

# ELUSION OF FREE AMINO ACIDS DURING MASTICATION FROM WAGYU SHABU-SHABU BEEF USING MODEL MOUTH AND PANELISTS

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## Introduction

Wagyu beef is a unique ingredient consisting of a lean part, mainly comprised of protein, and a highly marbled fat part. *Shabu-shabu* is one of the most famous recipes for cooking Wagyu beef. The lean part of Wagyu *shabu-shabu* beef supplies free amino acids, which are important for taste perception. Odake et al (2007) reported using 25 panelists that masticatory properties (masticatory duration, number of chew, saliva secretion, and masticatory force) during chewing of Wagyu *shabu-shabu* beef decided the elution level of free amino acids. The report (Odake et al, 2007) revealed the inter-panelists variability was observed in all masticatory measurements and the concentration of free amino acids (Asp, Glu, Gly and Ala) in water phase of beef bolus from the panelist who evoked high mastication force in short time chewing duration with less amount of saliva was 13-18 times higher than the panelist who showed weak mastication force in longer chewing duration with a high amount of saliva.

Model mouth was used to seize complicated phenomena which occur in oral cavities during mastication without variability derived from panelists (Van Ruth et al, 1995 and Odake et al, 2006). This study was conducted to verify the usefulness for using model mouth, equipped with a screw plunger which enabled vertical motion mimicking chew behavior to measure free amino acid elution. Comparing model mouth and panelists, efficiency and property of the mouth model was revealed.

## Materials and Methods

Wagyu (Japanese black cattle) beef loin (*M. longissimus dorsi*), produced in Saga Prefecture in Japan, which is called 'Sagagyu', was purchased from a local meat shop. The quality of marbling was more than No. 7 according to the beef marbling standard (Japan Meat Grading Association, 2000). Ten grams of thinly sliced beef, 10 x 5 x 0.2cm, was cooked for 20 seconds in 80°C water, which is called *shabu-shabu* style cooking in Japan. The protein and fat contents of the sample were 18.9±1.0% and 40.9±1.6%, respectively.

Model mouth shown in Fig.1 was used, with the sample flask kept at 37°C during the experiment. Beef sample and 2.45mL of artificial saliva (Van Ruth et al., 1995) were put in the sample flask and mimic mastication was conducted for 0, 30, 60, 90 and 120 seconds. Bolus was taken from the sample flask and the amount of four free amino acids (asparagine (Asp), glutamine (Glu), glycine (Gly), and alanine (Ala)) eluted from beef was measured with reversed-phased high performance liquid chromatograph (RP-HPLC) using precolum derivatization by phenylisothiocyanate (PITC) (Bidlingmeyer et al., 1984).

Masticatory force during mimic mastication of mouth model was measured using a computerized tactile sensor system called the FlexiForce Economical Load & Force (ELF) system 50-1014 (Nitta Corporation, Osaka, Japan).

## Results and Discussion

*Elution of free amino acids (FAA) during mimic mastication with model mouth.* Elution of four free amino acids (Asp, Glu, Gly, and Ala) during mimic mastication with the model mouth is shown in Figure 2. Every free amino acid increased drastically from 0 to 30 seconds of mastication, and more than 70% of FAA of equilibrium was eluted within 30 seconds. According to the results obtained by Odake et al (2007), 33.9 seconds was the longest duration among 25 panelists for chewing of Wagyu *shabu-shabu* beef before swallowing. Therefore mimic mastication for 30 seconds is important to seize phenomena occurring in the mouth. The values of recognition threshold of Asp, Glu and Ala were reported as 0.182-4 mM (sour), 0.063-4 (unique-sour), and 7.17-16.2mM (sweet), respectively (Shallenberger, 1993). The concentrations of Asp, Glu and Ala at 30 second mastication were 0.083mM, 0.671mM, and 1.564mM, respectively and the concentration of Glu was only higher than the recognition threshold of its unique taste.

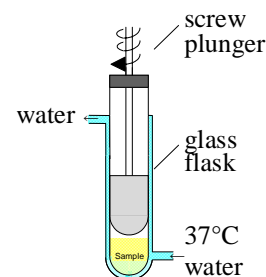
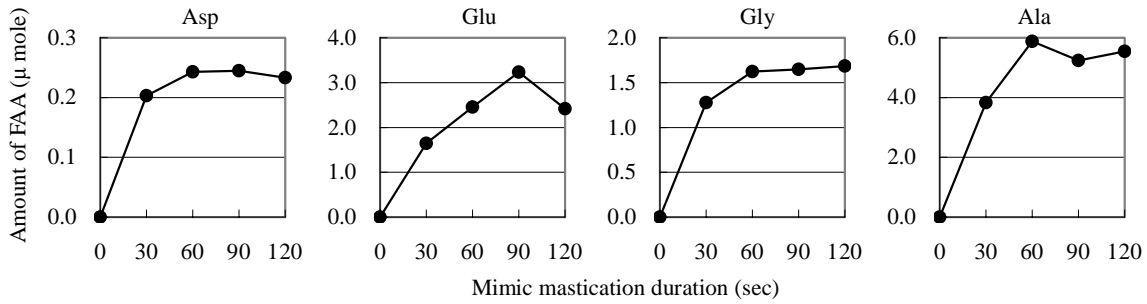
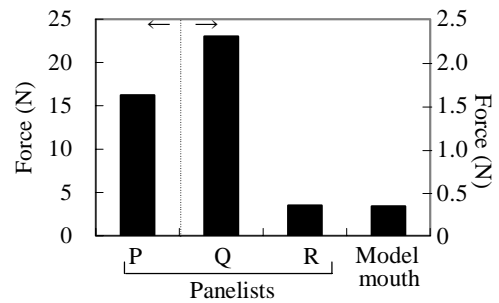


Figure 1. Model mouth



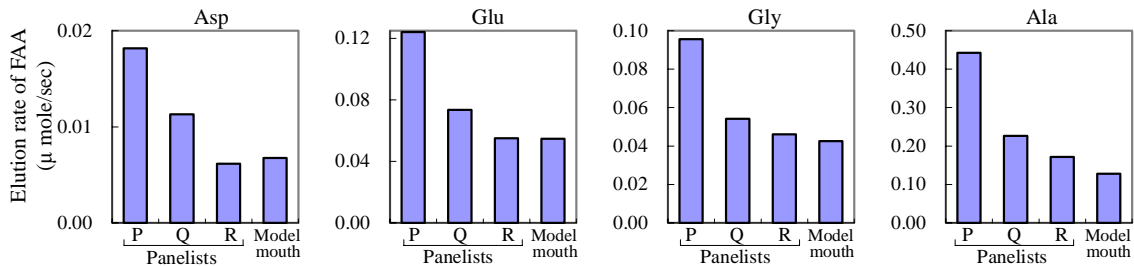
**Figure 2.** Eluted free amino acids during mimic mastication.

**Masticatory force.** Masticatory force was expressed as the maximum force evoked at the first chew explicated by Kohyama et al. (2001). Masticatory force during mimic mastication with model mouth was 0.34N. Otake et al (2007) reported that the masticatory force obtained from three panelists during mastication of the same kind of Wagyu *shabu-shabu* beef was 16.2N (panelist P, high force), 2.3N (Q, medium force), and 0.35N (R, low force) as shown in Figure 3. From these results, the masticatory force of model mouth was recognized as the same level of low force panelist who chewed the longest duration before swallowing.



**Figure 3.** Mastication force

**Elution rate of free amino acids.** The mean rate of elution of FAA was calculated as dividing eluted amount of FAA by chew duration before swallowing; panelists P, 10.9 seconds; Q, 22.1 seconds; R, 33.9 seconds. In the case of model mouth, 30seconds was chosen to calculate. Comparing with the model mouth to the panelists, the mean rate of elution of FAA of model mouth was the same level of the low force panelist R who showed the same level of masticatory force in every FAA.



**Figure 4.** Mean elution rate of free amino acids

## Conclusions

The model mouth used in this study was revealed to be useful to obtain taste substance elution during mimic mastication. The data obtained using the model mouth agreed with the data obtained from the panelist who showed the same level of masticatory force.

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