

POTENTIAL FEED RESOURCES FOR SWAMP BUFFALOES (*BUBALUS BUBALIS*) RAISED UNDER OIL-PALM ECOSYSTEM

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ABSTRACT

The domesticated buffalo (*Bubalus bubalis*) in Malaysia is represented mostly by the swamp type. The total population of the animal is less than 130,000 heads with 59% in Peninsular Malaysia, 35% in Sabah and 6% in Sarawak. Rearing of swamp buffaloes under the plantation environment, both under grazing and pen-fed situations, are of potential for meat production. The availability of grasses, legumes, shrubs and tree fodders under the plantation environment offer tremendous opportunities as feed resources for these animals. Palm kernel cake (PKC), oil palm fronds (OPF), palm press fibre (PPF), oil palm trunk (OPT), and palm oil mill effluent (POME) are potential feedstuffs to be utilized for *in situ* feeding of swamp buffaloes. Supplementation of high protein fodder leaves, such as *Gliricidia sepium*, *Leucaena leucocephala*, *Morris alba* and *Asystasia intrusa* could further enhance protein nutrition, especially for intensively-fed swamp buffaloes. Nutrient supplementation through non-medicated (UMMB) and medicated urea-molasses mineral blocks (MUMB) can also be considered to improve performances. Feeding strategies and examples of formulated ration for swamp buffalo meat production under oil palm plantation are highlighted

(**Keywords:** Swamp buffaloes; Oil-Palm Plantation, Oil-Palm By-Products, Forages).

INTRODUCTION

The domesticated buffalo (*Bubalus bubalis*) in Malaysia has been classified into river or dairy (Murrah buffaloes) and swamp types. The total population of the buffaloes is currently less than 130,000 heads with about 59% in Peninsular Malaysia, 35% in Sabah and 6% in Sarawak. Approximately 90% of the population is the swamp type. The swamp buffalo population is declining at the rate of about 1.2% per year. Main factors contributing to the decrease in population are increased mechanization, linking to displacement of swamp buffalo with machinery for draught power in the paddy fields and oil palm estates, lack of suitable land for extensive farming, lack of superior breeds, reproductive problems associated with low reproductive rate, susceptibility to endemic diseases (example HS and FMD) and high extraction rate (Jainudeen and Wan Zahari, 2000; Shanmugavelu and Wan Zahari, 2009). The emphasis on development of other livestock commodities have also resulted in reduced attention being given to swamp buffaloes (Wan Zahari and Ariff, 2001)

Swamp buffaloes have potential attributes that can be exploited to advantage, especially for meat production. Efforts to revive local swamp buffaloes industry for beef production is very important. It is evident that the buffalo cannot compete with the faster growing crossbred cattle in established pastures as a beef producer. It is also a known fact that the swamp buffalo industry has always been a low input enterprise, capitalizing on readily available feed resources, mainly native grasses and crop residues. The natural feed resources are constantly subjected to seasonal fluctuations, resulting in a shortage of feed, nutrient imbalances and deficiencies during the dry period of the year. Alternative feed resources are therefore needed to sustain or increase the swamp buffalo population. One such feed resource is in the oil palm industry where substantial amount of by-products are available to meet the nutritional needs of the local swamp buffalo population (Sevaraj et. al., 1993; Devendra, 2002).

POTENTIAL FEED RESOURCES

There are a number of potential feed resources which can be used for feeding swamp buffaloes under the oil palm environment. These resources can generally be classified into two broad categories i.e. (i) by-products from the oil palm plantation, and (ii) forages, fodder shrubs and tree fodders under the oil palm plantation (Alimon and Wan Zahari, 2012; Wan Zahari *et. al*, 2003)

By-Products from the Oil Palm Plantation

(i) ***Palm kernel cake (PKC)***

PKC is widely used as the main ingredient in total mix rations (TMR) for swamp buffaloes, as well as for other ruminant species (Wan Zahari *et al.*, 2009). Supplementing conventional rations with 30 – 50 % PKC showed improved performance and increased live weight gain (LWG) of beef cattle. Similar response could be achieved in intensively-fed swamp buffaloes, aimed at meat production. Feeding PKC at nearly 100 % inclusion level has been tested on feedlot growing cattle with no negative effects. However, attempt to provide similar type of ration to intensively-fed swamp buffaloes is totally not recommended for optimum meat production, as swamp buffaloes require a significant amount of “long-fibres”. Fibres from PKC (about 17%) are of “short-type” and of inferior value in terms of ruminant nutrition. It is of prime importance to include grass or hay or other suitable fibrous resources at minimum level of between 20 – 25% in order to overcome the occurrence of metabolic disorders in swamp buffaloes. Additionally, special attention needs to be given on Ca supplementation when utilizing PKC at high levels owing to the extreme low Ca: P ratio (0.36:1) inherited in the PKC. Limestone (calcium carbonate) is the most appropriate Ca supplement to be used as it is cheap and easily available locally.

Most important is to ensure that the ratio of Ca:P in the rations is within 1:1 to 3:1 in order to overcome skeletal deformities. Sodium chloride, vitamin A and Vitamin D should be supplemented at the appropriate levels to meet requirements. Addition of “long fibres” from grasses or other forages will undoubtedly reduce the rate of passage of PKC in the gastrointestinal tract of swamp buffaloes so that retention and digestibility of nutrients will be enhanced.

(ii) Oil palm fronds (OPF)

OPF is continuously available in the plantation and it can be collected and processed during pruning and replanting activities. Feeding OPF can almost meet the daily maintenance requirements of swamp buffaloes, both for energy and protein. Fresh OPF can be used to feed swamp buffaloes, especially for pen-fed or intensively fed-animals; at the recommended level of 30 – 40% of the total ration. In addition, chopped OPF can be preserved into silage with and without urea supplementation. The optimum level of OPF silage in a fattening ration for swamp buffaloes was found to be 30 - 40 %. Daily gain of swamp buffaloes fed 30 % OPF silage was comparable to that fed 50 % sago meal (Shamsudin *et. al.*, 1993).

A number of processing techniques have been developed to improve the feeding qualities of OPF. These include molasses and urea treatments, preservation as silage, alkali treatment, steaming under high temperature and high pressure, pelletizing and enzymatic degradation. Chipped-dried OPF can be turned into pellets or cubes for ease of storing, packaging and transporting (Wan Zahari *et. al.*, 2002; Wan Zahari *et. al.*, 2003).

(iii) Oil palm trunks (OPT)

OPT is an good source of roughage for swamp buffaloes, especially those in feedlots. OPT is only available after oil palms are felled for replanting at an age of about 30 years. Issue related to the supply must be considered if this material is to be utilized for long-term feeding in swamp buffalo production. OPT

can be collected and processed into chips (about 2 – 3 cm) for making silage and can be utilized for feeding after 21 days fermentation. Maximum level of inclusion for buffaloes is 30%. Earlier studies revealed that its digestibility can be increased with steaming and sodium hydroxide (NaOH) treatment. Without any treatment, the DM digestibility of OPT is only comparable to rice straw.

(iv) *Palm press fibre (PPF)*

PPF is a fibrous by-product of crude oil extraction of the mesocarp with about 86.2 % DM, 41.2 % CF, 69.3 % ADF and 26 % lignin. The CP content is about 4 % (**Table 1**). It can be fed fresh, or ensiled in drums or silos for longer storage. Suggested level for feeding swamp buffalo is 20 - 30% even though no negative effect was observed in grazing swamp buffaloes fed at 35 % feeding level. At higher level of inclusion (>40%), the use of PPF could result in bolus formation and impairment of rumen activity, as has been found in beef cattle (Wan Zahari, unpublished data). Further research on pre-treatments of PPF is therefore necessary to enhance its utilization for swamp buffaloes feeding. Alkali treatment did not show any significant effect in improving PPF digestibility but steaming at high pressure is worth considering for future research.

(v) *Palm oil mill effluent (POME) / Palm oil sludge (POS)*

POME is the residue left from the purification of the crude palm oil (CPO) and includes various liquids, dirt, residual oil and suspended solids. It contains about 95 % water. The material is characterized by considerable variability; high ether extract (11.7 %), ash (19.5 %) and medium content of crude protein (12.5 %). An assessment of feeding value using sheep indicated that up to 40 % POME can be used either alone in molasses urea-based diets or when combined in equal proportions with PPF. Hence, similar feeding levels can be used for swamp buffaloes raised on similar type of rations. Retardation in rate of growth and skeletal mineralization had been observed when POME was fed at 100 % level in dairy cattle.

Forages, Fodder shrubs and tree fodders

This issue is more relevant for swamp buffaloes under grazing situation. Extensive Information is available on the type, quality and carrying capacity of native herbage under oil palm plantation. The inclusion of swamp buffaloes into the plantation crops will definitely cause a more dynamic nutrient cycling, resulting in some changes in the soil and plant nutrient status, soil fertility as well as overall forage production. Similar to other ruminant species, the carrying capacity of swamp buffaloes in a particular grazing area needs to be monitored since the availability of forage is highly dependent on the extent of the canopy. If the stocking rate is strategically controlled, the amount of palatable forage available will be sufficient to cover growth and pregnancy stages of the swamp buffaloes. Flushing with concentrates can be performed especially during pre- and post-natal stages to maximize production. Local plants commonly available under oil palm plantation include *Paspalum conjugatum*, *Axonopus compressus*, *Ottachloa nodosa*, *Nephrolepis biserrata*, *Imperata cylindrical*, *Chrysopogon aciculatus* and *Mikania cordata*. Improved grasses, notably *Brachiaria decumbens*, *Brachiaria humidicola*, *Panicum maximum*, *Pennisetum purpureum* and *Setaria sphacelata* can be used as another option in the cut and carry system, both under semi-intensive or intensive-feeding regimens, in order to improve swamp buffalo nutrition.

Maximizing other potential plant resources

Nitrogen (N) -fixing fodder trees of potential to be grown in the oil palm environment include *Gliricidia sepium*, *Leucaena leucocephala* and *Sesbania grandifolia*. Multipurpose trees such as cassava (*Manihot esculenta*), banana (*Musa spp.*), jackfruit (*Artocarpus heterophyllus*) and kenaf (*Hibiscus cannabinus*) can also be introduced extensively in the oil palm plantation for generation of additional income. In this regard, the foliages can be utilized as

protein and fibre sources, especially for pen-fed or intensively-fed swamp buffaloes. Other suitable plants of potential are *Moringa pterygosperma*, a non-legume tree and a legume plant, *Flamingia congesta*. These fodder shrubs or tree legumes have traditionally been used for other ruminants in Malaysia, mainly as supplementary feeds or as reserve feed during critical periods. This also can contribute to increased swamp buffalo productivity and reduced cost of production under the oil-palm environment.

Introducing forage supplements at a feeding level of 20 – 25% is an alternative strategy for increasing nutrient intake and improving swamp buffalo performances, particularly when crop residues of poor nutritive values are used as the basal diets. Under the Malaysian condition, combining glyricidia or mulberry with OPF at the ratio of 1:4, for example, is adequate to allow positive livestock growth. Previous studies showed that the rumen protozoa population tended to decrease more quickly with supplemental feeding. Any feeding strategies that can enhance adhesion of rumen microbes to feed particles and improve fibrolytic activity may be beneficial to feed utilization in swamp buffaloes.

It is important to note that the incorporation of shrub and tree fodder into the feeding system of intensively-fed swamp buffaloes, have not yet been studied intensively in tropical region. Their feeding value in raw and processed forms must be evaluated for maximum utilization, more so with the existence of anti-nutritional factors in those feeds. Plants with high protein content and leaf to stem ratio as well as low anti-nutritive factors will be of importance for intensive planting under the oil palm plantation. The introduction of new promising forage species of high nutritive values and adaptable to the Malaysian environment, is one alternative approach to improve swamp buffalo nutrition

Strategic Nutrient Supplementation

Feeding supplementary urea molasses mineral blocks (UMMB) has been shown to improve performances of goats, sheep, beef cattle and dairy cattle in Malaysia (Wan Zahari *et al*, 2002). Apart from highly digestible forages,

productive performances can be greatly improved by supplementing with protein sources, concentrate or their combinations. This approach can also be applied to increase nutritional status of both grazing and pen-fed swamp buffaloes for meat production. Nutrient supplementation through medicated urea-molasses mineral blocks (MUMB) can also be considered for parasitic control, apart from increasing growth and reproductive performance (Wan Zahari *et. al.*, 2000)

Cost-effective rations for swamp buffalo production

Under the oil palm environment, rations for intensively fed swamp buffaloes should therefore be based on oil-palm by-products (Wan Zahari *et al.*, 2013). This is important in order to reduce feeding cost. PKC, OPF and POME can be used as the main ingredients in the ration. An example of a practical and cost effective ration is PKC: 50 %, OPF 30%, POME 10%, PPF 8 % limestone: 2 % and mineral and vitamin premix: 1 %. This ration can allow a reasonable gain of about 0.6 – 0.7 kg/day if the ingredients are fresh and of good quality. Feed cost can be further reduced when green forages are available as an ingredient to partially replace the PKC, apart from increasing the nutritive value of the rations. Supplementation of self-made UMMB and MUMB can be utilized only when necessary, i.e when protein, energy and mineral intake from the rations are limiting. **Table 2** shows the suggested inclusion levels of oil palm by-products as feeds for swamp buffalo feeding

CONCLUSION

Oil palm fronds (OPF), palm press fibre (PPF), oil palm trunk (OPT), palm kernel cake (PKC) and palm oil mill effluent (POME) are potential feedstuffs to be utilized as total mix ration (TMR) for *in situ* feeding of swamp buffaloes raised under oil palm environment. The availability of grasses, legumes, shrubs and tree fodders under the plantation also offer tremendous opportunities as feed resources for buffalo meat production. Supplementation of high protein fodder

leaves such as *Gliricidia sepium*, *Leucaena leucocephala*, *Morris alba* and *Asystasia intrusa*, coupled with strategic nutrient supplementations could further enhance protein nutrition of swamp buffaloes under both grazing and pen-fed conditions. There is tremendous opportunity to promote large-scale swamp buffalo feedlots in oil palm plantations to increase meat production in Malaysia.

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Table 1: Chemical composition (% of dry matter) and nutritive values of oil palm by-products

By-products	CP	CF	NDF	ADF	EE	Ash	ME (MJ/kg)
Palm kernel cake	17.2	17.1	74.3	52.9	1.5	4.3	11.13
Palm oil mill effluent	12.5	20.1	63.0	51.8	11.7	19.5	8.37
Palm press fibre	5.4	41.2	84.5	69.3	3.5	5.3	4.21
Oil-palm fronds	4.7	38.5	78.7	55.6	2.1	3.2	5.65
Oil-palm trunks	2.8	37.6	79.8	52.4	1.1	2.8	5.95
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Notes: CP: Crude protein, CF: Crude fibre, NDF: Neutral detergent fibre, ADF: Acid detergent fibre, EE: Ether extract and ME: Metabolisable energy.

Source: Wan Zahari *et al*, 2000.

Table 2: Suggested levels of inclusion of oil palm by-products for swamp buffalo feeding

Parameter	Suggested feeding level (%)
Palm kernel cake (PKC)	50
Palm press fibre (PPF)	20-30
Palm oil mill effluent (POME)	50
Oil palm trunk (OPT- fresh / ensiled)	30
Oil palm fronds (OPF- fresh /ensiled)	30 – 40
Oil palm pellet / cube	30

Source: Wong and Wan Zahari (1992)