Article

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Results of a survey on the nutritional value of soya bean and rapeseed meals and cereals for animal nutrition by Adisseo

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A survey on the nutritional value of soybean and rapeseed meals and wheat and corn for monogastric feeds has been conducted by Adisseo. Results show great variations in the nutrient value depending on year of harvest, cultivar, geographical origin, and processing conditions. The survey included analysis of the digestible amino acid and apparent metabolizable energy (AME) values using Adisseo's NIR predictive equations which have been calculated in reference to *in vivo* digestibility tests.

In 2012, Adisseo conducted a large survey of the nutritional content of soybean and rapeseed meals in Europe over a 6 week-period. Great heterogeneity was observed, with variation coefficients ranging from 3% to 8% for the main components: crude protein, total and digestible lysine, total and phytic phosphorus and AME. Highest variations were observed for AME of soyabean meals, and digestible amino acid contents of rapeseed meals (Table 1).

Table 1 Variations in nutrient values of oilseed meals*

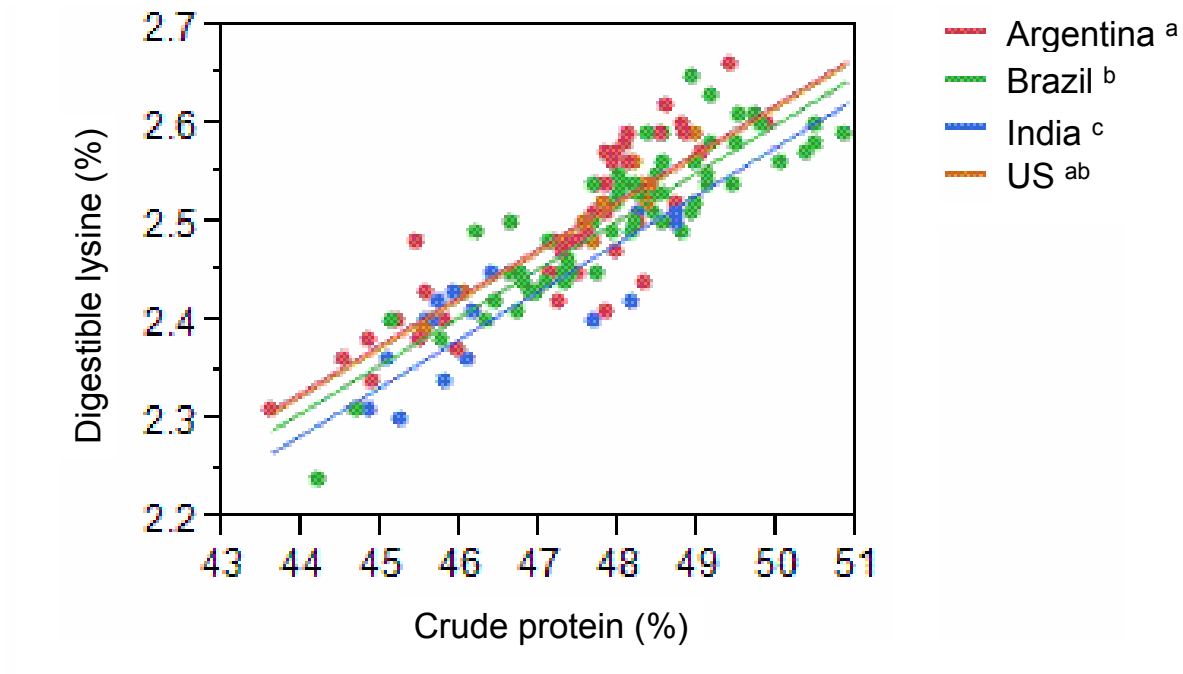
Min < Mean < **Max**	**Soybean meals** (n=170)	**Rapeseed meals** (n=118)
Chemical components		
Crude protein (%)	**44** < 48 < **51**	**31** < 35 < **39**
Total lysine (%)	**2.54** < 2.83 < **3.01**	**1.53** < 1.81 < **2.03**
Total phosphorus (%)	**0.48** < 0.64 < **0.73**	**0.97** < 1.03 < **1.11**
Phytic phosphorus (%)	**0.31** < 0.42 < **0.51**	**0.77** < 0.85 < **0.93**
Non phytic phosphorus (%)	**0.14** < 0.22 < **0.30**	**0.08** < 0.18 < **0.23**
Nutrients		
Lysine digestibility (%)	**85** < 88 < **91**	**72** < 75 < **80**
Digestible lysine (%)	**2.24** < 2.49 < **2.66**	**1.10** < 1.36 < **1.59**
Metabolisable energy (kcal/kg)	**2055** < 2363 < **2517**	n.d.

* All analyses performed with NIR

An important influence of the country of origin

In 170 samples of soya bean meals collected over a 6 weeks-period from 13 countries in Europe and America, crude protein content ranged from 44% to 51% and total lysine from 2.54% to 3.01%. The lysine to crude protein ratio depended on the country of origin. Botanical or cultural effect? Difficult to say without further investigation, but observations are clear; for similar crude protein contents, samples coming from Argentina had higher lysine levels than samples coming from Brazil and US. Interestingly, lysine digestibility was higher in US samples, as reported by Mateos *et al*. (2010). Consequently regarding the total content of digestible lysine, soya bean meals from Argentina contained the most, followed by those from the US, then those from Brazil and finally, with the least, those from India. (Figure 1)

Figure 1 Digestible lysine contents of soybean meals depend on crude protein and country of origin



Are you sure about the value of your soybean meal?

Even for a well characterized product, great variations in nutritional content were observed. “Soybean meal 48 ProFat” are supposed to contain 48% crude protein + fat, with comparable digestible amino acid and energy contents. In fact, the Adisseo study showed that crude protein content varied by 1 to 2 percentage-points and digestible amino acid content by 4 to 5%. The most variable nutrient was AME with variations between 80 to 120 kcal/kg.

The oil content is not the main cause of the variation in AME. Crude fibre explains a part of it. Let's explain why. To manufacture soybean meal 48 ProFat, the crushers can decide to dehull the beans before extracting the oil. They then add back the hulls to an extent they perceive is necessary to create a protein + fat content of 48%. The highest the initial protein content of the bean, the highest the amount of hulls to be added, and the highest the crude fibre content as well. We achieve a paradox where better seeds may result in meals of lower nutrient interest.

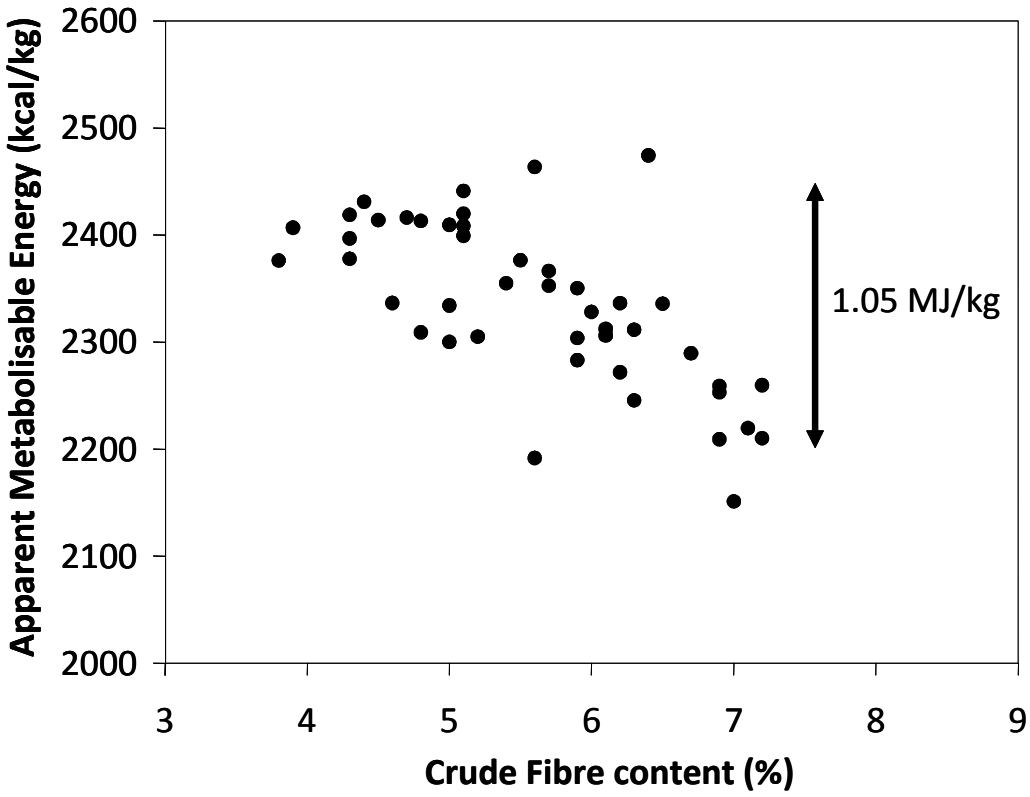
Energy value is somewhat correlated with fibre content, but the linear regression from fibre to energy content is not precise enough to be used in formulation: with 5% crude fibre content, a soybean meal can contain 2300 or 2450 kcal AME/ Kg (Figure 2). This 150 Kcal difference, picked up by PNE, Adisseo NIRS Service, would correspond to a soybean meal shadow price difference of 45 €/ T.

In practice, excluding high crude fibre contents for monogastrics should be the first reflex, but privileging the raw materials with the lowest levels of fibre is not a guarantee of high nutritional value.

Aurélie Preynat, Enzyme Research Manager with Adisseo and author of several reports on the efficacy of multi-enzyme Rovabio in soybean meal, explains: *"Indeed fibres do not act only as nutrient diluent. Their complex constituents, such as mannans, pectins, xylans, and cellulose, also specifically decrease energy and amino acid digestibilities. Our NIRS service is an efficient tool to rapidly and efficiently monitor the nutrients really available to the poultry."*

"*The commercial nomination '48 PRoFat' is not sufficient for precise nutrition and optimized feed production. More efficient characterization and selection of the ingredients, based on their nutritional values, can result in savings as high as 10 €/t of feed"* calculates Elisabeth Bourgueil, Adisseo Technical Manager France, Iberia and Italy.

Figure 2 Apparent Metabolisable Energy content of soybean meal 48 ProFat is highly variable



Rapeseed meal quality is largely affected by the crusher's process

Rapeseed meal quality also depends on the country of production and crushing plants.

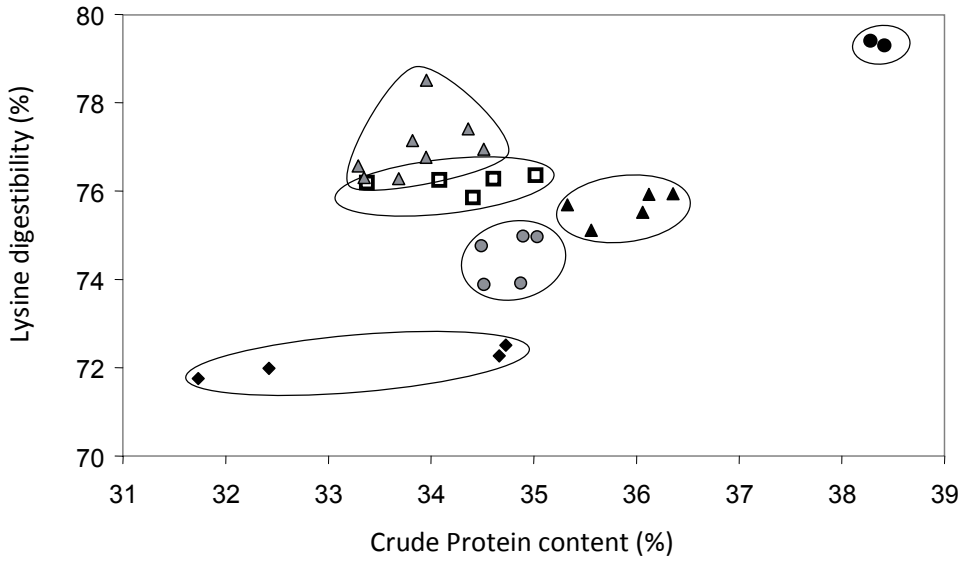
In this 2012 survey, rapeseed meals produced in Germany appeared to have higher non-phytic to phytic phosphorus ratios than those produced in France, suggesting higher available phosphorus values. On average, digestible lysine contents are also higher.

Differences *within* a country are however as high as *between* countries. Repeated sampling of six French rapeseed meal factories over a one month period showed for example that lysine digestibility ranges between 72% to 80% and is very plant-specific (Figure 3).

This analysis shows an important effect of suppliers, especially for digestible amino acid contents. The method using regressions to predict digestible amino acid content based on crude protein content is unable to reflect these differences. Introducing NIR calibrations for digestible amino acids in quality control plans at raw material reception is therefore a step forward to optimize ingredient purchases and proper use in feed formulations.

Figure 3 Rapeseed meal digestibility is pretty much affected by the manufacturing process

Different symbols represent rapeseed meals from different crushing plants (29 samples from 6 crushing plants)

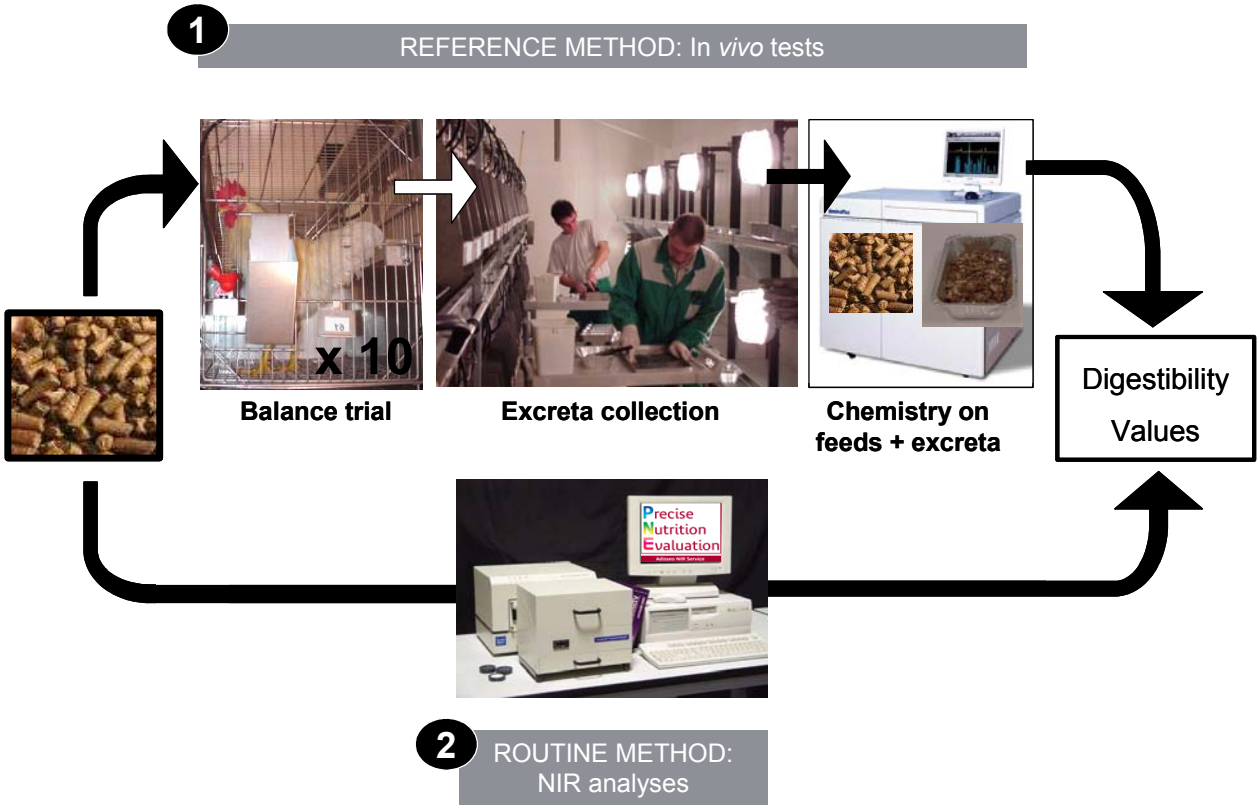


"*Digestible lysine content is a key marker of quality of rapeseed meals. We have similar findings in DDGS, the by-products of ethanol production, and this observation may be applied to a larger range of processed feedstuffs*", says Cécile GADY, Adisseo NIRS and Feedstuff Manager

400 equations to provide more precise values

This large scale study illustrates that classical laboratory analyses and knowledge of the origin of the raw material are a first steps in feedstuff characterizations, but they are not sufficient to get a good prediction of nutritional contents. 'PNE, Precise Nutrition Evaluation', the Adisseo NIRS service, gives the possibility to go one step further, with the measurement of the real digestible amino acid and AME values. For 15 years, Adisseo has been working on the correlations existing between feedstuff NIR spectra and *in vivo* data, obtained in vivo digestibility trials conducted at their research facility CERN in France. The outcome? 400 equations providing the most precise values on total and digestible amino acids, AME, total and phytic phosphorus and the possibility to estimate, on a routine basis, those most costly nutrients in monogastric diets (Figure 4).

Figure 4. NIR analyses as shortcuts for in vivo nutrient value measurements



These NIRS analyses are useful to ensure that diets provide the expected nutrients at the lowest cost. Knowing one's raw materials should be a concern shared by all functions: quality manager, nutritionist and buyer. Especially when feedstuffs are so expensive, it is important to ensure you are purchasing the right feedstuff for the right objective at the right price.

Box

Nutritionists also need Precise Nutrition Evaluation for wheat and corn.

In 2009 and 2010, Adisseo also carried out a large survey of 300 samples of wheat and corn collected from 19 countries from Europe and Africa. The aim was to measure the nutritional profile of cereals according to harvest and country. All samples were analyzed for their nutrient content, digestible amino acid concentrations and AME using NIR.

The concentrations of digestible lysine in wheats ranged from 0.23 to 0.32 g/100g, with a significant effect of geographical origin. For AME, Eastern countries exhibited the lowest content (from 2786 to 2860 Kcal/kg) whereas the highest concentrations were found in the northern countries (2880 to 2923Kcal/kg).

Amino acids and AME contents of corn showed a similar level of variability, with a significant country effect. AME ranged from 3367 Kcal/ kg in Romania and Spain to 3 441 Kcal/kg in Germany and Argentina. This observation may be due to the interaction of many factors, including grain growing and drying conditions.

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