Effects of Various Mechanical and Chemical Treatments of Rapeseed Meal on the Performance of Broilers

M. Z. Khan, S. Mahmood[1], M. Sarwar[2], M. Nisa[2] and F. Gulzar
Livestock and Dairy Development Department, Punjab, Pakistan

ABSTRACT : One hundred and eighty, 1-day old broiler chicks, randomly divided into 15 replicates of 10 brids each were employed to six treatment rations (A, B, C, D, E and F). Rapeseed meal (RSM) with or without treatment was incorporated in the rations at 20 percent level in lieu of soybean meal. The birds in group A were fed soybean based ration and those in group B, C, D, E and F were given ration containing untreated, solvent extracted, water treated, autoclaved and ferrous sulphate treated RSM, respectively. Presence of RSM in the rations whether untreated or treated, significantly reduced weight gain and feed consumption of the birds compared with those of control group but efficiency of feed utilization, dressed weight, dressing percentage and weights of internal organs amongst the groups remained unaffected. The size of thyroid galnds of the broilers using the meal was significantly larger than those having ration without RSM. The only exception was that the birds having solvent extracted meal had similar thyroid gland relative weight as those of control group indicating reduced antinutritional effect of isothiocyanates content due to solvent extraction of the meal.
(**Key Words:** Treated Rapeseed Meal, Weight Gain, Feed Efficiency, Thyroid Gland)

INTRODUCTION

Rapeseed meal is a by-product of the oil industry obtained after the extraction of oil by expeller or solvent process. It contains on an average of 34.5, 7.6, and 10.0 percent crude protein, fat and crude fiber, respectively (Malik and Chaughtai, 1979). The meal is available in sufficient quantity and at cheaper rates as compared with other vegetable protein sources. However, the meal prepared from rapeseed has deleterious effects on poultry birds when fed as the sole source of vegetable protein. It depresses growth, causes thyroid hypertrophy, liver hemorrhages and skeletal abnormalities (Fenwick and Curtis, 1980; Zhenchuan et al., 1988; Karunajeewa et al., 1990) due to the presence of a factor, "goitrin". This has limited the use of rapeseed meal as a protein source in poultry feeds.

Various attempts have been made to detoxify 'goitrin' by soaking, boiling, autoclaving (Malik, 1977) and by steaming (Kozlowski et al., 1991). However, some small scale procedures have been acclaimed successful. Detoxification of allyl-isothiocyanate has been achieved by chemical additives, particularly ferrous sulphate (Bell et al., 1971; Malik, 1977). These attempts for detoxification of the meal by different methods seem promising for commercial exploitation and greater use of detoxified rapeseed meal (RSM) in livestock and poultry feeding.

Keeping in view the above mentioned facts, a project was planned to determine the effects of growth inhibiting factor in RSM on the performance of broilers and to improve the nutritive value of indigenous RSM for poultry feeding, through different mechanical and chemical treatments like autoclaving, addition of water, solvent extraction and ferrous sulphate treatment.

MATERIALS AND METHODS

Preparation and chemical analysis of the meal

The rapeseed, "*Brassica compestris*" was purchased from local market of Lahore (Pakistan) to prepare meal to be used in the experimental rations. The oil of the rapeseed was extracted by the expeller method and attempts were made to avoid any heat or hot water treatment during oil extraction, so that the endogenous enzyme, "myrosinase" in the rapeseed meal might not be destroyed. The meals thus prepared (untreated) and the meal treated with different mechanical and chemical treatments were analyzed for their moisture, crude protein, crude fiber, ether extract, ash, nitrogen free extract, calcium, phosphorus and allyl-isothiocyanate contents using the technique recommended by A.O.A.C. 1990.

[1] Address reprint requests to S. Mahmood, Department of Poultry Husbandry, University of Agriculture, Faisalabad, Pakistan.
[2] Department of Animal Nutrition, University of Agriculture, Faisalabad, Pakistan.
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Detoxification of the rapeseed meal

To reduce the antinutritional effect of the indigenous RSM, it was treated with different mechanical and chemical treatments as mentioned below, before inclusion in the broilers rations.

a) Solvent extraction

The procedure of Yule and McBride (1978) was followed for the solvent extraction of the meal. The rapeseed meal (expeller extracted) was ground and extracted by pertroleum ether.

b) Water treatment

The method recommended by Malik (1977) was used by mixing the meal thoroughly with tap water (one kg RSM/l water) spreading approximately ½" thick in deep trays, and keeping for 48 hours at the temperature ranging 20 to 22℃ for 2 hours and later on dried at 70℃ for more than 48 hours to its original weight.

c) Autoclaving

Autoclaving of rapeseed meal was carried out by mixing the meal with water in the ratio of 4:1, i.e. one kg of meal in 250 ml of distilled water. After mixing thoroughly, the mixed meal was spread in about an inch thick trays to facilitate autoclaving. The autoclaving was done at a pressure of 15 lb per square inch (psi) for 30 minutes and then dried in draft oven at 70℃ to its original weight.

d) Ferrous sulphate treatment

The ferrous sulphate treatment of rapeseed meal was done by the method of Bell et al. (1971). The rapeseed meal was first moistened with 10 percent distilled water and ferrous sulphate was then added at the rate of 1.0 percent of the rapeseed meal and thoroughly mixed. The product was subjected to steam sparking in a jacketed kettle for 25 minutes. Finally the product was dried to its original weight at 50℃.

Experimental procedure

Day old broiler "Indian Rivers" chicks were used as experimental animals. The chicks were randomly divided into six groups so as to have three replicates of 10 chicks each. The feed and water were supplied *ad libitum* to the chicks. Continuous light was provided to the chicks throughout the experimental period. The chicks were reared in electrically heated and thermostatically controlled battery brooders during the first four weeks and then in grower batteries for the rest of the experimental period. Weighed amount of feed was offered during each week to each replicate and feed refused was weighed at the end of the each week. Weekly weight gain, feed consumption, mortality and general health of the chicks were recorded. The rapeseed meal with or without treatment was incorporated at 20 percent level in lieu of soybean meal on protein equivalent basis. The composition of each experimental ration is given in table 1.

Table 1. Ingredients (%) and chemical composition of experimental rations

Ingredients	Rations					
	Control	Untreated	Solvent extracted	Autoclaved	Water treated	$FeSO_4$ treated
Yellow maize	60.0	60.0	60.0	60.0	60.0	60.0
Soybean meal	12.5	–	–	–	–	–
Rapeseed meal*	–	20.0	20.0	20.0	20.0	20.0
Wheat bran	12.0	4.5	4.5	4.5	4.5	4.5
Wheat meal	8.0	8.0	8.0	8.0	8.0	8.0
Fish meal	6.0	6.0	6.0	6.0	6.0	6.0
D. C. P.	1.0	1.0	1.0	1.0	1.0	1.0
Vitamin-mineral premix	0.5	0.5	0.5	0.5	0.5	0.5
Chemical composition						
Crude protein (%)	20.2	20.8	20.8	20.8	20.8	20.8
Crude fibre (%)	3.8	4.6	4.6	4.6	4.6	4.6
ME (Kcal/kg)	2,832	2,830	2,830	2,830	2,830	2,830
Calcium (%)	1.2	1.4	1.4	1.4	1.4	1.4
Phosphorus (%)	0.9	1.1	1.1	1.1	1.1	1.1
Ether extract (%)	7.9	9.7	6.9	7.7	7.7	7.7
Energy : Protein	140	136	136	136	136	136

* Ration B, C, D, E and F contained untreated, solvent, extracted, autoclaved, water treated and ferrous sulphate treated RSM, respectively.

All the chicks were slaughtered at the end of the experiment to study the dressed weight and dressing percentage. The weights of liver, spleen, pancreas, heart, gizzard and thyroid glands were also recorded.

Statistical analysis

The data collected were subjected to the analysis of variance technique using completely randomized design and the means were compared by Duncan's Multiple Range test (Steel and Torrie, 1984).

RESULTS AND DISCUSSION

The treatment of RSM significantly ($p < 0.05$) reduced the allyl-isothiocyanate contents of the meal (table 2). Treatment with ferrous sulphate was the most effective followed by autoclaving, solvent extraction and water. However, there was no effect of the treatments on proximate composition of the meal except the ether extract value which was significantly reduced and the N.F. E. value increased in the solvent extracted RSM.

Table 2. Chemical composition (%) of untreated and treated rapeseed meal

Variable	Untreated	Solvent extracted	Autocalved	Water treated	$FeSO_4$ treated
Moisture	8.0	7.5	8.1	8.7	8.8
Crude protein	34.0	35.7	34.1	34.0	34.0
Crude fibre	10.7	11.3	10.7	10.7	10.8
Ether extract	14.9	0.8	14.9	14.7	14.7
Ash	6.9	7.2	6.9	7.0	7.4
Nitrogen-free extract	25.5	37.5	25.3	24.2	24.3
Calcium	1.0	1.1	1.0	1.1	1.0
Phosphorus	2.0	2.3	2.0	2.1	2.2
ME (kcal/kg)	1,880	1,880	1,880	1,880	1,880
Allylisothiocyanate	0.25	0.17	0.08	0.23	0.07

Weight gain

The inclusion of RSM in the rations significantly reduced the weight gain of the birds compared with those using soybean based ration (table 3). However, weight gain of the birds fed ration containing untreated RSM was slightly higher than those fed treated meal. The lowest gain was observed in the birds consuming ration containing RSM treated with water whereas, the values for the other treatment groups were almost similar. The growth depression in the birds using water treated RSM may be due to the formation of more toxic compounds such as, nitriles and isothiocyanates during enzymatic hydrolysis of the meal. The result of the present study are in line with the findings of Paik et al. (1981); Summer et al. (1982); Zhenchuan et al. (1988); Summer et al. (1989), who reported significant reduction in weight gain of the birds using untreated RSM in their diets.

Table 3. Body weight gain, feed consumption, feed efficiency, dressing percentage and mortality of broilers using untreated or treated rapeseed meal

Variables	Rations					
	Control	Untreated	Solvent extracted	Autoclaved	Water treated	$FeSO_4$ treated
Initial body weight (g)	42	41	40	41	42	41
Final body weight (g)	1,420	1,350	1,340	1,340	1,240	1,320
Weight gain (g)	1,380[a]	1,310[b]	1,300[b]	1,300[b]	1,200[b]	1,280[b]
Feed consumption (g)	2,840[a]	2,640[b]	2,640[b]	2,590[b]	2,560[b]	2,570[b]
Feed efficiency (g feed/g gain)	2.06	2.02	2.03	2.00	2.13	2.01
Carcass weight (g)	1,040	1,000	1,000	970	870	940
Dressing percentage	73[a]	74[a]	74[a]	72[a]	66[b]	75[a]
Mortality	0	3	3	0	0	0

Values within same row with different superscripts are significantly different ($p < 0.05$).

Feed consumption and feed efficiency

The birds using RSM consumed less feed than those fed on control ration. The feed intake of the birds having ration containing water treated RSM was the least among all the groups. However, there was no significant difference in the efficiency of feed utilization of the birds fed on soybean based ration and the ration containing treated or untreated RSM. Treatment of the RSM did not exhibited any effect of efficiency of utilization of the material. These results are compatible with those observed by Yule and McBride (1987) who reported lower feed consumption in broiler chicks due to the inclusion of RSM in their rations.

The results of the present study do not agree with the findings of Bell et al. (1971); Olomu et al. (1974); Shires et al. (1981) and Malik (1977) who reported improved weight gain and feed efficiency of the broilers fed rations containing treated RSM. This might be due to the reason that the indigenous variety of rapeseed used for the preparation of RSM was lower in glucosinulate content (0.3%) especially the more toxic hydroxy-glucosinolates as compared with the reported values (0.5%) by the above mentioned workers.

Dressed weight

The lowest carcass weight and dressing percentage were recorded in the chicks fed ration containing water treated RSM. These values showed a similar trend as the weight gain of the chicks for different experimental rations. Therefore, lower carcass weight and dressing percentage values in the chicks using water treated RSM may be ascribed to the lower weight gain of the birds in this group.

Weights of internal organs

The average relative weights (g/100 g body weight) of internal organs (gizzard, liver, spleen, pancreas heart) of the chicks fed different experimental rations when subjected to statistical analysis showed non-significant differences among the groups (table 4). However, the weight of thyroid glands of the chicks fed rations containing RSM were significantly higher ($p < 0.05$) than those of using soybean based diet. It was also observed that the mechanical and chemical treatments of RSM significantly decreased the relative weight of the thyroid gland except water treatment.

Table 4. Relative weights of internal organs (g/100 g of dressed carcass weight) of broilers using untreated or treated rapeseed meal

Organs	Rations					
	Control	Untreated	Solvent extracted	Autoclaved	Water treated	$FeSO_4$ treated
Thyroid gland	0.019^{a}	0.025^{c}	0.019^{a}	0.020^{ab}	0.024^{c}	0.021^{b}
Gizzard	3.01	3.11	2.80	2.67	2.97	3.04
Liver	2.92	2.89	2.91	2.89	2.95	2.88
Spleen	0.44	0.47	0.46	0.44	0.46	0.48
Pancreas	0.55	0.49	0.48	0.46	0.51	0.52
Heart	0.90	0.91	0.91	0.88	0.88	0.91

Values within same row with different superscripts are significantly different ($p < 0.05$).

The effect in reducing the weights of the thyroid glands of the chicks fed rations containing treated RSM may be because of reduction in the glucosinolate content, due to the treatment of the meal. Similar findings were reported by Kuchta and Malinowska (1976) and Malik (1977), that different mechanical and chemical treatments of RSM were effective in reducing the glucosinolate content and the weights of thyroid glands of the chicks fed rations containing treated meal.

It can be concluded from the results and discussion of the study that the treatments were effective in reducing content of the allyl-isothiocyanate and probably other isothiocyanates of RSM resulting into reduced relative size of the thyroid glands of broiler chicks, with the only exception that the water treatment of RSM was ineffective which rather produced adverse effects on the growth rate and efficiency of feed utilization of the chicks.

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