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Evaluation of Fermented Food Wastes (FFW) as Feedstuffs on Meat Quality in Growing-Finishing Pigs

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Abstract

To investigate the effect of feeding the fermented food wastes (FFW) on meat quality, twenty pigs produced from four treatments with different mixing rates of FFW [100% concentrate (control), 25% replacement with FFW (25% FFW), 50% replacement with FFW (50% FFW) and 100% fermented food wastes (100% FFW)] were slaughtered. Carcass characteristics were differentiated if FFW replacement rate was higher than 50%. The proximate compositions of hams and loins in control pigs were not different from ($p>0.05$) those of the FFW replacements, regardless of mixing rate of FFW replacement. Drip loss of pork loin increased ($p<0.05$) with increased rate of FFW replacement. Hunter color values were affected ($p<0.05$) by the FFW replacement and storage time, while not significantly changed ($p>0.05$) when replaced with lower than 25% FFW. With replacing more than 50% FFW, redness values tended to be decreased, while yellowness values increased. Aerobic plate counts (APC) were rapidly increased 12 d for the control and 8 d for FFW replacement, and microbial stability seemed to be lowered when the rate of FFW replacement rate was more than 50%. These results indicated that the replacement of concentrate diets with FFW was still nutritious feedstuffs for pig diet, however, no more than 50% FFW replacement was recommended to have similar effect to those with the control (100% concentrate).

Key words : fermented food wastes, carcass characteristics, drip loss, hunter color values, aerobic plate counts

Introduction

Food wastes (FW) are defined as any edible wastes obtained from the process of food handling, such as production, transportation, distribution and consumption(Price et al., 1985). They are generally high in fat and salt contents, and moderately high in protein and ash contents(Kornegay et al., 1970; Myer et al., 1999). There has been growing interested in using these as feedstuffs during the last few decades due to the increased disposal cost and environmental contamination(Westendorf et al., 1996; Bryhni et al., 1999). Thus, FW recycling might have economic advantages due to saving the disposal cost(Price et al., 1985; Derr et al., 1988). However, utilization of these as feeds must be sterilized prior to use to avoid health and safety risks(Westendorf et al., 1996).

To manufacture FW as feedstuffs, pelleting and drying may be necessary procedure to produce nutritious feeds for pig. Myer et al.(1999) blended wet food waste with a dry feedstock(soyhulls and wheat flour) and dried. They found that dehydrated food waste(DFW) products were nutritious for the inclusion of pig diet.

In addition, DFW products were well used by the pig which utilized the higher fat(%) contributed by the DFW diets. However, one of the problems of feeding FW is the variation in sources, resulting in nutrient composition. Thus, the standardization of FW would be performed to be solved before it is commercially utilized.

Fresh meat consumption in present times is reduced by several phenomena-healthy and safe food, as well as growing environmental and ethical concerns. Intrinsic pork quality characteristics, such as leanness, taste, odor, tenderness and

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juiciness can be affected at different stages through the pork chain. Factors affecting meat quality may include genotype choice, production conditions such as castration, diet composition, feeding and housing system. Feeding FW to livestock is important not only economic advantage, but also avoiding environmental contamination. Furthermore, evaluation of meat quality as affected by the feeding these FW at a different replacement rate should perform if it may commercialize to feed animals. Thus, the objective of this study was to determine the effects of feeding different rate of fermented food wastes to pigs on carcass characteristics and meat quality in growing-finishing pigs.

Materials and Methods

Animals, Diets and Fermented Food Waste (FFW) Management

Twenty male Duroc × Landrace crossbred pigs (27~29 kg), selected at about 4 weeks of age were used in this study. Fermented food wastes (FFW) obtained from food restaurant in Gwangju area was manufactured according to the procedure of Jung et al. (2000) and Lee et al. (2000). Processing procedure is shown in Fig. 1. The compositions of FFW were analyzed and the proximate composition was 24% crude protein, 12.2% crude fat, 7.8% crude fiber, and 8.3% ash. Four treatments with different mixing rates [0% FFW (100% commercial diet: control); 25% FFW ; 50% FFW and 100% FFW] were fed for pigs as a feeding trial.

Slaughter and Sampling

After 20 pigs were grown up to 27 wks in each pen, they were conventionally slaughtered to measure carcass weight, backfat and meat grade which measured according to Korean pork grading system. *M. semitendinosus* and *M. longissimus* were removed from the carcasses after 4 d of refrigerated storage, divided into 4 sections and then vacuum packaged for storage at 4℃. During storage, physico-chemical properties and microbial changes were measured at 2-wks interval up to 6 wks.

Analytical Measurements

The moisture, crude protein (CP), crude fat (CF) and crude ash contents of loin and ham were determined by standard procedures (AOAC, 1995). Drip loss was determined by

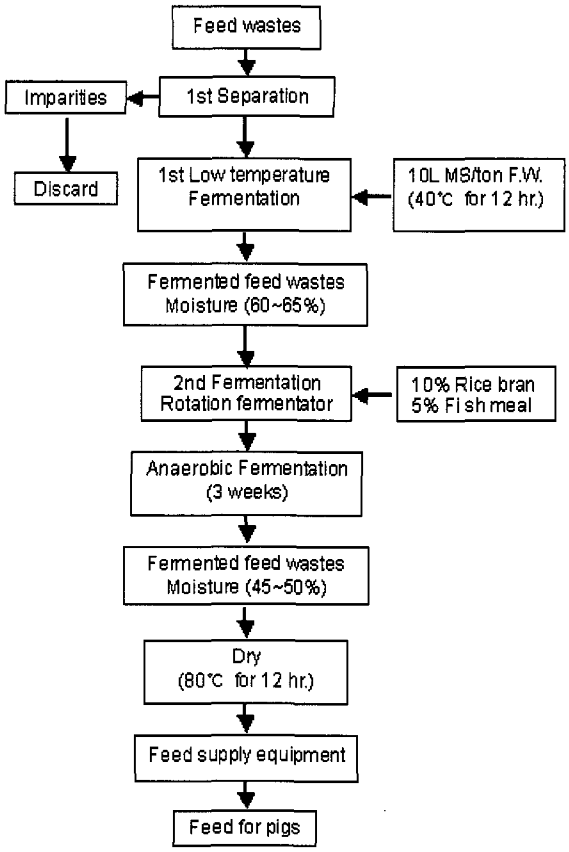

Fig. 1. Processing procedure for the manufacture of fermented food wastes.

weighing moisture release (%) during storage at 4-d interval. Meat color was measured after exposing surface to the air for 30 min at 2℃. A Color difference meter (D-25M, Hunter Lab.) was used for measurement and average of triplicate measurements was recorded. The standard white plate was as followed: Y=92.4, x=0.3136, y=0.3196. Total plate counts were carried out in accordance with the standard plate count method of AOAC (1995).

Statistical Analysis

Data were analyzed by mixed model analysis of variance with SAS program (1988) for a completely randomized design.

Result and Discussion

Carcass Characteristics and Meat Grading

The carcass characteristics containing carcass weight, back fat and meat grade in finishing pigs are summarized in Table 1. Mean values for carcass weight were approximately 82.4 kg in control pigs (100% concentrate), whereas carcass weight of

Table 1. Carcass characteristics in finishing pigs

Measurements	Mixing rate (%) (Concentrate : Fermented food wastes)			
	100:0	75:25	50:50	0:100
Carcass wt (kg)	82.4[b]	88.0[a]	80.0[b]	50.5[c]
Back fat (mm)	20.2[ab]	22.8[a]	18.8[bc]	7.5[d]
Carcass grade [head (%)]				
A	3 (60)	2 (40)	2 (40)	
B	1 (20)	2 (40)	1 (20)	
C	1 (20)		1 (20)	
D		1 (20)	1 (20)	1 (20)
E				4 (80)

[a-d] Means with different superscripts in the same row differ significantly ($p<0.05$).

pigs fed with 25% replacement rate of fermented food wastes (FFW) was higher ($p<0.05$) than control pigs. However, pigs fed with 50% FFW replacement had similar carcass weight to those with control. In addition, carcass weight gained distinguished decrement by 50.5 kg pig^{-1} in 100% FFW. These results indicated that the FFW can be replaced up to 50% of concentrate diet. Nam et al. (2000) reported that the carcass weight of pig fed with 30% FW pellet was not statistically different from ($p>0.05$) controls, however those with 50% FW pellet was lower than ($p<0.05$) the control. Thus, our result was supported by that of Lim et al. (2000) who reported that dressing yield of mallard fed with FFW up to 50% was not different from those with controls.

Back fat in control pigs was 20.2 mm, which was not different from those in pigs fed with 25 or 50% FFW replacement of concentrate diet. However, greatly lowered backfat by 7.5 mm was observed those in 100% FFW. This result was partially agreed with the results of Myer et al. (1999) who reported that the average back fat thickness was unaffected by the inclusion up to 80% of dehydrated FW in the finishing diet. However, Nam et al. (2000) reported that no differences in back fat thickness of pigs were observed between control and pigs fed with 50% pellet. This discrepancy was partially due to the compositional difference of each FFW pellet to be fed.

Carcass grade as affected by the replacement of FFW was followed: The percentage of A and B grade was 80% for the control and 25% FFW replacement. However the 50% FFW replacement was reduced the A, B grade by 60% and 100% FFW replacement had no A, B grade. These results indicated that carcass grade lowered as FFW replacing rate was increased, and especially 100% FFW replacement may not be used in the commercial meat production.

Proximate Analysis

Proximate composition of loin and ham produced by the different mixing rate of fermented food wastes (FFW) is shown Table 2. Moisture content of loin in control (100% concentrate) was by 60.03%. Moisture contents (%) of pigs fed with 25, 50 and 100% FFW were 60.88, 59.31 and 60.75%, respectively, and these values were not different from ($p>0.05$) that of control. Crude fat content of loin in control

Table 2. Proximate composition of loin and ham produced by the different mixing rate of fermented food wastes

Parameters	Mixing rate (%) (Concentrate : Fermented food wastes)			
	100:0	75:25	50:50	0:100
Loin				
Moisture (%)	60.03±0.00	60.88±0.19	59.31±0.11	60.75±0.31
Crude fat (%)	21.91±0.06	21.76±0.48	21.72±0.33	20.61±0.49
Crude protein (%)	17.06±0.28	16.26±0.56	17.87±0.09	17.46±0.19
Crude ash (%)	1.00±0.44	1.10±0.11	1.09±0.12	1.18±0.00
Ham				
Moisture (%)	61.67±0.68	62.27±0.65	62.13±0.17	62.94±0.06
Crude fat (%)	19.79±0.09	19.95±0.04	20.60±0.02	17.83±1.01
Crude protein (%)	17.35±0.33	16.50±0.72	16.07±0.17	17.84±0.70
Crude ash (%)	1.19±0.26	1.29±0.37	1.20±0.02	1.39±0.25

Mean±S.D.

was by 21.91% and was not different from ($p>0.05$) the others. Crude protein content of loin in control was 17.06% and tended to decrease in 25% FFW, but was not different from those with 50% and 100% FFW. Crude ash content of loin in control was 1.0% and increased slightly in 25%, 50% and 100% FFW, but not significantly different ($p>0.05$).

Like loin muscle, moisture, fat, protein and ash contents (%) of ham in control pig were not different from ($p>0.05$) other treatment for FFW replacement. These results indicated that the proximate composition of loin and ham was not affected ($p>0.05$) by the replacement of FFW in the concentrate diet.

Drip Loss (%)

Change in drip loss of pork loin produced by the different mixing rates of fermented food wastes is shown Fig. 2. Drip loss of pork loin in all group tended to increase throughout storage period. During increased storage at 2 d and 12 d, drip loss of pork loin in control increased from 15.93% to 16.56%. At each storage day, the drip loss of control was lower ($p<0.05$) than those with FFW treatment. Results of this study suggested that drip loss of pork loin increased ($p<0.05$) with increased rate of FFW. In excessive replacement with FFW, meat flavor and texture characteristics might be gradually reduced with continuous drip loss during storage. The reason why drip loss was reduced with increased mixing rate of FFW replacement was not clear, however, as a result, detrimental effects were expected if the meat was stored for long time at refrigerated temperature due to increased drip loss.

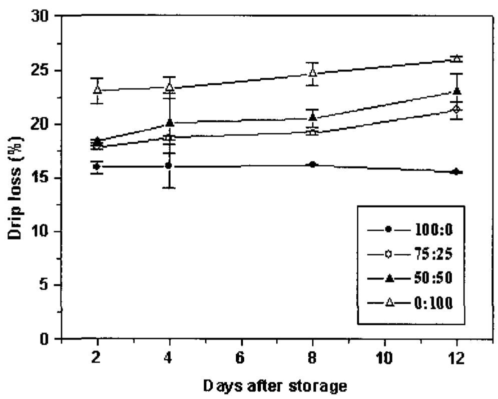

Fig. 2. Changes in drip loss (%) of pork loin as affected by the different rate of replacement with FFW during refrigerated storage. (● ; 100% commercial diet:0% FFW, ○ 75% commercial diet:15% FFW, ▲; 50% commercial diet: 50% FFW, △; 0% commercial diet: 100% FFW).

Hunter Color Values (L, a , b)

Changes in Hunter color values of pork produced by the different mixing rates of fermented food wastes (FFW) are summarized in Fig. 3. At the initial storage, muscle color of pig fed with more than 50% FFW was lighter than control and 25% FFW, and had similar trend during storage time. The control and 25% FFW replacement was redder than those of pigs fed more 50% FFW. However, the intensity of red color of 25% FFW was turn to be similar to those of 50 or 100% FFW from 4 to 8 d of storage. Yellowness (b) value of control and 25% FFW was lowered ($p<0.05$) relatively, while higher ($p<0.05$) in 50% and 100% FFW at initial storage. However, yellowness values of 100% FFW were higher than others after 4 d of storage. These results indicated that Hunter color values were affected by the FFW replacement and storage time, and the differences were minimal if the replacement rate was less than 25% FFW.

Aerobic Plate Counts (APC)

Changes in APC values of pork produced by the different mixing rates of fermented food wastes are summarized in Fig. 4.

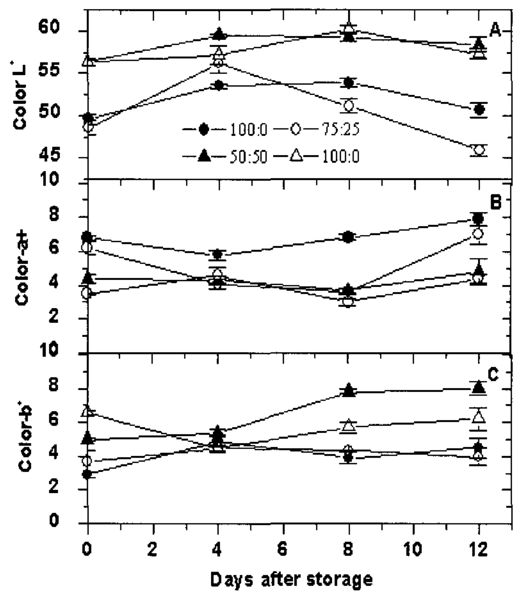

Fig. 3. Changes in Hunter color values of pork loin as affected by the different rate of replacement with FFW during refrigerated storage. (● ; 100% commercial diet:0% FFW, ○ 75% commercial diet:15% FFW, ▲; 50% commercial diet: 50% FFW, △; 0% commercial diet:100% FFW).

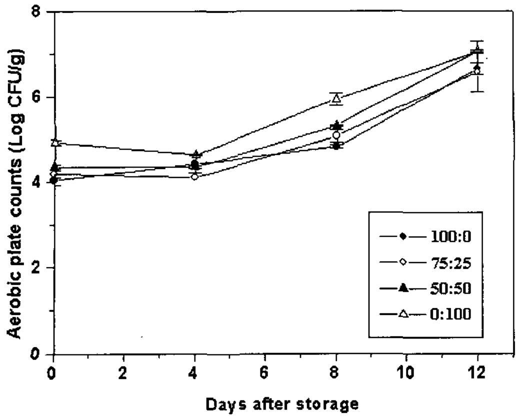

Fig. 4. Changes in aerobic plate counts (Log CFU/g) of pork loin as affected by the different rate of replacement with FFW during refrigerated storage. (● ; 100% commercial diet:0% FFW, ○ 75% commercial diet:15% FFW, ▲; 50% commercial diet: 50% FFW, △; 0% commercial diet:100% FFW).

Aerobic plate counts (APC) of control were started to increase after 6 d of storage, whereas APC in pig muscle fed with more than 25% FFW was rapidly increased 8 d of storage. Thus, differences were observed ($p<0.05$) after 8 d of storage between control and FFW mixing rate higher than 50%. Results of this study also indicated that APC value seemed to be higher when the mixing rate of FFW replacement was more than 50% FFW.

Conclusion

Twenty pigs produced from four treatments with different mixing rates of FFW [100% concentrate (control), 25% fermented food waste (FFW), 50% FFW and 100% FFW] were slaughtered and measured the characteristics. If FFW replacement rate was higher than 50%, carcass characteristics were differentiated. Although proximate compositions of hams and loins in control pigs were not different those of the FFW replacements, drip loss of pork loin increased ($p<0.05$) with increased rate of FFW replacement. With replacing more than 50% FFW, redness values decreased, but yellowness values increased. Microbial stability seemed to be lowered when the rate of FFW replacement rate was more than 50%. These results indicated that the replacement of concentrate diets with FFW no more than 50% had similar characteristics to those with the control without quality defects.

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