Evaluation of *Camelina sativa* meal as a feedstuff for layers: Effects of increasing dietary inclusion, copper supplementation and layer strain on post-mortem signs of toxicity, organ weights and serology

Matt Oryschak[1*], Colleen Christianson[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

Camelina sativa (a.k.a. false flax) is an oilseed belonging to the *Brassica* family and is closely related to mustard, canola and rapeseed. There is growing interest in camelina production in the northern Great Plains as it has shown promise as a feedstock for bio-based aviation fuel production. Unlike canola however, camelina and its co-products from oil extraction do not currently have regulatory approval for use as feedstuffs in Canada.

Like other *Brassica* species, camelina is known to contain antinutritional compounds which could adversely impact the health and productivity of poultry. These include glucosinolates, erucic acid, sinapine and condensed tannins. Toxicological data are critical components of any application to list a feed novel ingredient as a feedstuff for food producing animals in Canada.

The purpose of this study was, therefore, to study the effect of increasing dietary inclusion of expeller-pressed camelina meal (**CAM**), layer strain and copper supplementation on post-mortem organ morphology, organ weights and serology as indicators of toxicity.

METHODS AND MATERIALS

In a 36-wk experiment, hens (23 wk of age) housed in a 3-tiered, conventional layer battery (4 per cage; > 600 cm^2/bird) were partitioned into 3 study groups:

1. Brown hens (n=144; 'Brown Nick'; H& N International) randomly assigned to dietary regimens consisting of iso-caloric, iso-nitrogenous diets containing 0, 5, 10, 15, 20 or 25% CAM;
2. White hens (n=144; 'Nick Chick'; H& N International) randomly assigned to the same dietary regimens as Group 1 for a 36-wk laying period; and,
3. Brown hens (n=144; 'Brown Nick'; H& N International) randomly assigned to the same dietary regimens as Group 1, only with copper supplementation to 125 ppm Cu in the diets.

Each dietary regimen appeared twice in each block (tier of battery) in a randomized complete block design with 6 replicate cages per treatment.

Test diets within each production phase were formulated to contain similar levels of AME, crude protein and crude fat and exceeded requirements for all other nutrients as described in the production guides for these strains (H & N International, 2011).

During wk 12 of the study, blood was sampled from the wing vein from 1 bird per test cage and sent for analysis of serological parameters. Birds from which blood was drawn were weighed, euthanized by injectable barbiturate and sent for post-mortem evaluation of tissue morphology by a qualified Veterinary Pathologist (blind to treatment). After post mortem examination, key organs were dissected out and weighed. Actual organ wts were divided by intact body wt to obtain proportional wts.

Post mortem organ scores (0=normal, 1=pathological) were analyzed using the GENMOD procedure of SAS (v 9.1.3, SAS Institute; Cary, NC), specifying a binomial distribution and logit link function. Normalized serological and tissue wt data were analyzed using the MIXED procedure of SAS. Models included the fixed effects of CAM inclusion, bird strain (Group 1 vs. 2) or copper supplementation (Group 1 vs. 3) and the respective 2-way interaction.

For serological and organ wt data, block was included as a random effect in the model and linear contrasts for CAM inclusion level were specified.

RESULTS

The incidence of abnormal tissue morphology was very low for all layers sent for post mortem evaluation. There was no effect of dietary regimen, strain or copper supplementation on incidence of abnormal tissue morphology (data not shown). There was no interaction between CAM inclusion level and either bird strain or copper supplementation for any variable measured.

Increasing dietary CAM inclusion resulted in a linear reduction ($P < 0.01$) in intact body wt, but also a linear increase in proportional pancreas wt ($P < 0.01$). There was no effect of dietary CAM inclusion on any serological parameter.

Expected differences were observed between brown and white hens for proportional organ wt based on differences in mature body wt. Proportional liver and heart wt were both higher for white compared with brown strain hens ($P < 0.03$, **Table 2**). Serum T3 concentration was higher for white compared with brown hens ($P < 0.01$).

Table 1. Effect of increasing dietary camelina meal inclusion on proportional weight of selected organs and serological parameters.

	Camelina Meal Inclusion Level, %							*P* - value	
	0%	5%	10%	15%	20%	25%	SEM	Level	Linear
Organ weights									
Intact BW, g	1904[a]	1914[a]	1835[ab]	1718[bc]	1675[c]	1693[c]	45	0.001	0.001
Spleen, % BW	0.10	0.11	0.11	0.09	0.09	0.09	0.01	0.322	-
Pancreas, % BW	0.18[c]	0.19[c]	0.19[c]	0.20[bc]	0.22[a]	0.22[ab]	0.01	0.001	0.001
Heart, % BW	0.41	0.36	0.40	0.39	0.37	0.41	0.01	0.175	-
Liver, % BW	2.82	2.81	2.72	2.86	2.68	2.82	0.11	0.879	-
Serology									
Cholecystokinin	1300	1828	1493	2565	1531	1175	475	0.346	-
AST	183	174	186	203	177	183	14	0.727	-
T4	7.37	6.76	3.69	3.02	4.39	7.26	1.59	0.199	-
T3	1.71	1.56	1.36	1.36	1.43	1.37	0.14	0.437	-

Copper supplementation resulted in a slight increase in proportional heart wt ($P < 0.01$), but otherwise had no effect on proportional organ wt or serological parameters.

Table 2. Effect of layer strain and copper supplementation on proportional weight of selected organs and serological parameters.

	Layer strain			Copper Supplementation			*P* - value	
	Brown	White	SEM	(-)	(+)	SEM	Strain	Copper
Organ weights								
Intact BW, g	1976[a]	1603[b]	31	1976	1941	25	0.001	0.328
Spleen, % BW	0.10	0.10	0.01	0.10	0.10	0.01	0.854	0.771
Pancreas, % BW	0.19	0.21	0.01	0.19	0.19	0.01	0.418	0.990
Heart, % BW	0.35[b]	0.43[a]	0.01	0.35[b]	0.38[a]	0.01	0.001	0.004
Liver, % BW	2.68[b]	2.89[a]	0.07	2.68	2.76	0.09	0.026	0.484
Serology								
Cholecystokinin	1628	1670	274	1628	1774	241	0.913	0.668
AST	192	176	8	192	196	14	0.152	0.863
T4	5.23	5.60	0.92	5.23	5.96	0.80	0.777	0.516
T3	1.26[b]	1.67[a]	0.08	1.26	1.33	0.07	0.001	0.481

IMPLICATIONS

Data from 3 populations of laying hens indicate that CAM posed no toxicity concerns at levels exceeding those likely to be fed in least-cost layer rations.

The observed increase in pancreas wt with increasing CAM inclusion was not attributable to pathological hypertrophy, but does warrant further investigation.

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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