# EFFECTS OF INTRAMUSCULAR FFAs ON BEEF TASTE-TRAITS ANALYZED BY ELECTRONIC TASTE SENSING SYSTEM AND SENSORY EVALUATION

Y. Zhao[1], Y. Nakada[1], S. Ueda[1], Y. Shirai[1], S. Ichimura[2], Y. Yoshida[2], M. Habara[3], H. Ikezaki[3] and M. Yamanoue[1]*

[1]Graduate School of Agricultural Science, Kobe University, Kobe 657-8501, Hyogo, Japan

[2]Japan Meat Science & Technology Institute, Tokyo 150-0013, Japan

[3]Intelligent Sensor Technology, Inc., Atsugi 243-0032, Kanagawa, Japan

*Corresponding author email: yamanoue@kobe-u.ac.jp

## I. INTRODUCTION

Japanese Black Wagyu beef is popular in Japan and recently recognized as “Wagyu” around the world due to its deliciousness affected by marbling and fatty acid composition of intramuscular fat. The aims of this study were to investigate the effects of changes in intramuscular free fatty acids (FFAs) during postmortem aging on taste-traits of water-soluble extracts (broth) of Japanese Black Wagyu beef. Changes in the amounts and composition of FFA are considered to contribute to beef aroma [1]. However, the relationship between those changes and beef taste remains poorly understood. A lot of research examining the relationship between taste substances and sensory evaluation has been conducted [2] until electronic taste sensing system was developed as a method to evaluate taste-traits of meat and meat products [3]. Thus, in this study, effects of intramuscular FFAs on taste-traits were investigated in stored and cooked beef broth prepared by boiling method using electronic taste sensing system and sensory evaluation.

## II. MATERIALS AND METHODS

**Samples:** Japanese Black Wagyu and Holstein cattle raised for about thirty months were slaughtered in local abattoirs and the dressed carcasses were stored in refrigerator of meat processing center at least overnight. Beef samples taken from *longissimus thoracis* muscle of the sixth and seventh rib of the dressed carcass were sent in vacuum packing at 4°C to Kobe University within 7 days after slaughter. At our laboratory, beef samples were immediately taken out from the package and wrapped with sterile lap, then stored at 4°C until sampling. Both muscles at 7-, 14-, and 21-days postmortem including intramuscular fat tissues were used as "raw sample", and "cooked sample" from the remained portions were cooked to internal temperature of 65-70°C.

**Preparation of beef broth:** The method [3] adopted in our laboratory for preparation of beef broth was mainly focused on fat removing by boiling and low-temperature solidification.

**Measurements of the amounts of FFA:** The amounts of FFA in beef broth were photometrically measured by the method of Shimizu et al. [4] using commercial quantification kits.

**Taste-traits analysis:** An electronic taste sensing system SA402B (INSENT Co., Ltd, Kanagawa, Japan) equipped with six sensors was used for the taste-traits analysis of beef broth. Sensor outputs are converted to taste information of numerical data that helps distinguish differences in both taste quality and intensity between samples [5].

**Sensory evaluation:** Five trained panelists were members of Japan Meat Science & Technology Institute (Tokyo, Japan). Each taste intensity of Japanese Black Wagyu beef broth compared to Holstein beef broth at 21-days postmortem was evaluated by scoring of -3, -2, -1, 0, +1, +2 and +3 correspond to very weak, weak, a little weak, equal, a little strong, strong and very strong, respectively.

**Statistical analysis:** The amounts of FFA were compared by a one-way analysis of variance (ANOVA) with post hoc analysis using Tukey's HSD test among aging time and by Student's t-test between two bovine breeds. Results of beef taste-traits using electronic taste sensing system and sensory evaluation were expressed as mean values.

## III. RESULTS AND DISCUSSION

As shown in Figure 1, the amounts of FFA in both Japanese Black Wagyu and Holstein beef broth increased during postmortem aging. We found that the amounts of FFA increased dependently with increasing

marbling levels assigned by Beef Marbling Standard (BMS) which positively correlated with intramuscular fat (IMF) area (%) (data not shown). Mean values of the amounts of FFA in Japanese Black Wagyu beef (BMS No.4, 8, 10) were more than those in Holstein beef (BMS No.2) at corresponding postmortem aging days. In addition, at 21-days postmortem the amounts of FFA in Japanese Black Wagyu beef increased significantly in comparison with Holstein beef ($P < 0.05$), indicating that postmortem aging caused obvious effect on the amounts of intramuscular FFA in Japanese Black Wagyu beef.

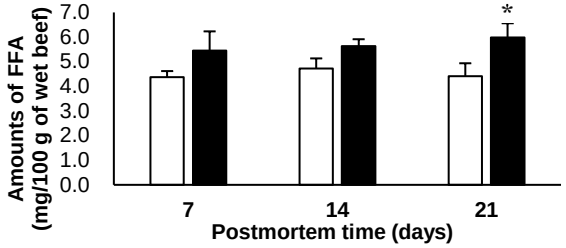


Figure 1. Changes in the amounts of FFA in Japanese Black Wagyu and Holstein beef broth during postmortem aging.
*significant difference ($P < 0.05$) between Japanese Black Wagyu (▮) and Holstein (▯) beef; n = 4, respectively.

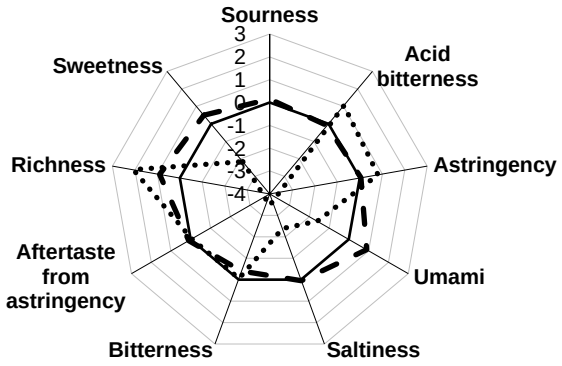


Figure 2. Taste-traits of Japanese Black Wagyu beef broth compared to Holstein beef broth at 21-days postmortem.
Electronic taste sensing system (·····) and sensory evaluation (– –) in Japanese Black Wagyu beef broth (n = 4); control of both analyses (——) in Holstein beef broth (n = 2).

As shown in the result of taste-traits analyzed by electronic taste sensing system (Figure 2), values of *acid bitterness*, *astringency* and *richness* were higher in Japanese Black Wagyu beef than those in Holstein beef in contrast to values of *umami* and *sweetness* at 21-days postmortem, considering closely associated with the amounts of FFA. On the other hand, results of sensory evaluation indicated that values of *umami*, *richness* and *sweetness* were higher in Japanese Black Wagyu beef than those in Holstein beef.

## IV. CONCLUSION

Taste-traits of Japanese Black Wagyu beef at 21-days postmortem are suggested to relate to the increased amounts of FFA in beef broth, even though the amounts of taste substances of Japanese Black Wagyu beef are less than those of Holstein beef (data not shown). Results of *richness* in Japanese Black Wagyu beef from both analyses coincide with each other, so *richness* can be probably used as an index of deliciousness of Japanese Black Wagyu beef.

## ACKNOWLEDGEMENTS

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