Palm-Based Animal Feed and MPOB's Energy and Protein Centre

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INTRODUCTION

Malaysia imported well over 2 million tonnes per annum of energy feed as corn in the last three years and another 1 million tonnes of protein supplement, mainly soyabean and fish meal. Well over 200 000 t of crude palm oil (CPO) were used in livestock feed. These feeds are essential items in the formulation of compound feed or ration for commercial livestock. Oil palm and palm oil industries provide several products and by-products which are suitable to be used as animal feed. They are available from the plantation, milling, crushing and refining. Livestock feed from palm products presents an excellent opportunity for replacing imported feed. Also it can be exported to regional and international markets.

FEEDS FROM THE PLANTATION

The plantation sector provides feeds that are high in fibre. Pruned oil palm fronds (OPF), oil palm trunks at replanting and forage growing under the oil palm provide cheap sources of energy to ruminant animals and, most importantly, these resources are renewable. In 2003, the total planted area in Malaysia was 3.802 million hectares of which 3.303 million hectares were mature and 0.499 million hectares immature oil palm (MPOB, 2004). Thus, the supply and availability of roughage from the oil palm and undergrowth in oil palm plantations are plentiful. They are available throughout the year, especially the palm fronds pruned during harvesting of the fruit bunches. Oil palm roughage from palm trunks and fronds are also available in large quantities during replanting. Under normal practice, two fronds are pruned per palm every month. This practice yields 24 fronds palm^{-1} yr^{-1}. There are 136 palms ha^{-1}. As such, 3264 pruned fronds are available per year per hectare. They can be freshly chopped and preserved as frond silage (Abu Hassan and Ishida, 1991) or chopped, dried and pelleted (Abu Hassan, 1996). They are most suitable for feeding beef and dairy cattle, sheep, goats, and even ostrich and deer. Other nutrients should be properly balanced in the formulation of a complete ration using palm fronds. Supplementation with other nutrients will ensure best performance in the production of beef or milk. Preliminary data show that Anglo Brahman feeder cattle fed on a ration containing 40% fresh chopped palm fronds gained 1 kg of live weight per day. The group fed with a ration containing 80% green chopped palm fronds gained 0.5 kg day^{-1}.

Palm leaf pellet is another valuable feed item, which furnishes quality fibre for equine feed. Abu Hassan (1996) reported that OPF pellets produced at the Malaysian Agricultural Research and Development Institute (MARDI) were utilized by the Malaysian Racing Association to replace oat chaff in horse ration. It also contains a significant quantity of vitamin E, which is known as an antioxidant and increases the male fertility, and female reproductive performance of equine animals.

FEEDS FROM PALM OIL MILL

The palm oil mill provides, among other products, empty fruit bunches (EFB) and CPO. About 2.9 million tonnes/year of EFB dry matter were available in 2001-2003 (Kamaruddin *et al.,* 1997). However, the EFB has limited use in ruminant feed as it has to be used with other feed ingredients to provide adequate and balanced nutrients to livestock. As a rule of thumb, the product is limited to 30% of the total ration of cattle. Slightly higher amounts may be used after treatment.

Another major product from the palm oil mill, which is most suitable for animal feed and an established feed ingredient in local poultry and pig rations, is CPO. The supply of CPO is plentiful (13.4 million tonnes in 2003 – MPOB) but only a small percentage is used as added fat in poultry and pig rations.

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Addition of up to 3% CPO in poultry and pig rations is a well-known practice among feed millers. Some may use slightly more if the price of CPO is competitive relative to other energy feeds. At higher than 3% CPO, the formulated feed is difficult to pelletise, especially at 5%-6% CPO. Thus, the room to use more CPO in livestock ration is limited due to this technical factor.

Annually, Malaysian livestock producers use about 123 000 t of CPO to produce 4.1 million tonnes of poultry and pig rations. Though feed millers use CPO as an energy source, it also contains significant amounts of natural antioxidants such as carotenes and vitamin E which help the feed quality from deteriorating during storage. Furthermore, carotenes enhances the skin colour of broilers while vitamin E increases the fertility and enhances the reproductive performance in chicken and pig for breeding. Adding fat to the ration also helps reduce the dustiness of the feed.

FEEDS FROM CRUSHING PLANTS

Palm kernel cake (PKC) is a popular ingredient for animal feed. It contains 16% crude protein and all the nine essential amino acids for monogastric animals. The availability of those amino acids is high and comparable to that of rice bran. The major fibre component of PKC is galacto-mannan (Daud *et al*., 1997). PKC is most suitable as beef and dairy feed.

Malaysia produced 1.91 million tonnes of PKC in 2003 of which more than 90% was exported to Germany, Netherlands and other countries in the European Union. In Germany and Netherlands, PKC is used as one of common ingredients in dairy ration (about 10%). Malaysian dairy farmers use more than 50% PKC in their ration. Shamsudin *et al.* (1997) formulated a supplemental concentrate with 50% PKC + 30% corn + 15% soyabean meal + 3% fish meal + 2% vitamin and mineral premix fed to Fresian-Sahiwal dairy cows at 4 and 8 kg head^{-1} day^{-1}. The average daily milk yield increased with the concentrate use to 1192 kg and 1396 kg/120 days/ lactation respectively.

Research is now focussing on using PKC in poultry feed. Unfortunately, the galacto-mannan is difficult for monogastric animals to digest. Mannan *per se* has low digestibility. Daud *et al.* (1997) treated PKC with an enzyme to increase its energy and protein bioavailability to poultry and pigs. Yeong *et al*. (1991) and Raghavan (1997) carried out several trials using PKC in starter and finisher rations at 10%-40%. Broiler performance in daily weight gain and feed efficiency was comparable to that from a straight corn-soya ration as the control. PKC is a sound feed for inclusion in broiler or layer ration and can be a cheap source of feed ingredient to livestock producers.

FEEDS FROM REFINING

Palm fatty acid distillate (PFAD) and palm kernel fatty acids distillate (PKFAD) are the major animal feed products from refining. The latter is less available since the volume of palm kernel oil (PKO) produced is small.

Production of Malaysian PFAD is directly related to the refining of CPO. On an average, the free fatty acid (FFA) content of Malaysian CPO is 3.7%. Therefore, the annual production of Malaysian PFAD should not be far from 3.7% of the total production of CPO. In 2003, the production of PFAD was 501 862 t.

Three feed products are available from PFAD. They are raw PFAD (RPFAD), calcium soap of PFAD (CSPFAD) and hydrogenated PFAD (HPFAD). RPFAD is an excellent source of energy and is included in poultry ration. Feed pellets are sprayed with liquid PFAD on exit from the extruder. Malaysia and Southeast Asian feed millers are increasingly using straight PFAD to totally replace CPO in poultry ration. This is an intelligent effort as CPO is more expensive.

The calcium soap of PFAD is a high energy feed and a most popular supplement to high producing dairy cows (Palmquist and Jenkins, 1980). It is the most effective energy supplement. PFAD has to be processed and converted to CSPFAD. The commercial process is patented and available from the patent holder. Limited numbers of manufacturers produce and market this product.

HPFAD is a new generation of high energy feed supplement produced by Malaysian manufacturers. The product comes in flake or other forms. The size and looseness of the product are the most significant factors determining its feeding value. A smaller and very loose or friable product enhances exposure to the digestive system, hence improving digestion. A compact and bigger size product tends to be less digestible and has a lower feeding value. Currently, several refineries produce HPFAD as high energy feed supplement for livestock.

ENERGY AND PROTEIN CENTRE

To further harness the potential of palm-based feeds, MPOB has established the Energy and Protein Centre (EPC). The centre is entrusted to find a technical solution, formula and feasible practice for utilizing and incorporating more total palm fat energy in commercial livestock feed, which would enhance the competitiveness of Malaysian palm oil and complement Malaysian livestock production. A higher fat energy would reduce heat stress and improve feed efficiency and growth performance of broiler chicken, especially in humid tropical climates. EPC is equipped with the current technology for rearing chicken.

Energy and Protein Laboratory

The EPC laboratory (*Figure 1*) is fully equipped with the latest analytical equipment and efforts are being made to certify the laboratory with ISO 9000 and accredit it for feed analysis. EPC adopts chemical-free analyses wherever possible. The analytical services available at this laboratory are for proximate composition, amino acids, fatty acids, simple sugars, gross energy, acid detergent fibre and neutral detergent fibre, total fibre, minor and major elements. Crude protein and other extract analysis is done via a chemical-free technique. The laboratory is equipped with among other things, a Waters 1525 Binary HPLC Pump with 2475 Multi Fluoresence Detector and 2414 Refrective Index Detector, GC, IKA C5000 Bomb Calorimeter to carry the analyses. EPC is planning to purchase a dedicated amino acids analyses at a later stage.

Figure 1. EPC laboratory.

Climates Control Houses (CCH)

The CCH are especially dedicated to commercial feeding trials of palm products as energy and protein supplements for broiler and layer chicken. These houses are fully automated to regulate and stabilize the temperature, lighting, feeding time and feeding sequence, and record the feed and water consumption, weight gain and air flow. They are fully fitted with CCTV, accessible to the operators and researchers through a PC at the main office and a modem at MPOB Headquarters in Bandar Baru Bangi.

CCH Broiler

Broilers are kept in a cage system of three tiers and three rows. In every tier, there are 18 cages, each capable of accommodating a total of 30 birds with a maximum weight of 60 kg. The birds are fed by a mobile feeder auger system. Loading of the feed and feeding frequency are pre-determined by input through a computer. The system will regulate the optimum feeding time and frequency for the best growth. There are 18 cages per tier and three tiers per row and three rows per CCH. Each CCH can accommodate 4860 birds. The EPC has two CCH for broiler feeding trials. The capacity of the two CCH is 9720 birds.

Feeding trials in the CCH for broilers can evaluate three types of diets/rations. There are three silos with a holding capacity of 3 t of feed per silo (*Figure 2*). The feed is transported to every tier of the cages via a spiral auger in a fully automatic feeding system. The amount of feed transported, feeding timing and amount of feed consumed are fully monitored via a management feeding programme set by the manufacturer. The system allows up-to-date close monitoring of the feed and water consumption. The feeding management programme and CCH programme adopted are the best tools available at EPC-MPOB to effectively evaluate the trial of any feed or ration to broilers as starters and finishers.

At a later stage, the EPC may allow others to use the facilities for evaluating other products, like vitamins, antibiotic-free additives, new types of feed and others at CCH broiler.

CCH Layer

There are two houses in the CCH for layers. In each house, there are two rows and two tiers of laying batteries. Individual cages are located on every tier with the cages separated by an air duct for drying the manure. This system is adopted to prevent the accumulation of wet manure. It prevents excessive ammonia gas release, which is known to be detrimental to the health of laying birds and workers.

There are six hopper feeders per row. Every tier has two hopper feeders to the left and right sides of the cages. The system allows six different feeds to be tested in any feeding trial. The feeds are stored and transported from six silos which hold 3 t of feed each. The eggs from laying birds from the left and right sides of the tier are collected from an egg belt, which brings the eggs to the collection station. The eggs are collected

Figure 2. Feed silos.

and counted manually. The environment temperature, air movement, feeding and water consumption are monitored via a management programme software.

Quarantine House

The CCH are fully isolated with perimeter fencing. Access to the CCH is via the quarantine house. The system is designed as a preventive measure to reduce the risk of spreading diseases from human or transport to the experimental chickens.

Spray House

Prior to entering the CCH compound, vehicles have to pass through a spray house for disinfection. This is to ensure that the vehicles are clean from any pathogenic bacteria or fungi that may spread diseases to the birds.

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