Feeding Trials in Malaysia: Palm Kernel Cake as a Feedstuff for Cattle

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INTRODUCTION

Palm kernel cake (PKC) is the solid residue left from the extraction of oil from palm kernel. The oil is extracted from the kernel by expeller, *i.e.* continuous screw press, or by solvent extraction. Solvent extraction is not commonly utilized anymore because of its high cost. As a result, almost all the PKC produced in this country is the expeller type. PKC is light to dark brown in colour and expeller PKC is usually darker than solvent extracted PKC.

PKC is a high value by-product of the oil palm industry and is potentially useful as an energy and protein source for feeding livestock, especially cattle. The only notable contaminant of concern in PKC used for feedstuffs is the palm shell, which has no nutritive value and is undigestable. Thus, high amounts of shell in PKC will reduce the efficiency of digestion.

PKC is generally used as an ingredient in compound feed for cattle and it can also be fed to cattle as a non-concentrate. A limited amount of PKC is also incorporated in the formulation of poultry and swine feed. There have been many studies based on feeding trials utilizing PKC as feed for livestock carried out by the various research institutions in the country and their outcomes have been favourable. Many trials showed that PKC can even be fed to cattle as the sole diet and that it gave good growth rates.

UTILIZATION

In a survey carried out in 1992 by the Department of Veterinary Services, Malaysia, 45% of dairy farmers fed PKC to their cows with an average consumption of 1.5 kg cow^{-1} day^{-1} (Birner, 1992). Similarly, it was also found that 78% of the farmers used dairy cattle pellets (DCP) and the average consumption was 1.8 kg cow^{-1} day^{-1}. As DCP contains about 40% PKC, the amount of PKC in 1.8 kg DCP was 0.72 kg. In 1999, there were a total of 13 474 heads of dairy cows. Assuming that there was no change in the habit of using PKC by the dairy farmers and that the number of animals were equally distributed, the total used for dairy cattle in 1999 was 6082 t. There were 20 000 heads of feedlot cattle in 1999 and if one feeder cattle consumed an average of 6 kg $head^{-1}$ day^{-1}, the total PKC utilized for feedlots was 43 800 t. Thus, the total PKC used for cattle feed in the country in 1999 was 49 882 t. As the total domestic consumption of PKC that year was 327 174 t, the remaining 277 292 t could have been used for formulation of pig and poultry feeds.

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NUTRITIVE VALUE

PKC is proven palatable to cattle and thus can be used for feeds. The nutrient content of PKC is shown in *Table 1*. Its high dry matter content ex-mill of above 90% is an advantage as it costs less to transport and can fulfil the requirement for dry matter intake for cattle. Cattle need to consume enough feed to meet their health and production requirements but feeds with high moisture contents will fill up the rumen and may not supply enough nutrients. Feed with low digestibility will give the same effect as the slowly digested or indigestible feed will remain in the rumen for a longer period of time and this would prevent further feed intake. However, this problem does not happen with PKC which has 70% dry matter digestibility. Cattle consuming 6 to 7 kg of PKC daily with minerals and vitamins were shown to produce growth rates of 0.7 - 1.0 kg $head^{-1}$ day^{-1} (Hutagalung, 1985). This shows that PKC is able to supply the correct amount of nutrient required by cattle.

The crude fibre of PKC, which ranges from 12% to 18 %, is relatively high compared to other oil cakes. However, the fibre length is short for normal ruminant digestion. Longer fibre is needed for stimulating the flow of saliva to dilute the rumen contents which then neutralize the acids produced by fermentation and accelerate outflow of the rumen contents to

TABLE 1. NUTRIENT CONTENTS OF PKC

	Types of PKC	
	Expeller	Solvent extracted
Dry matter (%)	90.0 - 91.8	88.2 - 90.7
Crude protein (%)	15.3 - 17.9	16.8 - 17.3
Crude fibre (%)	11.7 - 15.0	13.6 - 16.7
Ether extract (%)	3.4 - 8.9	3.4 - 5.3
Ash (%)	4.8 - 5.0	3.9 - 4.8
Nitrogen free extract (%)	55.8 - 62.2	58.3 - 59.9
Total digestable nutrient (%)	65.4 - 67.0	67.1 - 73.2
Metabolizable energy (MJ kg^{-1})	9.80 - 10.14	10.16 - 11.15
Calcium (%)	0.2	0.21 - 0.25
Phosporous (%)	0.52 - 0.63	0.61 - 0.65

Source: Technical guidebook for cattle feeding for use by department farms and farmers. *Feed Technical Report No. 2.* Department of Veterinary Services Publication.

the abomasum. Cattle fed with PKC supplemented with sodium bicarbonate showed better performance as compared to those without the supplement (Yusof Hamali and Mohd Shukri, 1993).

The metabolizable energy of PKC is above 10 MJ kg^{-1} dry matter which can be considered as high for cattle. The dry matter intake of PKC for various types of cattle will be able to supply their energy requirement as shown in *Feed Technical Report No. 2* prepared by the Department of Veterinary Services, Malaysia. The protein content of PKC which ranges from 15% to 18% is adequate to provide the nutrient requirements for cattle. The calcium and phosphorous contents of PKC are adequate for beef cattle fattening but not enough for high producing dairy cattle. Feeding of PKC as a sole feed also needs supplementation with minerals and vitamins, especially vitamin A.

The Malaysian standard for PKC as animal feed, MS 607:1987, as shown in *Table 2* can be easily followed by the millers. In the case of ether extract, millers are now able to obtain values as low as 3.4% for expeller which was not possible before. This could be due to improvement in the effectiveness of oil extraction.

PKC AS FEED FOR BEEF PRODUCTION

It was suggested that Malaysia should produce prime beef by using 100% PKC as feed (Davis and Zainur, 1995). The suggestion was made based on the technical feasibility shown by many feeding trials carried out since the early eighties. In reality, with the retail price of PKC ex-farm at RM 260 to RM 280 t^{-1}, the most viable amount for fattening cattle for slaughter is to use only between 20% to 30% of PKC in the diet as practiced by the biggest feedlot operator in the country (Rosli, pers. comm.).

Other sources of cheaper feed ingredients such as pineapple waste, rice bran, soyabean waste, wheat pollard, brewers grain, sago waste and soyabean hulls can be utilized for lower cost formulations. The least cost ration has to be formulated using the above ingredients to fatten imported Brahman crosses which can achieve the most profitable daily weight gain of 1.3 kg.

For the fattening of bull calves (produced by cows in integrated oil palm plantations), feeding 2.5 kg $head^{-1}day^{-1}$ of PKC with chopped palm fronds *ad libitum* resulted in an average daily weight gain 0.25 to 0.3 kg $head^{-1}$ day^{-1}. Similar results were observed for calves from the same source which were allowed to graze in a mature oil palm plantation and fed with 1 kg $head^{-1}$ day^{-1} of PKC (Razali, pers. comm.). Other than the price of PKC, the quality of beef cattle to be fattened plays an important role in deciding on the use of PKC as feed for fattening cattle. The quality of calves harvested for fattening from the integrated projects can be improved if post-weaning stress is under control. It was observed that supplementation of 0.5 kg $head^{-1}$ day^{-1} of PKC to calves immediately after separation from their dams for eight weeks was sufficient to overcome post-weaning stress and this was reflected in a higher weight gain (Azizan *et al.*, 1989).

Other than the good weaning performance, the quality of the herds of origin of feeder calves has to be improved to allow for the production of quality animals for fattening. Currently, imported feeder cattle from Australia are the better choice for large-scale feedlotters. This is due to the possibility of obtaining large numbers of feeder cattle at one time. The consistent weight gain and better performance when fed with PKC encourages the utilization of imported cattle for fattening.

TABLE 2. MALAYSIAN STANDARD FOR PKC AS ANIMAL FEED MS 607:1987

Item	Property	PKC	
		'as is'	dry basis
a.	Moisture, % by weight, max.	12.0	0.0
b.	Crude protein, % by weight, min.	13.0	14.8
c.	Ether extract, % by weight, max.	10.0	11.4
d.	Crude fibre, % by weight, max.	18.0	20.4
e.	Total ash, by weight, max.	5.0	5.7
f.	Aflatoxin, max.	N.D	N.D

Note: N.D. - not detectable.

The current estimated cost of production of feedlot cattle based on imported Brahman crosses is shown in *Table 3*. The gross margin per head obtained was RM 235 for six months rearing or RM 39.17 head^{-1} mth^{-1}. The gross margin obtained for small feedlots with 20 heads of feeder cattle as shown in the Department of Veterinary Services' Homepage was RM 23.38 head^{-1} mth^{-1} at a PKC price of RM 250 t^{-1} and purchase price of feeder cattle at RM 3 kg^{-1} live weight. With the price of PKC at RM 210 and the price of feeder cattle at RM 3.40 kg^{-1} live weight, the gross margin obtained was RM 15.82 head^{-1} mth^{-1} (Yusof Hamali, 1988).

There is enough PKC available in the country for feedlotting. It was estimated that to be self sufficient in beef, the feedlots require only 683 000 t of PKC a year (Davis and Zainur, 1995). Despite the abundant supply of PKC, the development of cattle feedlots in the country is slow and not able to produce enough meat for local consumption. The cost of production of local beef is far above the price of cheaper imported beef from India. The cost of production can be reduced by having big scale enterprises, for example 10 000 heads of feeder cattle managed intensively by the use of machines and automation. The very high investment cost, together with the high risk of the business, detracts entrepreneurs from investing in the feedlot industry.

TABLE 3. THE COST OF PRODUCTION FOR ONE HEAD OF CATTLE BASED ON FEEDLOT WITH A CAPACITY OF 100 HEADS

Assumptions		
1. Initial weight of feeder cattle	=	200 kg.
2. Finished weight	=	350 kg.
3. Average daily weight gain	=	0.83 kg.
3. Cost of feeder cattle	=	RM 4.90 kg^{-1} live weight.
4. Rearing period	=	six months.
5. Feed based on PKC	=	RM 0.26 kg^{-1}, 6 kg head^{-1}day^{-1}.
6. Mortality percentages	=	2%.
Output		
350 kg less 2%	=	343 kg @ RM 5 kg live weight.
	=	RM 1 715.
Operational Costs		
1. Variable costs		RM
Feeder cattle	=	980
PKC + vitamins + salt	=	394
Medicines and veterinary	=	4
Labour	=	30
Petroleum and oil	=	10
Repair and maintenance	=	12
Utility	=	8
Administration	=	8
Others	=	17
2. Depreciation cost for assets	=	10
3. Interest costs on investment @10%	=	7
Total cost	=	1 480
Estimated Cost of Production		
1. Cost head^{-1}	=	1 480
2. Cost kg^{-1} live weight	=	4.23
3. Cost kg^{-1} meat (33% of live weight)	=	12.81
Gross margin head^{-1}	=	235
Gross margin head^{-1} mth^{-1}	=	39.17

PKC AS FEED FOR DAIRY PRODUCTION

PKC could be utilized efficiently for feeding dairy cattle to give optimal output. Dairy cows fed on PKC produce as much milk as those fed on DCP. Supplementation of concentrate feed with 60% PKC increases milk production by 55% as compared to cows without supplement (Wong *et al.*, 1987). Dairy farmers in this country have used PKC as a supplement for dairy cattle.

The efficiency of dairy cows in utilizing PKC is comparable to their efficiency in utilizing concentrate supplement. After meeting its maintenance requirements, a cow is able to convert 1 kg of PKC to 2 litres of milk (Birner, 1992). This is a viable option since 2 kg of PKC cost only RM 0.54 and a litre of milk is sold at RM 1.50.

PKC is able to supply enough energy when fed solely to growing dairy heifers (Md Yusof, 1985). Dairy farmers are known to feed PKC to their calves and heifers. As a sole supplementary feed, PKC is able to provide the nutrients required for milk production although the calcium and phosphorus contents are not enough. A mineral mix containing the correct amounts of the elements has to be incorporated.

CONCLUSION

PKC has tremendous scope for feeding cattle in this country. The local demand for PKC for cattle feed is however small. The local ruminants sector is not well developed, perhaps due to the high investment cost and slow returns from investment. The low input and low output system practiced by ruminant farmers also contributes to the small amount of local

consumption of PKC. Imported beef and milk products are relatively cheaper. It was calculated that to produce 1 kg beef from PKC in 1991, the cost was RM 3.36 while imported meat price at that time was RM 4.09 (Davis and Zainur, 1995). The current cost to produce 1 kg beef from PKC is RM 12.81 while the retail price of imported beef from India ranges from RM 6 to RM 8 kg^{-1}.

In order for PKC to be used as a local feed source, the above situations have to be corrected. Ruminant production has to be attractive enough to attract investors. Ruminant farming has to be highly commercialized with a substantial number of cattle to reduce overhead costs. The feedlot and dairy industries have to be economically viable with the application of new technologies and systems of farming.

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