CHAPTER VI
GENERAL CONCLUSION

This thesis work presents three experiments that determined chemical composition and nutritive value of tropical feedstuffs, and investigated the energy requirement for maintenance and energetic efficiency for growth of Thai native cattle fed under humid tropical conditions in Thailand. The energy requirement was also determined by using meta-analysis of data from balance and feeding trials.

Experiment I was performed to determine the chemical composition, kinetic of gas production, *in vitro* digestibility and metabolizable energy content of tropical feedstuffs using the *in vitro* gas production technique. Feedstuffs were divided into 6 groups; 1) forage grasses and alternative forages 2) forage legumes 3) energy feed sources 4) protein source feedstuffs 5) oilseeds and 6) high fiber by-product. These groups of feedstuffs were evaluated in 6 experiments (Experiment 1.1 to 1.6).

In the forage grasses and alternative forages group (Experiment 1.1), data in this study indicate that the chemical compositions of selected forage grasses and alternative forages varied. The obtained data suggest that digestibility values varied among types of grasses. The IVDMD and IVOMD of whole sugarcane were greater than sweet sorghum but they did not differ in IVNDFD. Data indicate that both of them had lower IVNDFD than selected forage grasses. The estimated metabolizable energy of feedstuffs varied. The 30 dci of Ruzi grass and Pangola grass showed the highest estimated metabolizable energy. The results of this study demonstrate that whole sugarcane and sweet sorghum are high potential alternative roughage sources for beef and dairy cattle in the dry season when feed supplies are critically short in both quantity and quality.

In the forage legumes group (Experiment 1.2), in terms of CP content, Cavalcade, Verano stylo and Thapra stylo were considered to be high quality roughages for ruminants. The result demonstrates that the 30 dci Cavalcade had the highest digestibility. The kinetics of gas production varied among selected forage legumes. Rumen fermentation potential ranked from the highest to the lowest are, Thapra stylo, Cavalcade 1, peanut straw, Verano stylo and Cavalcade 2. Cavalcade 1 showed the highest estimated metabolizable energy.

Experiment 1.3 was performed to determine chemical composition and nutritive value of energy feed sources. The digestibility of selected energy feedstuffs, IVDMD and IVOMD were highest in broken rice while the lowest was cassava peel. Kinetics of gas production differed among the different energy feed sources. The potential extent of gas production, ranked from the highest to the lowest are; broken rice, cassava chip, ground corn, cassava pulp, cassava peel and rice bran. The calculated metabolizable energy of cassava chip was highest and not different from ground corn, followed by broken rice, cassava pulp, cassava peel and rice bran. Because cassava chip, cassava pulp and cassava peel are available locally and are inexpensive, they are the best potential energy source for beef and dairy cattle.

Protein source feedstuffs were evaluated in Experiment 1.4 These selected feed sources had CP content higher than 20%. Soybean meal had the lowest fiber content. Soybean meal showed the highest in all measures of digestibility. Potential of fermentation for protein feed source ranked from the highest to the lowest were; soybean meal, tomato pomace, dried brewery waste, wet brewery waste and kapok seed meal. Soybean meal demonstrated a higher estimated metabolizable energy than any other feedstuff in this group.

Experiment 1.5 was performed to determine chemical composition and nutritive value of oilseeds. Soybean seed showed the greatest CP content while EE content was highest in peanut with husk. The selected oilseed feedstuffs showed great variation in digestibility. Soybean seed showed the highest potential extent of gas production and demonstrated the highest estimated metabolizable energy. Based on these data, even though these feedstuffs are composed of high fiber content, they are potential energy and protein source feedstuffs. Oilseeds are high in protein and fat and able to be used as an alternative protein/energy source for cattle. Fed directly without processing may be beneficial for farmers in terms both of nutritive value and market price.

Some feedstuffs cannot be classified to either feed source, because of their low protein and high fiber content. However, such feedstuffs are usually used in ruminant feeding systems. The investigated high fiber by-product feedstuffs (Experiment 1.6) exhibited wide variations in chemical composition. The results of this study demonstrate that coconut meal has most potential of fiber digestibility. Soybean hull exhibited highest potential extent of gas production while coconut milk residue and rice pollard showed the

lowest. Based on this study, calculated metabolizable energy ranked from the highest to the lowest were coconut meal, palm meal, soybean hull, mung bean bran, coconut milk residue and rice pollard.

In Experiment II, the objective was to investigate metabolizable energy (ME) value of some local tropical feedstuffs with an emphasis on energy metabolism and requirement for maintenance in Thai native beef cattle using open-circuit indirect respiration calorimetry methodology. Total digestible nutrients (TDN) of Pangola grass hay, cassava chip, brewery waste, and cassava pulp was 48.65, 82.19, 58.91 and 71.52 % respectively. The ME content was was 6.42, 12.01, 10.07 and 10.89 MJ/ kg DM, respectively. The efficiency of utilization of ME (q_m) of cassava chip was the highest followed by cassava pulp. The ratio of methane production to GE intake of cattle fed Pangola grass hay based diet in this study ranged from 0.09 to 0.12. Nevertheless, this study fed cattle at near- or sub-maintenance level of feed intake. Therefore, further study is needed to evaluate the effect of the ratio of roughage fed at above maintenance level.

An estimate of FHP and ME_m is 314 and 509 kJ/kg $BW^{0.75}$/d, respectively. Results suggest that ME utilization efficiency for maintenance (k_m) of Thai native cattle is 0.616.

In addition, cassava chip, cassava pulp or brewery waste mixed with Pangola grass hay based diet at maintenance level can improve N retention in Thai native beef cattle. Decreasing Pangola grass hay in the ration decreased NDF content in the rations but increased time spent chewing per fiber intake. It has almost no effect on ruminal fermentation.

A meta-analysis was performed in Experiment III to determine energy requirements for maintenance and growth of global *Bos indicus*, *Bos indicus* outside of Thailand, Thai *Bos indicus*, Thai native cattle, Thai Brahman andThai Brahman crossbred from independent studies that used the feeding trial and indirect-calorimetry methodology. It found that ME_m of those *Bos indicus* types was 518.85, 465.37, 454.37, 478.77, 549.39 and 546.08 kJ/kg$BW^{0.75}$/d, respectively and ME_g for 1 g/kg$BW^{0.75}$/d of ADG was 31.60, 41.47, 25.92, 31.30, 21.39 and 30.55 kJ/kg$BW^{0.75}$/d, respectively. Data suggest that ME_m and ME_g are highly variable among provenance and genetic line of *Bos indicus* beef cattle. The ME_m of beef cattle may vary according to breed, stage of maturity, sex, body weight and the method of determination.