Research on feeding standard of beef cattle and feedstuff database in the Indochinese peninsula

T. Nishida,[1], T. Suzuki[2], I. Phaophaisal[3], P. Pholsen[3], R. Narmsilee[3], S. Indramanee[3], and S. Oshio[1]*

[1]Japan International Research Center for Agricultural Sciences, Tsukuba, Japan
[2]National Agricultural Research Center for Kyushu-Okinawa Region, Nishigoshi, Japan
[3]National Institute of Livestock and Grassland Science, Tsukuba, Japan, [3]Khon Kaen Animal Nutrition Research and Development Center, Khon Kaen, Thailand
*(*Present address; Obihiro University of Agriculture and Veterinary Medicine, Obihiro, Hokkaido, Japan)*

Abstract

At Khon Kaen in northeastern Thailand, energy metabolism in cattle was studied by a respiration trial system using a ventilated flow-through method with a face mask built with technical and financial support of Japan International Research Center for Agricultural Sciences (JIRCAS). Energy values of locally available feed resources have also been obtained from digestion and respiration trials. JIRCAS also had already completed a new ventilated head-hood apparatus for energy balance trials and started the data accumulation concerning the energy value of Pangola grass (*Digitaria eriantha*) with Brahman beef steers. As for the energy balance measurement technique, JIRCAS supports the establishment of feeding standard by measuring the energy requirement of domestic animals under the tropical environment and energy value of locally available feed resources in the Indochinese peninsula.

Keywords: energy requirement, energy value, locally available feed resources

Introduction

In northeastern Thailand, there are many farms, and most farm families own a small herd of either cattle or buffaloes. In this region, ruminant production contributes to cash income for farmers; however, this is not so reliable because of insufficient productivity. Some limiting factors for ruminant production have been recognized. The lack of appropriate feeding standards for the region is one of the main constraints for the further development of feed management. Nutrient requirements of cattle in Thailand are based on information compiled from countries in temperate zones. Examples of such sources of information include National Research Council (NRC) in the USA (National Research Council, 2000), Agricultural Research Counsil (ARC) in the UK (Agricultural Research Council, 1980), and Japanese Feeding Standard (Agriculture Forestry and Fisheries Research Council Secretariat, 2000; National Agriculture and Food Research Organization, 2006). As the breed of cattle, climate conditions, and available feed resources are different in Thailand compared to those in temperate zones; the nutrient requirements of cattle in Thailand may not be the same as recommended by those standards. However, the energy balances of the cattle bred in the tropics have not been measured very extensively.

Japan International Research Center for Agricultural Sciences (JIRCAS) has been studying in Khon Kaen, Thailand for more than 10 years with the Department of Livestock and Development (DLD) and Khon Kaen University.

Many researchers in JIRCAS continue to stay and conduct ongoing studies with financial support from JIRCAS. They obtained a lot of data concerning nutritive and energy value from locally available feed, digestion, and respiration trials from domestic cattle in Thailand. In March 2011, JIRCAS is going to publish the first edition of a feedstuff database and feeding standards for beef cattle for the Indochinese peninsula in English by using those accumulated data and ongoing data. At this time, we would like to introduce and describe these studies.

Energy metabolism study in northeastern Thailand by JIRCAS

In order to study energy metabolism in cattle, Kawashima et al. (2001, earlier JIRCAS researcher) made a respiration trial system using a ventilated flow-through method with a face mask at Khon Kaen Animal Nutrition Research and Development Center, Khon Kaen, Thailand with technical and financial support of JIRCAS. It was composed of four components: 1) main air flow component, 2) air sampling component, 3) gas analysis component, and 4) data record and calculation component (Fig. 1). The ventilated flow-through method with a face mask is an alternative system for respiration trials to that with a hood or a chamber. However, the cost for establishing the ventilated flow-through method is much lower, and the management of the system is relatively easy. Therefore, the system could be suitable for the research environment in developing countries.

Basal data for feeding standard in Thailand by JIRCAS

Application of feeding standards by farmers requires the following information: the nutritive value of available feed ingredients, the amount of feed intake, and the dietary requirements of animals. The accumulation of information concerning the nutritive value of locally available feeds by using domestic cattle is very important to supply an appropriate amount of nutrients to cattle. Kawashima et al. (2002, and unpublished data) and his DLD colleagues obtained much data concerning nutritive and energy values in locally available feed by using domestic

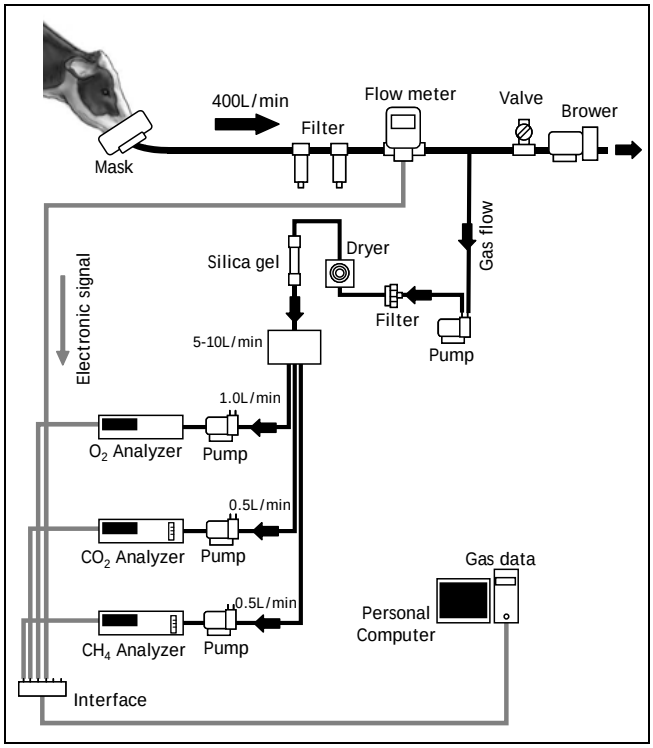


Figure 1. Respiration trial system using a ventilated flow-through method with a face mask (modified from Kawashima et al., 2001).

cattle in Thailand (Table 1). Additionally, JIRCAS also started accumulating data concerning the energy value of Pangola grass (*Digitaria eriantha*) using 4 Brahman steers (body weight, 372.8 ± 34.4 kg; mean ± standard deviation; age; 3 years old; Suzuki et al, 2008, earlier JIRCAS researcher). The steers were fed for 21 days with Pangola grass that had been harvested approximately 45 days after cutting in several farms around Bangkok. Digestible energy and metabolizable energy (ME) of Pangola grass hay in our study were 10.28 MJ kg^{-1} and 7.99 MJ kg^{-1} dry matter, respectively. These values are acceptable when compared with those obtained when low-quality tropical feed is provided to the steers.

Those researchers, as well as Odai et al. (2002, earlier JIRCAS researcher) and their colleagues, clarified ME requirements for maintenance in Holstein crossbred dry cows, Brahman, Swamp buffalo and Thai native steers fed in northeastern Thailand (Fig. 2). The ME requirements for maintenance were obtained by regression analysis of energy retention against ME intake on the basis of metabolic body size (body weight $kg^{0.75}$). The ME requirement for maintenance in Thai native cattle was the lowest among the animals examined in those studies.

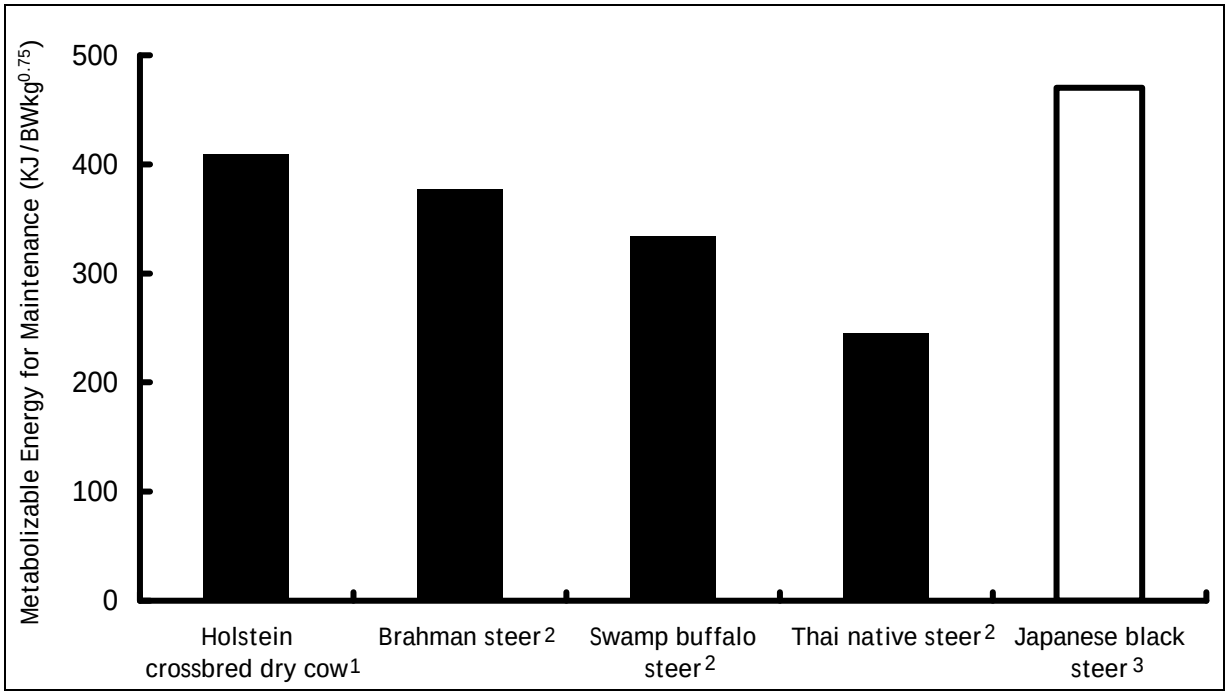
Table 1. Total digestible nutrient (TDN), crude protein (CP), and/or digestible energy (DE) and metabolizable energy (ME) content in locally available feed resources measured in northeastern Thailand.

	n	Animal	Reference
Cavalcade hay	4	Brahman steer	Pholsen, unpublished data
Cowpea line Tvu 11979 hay	6	wether	Chuenpreecha, unpublished data
Filter cake[2]	5	wether	[1]
Napier grass hay[6,7,8]	4	wether	[1]
Napier grass silage[3,4,5]	2	Thai native steer	Shinoda et al., 1999
Pangola grass hay	4	Brahman steer	Suzuki et al., 2008
Para rubber seed	4	Brahman steer	[1]
Purple Guinea grass	4	Holstein crossbred dry cow	Sumamal et al., 2002
Rice bran	5	wether	[1]
Ruzi grass hay	4	Holstein crossbred dry cow	Narmsilee et al., 2002
	4	Brahman steer	[1]
	4	Swamp buffalo steer	[1]
	4	Thai native steer	[1]
	6	wether	[1]
	5	wether	[1]
Soybean meal	4	Brahman steer	[1]
	6	wether	[1]
Sugarcane stalk	4	Brahman steer	Kawashima et al., 2002
Thapra stylo legume	4	Holstein crossbred dry cow	Sumamal et al., 2002
Verano stylo	4	Holstein crossbred dry cow	Narmsilee et al., 2002

1; Kawashima, unpublished data
2; By-product from sugar factory
3,4,5; Height of grass and chopping; 3: 1-m chopped, 4: 1-m unchopped, 5: 1.5-m chopped
6,7,8; cutting intervals; 6: 30 days, 7: 45 days, 8: 60 days

The ME requirement for maintenance in Brahman steers, swamp buffaloes, and Thai native cattle were 80%, 71%, and 52% of the value of Japanese black cattle, respectively, as suggested in the feeding standard (Agriculture Forestry and Fisheries Research Council Secretariat, 2000).

The ME requirement for maintenance in Holstein crossbred dry cows was 84% of the value of Holstein dry cows, as suggested in the feeding standard (487 KJ $BW^{-0.75}$; National Agriculture and Food Research Organization, 2006). Furthermore, Kawashima et al. (2006) conducted a metabolism trial with 4 Brahman cattle and 4 swamp buffaloes fed with Ruzi grass hay



1-Odai et al., 2002; 2-Kawashima, unpublished; 3-Agriculture Forestry and Fisheries Research Council Secretariat, 2000.

Figure 2. Energy requirement for maintenance in Holstein crossbred dry cows, Brahman steers, swamp buffaloes, and Thai native steers fed in northeastern Thailand.

(*Brachiaria ruziziensis*, 0.77% nitrogen content). They found no significant differences in energy and nitrogen balances and nutrient digestibility between cattle and buffaloes. However, fasting heat production was significantly lower in buffaloes.

Next step for establishment of feeding standard in Thailand (Indochinese peninsula) by JIRCAS

The open circuit respiratory procedure with a ventilated hood has been well established in the indirect calorimeter for farm animals due to its relatively quick response to short-term pulmonary changes. Furthermore, the ventilated hood system offers the advantage of conducting the gas exchange measurement all day even during eating, and it is less stressful for cattle compared to the calorimeter technique with a face mask. JIRCAS had already completed a ventilated head-hood apparatus for energy balance trial in February 2005, and subsequently started data accumulation concerning the energy value of sugarcane and Pangola grass with beef cattle at the Khon Kaen Animal Nutrition Research and Development Center (Suzuki et al, 2006, 2008; earlier JIRCAS researcher). The DLD in Thailand has organized a committee to compile the feeding standard and the database of feed resources, and the intention of cooperative research by laboratories in universities and institutes all over the Thailand have already been confirmed with JIRCAS. Furthermore, JIRCAS has already built research cooperative relationships with Laos and Cambodia. As for the energy balance measurement technique, JIRCAS is going to support the establishment of feeding standards by measuring the energy requirement of domestic animals in a tropical environment and by measuring the energy value of locally available feed resources in the Indochinese peninsula. As a result, owing to the

above JIRCAS project, more efficient beef production in tropical regions becomes possible by utilizing the feeding standard and the feedstuff database published. This must certainly contribute to increasing farmers' profits.

References

Agricultural Research Council, 1980. *The nutrient requirements of ruminant livestock*. CAB International, Slough, England, UK.

Agriculture, Forestry and Fisheries Research Council Secretariat, 2000. *Japanese Feeding Standard for Beef Cattle*. Central Association of Livestock Industry, Tokyo, Japan.

Kawashima, T., W. Sumamal, F. Terada, and M. Shibata, 2001. Respiration trial system using ventilated flow-through method with a face mask. *JIRCAS Journal* 9:53–74.

Kawashima, T., W. Sumamal, P. Pholsen, R. Chaithiang, W. Boonpakdee, M. Kurihara, and M. Shibata, 2002. Feeding value of sugarcane stalk for cattle. *Asian-Australasian Journal of Animal Sciences* 15:55–60.

Kawashima, T., W. Sumamal, P. Pholsen, R. Chaithiang, and M. Kurihara, 2006. Comparative study on energy and nitrogen metabolisms between Brahman cattle and swamp buffalo fed with low quality diet. *Japan Agricultural Research Quarterly* 40(2):183–188.

Narmsilee, R., P. Pholsen, T. Chuenpreeha, W. Sumamal, S. Indramanee, and M. Odai, 2002. A study on nutritive values of tropical forages (1) Ruzi grass (*Brachiaria ruziziensis*) (2) Verano stylo (*Stylosanthes hamata* cv. Verano). *JIRCAS Working Report* 30:83–86.

National Agriculture and Food Research Organization, 2006. *Japanese Feeding Standard for Dairy Cattle*. Japan Livestock Industry Association, Tokyo, Japan.

National Research Council, 2000. *Nutrient requirements of beef cattle, seventh revised edition*. National Academy Press, Washington DC, USA.

Odai, M., W. Sumamal, R. Narmsilee, P. Pholsen, T. Chuenpreeha, and S. Indramanee, 2002. Energy and nitrogen metabolisms of Holstein crossbred dry cows fed Ruzi grass hay with different levels of soybean meal. *JIRCAS Working Report* 30:79–81.

Shinoda, M., T. Kawashima, P. Pholsen, and T. Chuenpreecha, 1999. Evaluation of quality and nutritive value of Napier grass silage with different growth stages either chopped or unchopped in Northeast Thailand. *Proceedings of FAO Electronic Conference on Tropical Silage*. FAO Plant Production & Protection Paper 161, Rome, pp.147-149. http://www.fao.org/ag/AGP/AGPC/gp/SILAGE/Home.htm.

Sumamal, W., R. Narmsilee, P. Pholsen, T. Chuenpreeha, S. Indramanee, and M. Odai, 2002. A study on nutritive values of tropical forages (3) Purple Guinea grass (*Panicum maximum* cv. TD58) (4) Thapra stylo legume (*Stylosanthes guianensis* CIAT184). *JIRCAS Working Report* 30:87–91.

Suzuki, T., S. Ohmomo, I. Phaowphaisal, S. Nitisinprasert, P. Pholsen, R. Narmsilee, S. Indramanee, and T. Nishida, 2006. Utilization of sugarcane as additive of grass silage in tropic region. *XIIth AAAP Animal Science Congress Proceedings*, p.677.

Suzuki, T., I. Phaowphaisal, P. Pholsen, R. Narmsilee, S. Indramanee, P. Nitipot, A. Chaokaur, K. Sommart, N. Khotprom, V. Panichpol, and T. Nishida, 2008. In vivo nutritive value of Pangola grass (*Digitaria Eriantha*) hay by a novel indirect calorimeter with a ventilated hood in Thailand. *Japan Agricultural Research Quarterly* 42(2):123–129.