Research article

Changes in Surviving *E.coli*, Coliform Bacteria and General Bacteria in Manure with Air Drying Treatment

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Abstract Approximately 87 million tons of dung is being produced annually from cattle farms all over Japan. Considering the proper treatment of this waste product, applying manure to farmlands has been focused from a viewpoint of popularizing organic agriculture. However, pathogenic bacteria known as *E.coli* may be released from the immature fermented manure that was applied in farmlands. So, the treatment for decreasing *E.coli* should be considered. Although air drying is known as an effective treatment for decreasing *E.coli*, it might affect beneficial bacteria as well as pathogenic bacteria. So, this study dealt with the observation of the change in several microorganisms such as *E.coli*, coliform bacteria and general bacteria under air drying treatment. In the experiment, 3 types of cow manure such as fresh, 2 weeks fermented and 12 weeks fermented were employed. Air drying treatment was carried out to observe the survival of *E.coli*, coliform bacteria and general bacteria during 28 days. The experimental results showed that the number of *E.coli* and coliform bacteria decreased with passing day of air drying process. Also, the number of general bacteria decreased with time of air drying process. However, it was considered that the decrease in general bacteria possibly affects the decomposing process of manure. Therefore, it was concluded that air drying treatment for fresh cow dung is not a proper way but is applicable to the manure fermented for 2 weeks or 12 weeks.

Keywords cow dung, air drying, *E.coli*, coliform bacteria, general bacteria

INTRODUCTION

In Japan, about 87 million tons of dung has been produced annually from cattle farms. From a viewpoint of promoting organic agriculture, a proper treatment of this product has been recently focused. However, in a bulk production of manure, the unintended inclusion of immature fermented manure is possibly happened. Thus, there might be pathogenic bacteria known as *E.coli* surviving and remaining in the produced manure (Chun-Ming et al., 2005). Once, these manures were broadcasted into farmlands, the release of *E.coli* may occur through surface runoff resulting in a broad contamination of the surrounding environment, particularly in the watersheds (Mishra et al., 2007).

Accordingly, treatment for decreasing *E.coli* should be considered. Many kinds of treatment as the supply of lime nitrogen and hot air were executed (Minato et al., 2001). Especially, air drying is known as effective and simple treatment for decreasing *E.coli* (Saito and Mihara, 2010). However, air drying treatment might affect beneficial bacteria as well as pathogenic bacteria.

So, the objective of this study is to observe the differences of survival rate of several microorganisms such as *E.coli*, coliform bacteria and general bacteria under air drying treatment.

METHODOLOGY

The materials used in the experiment were collected from Fuji Farm of Tokyo University of Agriculture. As shown in Figure 1, there were three types of materials collected; the fresh cow dung, the 2 weeks and 12 weeks fermented manure having water content at 82%, 76% and 74%, respectively. In addition, organic matters constituted 88% in the fresh cow dung, 87% in the 2 weeks fermented manure and 85% in the 12 weeks fermented manure. The colony-forming unit (cfu) of *E.coli* was 9×10^4 cfu/g for the fresh cow dung. However, *E.coli* was not observed in the manure fermented for 2 weeks or 12 weeks. The colonies of coliform bacteria were 36×10^6 cfu/g for the fresh cow dung, 6×10^4 cfu/g for the 2 weeks fermented manure and 32×10^4 cfu/g for the 12 weeks fermented manure. The colonies of general bacteria were 68×10^7 cfu/g for the fresh cow dung, 43×10^6 cfu/g for the 2 weeks fermented manure and 3×10^6 cfu/g for the 12 weeks fermented manure.

Fig.1 Cow dung and manure

Table 1 Properties of cow dung and manure

	Period fermented	*E.coli* (cfu/g)	Coliform bacteria (cfu/g)	General bacteria (cfu/g)	Water content (%)	Organic matter (%)
Cow dung	0 days	9×10^4	36×10^6	68×10^7	82	88
Manure fermented for 2 weeks	2 weeks	0	6×10^4	43×10^6	76	87
Manure fermented for 12 weeks	12 weeks	0	32×10^4	3×10^6	74	85

Air drying experiment was conducted for 28 days. At 4th, 7th, 11th, 18th and 28th day, sampling and mixing of manure was carried out (Fig. 2).

The colonies of *E.coli*, coliform bacteria and general bacteria were evaluated through the laboratory experiments. The analysis of *E.coli* and coliform bacteria was carried out with XM-G agar medium as shown in Fig. 3. The analysis of general bacteria was carried out with general agar medium (Fig.4).

Fig.2 Air drying process in experiment

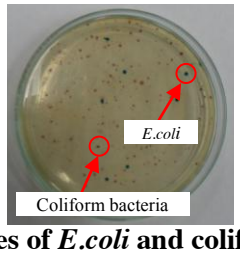

Fig. 3 Colonies of *E.coli* and coliform bacteria

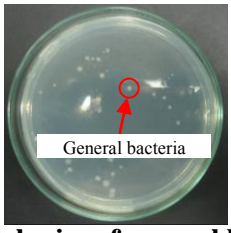

Fig. 4 Colonies of general bacteria

RESULTS AND DISCUSSION

Figs. 5-7 show the changes in the number of *E.coli* and water content in each sample. In cow dung, water content decreased with passing day, and further decreasing water content was not observed after 7 days passed. In addition, it was observed that the number of *E.coli* also decreased with passing day of air drying process. Based on the results of variance analysis, there was a significant difference between the number of *E.coli* of 0 day and that after 4 days passed. However, *E.coli* could not be sterilized perfectly. In 2 weeks or 12 weeks fermented manure, water content decreased with passing day, and there was no change in water content after 7 days passed as well as that of cow dung. In addition, *E.coli* was not detected from 2 weeks or 12 weeks fermented manure.

Figs. 8-10 show the changes in the number of coliform bacteria and water content in each sample. In cow dung, there was a tendency for the number of coliform bacteria to decrease with passing day of air drying process. And then, the number of coliform bacteria became stable at around 15×10^3 cfu/g. In 2 weeks or 12 weeks fermented manure, the number of coliform bacteria decreased with passing day of air drying process. Moreover, the number of coliform bacteria was not observed after 7 days passed.

Based on the results of variance analysis, there was a significant difference between the number of coliform bacteria of 0 day and that after 4 days passed. In 12 weeks fermented manure, the number of coliform bacteria also decreased with passing day of air drying process. Also, there was a tendency for the number of coliform bacteria to be stable after 11 days passed. Based on the results of variance analysis, a significant difference was observed between the number of coliform bacteria of 0 day and that after 4 days passed. Therefore, it was considered that air drying treatment is an effective way for decreasing pathogenic bacteria as *E.coli* or coliform bacteria.

Figs. 11-13 show the changes in the number of general bacteria and water content in each sample. In cow dung, there was a tendency that the number of general bacteria decreased with passing day of air drying process. Based on the result of variance analysis, there was a significant difference between the number of general bacteria before 7 days passed and that after 11 days passed. In 2 or 12 weeks fermented manure, the number of general bacteria decreased with passing day of air drying process as well. In addition, a significant difference was observed between the number of general bacteria of 0 day and that after 4 days or 11 days passed for 2 or 12 weeks fermented manure, respectively. Accordingly, it was considered that air drying process may diminish the number of general bacteria, which includes beneficial bacteria for decomposing cow dung.

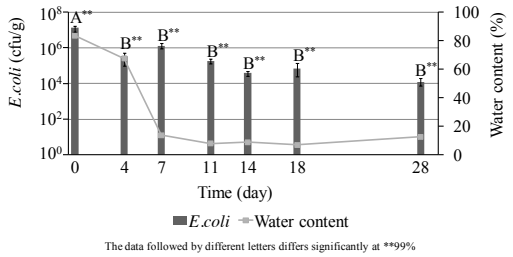

Fig. 5 Changes in *E.coli* and water content in cow dung

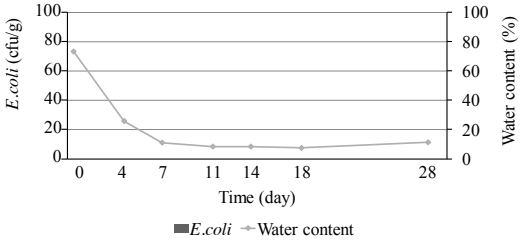

Fig. 6 Changes in *E.coli* and water content in 2 weeks fermented manure

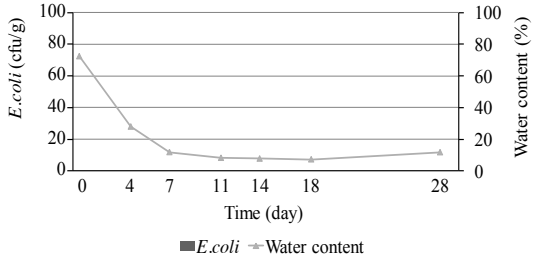

Fig. 7 Changes in *E.coli* and water content in 12 weeks fermented manure

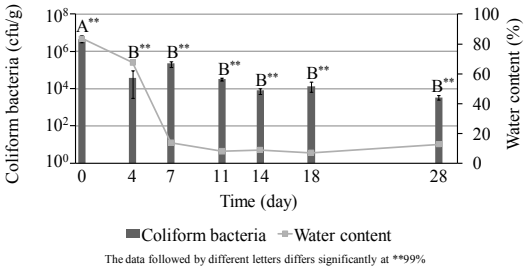

Fig. 8 Changes in coliform bacteria and water content in cow dung

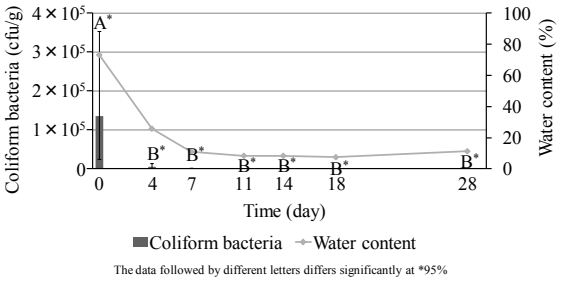

Fig. 9 Changes in coliform bacteria and water content in 2 weeks fermented manure

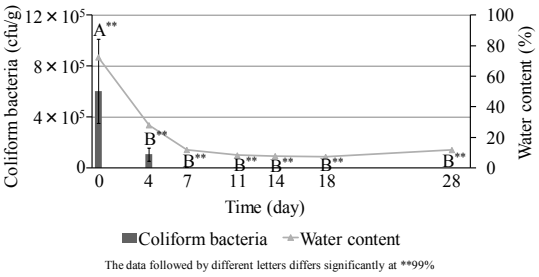

Fig. 10 Changes in coliform bacteria and water content in 12 weeks fermented manure

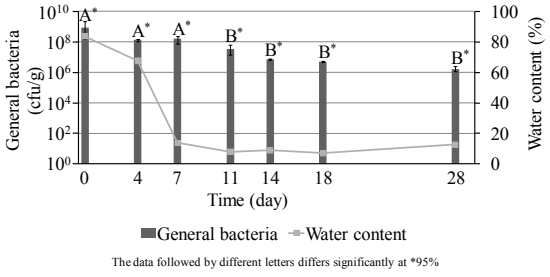

Fig. 11 Changes in general bacteria and water content in cow dung

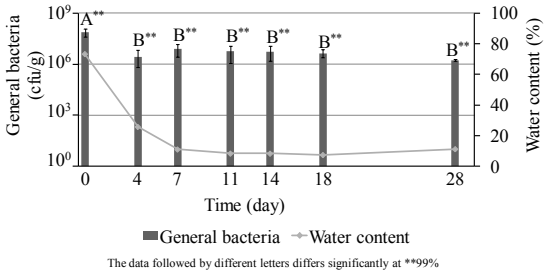

Fig. 12 Changes in general bacteria and water content in 2 weeks fermented manure

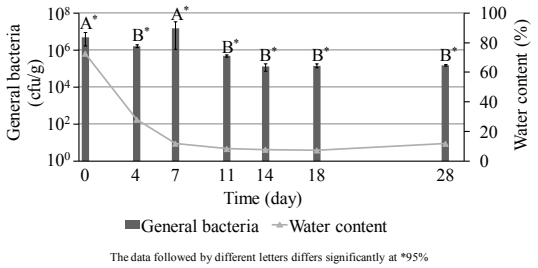

Fig. 13 Changes in general bacteria and water content in 12 weeks fermented manure

CONCLUSION

This study aimed to observe the difference in survival rate of *E.coli*, coliform bacteria and general bacteria under air drying treatment through air drying experiment for cow dung, 2 weeks and 12 weeks fermented manure.

Based on the experimental results, there was a tendency for the number of *E.coli* and coliform bacteria to decrease with passing day of air drying process. In addition, there was a significant difference between 0 day and after 4 days passed. It was considered that air drying treatment is effective way for decrease of pathogenic bacteria as *E.coli* or coliform bacteria.

However, the number of general bacteria also decreased with passing day of air drying process. It was considered that air drying process may diminish the number of general bacteria, which includes beneficial bacteria for decomposing cow dung.

Therefore, it was concluded that air drying treatment for cow dung is not proper treatment, but it is applicable to manure fermented for 2 weeks or 12 weeks from viewpoint of decreasing pathogenic bacteria as *E.coli* and coliform bacteria and of decomposing manure sufficiently. For manure fermented for 2 weeks or 12 weeks, it was proposed that air drying treatment for 10 days may be enough to decrease the number of *E.coli* and coliform bacteria extremely and to sustain certain population of general bacteria.

REFERENCES

Mishra, A., Benham, L. B. and Mostaghimi, S. (2007) Bacterial transport from agricultural lands fertilized with animal manure. Water Air Soil Pollut, 189-4, 127-134.

Gong, C., Koshida, J., Moriyama, N., Xiaodan Wang, Udou, T., Inoue, K., and Someya, T. (2005) Occurrence and survival of coliform bacteria, *Escherichia coli* and salmonella in various manure and compost. Journal of the Science of Soil and Manure, 76-6, 865-874.

Yagura, H., Tada, N., and Yasutomi, M. (2006) Nitrogen, phosphorus and coliform contamination of outflow in cattle grazing land. Research Bulletin of the Kyoto Prefectural Livestock Technological Research Center, 3, 71-73.

Minato, K., Tamura, T. and Maeta, Y. (2001) Effect of adding nitoroilime to composting of cattle manure and the impact on *Esherichia coli*. Bulletin of the Hokkaido Animal Research Center, 24, 11-16.

Minato, K., Tamura, T. and Maeta, Y. (2001) The effect of sterilized for *Eschrichia coli* in cattle manure by nitrolime adding. Bulletin of the Hokkaido Animal Research Center, 24, 21-24.

Saito, Y, and Mihara, M. (2010) Management of manure taking into account of *E.coli* loss from farmland. IJERD-International Journal of Environmental and Rural Development, 1-1, 175-180.