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Effect of simmering time on taste of beef soup stock

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Background

Beef soup stock is usually prepared by simmering beef cubes for hours and is used as a main foundation for many kinds of soups and sauces. It is well known that it contains 5'-inosine monophosphate (IMP), amino acids, peptides, nitrogen compounds and so on, and that IMP is also a main component of *umani* taste of soups. In preparation of beef soup stock, however, IMP was almost completely extracted from beef meat within 30 minutes' simmering (Tajima et al. 1991). Wang et al. has reported that beefy meaty peptide named by Spanier et al. (1992) has strong *umami* taste and it develops more strong taste by a synergistic effect of added monosodium glutamate. We have reported that collagen derivatives extracted from beef cubes into soup stock prepared by simmering for hours increase with increasing simmering time (Tajima et al. 1999). It is considered that the increase in the extraction of polypeptides from beef meat strengthens the taste of beef soup stock.

Taste sensor was developed by Toko (1996) based on a theory that is very different from that of conventional chemical sensors which selectively detect specific chemical substances. His theory has a basic concept that humans do not distinguish chemical substances individually, but express the taste of various chemical substances whole. Therefore, a new-type of taste sensor developed by Toko (1996) is composed of a transducer having 7 lipid/polymer membranes with different response in the electrode and an operation apparatus described below.

Our objective of this study was to investigate the effect of polypeptide constituents in beef soup stock on its taste by using methods of both sensory evaluation and the taste sensor.

Methods

Cooking procedure.. Fresh beef round meat stored at 1℃ for 3 days after slaughter was obtained from a commercial source and was stored at 0°C for 17 days, followed by storage at -35°C until use. Meat was thawed at 5°C for one night. Before cooking, meat was cut to 30 g cube. After 30 g of meat had been soaked in 100ml of distilled water for 20 min, it was simmered at 95℃ for 0.5, 1, 3, 6 and 15 h, respectively. During simmering, the evaporated water was replenished with distilled water at 95℃. The broth was filtered through Toyo No.5 filter paper and made up to 100 ml with distilled water.

Sensory evaluation procedure. Samples were evaluated and analyzed by Scheffé's paired-comparison method (1952) using 5-point scales where +2 was strong taste and -2 was week taste. Sensory ratings of the soup stock were evaluated by 12 panelists (ages from 21 to 23) who had previously been trained. The panelists evaluated *umami* taste, sour taste, mildness, body, and aftertaste. Each soup stock was served to panelists at 70°C.

Analysis of taste using taste-sensing system. Analysis of taste using the taste sensor was performed according to the method of Toko (1996) as follows. Seven kinds of lipids in the preparation of the membranes are summarized in Table 1. Each lipid was mixed in a test tube containing polyvinyl chloride (PVC) and plasticizer (dioctyl phenylphosphonate) which were dissolved in tetrahydrofuran, and then dried on a glass plate, which was placed on a hot plate kept at 30℃. Lipid/polymer membranes were fitted on a multichannel electrode. The electric signal from each membrane was passed through a high-input impedance amplifier and a seven-channel scanner. A voltage difference between the multichannel electrode having 7 kinds of membrane and an Ag/AgCl reference electrode was measured. Experiments were carried out at room temperature.

Table1. Lipids used for the membranes

Channel	Lipid
1	Decyl alcohol
2	Oleic acid
3	Dioctyl phosphate
4	Dioctyl phosphate : Trioctyl methyl ammonium chloride = 5 : 5
5	Dioctyl phosphate : Trioctyl methyl ammonium chloride = 3 : 7
6	Trioctyl methyl ammonium chlroride
7	Oleyl amine

Results and Discussions

Sensory evaluation. Table 2 shows the results of sensory evaluation of beef soup stock. The beef soup stock after simmering for 1 h has the lowest score in every attribute except mildness. It means that the simmering for 1 h is not enough to extract taste constituents from beef cube into soup stock. The differences between 1 h- and 3 h-simmering soup stocks and between 1 h- and 6 h-simmering soup stocks are significant in *umami* taste, body and after taste, while any significant difference was not observed between

Table 2. Mean sensory scores of beef soup stock and the significance

	Score			Contrast		
Attributes	1h[a]	3h[a]	6h[a]	1h vs 3h	3h vs 6h	1h vs 6h
umami taste	-0.7778	0.4445	0.3334	**	ns	**
sour taste	-0.4445	0.0278	0.4167	ns	ns	*
mildness	0.0278	-0.1111	0.0833	ns	ns	ns
body	-0.5000	0.2500	0.2500	**	ns	**
aftertaste	-0.4167	0.2223	0.1943	*	ns	*

*p<0.05, **p<0.01, Ns indicates no significance. [a]simmering time

3 h- and 6 h-simmering soup stocks. Those results indicate that 3 h simmering is enough to extract taste constituent, and that 6 h simmering does not significantly enhance the taste of 3 h-simmering soup stock. In sour taste, however, there was a significant difference between 1 h- and 6 h-simmering soup stocks.

Analysis of taste using taste sensor. Figure 1 shows the results of the response patterns to 5 kinds of beef soup stock and figure 2 shows the results of principal component analysis applied to the response patterns. The results of principal component analysis indicate that the contribution rate of the first principal component (PC1) is 98.6%, that is, the change of the taste of soup stock can almost explain by the difference on the first principal axis. Furthermore, the response for soup stocks on the PC1 axis increased with increasing simmering time.

The results of sensory evaluation and analysis of taste using the taste sensor suggested that the intensity of *umami* taste, sour taste, body and aftertaste increased with increasing simmering time of beef meat. Since IMP, one of main tasty components in soup stock,

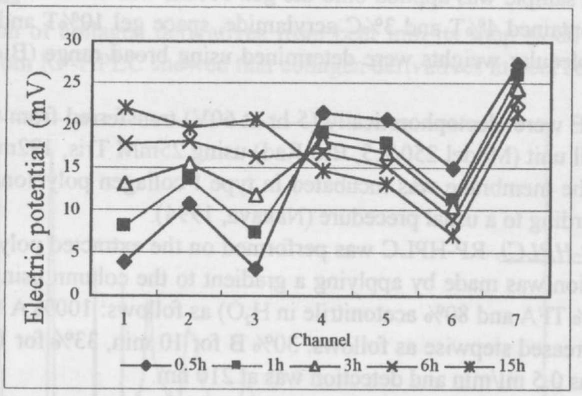

Fig.1 Response electric potential patterns for beef soup stocks

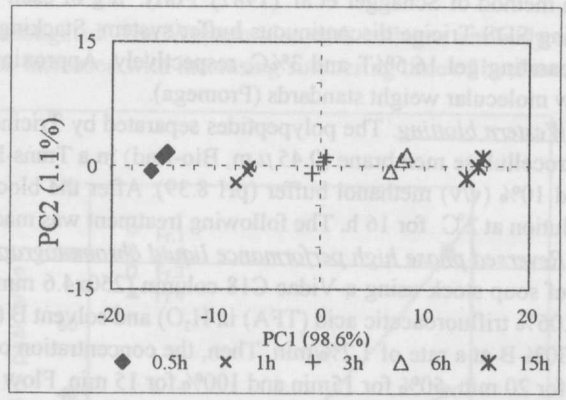

Fig.2 Principal component analysis of beef soup stocks

was almost completely extracted from beef meat within 30 minutes' simmering, the increase of intensity of taste might be explained by increasing of BMP, collagen derivatives, and other polypeptides from beef meat into soup stock. There were high correlation (r=0.90) between PC1 and protein content which was extracted from beef meat into soup stock (Tajima et al. 1999).

Conclusion

The taste of beef soup stocks prepared by simmering beef cubes for different time (0.5 - 15 h) was analyzed by sensory evaluation and taste sensor. Their results suggested that increase in the simmering time has brought about the increase of the intensity of *umami* taste, sour taste, body and aftertaste.

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