# Quality characteristics of meat sauce prepared from pig kidney

Yasuhiro Funatsu [1], Kanami Azekawa [1], Shori Tokito [1], Naoyuki Maeda [1], Takefumi Ono [2], Hirofumi Hayasaka [3],
Wataru Matsuda [4], Akira Tanaka [5], Shuji Yoshikawa [5]

*[1] Department of Food Science and Human Wellness, College of Agriculture, Food and Environmental, Sciences, Rakuno Gakuen University, , Ebetsu, Hokkaido 069-8501, [2] Hidaka Meat Center Co., ltd., Niikappu, Hokkaido 059-2418, [3] Taste & Aroma Strategic Research Institute, Chuo-ku, Tokyo 061-1104, [4] Otaru Kaiyo Suisan Co., Ltd., Otaru, Hokkaido 047-0048, [5] Food Processing Research Center, Industrial Technology and Environment Research Department, Hokkaido Research Organization, Ebetsu, Hokkaido 069-0836, Japan*

**Objective:** There are large amounts of livestock in Japan due to the high consumption of pork. However, the pig kidney is rarely used as a food material owing to its strong ammonia odor. The development of methods to utilize pig kidneys as food materials is required in the meat processing industry. In this study, the effects of ureter removal and soy sauce yeast (SSY) inoculation on the fermentation process were investigated to develop a method to use pig kidneys as a main fermented sauce ingredient.

**Materials and Methods:** Thirty Landrace pigs (live weight:~115 kg) were slaughtered at Hidaka Meat Center Co., Ltd. and the fresh kidneys were removed from the dressed carcasses before the meat manufacturing process and stored at −30 °C before starting the experiment. Approximately 47 kg of frozen pig kidney was partially thawed at 4 °C overnight. After removing the fat tissue, the kidney was treated separately, with and without ureter removal. Each section was boiled at 85 °C for 30 min in a boil-processing apparatus and drained well. After cooling to 25-30 °C, the kidneys were cut and minced with meat choppers. Approximately 10 kg of the ground meat was placed in a plastic bag and frozen at −30 °C. The next day, four kinds of pig kidney sauce mashes (Nos.1-4) were prepared using 40 % thawed boiled kidney sample, 35 % tap water, 1% commercial proteinase powder (CPP) (Sumizyme LP50, SNBL, Ltd.), 15 % salt and 10 % rice steamed and molded with *Aspergillus oryzae* (rice *koji*, Fukuyama jozou Co., Ltd.). The rice *koji* was rehydrated with 20 % tap water and stirred by hand for 40 min at 25-30 °C. Regular stirring and replacement of the sheet were conducted during fermentation at 35 °C. After two days of fermentation, pig kidney mashes with and without ureter were divided into two parts, and one part was inoculated with $10^6$ cfu/g of SSY (*Zygosaccharomyces rouxii*, Akita Konno Co., Ltd.). Furthermore, on the seventh day of fermentation, 1% CPP was added to each mash. Thus, four types of mashes were pre- pared, which were as follows: No. 1, prepared using boiled kidney without ureter removal and with SSY inoculation; No. 2, pre- pared using boiled kidney without ureter removal or SSY inoculation; No. 3, prepared using boiled kidney with SSY inoculation after ureter removal; and No. 4, prepared using boiled kidney without SSY inoculation after ureter removal. After fermentation for 10 weeks, these mashes were compressed, and the obtained liquid was heated at 85 °C for 30 min. The final products were obtained after the addition of 0.025 % clarifying agent to the mashes which were then filtered with 0.2 % diatomaceous earth. A portion of the mash was collected over time during fermentation and centrifuged. After centrifugation, the supernatant was filtered with filter paper, and the filtrate obtained was used as the analytical sample. The color ($L^*$, $a^*$, and $b^*$ values) of the analytical sample was measured using a spectrophotometer employing the transmission method with a glass cell. The pH of the sample was measured with a pH meter. The ammonia level of the sample was determined using the ninhydrin method. The amino acid composition of each filtered sample was measured using an auto amino acid analyzer. Organic acids were determined with post-column labeling using HPLC. Multiple taste tests of the products diluted with distilled water were conducted using a taste sensor (TS5000Z, Intelli- gent Sensor Technology Inc.). The taste of the measurement sample was interpreted with six kinds of first tastes (bitterness/food, bitterness/medicine, astringency, umami, saltiness, and sourness) and four kinds of after tastes (bitterness/food, bitterness/medicine, astringency, and umami). Principal component analysis (PCA) was carried out using the taste sensor data obtained in this study.

**Results and Discussion:** With regard to the quality of the mash, the $L^*$ values decreased, while the $a^*$ and $b^*$ values increased throughout the fermentation process upon ureter removal. These values showed opposite changes upon SSY inoculation. The rate of decrease in pH during fermentation was slightly different among the samples and affected the rate of increase in organic acids, and acidic and basic amino acids. In contrast, with regard to the quality of the final product, the main organic acid was pyroglutamic acid. Malic, succinic and acetic acid levels increased with SSY inoculation. Free amino acid levels were in the range of 7800- 8800 mg/100 mL, and the main amino acids were Asp, Glu, Ala, Leu, and Arg. The ammonia levels were 73-79 mg/100 mL. Ac- cording to the results from the PCA with TS data, umami was enhanced with SSY inoculation. These results revealed that the meat sauce product, which not only gives off less ammonia odor but also possesses a moderate umami flavor, could be obtained by fer- menting mash prepared with pig kidney and SSY inoculation, without ureter removal.

**Key words:** Pig kidney, Meat sauce, Koji mold, Soy sauce yeast, Fermentation