Short Communication

Reduction of ammonia gas emission by preliminary washing of bedding straw

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Abstract Effects of preliminary washing of straw on ammonia gas emission after using it for bedding were evaluated. Rice straw cut into 10cm was washed with tap water (experimental group 1), with hot water at 70℃ (experimental group 2) and not washed (control group). Straw was mixed with cow urine at a 1:1 ratio, and they were placed in polyethylene sample bags. Each bag was inflated with 4 liters of air. They were kept at 25±2℃ for 48 hrs. Ammonia gas concentration was determined with Kitagawa precision gas detector tubes every 12 hrs. Ammonia gas emission in the preliminary washing groups was significantly lower than that from the control group.

Key words: ammonia gas emission, bedding straw, preliminary washing
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Introduction

Rice straw has the advantage of deep cushioning and soft touch for hooves of domestic animals in comparison with the other bedding materials. Although the reuse of used bedding straw after drying under the sun reduces manure volume, large amount of ammonia gas is emitted during the sun-drying period. Higher concentration of ammonia gas in barns of domestic animals induces restlessness of animals [1,6]. The authors tried to prevent ammonia gas emission from the bedding straw and proposed that ammonia gas emission was reduced after washing of bedding straw [4,5]. From these experiments, it was observed that repetitive use of washing straw showed a gradual reduction of ammonia gas emission, although oppositely, the accumulated nitrogen volume increased in the straw. These results suggest that ammonia gas emission reduction by washing does not only depend on the removal of urea, but also the removal of microbes contributes to the ammonia gas emission. Komi et al. [3] elucidated the reduction of contaminating bacteria by jet stream and Imanishi and Furuta [2] reported that jet stream washing easily removed contaminated bacteria. Therefore preliminary washing of bedding straw to remove the microbes on the surface of straw may contribute the ammonia gas emission.

The present study aimed to evaluate, at a

laboratory scale, effects of preliminary washing on ammonia gas emission.

Materials and methods

Preparation of bedding straw: Rice straw was cut into 10 cm, and washed with tap water (experimental group 1), with hot water at 70 ℃ (experimental group 2) and not washed (control group), procedure was shown in Fig.1-1. The washed straw was dried under the sun before the following experiments. As used bedding straw, straw was mixed with cow urine at a 1:1 ratio in accordance with the previous report [4]. Urine was obtained from three cows fed at our university farm. Although we used horse urine in the previous studies [4-6], we used cow urine in this experiment, because ammonia gas emission from the cow farm causes offensive odor issues [7].

Determination of ammonia gas emission: Thirty grams of straw from both groups was placed in a polyethylene sample bag attached with a rubber tube. Ten bags were prepared for each treatment group. The bag was sealed after vacuum suction, and inflated with 4 liters of air. The bag was kept at 25±2℃ for 0,12,24,36, and 48 hrs. After treatment, ammonia gas concentration was determined with Kitagawa precision gas detector tubes for ammonia (SD type) as shown in Fig.1-2.

Statistical treatment: Ammonia gas emission from each group was compared by one-way ANOVA using Excel statistical software at significant level of $P<0.05$ and 0.01. Mean separation among the test groups was done using the Least Significant Difference method

Results and discussion

Ammonia gas emission in each group is shown in Fig.2. Ammonia gas emission from the preliminary washing groups (Experimental groups 1 and 2: washed by tap water or hot water, respectively) was relatively stable from 50 to 100 ppm. They were significantly lower than that from the control group in every sampling period. Especially, at 48hr, ammonia gas emission of the control group was 236±11 ppm, about two times higher than those

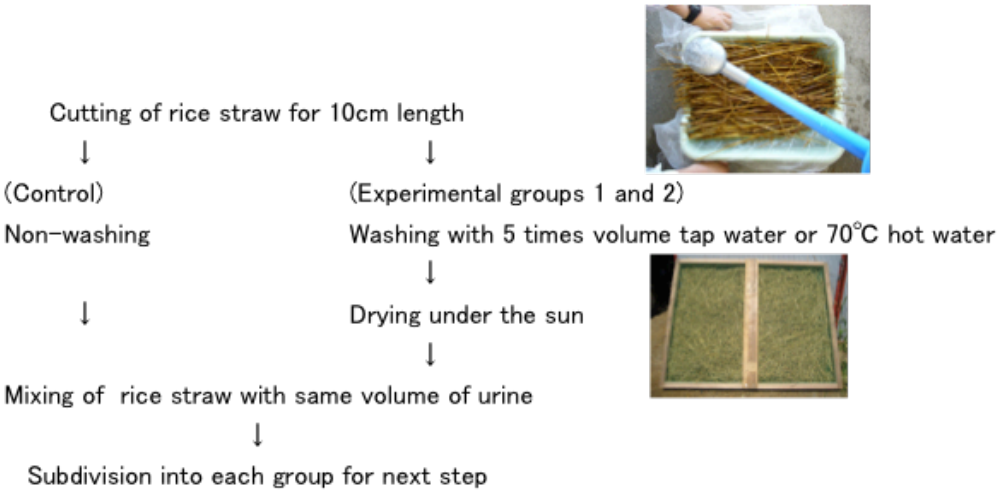

Fig.1-1 Procedure of practice used bedding straw preparation

Fig.1-2 Determination of ammonia gas emission with Kitagawa Precision gas detector tubes.

in the preliminary washing groups 1 and 2 (118±10 and 125±13 ppm, respectively). Therefore the present results suggest that preliminary washing of bedding straw prior to use is effective in reducing ammonia gas emission after contamination with urine.

In our previous report [5], we recognized that the washing procedure prevented ammonia gas emission from the used bedding straw, and the reduction mechanism could be determined in one of two following patterns: first, washing removes the water soluble nitrogen which is easily converted to ammonia gas and second, washing might remove the microbes which have urease activity on the surface of straw. The present results demonstrated the latter hypothesis, i.e. preliminary washing, in comparison with jet stream, was not so hard to remove the microbes that caused ammonia gas emission. On the other hand, there was no significant difference between the results of experimental groups 1 and 2. The present results suggest that a washing water temperature of 70℃ does not affect strongly the survival of microbes on the surface of straw.

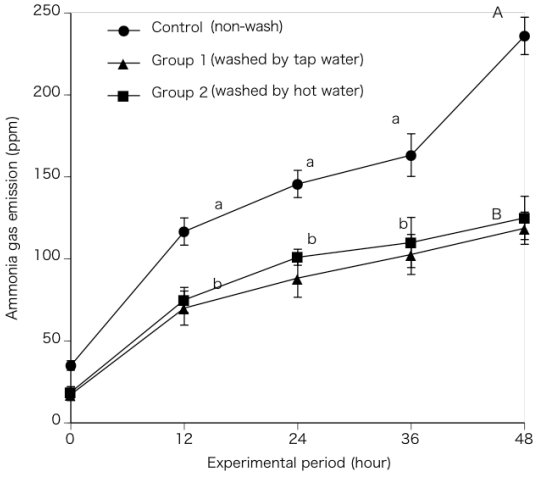

Fig.2 Chronological variation of ammonia gas emission in each group
Significant difference was recognized between different letters under the following significant levels (Large letter: P<0.01, small letter: P<0.05).

Preliminary washing of straw has an advantage for the reduction of ammonia emission after bedding use, and also the reduction of the concentration of the organic matters in the drainage of the washing in comparison with the washing of use bedding straw. Preliminary washing is the environment friendly procedure for the preparation of the bedding straw.

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短　報

敷きワラの利用前洗浄によるアンモニアガス揮散量の削減

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敷きワラを利用前に洗浄することによる利用後のアンモニアガス揮散量に及ぼす影響について検討した。ワラを 10cm 長に細断した後、対照区では、洗浄せず、試験区 1 では水道水で、試験区 2 では 70℃の熱水で洗浄した。洗浄区は乾燥した後、等量の乳牛尿と混合し、ゴム管を付けたポリエチレン製のサンプル袋に 30g ずつ入れ、中の空気を排出した。4L の空気を注入後、25±2℃の空調室で、試験開始から 48 時間後まで 12 時間ごとにアンモニアガス揮散量を北川式ガス検知管で測定した。水洗した 2 試験区はどの時間でもアンモニアガス揮散量は対照区に比べて有意($P<0.05$)に低かった。よって、利用前の敷きワラの水洗はアンモニアガス揮散を削減できると判断した。

キーワード：　アンモニアガス揮散、敷きワラ、利用前洗浄

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