The Nutritive Value of Palm Kernel Cake for Animal Feed

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INTRODUCTION

In Malaysia, most of the PKC produced are from expeller extraction. Though solvent extraction is also used in the extraction of palm kernel oil but the process is costly and screw press extraction (expeller) is the rule in many palm oil processing plants. The difference in the quality of expeller PKC and solvent extracted is small, although in general expeller PKC contains more oil (4%-8%) than solvent extracted PKC (1%-2%). In this paper, PKC refers to expeller palm kernel cake.

CHEMICAL COMPOSITION OF PKC

The proximate analyses of PKC showed that it can be classified as an energy feed (*Table 1*). This is because its protein content is only 16%-18%, which would exclude it as a protein feed. The chemical composition of PKC is very similar to that of corn gluten or rice bran. However, the protein content of PKC is considered sufficient to meet the requirements of most ruminants. To some extent, the protein level in PKC may also meet the requirement of certain classes of poultry, such as breeder and layer hens, provided that the limiting essential amino acids (namely, lysine, methionine) are supplemented.

The crude fibre content of PKC, ranging from 16%-18%, is acceptable to most ruminants, but is considered high for non-ruminants. It may not be suitable if included at high levels in poultry or pig diets. The shell content, which may reach as high as 10%, contributes a great deal to its high fibre content. However, PKC can be used as a filler to increase the bulkiness of the feed for non-ruminants, while providing some protein, energy, minerals and vitamins. The pig has a large caecum and, to a considerable extent, is able to digest the fibre in PKC. Analysis showed that more than 60% of PKC is cell wall components. The fibrous component is composed of mainly insoluble mannose-based polysaccharides (mannan). Jaafar and Jarvis (1992) showed that the cell wall consists of 58% mannan, 12% cellulose and 4% xylan. PKC appears to be more suitable for ruminants than for non-ruminants.

The metabolisable energy (ME) of PKC for ruminants is 10.5-11.0 MJ kg^{-1} which is considered suitable for most ruminants. PKC is commonly used as an energy source for both beef and dairy cattle. In fact, most local cattle feeds contain significant amounts of PKC. In some cases, PKC is included at 70%-80% for beef cattle depending on the costs of the other ingredients. Sheep and goat rations are also known to contain PKC but at a slightly lower rate. In poultry, the ME in PKC is rather low (6.5-75 MJ kg^{-1}). The ME for ducks also ranges from 7-8 MJ kg^{-1}. The ME for pig is higher than that for poultry (10-10.5 MJ kg^{-1}), but its intake may be depressed if the inclusion rate is higher than 30%.

PROTEIN AND AMINO ACID CONTENTS OF PKC

PKC is invaluable in supplying protein to ruminants. Nevertheless, poultry and pigs are also able to utilize its protein and other nutrients. The amino acid content of PKC is shown in *Table 2*. Lysine appears to be the first limiting amino acid, followed by the sulphur amino acids (methionine, cysteine) and tryptophan. Nwokolo *et al.* (1976) and Onwudike (1986) showed that the average availability of the amino acids in PKC was 85% which was lower than that in most oilseed meals. Yeong *et al.* (1981) reported that the amino acid availability for poultry ranged from 62%-87%. More recently, Mustafa *et al.* (2004) showed that the overall true available amino acids was 65%.

MINERAL CONTENTS OF PKC

The mineral contents of PKC are shown in *Table 3*. The contents of most of the common minerals are within the acceptable range.

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TABLE 1. PROXIMATE ANALYSIS (%) OF PALM KERNEL CAKE

Dry matter	88.0 – 94.5
Crude protein	14.5 – 19.6
Crude fibre	13.0 – 20.0
Ether extract	5.0 – 8.0
Ash	3.0 – 12.0
Nitrogen-free extract	46.7 – 58.8
Neutral detergent fibre	66.8 – 78.9
Metabolisable energy (MJ kg^{-1})	
Ruminants	10.5 – 11.5
Poultry	6.5 – 7.5
Swine	10.0 – 10.5

TABLE 2. AMINO ACID CONTENTS OF PALM KERNEL CAKE (g/16 g N)

Alanine	3.83
Arginine	11.56
Aspartic acid	3.63
Cystine	1.13
Glycine	4.17
Glutamic acid	16.80
Histidine	1.91
Isoleucine	3.22
Leucine	6.07
Lysine	2.68
Methionine	1.75
Phenylalanine	3.96
Proline	3.31
Serine	4.11
Threonine	2.75
Tyrosine	2.60
Valine	5.05

TABLE 3. MINERAL CONTENTS OF PALM KERNEL CAKE

Calcium (%)	0.21 – 0.34
Phosphorus (%)	0.48 – 0.71
Magnesium (%)	0.16 – 0.33
Potassium (%)	0.76 – 0.93
Sulphur (%)	0.19 – 0.23
Copper (ppm)	20.5 – 28.9
Zinc (ppm)	40.5 – 50.0
Iron (ppm)	835 – 6130
Manganese (ppm)	132 – 340
Molybdenum (ppm)	0.70 – 0.79
Selenium (ppm)	0.23 – 0.30

However, the ratio of calcium to phosphorus is low and diets based on PKC need to be supplemented with calcium to meet the requirements of most animals. The copper content of 21-28 ppm is higher than that required by ruminants. In fact, sheep fed diets containing PKC above 50% may suffer high accumulation of copper in the liver if fed too long and develop copper toxicity symptoms. Studies on the relationship between copper toxicity and the feeding of PKC to sheep have been conducted by many workers (Hair-Bejo *et al*., 1995; Alimon and Hair-Bejo, 1995). Malaysian indigenous sheep and their crosses were more susceptible to copper toxicity than exotic breeds. Al-Kirshi (2004) showed that Santa Innes hair sheep were more tolerant of copper than Malaysian indigenous sheep. In their studies, Santa Innes sheep fed PKC-based diets did not show physical symptoms of copper toxicity in spite of being fed for more than six months. The study also showed that both molybdenum and sulphur are effective in reducing the copper levels in the liver and kidneys of sheep fed PKC-based diets. Earlier, Hair-Bejo *et al*. (1995) showed that zinc sulphate can be used instead of molybdenum and sulphur. The iron content of PKC is also high but does not adversely affect the animal performance as most ruminants are able to regulate their iron absorption.

DIGESTIBILITY OF NUTRIENTS IN PKC

Table 4 shows the digestibility coefficient of nutrients in PKC by sheep and cattle. The digestibility values for ADF and NDF are much higher in cattle than in sheep, suggesting that sheep is less efficient than cattle in the digesting fibre. The digestible energy (ME) of PKC in sheep and cattle is similar to those of many feedstuffs of cereal origin. The ME for sheep (12.35 MJ kg^{-1}) appears to be much higher than that for cattle (10.96 MJ kg^{-1}) as reported by Wong and Wan Zahari (1997). In sheep fed PKC- based diets, Al-Kirshi (2004) showed that the apparent absorption of calcium, magnesium, iron, zinc and manganese were not significantly different between the diets but that these were significantly lower in PKC diets supplemented with molybdenum, molybedenum plus sulphur or zinc suggesting that these supplements are suitable for alleviating copper toxicity.

TABLE 4. DIGESTIBILITY COEFFICIENTS (%) OF THE NUTRIENTS IN PALM KERNEL CAKE

	Sheep	Cattle
Dry matter	70.00	75.80
Crude protein	-	77.60
Ether extract	91.0	83.6
Ash	-	66.9
NDF	52.0	76.0
ADF	53.0	73.1
DE (MJ kg^{-1})	15.06	13.37
ME (MJ kg^{-1})	12.35	10.96

Source: Wong and Wan Zahari (1997).

CONCLUSION

PKC will continue to play an important role in the feed industry in Malaysia. Its use in all types of livestock feed makes it one of the most flexible feed ingredients. With increased interest in research on PKC, the prospect of PKC becoming more important is bright. Farmers and feed millers in Malaysia can look forward to using PKC in all types of animal rations, thereby reducing the imports of conventional feedstuffs. Research on improving the nutritive value of PKC for poultry, especially through treatment with enzymes and solid state fermentation, will bring about new strategies in using PKC leading to a brighter future for both oil palm and the livestock sectors.

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