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AGRICULTURAL BY-PRODUCTS AND POULTRY NUTRITION IN MALAYSIA

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Introduction

The poultry industry is a fast growing industry in Malaysia. The production of poultry meat is 720,000 mt in 2001 and is on the increase. Per capita consumption of poultry meat has increased from 24.5 kg in 1994, to about 32kg in 2001. World wide, there has been an increase in the production of poultry meat and eggs, especially after the recent problems associated with the decrease consumption of beef as a result of BSE in Europe. Like many other enterprises, the poultry industry is changing and constantly evolving to become more efficient than before. Birds are kept in controlled housing so that uniform growth and increased performance can be achieved. In Malaysia, more and more farmers are changing their poultry housing system from open houses to closed houses. The public demand for stricter environment controls and cleaner and non-polluting poultry farms need not be further emphasized. Animal welfare is also becoming an important issue especially in the western world. In Europe, public outcry regarding chickens kept in battery cages has long been an issue. More and more of the European population are in favour of chickens raised on the range or aviary type of housing system. The consumers perception of quality poultry does not only include taste, nutritive and convenience but also extend to production methods and animal welfare. The consumers are also increasingly aware of food safety and hygiene and also their traceability.

Feedstuffs for Poultry in Malaysia

In general, about 70 % of the costs of poultry production is due to feed costs. Increases in feed costs would mean decreased profit margin. Good formulations will be reflected in the production performance of poultry. High FCR (feed conversion ratio) is dependent not only on the genetic factors within the birds but also on the quality of feed formulations. In Malaysia, the major feed ingredients used in poultry rations are largely imported. These include maize (corn), soya bean meal, fish meal, lucerne meal, corn gluten meal, dicalcium phosphate (DCP), and wheat by-products. Rice bran is commonly included in poultry diets but its inclusion rates vary between 5 –15 %. While a certain amount of rice bran is produced locally more than 70% of that required is imported from neighbouring countries. Attempts have been made to

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replace imported feedstuffs by locally available agricultural by-products such as broken rice, brewers grain, palm kernel meal, palm oil sludge, sago meal, copra cake, etc. Except for PKM, the other feed ingredients are not produced in large quantities, and are confined to certain locality and/or seasonal in supply (Table 1).

Table 1. Feedstuffs used in poultry diets in Malaysia

Locally produced	Imported
Rice bran	maize
Wheat pollard	skimmed milk powder
Wheat bran	fishmeal
Limestone	DCP/MCP
Palm kernel meal	meat and bone meal
Molasses	sesame cake
Brewers grain	vitamCorn gluten meal
	Rapeseed meal
	Feather meal

Although many experiments conducted by various institutes and agencies showed that, to a large extent, there have been positive responses to use these by-products as feed for poultry, the feed milling sector is reluctant to adopt the findings primarily because of supply and variability in quality. Also the increasing demand for feed formulations that are established and well accepted in terms of availability and performance to meet the requirements of new improved breeds of poultry. New strains of chickens, which are fast growing and more efficient converters of feed are in the market and subsequently require highly digestible feed which are also less variable in quality and easily available. Furthermore, the desired uniformity in the flock requires that the birds are fed feed that are of high quality and less variability in the nutrient content to achieve optimum growth and production. Nevertheless, agricultural by-products have a role to play in some sectors of the poultry industry. In village farming system or in smallholder type of farming the use of local agricultural by-products may contribute towards the lower costs of production, even though at the same time it takes longer period to raise the chickens to marketable age.

Agricultural by-Products and Poultry

Malaysia is the world's largest producer of palm oil (*Elaeis guineensis*) and as such produces large quantities of by-products, both at farm level and at factory level. At the farm level most of the by-products are fibrous in nature, such as oil palm

fronds, oil palm trunks, and are only suitable as feed for ruminants. At the factory level, both fibrous and not so fibrous by-products are produced. For example, the fibrous by-products include palm pressed fibre, empty fruit bunches, while the not so fibrous include palm kernel meal (PKM), and palm oil sludge. Other by-products of the oil refining process include palm fatty acid distillates (PFAD), glycerol, stearin, olein etc. The latter by-products are more valued and used in cosmetics and also as an energy sources for both ruminants and non-ruminants. Studies are underway on the utilization of palm oil and calcium stearate and other by-products for both ruminants and non-ruminants. Research results have shown that these products are potentially useful as energy source for poultry.

Palm Kernel Meal (PKM)

The use of PKM, also known as palm kernel cake, in livestock and poultry diets has long been researched in Malaysia. PKM is a by-product of the oil palm industry and is obtained after oil is extracted from the kernel of the fruit. Malaysia produces about 2.0 million tonnes of PKM, annually. A large portion of the PKM produced in Malaysia is exported to Europe and other countries, while that used locally are mainly used for feeding cattle. It is noteworthy that PKM exported to Europe are used in formulations for dairy and beef cattle. The level of inclusion of PKM in these rations is about 5-10 %. In Malaysia, PKM is used primarily in beef cattle and dairy cattle rations, quite frequently at levels higher than 50%. PKM is an excellent energy source for ruminants. Studies by Wong and Wan Zahari (1997) showed that the ME of PKM ranged from 10.0 to 11.5 MJ/kg for ruminants, while that for poultry 6.5 - 7.5 MJ/kg (Chong et al, 1998). The ME value is related to the oil content of the PKM. The lower value for non ruminants is attributed to its high crude fibre content which is not utilized by the non ruminant. The nutrient composition of PKM is as shown in Table 2. Its protein content of about 16-18% may be suitable for both ruminants and non ruminants. Among the attributes of PKM are that it is easily available in Malaysia, contains no known anti-nutritive factors, highly digestible and do not contain heavy metals.

Table 2. The nutrient compositon of palm kernel meal

Crude Protein	92.0
Crude fibre	16-18
Ether extract	16
Calcium	4-6
Dry matter	0.25
Phosphorus	0.78
ME MJ/kg (ruminants)	10.5
(poultry)	7.5

Yeong (1981) conducted several studies on the utilisation of PKM using day old chicks up to 7 weeks of age. These early studies suggest that PKM can be included at levels of 10-15 % in the diet without showing a reduction in performance. However, in a more recent study, Alimon et al, (1998) showed that PKM can be included in broiler grower-finisher rations (15 – 42 days of age) at a level of up to 25 % without significant differences in their performance and live weight gains. In this study the birds were given a commercial starter ration for two weeks followed by a diet containing various levels of PKM for 4 weeks after which they were slaughtered. This finding is supported by other studies conducted in Nigeria (Onwudike, 1988; Nwokolo et al, 1977; Onifade and Babatunde, 1998). The high fibre content (16-18%) in PKM was thought to be the constraints in using PKM at high levels in the diet. In a number of studies conducted it was shown that muscovy ducks can tolerate PKM even at 30 %. Mustafa et al (2001) showed that PKM can be a suitable source of energy for both growing and finishing ducks. The metabolisable energy of PKM was found to be similar to that of poultry which was about 7.5 MJ/kg.

In the last few years there has been increasing interest in the methods of enhancing the utilization of PKM for poultry through biological and enzymic treatments. The use of enzymes such as xylanase, mannase, cellulase has been tested on many feed ingredients such as barley, rye, wheat, oats and corn with the main objective of reducing the structural fibre content and increasing the availability of carbohydrates (Marquardt *et al*, 1996). Yahya et al (2000) included Hemicell, a mixture which contained b-mannase, in broiler rations with 10 – 15 % PKM and showed satisfactory growth and improved FCR when compared to birds without the enzyme preparation. PKM contains at least 60% non starch polysaccharides, of which the majority is linear mannans which are difficult to cleave at the b-1-4 linkages by enzymes. Daud et al (1997) treated PKM with glycanases and obtained inconsistent results.

Table 3. The effect of feeding PKM fermented with Rhizopus spp on the performance of broiler chickens (from15d –42 days of age)

SEM	Diet 1	Diet 2	Diet 3	Diet 4	
	Control	10%PKC	15%PKC	20%PKC	
Final LW (42 days, g)	1559	1513	1591	1513	19.1
Weight gain (g/bird)	858	813	889	830	16.7
Feed intact (g/bird)	2175	2219	2267	2179	21.8
FCR	2.54	2.74	2.56	2.69	0.04

From: Ismail (2001)

The application of solid state fermentation using various strains of fungus such as *Aspergillus niger, Rhizopus spp* has been shown to increase the protein content

and at the same time lower the fibre content of PKM. Studies by Swe et al (2002) showed that *Aspergillus spp* improved the availability of energy in PKM. The increase in crude protein was attributed to the increase in cell mass of the *Aspergillus* due to increased mycelial growth. It was also noted that the crude protein content of PKM can also be increased by 15-20% through fermentation with *Rhizopus oligosporus* (Ismail, 2001). In his study Ismail (2001) showed that replacement of maize with PKM in broiler diets did not significantly affect growth and performance of broilers (Table 3). Iyayi (2002) showed that the ME of PKM fermented with *Trichoderma viride* for 10 days increased by 13% when fed to layer.

Palm Oil and Palm Oil by- Products

The major product of the oil palm industry is palm oil. Crude palm oil (CPO) is extracted from the mesocarp of the palm fruit while palm kenel oil (PKO) is extracted from the kernel of the fruit. Traditionally, in feed formulations, soyabean oil is used at levels of 3-5 % to increase the energy content also to reduce dustiness in poultry feeds. In Malaysia crude palm oil is frequently used in rations formulations at similar levels although sometimes levels of up to 8.0 % have also been used. In experiments a level of up to 10% has been used to compensate the decrease in energy when PKM meal is added at levels of up to 30% (Wihandoyo et al, 2000). Adding palm oil also improves the texture of the feed to make it less powdery or dusty and easier to pelletize. Malaysian crude palm oil has a metabolisable energy (ME) of about 38MJ/kg. Hydrogenated palm oil has also been used as animal feed. The process of hydrogenation converts palm oil into a solid form and is easily transported, stored and mixed in feed.

Rice by-Products

A comprehensive study on the utilisation of rice bran has been conducted by Ukil et al (1999). Traditionally rice bran is included in poultry rations at levels of 10-15 %. The anti-nutritive factor in rice bran is mainly the phytic acid which reduces the availability of phosphorus. In his study Ukil *et al* (1999) showed that broiler rations can contain 20-25 % rice bran with added phytase, without affecting the growth performance and FCR. The concern about deposition of phosphorus into the soil and waterways led to the study on the utilisation of phytase to improve P utilisation and hence reduced excretion of P in the faeces. In several studies it has been shown that the addition of phytase improved the utilisation of organic P and other nutrients (Newkirk and Classen, 2001; Ahmad *et al*, 2000; Ukil *et al*, 1999; Yi *et al.*, 1996).

A more recent study Abd Khalid et al (2002) included replaced unpolished rice in broiler ration and obtained FCR values of 1.65 over a 5 weeks growing period. Adding Lucerne leaf meal improved the pigmentation but with a slightly reduced

FCR. However, adding carophyll improved the pigment without affect the FCR. In another study, Abd. Khalid et al (2001) showed that total replacement of maize with unpolished rice did not affect the growth performance and FCR of village (kampung) chickens.

Poultry Nutrition and Novel Products

The development of novel foods from chicken is gaining interest within the poultry producers. Research on the use of specific oils in attempts to reduce the cholesterol levels in poultry meat and eggs are on the increase. Consumers are in for the omega 3 eggs even though they may have to pay slightly high. Adverts and promotions regarding the benefits of omega 3 egg have slowly but consistently encouraged more and more to start purchasing these eggs.

Probiotics and Prebiotics

A general ban on the use of antibiotics as antimicrobial growth promoters in animal nutrition has led to the search for other additives that can act in a similar manner as antibiotics, acts as growth promoters and improve performance. Pro- and prebiotics have beneficial effects on microflora within the gastro-intestinal tract but do not result in residues in meat or other products. Probiotics are viable microorganisms used as feed additives which lead to beneficial effects to the hosts. In the EU, 19 microorganisms preparation are authorized, but only 7 are widely used for poultry. These organisms belong to the *Enterococcus, Bacillus* and *Pediococcus* groups. In general the effects of probiotics include improved weight gains and feed conversion efficiency. The mechanism of action of probiotics is still not clear but it is known that probiotics of different origin acts different ways, e.g. *Bacillus* spores or *Enterococcus*, their impact are usually on the pathogenic and non-pathogenic bacteria in the digestive tract. Also the effects of metabolites or metabolic products of bacteria e.g. lactic acid, or pH. In Malaysia, studies by Kalavathy et al (2002) and Sieo et al (2002) using *Lactobacillus spp* cultures improved performance of layer and broiler chickens.

Prebiotics are non-digestible carbohydrates of feed which selectively stimulates growth and metabolic activity of a limited number of intestinal bacteria thought to be beneficial to the host. Prebiotics should be (1) neither be hydrolysed nor absorbed by endogenous system in the gastro-intestinal tract (2) selectively utilized by desired intestinal bacteria e.g. *Lactobacillus* and *Bifidobacillus* (3) improve the performance and health status of animals. Mannanoligosaccharides (MOS) have the properties of modifying the intestinal microflora, reducing the turnover of rate of the intestinal tract and modulation of the immune system in the intestinal lumen. These properties have the potential to enhance growth rate, feed conversion efficiency and livability in poultry. Results of experiments showed that addition of MOS generally improved

growth performance and feed conversion rate (Peterson and Villadsen, 2002; Wilson and Kenyon, 2002; Parks et al, 2002).

Exogenous Enzymes

The use of enzymes such as phytase, optizyme and cell wall degrading enzymes and phospho lipase in cereal based diets showed that enzymes can be useful in increasing the bioavailability of feed nutrient (Attia et al, 2002). These enzymes improve the utilization of nutrients for example phytase improves the availability of phosphorus bound to phytic acid. Other enzymes used in poultry ration include xylanase, mannanase, cellulase (Mathlouthi et al, 2002). Proteases, alpha-galactosidase have also been used. The mechanism of action is still not clear but it is thought that these enzymes either act on the specific nutrient directly or are active within the gut to act on by-products of digestion.

Herbs and Botanicals

Wenk (2002) conducted several experiments on the use of tumeric in poultry rations to replace the function of antibiotics which are traditionally included as growth promoters. In a review he suggested that in the future increased utilization of herbs and biologicals to replace antibiotics and other drugs (eg anthelminthics, coccidiostats, etc) that are harmful to humans. Other herbs that can be used include garlic, rosemary and sage. Herbs and botanicals are known to stimulate appetite and endogenous secretions or have antimicrobial, coccidiostatic or anthelmintic activities. Herbs and their metabolites are known to have anti-inflammatory and antioxidative properties. These metabolites belong to isoprene derivatives, flavanoids and glucosinolates and a large number are known to act as antibiotics (Wenk, 2002). While not much work has been done on this aspects the studies conducted so far indicated that there are many potential herbs and plants that can be used not only to replace antibiotics but may also act as growth promotants.

Poultry Nutrition and the Environment

Zeolites are clay like compounds and are used in many industrial applications such water filteration, soil improvement. In recent years zeolites are added in diets of animals to improve feed utilisation and also reduce the ammonia production from faeces. It has been shown to be very useful in reducing the ammonia content in the faecal matter of layer and broilers. Wihandoyo et al (2001) showed that adding 5 % zeolite reduced the ammonia production in poultry manure by almost 50%. The moisture content of faecal matter was also reduced hence reduced fly population and

also maggots. Sprinkling zeolite directly to the manure also showed positive results. Bentonite which was thought to behave like zeolites has also been tested. Studies by Alimon and Wihandoyo (2002) suggests that in certain aspects the characteristics of bentonite can be similar to that of zeolites although it appears that zeolite is superior to bentonite in controlling misture content of faeces.

Conclusion

Poultry production whether in Malaysia or other parts of the world is a complex industry. This is especially true when consumers become more aware of the quality and source of poultry products that they are consuming. With the recent BSE incidence in Europe, it appears that the demand for poultry products will be on the increase. Health and hygiene are main factors that determine the choice by consumers. Also are factors such as animal welfare, whether at the farm house or during transportation, the use of antibiotics and other additives. Nutrition plays an important role in the welfare of poultry. Nutrition does not only provide the nutrients required by the birds, but feeding practices and its association with housing and management, the use of biologicals and herbs will dominate future research. The environment at which the farm houses are located need to be preserved. The use of zeolite and bentonite may be feasible to reduce ammonia emissions and odour. Heat stress in poultry in tropical countries can be reduced by nutritional manipulations. For example, addition of PKM to poultry ration appears to reduce heat stress among broiler chickens. Addition of palm oil and also changing feeding regimes may also reduce heat stress and mortality.

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