

# CHAPTER I

## BACKGROUND

### 1.1 Introduction

Grazing ruminants have a highly developed and specialized mode of digestion that allows them better access to energy in the form of fibrous feeds than most other herbivores. The challenge to ruminant nutritionists now is to improve forage and fiber utilization so that ruminants can exploit their true ecological and economic niches. This need is most keenly felt in the developing tropics. Animal agriculture will always be an important complement to plant agriculture because animals can use by-products that people find unsuitable. Large land areas unsuitable for cultivation could be grazed by animals. Animal agriculture thus renders plant agriculture more efficient (Van Soest, 1994).

Grazing lands and cereal by-products are two major sources of feed energy that can not provide food for humans without prior processing by ruminants. Ruminant use of grazing land and cereal by-products is thus necessary for efficient world agriculture (Van Soest, 1994). Thailand is a tropical agricultural country. General weather conditions throughout the country are those of a tropical climate and it remains hot throughout the year (Na-Chiangmai, 2002; Khemsawat and Phonbumrung, 2008). Traditionally, the farmers raised their cattle with green forage in natural pasture as the main feed resource. Forages in pasture are native Graminae, Leguminosae, other herbaceous plants and dropped ripening fruits. Natural feed resources are abundant only in rainy season but scarce in dry season (Sruamsiri, 2008).

Cattle production in Thailand is based largely on traditional mixed crop-livestock smallholder systems (T Mannelje, 1978; Wanapat, 1999; Na-Chiangmai, 2002; Khemsawat and Phonbumrung, 2008). The shortage of roughage in the dry season forces the farmers to use rice straw as their major feed for cattle. But the feeding value is limited by low voluntary intake, low digestibility, low nitrogen, mineral and vitamin contents. However, many available agricultural and agro-industrial by-products are available e.g. corn stover, soybean straw and soybean pod husk which can also be utilized as cattle feed in the dry season. Agro-industrial by-products from cannery

industries e.g. pineapple waste, tomato waste, potato waste, molasses, distiller's grain waste, sweet corn peel, husk, silk and baby corn waste are usually used as cattle feed (Sruamsiri, 2008). Furthermore, nowadays, there are interesting high potential alternative roughage sources for beef and dairy cattle in the dry season e.g. whole sugarcane (*Saccharum officinarum*) and sweet sorghum (*Sorghum bicolor*) (Van et al., 2002; Blummel et al., 2003; Sommart et al., 2005a,b; Di Marco et al., 2009; Yosef et al., 2009). However, only a few studies have reported on the chemical composition, digestibility of nutrients and especially metabolizable energy of these forages and by-products in beef cattle. Thus, more information on the nutritive and energy values of tropical feedstuffs is indicated to help formulate beef cattle diets.

Ruminant livestock play a very important role as an integral part of farming and rural life in tropical developing countries providing food, family income and employment (Pezo and Devendra, 2002). In Thailand, the beef cattle population stood at 8.6 million in 2009 (Department of Livestock Development; DLD, 2010) representing 14.2% and 1.4% of South-East Asia and total Asia, respectively (FAOSTST, 2008). Meat production in Thailand was 0.19 million ton in 2007 and represented 16.7% and 1.4% of South-East Asia and total Asia respectively (Food and Agriculture Organization of the United Nations Statistics; FAOSTST, 2008). The latest statistics of beef cattle population in Thailand showing an increase from 4.6 to 8.6 million head, from 1999 to 2009 (DLD, 2010) is likely to continue.

Animals have been selected by farmers for their particular characteristics or cultural value, whilst they were also adapting genetically to local conditions, diseases, available feed, climate, predators and many other persistent variables imposed by the local environment (Kawashima, 2000). The result has been the development of breeds that contribute to local, national and, eventually, global needs and demands. In Thailand, Zebu (*Bos indicus*) cattle including crossbred are the main phenotypes found in various regions of the country (DLD, 2010). The crossbred beef cattle include main breed improvements by both Zebu breeds (*Bos indicus*; Brahman) and European breeds (*Bos taurus*; Charolais, Simmental) (Tongthainan, 2002).

There is a general belief that native ruminants possess an inherent ability to utilize dietary fiber better than improved breeds. According to National Research Council; NRC (2000), *Bos indicus* breeds of cattle require about 10% less energy for

maintenance than beef breeds of *Bos taurus* cattle. The data of Chaokaur et al. (2007) indicated that Brahman cattle (*Bos indicus* breeds) require 458 KJ ME/kgBW<sup>0.75</sup>/d of metabolizable energy for maintenance, approximately 15% less than *Bos taurus* cattle. Furthermore, Tangjitwatanachai et al. (2008) reported energetic efficiency of *Bos indicus* was higher than that of *Bos Taurus*. However, in the Indochinese Peninsula including Thailand, a lot more elucidation is required to clarify the digestion characteristics and still very limited information on energy requirements to establish feeding standards for indigenous beef cattle in the region.

With respect to tropical feedstuffs, limited information is available on the chemical composition, digestibility of nutrients and especially metabolizable energy, and more data on energy requirements are required urgently in Thailand (The Working Committee of Thai Feeding Standard for Ruminant; WTSR, 2008) to establish a sustainable feeding management for beef cattle in the region. Thus, the aims of this study were to investigate the nutritive and energy values in some feedstuffs and energy metabolism and the metabolizable energy requirements for maintenance and for gain of Thai native cattle fed under humid tropical conditions in Thailand.

## 1.2 Objectives

1.2.1 To evaluate nutritive value and metabolizable energy value of some tropical feedstuffs in Thai native cattle.

1.2.2 To quantify metabolizable energy requirements for maintenance of mature Thai native cattle using open-circuit indirect calorimetry.

1.2.3 To quantify metabolizable energy requirements for maintenance and for gain of mature *Bos indicus* cattle from review data using meta-analysis of relationship between metabolizable energy intake and average daily gain.

## 1.3 Anticipated Outcome

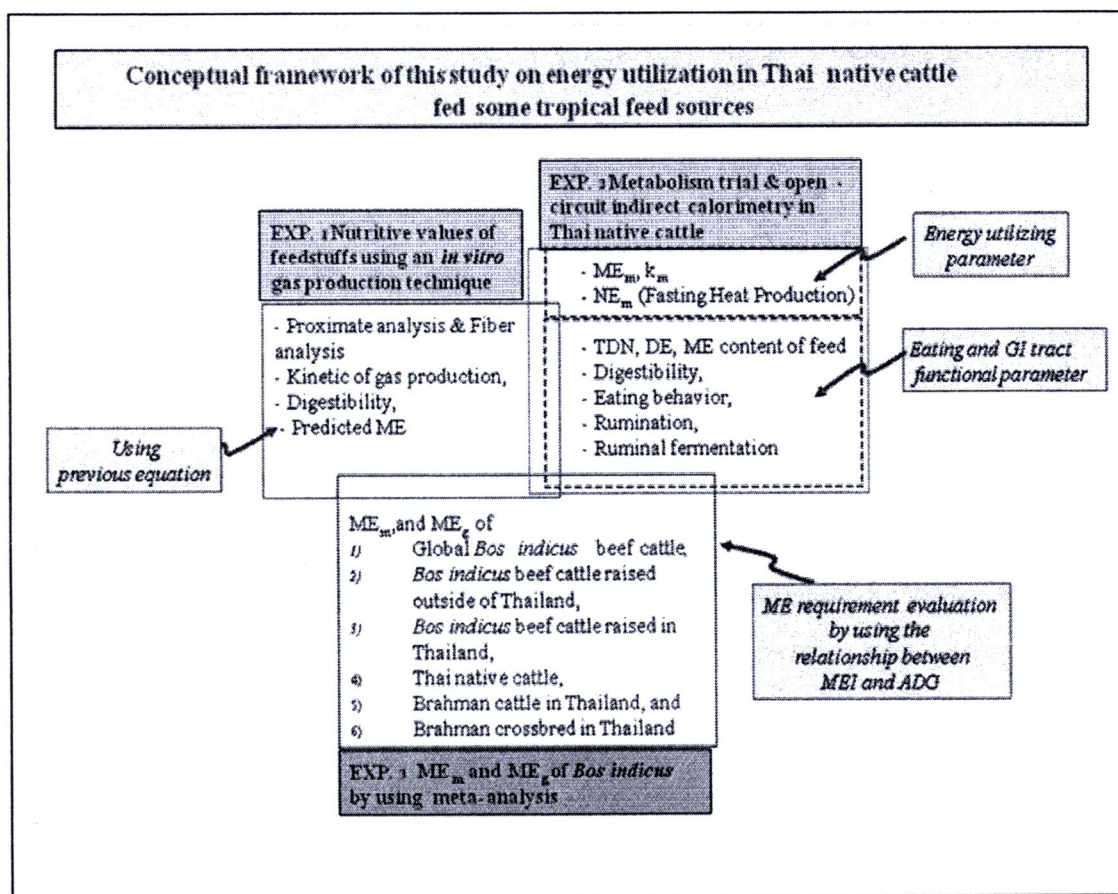
1.3.1 To obtain the nutritive value and metabolizable energy value of some tropical feedstuffs.

1.3.2 To obtain the metabolizable energy requirements for maintenance of mature Thai native cattle.

1.3.3 To obtain the metabolizable energy requirements for maintenance and for gain of *Bos indicus* cattle.

#### 1.4 The Conceptual Frameworks

This thesis presents the work from three experiments: firstly, the determination of nutritive value and metabolizable energy value of some tropical feedstuffs *in vitro*, secondly, the determination of metabolizable energy value of some tropical feedstuffs and the energy requirements for maintenance of mature Thai native cattle raised under humid tropical conditions in Thailand using open-circuit indirect calorimetry and thirdly estimated requirements for maintenance and for gain of *Bos indicus* breeds raised outside of Thailand and in Thailand by using a meta-analysis. A conceptual framework of this thesis is summarized in Figure 1.1.



**Figure 1.1** A conceptual framework of this thesis.