NUTRITIONAL VALUE OF VERY LOW GLUCOSINOLATE CANOLA MEAL FOR BROILER CHICKENS

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INTRODUCTION

Since the development of the rapeseed industry in Canada, the importance of glucosinolates in oil and meal fractions has been recognized. In meal, hydrolysis of glucosinolates by the enzyme myrosinase results in products which not only affect thyroid function but also have been shown to influence other important traits in livestock and poultry. The development of low glucosinolate "Canola" cultivars has greatly reduced problems associated with glucosinolates and enhanced the feeding value of rapeseed meal.

Despite the improvement, indications of a continued glucosinolate effect remain. These include thyroid hypertrophy and reduced biological performance of animals fed high levels of Canola meal. As a consequence there are limits on the inclusion of Canola meal in animal rations. Recent developments of rapeseed cultivars with even lower levels of glucosinolates (Agriculture Canada, Saskatoon) offers the potential to further study the impact of glucosinolates on broiler productivity and to possibly increase the maximum recommended level of Canola meal in broiler diets.

The objective of this research was to compare the nutritional value of very low glucosinolate meal (LGM) to Tobin Canola meal (TCM) and soybean meal (SBM) for chickens. Included in the evaluation are apparent metabolizable energy (AME) and studies on the use of the above meals in the diets of broiler chickens to market age.

MATERIALS AND METHODS

Meal samples were derived from seed grown during the 1987 and 1988 crop years with the former commercially processed and the latter processed at the POS Pilot Plant Corporation. Glucosinolate analyses of the samples are shown in Table 1 (I. McGregor, personal communication). The LGM contained much lower levels of glucosinolates than the TCM, although some weed seed contamination was indicated by the glucosinolate content of 1987 samples.

Apparent Metabolizable Energy Determination

Separate experiments were completed to determine the AME of meals from the two years. The procedure utilized commercial broiler cockerels housed in battery cages. Chicks were fed a wheat-soybean meal starter diet from 1 to 17 d of age and then transferred to a treatment diet. For the 1987 meals, 0, 15, 30 or 45% of a basal diet was replaced with LGM, TCM or SBM while only the 0 and 45% levels were used for the 1988 samples. Test meal and chromic oxide (0.5%) were added at the expense of the basal diet as a whole. A micronutrient mix was added at the same level to all diets. After an adjustment period of 4 days, excreta were collected over a period of 3 days and frozen for further analysis. Six replications of 5 chicks were used for each treatment. All diets were fed in a mash form and with water provided on an *ad libitum* basis. Chicks were given constant light and temperature was maintained as required for chicks of that age.

Treatment diets and excreta were dried, ground and mixed thoroughly before analysis for moisture, gross energy, gross nitrogen (A.O.A.C. 1980) and chromic oxide (Fenton and Fenton 1979).

Broiler Growth Trials

Two experiments were used to study the nutritional value of Canola meals for broiler chickens. In each experiment, a total of 3,600 broilers were fed graded levels of LGM and TCM to market age (43 and 42 days respectively for the first and second experiment). In the first experiment, 1987 Canola meals were added at 10, 20 and 30% of the broiler diet in place of cereal grain and soybean meal with the resulting diets isonitrogenous but not isoenergetic to the control diet. Canola meal was also added at 20 and 30% of broiler diets using the determined AME for each meal type. In this case diets were isonitrogenous and isoenergetic to the control. In the second experiment, 1987 meals were fed at 10 and 20% inclusion levels while the 1988 meals were tested at 10, 20 and 30% of the ration. All diets were formulated to be isonitrogenous and isoenergetic based on the AME determined for the 1987 samples and protein levels determined for each sample.

Broilers were fed starter and finisher diets from 0 to 21 and 21 days to market, respectively. Feed and water were available on an ad libitum basis. Broilers were housed in 6 light controlled rooms with 12 pens in each room. The pens had litter floors and each contained 25 males and 25 females. Each treatment was randomly assigned to one pen per room, therefore resulting in 6 replications per treatment. An exception was the control treatment which was assigned to 2 pens per room or a total of 12 replications.

Two lighting treatments were superimposed on the first study. Intermittent and increasing lighting programs were each randomly assigned to 3 rooms. There were no significant interactions between lighting and dietary treatments so the lighting effects will be ignored in this paper. Increasing lighting was used for all rooms in the second experiment. Pen body weight gain and feed consumption were determined from 0 to 21 and 21 to 43/42 d. All dead birds were weighed, recorded and examined for cause of death.

Data were analyzed using the Statistical Analysis System (SAS Institute, Inc. 1982). Percentages were converted to arcsine before analysis and where appropriate, means were separated using Duncan's multiple range test. Differences were considered significant where $P \leq 0.05$.

RESULTS AND DISCUSSION

Apparent Metabolizable Energy Determination

Testing of the 1987 samples showed that protein meal had a significant impact on AME as shown in Table 2. LGM contained more AME than TCM and both Canola meals had lower values than SBM. As level of meal increased in the treatment diets the level of energy decreased. Although it would appear that this effect was larger for the Canola meals, analysis of variance did not reveal a significant interaction between meal type and level of inclusion. The results for the 1988 samples were similar with LGM higher in AME than TCM (Table 2).

Broiler Growth Trials

In the first experiment, adding Canola meal to broiler diets caused a number of significant effects (Table 3). Body weight decreased in a linear fashion with addition of Canola meal. This effect was moderated to some extent by the formulation of diets to be both isonitrogenous and isoenergetic to the control. Also the degree of effect on body weight was significantly less for birds fed LGM in contrast to TCM; this was particularly marked at the 30% inclusion level.

Feed to gain ratio was affected in a similar manner to body weight with significant effects due to level of meal inclusion, method of formulation and meal type. The accuracy of the determined AME values is demonstrated by the fact that the feed to gain ratios for the isoenergetic treatments were similar to the control.

Mortality during the trial was collected daily and examined for cause of death. In addition birds were individually handled at 43 d and judged for the presence of leg abnormalities. Total mortality increased with level of Canola meal and again the effect was less evident for LGM. The majority of the this effect was due to an increase in leg abnormalities although a numerical increase in the incidence of sudden death syndrome was also noted.

The second broiler experiment confirmed that LGM was superior to TCM in terms of growth rate (Table 4). A significant meal by inclusion level interaction showed that as the level of Canola meal increased in the diet, growth rate decreased for TCM but performance of birds fed LGM remained equal to the control. Feed to gain ratio was not affected to a major degree by dietary treatment, indicating that the AME values used for Canola meals were accurate. There were no significant effects of dietary treatment on overall mortality but the level of ascites was higher for birds fed TCM than those fed LGM. Although mortality due to ascites was not high, the reduced incidence for birds fed LGM suggests that the glucosinolates present in TCM influence bird metabolism and therefore mortality.

The results of this research indicate that meal from the LGM is nutritionally superior to TCM for broiler chickens. Although it may not be possible to positively determine whether this is due to the reduction in glucosinolate content or another genetic characteristic, the evidence from AME analyses and broiler trials strongly implicates glucosinolates as the factor responsible. The data also suggest that the maximum recommended inclusion level of Canola in broiler diets could either be increased or eliminated if the very low glucosinolate characteristic was included in commercially grown seed.

CONCLUSIONS

LGM contained more AME and resulted in superior broiler performance than TCM. Therefore, reduced meal glucosinolate content is considered nutritionally superior for broiler performance and a desirable characteristic for newly developed Canola cultivars.

REFERENCES

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Table 1. Glucosinolate content of 1987 and 1988 meals[1]

Canola sample	LGM		TCM	
	1987	1988	1987	1988
Allyl	0.60	0.00	0.63	0.00
Butenyl	0.15	0.00	2.97	3.79
Pentenyl	1.01	0.00	1.13	1.91
Hydroxy butenyl	0.42	0.00	4.71	7.00
Hydroxy pentenyl	0.00	0.00	0.00	0.79
Hydroxy benzyl	3.87	0.00	4.41	0.00
Indolyl	0.14	0.05	0.12	0.15
Hydroxy indolyl	0.08	0.49	1.33	1.99

[1] Micromole/g, oil free basis.

Table 2. Apparent metabolizable energy (AME) of protein meals[1]

% Inclusion Level	LGM	TCM	SBM	Mean
1987 meals				
15	2608	2279	2764	2550[a]
30	2199	1700	2639	2179[b]
45	1750	1575	2461	1929[c]
Mean	2186[b]	1851[c]	2621[a]	
1988 meals				
45	2130[b]	1837[c]	2575[a]	

[1] Values determined on a dry matter basis.

[a,b,c] Means with different superscripts within a treatment are significantly different ($P \leq 0.05$).

Table 3. The effect Canola meals on broiler performance (1987 meals)

Level of Canola (%)	0	10	20	30
Body weight (kg) - 43 days of age				
Control	2.141			
LGM[1]		2.101	2.069	2.032
LGM[2]			2.070	2.069
TCM[1]		2.080	2.026	1.945
TCM[2]			2.029	2.002
Feed to gain ratio - 0-43 days of age				
Control		1.84		
LGM[1]		1.81	1.93	1.95
LGM[2]			1.86	1.86
TCM[1]		1.87	1.87	2.00
TCM[2]			1.85	1.88
Percent mortality				
Control	9.00			
LGM[1]		10.33	12.00	13.00
LGM[2]			12.33	14.33
TCM[1]		13.00	12.00	16.33
TCM[2]			14.33	17.43

[1] Formulated to be isonitrogenous but not isoenergetic with the control diets.
[2] Formulated to be isonitrogenous and isoenergetic with the control diets.

Table 4. The effect Canola meals on broiler performance (1987 & 1988 meals)

Level of Canola (%)	0	10	20	30
Body weight (kg) - 42 days of age				
Control	1.971			
LGM[1]		1.970	1.989	1.974
LGM[2]		1.985	1.962	
TCM[1]		1.974	1.912	1.868
TCM[2]		1.954	1.936	
Feed to gain ratio - 0-42 days of age				
Control	1.88			
LGM[1]		1.88	1.89	1.86
LGM[2]		1.85	1.93	
TCM[1]		1.86	1.84	1.88
TCM[2]		1.85	1.87	
Percent mortality				
Control		7.68		
LGM[1]		9.01	8.65	8.32
LGM[2]		9.36	10.33	
TCM[1]		9.00	8.69	7.67
TCM[2]		7.99	9.33	

[1] 1988 meals.
[2] 1987 meals.