Effect of pH, dryness, and fat on the intensity of cold smoke treatment in raw ham (Japanese style 'lachs ham')

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Objectives: Smoking is a method of food processing that is used for preservation and adding a distinctive flavor via exposure to smoke generated by heating wood. In general, the methods of smoking food are classified according to the food-processing temperature; that is, hot-smoking, warm-smoking, and cold-smoking. Smoking at low temperature (cold-smoking) is performed to prevent protein denaturation upon heating, to ensure that the smoked products remain moist. Many smoke components, such as phenols, alcohols, aldehydes, and organic acids, are absorbed by food during the cold-smoking process; however, very few studies have demonstrated the effect of properties of the raw food attributes (such as pH, dryness, and fat) on the quality of the cold-smoked product. Japanese style 'lachs' ham (raw ham) is a popular meat product in Japan. Raw ham is commonly manufactured from cured pork loin; the intensity of cold-smoke is an important factor affecting the final product quality. The cold-smoking techniques used are empirically determined by the manufacturers of these products, which prevents food quality control. In this study, we aimed to control the smoke components associated with cured meat by adjusting the properties of the cured ham.

Materials and Methods: First, cured meat was cut into equal-sized cubes. Then, the samples were subjected to cold-smoke treatment for 4 h; cold-smoked samples were collected at 1-h intervals. The first sample was collected at 0 h. The samples were homogenized and extracted using 60% (v/v) ethanol. Smoke components present in the ham extracts were analyzed using gas chromatography mass spectrometry (GC-MS). Subsequently, the differences between raw ham samples with and without fat were evaluated. Furthermore, to examine the effect of variation in pH on the cold-smoked products, agar gel was used as a model food gel. The pH was adjusted to a range of 5-9 using phosphate buffer.

Results and Discussion: More than 100 compounds were detected in the smoked raw ham extracts, and nine of them were quantified. The quantities of these nine compounds were positively correlated with the duration of smoke treatment. In contrast, the time taken to dry out the ham and smoke intensity showed a negative correlation. GC-MS analysis revealed that the composition of samples containing fat and the composition of samples from which fat had been removed was different. Moreover, there was a positive correlation between pH and color of the smoked agar gels. The results implied that the flavor of the product was influenced by the intensity of smoke, which can be altered by changing the pH of the pickling solution used for curing. Overall, all three attributes evaluated in this study affected the quality of the cold-smoked ham. However, it should be noted that dryness only affected the smoke intensity, whereas presence or absence of fat in the ham samples affected the composition of the smoke compounds. Furthermore, pH of the raw ham affected the color of the smoked product. Thus, alteration in pH, moisture content, and fat content of raw ham can help in improving the quality of the cold-smoked product.

Conclusions: In conclusion, analysis of smoke components in cold-smoked ham and agar gel (used as a model food gel) by GC-MS showed that drying time, pH, and fat content of raw ham affected the smoke intensity. In particular, a negative correlation was observed between the smoke intensity and drying time. Furthermore, pH of raw ham also influenced the color of the product. The findings of this study can help in the quality control of raw ham via adjustment of smoke properties during the cold-smoke process and may extend the shelf-life and improve the smoky aroma of raw ham.

Key words: Raw ham, Cold smoking, Meat products