THE USE OF TASTE AND ODOUR SENSORS TO EVALUATE THE FLAVOUR OF BEEF DURING CONDITIONING

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Introduction

In general, it is well known that beef flavour is improved by conditioning. The flavour of beef has become one of the most significant factors in consumer decision processes (Bruce *et al.*, 2005). Flavour results from compounds are divided into two broad classes: Those responsible for taste and those responsible for odours, the latter often designated as aroma substances (Belitz *et al.*, 2000). Compounds responsible for taste are generally nonvolatile at room temperature. The five important basic taste perceptions are provided by: sour, sweet, bitter, salty and umami compounds. Especially, glutamic acid, IMP and peptides in beef contribute to the delicious taste (umami). Aroma substances are volatile compounds which are perceived by the odour receptor sites of the smell organ. There are many odour substances which contribute to the aroma of boiled beef (Coppock and MacLeod, 1977). Matsuishi *et al.*, (2004) reported that aroma is the most important contributor to the identification of the animal spices of meat, and the contribution of taste appears much smaller than that of aroma and texture. On the other hand, the objective sensory evaluation of meat flavour is made so difficult by the conditions of selection of panelists, sample procurement and preparation, cooking and sensory presentation, establishing beef flavour profiles etc. Recently, taste and odour sensors technology imitating human's tongue and nose is steadily improving. Already, Taste Sensing System SA402B equipped with taste sensors and Fragrance and Flavour Analyzer FF-2A equipped with odour sensors have been developed by Japanese companies. The purpose of this study was to examine the possibility of the use of taste and odour sensors to evaluate the flavour of beef during conditioning.

Materials and Methods

1. Materials: *Semimembranosus* muscles from five Japanese Black Cattles approximately 29 month of age were used. 2. Methods of conditioning: Samples are conditioned at 2-4°C in refrigerator for 7, 14, 21 and 28 days after slaughter. 3. Types of sample for sensor measurements: Raw, boiled at 75-80°C for 30 min and cooked at 160-200°C for 2.3 min on a hot plate (griddle). Samples were subjected to various sensor measurements. 4. Sample preparation: For taste sensor measurement, raw, boiled and cooked samples were homogenized in deionized water at 10,000 rpm for 2 min. The homogenate was centrifuged at 10,000 x g for 30 min. The upper layer filtered through an Advantec 5A filter paper. The filtrate was frozen in a deep freezer at -80°C in preparation for a taste sensor measurement. Sample for odour sensor was thin sliced and frozen in deep freezer at -80°C. Each sample was thawed out in refrigerator and used to the measurement. 5. Sensory evaluation: Taste and odour sensory evaluation was conducted by paired comparison method. Panelists were our laboratory staff and students. 6. Sensor instruments: Taste Sensory System SA402B (Intelligent Sensor Technology, Inc. Japan) was used for taste sensor imitating human's tongue. This system, the first "Equipment carrying out scientific knowledge of the taste" in the world, has been developed in Japan. This instrument constructed to detect tastes such as bitterness, sourness, astringency, sweetness, umami etc., a robot arm and computer. The detecting sensor part of the equipment consists of eight electrodes composed of lipid/polymer membranes. SHIMADZU Fragrance and Flavour Analyzer FF-2A was used for odour sensor imitating human's nose. This electronic nose resembles a human nose, with the receptor proteins replaced by multiple sensor elements having different properties. The signals generated by these sensor elements in response an odour are sent as vectors to a computer, which plays the role of the human brain. This system can display the odour and smell in absolute value and can reject the humidity interferences by using the trap tube.

Results and Discussion

From the measurement of beef taste conditioned days 7, 14, 21 and 28 using taste sensors, saltiness and sustainable umami intensity were shown to have a gradual higher tendency during conditioning of beef (Figure 1). Figure 2 shows that changes in umami derived from amino acids, nucleotides and sustainable umami intensity during conditioning. Umami and sustainable umami intensity were measured by a separate taste sensor with deferent characteristics. Umami by amino acids and nucleotides was not changed during conditioning, but sustainable umami intensity in the beef conditioned for 14, 21 and 28 days was higher than in the beef conditioned for 7 days, except for a single sample

conditioned for 21 days. It is interesting that the sustainable umami intensity evaluated by taste sensor was strengthened during conditioning of beef.
From the radar chart of cooked steaks odour conditioned days 7, 14, 21 and 28 using odour sensors, the intensity of some odour types appeared to have a slightly higher tendency during conditioning of beef (Figure 3). Figure 4 shows the amines intensity was rapidly enhanced from days 14 to days 28, and hydrogen sulfide intensity of steaks was promoted from 14 days to 21 days of conditioning. Further investigations are needed to ascertain the relationship between sensory evaluation using panelists and the output of taste and odour sensor systems.

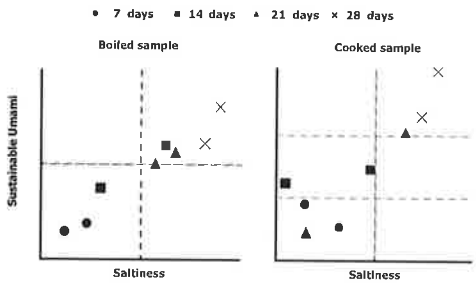

Figure 1: Changes in sustainable umami and saltiness during conditioning of beef measured by taste sensors (n=2).

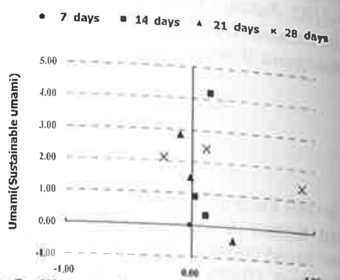

Figure 2: Changes in sustainable umami and umami during conditioning of beef measured by taste sensors (n=3). Based on the calculated data, value of sample conditioned 7 days was denoted in zero point.

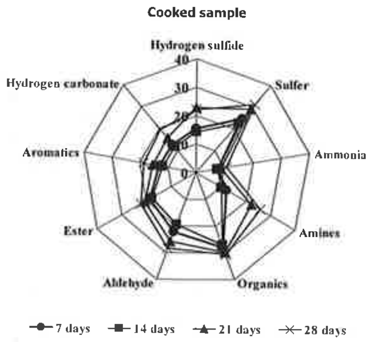

Figure 3: Changes in odour intensity during conditioning of beef measured by odour sensors.

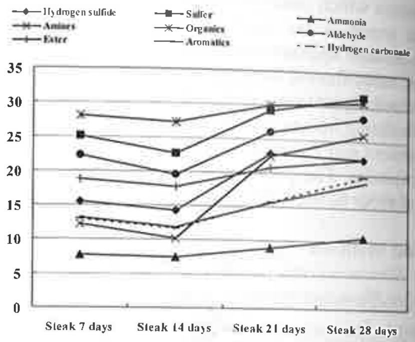

Figure 4: Changes in odour quality during conditioning of beef measured by odour sensors.

Conclusions

This study was aimed to examine the possibility of the use of taste and odour sensors to evaluate the flavour of beef during conditioning. From the results of beef taste conditioned at days 7, 14, 21 and 28 using taste sensors, sustainable umami intensity was increased by conditioning of beef. The results of radar chart and the intensity of some quality of odour of steaks using odour sensors exhibited the change of aroma of beef by conditioning. It is suggested that the taste and odour sensors from these results can be utilized as useful and powerful support tools of sensory evaluation.

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