Pigs: Use of biofuel co-products, economics and nutritional limitations

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It is anticipated that there will be a significant increase in the quantity of co-products available from the biofuel industry for use in animal feed. The co-products are the result of either biodiesel or bioethanol production. Biodiesel is produced from oil. One of the main sources of oil is oil seed rape but other oil seeds such as sunflower, Crambe and *Camelina sativa* (Cottrill *et al*., 2007) may be used. Bioethanol is produced from the fermentation of sugar which is either added directly to the process or obtained from the digestion of starch. The co-products produced include glycerol (glycerine or glycerin) from the production of biodiesel and dried distillers grains with solubles (DDGS) from the production of bioethanol from starch.

The process of producing biodiesel involves the hydrolysis of triglycerides using sodium or potassium hydroxide as catalysts and methanol for methylation. The glycerol produced, which is neutralised using hydrochloric acid, may therefore be limited in its inclusion level due to the high sodium or potassium content. Glycerol may contain levels of methanol but the risk of methanol toxicity is low and limited to meals since methanol will evaporate during the pelleting process. Glycerol is a sweet, high energy liquid that may be utilised by pigs as either a glucogenic or a lipogenic nutrient depending upon the energy status of the animal. During the energy dependant phase of growth glycerol would be metabolised via gluconeogenesis and have a net energy value of 14 MJ/kg. The utilisation of glycerol also requires enzyme activation which is limiting in the pig. High levels of glycerol have a lower energy value because the enzyme system becomes saturated and excess glycerol is excreted via the urine (Doppenberg and van der Aar, 2007). Including glycerol up to a level of 5% in pig diets gives optimum utilisation and increased feed intake and gain have been observed (Kijora *et al*., 1995). Glycerol has also been demonstrated to reduce carcass drip and cooking losses and increase the levels of C16:0 and C18:1 in the fat via *de novo* synthesis at the expense of polyunsaturated fatty acids.

Where oil seeds are used as the source of oil then oil seed meal is the other co-product produced from the production of biodiesel and rapeseed is often used for this process. The maximum level of inclusion of rapeseed meal in pig diets is primarily dependant upon the level of glucosinolates in the product. The glucosinolate levels may differ between processing conditions used to extract the oil and cold pressed meals have been shown to contain twice the level of glucosinolates as that subjected to heat processing. Trials have shown that ‘00’ rape seed meal, containing 10umol glucosinolate per g, can be included at levels up to 20-25% in finishing pig feeds. It is likely that rapeseed meal will become more cost effective, if the volume of production increases, thus increasing the use of the material in pig feeds.

The main concern with the use of DDGS in pig feeds is the degree of variation in composition and digestibility of nutrients. Variation arises from differences in nutrient analyses of the incoming raw material, amount of condensed distillers solubles added to the distillers dried grains, quantity of starch converted to ethanol by fermentation process and temperature and duration of the drying process (Shurson *et al*., 2004). Heat processing reduces the availability of amino acids and this will reduce growth unless the inclusion level of DDGS is reduced or the amino acid availability is accurately assessed and accounted for. DDGS also tends to show a high degree of variation in energy content. Phosphorus however has a relatively high digestibility due to the destruction of phytate during processing. Maize DDGS has been used successfully at levels of up to 15% in finishing pig diets but soft carcass fat may be an issue due to the level of poly unsaturated fatty acids in the diet. Wheat DDGS has been used up to a level of 10% in finishing pig diets but a reduction of feed intake has been observed above this level. The use of enzymes may offer a means of increasing the utilisation of DDGS but further investigation appears necessary to determine the type and level of enzyme required. To fully exploit the economic and nutritional value of DDGS in diets for pigs either a rapid method of accurately assessing the nutrient availability is required or processes, which minimise heat damage, should be adopted to ensure the production of a consistent material.

Co-products from the biofuel industry have the potential to be important sources of raw material for the pig industry. In certain areas obtaining further knowledge of how to: 1) improve the production process, 2) rapidly measure the nutrient availability and 3) use new technology to improve the nutrient value, would allow increased utilisation and add value to the co-products produced.

References

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