

Processing Canadian Barley Grain for Poultry

- Feeding Canadian barley grain to poultry ranges from feeding the hulled, intact kernel to dehulling and reducing particle size.
- Dehulling barley is best achieved using a perling, disk (Figure 2) or roller mill first and then separating the hulls by sieving or blowing them off. Hulls can then be used to bulk diets for broiler breeders that are normally restrict fed.
- Fine grinding of barley is not recommended for poultry unless feed will be pelleted or extruded after mixing the whole diet.
- Barley is best fed to poultry cracked or rolled.

Figure 2. A roller mill can be used to reduce particle size of cereal grains intended for poultry



Feeding Canadian Barley Grain to Broiler Chickens

- If fed to young broilers (0-10d of age) as a partial replacement for wheat, corn or sorghum grain in pelleted or extruded starter feed, barley should ideally first be mechanically dehulled.
- After 10 d of age, broilers can be fed barley (either hulled or dehulled, rolled or coarsely ground) as a partial replacement for wheat, sorghum or corn grain (Table 5).
- Feeding mechanically dehulled barley grain with higher energy value may allow greater inclusion level for a given target energy density.
- Reducing the energy density of broiler diets would permit greater dietary inclusion of barley, assuming there is no impediment (e.g., high temperature, disease) to birds being able to increase feed intake.

Table 5. Example diets for broiler chickens. The starter diet (40-300 g BW) may be fed extruded or pelleted (3 mm). The grower diet (300-1000 g BW) may be fed as pellets (3 mm) or mash form. The finisher diets (>1000 g BW) may be fed as pellets or mash form. Finisher diets may include whole or cracked grain.

Ingredients, %	Starter	Grower	Finisher 1	Finisher 2
Wheat	31.30	32.56	33.69	30.26
Corn	20.00	20.00	15.00	10.00
Hulled barley	5.00	10.00	20.00	30.00
Soybean meal	20.00	15.00	10.00	5.00
Canola meal	5.00	10.00	15.00	20.00
Soy protein concentrate	5.00	2.50	-	-
Fish meal	5.00	2.50	-	-
Soy or canola oil	5.00	4.00	3.00	2.00
Limestone	0.80	0.90	1.00	0.95
Mono/dical phosphate	0.70	0.75	0.90	0.70
Salt	0.40	0.35	0.40	0.40
Sodium bicarbonate	0.30	0.30	0.20	0.15
Vitamins, trace minerals	0.50	0.40	0.30	0.20
L-Lysine HCl	0.30	0.30	0.30	0.20
L-Threonine	0.24	0.18	0.12	0.06
DL-Methionine	0.35	0.16	-	-
Phytate enzyme 500FTU	0.01	0.01	0.01	0.01
Carbohydrase enzymes	0.05	0.05	0.05	0.05
Choline Chloride 60%	0.05	0.04	0.03	0.02
AMEn, MJ/kg	13.16	12.77	12.25	11.80
gSIDlys/MJ AMEn	1.01	0.88	0.75	0.68

Feeding Canadian Barley Grain to Egg Layers

- Whole, cracked or coarsely ground barley can be included in diets for egg layers as partial or total replacement for wheat, corn or sorghum grain (Table 6).
- Layers are usually fed decreasing protein/lysine levels at the later stages of the production cycle. More barley grain may therefore be easily incorporated into diets fed to older hens later in their production cycle.

Feeding Canadian Barley to Ducks and Geese

- Research has demonstrated that the nutritional value of barley grain is similar for ducks and geese as compared with broiler chickens.
- Some reports in the literature suggest that more of the soluble fibre component in barley grain is fermented in the hindgut of geese compared with either broiler chickens or ducks.

Table 6. Example phase diets for table egg layers.

Ingredients, %	Pre-lay	20-30wks	30-40wks	>40wks
Wheat, cracked	30.35	26.50	22.52	18.92
Hulled barley, cracked	10.00	15.00	20.00	25.00
Corn, cracked	20.00	20.00	20.00	20.00
Soybean meal	12.00	8.00	4.00	1.00
Canola meal	10.00	14.00	18.00	21.00
Soy or canola oil	5.00	4.50	4.00	3.50
Limestone fine	2.50	2.20	2.00	1.50
Limestone coarse	7.00	7.00	7.00	7.00
Mono/dical phosphate	1.40	1.30	1.20	1.00
Salt	0.30	0.30	0.30	0.30
Sodium bicarbonate	0.35	0.35	0.35	0.35
Vitamins, trace minerals	0.50	0.40	0.30	0.20
L-Lysine HCl	0.15	0.14	0.11	0.09
DL-Methionine	0.20	0.10	0.05	-
L-Threonine	0.08	0.06	0.03	0.01
Phytase enzyme 500F-TU	0.01	0.01	0.01	0.01
Carbohydrase enzymes	0.05	0.05	0.05	0.05
Choline chloride 60%	0.11	0.09	0.08	0.07
AMEn, MJ/kg	11.75	11.50	11.25	11.00
gSIDlys/MJ AMEn	0.68	0.64	0.60	0.56

Feed Enzymes for Barley Grain in Poultry Feeds

The endosperm of barley grain is relatively high in nonstarch polysaccharides (NSP) like arabinoxylan, mannan, pectins, and in particular β -glucan, which can increase digesta viscosity. Viscous digesta can interfere with normal digestion and absorption of nutrients and therefore reduce feed efficiency. In poultry, viscous digesta can contribute to sticky droppings, wet litter and an increase in the number of dirty eggs.

Poultry feeds including barley grain should therefore include feed enzymes to mitigate the viscosity-inducing properties of soluble NSP in barley. There is little data suggesting that these same feed enzymes are effective against the hull insoluble NSP fraction.

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Disclaimer: Genetic lines, production conditions, management, environment and marketing objectives may differ from those in western Canada. Information summarized herein is intended as guidance, not as recommendations. Interpretation and use of this information is the responsibility of the user.

A Quick Guide to

Feeding Canadian Barley Grain to Pigs and Poultry

Conseil de l'orge du Canada



Barley Council of Canada

Alberta

Agriculture and Forestry

Canadian Barley Facts

- Canada produces 8.5M tonnes of barley grain, of which 2.4M are available for exports as malt for brewing, for animal feed, human food, and bioindustrial uses.
- 65% of barley grain in Canada is grown for malt, but only 20% makes brewing grade. The balance of barley grain is therefore destined primarily for animal feed.
- Most Canadian malting barley cultivars have heads with 2 rows of kernels, as opposed to 6 rows in feed varieties. The plumper kernels from 2 row varieties explain why Canadian barley has a greater content of both protein and starch than barley grain from other countries.
- Most (~99%) Canadian barley is hulled. Hulless barley cultivars exist, but are mostly destined for human food. Eating barley grain with high β -glucan content aids in reducing human blood cholesterol.
- Barley has 20% less starch (Table 1) than wheat or corn, but 20% more protein than corn or sorghum.

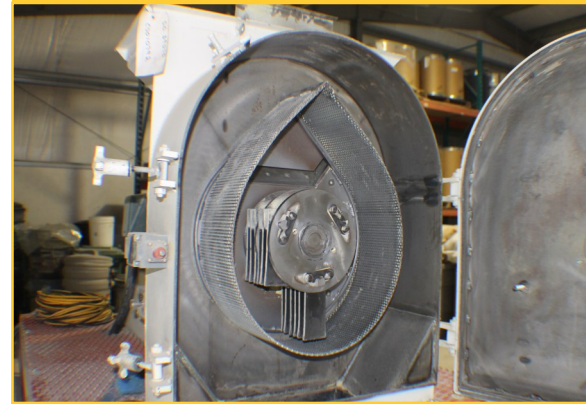
Table 1. Nutrient composition and amino acid digestibility coefficients for pigs and poultry (averaged from NRC 2012, Sauvant et. al. 2002, AminoDat 5.0).

As is basis	Nutrient	AA	g/kg	Pig SID	Poultry SID
Moisture, g/kg	120	CP	115.4	0.79	-
Starch, g/kg	518	Arg	5.2	0.85	0.82
NDF, g/kg	180	His	2.4	0.82	0.83
ADF, g/kg	55	Ile	3.7	0.81	0.83
Crude fibre, g/kg	42	Leu	7.3	0.82	0.83
Sugars, g/kg	20	Lys	3.9	0.75	0.81
Ether extract, g/kg	21	Met	1.9	0.83	0.86
Ash, g/kg	23	Phe	5.2	0.83	0.83
Total P, g/kg	3.3	Thr	3.6	0.77	0.76
Phytate P, g/kg	1.9	Trp	1.3	0.81	0.69
STTD P, coeff.	0.45	Val	5.3	0.80	0.81
Ca, g/kg	0.4	Ala	4.3	0.72	0.73
Cl, g/kg	1.2	Asp	6.4	0.76	0.75
Na, g/kg	0.2	Cys	2.5	0.82	0.86
GE, MJ/kg	16.2	Glu	24.8	0.88	0.89
DE pig, MJ/kg	13.1	Gly	4.3	0.79	0.88
ME pig, MJ/kg	12.7	Pro	11.5	0.86	0.87
NE pig, MJ/kg	9.8	Ser	4.5	0.81	0.78
AMEn poul., MJ/kg	11.5	Tyr	2.8	0.81	0.81

Antinutritional Factors in Barley Grain

- The hull of the barley grain (11% of grain mass) is made up largely of insoluble fibre, which is not digested by pigs and poultry, so it is excreted.
- Soluble fibre in barley endosperm can be partially fermented by bacteria in the hindgut. The volatile fatty acids (VFA) that result, however, make only a small contribution (<10%) to the overall energy requirements of monogastric animals.
- Insoluble fibre, primarily found in the hull, dilutes energy and nutrients, increases digesta transit time thus potentially reducing nutrient absorption.

Figure 1. Typical hammer mill used for particle size reduction of cereal grains intended for pig diets.



Processing Canadian Barley Grain for Pigs

- Barley grain fed to pigs is generally processed using hammer mills (Figure 1). Recommended screen hole size ranges from 2.5 to 5 mm, depending on the class of pig to be fed and whether or not the feed is to be pelleted. Barley fed in mash diets for pigs should target a particle size of 500 μ m.
- Rolling or disk-milling barley grain results in more uniform particle size, less powder and dust. Hulls may then be separated by sieving or blown off and included in gestating sow feed.
- Reducing barley grain particle size improves feed efficiency, but may also increase the incidence of gastric ulcers if dehulled and ground too finely.

Feeding Canadian Barley to Weaned Pigs

- Weaned pigs can be fed hulled or dehulled barley (Table 2) as the sole cereal grain in the ration.
- Feeding wheat, corn or dehulled barley initially and progressively replacing these with hulled barley may increase growth performance and reduce cost.

- Certain fibre in barley grain exert a prebiotic effect reducing incidence of diarrhea after weaning. Any reduction in early growth performance feeding hulled barley will be short lived.
- Young pigs initially fed high barley-based diets may show compensatory growth during the growout period resulting in reduced overall feed cost per unit of weight gain.

Table 2. Example diets for young pigs. The first diet (5-7 kg BW) may be fed extruded or pelleted (3 mm). The second diet (7-11 kg BW) should be fed in pellet form (5 mm). The third diet (11-25 kg BW) can be fed as mash or pellets.

Ingredients, %	Pigs 5-7 kg	Pigs 7-11 kg	Pigs 11-25 kg
Corn, ground	16.63	28.23	20.50
Wheat, ground	20.00	10.00	-
Hulled barley, ground	10.00	20.00	40.00
Spray dried whey	15.00	7.50	-
Soybean meal	15.00	20.00	25.00
Corn DDGS 6-9% oil	-	-	10.00
Fish meal	8.50	4.50	-
Soy protein concentrate	8.50	4.50	-
Soy or canola oil	3.00	2.00	1.00
Limestone	1.30	1.25	1.50
Mono/dical phosphate	0.30	0.40	0.50
Salt	0.70	0.70	0.70
Vitamins, trace minerals	0.10	0.10	0.10
L-Lysine HCl	0.40	0.40	0.40
L-Threonine	0.15	0.13	0.10
DL-Methionine	0.20	0.15	0.10
L-Tryptophan	0.06	0.04	0.02
Carbohydrase enzymes	0.05	0.05	0.05
Phytase enzyme 500FTU	0.01	0.01	0.01
Choline Chloride 60%	0.10	0.05	0.025
NE, MJ/kg	10.66	10.36	9.70
gSIDlys/MJ NE	1.49	1.33	1.22

Feeding Canadian Barley to Growout Pigs

- Pigs not fed barley grain during the weaning period can be fed barley as the sole cereal grain in the ration during the entire growout period to market weight (Table 3).
- Barley grain provides more protein (11.5%) than corn (8-9%) or sorghum (9-10%). Therefore inclusion level of protein meals (soybean or canola meal, DDGS) can be reduced in growout diets.
- Barley grain can be used to reduce the energy density of finishing diets, which can increase profit margin over feed cost provided that pigs are able to increase feed intake in response.
- Feeding barley grain results in whiter, firmer pork fat than feeding yellow corn enhancing the visual appeal of marbling and the firmness of pork cuts.

Table 3. Example diets for growout pigs. All diets can be fed in mash form or pellets (7 mm).

Ingredients, %	25-50 kg	50-75 kg	75-100 kg	100-130 kg
Corn, ground	48.07	21.60	-	-
Hulled barley, ground	25.00	50.00	75.61	83.42
Soybean meal	18.00	13.00	7.50	5.00
Corn DDGS 6-9% oil	6.00	13.00	15.00	10.00
Limestone	1.35	1.35	1.20	1.00
Mono/dical phosphate	0.50	0.20	-	-
Salt	0.50	0.40	0.30	0.25
Vitamins, trace minerals	0.10	0.10	0.10	0.10
L-Lysine HCl	0.35	0.30	0.25	0.20
L-Threonine	0.05	0.04	0.03	0.02
DL-Methionine	0.05	-	-	-
L-Tryptophan	0.02	-	-	-
Phytase enzyme 500FTU	0.01	0.01	0.01	0.01
NE, MJ/kg	10.00	9.67	9.44	9.51
gSIDlys/MJ NE	0.95	0.88	0.76	0.64

Feeding Canadian Barley to Sows and Boars

- Feeding programs for gestating sows focus on preventing excess weight gain. Feeding high-fibre barley-based (Table 4) diets may reduce incidence of undesirable chewing behaviours of sows housed in stalls.
- Owing to its higher protein content, replacement gilts, sows and boars can be fed barley-based diets with minimal need for supplemental protein from soybean meal, canola meal or DDGS.
- Lactating sows can be fed all barley-based diets, but barley is usually fed together with wheat, sorghum or corn grain (Table 4) to increase the caloric density of the diet.

Table 4. Example diets for gestating and nursing sows. Sow diets can be fed in mash form or pellets (10 mm).

Ingredients, %	Gestating sows	Nursing sows
Corn, ground	-	20.84
Hulled barley, ground	82.69	50.00
Soybean meal	5.00	15.00
Corn DDGS 6-9% fat	10.00	10.00
Soy or canola oil	-	1.00
Limestone	1.25	1.50
Mono/dical phosphate	0.05	0.50
Salt	0.75	0.80
Vitamins, trace minerals	0.10	0.10
L-Lysine HCl	-	0.15
L-Threonine	0.05	0.05
Phytase enzyme 500FTU	0.01	0.01
Choline Chloride 60%	0.10	0.05
NE, MJ/kg	9.42	9.78
gSIDlys/MJ NE	0.48	0.78