

Sensory Property Improvement of *Jokbal* (Korean Pettitoes) Made from Frozen Pig Feet by Addition of Herbal Mixture

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Abstract

This study was conducted to improve sensory quality of *Jokbal* (Korean Pettitoes) made from frozen pig feet by addition of herbal mixture (glasswort, raspberry and *Sansa* powders). After adding herbal mixture, lipid oxidation (2-thiobarbituric acid values, TBARS), sensory property, and textural property were determined. Herbs were individually added into cooking soup at concentration of 6% (low concentration treatment, LCT) or 12% (high concentration treatment, HCT) of raw pig feet. Refrigerated pig feet were used as control. Thawed feet without any herbal mixture were used as freezing treatment (FT). TBARS in LCT or HCT were lower than that in FT, and showed the similar to that in Control. Addition of the herbal mixture was effective in improving the flavor and textural property of thawed feet by inhibiting lipid oxidation and protein denaturation in a dose-dependent manner.

Keywords: freezing-thawed pig feet, *Jokbal*, oriental herbs, quality improvement, sensory property, textural property

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Introduction

Jokbal (Korean Pettitoes) is one popular food made from pork trotters with various seasoning. *Jokbal* contains abundant protein (especially collagen) and minerals. Pig feet have been generally distributed in refrigerated condition. Sometimes, feet are stored frozen under demand-supply program of pork in order to adjust the supply and demand. However, freezing treatment of raw feet deteriorates the textural and organoleptic quality of *Jokbal* by denaturing protein and causing lipid oxidation during long term storage. Even though data on frozen pig feet or *Jokbal* could not be obtained, quality deterioration by freezing and frozen storage can be inferred from various reports (Kim *et al.*, 1998; Levie, 1984; Moon *et al.*, 2000; Pikul *et al.*, 1984). Several studies have tried to add natural antioxidants and herbal ingredients to improve the sensory quality of meat products deteriorated by freezing (Han *et al.*, 2003; Hong *et al.*, 2002; Hwang *et al.*, 2014; Lee *et al.*, 2013). Textural property can be dependent upon cooking condition (time, temperature, pH, and salt content, etc). Pig skin is consisted of collagen type A (iso-

electric point, pH 7-9.5). Gelation can be easily extracted from pig skin by acidic treatment. Meat tenderness can also be improved by acidic treatment (Divakaran, 1984). Therefore, it has been hypothesized that frozen pig trotters may be tendered by cooking under acidic condition originated from herbal ingredients containing organic acids (Yeom *et al.*, 2004; Yoon *et al.*, 2003). In addition, addition of herbal ingredient can mask the rancid odor. Of many herbal ingredients, glasswort (*Salicomia herbacea* L), raspberry (*Rubus coreanus*), and *Sansa* (*Crataegi fructus*) have abundant organic acids with antioxidant effect. They have been shown to improve sensory qualities of meat products (Yoon *et al.*, 2003). Therefore, these three herbal powders were prepared to improve the sensory quality of *Jokbal* made from frozen trotters in this study. Their effect on the sensory and textural properties of *Jokbal* was examined in this study.

Materials and Methods

Sample preparation

Pig trotters (n=75) frozen at -20°C for at least 6 mon and refrigerated trotters (n=25, Control) were obtained from a local meat packer. Glasswort, raspberry, and *Sansa* powders were purchased from an oriental herbal market. Herbal mixture was prepared with equal weight of each

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powder. Other ingredients were obtained from a domestic market.

Frozen trotters were thawed with flowing tap water for 8 h. Thawed or refrigerated trotters were used to make *Jokbal* samples as Treatments and Control, respectively. Treatments (frozen and thawed) were divided into three groups: 1) only freezing treatment without addition of herbal mixture (FT, n=25); 2) low concentration treatment (LCT, 6% of herbal mixture in 100 g of raw feet weight, n=25); 3) high concentration treatment (HCT, 12% of herbal mixture in 100 g of raw feet weight, n=25).

Jokbal samples were prepared with the method of Lee *et al.* (2014) with slight modifications. Briefly, each sample was boiled for 15 min, washed with tap water, and stored at refrigerator. *Jokbal* cooking soup from 2 kg of raw feet weight was also prepared with 4.0 L of tap water, 91.0 g of ingredients (15.0 g of soy sauce, 15.0 g of soybean paste, 16.0 g of corn syrup, 4.0 g of rice wine, 3.0 g of Mirim, 4.0 g of brown sugar, 10.0 g of ginger, 10.0 g of leek, 8.0 g of garlic, 4.0 g of turnip, 0.5 g of dried red pepper, 1.0 g of cinnamon, 0.2 g of bay leaves, and 0.3 g of whole pepper), and 120 mL of tap water with 120 g of herbal mixture for LCT or 240 g of herbal mixture for HCT. Two hundred forty ml of tap water was added for the Control or FT instead of the herbal mixture. All ingredients and water were added into a 10 L of stainless pot and boiled for 30 min. Pig feet samples were cooked into a boiling soup with three steps of cooking. The first step was strong boiling for 1 h. The second step was mild boiling for 2 h. The third step was weak boiling for 1 h. After cooking, each *Jokbal* sample was removed from the pot and cooled at a room temperature for subsequent experiments.

2-Thiobarbituric acid (TBARS) values

To determine lipid oxidation of *Jokbal* samples, TBARS value was measured using the method of Shin *et al.* (2014) with slight modification. After deboning, *Jokbal* whole sample was chopped and homogenized into a lab meal to prepare homogenate. The homogenized sample (5 g) was homogenized in a 50-mL centrifuge tube with 50 μ L of butylated hydroxyanisole (BHA) (7.2% in ethanol) and 15 mL of distilled water using a homogenizer (DIAX 900, Heidolph Co., Ltd., Germany). One milliliter of the homogenate was then mixed with 3 mL of 20 mM 2-thiobarbituric acid (15% in trichloroacetic acid solution), heated in boiling water for 15 min, and centrifuged at 2,500 g for 10 min in a centrifuge (UNION 5 KR, Hanil Science Industrial, Co., Ltd., Korea). The absorbance value of the super-

natant was measured at 532 nm using a spectrophotometer (UV1600 PC, Shimadzu, Japan). TBARS values were expressed as μ g malondialdehyde/g.

Textural properties and sensory evaluation

All instrumental texture analyses were measured at ambient temperature (20°C) using method of Shin *et al.* (2014) and a texture analyzer system (TA-XT2i, Stable Micro System, England) equipped with a probe (1.0 cm thickness). Briefly, middle part of *Jokbal* was prepared from deboned whole sample to give a accuracy of data and to reduce differences of determination position of texture analysis among the samples. The same part was cut with 3 cm thickness from middle part of *Jokbal* sample.

Sensory evaluation of *Jokbal* was conducted using a 21 trained member panel as described by Shin *et al.* (2014). Panelists scored each sample using a 7 point descriptive scale. Score of 1 point indicated extremely dislike or extremely weak. Score of 7 points indicated extremely like or extremely strong for the color, texture, or flavor. *Jokbal* samples were steeped in a water bath at 85°C so that the internal temperature could reach 65°C for about 20 min. Samples were cut to 1 cm of thickness, put on a white dish, and then served to panelists.

Statistical analysis

Data were analyzed with general linear procedures, least-square means with limited standard deviations, and Duncan's multiple-range test using by SAS[®] software (SAS Institute, 2008).

Results and Discussion

TBARS of *Jokbal* samples with herbal mixture

The results of TBARS of *Jokbal* samples made with freezing-thawed pig feet and herbal mixture are summarized in Table 1. TBARS value in the Control was significantly different compared with that in HCT. However, LCT and HCT were significantly lower than those in FT ($p < 0.05$). This result indicated that the herbal mixture inhibited lipid oxidation accelerated by cooking. This inhibitory effect depends on the concentration of herbs (Pikul *et al.*, 1984). Freezing of pig feet (FT) might have significantly induced the acceleration of lipid oxidation during cooking compared to the Control. Herbal mixture (glasswort, raspberry and *Sansa* powders) used in this study provided antioxidant effect to *Jokbal* made with freezing-thawed pig feet. Most antioxidant activities of medicinal herbs are due to redox properties of phenolic compounds

Table 1. TBARS values and palatability of *Jokbal* made with freezing-thawed pig feet after adding herbal mixture (glasswort, raspberry and *Sansa* powders) at two different concentrations

Parameters	Sample*			
	Control	LCT	HTC	FT
TBARS values**	0.20±0.01**** ^{ab}	0.21±0.01 ^b	0.19±0.01 ^a	0.23±0.01 ^c
Hardness (kgf)	24.14±0.38 ^b	24.17±0.17 ^b	22.65±0.18 ^c	27.34±0.36 ^a
Cohesiveness (kgf)	6.32±0.26 ^a	5.89±0.13 ^b	6.14±0.21 ^{ab}	5.09±0.17 ^c
Break force (kgf)	7.08±0.16 ^a	6.86±0.21 ^b	6.96±0.17 ^{ab}	6.84±0.34 ^b
Palatability***	Flavor	6.86±0.14 ^a	6.65±0.12 ^b	6.78±0.11 ^{ab}
	Texture	6.69±0.18 ^a	6.38±0.21 ^b	6.65±0.14 ^a

*Samples were individually prepared for low concentration treatment (LCT, 120 g of herbal mixture and 120 mL of tap water), high concentration treatment (HCT, 240 g of herbal mixture), or freezing-thawed treatment (FT, 240 mL of tap water) with 2 kg of thawed pig feet. Control was prepared with refrigerated feet and 240 mL of tap water instead of herbal mixture.

**Unit of TBARS value is μg malondialdehyde/g.

***The result of palatability is expressed as 1 (very poor) to 7 (very good) based on the score from panelists.

****Mean±standard deviation (n=5)

^{a-c}Means in the same row with different letters indicate significant difference ($p<0.05$).

acting as reducing agents, hydrogen donors, and free radical quenchers (Yoon *et al.*, 2003).

Textural properties of *Jokbal*

Three textural properties (hardness, cohesiveness, and break force) were significantly different ($p<0.05$) among *Jokbal* samples (Table 1). Addition of herbal mixture improved the textural properties of *Jokbal* made with freezing-thawed pig feet. HTC samples were softer and more cohesive compared to other samples due to more gelation of connective tissues with collagen. Plentiful organic acids from raspberry and *Sansa* powders might have changed the acidic condition of cooking soup. In addition, collagen might have been converted to gelatin more easily in treatment with herbal mixture (LCT and HCT) compared to samples not added with herbal mixture, especially FT (Divakaran, 1984; Yeom *et al.*, 2004).

Palatability of *Jokbal*

Palatability of *Jokbal* was organoleptically evaluated in texture and flavor by the panelists. Significant differences ($p<0.05$) in flavor and texture were found among samples (Table 1). HCT showed similar results as in Control. Panels indicated that frozen storage in FT produced off-flavor and tough texture. The herbal mixture might have masked the off-flavor caused by rancid odor generated from lipid oxidation and denatured sulfur-containing protein (Levie, 1984).

In conclusion, the herbal mixture of glasswort, raspberry, and *Sansa* powders to *Jokbal* inhibited lipid oxidation during cooking. The off-flavor and tough texture of thawed pig feet could be dose-dependently improved by the addition of this herbal mixture.

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