# The Nutritive Value of Dehulled Protein Rich Rapeseed Meal Produced by Aqueous Enzymatic Extraction

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Meal of traditional double low rapeseed varieties of high quality is an excellent protein source to ruminants as well as to monogastric animals. However, the glucosinolate level may limitate the amount of rapeseed meal, which can be included in the diet (1,2,3). In addition the high content of dietary fibres has a negative effect on the digestibility of protein and energy (4).

In the present paper is given a brief description of the nutritional quality of dehulled protein rich rapeseed meal (DPR-meal) produced by a new process based on aqueous enzymatic extraction of rapeseed (5,6,7).

The process involves heat inactivation of myrosinases prior to addition of cell wall degrading enzymes, a multi-activity enzyme mixture, from a selected strain of Aspergillus niger. This aqueous enzymatic process is performed at gentle conditions, without use of organic solvents, and the rapeseeds are separated into four fractions: oil, DPR-meal, syrup and hulls. DPR-meal (55% protein and 20% fat) is low in glucosinolates and other low molecular weight compounds, which are concentrated into the syrup fraction. Due to the dehulling procedure the dietary fibre content is also reduced (6,7).

Feeding experiments comprising balance trials with young growing rats, (Table 1) piglets (8) broilers, (Table 2) and long term studies with mink showed no adverse effects of glucosinolates and products thereof (6,7).

**Table 1.** Biological data obtained in balance trials with rats for products from aqueous enzymatic processing of rapeseed

| | TD[a](%) | BV[b](%) | NPU[c](%) | DE[d](%) |
|---|---|---|---|---|
| 1 DPR-meal | 82.3(0.9[f]) | 94.9(1.5) | 78.0(0.7) | 84.4(1.1) |
| 2 DPR-meal(defatted)[e] | 85.0(0.8) | 95.4(0.9) | 81.2(0.6) | 86.8(0.8) |
| 3 DPR-meal + pea meal + Met + Thr + Try | 84.0(0.5) | 98.3(0.5) | 82.5(0.7) | 84.4(1.1) |
| 4 DPR-meal+10% syrup | 83.0(1.2) | 92.4(1.5) | 76.7(2.0) | 86.6(1.0) |
| 5 Syrup | 84.7(1.2) | 81.3(2.5) | 69.0(2.9) | 87.8(1.3) |
| 6 Hulls | 47.1(0.5) | 91.9(1.1) | 43.3(0.6) | 23.2(1.2) |
| 7 1+5+6 (51;26;23) | 77.2(0.7) | 92.7(1.2) | 71.5(0.6) | 63.6(0.8) |

a) True protein digestibility; b) Biological value; c) Net protein utilization, d) Digestible energy; e) 3.2% fat; f) Standard error of means; g) 1.0 g Met, 0.4 g Thr and 0.1 g Try per 16 g N

The balance trial with rats revealed a beneficial effect on the nutritive value of rapeseed by dehulling and removal of glucosinolates into the syrup fraction from the DPR-meal.

Post mortem examinations of the thyroid gland and liver from the rats revealed no lessions, neither at the macroscopic level nor by the histological examinations. The weight of the organs showed also no difference between the different groups.

The hull fraction on the other hand showed very poor digestibility with respect to both protein and energy, and will thus be of limited interest as feed to monogastric animals.

Regression analyses of different essential amino acids and glucosinolates versus the BV showed only correlation coefficients of considerable values for lysine ($r = 0.81$) and methionine ($r = 0.86$) indicating that these two amino acids are the limiting compounds in DPR-meal and not the glucosinolates ($r = -0.21$) (7).

The fat content of DPR-meal did not seem to cause nutritional problems. A reduced fat

**Table 2.** Results from energy and N-balance trials with increasing dietary levels of DPR-meal to broilers (twelve broilers with four collection periods = 48 observations per diet)

| Diet[1] | 1 | 2 | 3 | 4 | F[2] |
|---|---|---|---|---|---|
| % DPR-meal | 0 | 6 | 12 | 18 | |
| Percent fish meal | 8 | 8 | 4 | 0 | |
| Percent + skim milk powder | 9 | 0 | 0 | 0 | |
| Initial weight, g | 242 | 231 | 232 | 244 | |
| Final weight, g | 1439 | 1505 | 1506 | 1372 | |
| Weight gain, g | 1197 | 1274 | 1274 | 1128 | |
| Average daily weight gain, g | 42.7 | 45.5 | 45.5 | 40.3 | NS |
| Feed consumption, g | 2498 | 2328 | 2349 | 2063 | |
| Feed consumption, kg per kg weight gain | 2.10[3] | 1.84[b] | 1.85[b] | 1.84[b] | *** |
| Digestible DM, % | 71.4[c] | 73.2[ab] | 74.2[a] | 72.3[bc] | *** |
| Metabolizable energy in pct of gross energy | 74.7[b] | 76.4[ab] | 76.9[a] | 75.1[ab] | * |
| Deposited N per day, g | 1.97[a] | 1.74[ab] | 1.88[ab] | 1.64[b] | ** |
| Deposited N in pct of consumed N | 56.3 | 55.7 | 58.5 | 57.4 | NS |

1) The diets were equal to the diets used in the balance trial with piglets.

2) *** = P≤ 0.001; ** = ≤ 0.01; * = ≤ 0.05; NS = Non Significant (Tukey's test).

3) Values with different superscripts within a row are significantly different

content in DPR-meal may increase NPU and DE with only 2-3%. Dehulling solve some but not all the problems with respect to the digestibility of the rapeseed products. Other experiments have revealed that much of the digestibility problem is connected to the IDF fraction (4).

The high BV (98.3%) obtained by the mixture DPR-meal + pea and supplemented with amino acids revealed that it is possible to mix a diet on the basis of DPR-meal with an almost perfect amino acid composition. Moreover and of greater importance: the concentrations of antinutritional compounds have to be very low. Otherwise the high BV could not be obtained (3).

The energy- and N-balance trial with broilers showed decreasing voluntary feed intake with increasing content of DPR-meal in the diet.

Digestible dry matter and metabolizable energy in percent of gross energy were highest for diet 3 and lowest for diet 1.

Deposited N in percent of consumed N was at the same level for all four diets, so the amount of deposited N per broiler followed closely the feed intake. A trend towards increasing deposits of the N consumed with increasing levels of DPR-meal revealed the excellent amino acid composition and nutritional quality of this product. A likely explanation for the low values obtained for diet 1 regarding digestible dry matter and metabolizable energy and the higher feed conversion ratio was the content of 4.9% lactose in this diet. Lactose is only 67% digestible by the poultry compared to 97% by pigs.

The low digestibility observed by feeding rapeseed products is often explained by the high content of hulls rich in fibre. The meal obtained with the new type of rapeseed processing can probably not, in an economical way, be further improved with respect to digestibility. This assumption is based on that significant amounts of protein are associated to the dietary fibres in the cell walls of the meal. Irrespective of the potential for further quality improvements, the meal obtained in the aqueous enzymatic processing technique has an improved value as animal feed. In particular to young animals as piglets, chickens, mink and eventually to young calves, where the requirements to protein quality are high.

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