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Potentials of the Fermented Food Wastes as the Animal Feed

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발효된 음식폐기물의 사료화 잠재력에 관한 연구

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요 약

음식쓰레기를 고속발효시켜 동물사료로서 이용할 수 있는가의 여부를 검토하고자 인하대학교 병원과 한양대학교 병원에서 환자급식용으로 제공하는 음식쓰레기를 일정량 채취하여 140L들이의 고속발효기에서 발효시켰다. 첨가제로서는 수분조절 및 영양분의 균형을 위하여 건조한 비지와 톱밥을 습중량으로 약 40~50% 섞었고 종균제를 내용물 총량의 1/300 정도 넣었으며 46~52°C의 발효온도에서 40~48시간 발효시켰다. 건조비지를 수분조절제로 사용한 경우는 조단백질과 조회분, 칼슘, 인의 함량이 시판되는 돼지사료보다 약간 떨어졌으며, 톱밥을 수분조절제로 사용한 경우는 조섬유의 함량만 크게 높았고, 기타 다른 성분은 크게 낮았다. 이러한 사실로 미루어 볼때 건조비지를 첨가제로 사용했을 때만이 보조사료로서의 가치가 인정된다고 하겠다.

핵심용어: 음식쓰레기, 발효, 사료

ABSTRACT

The purpose of this study was to evaluate the potentials of food wastes as an animal feed. The food wastes from the Inha University and Hanyang University Hospitals were used for this fermentation study. As the additive, approximately 40~50% of dry bean curd dregs and sawdust was mixed for moisture adjustment, certain amount(1/300 of the total content) of inoculum was added into the 140L volume fermenter and fermented for 40~48

hours with the temperature of 46~52°C maintained.

Fermentation product with the dry bean curd dregs had the lower content of crude protein, crude ash, calcium and phosphorus than the commercial pig feed. Fermentation product with sawdust had the lower content in most components than the commercial pig feed except crude fiber content. Based upon these findings, it was considered that only the fermentation product with dry bean curd dregs as the additive could be used for the animal feed aid.

Keywords: Food waste, Fermentation, Animal feed.

1. INTRODUCTION

In the fairly recent past, food wastes was almost completely recycled such as animal feed and compost. However, nowadays, most of food wastes is landfilled without any recycling.

Currently, food wastes comprises about 32% of municipal solid wastes and absolute amount of it increases annually. Since the food wastes is highly putrescible, it contaminates recyclables and produce most of leachate in the landfill site.

Recognizing the importance of recycling, Korean government legislated in 1992 the "Resource Conservation and Activation of Recycling Act"[1]. This act stipulates many important regulations concerning recycling of wastes. It also mandates the installation of on-site treatment facility for large scale restaurants which have daily service peroples over 2,000(Korea EPA, 1992)[2] until now, relatively few research have been done for recycling food wastes as an animal feed. Only a handful of researcher have performed some study on this subject.

Park[3](1993) in Japan succeeded in the animal feed production from waste food. She mixed waste food with bin curd residue and rice bran, and put this material into a drier. The resultant material was suitable for an animal feed. Shukei[4] (1993) investigated optimum parameters in food waste fermentation.

The purpose of this study was to examine potentials of food wastes from hospital as an animal feed using a lab-scale fermenter.

2. MATERIALS AND METHOD

2. 1 Configuration of the reactor

Fig. 1 shows the schematic diagram of the reactor used in this study and Fig. 2 shows the cross-sectional view of the fermenter.

The reactor was made of stainless steel. The external dimension was 1.0m

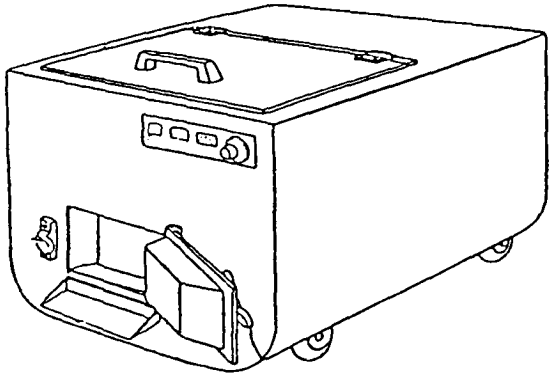

Fig. 1. Schematic diagram of the reactor.

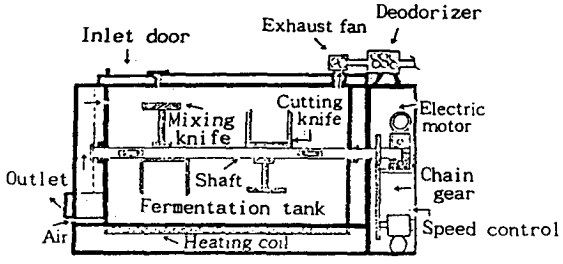

Fig. 2. Cross-sectional view of the fermenter.

in length, 0.64cm in width and 0.94cm in height. The thickness of the reactor material was 3mm and total volume was 140L.

2. 2 Operation

Approximately 80L of food waste whose moisture content adjusted to about 60% was introduced to the fermenter. A fermenting inoculum purchased from Pyeng dong B.G.C. Tech Co., LTD, in Japan was added to accelerate the fermentation. The amount was approximately 1/300 of the food waste added in wet weight basis.

The fermenter was operated until the moisture content of the fermenting material went down to 20%. This was achieved after about 36 hour's operation. The temperature inside the fermentor was maintained at approximately 50 during the operation.

The food waste used for this study was taken from the Inha University Hospital, which was providing to pati-

Table 1. Preparation of food waste from the Inha University Hospital.

Additive		Food waste added		Additive added		Inoculum added(g)
		Wet weight(kg)	Moisture content(%)	Wet weight(kg)	Moisture content(%)	
Dry bean curd dregs	Control	21	82.2	12	9.3	-
	Run 1	25	81.2	20	9.3	150
	Run 2	31	80.8	19	3.0	-
	Run 3	25	80.0	34	15.0	-
sawdust	Control	21	82.0	15	31.0	-
	Run 1	20	80.4	20	20.0	133
	Run 2	20	85.0	16	28.7	
	Run 3	18	85.0	18	20.7	

ents. Dried bean curds drege and sawdust were added as an additive to adjust the starting moisture content. Table 1 and 2 shows the food waste used for this research.

2. 3 Analysis

For the measurement of temperature and moisture content, Korean Standard Method for environmental samples(Korea EPA, 1992)[2] was followed. Carbon dioxide concentration was measured by gas syringe/gas sampling tube(Gastec) according to the method shown by the Standard Analysis Method for Animal Feed(Ministry of Agriculture, Forestry and Fishery[5], 1987).

3. RESULTS AND DISCUSSION

Table 5 and 6 show some operational results. The percentage of dry weight loss was between 35.6~64.5%, with dry bean curd dregs added, dry weight loss

Table 2. Preparation of food waste from the Hanyang University Hospital.

Additive		Food waste added		Additive added		Inoculum added(g)
		Wet weight(kg)	Moisture content(%)	Wet weight(kg)	Moisture content(%)	
Dry bean curd dregs	Control	25	82.2	18.9	9.3	-
	Run 1	25	75.0	14.5	27.3	132
	Run 2	25	75.0	9.1	18.8	30
	Run 3	25	81.0	11.0	12.0	30
sawdust	Control	21	82.0	15.0	31.3	-
	Run 1	25	75.0	13.1	31.3	126
	Run 2	25	75.0	11.8	17.6	30
	Run 3	25	81.0	13.5	21.1	30

Table 3. Biochemical composition of the food waste from the Inha University Hospital. (unit: %)

Component	Breakfast	Lunch	Dinner	Mean
Moisture content	84.4	84.0	84.0	84.1
Crude protein	19.9	35.4	26.7	27.3
Carbohydrate	61.0	41.3	55.2	52.5
Crude fat	7.4	8.5	7.3	7.7
Crude fiber	2.6	3.1	2.8	2.8
Crude ash	9.1	11.6	7.9	9.5
Calcium	2.4	1.5	0.4	1.4
Phosphorus	0.2	0.3	0.2	0.2
pH	6.8	6.9	6.7	6.8

Table 4. Biochemical composition of the dry bean curd cake dregs and sawdust. (unit: %)

Component	Dry bean curdcake dregs	Sawdust
Moisture content	9.3	31.0
Crude protein	21.8	-
Carbohydrate	40.9	54.5
Crude fat	10.9	-
Crude ash	3.5	-
Crude fiber	18.0	-
Calcium	0.4	-
Phosphorus	0.3	-
Total Nitrogen	-	0.16
pH	-	5.1

Table 5. Some operational results of food waste from the Inha University Hospital.

Additive		Dry weight loss (%)	Operation time (hrs)	CO_2 conc. (ppm)	Mean fermentation temperature(°C)
Dry bean curd dregs	Control	62.4	46.5	900	52
	Run 1	47.7	40	1,500	52
	Run 2	47.7	40	1,300	46
	Run 3	35.6	40	1,000	51
saw-dust	Control	13.9	48	800	49
	Run 1	47.7	48	1,000	51
	Run 2	45.8	59	1,000	48
	Run 3	48.6	48	1,000	52

Table 6. Some operational results of food waste from the Hanyang University Hospital.

Additive		Dry weight loss (%)	Operation time (hrs)	CO_2 conc. (ppm)	Mean fermentation temperature(°C)
Dry bean curd dregs	Control	62.4	46.5	900	52
	Run 1	64.5	47	1,300	53
	Run 2	47.2	35	1,000	51
	Run 3	54.2	32	1,000	51
saw-dust	Control	13.9	48	800	49
	Run 1	63.2	48	1,100	50
	Run 2	53.8	36	1,100	49
	Run 3	51.9	36	1,100	49

percentage was lower than the control, which was without the additive. In the case of sawdust additive, the test group with the additive showed the higher dry weight loss percentage.

The concentration of CO_2 was higher in the test group with additives, which indicated the more active microbial action. Considering this, the smaller dry weight loss seems to be ascribed to the original composition of the mixed food wastes, which would not easily biodegradable within a short time period.

Table 7 and 8 show the biochemical composition of the fermentation product. There was no difference in the biochemical composition between the fermentation product from food waste samples from the two hospitals. The fermentation product with dry bean curd dregs as the additive showed the higher content of crude protein, carbohydrates, crude fat and crude ash than the one with sawdust as the additive.

The content of crude fiber was much higher in the fermentation product with

Table 7. Biochemical composition of the fermentation product of food waste from the Inha University Hospital.

Additive		pH	Moisture Content(%)	Crude protein(%)	Cabo-hydrate(%)	Crude fat(%)	Crude fiber(%)	Crude ash(%)	Ca (%)	P (%)
Dry bean curd dregs	Control	4.6	12.3	12.8	61.1	7.0	11.41	7.55	0.28	0.28
	Run 1	4.5	10.6	13.1	62.2	7.5	11.74	5.50	0.42	0.31
	Run 2	4.4	13.4	13.8	60.2	9.6	9.44	5.50	0.42	0.31
	Run 3	4.4	9.8	14.3	59.5	9.6	9.44	6.79	0.28	0.31
saw-dust	Control	4.6	16.7	3.7	47.0	2.6	42.95	3.60	0.08	0.10
	Run 1	5.5	18.9	3.4	37.4	0.3	55.46	3.34	0.11	0.12
	Run 2	4.9	17.7	6.1	47.0	2.4	39.15	5.19	0.13	0.15
	Run 3	4.5	11.8	5.6	55.4	3.6	29.39	5.83	0.14	0.21

Table 8. Biochemical composition of the fermentation product of food waste from the Hanyang University Hospital.

Additive		pH	Moisture Content(%)	Crude protein(%)	Cabo-hydrate(%)	Crude fat(%)	Crude fiber(%)	Crude ash(%)	Ca (%)	P (%)
Dry bean curd dregs	Control	4.57	12.3	12.8	61.1	7.0	11.41	7.5	0.28	0.28
	Run 1	4.46	10.3	13.0	64.2	5.2	11.2	6.1	0.42	0.32
	Run 2	4.36	13.3	13.3	63.7	7.1	9.0	6.6	0.47	0.32
	Run 3	4.28	14.8	14.2	64.1	7.2	6.9	7.3	0.45	0.38
saw-dust	Control	4.58	16.4	3.7	53.4	2.6	42.9	3.6	0.08	0.10
	Run 1	4.36	14.1	6.2	48.6	3.4	37.1	4.4	0.24	0.22
	Run 2	4.31	18.5	7.9	50.3	4.8	31.2	5.5	0.29	0.28
	Run 3	4.35	18.1	8.8	57.0	4.4	22.2	7.3	0.24	0.19

sawdust addition. This is probably due to the high fiber content in the raw material. Table 9 shows the biochemical composition of a commercial pig feed.

When the results from Table 7 and 8 were compared to that of Table 9, the fermentation product which dry bean curd drege as the additive showed less percentage of crude fiber, crude ash, calcium and phosphorus than the commercial pig feed. In the case of the fermentation product with sawdust additive, most of the content except fiber were lower than the commercial one.

Table 9. Biochemical composition of a commercial pig feed.

Component	Remarks
Crude protein	More than 15%
Crude fat	More than 25%
Crude fiber	More than 5.5%
Crude ash	More than 8.0%
Calcium	More than 0.6%
Phosphorus	More than 0.4%

In sum, It was found that dry bean curd dregs as the additive for animal feed production with food waste was acceptable when the product is used as feed aid component, not as a main feed component. Further study is necessary to elucidate the microbiology, digestion efficiency and the growth rate of the live stock animals.

4. SUMMARY AND CONCLUSION

To evaluate the possibility of food waste as an animal feed, food waste obtained from two university hospitals was fermented with dry bean curd dregs and sawdust as the additive. The results can be summerized as follows.

(1) There was no difference in the biochemical composition between the fermentation product by food wastes samples from the two hospitals.

(2) Fermentation product with the dry bean curd dregs had the lower content of crude protein, crude ash, calcium and phosphorus than a commercial pig feed.

(3) Fermentation product with sawdust had the lower content of most components than the commercial pig feed except crude fiber content.

(4) It would be possible to use the fermentation product with dry bean curd dregs as the additive for the animal feed aid.

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