Ruminants: Use of novel co-products, economics and nutritional limitations, including new technologies for overcoming constraints

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Bio-fuels are probably the most obvious and well known recent development, but whatever the industry the term co-products is now outdated as no factory will ever be constructed without recognition of the value contribution of all products. For example the new Cargill plant in Manchester, that uses wheat as the substrate, produces, starch plus its derivatives, vital wheat gluten, potable alcohol via a joint arrangement with an adjacent company Nedalco, wheatfeed, potentially a liquid feed for pigs and ruminants, plus a ruminant moist feed C☆Traffordgold. They are all essential products to justify capital investment and profitable plant operation.

First generation bio-fuel production is split between bio-ethanol, using grains, sugar cane or beet (or sugar rich derivatives) and bio-diesel, using palm oil, rape seed, soya beans and recovered vegetable oils and tallow. Hence the feed products derived from these processes will vary widely.

In the case of grains for bio-ethanol, these will be distillers grains (with or without the solubles added as these potentially could represent a product in their own right), with a protein content and amino acid composition being a reflection of the grains used plus a contribution from the yeast the extent of which will depend on the actual fermentation process employed, batch or continuous. It is recognised that the particular bio-ethanol production process used can have a marked effect on the nutritional value of these feed products, factors such as, grain quality, grinding conditions, pre-fermentation enzyme and heat treatments to saccharify the starch, the yeast employed, plus the type of evaporation and drying processes.

In the UK wheat will be the grain of choice, and will produce a distillers grain of 32 to 34% protein, on an as received basis, and hence from a protein perspective compete directly with rape seed meal but the higher energy content will command a premium. Rumen protein degradability and digestibility of the by-pass protein, and its' amino acid profile, will impact on its value also and will be affected by the processing conditions. There is very little information on the impact of processing on the nutritional value of wheat distillers for ruminants, the majority of the studies have been undertaken on maize based products and cannot be directly extrapolated to wheat DDGS. Formation of Maillards reactions between the amino acids, especially lysine, and sugars, particularly if they form second stage Maillards will reduce digestibility. It is recognised that the levels of xylose and non starch polysaccharides in wheat DDGS are several times more than those in maize DDGS and hence the potential to form Maillards products is much greater. Current estimates for lysine as a % of metabolisable protein for wheat DDGS are ~ 4.5% compared to soya bean meal at ~ 6.8%. Clearly the feed analysis will be source specific and cannot be treated generically.

The use of sugar cane and beet for bio-ethanol production will produce liquid 'vinasses', a crude EU legal definition, that is rich in fermentation acids, glycerol, soluble protein and NPN, minerals and yeast fragments.

As with the solubles streams from grain based fermentation systems these liquid products appear to have a stimulatory effect on rumen fermentation, probably from the yeast fragments, not live yeast as the distillation process kills the yeast. These effects add to the nutritional value that is not considered in conventional matrix descriptions.

Where oil seeds are used to produce bio-diesel there will be two feed products, the respective protein meals and glycerol the purity of which will depend on the process employed. The impurities will be moisture, organic materials from the oil used that have not been methylated, sodium or potassium as a consequence of hydroxide addition plus a residual amount of methanol. Glycerol yield is approximately 10 to 11% of the oil volume. With the rising cost of cereal grains and other low protein feeds glycerol will provide a valuable means of reducing total dietary protein allow full exploitation of the high protein distillers and oil seed meals from bio-fuel production

Glycerol, a precursor of glucose, has the potential to be a significant part of ruminant rations. The fate of glycerol in the rumen is unclear, early studies indicated it was extensively fermented in the rumen to propionic acid, but more recent from Germany suggest no difference in total tract digestibilities when 15% of the concentrate was replaced with glycerol but only a slight reduction in the acetic acid to propionic acid ratio indicating the rumen may not be as important as first speculated. Our own initial studies suggest that glycerol does not behave in the rumen in a similar manner to cane molasses. Estimates of the energy content undertaken recently in Germany, have suggested an interaction between the concentrate, with high starch diets providing a lower ME than low starch diets, hinting at a rumen involvement.

The volume of rape meal will increase in the EU and with a self sufficiency for soya of only 2.5% there is a growing need to improve the nutritive value of rape meal by removing some of the anti-nutrient factors, e.g. tannins. This may become more economically viable as the differential between rape and soya meal increases.

Clearly, accurate feed material description is fundamental to the full value of the new and novel products being realised.