Evaluation of Kokumi Taste of Japanese Soup Stock Materials Using Taste Sensor

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It is difficult to describe the Katsuobushi (dried bonito) taste, especially that of Karebushi (molded died bonito), because it contains heartiness (kokumi) taste. Therefore, there is no study on the taste of Karebushi. In this study, we revealed the kokumi taste of Karebushi and other Japanese soup stock materials using a taste sensor.

1. Introduction

Dried-and-smoked fish products are commonly called fushi in Japan. A variety of fushi products such as dried bonito (Katsuobushi), dried bullet tuna (Sodabushi), dried mackerel (Sababushi), dried mackerel-scad (Muroajibushi), dried flying fish (Agobushi) and dried sardine (Iwashibushi) are manufactured, but the word fushi is usually used to specify dried bonito (Katsuobushi), whose production occupies almost half of the total production of fushi.

Katsuobushi, one of the Japanese traditional preserved foods, has been widely used as a seasoning, and it is an indispensable soup stock material for Japanese-style dishes.

The production processes of Katsuobushi are as follows: (1) making fillets from fresh bonitos, (2) boiling the fillets, (3) cooling and boning, and (4) smoking, where the boneless fillets are placed in a smoking furnace for half a day, followed by drying in open air for half a day. This process is repeated about ten times. Smoking is important for drying, flavoring, antioxidizing, and decomposition of protein.1-3 The product of these processes is called Arabushi. (5) The final process is molding, where the Arabushi is placed in a room for two weeks to allow molding, mainly by Aspergillus, on the surface. The molded Arabushi is then dried in the sun. This process is performed 2-4 times. The molding process is indispensable for improving the flavor and taste of Katsuobushi. The

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The final product is called Karebushi. Generally, it takes about two months to complete the manufacturing of Karebushi.

Katsuobushi abundantly contains amino acids and 5’-inosinic acid (5’-IMP), and has been used as a seasoning in Japan, and some chemical studies on the taste of Katsuobushi have been reported. Although a principal taste-active component was identified as 5’-IMP, Fuke et al. reported the contribution of other components to the characteristic taste of Katsuobushi. Hosokawa et al. reported differences in the amounts of taste-active components (such as free amino acids and their related compounds, nucleotides, organic acids, and peptides) among the dorsal, abdominal, and dark muscle parts of Katsuobushi. Kotani et al. determined the contents of free amino acids and 5’-ribonucleotides on 27 samples of fushi (14 samples of Katsuobushi, 2 of Sodabushi, 4 of Sababushi, one of Muroajibushi, 2 of Urumeiwashibushi, and 4 of Niboshi), and demonstrated that Katsuobushi and Sodabushi were higher in total free amino acids and lower in 5’-ribonucleotides than Sababushi, Muroajibushi, and Niboshi. Okuma and Abe reported that the contribution of histidine-related compounds (free histidine, carnosine, and anserine) to the buffering capacity of the hot water extract of Katsuobushi was as high as 40%.

However, little has been reported concerning the kokumi taste of Katsuobushi. In this paper, we report the evaluation of the taste of Katsuobushi and other soup stock materials using a taste sensor, particularly kokumi taste.

2. Materials and Methods

2.1 Fushi products

Fushi products are dried bonito (Katsuobushi), dried bullet tuna (Sodabushi), dried mackerel (Sababushi), dried mackerel-scad (Muroajibushi), dried flying fish (Agobushi), and dried sardine (Iwashibushi). Fushi products, obtained from a fushi factory in Kagoshima prefecture, were shaved just before use. A thousand milliliter of water was boiled, then the flame was reduced. Thirty grams of shaved Katsuobushi was then placed in the boiled water, and then it was allowed to stand for 5 min. The resulting shaved Katsuobushi was removed by filtration. The filtrate was subjected to taste analysis.

2.2 Instrument

The taste-sensing system SA 402B of Intelligent Sensor Technology Co., Ltd., (Atsugi, Kanagawa, Japan) was used to measure the kokumi taste of various samples. The electrode set was attached to a mechanically controlled robot arm. The detecting sensor part of the equipment consists of eight electrodes, each associated with a corresponding kokumi value.

3. Results and Discussion

3.1 Fushi products

Figure 1 shows that fushi products are divided into two groups. One is the Katsuobushi group, the other is the Zatsubushi group. Zatsubushi is the generic name for...
for fushi products, except for Katsuobushi. The Zatsubushi group has a rich kokumi taste that accompanies bitter taste, particularly Agobushi. The soup stock of Agobushi is suitable for ramen soup.

3.2 Arabushi and Karebushi

Katsuobushi has two types: one is named Arabushi, which is produced by smoke treatment after boiling, and the other is named Karebushi, which is produced from Arabushi by molding treatment. The molding step is a type of fermentation by Aspergillus species, and the step requires a considerably long period of about 2 months. Therefore, the amount of Karebushi manufactured is limited by this step, and thus, it is expensive. However, Karebushi is more fascinating to many people because of its mild taste and flavor.

From the viewpoints of flavor, fragrance, and texture, molded dried bonito is milder than the nonmolded one. The difference between the molded and nonmolded ones is minimal. The manufacturing process of dried bonito was established in the 17th century, and the molding process was established in the 18th century. At that time, the purpose of molding was to improve its shelf-life. At ordinary temperatures, dried bonito will decay, but the molded dried bonito will not decay. In those days, there were no freezers. Molding is a simple preservation method. However, recently, the purpose of molding has been to create a mild flavor, fragrance, and texture.

In a previous paper, we reported that Aspergillus species isolated from Katsuobushi O-methylated some phenols and made the pungent smoky flavor milder (Fig. 2). Such
ability of the mold is very interesting to us from the standpoint of the alteration of organic compounds by microorganisms.\(^{10-17}\) However, there have been a few papers on the fate of the nonvolatile components of Katsuobushi during the molding process.\(^{18,19}\)

The characteristic taste of Karebushi using a taste sensor has become apparent (Figs. 3 and 4). Arabushi extracted for 60 min has an astringent and sour taste. However, Karebushi has only kokumi taste. The molding period (2 times=1 month, 4 times=2 months) contributes to creating the kokumi taste of Karebushi.

The kokumi compounds of Zatsubushi and Karebushi await further investigation. Experiments directed toward this line are in progress.

### 3.3 Bonizyme

Agobushi and Karebushi represent soup stocks of Japanese cuisine. However, these are expensive materials, and thus difficult to use easily. Therefore, we introduced Bonizyme, a kokumi liquid seasoning. Bonizyme is an extract of Katsuobushi obtained by enzymolysis, a sort of fish sauce made with Katsuobushi. The name is derived from bonito and enzyme.

The kokumi taste of noodle soup is enhanced by the addition of Bonizyme ranging in concentration from 0.5 to 2%. The addition of Bonizyme to noodle soup has been recommended to improve the kokumi taste at a low price (Fig. 5).

The kokumi enhancing effect of Bonizyme is attributable to peptides. Bonizyme is an extract of dried bonito obtained by enzymolysis. Using two enzymes in complex prevents the occurrence of bitter taste. Fifty percent of the gustatory components is free amino acid, and the other 50% is a low-molecular-weight peptide.
Fig. 3. Kokumi and astringent tastes of Katsuobushi (Arabushi and Karebushi) using taste sensor.

Fig. 4. Kokumi and sour taste of Katsuobushi (Arabushi and Karebushi) using taste sensor.
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References

1 M. Motosugi, T. Suzuki, K. Oishi, S. Dohi and M. Ishikawa: Bulletin of the Government Industrial Research Institute, Shizuoka, 26 (1982) 109.
2 T. Suzuki and M. Motosugi: Bulletin of the Government Industrial Research Institute, Shizuoka, 29 (1985) 83.
3 T. Suzuki and M. Motosugi: Nippon Shokuhin Gakkaishi 38 (1991) 675.
4 T. Fujita and Y. Hashimoto: Nippon Suisan Gakkaishi 25 (1959) 312.
5 S. Fuke, K. Watanabe, H. Sakai and S. Konosu: Nippon Shokuhin Gakkaishi 36 (1989) 67.
6 M. Hosokawa, H. Sakakibara, I. Yajima and K. Hayashi: Nippon Shokuhin Gakkaishi 37 (1990) 856.
7 K. Kotani, K. Kawamura, T. Wada and E. Satani: Nippon Shokuhin Gakkaishi 31 (1984) 624.
8 E. Okuma and H. Abe: Nippon Shokuhin Gakkaishi 39 (1992) 239.
9 M. Doi, M. Ninomiya, M. Matsui, Y. Shuto and Y. Kinoshita: Agric. Biol. Chem. 53 (1989) 1051.
10 M. Doi, M. Matsui, Y. Shuto and Y. Kinoshita: Agric. Biol. Chem. 53 (1989) 3031.
11 M. Doi, M. Matsui, Y. Shuto and Y. Kinoshita: Agric. Biol. Chem. 54 (1990) 1177.

Fig. 5. Kokumi and umami tastes of noodle soup added with Bonizyme using taste sensor.
12 M. Doi, M. Matsui, Y. Shuto and Y. Kinoshita: Agric. Biol. Chem. 54 (1990) 2753.
13 M. Doi, M. Matsui, T. Kanayama, Y. Shuto and Y. Kinoshita: Biosci. Biotech. Biochem. 56 (1992) 958.
14 H. Yamauchi and M. Doi: Biosci. Biotech. Biochem. 59 (1995) 2094.
15 M. Doi and Y. Shuto: Biosci. Biotech. Biochem. 59 (1995) 2324.
16 H. Onishi, M. Doi, Y. Shuto and Y. Kinoshita: Biosci. Biotech. Biochem. 60 (1996) 486.
17 H. Yamauchi and M. Doi: Biosci. Biotech. Biochem. 61 (1997) 1386.
18 H. Tsuyuki and T. Abe: Bull. Coll. Agr. & Vet. Med., Nihon Univ. 37 (1980) 312.
19 M. Motosugi, S. Dohi, T. Suzuki and M. Ishikawa: Bulletin of the Government Industrial Research Institute, Shizuoka 25 (1981) 117.