Effect of increasing dietary inclusion of solvent-extracted *B. napus* or *B. juncea* meals for broilers grown to 35-d of age on nutrient mass balance and calculated nitrogen emissions

Matt Oryschak[1*] and Eduardo Beltranena[1,2]

[1]Alberta Agriculture and Rural Development, Edmonton, AB; [2]Department of Agriculture, Food and Nutritional Science, University of Alberta, Edmonton, AB

INTRODUCTION

Literature over the past 25 years has established that there is a direct relationship between P and N (i.e., CP) intake and excretion in poultry. Excretion of easily-volatilized forms of N (e.g., metabolic N, such as uric acid) is of particular concern, as there are several jurisdictions where ammonia (NH_3) emissions from confined animal feeding operations are regulated. In such jurisdictions, the use of high levels of canola meal (and other co-products) may be discouraged out of concern for increasing NH_3 emissions due to lower digestibility of CP. There is, however, little information in the literature regarding how diets formulated on a digestible nutrient basis and including high levels of co-products affects nutrient balance and volatile N emissions from broilers.

The objective of this study, therefore, was to study the effect of increasing dietary inclusions of two species (*B. napus* and *B. juncea*) of solvent-extracted canola meal on N and P balance and volatile N losses from broilers raised to 35 d of age.

METHODS AND MATERIALS

Mixed-sex broilers (Ross 308; n=1900) were randomly distributed on the day of hatch among floor pens bedded with a 5 cm layer of softwood shavings. Each pen was assigned to one of 7 dietary regimens, consisting of 10, 20 or 30% of either *B. napus* or *B. juncea* meal, or a 0% canola meal control for the duration of a 35-d growth cycle. Each treatment regimen was assigned to 6 replicate pens in a completely randomized design.

Diets within each phase were formulated to provide similar levels of AME, ileal digestible AA and exceeded NRC (1994) requirements for other nutrients (**Table 1**).

Table 1. Formula target specifications for test diets within each phase (%).

	Starter (d0 - 14)	**Grower** (d 15 - 24)	**Finisher** (d 25 - 35)
AME, kcal/kg	2905	2950	2995
Available phosphorus	0.50	0.45	0.42
Ileal digestible AA's			
Lysine	1.22	1.03	0.88
Methionine + cysteine	0.90	0.78	0.69
Threonine	0.79	0.68	0.59
Isoleucine	0.91	0.78	0.67
Arginine	1.26	1.07	0.92
Tryptophan	0.30	0.27	0.24

Birds were weighed on d 0, 14, 25 and 35 and feed consumption for each phase was measured for each test pen. Test diets were sent for laboratory analysis to determine N and P content. On d 35 of the study, 15 males and 15 females representing each dietary regimen were slaughtered according to commercial practice to obtain carcass data. A further 15 males and 15 females per dietary regimen were also euthanized on d 35 of the study to permit determination of whole body N and P composition. On d 36, litter in each test pen was weighed, thoroughly homogenized and sampled several times to create a representative composite sample for each pen. Litter samples were sent for laboratory analysis of N, NH_3 and P.

Nutrient mass balance was calculated as the difference between nutrient input (feed) minus nutrient retained in litter and removed as bird mass on d 35. Net positive mass balance for N was assumed to be due to nutrient lost from the system through volatilization.

Normalized data were analyzed using the MIXED procedure of SAS (v 9.1.3, SAS Institute; Cary, NC). Statistical models included the fixed effects of canola species (*B. napus* vs. *B. juncea*), inclusion level (0, 10, 20 or 30%) and the 2-way interaction. Block (pen location within room) served as the random term. Linear contrasts were specified for canola meal inclusion level.

RESULTS

There was no interaction between canola meal species and inclusion level for any variable measured in the present study. Aside from higher total P intake and total N retention for birds fed *B. napus* compared with *B. juncea* meal ($P < 0.01$), there were no observed differences between canola meal types (data not shown).

Increasing dietary inclusion of canola meal altered nutrient balance (**Table 2**). Nutrient (N and P) intake and recovery in litter both linearly increased with increasing dietary inclusion of canola meal ($P < 0.01$). Total N removed from the system as bird mass was lower for diets containing canola meal compared with the 0% control ($P < 0.01$).

Table 2. Effect of canola meal inclusion on nutrient intake, nutrient retained in litter and nutrient removed from the system as bird mass.

	Canola meal inclusion level, %					*P* - values	
	0	10	20	30	SEM	Level	Linear
Nutrient intake							
Total P, kg/EU	1.22^{c}	1.29^{b}	1.34^{ab}	1.36^{a}	0.02	0.001	0.001
Total N, kg/EU	5.30^{c}	5.58^{b}	5.69^{b}	5.95^{a}	0.06	0.001	0.001
Nutrient recovered in litter							
Total P, kg/EU[1]	0.81^{b}	0.93^{a}	0.88^{ab}	0.96^{a}	0.03	0.007	0.012
Total N, kg/EU	1.92^{c}	2.18^{b}	2.27^{b}	2.55^{a}	0.07	0.001	0.001
Nutrient removed as bird mass							
Total P, kg/EU	0.29^{a}	0.27^{ab}	0.28^{a}	0.27^{b}	0.01	0.049	0.127
Total N, kg/EU	2.44^{a}	2.23^{b}	2.16^{b}	2.26^{b}	0.06	0.006	0.028

[1] EU = experimental unit (pen of 44 mixed-sex broilers)

Table 3. Effect of canola meal inclusion level on total N lost from the test system through volatilization (assumed to be NH_3) from litter-raised broilers harvested at 35 days of age.

	Canola meal inclusion level, %					*P* - values	
	0	10	20	30	SEM	Level	Linear
NH_3 emissions							
kg NH_3/EU	1.14^{b}	1.42^{a}	1.52^{a}	1.39^{a}	0.08	0.010	0.020
g NH_3/kg bird marketed	11.90^{b}	14.70^{a}	15.88^{a}	14.89^{a}	0.86	0.015	0.012
g NH_3/kg carcass	17.08^{b}	21.18^{a}	22.91^{a}	21.62^{a}	1.24	0.012	0.009
Adjusted NH_3 emissions[1]							
kg NH_3/EU	1.29^{b}	1.56^{ab}	1.76^{a}	1.55^{ab}	0.11	0.039	0.045
g NH_3/kg bird marketed	13.42^{b}	16.18^{ab}	18.37^{a}	16.61^{ab}	1.23	0.051	0.032
g NH_3/kg carcass	19.27^{b}	23.30^{ab}	26.54^{a}	24.16^{ab}	1.76	0.043	0.024
% of excreted N volatilized	32.80	34.84	35.62	30.99	1.87	0.303	-

[1] Emissions adjusted to 100% P recovery from the test system.

Diets containing canola meal (10, 20 or 30%) resulted in higher volatile N losses (i.e., NH_3 emissions; $P < 0.05$; **Table 3**). While NH_3 losses increased linearly ($P < 0.05$) with increasing canola meal inclusion, there was no statistical difference among the different levels of canola meal inclusion (10, 20 and 30%). The proportion of excreted N lost through volatilization was not affected by canola meal inclusion level.

IMPLICATIONS

Inclusion of canola meal in diets increased nutrient excretion and volatile N losses compared to a wheat-soybean meal diet.

If, however, diets containing canola meal are formulated on a digestible AA basis, increasing the dietary inclusion level will not necessarily increase NH_3 emissions from the production system.

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canolacouncil
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Matt Oryschak
Research Associate - Monogastric Feeds
Alberta Agriculture and Rural Development
Tel: (780) 415-2220
e-mail: matt.oryschak@gov.ab.ca
Fax: (780) 427-1057