

THE EFFECT OF FERMENTED CORTEX RESIDUE OF ALOE AS FOOD ADDITIVES ON PIG'S GROWTH

Won-Sik Choi*¹, Pandu Sandi Pratama², Jong-Min Park³, Song-Won Chung⁴

*^{1,2,3 & 4} Department of Bio-Industrial Machinery Engineering, Pusan National University, Republic of Korea

Abstract

This paper investigated the effect of fermented Aloe saponaria species cortex residues as an alternative dietary supplement on pig's growth. In this research, the growth of one group of pigs fed by diets food containing general food were compared to another group fed by diets food containing fermented aloe. The diet food was fed once every 10 days up to 70 days, and then once every 20 days up to 152 day. During the experimental period, the feed amount, feed efficiency, daily weight gain and total weight gain of both groups was analyzed. The experimental results shows that the growth of pigs fed by fermented aloe is almost similar with the pigs fed by general food. This shows that fermented Aloe saponaria could be an alternative solution for dietary supplement.

Keywords:

Aloe Saponaria, Fermentation, Food additive, Pig's growth, Meat quality.

INTRODUCTION

Pigs require a number of essential nutrients to meet their needs to grow. Six general classes of nutrients including water, carbohydrates, fats, protein (amino acids), minerals, and vitamins. Moreover, antibiotics, chemotherapeutic agents, microbial supplements (prebiotics and probiotics), enzymes, and other feed additives are often added to pig diets to increase the rate and efficiency of gain, to improve digestibility.

According to Choi (2016), Aloe saponaria content rich in dietary fiber, cellulose, and minerals. This component is suitable for replacement the general dietary food. Aloe saponaria consist of three parts such as a cortex, a yellow fluid layer and a gel layer. The yellow fluid layer has an anthraquinone and chromium effective ingredients. The thick gel layer called aloe flesh is composed of polysaccharides and glycoproteins. Gel layer is mainly used as raw materials of medicines and cosmetics. After extracting the inside of the aloe leaf, a large amount of cortex part of the aloe leaves should be recycled.

This paper investigates the feasibility of using Aloe saponaria species cortex residues as a dietary supplement for pigs. Aloe saponaria fermentation could be an alternative solution dietary supplement.

MATERIAL AND METHOD

Material

In this experiment, 120 piglets were divided into two groups. One group was fed by diets food containing general food and the other group fed by diets food containing fermented aloe. The diet food was fed once every 10 days up to 70 days, and then once every 20 days up to 152 day.

Method

1) Feeding amount

The amount of feed was based on the notified label, which was fed on the farm at the time of the visit on the farm.

2) Feed efficiency

The feed efficiency was determined by dividing the amount of gain during a certain period by the amount of feeding.

3) Statistical analysis

The data obtained from the experiments were analyzed using the SAS Program (9.2 version) and Duncan (1995).

4) Daily weight gain

In the farm, breeding pigs were selected to separate pig farms, and diets containing the combination of general feeds and aloe additives were divided into feeds, which were fed once every 10 days until 70 days, and then once every 20 days until the passage of 152 days. The amount of daily gain was calculated by dividing the difference amount by the number of days.

5) Weight

Once every 10 days until 70 days have elapsed from the cooperative farm and every 20 days until 152 days have elapsed.

6) Crude fat

For crude fat, after 152 days the fresh fillet muscle were analyzed by animal husbandry laboratory at Pusan National University. To do this, 150 ml of Folch solution (methanol: chloroform = 2: 1) was added to 10 g of the sample according to Folch et al. (1957) method, homogenized with a homogenizer at 14,000 rpm for 2 minutes and filtered with a Whatman No. 1 filter. After removing the residue and the filter paper from the funnel, 100 ml of Folch solution was re-pulverized and filtered again. Then, 50 ml of distilled water was added to the filtrate, and after shaking, 200 ml of the lower layer solution was transferred. After the solution was taken out to room temperature, the water layer was removed with a Pasteur pipette, and then the solution was again filled with chloroform. Then, the extract was transferred to an Erlenmeyer flask, and anhydrous sodium sulfate (Na₂SO₄). Transfer the chloroform extract to a tube, mark the amount of the extract on the outside of the tube, select a clean 50 mL beaker, take the sample, dry it in a 100°C drying oven for about 1 hour, cool it in a desiccator for about 1 hour. After measuring the weight using a precision scale up to 5 digits, put 10 ml of the fat extract in the bag, put the hood in the tray and blow the solvent, and then put the sample beaker in the 100 °C drier. After drying for about 1 hour and a half, it was allowed to cool for about 1 hour.

- A. Weight of fat in 10 ml of chloroform extract (a), beaker weight before drying minus beaker weight after drying
- B. The amount of fat extracts (200 ml)
- C. First meat sample weight (10g)
- D. Fat extracts (10 ml)

7) TBARS

TBARS was prepared by adding 50 ml of 20% TCA (trichloroacetic acid, in 2M phosphate) to 20 g of a sample according to the method of Witte et al. (1970), and then homogenized using a homogenizer (Ultra-Turrax T25 Basic, IKA-Labortechnik, USA). After homogenization, 100 ml of distilled water was added to the homogenate, stir it, filter it with filter paper (Whatman No.1), and add 5 ml of this filtrate and 5 ml of 0.005M 2-thiobarbituric acid into a test tube. The absorbance was measured at a wavelength of 530 nm by a spectrophotometer (Optizen 3220UV, Mecasys Co., Ltd, Korea) and the absorbance was multiplied by 5.3 to calculate the TBARS value.

8) VBN

For VBN content, 90 ml of distilled water was added to 10 g of sample according to Takasaka's method (1975), homogenized with a homogenizer at 14,000 rpm for 2 minutes, filtered with a Whatman No. 1 filter, and 3 ml of the filtrate (0.066% methylred + 0.066% bromocresol green) prepared with 3 mL of 0.01N H₂BO₃ and ethanol at a ratio of 1: 1, and 3 mL of 50% K₂CO₃ was rapidly added to the inner chamber. The solution was kept at 37°C for 120 minutes and titrated with boric acid solution of 0.02 NH₂SO₄.

F: 0.02N-H₂SO₄ Standardization index

28: 0.02N-H₂SO₄1ml, the amount of N needed to consume, $0.02 \times 1.4 \times 1000$

RESULTS AND DISCUSSION

1) Feeding amount

Table 11 shows the amount of feed per pig per growing period of pigs fed with or without aloe. The feed intake of both control and experimental groups increased gradually. Jeon et al. (1996) showed that the addition of probiotics resulted in a higher intake of aloe than the control diet. There is no difference in the feed intake of the raised finishing pigs. Considering that there are conflicting results according to the preference of pigs, it was concluded that the addition of aloe supplement did not affect the preference of finishing pigs to feed.

Table 11. Changes in feeding weights of pigs fed different fermented feeds during fattening periods (kg)

Treatments ¹⁾	Fattening periods (days)										
	0	10~20	20~30	30~40	40~50	50~60	60~70	70~90	90~110	110~130	130~152
C	0.15	0.73	0.56	1.13	1.29	1.63	1.88	2.16	2.44	2.44	2.70
T	0.15	0.66	0.59	1.03	1.31	1.66	2.00	2.00	2.22	2.81	2.59

¹⁾ C: Pork feds without fermented aloe feed, T: Pork feds with fermented aloe feed.

2) Feed efficiency

Table 12 shows the feed efficiency of the breeding pigs fed with or without added aloe. The efficiency is based on the results of daily body weight gain and feeding rate. When the aloe was added, the feed efficiency was slightly better than that of the control group. It can be seen that the numerical value is higher than that of the control. As a result, it is considered that aloe supplemented feed is good for raising pigs.

Table 12. Changes in feeding efficiency of pigs fed different fermented feeds during fattening periods (%)

Treatments ¹⁾	Fattening periods (days)										
	0	10~20	20~30	30~40	40~50	50~60	60~70	70~80	90~110	110~130	130~152
C	-	64.66	55.56	57.78	64.81	65.00	21.88	26.45	30.19	29.96	34.80
T	-	64.15	66.05	62.73	70.60	64.38	22.77	35.65	31.78	31.15	34.10

¹⁾ C: Pork feds without fermented aloe feed, T: Pork feds with fermented aloe feed.

3) Statistical analysis

Table 13 shows the results of the grading of pigs fed with and without aloe. The incidence rate of grade 1 or higher was 90.48% in the control and 74.42% in the experimental group. On the other hand, the rate of 2nd grade is 9.52% in the control and 25.58% in the experimental group. Based on this, it is judged that the benefit of aloe in grading does not give good grades. Therefore, when the feed is fed, the addition of aloe gradually decreases the amount of feed after a certain period of feeding.

Table 13. Changes in ratio of quality grades from pigs fed different fermented feeds during fattening periods (%)

Treatments ¹⁾	Quality grade ratio		
	1+	1	2
C	52.38	38.10	9.52
T	27.91	46.51	25.58

¹⁾ C: Pork feds without fermented aloe feed, T: Pork feds with fermented aloe feed.

4) Daily weight gain

Table 9 shows the results of daily gain per day of pigs fed with or without aloe. In the control group, high weight gain was shown at 0 ~ 10 days, 40 ~ 60 days and 130 ~ 152 days, and high weight gain was observed at 0 ~ 10 days, 40 ~ 60 days and 110 ~ 130 days in experimental group. There was no significant difference in daily weight gain between the control and experimental groups during each feeding period.

Table 9. Changes in gained weights per a day of pigs fed different fermented feeds during fattening periods (kg)

Treatments ¹⁾	Fattening periods (days)											
	0	10	20	30	40	50	60	70	90	110	130	152
C	0.76±0.13 BCD	0.47±0.14 EFG	0.31±0.1 5G	0.63±0.21 CDE	0.83±0.28 BC	1.06±0.2 5A	0.41±0.40 FG	0.57±0.24 DEF	0.74±0.33 CD	0.73±0.32 CD	0.95±0.23 AB	
T	0.82±0.11 BC	0.43±0.15F	0.39±0.1 5F	0.65±0.19 D	0.93±0.30 AB	1.07±0.4 4A	0.46±0.46 EF	0.72±0.32 CD	0.71±0.35 CD	0.88±0.37 B	0.61±0.32 DE	

¹⁾ C: Pork feds without fermented aloe feed, T: Pork feds with fermented aloe feed.

There was a report that the intake of aloe powder supplemented diet was lower in the experimental group than in the control group. There was no significant difference in the amount of daily gain in this experiment group. These results are similar to those reported in the case of the addition of probiotics to growth pigs, but the increase in daily gain was somewhat improved compared to the control.

5) Weight

Table 10 shows the changes in body weight of pigs fed with and without aloe. In the control and experimental groups, there was a tendency to increase gradually with the lengthening period, while the control group increased in all the periods and the experimental group showed a significant increase with the lengthening of the rearing period ($p < 0.05$). There was no significant difference between control and experimental values in the same growth period. In this study, the effect of organic acid additions on the body weight and body weight gain of pigs was higher than that of the control in all treatments, but the difference was not significant.

Table 10. Changes in body weights of pigs fed different fermented feeds during fattening periods (kg)

Treatments ¹⁾	Fattening periods (days)											
	0	10	20	30	40	50	60	70	90	110	130	152
C		7.63±1. 26J	12.31±2. 09IJ	15.44± 3.27I	21.94±4. 72H	30.28±6. 88G	40.84± 8.22F	47.84± 5.52E	59.25±1 1.33D	73.97±1 2.61C	88.56±1 3.31B	107.69±1 2.10A
T		8.17±1. 13K	12.42±2. 00J	16.34± 2.55I	22.81±3. 04H	32.08±4. 17G	42.78± 1.07F	50.20± 4.88E	64.46±8. 36D	78.57±9. 22C	95.60±9. 59B	113.78±1 0.57A

¹⁾ C: Pork feds without fermented aloe feed, T: Pork feds with fermented aloe feed.

6) Crude fat

Table 8 shows the results of the fat measurement of the sirloin from pigs fed with and without aloe. Both the control and experimental groups showed a tendency to increase over the storage period, then to decrease and then increase again. The control value was significantly higher at 9th day, and the 15th day value was not significantly different from the whole value. In the experimental group, there was no significant difference between the measured values at all intervals. Significant differences between the control and experimental measurements in the same storage period were not seen in the whole interval.

Table 8. Changes in crude fat of longissimusdorsi from pigs fed different feeds during storage periods at 4±1 °C (%)

Treatments ¹⁾	Storage periods (days)					
	1	3	6	9	12	15
C	2.96±0.36B	2.93±0.79B	3.46±0.55B	4.80±0.93A	3.16±0.25B	3.80±0.21AB
T	3.20±0.84	3.58±0.63	4.69±1.59	4.28±1.84	2.88±0.65	3.49±0.56

¹⁾ C: Pork feds without fermented aloe feed, T: Pork feds with fermented aloe feed.

In this experiment, the crude fat content was maintained at 2.88 ~ 4.80% throughout the whole period. However, as a result of investigating the content of crude fat in seven meat processing centers in Korea, it was found that the content of fat in all sirloin was lower than that of fat in crude fat of 5.0 or more. The fat content of each domestic sirloin in Korea was 3.30 ~ 7.50.

7) TBARS

Table 6 shows the results of the TBARS experiment using the sirloin obtained from pigs fed with and without aloe. As the storage period elapsed, the experimental values of 6, 12, and 15 days were significantly increased compared with the rest of the control ($p < 0.05$), and the experimental values of 15 days were significantly different from the experimental values of all the intervals ($p < 0.05$). There was no significant difference between the control and experimental groups during each storage period, which means that the addition of aloe did not affect the TBARS value of the fillet muscle.

Table 6. Changes in TBARS of longissimusdorsi from pigs fed different feeds during storage periods at 4±1 °C (mgMA/kg)

Treatments ¹⁾	Storage periods (days)					
	1	3	6	9	12	15
C	0.04±0.01CD	0.06±0.01BC	0.03±0.01D	0.04±0.02CD	0.07±0.02B	0.17±0.01A
T	0.04±0.01B	0.04±0.02B	0.05±0.01B	0.07±0.03B	0.05±0.02B	0.15±0.02A

¹⁾ C: Pork feds without fermented aloe feed, T: Pork feds with fermented aloe feed.

As a result of this study, Brewer et al. (1993) showed that the oxidation of fat resulted in the decomposition of hydroperoxide, which is the primary product, into the secondary oxidation product, and the organic acid, aldehyde, ketone, Alcohols, carbonyl groups and polymers are still produced and are caused by microbial metabolism and degradation products produced by lipolytic enzymes. In addition, when the TBA value was 0.46 mgMA/kg or higher, the sensory quality was deteriorated. When the TBA value was above 1.2 mg MA / kg, it was determined to be completely corroded. And more than 4.0 mg MA/kg was completely corroded. The TBARS value increased from 0.04 at the initial storage time to 0.17 at the end of the storage period. As a result, it can be confirmed that the state of fresh meat has been maintained until the day has elapsed.

8) VBN

Table 7 shows the results of VBN experiments using beef from pigs fed with and without aloe. The experimental values of 12 and 15 days were significantly different from the experimental values of the rest of the experimental period ($p < 0.05$). And the addition of aloe does not seem to significantly affect the VBN value. There

was no significant difference between the control and experimental groups during each storage period, which means that the addition of aloe did not affect the VBN value of the fillet muscle.

The changes of VBN values during storage period showed a tendency to increase over time. Muscle proteases and microbial secreted enzymes in muscles during meat storage break down muscle proteins into amino acids and amino acids decompose into inorganic minerals of VBN. In addition, a significant increase in volatile basic nitrogen until the initial corruption was sensed by increasing bacterial counts. However, as the corruption progressed rapidly, it is said that the increase of nitrogen was greatly changed. As a result, the VBN value is 5 ~ 10mg% fresh and 30 ~ 40mg% is the initial corruption stage. Therefore, it is possible to maintain the state of the raw meat which has not been decomposed until the passage of time.

Table 7. Changes in VBN of longissimusdorsi from pigs fed different feeds during storage periods at 4±1 °C (mg%)

Treatments ¹⁾	Storage periods (days)					
	1	3	6	9	12	15
C	1.36±0.28C	1.09±0.09C	1.68±0.54C	16.55±6.06B	18.62±1.13B	27.73±8.89A
T	0.89±0.23B	0.95±0.64B	0.77±0.57B	19.09±10.51B	19.89±1.87A	18.32±1.26A

¹⁾ C: Pork feds without fermented aloe feed, T: Pork feds with fermented aloe feed.

CONCLUSION

The conclusion of this research are:

1. The amount of feed was gradually increased in both the control and experimental groups.
2. Feed efficiency showed a tendency to decrease in both control and experimental groups.
3. The results of the grading showed that the control was significantly higher than that of the experimental group, and the grade 2 occurrence rate was 2.6 times lower.
4. The daily gain was significantly higher in the control group from 0 to 10 days, 40 to 60 days, and 130 to 152 days, and from 0 to 10 days, 40 to 60 days, and 110 to 130 days in the experimental group respectively. There was no significant difference between the control and experimental groups.
5. The weight change did not show any significant difference between control and experimental groups, and it increased significantly with the duration of experiment.
6. Crude fat content increased with storage period but decreased to 4.80%. There was no significant difference between control and experimental groups.
7. TBARS was significantly increased with storage period in the control, and only the experimental value of 15 days showed significant difference in the experiment. There was no significant difference between control and experimental group.
8. There was no significant difference between VBN and storage period and between control and experimental period.

REFERENCE

1. Choi, S.M. 2016. Chemical Characteristics of Aloe Vera and Aloe Saponaria in ulsan Korea. *Intl. J. of Bio-Sci. and Bio. Tech.*, Vol.8, No.3, pp.109-118.
2. Choi, S.M. 2016. The Identification of Saponin to Obtain the Maximum Benefit from Aloe Saponaria. *Advance Sci. and Tech. Letters*, Vol. 120, pp.558-563.
3. Folch J., Less. M, Stanley G.H.S. 1957. A simple method for the isolation and purification of total lipids from animal tissues. *J. Biol. Chem.*, Vol.226, pp.497-509.

4. *Witte, V.C., Krause, G.F. and Baily, M.E. 1970. A new extraction method for determining 2- thiobarbituric acid values of pork and beef during storage. Journal of Food Science, Vol.35, pp.582-585.*
5. *Takasaka, W. K. 1975. Determination of freshness in meat. The Food Industry, Japan. Vol.18, pp.105-108.*
6. *Jeon B.S., Gwak J.H., Yu Y.H., Cha J.O, Park H.S., 1996. Effects of Feeding Enzymes, Probiotics or Yucca Powder on Pig Growth and Odor - Generating Substances in Feces. Journal of Animal Science and Technology, Vol. 38, pp. 52-58.*
7. *Brewer, M. S., Ikins, W.G. and Harbers, C.A.Z. 1992. TBA values, sensory characteristics and volatiles in ground pork during long-term frozen storage: Effect of packaging, J. Food Sci., Vol. 57, No. 3, 558-563.*