The value of canola meal in poultry diets

Article supplied by the Canola Council of Canada

Canola meal is fed to all types of poultry throughout the world. It provides an excellent amino acid profile and protein content and serves as an alternative or complement to other protein ingredients such as soya bean meal.

Canola meal provides greater value in egg layer and turkey diets over broiler feeds due to greater emphasis being placed on protein than on energy. However, canola meal can be a cost-effective alternative in high-energy broiler diets. Care must be taken to formulate diets on a digestible amino acid basis to ensure excellent performance with birds fed high canola meal inclusions.

Feed intake

Various publications have demonstrated that poultry, both broilers and layers, will maintain appropriate feed intake levels with diets high in canola meal that are formulated for digestible amino acids. Oryschak and Beltranena (2013) demonstrated that proper diet formulation can allow for canola meal to be included at 20% of the diet with no effect on feed intake.

Rogiewicz *et al*., (2015) also demonstrated excellent performance of hens fed 15 to 20% canola meal. Feed intake was maintained for broilers fed up to 20% canola meal from days one to 35 of life (Naseem *et al*., 2006) and broiler growers can be fed 30% canola meal (Newkirk and Classen, 2002; Ramesh *et al*., 2006).

Value of energy

Canola meal has a lower energy value for poultry compared with soya bean meal, the most common vegetable protein source. In certain diets, the greater emphasis placed on the value of energy could limit the inclusion of canola meal.

Egg layer diets and early-phase, high-protein turkey diets based on least-cost formulation include canola meal in the ration at a higher price. Research (*Table 1*) suggests that the energy value of canola meal for broilers in the grower/finisher stage is 200kcal greater than previously established (Beltranena, 2015).

Several researchers have fed dietary enzymes to increase protein, phosphorus and carbohydrate digestibility in canola meal (Kocher *et al*., 2000; Mandal *et al*., 2005; Meng *et al*., 2005; Meng and Slominski, 2005; Meng *et al*., 2006; Ravindran *et al*., 1999; Ramesh *et al*., 2006; Simbaya *et al*., 1996; Slominski and Campbell, 1990). Most studies examining the inclusion of cellulase or non-starch polysaccharides (NSP) degrading enzymes to improve canola meal digestibility have demonstrated limited benefits.

Meng and Slominski (2005) examined the effects of adding a multi-enzyme complex (xylanase, glucanase, pectinase, cellulase, mannanase and galactonase)

Table 1: Available energy values for canola meal (12% moisture basis).

Animal		Average value
Broiler chickens	AMEn (kcal/kg)	2,200[1]
Laying hens	AMEn (kcal/kg)	2,200[1]
Turkeys	AMEn (kcal/kg)	2,007[2]

[1]*Beltranena, 2015;* [2]*Jia et al., 2012.*

to broiler diets. The enzyme combination increased total tract NSP digestibility of canola meal, but no improvements were observed in other nutrient digestibilities or animal performance.

Jia *et al*., (2012) fed broiler diets containing canola meal and a multi-carbohydrase enzyme to determine their effect on AMEn values (*Table 1*). The inclusion of a feed enzyme with canola meal increased its AMEn value from 1,904 to 2,018kcal/kg for broilers. The low AMEn values may be due to the feeding of canola meal containing only 1,8% fat (dry matter basis). The use of dietary enzymes is common in poultry feeds, especially those containing barley and wheat. Although the data is not completely conclusive, some enhancement of canola meal digestion may occur.

Layers

Canola meal is a commonly fed and economically effective feed ingredient in commercial egg layer diets. Various studies have looked at the effects of feeding canola meal on egg production and associated parameters (Perez-Maldonado and Barram, 2004; Kaminska, 2003; Badshah *et al*., 2001; Kiiskinen, 1989; Nasser *et al*., 1985; Robblee *et al*., 1986).

Feeding canola meal supports high levels of egg production and has no negative effect on the number of eggs produced. Feed intake and egg size also show no difference. A negative effect on egg size was noted in some earlier studies (Summers *et al*., 1988a, b), but in more recent experiments, this was not the case (Perez-Maldonado and Barram, 2004; Marcu *et al*., 2005; Badshah *et al*., 2001; Classen, 2008).

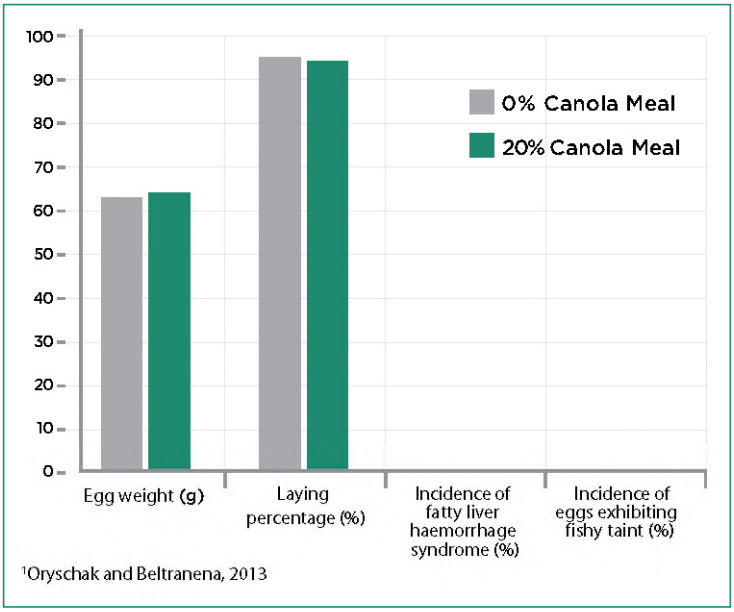
As with swine diet formulation, ileal digestible amino acids must be considered. Oryschak and Beltranena (2013) demonstrated that proper diet formulation can allow for canola meal to be included at 20% of the diet with no negative effects on egg production, egg quality or egg fatty acid content (*Figure 1*). Rogiewicz, *et al*., (2015) also demonstrated excellent performance of hens fed 15 to 20% canola meal.

Published research showed a reduction in egg weight when canola meal was substituted for soya bean meal, but diet formulation on a crude protein basis resulted in insufficient lysine content in the canola meal diet (Kaminska, 2003).

Work by Novak *et al*., (2004) supported the hypothesis that insufficient lysine can affect egg weight. They increased lysine intake from 860 to 959mg per day and observed an increase in egg weight from 59 to 60,2g but the added lysine had no effect on egg production rate.

Figure 1 shows the results of a study conducted at the University of Alberta in conjunction with Alberta Agriculture and Rural Development. Based on these findings, canola meal can be fed effectively at elevated levels in laying diets without negatively affecting egg production, egg weight, egg quality or fatty acid content as long as the diets are formulated on digestible amino acid content.

Figure 1: Performance results from feeding canola meal to laying hens. (Average over 36 weeks of production).



[1]Oryschak and Beltranena, 2013

Canola meal and liver haemorrhage

Traditionally, including canola meal in laying hen diets was limited to a maximum of 10% due to a potential association between liver haemorrhage mortality and feeding canola meal (Butler *et al*., 1982; Campbell and Slominski, 1991). Authors suggested that this could have been the result of residual glucosinolate content found in early varieties of canola (Campbell and Slominski, 1991).

Plant breeding has steadily reduced the level of glucosinolates to the point where they are currently one-third of those found in the first canola varieties that were fed in these studies. More recent studies with current low-glucosinolate meal varieties failed to observe an incidence of liver haemorrhage, even when as much as 20% canola meal was included in the diet (Oryschak and Beltranena, 2013; *Figure 1*).

Canola meal was included in the diets of brown and white egg layers at levels of 0, 10 and 20% with no effect on liver damage and a zero mortality rate. Laying hens have repeatedly demonstrated an ability to handle high levels of canola meal as long as total diet glucosinolate levels are below 1,43µmol/g (Bell, 1993).

Fish-like smell in eggs

A wrongfully attributed effect of feeding canola meal to some strains of brown-shelled egg layers was the incidence of a fish-like smell in the eggs (Butler *et al*., 1982). Canola meal contains sinapine, which is composed of sinapic acid and choline. In the digestive tract of birds with a genetic deficiency, choline is converted to trimethylamine (TMA). These strains of brown hens were unable to produce TMA oxidase, the enzyme necessary to convert the odorous TMA to non-odorous TMA N-oxide, which is then excreted in the urine (Ward *et al*., 2009).

If this enzyme is not present due to the layers' genetic defect, then TMA will pass into the yolk of the egg and impart a fish-like flavour. This genetic deficiency has been well studied and many commercial breeders have developed lines of brown egg layers that no longer carry this defect (Honkatukia *et al*., 2005; Classen, 2008, personal communication).

The data presented in *Figure 1* was conducted with Brown Nick hens. There was not one observation of a fish-like smell in the eggs produced. Canola meal has therefore not been fed at all or has been fed at extremely small amounts in brown egg hen diets. This type of formulating results in unnecessary exclusion of canola meal and greater feed costs.

Breeding chickens

Canola meal has no negative effect on egg fertility or hatchability of leghorn breeders (Kiiskinen, 1989; Nasser *et al*., 1985). The average weight of the one-day-old chick decreased with increasing canola meal, and the weight of the thyroid gland of one-week-old chicks was greater with increasing canola meal levels in these older studies. The decrease in chick weight did not result in an impairment of productive function.

A more recent study by Ahmadi *et al*., (2007) evaluated the effects of adding 0, 10, 20 or 30% rapeseed meal to the diet of broiler breeders, and it is unclear as to what the glucosinolate content of the diets was. However, they concluded that rapeseed meal can be used effectively in broiler breeder diets without affecting production, egg weight or chick quality.

Due to the potential effect on egg and chick weight and the lack of current studies on feeding canola meal to broiler breeders, many feed manufacturers do not use canola meal or limit it to low-inclusion levels in poultry breeder feeds. The high protein and fibre content of canola meal makes it an ideal feedstuff to manage weight gain in broiler breeder diets.

Broiler chickens

Current low levels of glucosinolates in canola meal do not have any negative effects on broiler mortality or feed intake. Two recent studies have shown that canola meal can be effectively fed in broiler diets of up to 30% without negatively affecting growth performance, as long as the diets are formulated on a digestible amino acid basis (Newkirk and Classen, 2002; Ramesh *et al*., 2006).

The lower assumed energy value in canola meal compared with other protein sources such as soya bean meal has limited its use in broiler feeds. However, lower cost per gram of key available amino acids and phosphorus has nutritionists considering greater dietary inclusions of canola meal in broiler diets.

It was argued that feeding rapeseed meal (high glucosinolate) to broilers resulted in an elevated incidence of leg problems, especially tibial dyschondroplasia. The leg problems have somewhat been alleviated by feeding canola meal. This could suggest that glucosinolates were partially responsible.

Summers *et al*., (1990, 1992) showed that the situation is related more to sulphur levels (a component of glucosinolates) rather than to the toxic effect of glucosinolates themselves. They noted that feeding organic sulphur in the form of cystine caused a greater incidence of leg problems. It is known that sulphur interferes with calcium absorption. Supplementing the diet with extra calcium helps to a certain extent, however, too much dietary calcium can depress feed intake.

Feed intake in broilers has been correlated with the cation-anion balance of a diet in some pioneering investigations into feeding canola meal to poultry (Summers and Bedford, 1994). Canola meal contains slightly less potassium (1,2%) than soya bean meal (1,9%) so that the electrolyte balance is lower in a diet based on canola meal compared with soya bean meal. When total cation-anion balance is considered, the higher sulphur levels in canola meal result in an even lower positive balance of dietary cations (Summers and Bedford, 1994).

These authors suggested that the decrease in feed intake when including canola meal in broiler feeds could be related to cation and anion levels in the diet. However, attempts to increase levels of dietary cations by adding extra calcium carbonate had marginal success, likely due to the feed intake depressing effects of high calcium inclusions (Khajali and Slominski, 2012). Adding potassium bicarbonate to diets is a better alternative as this corrects the problem at its source.

Canola expeller meal

Canola meal is an excellent source of protein for poultry, but the energy content of solvent-extracted canola meal can limit its use in the diets of rapidly growing poultry. Due to the remaining oil content, canola expeller meal contains more energy than solvent-extracted meal with an AMEn of 2,694kcal/kg (Woyengo *et al*., 2010), and it can be included as the sole source of protein in the diet.

A study conducted in Australia to examine feeding expeller-pressed canola meal subject to various processing temperatures determined the AMEn in broilers to be a mean value of 2,260kcal/kg (Toghyani *et al*., 2014). Expeller meal provides a high level of the essential fatty acid linoleic acid, thus exceeding the requirements of the birds without the need for supplemental fat.

Oryschak and Beltranena (2013) fed 20% expeller pressed canola meal to Brown Nick hens and demonstrated excellent egg production, egg quality and egg fatty acid content. Canola expeller meal can also be fed to turkeys as an effective protein source. Palander *et al*., (2004) studied the effects of feeding canola expeller meal in growing turkeys on protein digestibility and found digestibility coefficients similar to solvent-extracted meal.

Fat content of expeller meal varies between sources (8 to 11% crude fat) due to the efficacy of the type of press used, so the product should be tested, and the energy value adjusted accordingly. The AMEn of expeller meal can be estimated using the equation 1,800 + (% fat * 80) = kcal/kg. This assumes that each percentage point of fat contains 80kcal.

Feeding canola seed and oil

Canola oil is routinely fed as an energy source to broiler chickens. Along with its energy value, it is an excellent source of linoleic acid. Broiler starter diets that are based on barley or wheat instead of maize may be deficient in linoleic acid, especially when other saturated dietary fat sources are fed, such as tallow. In these situations, it is common to add 1 to 1,5% canola oil to the diet. Full-fat canola, after particle-size reduction (rolling), is a mainstay protein and energy ingredient in broiler feeds in certain countries such as Denmark.

This article was shortened for *Oilseeds Focus*. To read the original full document titled *Canola Meal Feeding Guide*, visit the Canola Council of Canada's website at *www.canolacouncil.org* or go to *www.canolacouncil.org/canolamazing/poultry/*.