EFFECTS OF EXTRACTION TIME ON PHYSICO-CHEMICAL CHARACTERISTICS OF SHANK BONE EXTRACT IN HANWOO

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Abstract – This study was carried out to determine proper extract time of shank bone extract in Hanwoo. Experimental design was devided into 5 treatments (T1: 1h, T2: 6h, T3: 10h, T4: 24h and T5: 48h). As the extraction time increased, the moisture content was reduced whereas the protein, fat, and ash were increased ($p<0.05$). Also, quality characteristics including salinity, sugar content, and meat color were improved by the extraction time increase. In the sensory characteristics, T4 and T5 showed higher all sensory scores than T1, T2 and T3. Therefore, the extraction time of Hanwoo shank bone is appropriate for more than 10 hours.

Key Words – Shank bone extract, Extraction time, Physico-chemical characteristics.

I. INTRODUCTION

Koreans traditionally consume soups using extracts that have been obtained from the shank bone, tail, rib, knee cartilage, and variety-bones of cattle and have been boiled for a long time (Choi *et al*., 2016). The soup "Gomtang" was mainly produced using extracts from legs and other portions of Hanwoo cattle (Kim, Kim, & Shim, 2014). Bone mainly consists of the following: 1/3, organic substances; 2/3, inorganic substances such as collagenous fiber and bone minerals (Malmberg & Nygren, 2008). In addition, collagen is a key building block of cells of bones, cartilage, ligaments, and the brain (Poundarik *et al*., 2015). Kim *et al*. (2007) reported that collagen protein and chondroitin sulfate were abundant in the Hanwoo shank bone.

Recently, the nutritional importance of microelements in the diet has gained attention; among these, calcium is one of the most nutritive components whose deficiency is often seen in human diets. Lack of calcium intake is closely related to growth and bone maintenance, osteoporosis, fractures, and bone diseases (Lupsa & Insogna, 2015). In particular, as aging progresses, calcium intake becomes more important for the prevention and cure of skeletal disorders (Chapuy *et al*., 1992).

However, the bone extract soups traditionally are produced by boiling water extraction for a long time and complex manufacturing methods. Thus, it is very difficult to make the bone soup at home.

Therefore, this study was conducted to investigate the effects of extraction time on proximate composition, quality and sensory characteristics of shank bone extract in Hanwoo.

II. MATERIALS AND METHODS

(1) Testing materials

Commercial Hanwoo shank bone was purchased from a local market.

(2) Manufacture of shank bone extract

Visible impurities, subcutaneous debris, and excessive connective tissues were removed from bones. The bones were washed thrice with water, and this water was discarded. The extraction process was performing by adding 2.5 L distilled water to the bones and boiling them over medium heat as experimental design(T1-1 hours, T2-6 hours, T3-10 hours, T4-24 hours, T5-48 hours).

(3) Statistical analysis

Statistical analyses were carried out using the generalized linear model procedure of the SAS package Release 9.4 (SAS Institute, Cary, NC, USA). Means were compared using Duncan's multiple range test at a level of significance of $p< 0.05$.

III. RESULTS AND DISCUSSION

The effects of extract time on proximate composition of shank bone extract are presented in Table 1. The moisture content was decreased as the extraction time increases ($p<0.05$). Whereas the

protein, fat and ash contents were increased by the increase of extraction time ($p<0.05$). These results were similar with result of Kim (2006).

Table 1. Effects of extraction time on proximate composition of shank bone extract (%)

Treatments*	T1	T2	T3	T4	T5
Moisture	99.29±0.01^{a}	98.15±0.11^{b}	97.66±0.17^{c}	97.08±0.02^{d}	94.83±0.04^{e}
Protein	0.52±0.02^{e}	1.59±0.09^{d}	2.08±0.15^{c}	2.55±0.06^{b}	4.78±0.16^{a}
Fat	0.05±0.01^{b}	0.04±0.00^{b}	0.11±0.04^{ab}	0.18±0.03^{a}	0.16±0.08^{ab}
Ash	0.13±0.04^{c}	0.20±0.02^{ab}	0.15±0.02^{bc}	0.18±0.00^{ab}	0.22±0.02^{a}

*T1: 1h, T2: 6h, T3: 10h, T4: 24h, T5: 48h
a-e Means±SD with different superscripts in the same row differ significantly ($p<0.05$).

The effects of extraction time on quality characteristics of shank bone extract are presented in Table 2. The increase of extraction time significantly increased the values of pH, salinity, sugar content and cooking loss. The T4 (24h) was the highest turbidity value among the shank bone extracts significantly. In the hunter color, the lightness (L^{*}) values of T1, T2, T3 and T4 were higher compared with T5 and the redness (a^{*}) and yellowness (b^{*}) values were the highest in the T5 (48 h) ($p<0.05$).

Table 2. Effects of extraction time on quality characteristics of shank bone extract

Treatments		T1	T2	T3	T4	T5
pH		6.42±0.03^{c}	6.44±0.01^{c}	6.71±0.01^{b}	6.72±0.00^{b}	6.82±0.00^{a}
Salinity(%)		0.46±0.05^{e}	1.30±0.10^{d}	1.56±0.05^{c}	2.66±0.05^{b}	5.06±0.11^{a}
Sugar content(%)		0.56±0.05^{e}	1.63±0.25^{d}	2.06±0.11^{c}	3.36±0.28^{b}	5.93±0.05^{a}
Turbidity(%)		0.37±0.02^{d}	1.82±0.01^{c}	1.82±0.01^{c}	2.43±0.00^{a}	2.08±0.00^{b}
Viscosity(cP)		1.80±0.40^{b}	2.00±0.20^{b}	1.93±0.11^{b}	2.66±0.23^{a}	2.86±0.23^{a}
Cooking loss(%)		9.19±2.24^{e}	25.13±4.38^{d}	27.83±5.25^{c}	40.93±9.65^{b}	45.23±3.34^{a}
Hunter color**	L	35.43±0.14^{a}	35.35±0.21^{a}	35.39±0.27^{a}	35.53±0.07^{a}	30.49±0.08^{b}
	a	-0.64±0.08^{b}	-1.03±0.05^{c}	-1.17±0.04^{c}	-1.32±0.11^{d}	0.76±0.07^{a}
	b	2.09±0.52^{d}	1.72±0.42^{d}	3.12±0.10^{c}	11.68±0.14^{b}	16.09±0.57^{a}

*Treatments are the same as in Table 1.
**L: lightness, a: redness, b: yellowness
a-e Means±SD with different superscripts in the same row differ significantly ($p<0.05$).

The effects of extraction time on sensory characteristics of shank bone extract are presented in Table 3. The extraction time of T5 (48h) significantly increased the color score of shank bone extract. The shank bone extract of T1 (1h) showed the lowest scores in aroma, taste, viscosity and total acceptability than those of the other extracts. On the other hand, the sensory traits scores above 3-point were observed in the T4 and T5.

Table 3. Effects of extraction time on sensory characteristics[1)] of shank bone extract

Treatments*	T1	T2	T3	T4	T5
Color	1.25±0.50^{d}	2.37±0.47^{c}	2.62±0.47^{c}	3.75±0.28^{b}	4.62±0.47^{a}
Aroma	1.75±0.95^{b}	2.62±0.75^{ab}	2.87±0.62^{a}	3.25±0.28^{a}	3.12±0.25^{a}
Taste	2.00±0.00^{d}	2.62±0.47^{c}	3.12±0.25^{bc}	3.37±0.47^{ab}	3.75±0.50^{a}
Viscosity	1.75±0.64^{b}	2.12±0.47^{ab}	2.50±0.70^{ab}	2.62±0.85^{ab}	2.87±0.62^{a}
Total acceptability	1.50±0.57^{d}	2.25±0.28^{c}	2.62±0.47^{bc}	3.62±0.47^{a}	3.12±0.47^{ab}

*Treatments are the same as in Table 1.
1) 1 = very light, very week, very mild, very low viscosity, very unacceptable
5 = very darkness, very strong, very intense, very high viscosity, very acceptability
a-d Means±SD with different superscripts in the same row differ significantly ($p<0.05$).

IV. CONCLUSION

The results of this study suggest that the extraction time is needed more than 10 hours for the improvement of physico-chemical characteristics of shank bone extract in Hanwoo.

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