New prospects for using rape seed (canola) in layer rations

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Many people driving through Germany or flying into Frankfurt in spring will recognize rape seed (in many countries better known as canola) as beautiful, yellow blooming fields. Increased demand for rape seed oil and attractive prices relative to other crops helped to expand the cultivation considerably, especially in North-Eastern Germany, but in other regions as well. Rape seed meal (RSM) is a by-product of processing rape seed for oil. RSM, however, does not look as pretty as a blooming canola field, it is dark brown and still has a negative image as a potential ingredient for poultry feed since it has been associated with the occasional “fishy flavor” of some brown eggs.

Why should Lohmann Tierzucht, as a primary breeder of brown-egg type laying hens, now take up this subject and consider RSM in layer rations – instead of repeating the well-known warning against RSM in rations for brown-egg layers? Since consumers tend to quit eating eggs whenever they find an egg with “fishy taint”, breeders of laying hens must have a direct interest to minimize this unpleasant experience to happen. Nutritionists know that RSM can cause “fishy taint” in brown-shelled eggs (seldom also in white eggs from breeds such as Brown Leghorns). However, RSM is generally considered as a good component for ruminant feed. Due to the dark color of RSM, its inclusion may not please conservative egg producers who prefer the light color of a maize-soya feed, but we should focus here on questions of egg quality, adequate nutrition and production cost per egg.

Since the early 1980s, before it was recognized that the cause of “fishy taint” was due to the inability of some hens to metabolize trimethylamin (TMA), Lohmann Tierzucht started to screen brown-egg lines for individual hens laying tainted eggs and to eliminate them before reproduction. While RSM was used in pedigreed test flocks to expose this defect, it was recommended not to use RSM in layer feeds for commercial layers. Unfortunately, many years of conventional selection did not solve the problem completely, and eggs with “fishy taint” still occurred – even if the rations were guaranteed without RSM. Therefore, a more fundamental solution was sought, involving the search for a gene causing this defect. After six years of dedicated research (Honkatukia et al., 2005) and application of results in the breeding program, we can now take a second look at RSM as a useful component of layer feed.

If rape seed meal can be included as a source of protein in layer rations, this will help to reduce feed cost per egg and benefit the whole egg industry. All commercial layers of Lohmann and H&N strains hatched after 2006 should be free of the defect, and we expect that other breeders will use these new tools in their selection programs as soon as possible. RSM has been used successfully as a source of protein in feed for white-egg layers for a long time. However, to minimize possible loop-holes in feed logistics for small egg producers with white-egg and brown-egg layers and a single feed silo for all flocks, the conservative approach has been not to include RSM in feed for laying hens in general.

With increasing cultivation of rape seed and its use as renewable energy source in Europe, rape seed meal and rape seed cake (cold-pressed rape seed containing oil residue) are also increasingly available as feed components and included in compound feed. Poultry nutritionists in Germany can refer to successful usage of rape seed protein in compound feed for broilers, turkeys, water fowl, growing pullets, as well as white-egg layers. Efforts of plant breeders to reduce unwanted ingredients in rape seed resulted in “00-rape seed” (0-rape seed = free of erucic acid, 00-rape seed = low in glucosinolate).

The limited usage of RSM in layer feed, especially for brown-egg layers, was due to the component sinapin, which may cause “fishy taint” in some eggs. The residual content of glucosinolate (mustard oil) can be reliably analyzed with the techniques of HPLC and will be further reduced by plant breeders.

German feed laws specify upper limits for glucosinolate contents in RSM to be used in compound feed. Rape varieties rich in erucic acid, which may be cultivated for industrial purposes, are not suitable for use in poultry (and pig) feed.

With about 4.5 million hectares, rape is the most important oil plant in Europe and the second most important worldwide, following soy beans. Rape is a highly productive crop in Europe; rape oil is already an important raw material for the manufacture of margarine and is gaining special interest in human nutrition due to its content of Omega-3 fatty acids. The growing demand for human nutrition also contributes to the increase in the cultivation of rape.

In Germany, 10% of the agricultural cropland is currently being used for rape seed, about 70% of which for the production of Bio-diesel as plant oil fuel. In 2005/2006, the cultivation of rape seed expanded by 10% over the previous fiscal year in the state North Rhein-Westphalia, following a trend throughout Germany which leads to an increase in supply of rape seed meal and rape cake as well as an increase in competitiveness in comparison to soy bean meal, which has to be imported from overseas.

As rape cake contains variable and considerable residual oil content, it is necessary to clarify a few issues in this context. Rape seed oil was never suspected of being a cause of egg taint and has been used in the nutrition of laying hens for a long time. As can be seen from the figures in table 1, rape seed oil has a much lower linoleic acid content than soybean oil or sunflower oil, which can be used in phase feeding to control undesirable increase in egg weight in older hens.

Table 1: Fatty acids (in %) in typical fat and oil components

Fatty acid	Animal fat	Kokos fat	Palm oil	Rape-seed oil	Soybean oil	Sun-flower oil	Poultry fat	Bone fat
Laurin C 12 : 0	0-0.2	48	50	-	-	-	-	-
Palmitin C 16 : 0	23-27	9	7	5	8	6	20	19
Stearin C 18 : 0	14-18	2	2	2	4	4	8	16
Oil C 18 : 1	40-60	7	15	51	28	20	37	47
Linoleic C 18 : 2	7-10	1	1	24	53	70	25	8
Linolenic C 18 : 3	0-1	-	-	6	6	-	4	1

How is rape seed protein used in the nutritionist's program to formulate a specific ration for laying hens? At first, a matrix for all available components with their nutrient and energy content is defined as a unique finger print for every raw material which may be used in the manufacture of a batch of feed. In order to obtain a linear optimization, various raw materials would be allowed to compete. The inclusion in a feed mix is subject to a minimum and maximum limit to be fixed and then optimized on the basis of price and nutritional value of all components. This "price value" of a raw material (e.g. RSM) for a particular feed mix is based on (estimated) nutrient content and current market prices (e.g. in Euro per 100kg). The declaration of the "price value" of a raw material, e.g. RSM in layer mash with 11.4 ME MJ/kg, can be completely different from the actual price on the raw material market: a more expensive raw material with higher nutrient content can be relatively "cheaper" in terms of the feed formulation and in turn contribute to lower feed cost per kg egg mass.

Rape seed meal and rape seed cake (RSC) are good protein sources for poultry nutrition due to their high content of methionine, the most important amino acid in poultry feed. The crude fiber content is high compared to other protein sources, resulting in lower energy content, but this can be balanced in the feed mix with higher fat content, in particular oil. A higher crude fiber content is actually desirable in layer rations. The energy in rape seed cake varies, depending on the residual oil content. Therefore, rape seed cake should be regularly tested for crude fat content.

Table 2: Nutrient content of different raw materials (Source: Degussa and WPSA)

	Soybean meal Hypro	Soybean meal Brasil	Rapeseed cake (5.8%)*	Rapeseed meal (2.0%)*	Sunflower meal Argentina	Peas
Crude protein %	47.8	46.7	34.8	34.0	31.4	20.7
Lysine %	2.86	2.83	1.74	1.81	1.11	1.48
Methionine %	0.65	0.60	0.73	0.68	0.69	0.20
Threonine %	1.85	1.79	1.50	1.47	1.16	0.77
Crude fiber %	3.7	6.2	10.5	12.0	22.3	5.3
ME MJ/kg	10.1	9.8	9.3	7.9	6.7	11.3

* Crude fat

To determine the potential advantage of using RSM or RSC, they were included in optimizing theoretical layer rations. Raw material prices used for the calculations corresponded to actual market prices in Germany in August/September 2006. The compound feed contains the following nutrient specifications: 11.4 ME MJ/kg, 17.5% crude protein, 0.40% methionine, max. 7% crude fat, 3.7% calcium and 0.5% phosphorous. The following table 2 illustrates the compounds which are based on a common German feed for layers containing wheat, maize, soya 48 as well as some sunflower meal extract and wheat by-products.

In table 3, the results of optimizing layer rations with a maximum of 5% or 10% RSM or RSC, respectively, are shown. As expected, the proportion of soybean meal goes down with the inclusion of rape products. Sunflower meal extract and wheat by-products are omitted or reduced, as opposed to wheat, which will increase. When RSM is included, fat is slightly increased, whereas fat content is slightly reduced when RSC is included. The remaining raw materials, i.e. lime stone, mineral nutrients and additional additives remain unchanged. It should be mentioned that the appearance of compounds with rape seed products would naturally be darker in color.

Further consequences result from the optimization. Each % soybean meal is replaced by about 1.4% RSM. Since RSM requires more room in the compound, it suppresses other raw materials which are low in energy. The energy level can be balanced by including a little more fat or oil. Further consequences are a somewhat higher crude fiber content and a lower level of potassium due to reduced soybean meal, both of which are considered favorable for layer feed.

For organic feed, RSC is of special interest, because it is not an “extract”. As extracts are not allowed in organic feed, RSC offers a new high-quality source of protein, contributing to a balanced compound at reduced cost.

Table 3: Optimized feed mixtures with rape seed products, compared to a control without RSM or RSC

Parts in %	Control	Mixture 2	Mixture 3	Mixture 4	Mixture 5
Rape seed meal	-	5.0	10.0	-	-
Rape seed cake	-	-	-	5.0	10.0
Wheat	34.0	25.2	37.8	34.6	36.6
Maize	19.0	19.0	19.2	18.6	18.2
Soybean meal 48	20.0	18.3	16.1	17.8	15.1
Fat & Oil	4.7	4.8	4.9	4.6	4.5
Sunflower meal	2.0	-	-	-	-
Wheat by-products	9.5	6.9	1.2	8.6	4.8
Minerals, premix	10.8	10.8	10.8	10.8	10.8

The “value for money” and cost reduction potential of rape seed products in layer feed depends on the actual nutrient ingredients of RSM and RSC and the energy content of the feed. The value of rape seed products is negatively related to the desired energy level. The higher the concentrate in nutrient contents of the remaining raw materials of the feed, the more rape seed products can be included in the feed compound. A higher crude fat content “paves the way” for recipes in higher portions, especially that of RSM. The value of rape seed products depends on the relative prices of other sources of protein, e.g. soybean meal. Since soybean meal is still the most important source of protein for vegetarian rations, rape seed protein offers high value for money especially in Northwest Europe. In the examples calculated it leads to a reduction in cost by up to 3% (0.20 – 0.60 Euro/100 kg) for layer feed.

The following maximum content of rape seed products can be recommended as ‘tried and tested’: 0% in chick starter, 5% in chick feed, 7% in pullet feed, 10% in layer feed. The actual level to be included, however, has to take into account the targeted composition of the final feed mix (e.g. content of specified components).

The practical consequence is that feed compounders may include RSM or RSC in poultry feed for brown-egg strains of LTZ and H&N origin from now on. Until the tainted egg problem has been overcome in all other brown-egg strains in a given market, it will be necessary to continue offering feed without rape seed protein, which will expand the range of products and require special diligence in merchandising different types of feed.

As we know, rape seed is not the only possible cause of egg taint; e.g. some sources of added choline have been suspected of contributing to off-flavor. Also, eliminating the identified major gene from poultry populations does not exclude the possibility that other genes may play a role and will force us to address this topic again at some future point in time. While we benefit from one major achievement due to the application of modern genetic tools, we should not forget that the taste of eggs is influenced by feed quality in many ways. Only raw materials of high quality should be used in layer feed to ensure that consumers can enjoy every egg they eat, whether white or brown.

Summary

Rape seed (better known as canola in some countries) is a highly productive crop, produced primarily for its oil content. Canola oil is used in human nutrition for the production of margarine and as a source of renewable energy (bio-diesel). Rape seed meal (RSM) and rape seed cake (RSC) are by-products which may be used as valuable protein source in animal and poultry nutrition. Until recently, their use

in layer feed has been discouraged, because the occasionally observed “fishy taint” of brown eggs may be due to the inclusion of rape seed products in layer feed. This problem has been solved by identifying the gene which is responsible for the inability of some hens to metabolize trimethylamin (TMA). Lohmann Tierzucht announced that all commercial day-old chicks of Lohmann and H&N origin hatching from January 2007 are free of the genetic defect and can therefore be fed with rations containing rape seed products.

Examples for optimized layer feed including RSM or RSC are given. Rape seed protein has a favorable amino acid profile, with significantly higher methionin level than soybean meal. This makes protein from rape seed especially attractive for organic feed, which is not allowed to contain synthetic amino acids.

Based on actual ingredient prices in Germany in August/September 2006, the cost of compound feed for layers ca be reduced by up to 3% (0,20 – 0,60 Euro/100 kg). This shows the high value for money of rape protein and is of great interest in competition with soybean meal, which is still the main protein source in layer feed.

Based on our experience under commercial conditions, we recommend the following levels of RSM in compound feed as safe for efficient production: chick starter 0%, chick mash 5%, pullet developer 7%, layer mash 10%. The optimal level has to be determined on the basis of current prices for all raw materials, in order to maximize egg income over feed cost without compromising egg quality.

Zusammenfassung

Raps ist eine ertragsstarke Feldfrucht. Mit steigendem Anbau für Rapsölproduktion fallen Rapsextraktionsschrot und Rapskuchen in zunehmendem Umfang als Rohstoff für die Tiernährung an. In der Legehennenfütterung wurden diese kaum genutzt, seitdem ein Zusammenhang zwischen Raps im Futter und dem Auftreten „fischigen“ Geruchs bei Eiern bekannt ist. Die Ursache des „fischigen“ Geruchs ist ein Enzymdefekt einzelner Hennen, die Trimethylamin (TMA) nicht abbauen können. In Zusammenarbeit mit anderen Forschungseinrichtungen ist es der Lohmann Tierzucht gelungen, das Gen für diesen Enzymdefekt zu identifizieren und das Problem durch konsequente züchterische Maßnahmen zu lösen. Mit Beginn des Jahres 2007 können nicht nur Weiße Leghorn, sondern auch braune Legehennen der Herkünfte Lohmann und H&N mit rapshaltigen Rationen gefüttert werden.

Als Optimierungsbeispiele werden Veränderungen von Legehennenfutter bei Einsatz von Rapsschrot (RSM) bzw. Rapskuchen (RSC) dargestellt. Rapsprotein hat für die Legehennenfütterung ein günstiges Aminosäurenmuster mit deutlich höherem Methioningehalt im Rohprotein als Sojaschrot. Dies macht Rapsprotein für die Biofütterung besonders attraktiv, da im Biofutter keine synthetischen Aminosäuren eingesetzt werden dürfen.

Auf Basis aktueller Rohstoffpreise im Zeitraum August/September 2006 in Deutschland reduzieren sich die Kosten eines Standardlegehennenfutters um bis zu ca. 3% (0,20 – 0,60 Euro/100 kg). Dies zeigt die hohe Preiswürdigkeit von Rapsprotein, besonders vor dem Hintergrund, dass Sojaschrot nach wie vor die wichtigste Proteinquelle im Legehennenfutter ist.

Auf der Basis von Praxiserfahrungen können folgende maximalen Einsatzraten von Rapsprotein als unbedenklich empfohlen werden: Kükenstarter 0%, Kükenaufzuchtfutter 5%, Junghennenfutter 7%, Legehennenfutter 10%.

Die exakten Einsatzraten sind im Einzelfall auf Basis einer Optimierung und den Rahmenbedingungen zu erarbeiten, um den bestmöglichen Nutzen hinsichtlich einer Kostenreduzierung bei Absicherung der Eiqualität zu erzielen.

Folien aus einem Vortrag des Autors (Pottgüter, 2006) stehen im Internet.

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