Evaluation of meat taste using taste sensor and sensory evaluation

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***Abstract*— Improving quality is more paid attention on the production of meat. It is known that improve texture and increase taste active components of meat by aging. And also, it is requested to develop new taste evaluation tool of meat. Pork loins were stored at 4 ºC for 1, 8 or 14 days. These samples were made to soup, and measured the free amino acid contents and tastes (umami, richness, sweetness, sourness, bitterness and saltiness) by sensory evaluation and the taste sensor. Total amino acid contents were increased as asing advances. Free glutamic acid content, the main taste-active component of meat, on 14 days was significantly increased than others. And 8 days was significantly increased than 1 day. From sensory evaluation, umami and richness on 8 days were stronger than 1 day and weaker than 14 days. Sourness on 8 days were weaker than 14 days. From result of taste sensor, Umami and richness on 8 days were stronger than 1 day. Sourness, on 8 days, was weaker than 1 and 14 days. It is suggested that increasing of total amino acids and glutamic acid contents by aging contribute to improve umami and richness of meat. The results of umami, richness and sourness intensity from sensory evaluation and the taste sensor were similar. Therefore the taste sensor can be effective method to evaluate the tastes of meat**.

***Keywords*—pork loin, taste sensor, sensory evaluation**

I. INTRODUCTION

Pork is the most consumed meat in Japan. Pork production has been focused on the predictability up to now. However, improving quality is more paid attention on the production of meat. Many factors contribute meat palatability, such as taste, inner muscle fat, texture, color and aroma. In these factors, the evaluation of the taste is very important. It is known that improve texture and increase taste active components of meat by aging process. Free amino acids play important roles eliciting characteristic tastes of food. Glutamic acid (Glu) contributes to meat taste including delicious, umami, and brothy tastes, and is one important taste-active component of meat.

The taste of food is one of the most important factors in its quality and generally has been evaluated by a human gustatory sense. However, the subjectivity and low reproducibility in this sensory test often have been pointed out as faults. To solve these problems, an objective evaluation method using a taste sensor has attracted attention. The taste sensor is a biomimetic sensing device that detects taste information as electrical potential changes with several sensory probes corresponding to human taste cells. The taste sensor has been used to evaluations of various drinks but little evaluation of meat by the sensor is limited. Also there is no data that compare sensory evaluation with taste sensor on meat sample. Therefore this research was conducted to evaluate taste by sensory evaluation and taste sensor and compared these results.

II. MATERIALS AND METHODS

A. Samples and Soup preparation

Pork loin samples were stored at 4 ºC for 1, 8, and 14 days for aging and then the samples were stored -80 ºC until analysis. Before analyzing, frozen samples had been thawed at 4 ºC for 24 hours. For the soup preparation, samples were cut into small pieces. Water was added to the pieces of meat (the final volume of water was 1.5 times the sample weight) and the mixture was heated for 2 hours. After the boiling, soup was cooled for 1 hour at low-temperature chamber until fat was hardened. The NaCl concentration was adjusted to 0.3% of the soup. The soups were used to amino acids analysis, sensory evaluation and taste sensor.

B. Free amino acid content in soup

Free amino acid concentrations were determined by amino acid analyzer (JLC-500/V, JEOL, Tokyo, Japan). The column used was a multi-segment tandem packed column (LC-500AC4016, Li type, 4 mm diameter x 160 mm; JEOL, Tokyo, Japan). The detection wavelengths were 440 and 570 nm. Amino acids were detected by the ninhydrin method.

C. Taste sensor

The taste sensor system, TS-5000Z (Intelligent Sensor Technology Co., Ltd., Atsugi, Japan) was used to measure the taste of meat soup samples. Fresh 30 mM KCl solution containing 0.3 mM tartaric acid (corresponding to saliva) was used as the reference sample (Vr) and also to rinse the electrodes after every measurement. The electrode was first dipped into the reference solution (Vr) and then into the sample solution or suspension (Vs). When the electrode is dipped into the reference solution again, the new potential of the reference solution is defined as Vr'. The difference (Vr'–Vr) between the potentials of the reference solution before and after sample measurement is defined as CPA (Change of membrane Potential caused by Adsorption) and corresponds to aftertaste. Each measuring time was set at 30 second, and the electrodes were rinsed after each measurement.

D. Sensory evaluation

Twelve trained panelists belonging to Niigata University, all in their ages were 20s, performed the sensory evaluation. The tastes of soups of different aging stages were compared using a closed panel method at room temperature (20 to 25 ºC). These soups were compared Scheffe's paired comparison test to clarify the characteristics of meat sensory attributes. In Scheffe's paired comparison test, panelists used a 7-grade scale (−3 to +3) to estimate umami (weak to strong), sourness (weak to strong), sweetness (weak to strong), bitterness (weak to strong), richness (weak to strong) and overall preference (not prefer to prefer).

E. Statistical methods

Means and standard errors were calculated among meats in each group. For statistical analysis, one-way ANOVA was employed using the general linear model in SAS (SAS Institute, 1985). Significant differences between means were determined according to the LSD method.

III. RESULTS

The content of all free amino acids were increased with aging process; especially, the increases of Thr, Ser, Glu, Ile and Leu were significant ($p<0.05$). The content of free Glu was 16.92, 39.25, and 91.61 μg/ g muscle on 1, 8, and 14days respectively.

The soup of pork meat that was aged 1 or 14 days were evaluated on the basis of 8 days. A comparison of 1day and 8days, in the Scheffe's pair comparison test, the variance analysis was done to each parameter, and the main effects and the order effects were given to official approval. Average point of the main effect of the umami, saltiness, sweetness, sourness, bitterness and richness were calculated and were -0.75, 0.25, -0.18, 0.08, -0.08, and -0.92 respectively, and a significant difference was seen umami ($p<0.05$) and richness ($p<0.01$). Similarly, 8days and 14days test were calculated and were 0.33, -0.17, -0.33, 0.42, -0.00, and -0.08 respectively, and a significant difference was seen sweetness ($p<0.05$). So, umami and sourness increase by asing.

Sensor outputs were converted into estimated intensity of taste (EIT) values. One unit in the EIT scale was defined as the amount of sensor output corresponding to a difference of 1.2 times the concentration of the standard solution. From sensory evaluation, umami intensity on 8 days (0.54) was stronger than 1 day (0.34) and similar to14 days (0.51). Richness intensity was stronger by asing. Sourness, on 8 days (5.10), was weaker than 1 (5.75) and 14 days (5.79).

IV. DISUCUSSION

The content of free amino acids increased with aging process can be contributed with umami and richness. Especially, increased Glu content could be related with increased umami. Boweres *et al.* (1969) reported that Ala, Ser, Thr, and Glu were greatly increased aging pork loin which has been stored for 7 days at 2 ºC. Their results were in good accord with our results from this study. It is known Glu is an amino acid that shows umami, and Thr and Ser are an amino acid that shows sweetness. Thr and Ser could be effect of sweetness by sensory evaluation.

V. CONCLUSIONS

It is suggested that increasing of total amino acids and glutamic acid contents by aging contribute to improve umami and richness of meat. The results of umami, richness and sourness intensity from sensory evaluation and the taste sensor were similar. Therefore the taste sensor can be effective method to evaluate the tastes of meat.

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