B-51-(2) ⑦ Methane emission from ruminants

Contact Person: Fuminori Terada
Head
Energy Metabolism Laboratory, Department of Animal Nutrition,
National Institute of Animal Industry, Ministry of Agriculture, Forestry and Fisheries
Norinkenkyu-Danchi P.O.Box 5, Tsukuba, Ibaraki 305, Japan
Tel: +81-298-38-8655, Fax:+81-298-38-8606
Email: sakura04@niai.affrc.go.jp

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Abstract

In order to develop an estimation method of methane emission from ruminants and to improve the accuracy of estimation of methane emission in Japan and Asia, the following experiments using cattle and buffaloes have been conducted.

1) In experiment one, a simple measuring system (Mask System) of methane emission using of mask, blower, flow meter, gas analyzer and personal computer, has been developed. This system can be used in an ordinal cattle barn. The accuracy of measurement of methane emission from ruminants using this system is affected by individual variation, day to day variation and diurnal variation. Among these the diurnal variation is the most important factor to the accuracy of this system. Moreover, the pattern of methane emission is affected by feeding schedule. Based on these results, therefore, the suitable sampling schedule for this system has also been proposed. The experiment was conducted with four Brahman cattle and four buffaloes fed on Ruzi grass hay using the Mask System to measure the methane emission. The Brahman cattle and buffaloes produced 20 and 17 L methane/day/kg dry mater intake (DMI) , respectively.

2) In experiment two, methane emission from cows fed on fresh grass and artificially dried grass were measured using ventilated food system. Methane emission/kg DMI of the grass increased from 17 to 31 L with increase in the stage of maturity of the grass. Methane emission from cattle fed on fresh grass and the artificially dried grass were similar when the grass harvested at similar stages of maturity.

Key Words: Cattle, Buffalo, Methane, Measurement equipment, Fresh grass,

1. Introduction

Environmental crisis from global warming or the commonly called 'greenhouse effect' is a major issue in these days. Methane (CH_4) a potential greenhouse gas produced from ruminants by means of ruminal methanogenesis-a nutritionally wasteful process. Methane emission from ruminants accounts for about 16% of total methane emission from the earth and is a targeted source [1]. The total methane produced from domesticated ruminants is about 80Mt/year, where cattle and buffaloes account for 80% of the global annual methane emission [2]. In Asia, cattle contribute 52% of the estimated CH_4 emission from farm animals and the buffaloes contribute 32% [3]. Thus it is important, to develop the method to estimate methane emission from different species of ruminants such as cattle and buffaloes. To elucidate the amounts of methane emitted from ruminants and to suppress global warming, the methane emission estimation using different diets and in different species of ruminants are also important. Moreover, in the field of animal production, efforts for increasing the

accuracy of estimation techniques of methane emission from ruminants and to control methane emission are important.

2. Research Objectives

Methane gas produced by ruminant livestock in Japan is estimated using the equation based on DMI[4)] and the method is very useful with *Bos taurus* under the temperate forages and cereal grains. However, feed quality is widely different among the Asian countries. Moreover, in Asia, there are many buffaloes and zebu cattle, and they contribute a major part of the global methane emission from ruminants. Therefore, it is needed to get more information concerning methane emission from ruminants in Asian countries considering different diets. Moreover, a simple estimation method is also necessary to measure the methane emission form ruminants in Asian countries and to improve the existing estimation method of methane emission from ruminants in Asia.

Hence, the objectives of this study were; 1) to develop a simple measuring method of methane emission from different species of ruminants, 2) to measure and compare the methane emission from *Bos indicus* and buffaloes, and 3) to measure the methane emission from ruminants fed fresh and dried grasses as a model for grazing ruminants in Asian countries.

3. Materials and methods

Experiment 1. Development of simple measuring technique of methane emission from ruminants

(1) A simple measuring system (Mask System) using mask, blower, flow meter, gas analyzer and personal computer was constructed. The materials and equipment used in this system are transportable and can easily be used in an ordinal cattle barn.
(2) Using the Mask system estimation of methane produced from castrated Brahman cattle and buffaloes was conducted. Four cattle and buffaloes were used to measure the methane emission fed on Ruzi grass hay.
(3) According to the proposed sampling schedule, methane emission from Brahman cattle and buffaloes were measured.

Experiment 2. Methane emission from cows fed fresh and dried grasses

(1) Four Holstein dry cows were fed on fresh and dried Italian ryegrass harvested at blooming stage. The feed composition was determined using standard methods of AOAC. The dry matter intake and the methane emission of the cows were measured using the ventilated food system.
(2) The sampling schedule of the Mask system was followed to check the propose sampling schedule for the mask system. The factors considered in mask system (individuals, day to day variation and diurnal variation) was followed to check the effect on accuracy using the data of respiration trials which conducted with four dairy cows.
(3) Methane emissions from four Holstein cows fed fresh and dried grass harvested at same stage of maturity were compared.

4. Results and discussion

Experiment 1. Development of simple measuring system of methane emission from ruminants

Figure 1 shows the measuring way of the Mask system of estimation of methane emission from ruminants and Figure 2 shows the example of raw data of methane emission obtained from the cattle using the Mask system. The methane oroduction rate obtained from the cattle

during the 15 minutes are also shown in Figure 2.

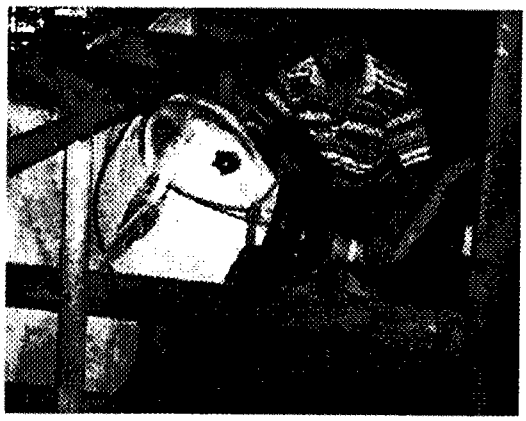


Fig.2 Example of measurement of methane emission using face mask system

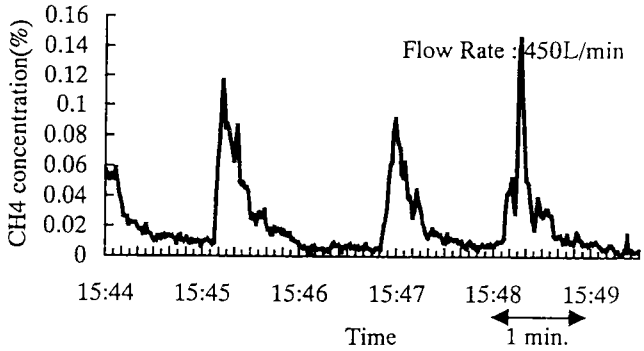
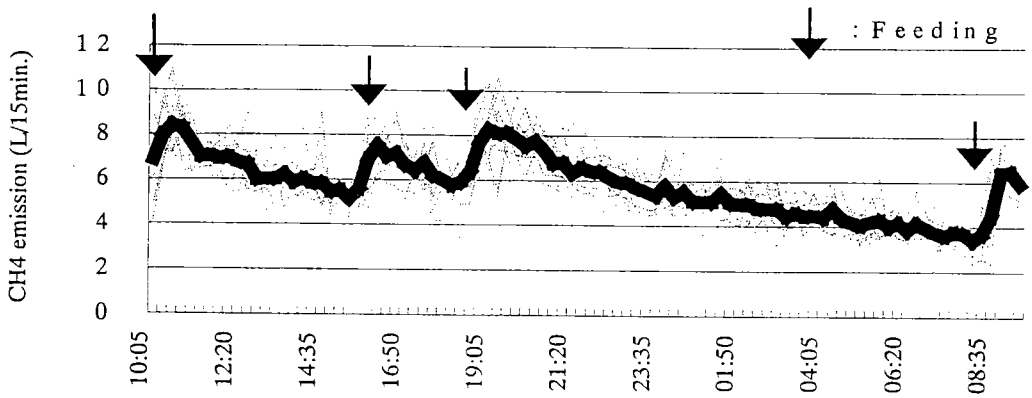


Figure 1.Gas collection from Brahman cattle using Mask system

(1) The Mask System is very simple but not suitable to measure gas production continuously. Therefore, suitable interval measuring schedule is needed to get good accuracy. Figure 3 shows diurnal pattern of methane emission from four dairy cows using ventilated food system and that can be used in the mask system. This figure clearly showed that the diurnal pattern

Fig.3 CH4 emission from cows during 15 min.



was very big and dependent on feeding schedule. When three variation sources (individuals, day and diurnal) were assumed, the biggest contributor was diurnal variation, next to individuals. In consequence, it is proposed that to use mask system in measuring methane emission from ruminants, experimental animal is needed to use at least 4, experimental period is required to be 3 to 4 days and the measuring interval should be 3 or 4 hours.

Table 1 Comparison of methane emission between Brahman cattle and buffalo fed low quality

	Brahman cattle	Buffalo
Body weight(kg)	336±13	255±7
Dry matter intake, kg/day)	4.2±0.4	3.4±0.2
CH_4 emission(L/day)	85±19	57±7
CH_4 emisson (L/kgDMI)	20±4	17±2

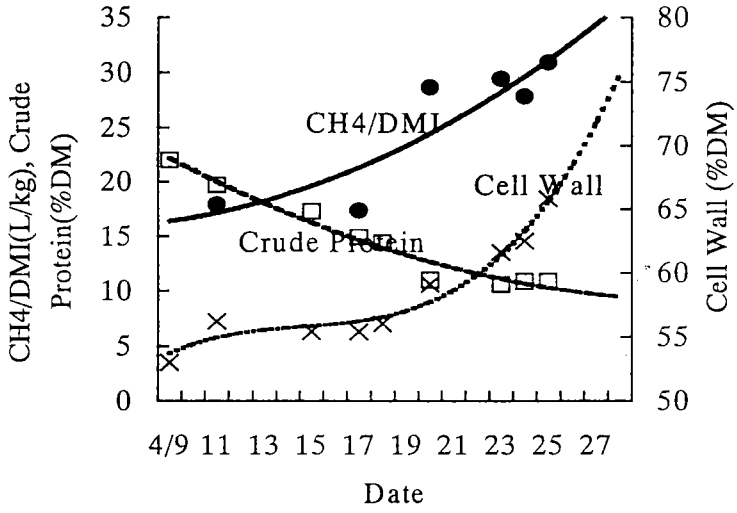
(2) According to the sampling schedule, methane emission from four Brahman cattle and four buffaloes were measured. The results were shown in Table 1.
Methane emission from Brahman cattle and buffalo were 20 and 17 (L/kgDMI), respectively,

and these values were lower than the value reported by Crutzen et al [5].

Experiment 2. Methane emission from cows fed fresh and dried grasses

(1) The changes of crude protein and cell wall of Italian ryegrass harvested at different stages of growth during the experimental period are shown in Fig. 4. The figure shows that the crude protein content decreased and the cell wall content increased with the increase of stage of maturity of the grass. A lower methane emission obtained from the grass harvested at earlier stage of growth compared to the late stage of growth. The late stage grasses produced less protein and high cell wall content, which resulted in an increased CH_4 emission in the late stage growth grasses. The methane emission (L/kg/DMI) increased from 18L to 30L with an increase in maturity of the grasses.

Fig.4 Change of chemical composition of fresh grass and CH4 emission from cows



(2) Cows fed on the fresh grass (blooming-stage) produced 30.8L methane/kg DMI, and the value was similar to the value of methane emission from the cows fed on dried grass at same stage of maturity. This showed that there was no effect of drying the grass on the methane production.

These results showed that the Mask system could be used to measure methane emission from ruminants and our information from the experiment using dried grasses is useful for under grazing condition in Asia.

5. References

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