The Availability of Lysine in Protein Concentrates for Growing Pigs

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Considerable research has been directed towards developing techniques for estimating the availability of lysine in feeds. The various techniques developed include animal growth, digestibility, plasma lysine level, chemical, enzymic and microbiological (Carpenter and Booth 1973). The most commonly used techniques are the chemical ones, particularly the Carpenter available lysine (Carpenter 1960) and the Silcock available lysine (Roach, Sanderson and Williams 1967) tests. These tests are based on the reaction of the free s-amino group of lysine with fluorodinitrobenzene. It is assumed that any c-amino group of lysine that is bonded in any way so that it doesn't react with fluorodinitrobenzene is also unavailable to animals.

While there has been considerable research into developing new techniques for assessing lysine availability there have been few investigations into the applicability of these techniques for growing pigs. Batterham (1973) reported large differences in the Silcock and *Tetrahymena* (a microbiological assay) estimates of the available lysine content of a number of protein concentrates. In subsequent pig experiments, designed to evaluate the two techniques, the results were inconclusive as factors other than lysine appeared to influence the results. Taverner and Rayner (1975) however, reported good correlations between both total and Silcock lysine values in expeller and solvent processed rapeseed and soybean meals and the growth rates of pigs fed diets containing these meals (r^2 = 0.910 and 0.998 respectively).

In view of the limited information on the availability of lysine in local protein concentrates for pigs, research is currently being undertaken in this field at Wollongbar. An initial experiment was designed to determine if total lysine values were satisfactory as an indicator of the lysine status of protein concentrates for pigs. Diets were formulated with each of the major protein concentrates as the sole protein concentrate in wheat-based diets. The diets were formulated to contain 0.6% lysine with half the lysine from the protein concentrate and the other half from the wheat base. The diet thus contained approximately 75% of the pigs' estimated lysine requirements (Agricultural Research Council 1967). If there was little difference in the availability of lysine in the protein concentrates then similar pig responses should have resulted. However, when the diets were fed to pigs, there was an overall 17% difference in the growth rates of the pigs. Fish meal, rapeseed meal, skim milk and soybean meal produced similar growth responses which were superior to cottonseed meal, meat meal, meat and bone meal and sunflower meal. Additional treatments verified that lysine was the first and major limiting amino acid in these diets. The

question then arose as to what variation in lysine availability was needed to produce the 17% difference in pig response. From associated experiments it was estimated that if the availability of lysine in fish meal, rapeseed meal, skim milk and soybean meal was taken as 100%, then the availability of lysine in cottonseed meal, meat meal, meat and bone meal and sunflower meal was approximately 50%.

The above experiment demonstrated that total lysine values were unsuitable as an indicator of the lysine status of protein concentrates for pigs. In order to more accurately define the available lysine content in these meals, the growth assay technique was applied to rats and pigs. With this technique the animals are fed diets containing pre-determined graded levels of lysine from the test pro-tein and the results are compared to the growth response obtained from diets containing similar levels of free lysine. This technique was chosen, as although it is time consuming and requires considerable numbers of animals, it is the only direct means of determining available lysine values applicable to a particular species (Carpenter and Booth 1973). Initially the growth assay was conducted with rats. Preliminary results of the rat growth assays on the protein concentrates fed in the pig experiment described earlier are presented in Table 1, together with the estimates from that pig experiment.

Table 1. Preliminary estimates of lysine availability in protein concentrates from pig and rat experiments

Protein concentrates	Estimates from pig experiments (%)	Estimates from rat growth assays (%)
Cottonseed meal	50	51
Fish meal	100	102
Meat meal	50	59
Meat and bone meal	50	63
Rapeseed meal*	100	
Skim milk	100	105
Soybean meal	100	111
Sunflower meal	50	42

* The rat growth assay with rapeseed meal was unsuccessful as the rats rejected the diets, presumably due to the bitter taste of the rapeseed meal.

The rat growth assays confirmed that the availability of lysine is a major problem in protein concentrates. The differences in lysine availability in both the pig and rat experiments are far greater than those published for Silcock estimates in these meals (Milner and Westgarth 1973; Taverner and Rayner 1975). In view of

these differences a growth assay for lysine with pigs is currently being developed. In initial trials, values of 105% and 68% have been obtained for rapeseed meal and sunflower meal respectively. Although the pig growth assays are time consuming and involve large scale experimentation, the results have direct application for use in least cost diet formulation for pigs. These assays can also supply reference values of lysine availability on which chemical and other techniques can be based.

If the pig growth assays confirm that lysine availability is a major problem in meat meals, meat and bone meals, cottonseed meals and sunflower meals then the results have considerable economic implications. Meat meals and meat and bone meals are the major source of protein concentrate used by the pig industry. Similarly cottonseed meal and sunflower meal form approximately two thirds of the current total vegetable protein concentrate production in Australia. There also appears to be considerable potential for the use of free lysine in this situation. If the availability of lysine in meat meal is approximately 50%, and with the current price of meat meal at $200/tonne, then the cost of available lysine is approximately $13/kg. In comparison, free lysine is currently $4-$5/kg. Even allowing for a 50% wastage of free lysine under once daily feeding (Batterham 1974) the price difference is still considerable.

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