



FEEDING RAPESEED MEAL OR CANOLA MEAL TO HY-LINE BROWN AND HY-LINE SILVER BROWN HENS

INTRODUCTION

Hy-Line Brown and Hy-Line Silver Brown hens can be fed diets containing at least 24% double-low rapeseed meal or Canola meal without causing fishy taint eggs. However, the highest recommended dietary content of rapeseed meal or Canola meal for Hy-Line Brown and Hy-Line Silver Brown hens is 8 to 10%, similar to that of white laying hens.

RAPESEED (CANOLA) MEAL

Rapeseed meal and Canola meal are the products remaining after the oil has been extracted from rapeseed and Canola, respectively. Rapeseed (*Brassica napus* and *Brassica campestris/rapa*) that have been bred to contain low levels (i.e., less than 2%) of erucic acid in the oil and low levels (i.e., less than 30 $\mu\text{mol/g}$) of glucosinolates in the meal portion are called double-low rapeseed or Canola. Depending on the type of rapeseed used, the extent to which oil is extracted, and the addition of the fibrous hulls back to the meal, rapeseed meal contains 32 to 38% crude protein and is a good source of amino acids (Table 1). However, the relatively high content of fiber reduces the metabolizable energy content and also adversely affects the digestibility of amino acids. Nevertheless, rapeseed meal is used throughout the world as a protein source in pullet and laying-hen diets, and its use is second only to soybean meal.

In the 1970s, it was recognized that rapeseed meal in the diet of brown-shell laying hens could result in a low proportion of the eggs produced having a fishy taint or odor. This does not normally occur in white-shell laying hens. As a result, rapeseed meal is usually only fed to brown-shell laying hens in small amounts (i.e., no more than 2 to 3% of the diet), if at all.

FISHY TAIN EGGS

Fishy taint eggs are caused by deposition of fishy smelling trimethylamine (TMA) in the egg yolk. Although variable, people can detect a fishy taint in eggs when the yolks contain more than about 4 μg TMA per gram yolk. The contents of sinapine and glucosinolates in dietary rapeseed meal along with a defective gene in some brown hens are the main causes of the fishy taint eggs.

Rapeseed meal contains 0.6 to 1.8% sinapine, which consists of sinapinic acid bound to choline (Figure 1). Sinapine is not digested by the hens, but moves with other undigested feed into the large intestines, where one of the fermentation products is TMA. The TMA is subsequently absorbed into the blood. Normally, the TMA is oxidized in the liver by the enzyme, flavin-containing monooxygenase 3 (FMO3), to the odorless TMA *N*-oxide, which is excreted by the kidneys. However, a small proportion of brown hens have a mutation in the FMO3 gene that

renders the enzyme defective and allows the fishy smelling TMA to be deposited in the egg yolk. Although sinapine is a form of choline, other forms of choline (e.g., choline chloride) fed to brown hens at normal inclusion levels do not cause fishy taint eggs, because the choline is absorbed in the small intestines before it can be fermented to TMA in the large intestines.

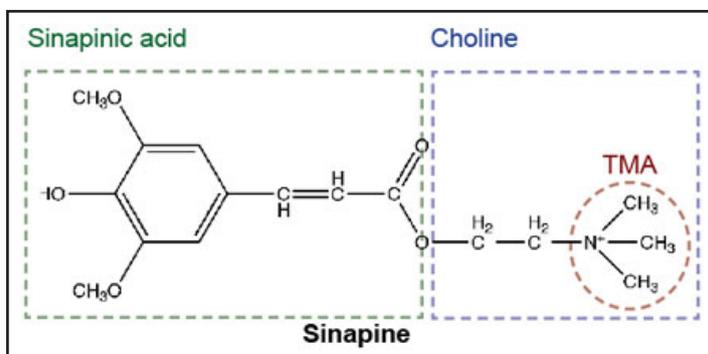


Figure 1. Structure of sinapine, showing its components, sinapinic acid, choline, and trimethylamine (TMA). The bond between sinapinic acid and choline is broken by bacterial fermentation in the large intestines; choline is further broken down by bacteria in the large intestines to TMA, which is absorbed into the blood.

Rapeseed meal contains glucosinolates—although the glucosinolate content must be less than 30 $\mu\text{mol/g}$ to be called double-low rapeseed or Canola. Typically, Canadian-grown Canola meal contains about 7 $\mu\text{mol/g}$ glucosinolates, whereas traditional (i.e., non-double-low) rapeseed meal contains 120 to 150 $\mu\text{mol/g}$. The glucosinolates are undesirable in part because they are unpalatable and in part because their breakdown products can inhibit the hens' production of thyroid hormones. In addition, the glucosinolates inhibit oxidase enzymes, including the FMO3 enzyme that oxidizes TMA to the odorless TMA *N*-oxide. Thus, consumption of glucosinolates may cause fishy taint eggs, depending on the amount of glucosinolate (and sinapine) consumed.

RAPESEED (CANOLA) MEAL AND CANOLA MEAL CAN BE FED TO HY-LINE BROWN HENS

Hy-Line Brown and Hy-Line Silver Brown hens can tolerate high amounts of rapeseed meal without fear of causing fishy taint eggs. In a recent experiment conducted in Dr. Hank Classens' laboratory at the University of Saskatchewan in Canada, Hy-Line Brown hens were fed diets containing up to 24% Canola meal. Even with this very high dietary content of Canola, the Hy-Line Brown hens were able to maintain a TMA content in the yolk below the 4 $\mu\text{g/g}$ detection level (Ward et al., 2009).

When applying the information from the research by Ward et al. (2009) to field situations, there are a few items to consider:

- The highest level of Canola meal fed was 24%, so it is possible that the Hy-Line Brown and Hy-Line Silver Brown hens can tolerate higher amounts without affecting the TMA content in the yolk. That said, it is unlikely that commercial diets will contain more than 24% Canola meal. Indeed, typically, no more than 5 to 8% Canola meal is recommended in diets for white laying hens, because of relatively low energy and nutrient contents that limits the dietary inclusion rate, a relatively high content of tannins that adversely affect palatability, and the contents of goitrogens (even in double-low rapeseed meal) that adversely affect egg production. So, in white laying hens, no more than about 8% rapeseed meal is recommended in the diet. It is therefore unlikely that Hy-Line Brown and Hy-Line Silver Brown hens will be fed diets containing more than 8% rapeseed meal.
- The highest level of rapeseed meal that can be fed to Hy-Line Brown and Hy-Line Silver Brown hens without causing fishy taint eggs depends on the concentration of sinapine (and other forms of choline) in the specific rapeseed meal that is fed. If the locally available rapeseed meal contains "high" amounts of sinapine and if the rapeseed meal is included in "high" amounts in the diet, it is technically possible to overwhelm the FMO3 enzyme so that not all the TMA is oxidized to non-odorous TMA *N*-oxide.
- The experiment by Ward et al. (2009) lasted for only four weeks. From this particular study, it is impossible to know if dietary rapeseed meal will cause fishy taint if fed to Hy-Line Brown hens throughout their entire grow and production cycle. That said, it is unlikely that feeding even very high levels of double-low rapeseed to Hy-Line Brown or Hy-Line Silver Brown hens for more than four weeks or throughout the hens' life cycle will cause fishy-taint eggs.

Table 1. Nutritional composition of rapeseed (Canola) meal and soybean meal (as-fed basis, standardized to 88% dry matter). Note that the composition of rapeseed meal and soybean meal depends on variety, local growing conditions, and processing.

Item	Double-low rapeseed or Canola meal			Soybean meal		
Dry matter, %	88.00			88.00		
Crude protein, %	36.75			47.80		
MEn, ¹ kcal/kg	2,040			2,458		
MEn, ¹ kcal/lb	925			1,115		
MEn, ¹ MJ/kg	8.54			10.29		
Ether extract, %	3.67			1.00		
Linoleic acid (C18:2 n-6), %	0.77			0.50		
Crude fiber, %	10.73			3.00		
Calcium, %	0.66			0.20		
Phosphorus (total), %	1.13			0.65		
Phosphorus (available), %	0.29			0.21		
Sodium, %	0.10			0.04		
Potassium, %	1.25			1.90		
Sulfur, %	0.97			0.43		
Chloride, %	0.10			0.02		
Ash, %	6.96			6.00		
Goitrogens, $\mu\text{mol/g}$	< 30. ²			–		
Erucic acid (C22:1 n-9), %	< 0.07 ²			–		
Tannins, %	1.5–3.0			–		
Sinapine, %	0.6–1.8			–		
Price, ³ US dollars per 1,000 kg	238			326		
	Total content	Digestibility ⁴	Digestible ⁴ content	Total content	Digestibility ⁴	Digestible ⁴ content
Methionine, %	0.74	84	0.63	0.70	91	0.64
Cystine, %	0.94	77	0.72	0.71	82	0.58
Methionine + Cystine, %	1.68	–	1.35	1.41	–	1.22
Lysine, %	1.95	80	1.56	3.02	90	2.72
Tryptophan, %	0.44	80	0.36	0.70	89	0.62
Threonine, %	1.45	73	1.06	2.00	85	1.70
Isoleucine, %	1.46	79	1.15	2.60	89	2.31
Histidine, %	1.06	85	0.90	1.30	92	1.20
Valine, %	1.88	79	1.48	2.70	88	2.38
Leucine, %	2.51	82	2.06	3.80	89	3.38
Arginine, %	2.22	87	1.94	3.60	93	3.35
Phenylalanine, %	1.45	83	1.20	2.70	89	2.40

¹Nitrogen-corrected metabolizable energy.

²By definition, double-low rapeseed and Canola must contain less than 30 $\mu\text{mol/g}$ total glucosinolates in the meal and less than 2% erucic acid in the oil.

³Price including delivery in Minneapolis, Minnesota, USA (October 12, 2009).

⁴Standardized (true) ileal digestibility.

RECOMMENDATION

Hy-Line Brown and Hy-Line Silver Brown hens can tolerate relatively high amounts of rapeseed meal without causing fishy taint eggs. From the study by Ward et al. (2009), conducted with Hy-Line Brown hens, it is evident that the diet can contain at least 24% rapeseed meal without causing fishy taint eggs. Under practical, commercial conditions, it is unlikely that a laying hen diet will contain rapeseed meal at such high levels. Therefore, the content of rapeseed meal in diets for Hy-Line Brown and Hy-Line Silver Brown hens is only limited by its energy and nutrient contents, its contents of tannins, and its price relative to other protein supplements. The fear of fishy taint eggs need not influence the dietary inclusion level of rapeseed meal to Hy-Line Brown or Hy-Line Silver Brown hens. In other words, **egg producers can use rapeseed meal in diets for Hy-Line Brown and Hy-Line Silver Brown hens the same way as they would for white laying hens.**

For more information about feeding rapeseed meal or Canola meal to Hy-Line Brown and Hy-Line Silver Brown hens, please contact Hy-Line Technical Services at www.hyline.com.

LITERATURE CITED

Ward, A. K., H. L. Classen, and F. C. Buchanan. 2009. Fishy-egg tainting is recessively inherited when brown-shelled layers are fed canola meal. *Poultry Science* 88:714–721. <http://ps.fass.org>.



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