P-09-08

Factors Affecting DMHF Generation By The Maillard Reaction In Cooked Meats (#178)

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Introduction

The Maillard reaction, a critical chemical reaction that occurs during cooking, generates numerous chemicals which affect sensory properties of meats. 2,5-Dimethyl-4-hydroxy-3(2*H*)-furanone (DMHF) is one of the major odor compounds generated by the Maillard reaction and affects the palatability of cooked meats [Arihara et al., Advances in Food and Nutrition Research, 2017]. Previously, we reported that the exposure of DMHF to rats changes the autonomic nerve activities [Zhou et al., J. Sci. Food Agric., 2017] and causes physiological activities (decrease of blood pressure [Ohata et al., IMARS Highlights, 2018], promotion of appetite [Yokoyama et al., 64th International Congress of Meat Science and Technology, 2018]. Therefore, the generation of DMHF during the cooking of meats is related to improvement of palatability and physiological functions. Although some studies have been reported that DMHF is detected in cooked beef odors [Watanabe et al., Meat Science, 2015], there have been few studies of other species and aged meats. It is also unclear that the factors affecting DMHF generation in meats. In this study, we investigated the factors that affect DMHF generation during cooking of meats.

Methods

To detect DMHF in cooked meats odors, the round cut of meats (Wagyu, imported beef, pork, chicken, lamb, horse) were heated at 230 for 5 minutes. The weights were changed to elucidate the potent odors of the characteristic odor in cooked meats (5, 2.5, 1.25, 0.625, 0.3125g.) The odor compounds generated during heating were obtained by solid-phase micro extraction (SPME) method, and were then subjected to GC-MS and GC-sniffing analysis. Furthermore, round meats (Aberdeen Angus, Australia) were aged for 0, 1, 3, 5, 7, 9 weeks at 4 to evaluate temporal changes quantitatively. After the aging process, meats were heated and then quantified of DMHF in cooked meats. All meats were used for further measurements of both tyrosine (indicator of free amino acids) and glucose (reducing sugar).

Results

DMHF was detected in all cooked meats odors. GC-sniffing analysis showed DMHF is one of the potent odor compounds in cooked Wagyu and horse flavor. Although it has been reported that DMHF is an important odor compound in cooked Wagyu [Inagaki et al., J. Agric. Food Chem., 2018], it is the first report in cooked horse. The concentration of DMHF in cooked meats varied according to the animal species and it was the lowest in chicken (Table 1). Futhermore, concentration of tyrosine and glucose in meats suggests that the generation of DMHF was affected by free amino acids and glucose content.

After the aging process, the concentration of DMHF in aged beef increased significantly from 1 to 3 weeks (Figure 1). However, it was lower than that of 0 week and 5 to 9 weeks. The content of tyrosine tended to increase with the aging period (Figure 2). Although the content of glucose in meats also increased, it decreased from 5 to 9 weeks. Interestingly, change of glucose content in aging beef was similar to the change of DMHF concentration. Moreover, there was a stronger correlation between DMHF concentration and glucose content in aging beef (R^2= 0.76). These results suggest that the content of glucose in meats affects DMHF generation during cooking critically.

Conclusion

DMHF generated by the Maillard reaction during the cooking of meats contributes to flavor development of Wagyu and horse meats. Also, its generation is affected by the glucose content in meats. From these results, the generation of DMHF in cooked meats would be regulated by the glucose content.

Notes

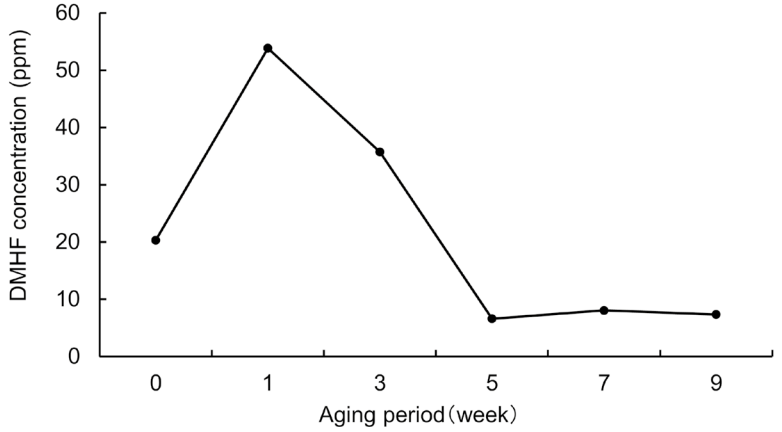

Figure 1.
Change of DMHF concentration in aged beef

	Animal species					
	Wagyu	Imported beef	Pork	Chicken	Lamb	Horse
DMHF (ppm)	48.1	25.7	12.9	5.1	67.1	39.9
Tyrosine (μg/g)	10.2 ± 4.3	8.9 ± 3.7	8.2 ± 5.9	6.9 ± 2.9	16.7 ± 12.1	9.6 ± 6.8
Glucose (μmol/g)	56.2 ± 1.9[a]	56.7 ± 2.3[a]	55.5 ± 2.6[a]	15.5 ± 0.2[b]	51.2 ± 2.1[a]	60.2 ± 2.6[a]

Table 1. Measurement of DMHF and odor precursors in meats
Mean ±S.E. (n=3) a, b Different letter indicates significant difference (*P*<0.01)

Notes

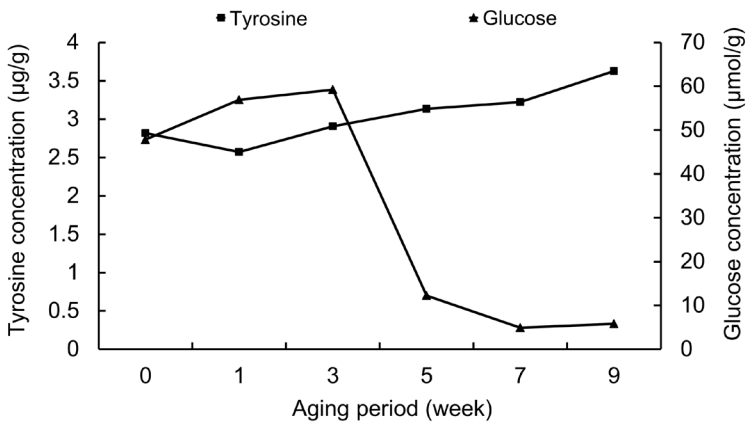

Figure 2.
Changes of tyrosine and glucose content in aged beef

Notes