Potential Benefits from the Utilization of Some Natural Feed Resources in Thai Swamp Buffaloes

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ABSTRACT
This paper aims to comply from studies of using some natural feed resources (NFRs) in several experiments for Thai swamp buffaloes, which were conducted by the Research and Development Center for Livestock Production Technology, Faculty of Veterinary Science, Chulalongkorn University, Thailand, during 2002-2012. Most of NFRs are interesting, only some of available NFRs are selected to investigate whether they are suitable to use as feeds for swamp buffaloes. In general NFRs used as feed for ruminants may be simply divided into two types; i) as a roughage and ii) as a supplement. Pineapple waste (PW), rice straw (RS), pangola hay (PH), Ruzi grass (RG) and Vetivar grass (VG) were used as roughage diets, whilst leaves of luecaena, cassia, and mulberry, rain tree pods (RTP) and cassava chip (CSC) were used as supplement diets in this review. The results indicated that differences in using NFRs for swamp buffaloes are noticed. PW, PH and RG are suitable as a basal diet, while RS, VG and cassia leaves need further study to improve their quality. Only appropriate proportion of leucaena in diets fed to buffaloes, it enhances intake, digestion, N balance and ruminal microbial production. The treatments of leucaena to inactive of tannins may not necessary for animals fed leucaena forage couple with RTP. However, the supplementary diets containing high starch and high sugar in CSC and RTP, depressed fibrous diet digestion in swamp buffaloes. The supplementary diet with RTP increased ruminal microbial yields in animals. The high starch but low N content in CSC when this material is used as a feedstuff in ruminants, urea or non protein nitrogen is required to fulfill N sources. Mulberry leaves can be absolutely used as a supplement in ruminants as they are without anti-nutritional factors and toxic compounds. Subsequently, the supplementary diet with mulberry leaves increases fibrous diet digestion and ruminal microbial yields. Several studies demonstrated the approach to use NFRs as the alternative feeds; roughage and supplement, to improve the quality of feeds in swamp buffaloes. The practical implication of this review is that it would be benefit the smallholder farmers to use NFRs because they do not only improve quality of feeds but also reduce cost of feed.

Keywords: cassava chip, cassia, luecaena, mulberry, pangola hay, pineapple waste, rain tree pod, rice straw, swamp buffaloes, vetivar grass

INTRODUCTION
There are widely natural feed resources (NFRs) in tropical countries, particularly in Thailand, which they are required to investigate whether they are suitable to use as feeds for ruminants. In general, feeds used in ruminants may be simplify divided into two types; i) as a roughage and ii) as a supplement diet. The most important agricultural by-product for cattle and buffaloes is rice straw (Oryza sativa var. RS), the annual production is approximately 24.7 million tons in Thailand. Although, many means have been attempted not only to improve low quality of agricultural by-products, but new feed resources such as other agricultural by-products and the multiple proposed trees are also seeking for, including selection of several improved grasses and local plants in order to improve the quality of buffalo’s feeds. The pineapple waste (Anasa comosus Linn. Mer.) from factory, Vetiver grass (Vetiveria nemoralis A. Camus), Pangola grass (Digitaria decumbens) and Ruzi grass (Brachtiaria ruzizensis) were selected to study as roughages, on the other hand leaves of leucaena (Leucaena leucocephala), cassica (Cassia siamea Lam. Fabaceae), mulberry (Morus alba), rain tree pods (Samanea Saman) and cassava chip [Manihot esculenta (L.) Crantz] were selected to study as supplement diets in several experiments of swamp buffaloes

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The objective of this review is to report crude protein (CP) composition, digestibility and metabolisable energy for ruminant (MEr) content in some natural feed resources (NFRs) which are used as roughage and supplement in swamp buffaloes and their possibility feeding potential is evaluated.

1. Some NFRs are used as a roughage in swamp buffaloes

*Rice straw*: Rice straw has generally been considered as waste product, it has limited nutritive value [4.7%CP, 48% organic matter digestibility (OMD) and metabolisable energy for ruminant (MEr) 6.3 MJ/kg DM: OMD and MEr were calculated according to Menke et al. (1979)]. Therefore it should be used only as replacement for part of the forage in a ration or in dry season. It should not be used as a complete ration. A study of feeding rice straw has shown better response than that feeding ammoniated RS (RSNH4OH) [Figure 1]. Fibre digestion in swamp buffaloes fed only rice straw has usually occurred poorer than that fed only ruzi grass, pangola hay, pineapple waste (Figure 1). It is surprising that none difference of nutrients digestion of RS and RSNH4OH in swamp buffaloes was detected, it is probably because i) buffalo is better in N recycling and ii) RSNH4OH is too high N to suitable for buffaloes.

*Pineapple waste*: Pineapple waste (PW) is potentially useful in Thailand. Pineapple peel from canning factories has been widely used for dairy cattle in southern Thailand while the by-products of stem and root of pineapple used for cosmetic industries can also used as feedstuff because it contains high potentially digestible fibre (6.0%CP, 77%OMD, MEr 6.5 MJ/kgDM) and is aslo cheaply available (Jetana et al. 2004). Based on a previous study it was suggested that the optimum proportion of concentrates to PW was 60:40 (Jetana et al. 2009). It was shown that PW has the highest of nutrients digestion compared to other roughages (Figure 1), it may be that the particle size of the industry processed pineapple waste is very fine and could be easily attached and utilized by microorganisms.

*Vetiver grass*: Vetiver grass can generally be classified into 2 types, i) Vetiveria zizanioides Nash and ii) Vetiveria nemoralis A. Camus. Vetiver grass (Vetiveria nemoralis A. Camus) was used to study as roughage in swamp buffaloes. Though, the nutritive value is rather high (7.1%CP, 48%OMD, MEr 6.4 MJ/kgDM), but the digestibility of Vetiver grass was similar to that of rice straw (Figure 1). It is probably because the structure of this grass is hard, rough and shape, therefore these characteristic will disturb the gastric tract, then outflow rate is very fast (Jetana et al. 2008). In case of Vetiver grass is required to use as roughage, further study must should be the improvement of its quality, in particular the structure of grass.

*Pangola hay*: Pangola grass (PH) is among the type of grasses, being planted in Thailand, this grass has fairly nutritive values (6.0-9.0%CP, 60%OMD, MEr 8.1 MJ/kgDM) and is suitable to make hay and can be kept for a long time. It was shown that fibre digestion in PH is similar to that in PW (Figure 1).

*Ruzi grass*: Ruzi grasses also had high nutritive values (8-16%CP, 71%OMD, MEr 9.8 MJ/kgDM) as same as the selected grasses, but they are high in lignin content (8-10%), consequently the digestibility is low (Figure 1). Even though Ruzi grass can grow well in Thailand, but it should be considerably utilized for small ruminants, as photosensitization and high oxalate may occur when Ruzi grass is fed particularly in sheep, goats and calf (Hare and Phaikew 1997).

2. Some NFRs used as a supplementary diet in swamp buffaloes

*Leucaena*: A short feeding study in swamp buffaloes, none of the animals showed any visible toxicity symptom during the period of leucaena addition to the diets was fed. The results however indicated that only appropriate proportion of leucaena to ruzi grass was fed to buffaloes; it enhanced intakes, digestion, N balance, ruminal microbial production (Jetana et al. 2012a). Although leucaena is high in nutritive values (25%CP, 70%OMD, MEr 10 MJ/kgDM), a problem of leucaena is high in tannin content (2-6%), it should not be overlooked. There are however two ways which have been attempted to be deactivated tannins and other secondary compounds in leucaena; i) the addition of chemicals with a high affinity for tannins, such as polyvinylpyrrolidone (PVP) and polyethylene glycol (PEG), a synthetic polymer to which tannins have a greater binding affinity than protein (Waghorn et al. 1994) and ii) the use of alkaline treatments, such as NaOH solution
However, the forms of untreated leucaena combined with rain tree pod fed swamp buffaloes, have not shown only enhancing microbial production supply into small intestine but also increasing fiber digestion and N balance (Figure 2).

**Figure 1.** Digestion of nutrients in swamp buffaloes fed *ad libitum* natural feed resources as a basal diet.

*Cassia siamea*: *Cassia siamea* is one of the vegetable trees most cultivated in Southeast Asia. This plant has great nutritional (20-22%CP, 60-70%OMD, MEr 9.0 MJ/kgDM) and medical values. The use of *Cassia siamea* leaves supplemented in swamp buffaloes has resulted in better fibre digestion than the other supplements containing similar protein such as leucaena, and mulberry leaves (Figure 2). Consequence, the *Cassia siamea* is considered to be an additional protein source to improve the efficiency of microbial growth in the rumen. Further study, this material must be defined anti-nutritional factors and toxic compounds before it is practically used as feedstuff (Jetana et al. 2010).

**Mulberry**: Mulberry leaves are also highly palatable and digestible (70-80%OMD, MEr 10-12 MJ/kgDM) to ruminants and can also be used for monogastrics and human beings. Protein content in leaves and young stems, with a good essential amino acid profile, varies from 18-22% depending on variety and age. Mulberry leaves can be undoubtedly used as a supplement in ruminants as they are without anti-nutritional factors and toxic compounds. Subsequently, the supplementary diet with mulberry leaves increases fibrous diet digestion when compared with RTP supplementation (Figure 2) and ruminal microbial yields (Jetana et al. 2010).

**Rain Tree Pod**: The rain tree is a tropical legume. It contained 766 g DM/kg as fresh-basis and it contained (g/kgDM), 87.3 g ash, 29.4 g nitrogen, 313 g neutral detergent fibre, 287 g acid detergent fibre, 52 g acid detergent lignin, 182 g total sugar, 84 g sucrose, 50 g phenolic compound, 35 g tannins, 11 g condensed tannins. As this material containing high total sugar and crude protein, it is probably suitable to be used as a feed (Jetana et al. 2011). A study demonstrated that the high sugar and protein content in the rain tree pod is not only advantage to the increase in the efficiency of microbial growth in the rumen of buffaloes (Jetana et al. 2011) but also improves the quality of milk in dairy goats (Jetana et al. 2012b). However, supplementation with RTP containing high sugar always depresses pH in the rumen; therefore fibre digestion decreases (Figure 2). The rain tree pod can also be substituted for molasses/sugars when required for producing a bio-extract from some fruits/vegetable/herbs in order to save cost of using sugar and molasses.
Digestion in swamp buffaloes

![Digestion in swamp buffaloes graph]

**Figure 2.** Digestion of nutrients in swamp buffaloes fed rice straw as a basal diet and supplemented with different natural feed resources.

*Cassava chip:* Cassava chip (CSC) contains high level of readily soluble carbohydrates (700 g starch/kgDM) but low N content (3%CP, 80%OMD, MEr 9.4 MJ/kgDM) and is highly degradable in the rumen comparing with other energy sources. Urea, therefore, a highly rumen degradable non protein-nitrogen, always used as an N source when CSC is added in ruminant feed. Swamp buffaloes fed pangola hay and supplemented with CSC+3%Urea increased DM and OM digestions but decreased NDF digestion (Figure 3). It may be due to i) high starch content and ii) small particle size and structure of starch easily degradable and rapid fermentation in the rumen.

![Digestion in swamp buffaloes graph]

**Figure 3.** Digestion of nutrients in swamp buffaloes fed pangola hay as a basal diet and supplemented with different natural feed resources.

**CONCLUSIONS**

Several studies demonstrated the approach to use NFRs as the alternative feeds; roughage and supplement, to improve the quality of feeds in swamp buffaloes. The practical implication of this review is that it would be benefit to the smallholder farmers to use NFRs because it is not only to improve quality of feeds but also to reduce cost of feed.

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