Low Glucosinolate Rapeseed Meal - a High Quality Protein Feed from European Production

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Effective breeding and introduction into commercial production of rapeseed cultivars low in erucic acid and glucosinolate content (so-called double-low cultivars) in the recent decades created an essentially new oilseed crop for cultivation in the temperate climatic zones. These new rapeseed cultivars produce a high quality vegetable oil, and their meal is a valuable animal feed.

In order to secure the quality of the rapeseed oil, the certified seed of double-low rapeseed cultivars must have an erucic acid content of less than 2% (as a % of total fatty acids), while commercial seed for crushing must have an erucic acid content of less than 5% at present. In reality today the commercial commodity of rapeseed produced in Europe has a much lower erucic acid content than that.

Rapeseed meal, remaining after oil extraction, contains approximately 40% high quality protein. Its feed value for poultry and swine feeding has been significantly improved by the genetic reduction of the glucosinolate contents to one tenth of the concentration found in the old rapeseed cultivars. This made double-low rapeseed meal a direct competitor to soybean meal.

With the introduction of double-low rapeseed cultivars into commercial production limits for glucosinolate contents were also established. Since several different glucosinolates with different molecular weights had to be considered, it generally was agreed that the total glucosinolate content would be reported in µmoles per 1 g of seed at 91 % dry matter content. All glucosinolates present in the seed at concentrations of greater than 1 µmole per 1 g of seed are counted, irrespective of their antinutritional attributes. The maximum glucosinolate content for registration of double-low rapeseed cultivars in Europe was set at 18 µmoles per 1 g of seed. So far, support payments for rapeseed production in the European Community require the use of registered double-low cultivars (positive list), and the total glucosinolate content of the commercial production must be less than 25 µmoles per 1 g of seed. These limits are generally met, and very frequently the content is significantly lower in open pollinated cultivars as well as in hybrid cultivars. Results from official cultivar tests over the last 3 years in Germany indicated that no correlation exists between glucosinolate content and seed yield (r=0.22), which means that high seed yields can be combined with low or very low glucosinolate contents in new double-low cultivars.

Despite these improvements in rapeseed quality, meal of the double-low cultivars still has a poor image in the market. Analyses of samples from all steps in the production process from farmers' fields up to the crushing plants indicate the high quality of this meal, and overall low glucosinolate contents were found. Such studies were conducted in France and Germany over the last 3 years. Average glucosinolate contents of commercial productions varied between 12.5 and 14.5 µmoles per 1 g seed in both countries. There was, however, variation in glucosinolate contents of individual samples ranging from 5 to 36 µmoles per 1g seed. This most likely resulted from specific production conditions affected by factors such as sulphur supply in the soil, volunteer plants with high glucosinolate contents in the field, use of farm-saved seed and others. In Germany, 15.2%, 8.8% and 6.4% of all analysed samples exceeded the level of 18 µmoles of total glucosinolates per 1g seed in the years 2000, 2001, and 2002, respectively. Rapeseed samples obtained from German crushing plants ranged in glucosinolate contents from 12.6 to 14.8 µmoles per 1g seed. There were also samples detected with up to 40 µmoles of glucosinolates; but these were exclusively samples from rapeseed imports from non-EU countries except Canada. In

Canada the maximum total glucosinolate content for cultivar registration is 12 µmoles per 1g of seed at 8.5% moisture content, and according to investigations of commercial farm samples by the Canadian Grain Commission (harvest survey data) this very low glucosinolate content is maintained at this level in Canadian commercial rapeseed (canola) productions, too.

Of even greater importance for the quality of the rapeseed meal would be a correct identity of the rapeseed meal produced in the crushing plants. In the above study, approximately 200 samples per year of rapeseed meal delivered to feed manufacturers exhibited glucosinolate contents ranging from zero to 18 µmoles with an average of 8.3 µmoles per 1g of defatted meal. These levels were significantly lower than those observed in the harvested grain, in spite of the effect of concentration, which the glucosinolates undergo in the rapeseed meal as a result of the seedoil extraction. Evidently, between 30 to 85% of all glucosinolates are destroyed during the prepress-extraction process in the crushing plant. This glucosinolate reduction depends, to a large extent, on the temperatures applied for toasting the meal in the crushing plant. But high temperatures simultaneously reduce the protein digestibility and protein value of the meal; therefore this practice is a not desirable procedure to obtain glucosinolate reduction in the meal.

In the near future, support payments for agricultural productions in the EU will no longer be based on the quality of the product (decoupling of farm subsidies), and consequently the present quality requirements for double-low rapeseed will no longer be officially regulated. For such reason, the partners of the rapeseed market are requested to establish their own control system in order to secure the high quality of the rapeseed produce throughout the production chain. Animal nutritionists in Europe demand further reductions in glucosinolate contents of the rapeseed meal similar to the levels of about 12 µmoles per 1g seed as realized in commercial spring rape productions in Canada. There are good chances for increasing use of rapeseed meal in animal feeding in Europe, which is made economically feasible at current price levels. However, the development and registration of new improved double-low rapeseed cultivars with a maximum glucosinolate content of less than 18 µmoles per 1g of seed must continue. Also ways must be found to guarantee the existing quality parameters of the commercial grain up to the crushing plant. Relevant environmental effects in production, potential contamination by volunteers, mechanical admixtures of grain in the marketing chain or higher glucosinolate rapeseed imports from non-EU countries must be controlled in order to early identify problematic rapeseed lots and to separate these from the high quality seed lots before processing in the crushing plants.

Prerequisite for this is the availability and use of an effective and approved analytical method for determinations of the glucosinolate content, such as the near infrared spectroscopy (NIRS) method, which is sufficiently fast, accurate and cheap to use. This method could be used to control the quality of the production at the point of delivery to the crushing plant before the grain is being processed. Thereby the high feeding value of low glucosinolate rapeseed meal could be maintained or even increased to improve the image of rapeseed meal in the feed market, and to secure a fair price for this product. In addition, a quality seal might be developed to distinguish particularly high quality lots of rapeseed meal. Such means could favourably contribute to increasing uses of rapeseed meal as a high quality animal feed.

The 11th International Rapeseed Congress, held in Copenhagen, Denmark, from July 6 to 10, 2003, particularly focussed on the "Enhanced Value of Cruciferous Oilseed Crops by Optimal Production and Use of the High Quality Seed Components". At this occasion, more than 650 scientists from all rapeseed growing countries of the world extensively discussed the present status based on their competence and actual experience. As the result of a workshop they unanimously agreed to issue the following four recommendations for

Measures Securing High and Stable Quality of Rapeseed Meal/Cake in European Markets:

Recommendation 1

Maximum levels of total glucosinolate content in the commercial grain shall be observed as follows:

< 18 µmoles per 1g seed	i.e. present stand in Europe,
< 15 µmoles per 1g seed	optional European target,
< 12 µmoles per 1g seed	i.e. present stand in Canada,
< 8 µmoles per 1g seed	optional target for future global developments.

Recommendation 2

At the oil mill (crushing plant), glucosinolate levels of the incoming commercial grain shall be monitored.

Recommendation 3

Oil mills are requested to declare the quality of the outgoing rapeseed meal/cake regarding:

- concentration of glucosinolates in the outgoing meal/cake produce in comparison to the average content of the commercial grain processed,
- protein quality, and
- energy value.

Recommendation 4

Feed manufacturers are requested to declare the usefulness of high quality rapeseed meal to ensure a high quality of the compound feed that reaches the enduser (animal).