Not all canola meals are created equal:
Nutritional quality of meals produced by different oil extraction methods

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

Research and Innovation Division, Alberta Agriculture and Rural Development, Edmonton, AB;
Department of AFNS, University of Alberta, Edmonton, AB.

Background

With the expanded acreage of canola being grown in Western Canada there has also been an increase in crushing capacity. This increased capacity has not only consisted of conventional solvent extraction plants, but also lower capital crushing operations which employ less intensive oil extraction processes.

One example of an alternative crushing process is 'double-pressing', which omits the solvent-extraction step in favour of a second expeller pressing to remove additional oil from the press-cake. Another is extruder-pressing, where oil extraction and heating (necessary to inactivate the myrosinase enzyme) are achieved in a single step. This is sometimes followed by passing the extrudate through an expeller press to remove additional oil.

The net result of these different processes is a wide difference in oil content among the meals that result from each. Typically, residual oil content in conventional solvent-extracted meal is 2-3%, compared to 9-12% in double pressed meal and 15-18% in extruder-pressed meal.

While the residual oil content undoubtedly impacts the energy content of the meal, amino acid digestibility may also be impacted by the process used to extract oil from the seed. There is currently little information on nutrient digestibility in canola meals produced via methods other than solvent extraction for growing broilers.

Our Objective

The objective of this study was to compare nutrient and energy digestibility among *B. napus* canola meals produced by three crushing procedures: conventional solvent extraction, 'double-pressing' and extruder pressing.

What We Did

On the day of hatch, male Ross 308 broiler chicks (n=300) were divided among 24 test cages (12 or 13 birds/cage) and received a starter phase diet from d 0 to 14. On d 14, cages were then put onto one of 4 test diets, consisting of:

1. Grower phase concentrate (i.e., basal diet)
2. 70% basal diet / 30% solvent-extracted B. napus meal
3. 70% basal diet / 30% double-pressed B. napus meal
4. 70% basal diet / 30% extruder-pressed B. napus meal

To permit estimation of nutrient digestibility, all 4 test diets included 0.3% chromic oxide as an indigestible marker. Pooled excreta and digesta samples were collected on d 21 of the study and sent for chemical analyses.

Each treatment was applied to 6 replicate pens of birds in a randomized complete block design with pen as the experimental unit.

What We Observed

As expected, energy digestibility tended to mirror the crude fat content in the test ingredients. Digestibility coefficients for all amino acids was highest for the extruder-pressed meal, followed by the solvent-extracted and double-pressed meals.

The AME content of the meals reflected the energy digestibility coefficients. The extruder-pressed meal was estimated to contain nearly 40% more AME than the solvent extracted meal and 15% more than the double-pressed meal.

Despite the observed differences in amino acid digestibility, digestible amino acid content appeared to be influenced more by total amino acid concentrations in the respective meals.

Table 1. Apparent nutrient and energy digestible nutrient coefficients and calculated digestible nutrient content in solvent-extracted, double pressed and extruder-pressed canola meals for growing broilers.

	Canola meal type			
	Conventional (Solvent Ext)	Double-Pressed	Extruder-Pressed	SEM
Nutrient digestibility coefficients[1]				
Gross energy	48.44^{c}	56.73^{b}	67.77^{a}	1.88
Crude protein	71.88^{b}	68.73^{b}	79.40^{a}	1.17
Total AA	81.66^{a}	75.22^{b}	84.83^{a}	1.16
Amino acids				
Lysine	81.79^{b}	72.52^{c}	97.33^{a}	1.23
Methionine	88.58^{a}	81.43^{b}	91.37^{a}	0.89
Total Sulfur AA	82.20^{a}	75.79^{b}	84.92^{a}	1.17
Threonine	73.88^{b}	67.44^{c}	85.80^{a}	1.31
Tryptophan	78.86^{c}	85.08^{b}	88.86^{a}	0.99
Arginine	90.17^{b}	85.41^{c}	97.13^{a}	0.83
Calculated digestible nutrient content[2]				
AME, kcal/kg	1974^{c}	2699^{b}	3192^{a}	87
Crude protein	27.26^{a}	24.47^{b}	23.45^{b}	0.42
Total AA	28.23^{a}	24.36^{b}	20.30^{c}	0.38
Amino acids				
Lysine	1.76^{a}	1.53^{b}	1.17^{c}	0.02
Methionine	0.66^{a}	0.56^{b}	0.49^{c}	0.01
Total Sulfur AA	1.34^{a}	1.17^{b}	1.05^{c}	0.02
Threonine	1.17^{a}	1.03^{b}	1.00^{b}	0.02
Tryptophan	0.47^{a}	0.44^{b}	0.35^{c}	0.00
Arginine	2.08^{a}	1.87^{b}	1.50^{c}	0.02

[ab] Different superscripts within rows indicate statistically different means ($P < 0.05$)
[1] Coefficients are for apparent ileal digestibility, except energy which is apparent total tract digestibility.
[2] Digestible nutrient contents are in % as-fed basis unless otherwise indicated.

Take-Home Message

Residual oil content in canola meal is:

1. indicative of the extraction process used to produce the meal;
2. is positively correlated to AME content; and,
3. is inversely related to digestible amino acid content

B. napus and *B. juncea* canola meals for broilers: I. Nutrient and energy digestibility

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

Research and Innovation Division, Alberta Agriculture and Rural Development, Edmonton, AB; Department of AFNS, University of Alberta, Edmonton, AB.

Background

Brown mustard (*B. juncea*) is a closely related crop to canola (*B. napus*). It is better suited to the drier regions of Western Canada, thus allowing producers in these areas to benefit economically from the demand for oilseed crops for crushing. Aside from its beneficial agronomic properties, the seeds of *B. juncea* also have a thinner seed coat, which resulting in a lower fibre meal.

While preliminary lab analyses suggest that the total amino acid content is similar between *B. juncea* and *B. napus*, the lower fibre content in *B. juncea* meal could result in better energy or amino acid digestibility. Dietary inclusion of co-products, such as canola meal, is generally limited by their digestible energy and nutrient content. If the lower fibre content translates to higher nutrient digestibility, this suggests that *B. juncea* meal could be included at higher levels in practical broiler diets compared to *B. napus*.

Our Objective

The objective of this study was to compare nutrient and energy digestibility between samples of solvent-extracted *B. napus* and *B. juncea* meals.

What We Did

On the day of hatch, male Ross 308 broiler chicks (n=225) were divided among 18 test cages (12 or 13 birds/cage) and received a starter phase diet from d 0 to 14. On d 14, cages were then put onto one of 4 test diets, consisting of:

1. Grower phase concentrate (i.e., basal diet)
2. 70% basal diet / 30% solvent-extracted *B. napus* meal
3. 70% basal diet / 30% solvent-extracted *B. juncea* meal

To permit estimation of nutrient digestibility, all 3 test diets included 0.3% chromic oxide as an indigestible marker. Pooled excreta and digesta samples were collected on d 21 of the study and sent for chemical analyses.

Each treatment was applied to 6 replicate pens of birds in a randomized complete block design with pen as the experimental unit.

What We Observed

Energy and crude protein digestibility were higher for *B. juncea* meal compared to *B. napus*, however digestibility of most amino acids appeared to be similar. The apparent digestibility of arginine was higher in *B. juncea* compared to *B. napus*.

Calculated AME and digestible tryptophan content tended to be higher in *B. juncea* compared to B. napus. Digestible methionine + cysteine was higher in *B. juncea* while digestible arginine content was higher in *B. napus*.

Table 1. Apparent nutrient and energy digestible nutrient coefficients and calculated digestible nutrient content in solvent-extracted *B. juncea* and *B. napus* meals for growing broilers.

	Canola meal type		Comparison[1]
	B. juncea	*B. napus*	Juncea vs. Napus
Nutrient digestibility coefficients[2]			
Gross energy	0.65	0.56	*
Crude protein	0.77	0.72	*
Total AA	0.80	0.78	NS
Amino acids			
Lysine	0.76	0.77	NS
Methionine	0.86	0.87	NS
Met + Cys	0.78	0.77	NS
Phenylalanine	0.81	0.78	NS
Threonine	0.72	0.73	NS
Tryptophan	0.86	0.85	NS
Arginine	0.91	0.89	*
Calculated digestible nutrient content[3]			
AME, kcal/kg	2944	2543	*
Crude protein	29.73	28.37	NS
Total AA	26.77	27.23	NS
Amino acids			
Lysine	1.52	1.56	NS
Methionine	0.65	0.64	NS
Met + Cys	1.31[a]	1.21[b]	**
Threonine	1.17	1.17	NS
Tryptophan	0.37	0.35	*
Arginine	2.04[b]	2.24[a]	***

[1] NS= not statistically different (P > 0.10), * P < 0.10, **P < 0.05, *** P < 0.01
[2] Coefficients are for apparent ileal digestibility, except energy which is apparent total tract digestibility.
[3] Digestible nutrient contents are in % as-fed basis unless otherwise indicated.

Take-Home Message

Lower fibre content in *B. juncea* meal appears to positively influence energy digestibility and AME content, but does not appear to affect digestible amino acid content relative to *B. napus* meal.

This implies that established amino acid digestibility coefficients for *B. napus* meal can reasonably be used for *B. juncea* meal as well to estimate digestible amino acid content.

B. napus and *B. juncea* canola meals for broilers: II. Effects of increasing dietary inclusion on growth performance, carcass traits and profitability

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

Research and Innovation Division, Alberta Agriculture and Rural Development, Edmonton, AB; Department of AFNS, University of Alberta, Edmonton, AB.

Background

Dietary inclusion of canola (*B. napus*) meal in broiler rations has traditionally been restricted by its low dietary energy content (2000 kcal of AME/kg; NRC 1994). Brown mustard (*B. juncea*) is a closely related crop to canola and is better suited to the drier regions of Western Canada, allowing producers in these areas to benefit economically from the demand for oilseed crops for crushing. Aside from its beneficial agronomic properties, the seeds of *B. juncea* also have a thinner seed coat, which results in a lower fibre meal. In previous digestibility studies, we observed that *B. juncea* and *B. napus* meals fed to growing broilers had very similar digestible amino acid content, but that *B. juncea* meal tended to have higher apparent metabolizable energy (AME) content, likely as a result of its lower fibre content.

Higher AME content in *B. juncea* could permit higher inclusion levels in practical broiler diets compared to *B. napus*. This would potentially displace more costly protein ingredients (e.g., soybean meal) from the formula, thereby reducing reliance on imported ingredients and increasing the feed competitiveness of Western Canadian chicken producers.

Our Objective

The primary objective of this experiment was to determine the effect increasing dietary inclusions of either *B. napus* or *B. juncea* meal on growth performance and carcass traits of growing broilers.

A secondary objective was to compare the economics of feeding increasing dietary inclusions of each type of meal.

What We Did

On the day of hatch, mixed sex Ross 308 broiler chicks (n=1900) were placed in one of 42 floor pens (45 birds/pen) bedded with pine shavings. Pens were assigned one of 7 dietary regimens consisting of either a control diet (0% canola meal) or diets containing 10, 20 or 30% of either *B. napus* or *B. juncea* meal. All diets were formulated to be similar in AME and digestible nutrient content within each of three growth phases in a 35-d growth period. All diets contained a constant 5% wheat DDGS to reflect the composition of contemporary practical diets.

Birds were weighed as pen groups at the beginning and end of each phase and feed disappearance in each phase was determined. Average daily gain (ADG), average daily feed intake (ADFI) and gain-to-feed ratio (G:F) was calculated for each phase.

On d 36 of the experiment, 5 birds per pen were slaughtered under commercial conditions. The chilled carcasses were weighed and divided into primary components (breast muscles, thighs, drumsticks wings). Yield of each component as a percentage of the carcass was then calculated.

Each treatment regimen was applied to 6 replicate pens in a randomized complete block design with pen as the experimental unit.

Table 1. Effect of increasing dietary inclusion of *B. napus* or *B. juncea* meal for growing broilers on overall growth performance, carcass traits and economic variables.

	Dietary inclusion level of CM, %						
	0%	*B. napus*			*B. juncea*		
		10%	20%	30%	10%	20%	30%
Overall growth performance (d 0 - 35)							
ADG, g/d	61.9	60.7	62.0	61.7	62.5	62.9	61.4
ADFI, g/d	106.8	107.1	106.7	107.3	107.5	107.9	108.4
Gain:Feed	0.614	0.607	0.625	0.616	0.621	0.614	0.606
Carcass traits							
Dressing percentage, %	69.7	69.4	69.5	69.0	69.4	68.9	68.7
Carcass Wt, g	1518	1511	1514	1502	1512	1504	1499
P. major, % yield	24.0^{b}	25.3^{a}	25.3^{a}	25.1^{a}	24.7^{ab}	25.4^{a}	25.4^{a}
P. minor, % yield	5.0^{c}	5.3^{ab}	5.3^{ab}	5.4^{ab}	5.3^{ab}	5.2^{bc}	5.5^{a}
Thighs, % yield	17.7	17.4	17.5	17.7	18.0	17.5	17.8
Drumsticks, % yield	14.0	13.7	13.9	13.9	13.9	13.9	13.6
Wings, % yield	11.0	11.0	11.0	11.5	11.0	11.2	11.3
Total saleable, % yield	71.6^{b}	72.6^{ab}	72.9^{a}	73.6^{a}	73.0^{a}	73.3^{a}	73.7^{a}
Economic variables							
Total feed cost, $/bird	1.20^{a}	1.20^{a}	1.20^{a}	1.21^{a}	1.16^{b}	1.13^{c}	1.11^{d}
Total feed cost, $/kg	0.53^{b}	0.54^{a}	0.53^{b}	0.53^{ab}	0.51^{c}	0.49^{d}	0.50^{cd}
Cost of gain, $/kg gain	0.38^{a}	0.38^{a}	0.37^{ab}	0.38^{a}	0.36^{bc}	0.35^{c}	0.35^{c}
Income over feed costs							
$/bird placed	2.64^{abc}	2.58^{c}	2.63^{bc}	2.59^{c}	2.72^{ab}	2.74^{a}	2.59^{c}
$/bird marketed	2.73^{bc}	2.66^{d}	2.74^{bc}	2.70^{cd}	2.80^{ab}	2.86^{a}	2.74^{bcd}

^{abc} Different superscripts within rows indicate statistically different means ($P < 0.05$).

What We Observed

There were no differences observed among treatments for overall growth performance, carcass weight or dressing percentage. The percent yield of breast muscle and yield of total saleable carcass components was lower for the 0% control diet compared to the other treatments.

Feed costs and cost of gain were similar between the control and the three *B. napus* regimens, but were lowest for the three *B. juncea* regimens. The 20% *B. juncea* dietary regimen yielded the highest income over feed costs of all dietary regimens.

Take-Home Message

By formulating diets on a digestible nutrient basis it was possible to include up to 30% *B. napus* or *B. juncea* meal without adversely impacting growth performance, carcass weight or dressing percentage of mixed sex broilers compared to a wheat-soybean meal control diet.

Can triticale be a reliable alternative to wheat in broiler diets?

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

Research and Innovation Division, Alberta Agriculture and Rural Development, Edmonton, AB;
Department of AFNS, University of Alberta, Edmonton, AB.

Background

Wheat is the favored grain for poultry rations in Western Canada. Global wheat supplies have been impacted in recent years by adverse growing conditions in important wheat producing areas. In addition, high energy prices and increased demand for non-food quality wheat from the ethanol sector has contributed to high wheat prices. This impacts the feed competitiveness of Western Canadian poultry producers and has led some to consider alternative grains as a way to cut feed costs.

Triticale (*x triticosecale*) is a hybrid of wheat and rye. From an agronomic standpoint, triticale has advantages over wheat in terms of yield, disease resistance and lower input (e.g., fertilizer) requirements. For these reasons, there have been recent efforts to develop triticale as a dedicated bio-industrial crop for ethanol production, which could alleviate pressure on local feed wheat supplies.

Due to the limited applications for human food, a large proportion of locally-produced triticale is harvested as silage and fed to ruminants. There are, however, anecdotal reports from producers in Western Canada that replacing wheat with triticale in poultry rations has no adverse impact on broiler growth performance. While there are no recent reports in the literature describing nutrient digestibility in triticale, these anecdotal reports suggest that triticale has similar nutrient digestibility to that seen in hard red spring wheat for broilers.

Our Objective

Our objective in this experiment was to compare nutrient digestibility and digestible nutrient content in 4 varieties of locally-grown triticale (Alta, Bunker, Pronghorn and Tyndal) to two mixed samples of hard red spring wheat.

What We Did

On the day of hatch, male Ross 308 broiler chicks (n=450) were divided among 36 test cages (12 or 13 birds/cage) and received a generic starter phase diet from d 0 to 14.

On d 14, cages were then placed on one of 6 test diets that comprised premix (which included 0.3% chromic oxide as an indigestible marker) and one of 6 test grains (Alta, Bunker, Pronghorn, Tyndal triticales or hard red spring wheat samples 1 or 2). The test grain comprised more than 90% of each test diet and was the only dietary source of amino acids and AME. Birds continued to receive test diets from d 14 to 21, at which time pooled excreta and digesta samples were collected for each pen.

Each treatment was applied to 6 replicate pens of birds in a randomized complete block design with pen as the experimental unit.

What We Observed

Energy and amino acid digestibility was generally similar among the different cultivars of triticale, while significant differences were apparent between the two samples of HRS wheat. Nutrient digestibility was generally similar or better in the cultivars of triticale compared to the wheat samples.

Table 1. Nutrient digestibility and calculated digestible nutrient content in 4 varieties of spring triticale compared to 2 samples of hard red spring wheat for growing broilers.

	Triticale samples				Wheat samples		Comparison[1]	
	Alta	Bunker	Pronghorn	Tyndal	HRS 1	HRS 2	Within triticales	Triticales vs wheat
Nutrient digestibility coefficients[2]								
Gross energy	0.73[a]	0.69[a]	0.73[a]	0.73[a]	0.56[b]	0.72[a]	NS	**
Crude protein	0.80[a]	0.84[a]	0.83[a]	0.82[a]	0.68[b]	0.81[a]	NS	**
Lysine	0.76[bc]	0.83[a]	0.82[ab]	0.80[abc]	0.64[d]	0.75[c]	NS	**
Methionine	0.85[a]	0.90[a]	0.88[a]	0.88[a]	0.74[b]	0.88[a]	NS	*
Met + Cys	0.82[a]	0.86[a]	0.84[a]	0.85[a]	0.69[b]	0.86[a]	NS	*
Threonine	0.70[b]	0.77[a]	0.75[ab]	0.73[ab]	0.57[c]	0.74[ab]	NS	*
Tryptophan	0.88[b]	0.87[bc]	0.86[bc]	0.87[bc]	0.84[c]	0.92[a]	NS	NS
Arginine	0.87[b]	0.91[a]	0.90[ab]	0.89[ab]	0.75[c]	0.87[b]	NS	*
Total AA	0.84[a]	0.88[a]	0.87[a]	0.86[a]	0.73[b]	0.87[a]	NS	*
Calculated digestible nutrient content[3]								
AME, kcal/kg	2975[ab]	2831[b]	2981[ab]	2988[ab]	2191[c]	3178[a]	NS	*
Crude Protein	10.78[cd]	14.08[a]	11.28[bc]	11.76[b]	9.36[e]	10.40[d]	NS	*
Lysine	0.31[c]	0.45[a]	0.38[b]	0.39[b]	0.27[d]	0.27[d]	*	*
Methionine	0.16[c]	0.24[a]	0.19[b]	0.19[b]	0.17[c]	0.17[c]	NS	*
Met + Cys	0.39[c]	0.50[a]	0.43[b]	0.45[b]	0.36[c]	0.38[c]	NS	*
Threonine	0.27[c]	0.38[a]	0.32[b]	0.31[b]	0.23[d]	0.27[c]	NS	*
Tryptophan	0.14[b]	0.17[a]	0.13[c]	0.13[c]	0.14[b]	0.14[b]	*	NS
Arginine	0.53[d]	0.75[a]	0.61[c]	0.64[b]	0.48[f]	0.50[e]	*	*
Total AA	9.85[c]	13.11[a]	11.00[b]	11.30[b]	9.59[c]	10.04[c]	NS	*

[1] NS= not statistically different ($P > 0.10$), ** $P < 0.01$
[2] Coefficients are for apparent ileal digestibility, except energy which is apparent total tract digestibility
[3] Calculated digestible nutrient content is on a % as-fed basis unless otherwise indicated.
[abc] Different superscripts within rows indicate statistically different means ($P < 0.05$).

While the sample of Bunker triticale had lower calculated AME compared to the other triticale varieties, it contained the highest content of digestible CP and amino acids of all grains tested.

Calculated AME was similar for 3 of 4 triticale varieties compared to the high AME HRS wheat sample (HRS 2). Digestible amino acid content in all of the triticales was similar or greater than in either of the HRS wheat samples.

Take-Home Message

These data suggest that spring triticale varieties should be able to replace HRS wheat in poultry rations without adversely impacting AME or digestible nutrient content.

Could pulses give soybean meal a run for your money?: I. Soy– vs. pulse protein concentrates for chicks

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

Research and Innovation Division, Alberta Agriculture and Rural Development, Edmonton, AB; Department of AFNS, University of Alberta, Edmonton, AB.

Background

The use of animal protein sources in animal feeding is under growing public scrutiny. There is a negative perception among consumers regarding the safety of recycling animal protein within livestock production systems. In the case of fish meal, there are questions regarding effects on sustainability of fish stocks and the concentration of aquatic contaminants (e.g., mercury). In addition, virtually all animal protein sources are imported, which has implications for feed competitiveness of Western Canadian producers.

Soybean (*Glycine max*) meal is the most common protein source in poultry diets worldwide but is not planted in western Canada due to temperate growing conditions. Field pea (*Pisum sativum*) instead is the most common legume grown in the Prairie provinces. Zero-tannin (ZT) faba bean (*Vicia faba*) is an emerging pulse crop in western Canada that is better suited to more northern regions of the Prairie Provinces. Soybean meal, pea and faba bean can all be fractionated to produce protein concentrates with higher levels of digestible amino acids than the parent stock. While these products are more expensive relative to their respective parent stock commodities, they may be an economic alternative to animal-based protein sources (e.g., fish meal) in poultry rations, particularly for young chicks.

Currently, there is no information regarding the feeding value of these pulse protein concentrates for poultry, particularly compared to soy protein concentrates.

Our Objective

The objective of this experiment was to compare nutrient digestibility in commercially available soy (Soycomil®; ADM), faba (Faba bean protein; Parrheim Foods, Saskatoon, SK) and pea (Prestige pea protein; Parrheim Foods, Saskatoon, SK) protein concentrates in broiler chicks.

What We Did

On the day of hatch, male Ross 308 broiler chicks (n=600) were divided among 48 test cages (12 or 13 birds/cage) and received a generic starter phase diet from d 0 to 8. On d 8, cages were then switched onto one of 4 test diets, consisting of:

1. Starter phase concentrate (i.e., basal diet)
2. 80% basal diet / 20% soy protein concentrate
3. 80% basal diet / 20% faba protein concentrate
4. 80% basal diet / 20% pea protein concentrate

To permit estimation of nutrient digestibility, all test diets fed from d 8 –15 included 2% celite as a source of acid insoluble ash. Pooled excreta and digesta samples were collected on d 15 of the study and sent for chemical analyses.

Each treatment was applied to 8 replicate pens of birds in a randomized complete block design with pen as the experimental unit.

Table 1. Apparent nutrient digestibility and calculated digestible nutrient content of soy-, faba– and pea protein concentrates for 15 day -old broiler chicks.

Nutrient	Soy protein concentrate	Faba protein concentrate	Pea protein concentrate
Nutrient digestibility coefficients[1]			
Gross energy	0.71	0.66	0.66
Crude protein	0.57	0.51	0.54
Indispensable AA's			
Lysine	0.88	0.91	0.91
Methionine	0.73[a]	0.21[b]	0.21[b]
Threonine	0.70	0.68	0.71
Arginine	0.87	0.90	0.90
Digestible nutrient content, as-fed basis[2]			
AME, kcal/kg	3212	2959	2925
Crude protein	56.40[a]	26.64[b]	23.44[c]
Indispensable AA's			
Lysine	3.68[a]	1.60[b]	1.54[b]
Methionine	0.70[a]	0.06[b]	0.06[b]
Threonine	1.85[a]	0.69[b]	0.66[b]
Arginine	4.20[a]	2.64[b]	1.75[c]

[1] Coefficients are for apparent ileal digestibility, except energy which is apparent total tract digestibility
[2] Calculated digestible nutrient contents are expressed in % as-fed, unless otherwise indicated
[abc] Different superscripts within rows indicate statistically different means ($P < 0.05$).

What We Observed

In general nutrient digestibility coefficients were similar among the test ingredients, with the notable exception of methionine (and Met + Cys; data not shown). Methionine digestibility was considerably lower in the pulse protein concentrates compared to the soy protein concentrate.

Differences in calculated digestible nutrient content are largely attributable to higher amino acid content in the soy protein concentrate compared to the pea and faba bean concentrates (63, 23 and 30%, respectively).

Take-Home Message

With the notable exception of the sulfur amino acids, nutrient and energy digestibility in pulse protein concentrates is similar to that of soy protein concentrate.

The use of pulse protein concentrates in starter poultry rations would need to be accompanied by higher supplementation with synthetic methionine in order to meet digestible amino acid requirements. Such diets would also need to be formulated on a digestible, rather than total amino acid basis.

Could pulses give soybean meal a run for your money?: II. Whole pulses vs. soybean meal for growing broilers

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

Research and Innovation Division, Alberta Agriculture and Rural Development, Edmonton, AB; Department of AFNS, University of Alberta, Edmonton, AB.

Background

Soybean (*Glycine max*) meal is the most common protein source in swine diets worldwide. Soybean is not planted in western Canada due to temperate growing conditions. Field pea (*Pisum sativum*) instead is the most common legume grown in the Prairie provinces. It is primarily destined for human consumption in Asia, but excess production and splits are diverted locally for swine feeding. Narrow-leafed lupin (*Lupinus angustifolius*) and zero-tannin (ZT) faba bean (*Vicia faba*) are emerging pulse crops in western Canada that also offer good potential for feeding broilers and pigs. Replacing soybean meal in poultry rations with pulses could lower feed costs and eliminate reliance on imported nutrients, thereby increasing the feed competitiveness of Western Canadian producers.

Currently, little to no information is available regarding the feeding value of Canadian pulse crops, other than peas, for poultry.

Our Objective

The objective of this study was to characterize and compare apparent nutrient digestibility in dehulled lupin, ZT faba bean and field pea to that of soybean meal for growing broilers.

What We Did

On the day of hatch, male Ross 308 broiler chicks (n=600) were divided among 48 test cages (12 or 13 birds/cage) and received a starter phase diet from d 0 to 15, and then a grower phase diet from d 15 to 22. On d 22, cages were then switched onto one of 6 test diets, consisting of:

1. Grower phase concentrate (i.e., basal diet)
2. 70% basal diet / 30% de-hulled, high crude protein lupin
3. 70% basal diet / 30% de-hulled, low crude protein lupin
4. 70% basal diet / 30% field pea
5. 70% basal diet / 30% zero-tannin faba bean
6. 70% basal diet / 30% soybean meal

To permit estimation of nutrient digestibility, all test diets fed from d 22 -29 included 2% celite as a source of acid insoluble ash. Pooled excreta and digesta samples were collected on d 29 of the study and sent for chemical analyses.

Each treatment was applied to 8 replicate pens of birds in a randomized complete block design with pen as the experimental unit.

What We Observed

Energy digestibility coefficients were similar between soybean meal and pea, which were higher than coefficients for either faba bean or the two lupin samples.

Amino acid digestibility was similar among soybean meal, faba bean and the high CP lupin. The notable exception was methionine which was considerably less digestible in the pulses compared to the soybean meal. Calculated AME was highest for field pea, followed by soybean meal, faba bean and the two lupin samples. Digestible amino acid content was highest in soybean meal, which was largely due to a higher total amino acid content as opposed to higher digestibility. Digestible methionine (and methionine + cysteine) content was generally low in all pulses.

Table 1. Apparent nutrient digestibility and calculated digestible nutrient content in soybean meal compared to low and high CP lupin, field pea and zero-tannin faba bean for 29 day-old broilers.

Nutrient	Soybean meal	Low CP lupin	High CP lupin	Field pea	Faba bean
Nutrient digestibility coefficients[1]					
Gross energy	0.84[a]	0.59[c]	0.63[bc]	0.90[a]	0.68[b]
Crude protein	0.77[a]	0.81[a]	0.80[a]	0.68[b]	0.77[a]
Indispensable AA's					
Lysine	0.82[a]	0.76[b]	0.76[b]	0.73[b]	0.81[a]
Methionine	0.72[a]	0.27[c]	0.34[bc]	0.46[b]	0.47[b]
Met + Cys	0.32[ab]	0.15[b]	0.40[a]	0.46[a]	0.41[a]
Threonine	0.73[a]	0.75[a]	0.73[a]	0.61[b]	0.71[a]
Arginine	0.83[b]	0.83[ab]	0.87[a]	0.77[c]	0.88[a]
Calculated digestibility nutrient content, as-fed[2]					
AME, kcal/kg	3465[b]	2893[d]	3182[c]	3983[a]	3039[cd]
Crude protein	35.57[a]	26.14[b]	34.76[a]	16.07[d]	23.46[c]
Indispensable AA's					
Lysine	2.42[a]	1.15[c]	1.44[b]	1.19[c]	1.41[b]
Methionine	0.48[a]	0.06[c]	0.10[bc]	0.12[b]	0.13[b]
Met + Cys	0.86[a]	0.10[c]	0.34[b]	0.30[b]	0.32[b]
Threonine	1.26[a]	0.88[c]	1.11[b]	0.62[e]	0.74[d]
Arginine	2.72[b]	2.33[c]	3.91[a]	1.47[d]	2.32[c]

[1] Coefficients are for apparent ileal digestibility, except energy which is apparent total tract digestibility
[2] Calculated digestible nutrient contents are expressed in % as-fed, unless otherwise indicated
[abc] Different superscripts within rows indicate statistically different means ($P < 0.05$).

Take-Home Message

Pulse crops generally exhibited similar crude protein and amino acid digestibility compared to soybean meal for growing broilers. Increased utilization of pulse crops for poultry feed applications could reduce dependence on imported soybean meal to meet digestible amino acid requirements.

Diets including pulses should be formulated on a digestible amino acid basis and will require higher supplementation with synthetic methionine, due to low intrinsic sulphur amino acid digestibility in these ingredients.