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Effects of Poultry Waste and Shochu Distillery By-product Fermented with Indigenous Microorganisms on the Growth and Behavior of Feeder Cattle, and Floor Condition in the First Half of the Fattening Stage

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Introduction

In Kagoshima Prefecture, about 170,000 tons of shochu distillery by-product is produced and 40% is used as fertilizer and as feed. However, 60% is thrown away into the sea. Throwing shochu distillery by-product into the sea is supposed to be prohibited in 2001. Therefore, an attempt was made to find out an effective use of shoshu distillery by-product in order to study the supplies of fresh shochu distillery by-product available for animal, pellet making and silage making. However, because of the shochu distillery by-product is high in moisture and easily spoiled, it is difficult to store in a way that is environmentally effective. Furthermore, pellet making is of high cost and making high quality silage is problemsome.

On the other hand, in this prefecture, cattle, pig and poultry farming is popular and the number of heads breed in 1996 is 320,000 cows, 1,330,000 pigs, 7,690,000 layer and 19,240,000 broilers. About 30% of the nitrogen which occurs from the discharge of dung and urine from this livestock is put back into the agricultural lands, but the remainder becomes surplus and causes problems as underground water pollution. In a study on making livestock dung and urine feed, Arave et al. [1] reported the possibility to use dried fermented fowl dung as feed for cows. Also, fermented organic good sources such as livestock dung and urine are proposed for making feed.

In this study, shochu distillery by-product and fowl dung with indigenous microorganisms: IMO[2-6,7,8-10,11,12] were fermented and fed to cattle in the first half of the fattening stage, and the growth of the cattle, influence of the paddock environment and cattle behavior were examined.

Material and Methods

Eight Japanese Black beef cows (5 heifers and 3 steers) were put in a feeder paddock

(49㎡) and the experimental feed was fed.

This fattening experiment was conducted from September 10th, 1997 to January 9th, 1998. The feed was based on a roughage-mix, soybean mix, soybean meal, pressed barley and corn. Identical feed was given to 2 and 3 experiment groups. Marushi feed was given to group 1.

In group 2, the main materials for the feed were shochu distillery by-product (23%), fowl dung (17%), sawdast (4%), rice bran (12%), fish meal (6%) and Marushi-combination feed (38%). They were mixed with preserved IMO.

These mixtures were then processed with recycling equipment using a steam pressure of 2.5 MPa and a pipe body internal pressure of 0.08 MPa. Moreover, 5 liters of IMO, 5 liters of marine plant juice (MPL), 5 liters of fish amino acid (FAA)[5], 5 liters of fermented plant juice (FPJ)[5] and 1 liter of extracted Shirasu solution (ESS) preserved in 300 liter of shochu distillery by-product were then added, mixed and stirred for 2 hours using the equipment. The fermented feed was 12.1% DCP and 65.3% TDN.

For group 3, the main materials for the feed were shochu distillery by-product (21%), fowl dung (22%), rice bran (43%) and IMO (14%) which was cultivated in the expansion. They were mixed and stirred for 2 hours in the same equipment using the same method and given at the rate of Marushi/obtained feed ratio of 7.1% DCP and 50.8% TDN (5 : 5). The animals were able to drink freely from cup and to eat salt as they liked. The profile of the experimental cattle is shown in Table 1.

Table 1. Profile of experimental cattle

Item	Group		
	1 (N=8)	2 (N=8)	3 (N=8)
Initial age (month)	12.8±2.4	12.0±3.0	12.3±2.0
Initial body weight (kg)	267.3±47.8	285.1±64.8	269.9±48.5

Body weight and body measurement were taken at the time of examination, beginning on December 19th and the daily weight gain was calculated. The ammonia concentration and moisture content of the cow floor was measured twice per month from September 10th, 1997 to January 9th, 1998. Their temperature was also measured twice per month from September 26th, 1997 to January 9th, 1998. For measurement of ammonia gas concentration, a detection pipe (G. Tech. Co.) was used and installed in a circular cylinder in a fixed place, and kept from being influenced by the wind when measurements were made. It calculated the moisture content of the cow floor from the weight difference before and after ventilation dryness. The cow floor temperature was measured with a digital thermometer (SK-2000MC) at a depth of about 30㎝ from the floor surface. Behavioral observations were made from October 1997 to January 1998, once per month and from 7 a.m. to sunset. Observations were made 3 minutes a part. Then, the frequency of occurrence for maintenance act of each individual and all observation frequencies in one day were noted. Behaviors were classified into eating, drinking, rumination standing, rumination-lying, stand-resting, recumbence, locomotion, etc.

Results and Discussion

Weight at the end of the experiment, daily gain (DG) and feed conversions are shown in Table 2.

Significant difference of weight was not found at the end of the experiment, when comparing a weight with the initial weight of the experiment. As for DG and feed conversion in all 3 groups, no significant difference was also found. From these results, it was thought that there was no influence of the fermented feed saving daily weight gain and feed conversion during the first half of the experiment.

The change in the ammonia gas concentration for the feeder cattle floor in 3 groups is shown in Figure 1. The ammonia gas concentration showed no significant difference among groups.

Table 2. Weight at the end of experiment, daily gain and feed conversion

Item	Group 1	Group 2	Group 3
Weight at the end of experiment (kg)	333.9±43.3	351.8±64.1	338.0±53.2
DG (kg)	0.66±0.10	0.66±0.20	0.67±0.14
Feed conversion*	12.7	13.1	13.1

* : Pooled data of all animals within each group.

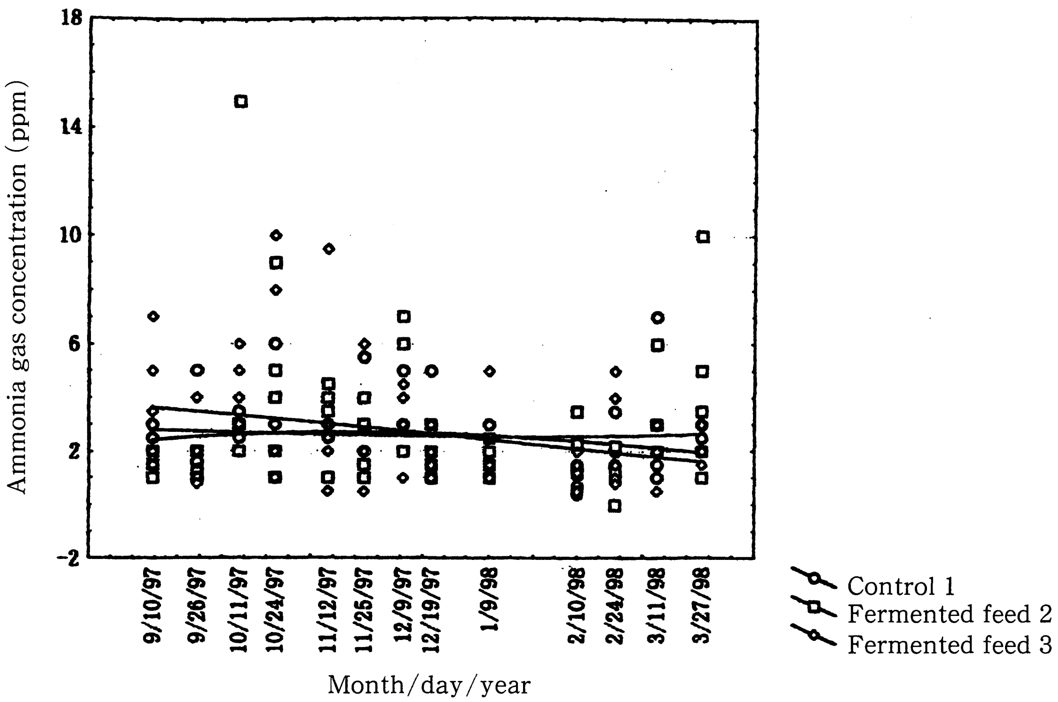

Fig. 1. The influence of the supply feed differences on the ammonia gas concentration in the floor for beef fattening cattle.

The change in floor moisture for all 3 groups is shown in Figure 2. As for floor moisture at the beginning of the experiment, group 3 showed a significanly lower value than other groups, but after September 26th, the difference was insignificant. However, floor moisture of

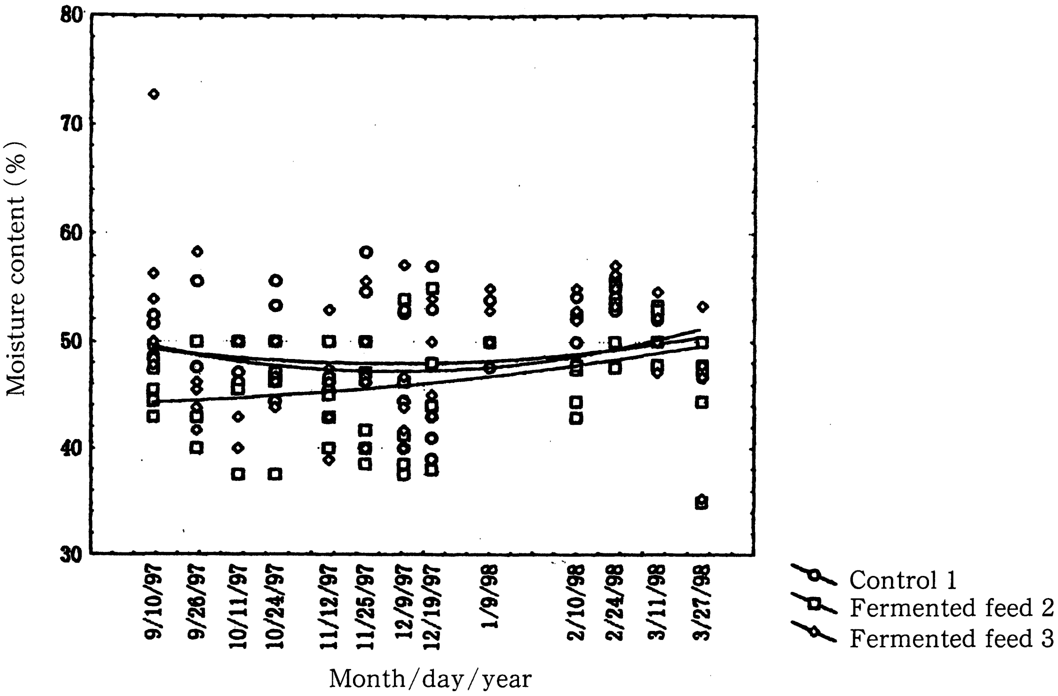

Fig. 2. The influence of the supply feed differences on the moisture content in the floor for beef fattening cattle.

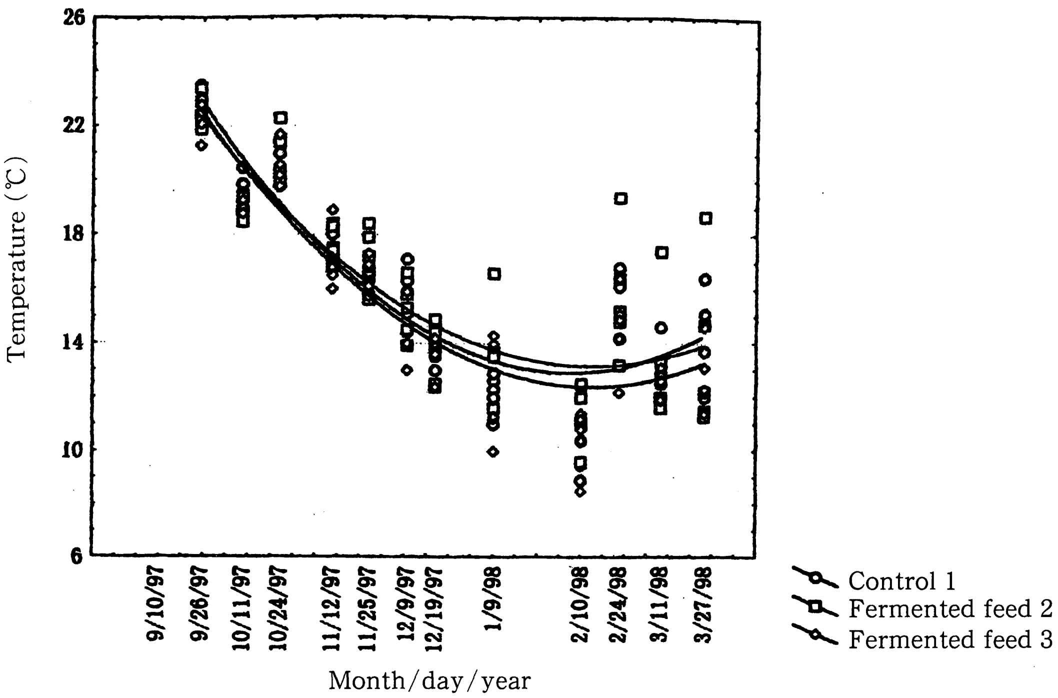

Fig. 3. The influence of the supply feed differences on the temperature in the floor for beef fattening cattle.

feeder cattle had a high tendency in the first half of the fattening stage in all 3 groups. Especially, the place where the cattle often stood and the place of feeding became muddy. Therefore, to clarify the reasons for the decreased floor moisture is needed.

The change in floor temperature of all 3 groups is shown in Figure 3. There was a tendency in the floor temperature to be low with the passage of the season. In all groups, a significant difference was not found.

The percentage for each maintenance behavior/day/head in the experimental periods is shown in Tables 3, 4, 5 and 6. There was no significant difference in eating behavior of 3 groups even when the investigation was made for four times. This may be due to no distinct difference in the taste of supplied feed. The rumination-lying behavior in the 3rd investigation showed to be significantly high in the 2nd and 3rd group. Also, as for the rumination-standing behavior in the 3rd investigation, 2nd and 3rd groups showed a significantly low value, when compared with the 1st group. However, no constant tendency was seen in the 1st, 2nd and 4th investigation. Therefore, in this study, no relationship between the type of fermentation feed

Table 3. Percentage for each individual maintenance behavior on day 1 ('97/10/4) in 1st investigation

Behavioral type	Group		
	1	2	3
Eating (%)	26.8±6.1	24.4±9.0	25.7±2.9
Drinking (%)	2.1±0.9	1.6±1.0	1.7±1.0
Rumination-standing (%)	4.1±2.5	16.9±7.4	5.2±3.5
Rumination-lying (%)	16.1±3.8a	4.4±3.3b	17.7±4.9a
Stand-resting (%)	20.1±6.2	37.4±10.9	16.7±2.8
Recumbency (%)	25.4±6.2	5.2±2.9	23.8±6.8
Locomotion (%)	2.0±1.0a	6.2±6.0b	3.4±1.5ab
Other (%)	3.1±1.6a	4.1±3.1ab	5.9±2.7b

a, b ($p<0.05$)

Table 4. Percentage for each individual maintenance behavior on day 1 ('97/11/13) in 2nd investigation

Behavioral type	Group		
	1	2	3
Eating (%)	25.9±4.9	21.5±5.4	22.7±7.1
Drinking (%)	1.6±0.8	1.2±0.8	1.0±0.6
Rumination-standing (%)	3.7±2.5	7.2±5.0	6.0±3.4
Rumination-lying (%)	12.6±4.2	8.2±4.2	12.3±8.0
Stand-resting (%)	24.2±3.7	33.0±11.9	28.5±12.2
Recumbency (%)	23.0±6.6	21.5±13.1	18.5±7.5
Locomotion (%)	2.2±0.8a	2.2±1.8ab	4.1±2.6b
Other (%)	6.5±3.5	6.8±3.4	6.8±1.8

a, b ($p<0.05$)

Table 5. Percentage for each individual maintenance behavior on day 1 ('97/12/6) in 3rd investigation

Behavioral type	Section 1	2	3
Eating (%)	22.8±8.8	25.0±3.5	25.0±7.3
Drinking (%)	2.7±2.1a	1.1±0.3b	1.6±1.3ab
Rumination-standing (%)	11.3±7.2a	5.4±2.4b	4.1±2.4b
Rumination-lying (%)	2.8±2.1a	10.6±3.7b	17.4±4.1c
Stand-resting (%)	41.7±16.0a	25.2±5.2b	23.6±8.8b
Recumbency (%)	4.5±3.0a	22.4±8.7b	18.9±8.2b
Locomotion (%)	5.5±2.5a	1.9±1.6b	2.3±0.7b
Other (%)	8.7±2.7	8.3±3.1	7.0±1.8

a, b ($p<0.05$)

Table 6. Percentage for each individual maintenance behavior on day 1 ('98/1/7) in 4th investigation

Behavioral type	Section 1	2	3
Eating (%)	27.5±3.7	28.3±4.3	30.5±4.5
Drinking (%)	1.7±1.0	1.4±0.6	1.4±1.1
Rumination-standing (%)	2.9±2.1a	8.6±4.3b	6.0±3.4ab
Rumination-lying (%)	10.8±4.0a	6.4±3.3b	10.6±3.5a
Stand-resting (%)	29.3±6.9	28.0±7.7	24.0±6.4
Recumbency (%)	20.3±5.5	18.1±9.6	18.4±6.7
Locomotion (%)	1.9±0.5a	2.2±1.1ab	2.9±0.9b
Other (%)	5.6±2.6	7.1±2.6	6.2±1.8

a, b ($p<0.05$)

and the ruminating behavior was found. Also, estrus in the heifers was observed four times and a significant difference was found in forms of locomotion behavior between groups 1 and 3. During the experimental period, no disease was observed in any groups.

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Summary

For the experimental feed in group 2, fermented feed (DCP 12.1%, TDN 65.3%) having 23% shochu distillery by-product, 17% poultry waste, 4% sawdust, 12% rice bran, 6% fish meal and 38% Marushi-combination feed was made with indigenous microorganisms. For the experimental feed (DCP 7.1%, TDN 50.8%) in group 3, fermented feed having 21% shochu distillery by-product, 22% fowl dung, 43% rice bran and 14% IMO, cultivated in the expansion, was made with indigenous microorganisms. The feeds for group 2 and 3 were distributed to each of the feeder cattle and compared with normal group on daily gain (DG), in terms of feed conversion and maintenance behaviors during the first half of the fattening stage.

The results obtained were as follows:

1) The body weight gain (DG) was 0.66～0.67kg and no significant difference was found among 3 groups.
2) As for the feed conversion, no significant difference was found among 3 groups.
3) Concerning ammonia gas concentration, there was no significant difference among 3

groups during experimental period.

4) The floor moisture at the beginning of the experiment showed significantly lower value in group 3. However, there was no significant difference among 3 groups afterward. Especially, the place where the cattle often stood and the place of feeding became muddy.
5) There was a tendeney in the floor temperature to be low as the season went by. In all groups, a significant difference was not found.
6) No disease was observed either in the experimental group or in the normal group.

Therefore, it couid be concluded that shochu distillery by-product and poultry waste can be used for fermenting feed with indigenous microorganisms, being possible for a 50% substitution for the feed for feeder cattle during the first half of the fattening stage.