent year to evaluate

Table 4: Average of live weight at 64 (W64) days of age and main 3 characteristics in the 1st 2 weeks (from 50-64 days of age)

Characteristics	Diet groups			
	C	E1	E2	E3
W64 (g)	310	305	308	301
DWG (g)	5.71	5.63	5.61	5.6
DFI (g)	22.3	21.3	22.4	20.6
FCR	0.256	0.264	0.250	0.272

Table 5: Average of live weight at 78 (W78) days of age and main 3 characteristics in the 2nd 2 weeks (from 64-78 days of age)

Characteristics	Diet groups			
	C	E1	E2	E3
W78 (g)	400	400	403	395
DWG (g)	6.42	6.38	6.39	6.38
DFI (g)	23.6	22.6	23.1	21.3
FCR	0.272	0.282	0.277	0.299

Table 6: Average of live weight at 92 (W92) days of age and main 3 characteristics in the 3rd two weeks (from 50-92 days of age)

Characteristics	Diet groups			
	C	E1	E2	E3
W92 (g)	495	490	494	488
DWG (g)	6.76	6.67	6.73	6.72
DFI (g)	24.1	23.1	24.9	23
FCR	0.280	0.289	0.270	0.292

Table 7: Total amounts of 3 characteristics for all diet groups, from the first to the last day of trial

Characteristics	Diet groups			
	C	E1	E2	E3
TWG (g) ^A	265	260	264	258
DWG (g)	6.31	6.19	6.29	6.14
DFI (g)	23.3	22.3	23.5	21.6
FCR	0.271	0.278	0.268	0.284

^A Total Weight Gain (during the trial)

using canola meal in animal nutrition that have shown different results (Sauer *et al.*, 1982; Rabot *et al.*, 1993; Jorgensen 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.

CONCLUSION

By reviewing the results of this study and other related surveys, we conclude that independently on CM inclusion levels as a substitute for soybean meal, it is showed that CM slightly worsened the performance of the male Wistar rats but 20 and 30% substitution of canola meal can increase FCR, by reducing feed intake and consequently, decrease the total cost of animal husbandry. In addition, lower price, widely cultivation and availability of canola meal in Iran, led us to its partial replacement for soybean meal.

On the basis of achieved body weights, it confirmed the inclusion of 20% of canola meal in diet of Wistar rats can be used in experimental sites.

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