EFFECTS OF APPLE POLYPHENOL ON PIG PRODUCTION AND MEAT QUALITY

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Background and Objectives

Apples are one of the most popular and highly consumed fruit in the world. "An apple a day keeps the doctor away," as the old saying goes in western Europe. Recently it was discovered that apples contain the functional components (e.g. apple polyphenol etc.,) which perform a variety of effects such as anti-oxidation etc. Research and development of healthy or functional food making use of this polyphenol have been remarkable. Polyphenol has the effects such as anti-oxidation, anti-allergy, anti-variability, hypotensive, bacteriostatic action, anti-tooth decay, vital control etc. It is also said to meet the necessary condition as an anti-cancer substance. With the background mentioned above, evaluation of apples as food has been rising.

It has been reported that feeding green tea grounds to pigs can reduce the quantity of cholesterol in meat (Oshida et al; 1996). There are also the effects of polyphenol in green tea grounds. After applying apple polyphenol and apple fiber like green tea grounds, which are reproduced from pomace of apple juice or immature apples as agricultural waste, as feed for fattening pigs, we had examined the utility value of the feed, the change of serum lipid component, bacterial flora in feces, carcass and meat quality and the effects on the quantity of cholesterol in meat.

Materials and Methods

(1) Apple polyphenol and apple fiber

As for apple polyphenol, Apple Phenon 50 (AP50), made by Nikka Whisky, Japan, was used. AP 50 is made from immature apples and it is prepared by processing apple juice and adding dextrin. It consists of 2.4% of moisture, 45.5% of glucide and 51.1% of tannine. Apple Fiber (AF), made by Nikka Whisky, is prepared by drying and crushing pomace. Ingredients of AP50+AF, which is the mixture of AP50 and AF with the same weight ratio, are 8.9% of moisture, 4.1% of crude protein, 4.5% of crude fat, 45.6% of dietary fiber, 29.3% of glucide, 20% of ash and 6.2% of tannine.

(2) Experimental pigs and groups

The pigs for experiment were 30 heads of LWD at the age from 116 days to 149 days (average 131 days) with 67.0kg of average weight. The pigs were divided into three groups of 10 each in order to make the average weight and the ratio of male and female the same. Two groups out of three were trial groups and one was a control group. Formula feed with 1% of AP50 was provided to trial group I, and one with 0.2% of the mixture of AP50+AF was provided to trial group II. Control group was fed only formula feed.

(3) Measurement items and methods

Usability of feed, serum lipid component (T-cho, LDL-cho), bacterial flora in feces, carcass quality, meat quality including sensory evaluation by method of Sheffé (1952), quantity of cholesterol in meat and fatty acid composition were measured.

Principal Results

(1) Usability of feed: At the midpoint of the experiment period (4 weeks after the experiment had started), there were significant differences between trial I and II, and trial I and control group ($p<0.01$). As for the gain of body weight, trial I was 44.6kg, trial II was 42.1kg and control group was 39.8kg. The daily gain in trial I was 823g, II was 772g and control group was 741g (Table 1).

(2) Serum lipid component: There was no significant difference among the three groups on each item (Table 2).

(3) Feces: The average value of bacterial flora in feces of each group is shown by common logarithm (log) of bacteria per 1g of feces. *Bifidobacterium* which is a useful bacteria was detected 75% in trial group I, 0% in trial II and 25% in control group. *Magasphaera* which utilizes lactic acid generated by *Bifidobacterium* was detected in a high abundance in trial I. As for *Lactobacillus*, there was no difference among the three groups, while *Strertococcus* was hardly detected in trial group I. In trial II, there was a little low amount of *Enterobacterianceae* which is a harmful bacteria (Table 3).

(4) Carcass quality: There was no significant difference among three groups on each item (Table 4).

(5) Meat quality: There was no significant difference among the three groups except crude protein. There were significant levels of crude protein detected between trial groups I and II, between trial I and control group ($p<0.05$) and between trial II and control group ($p<0.01$) (Table 5).

From the results of sensory evaluation, there was no significant difference among trial I, trial II and control groups about color, odor, tenderness flavor and total point evaluation scores (data not shown).

(6) Cholesterol in meat: Cholesterol in meat (mg/100g) were 67.3±6.39 in trial I, 78.1±9.66 in trial II and 109.8±19.28 in control group. It means there are significant differences between trial I and control group and between trial II and control group ($p<0.01$).

(7) Fatty acid composition: Though there was no significant difference among the three groups on each item, trial I tended to contain more unsaturated fatty acid than trial II (Table 6).

Table 1. Productivity of pigs

Items	Trial I	Trial II	Control
Initial BW(kg)	66.6	67.3	66.9
Middle BW(kg)	88.8^{AB}	71.4^{A}	78.4^{B}
Final BW(kg)	111.2	109.4	106.7
Live weight gain(kg)	44.6	42.1	39.8
Daily gain(g)	823	772	741
Feed conversion	3.56	3.62	3.76
Feed efficiency	0.29	0.28	0.27

^{AB}:There are significant differences. ($p<0.01$)

Table 2. Serum lipid component in initial, middle and final(mg/dl)

Items		Trial I	Trial II	Control
T-cho	Initial	157	165	171
	Middle	113	111	104
	Final	102	98	96
HDL	Initial	66	75	69
	Middle	42	44	42
	Final	41	40	43
LDL	Initial	93	92	102
	Middle	72	67	62
	Final	63	61	58

Table 3. Bacterial flora in porcine feces (log)

Species of bacteria	Trial I	Trial II	Control
Total bacterial number	9.99	10.12	9.93
Bifidobacterium	8.56	ND	8.22
Lactobacillus	9.46	9.36	9.32
Eubacterium	8.72	8.78	8.47
Bacillus	ND	ND	ND
Corynebacterium	ND	ND	ND
Bacteroidaceae	6.66	9.50	9.39
Enterobacteriaseae	4.94	4.52	5.12
Streptococcus	8.94	9.58	9.53
Peptococcaceae	8.40	8.68	8.38
Veionellaceae	ND	ND	4.23
Megasphaera	6.84	6.01	6.22

ND: Not detected

Table 4. Carcass quality of pigs

Items	Trial I	Trial II	Control
Final body weight(kg)	111.2	109.4	106.7
Carcass weight(kg)	73.0	72.0	71.0
Dressing percent(%)	68.0	67.0	67.0
Weight ratio(%)			
Front	36.0	35.1	35.0
Center	35.8	36.6	36.9
Back	28.2	28.7	28.1
Carcass width(cm)	37.3	37.4	38.6
Carcass length(cm)	94.4	93.6	94.8
Rib length(cm)	54.9	55.4	57.1
Rib eye area(cm^2)	23.1	21.7	18.4
Rib eye volume(cm^3)	1,226	1,202	1,055
Back fat thickness(cm)	3.0	3.0	2.9

Table 5. Meat quality of pigs

Items	Trial I	Trial II	Control
Visual color score*			
Meat	3.3	3.5	3.9
Fat	2.2	1.6	2.1
Hunter values			
L	43.0	43.3	43.2
A	2.2	1.8	2.6
B	4.7	4.5	4.9
B/a	2.1	2.6	1.9
pH	5.7	5.7	5.6
Melting point of fat(℃)			
Back	31.8	31.6	33.2
Abdominal	44.8	43.4	42.1
Moisture(%)	74.1	74.2	74.2
Crude protein(%)	21.4^{ab}	21.8^{Aa}	21.1^{Ab}
Crude fat(%)	3.9	3.6	4.3
Crude ash(%)	1.1	1.1	1.1

*Evaluated with Pork Color Standard(1975)
There are significant differences in capitals ($p<0.01$) and in small letters ($p<0.05$).

Table 6. Fatty acid composition of meat(%)

Composition	Trial I	Trial II	Control
C16:0 palmitic acid	25.8	25.6	26.4
C18:0 stearic acid	13.5	14.0	14.4
C18:1 oleic acid	43.9	43.7	41.5
C18:2 linoleic acid	7.3	7.6	7.2
Lipid content(g/100g)	3.9	3.6	4.3

Conclusion

Fattening finishing pigs were provided feed added with Apple Phenon (AP) and Apple Fiber (AF) for two months. The effects of it on body weight, usability of feed, serum lipid component, cholesterol in meat, carcass and meat quality were experimented for three groups (trial group I and II with AP and AF added, and control group). The following results were obtained:

1)Usability of feed improved by adding AP and AF to feed.
2)*Bifidobacterium* in feces increased by adding AP and AF to feed.
3)Crude protein in meat increased by adding AP and AF to feed.
4)Cholesterol in meat decreased maximum 42% by adding AP and AF to feed.

From these results, AP and AF deserve to be called as functional feed.

References

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