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Effect of cooking methods and doneness on formation of biogenic amines in pork belly during storage at 9℃ (#241)

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Introduction

The quality and freshness of meats can be changed during storage. Biogenic amines (BAs) can be mainly produced during storage by microbial decarboxylation of amino acids (Fan et al., 2015), which include putrescine (PUT), cadaverine (CAD), histamine (HIM), tyramine (TYM), and spermidine (SPD). BAs are an indicator to evaluate levels of microbial contamination and retard quality of foods (Min et al., 2007). The BAs is toxic and intake of high amount of TYM and HIM can cause migraine and food poisoning, respectively (Balamatsia et al., 2006). Therefore, controlling the level of BAs can play an important role in food safety. The aim of this study was to determine the levels of BAs in pork belly during storage and to evaluate the effect of cooking method and doneness on the formation of BAs.

Methods

The pork belly was cut into 1 cm of thickness and stored in a vacuum pack at 9ºC for 15 days. The pork belly was taken out at day 0, 5, 10, and 15, and cooked according to three cooking methods (boiling, pan-frying, and grilling) and doneness (moderate and well-done). In doneness, moderate and well-done pork belly were defined as cooked pork belly with internal temperature at 70±2ºC and 80±2ºC, respectively. Boiling was done at 100 ºC in distilled water for 5 min as moderate and for 30 min as well-done. Pan-frying was performed at 190ºC for 5 min and 4 min as moderate, and for 8 min and 7 min as well-done on the front and back sides of pork belly, respectively. Grilling was performed over charcoal at 600 ºC for 5 min and 4 min as moderate, and for 3 min and 3 min as well-done on the front and back sides of pork belly, respectively. After cooking, each cooked pork belly was ground finely by food processor. BAs (PUT, CAD, HIM, TYM, SPD) were measured by HPLC at 254 nm and expressed in μg/g using standard curve. Statistical analysis was performed using SAS program version 9.4 with Tukey's test at $p < 0.05$.

Results

The change of BAs content in pork belly by the boiling method and doneness was shown in Figure 1. The boiling method reduced PUT, CAD, HIM, and TYM contents of pork belly during storage compared to that of raw pork belly ($p<0.05$). Especially, well-done boiled pork belly inhibited the formation of PUT and TYM on day 10 of storage ($p<0.05$). In addition, the boiling significantly reduced the content of SPD on day 1, day 10 and day 15 of storage. The change of BAs content in pork belly by the pan-frying method and doneness was shown in Figure 2. The PUT content in moderately pan-fried and well-done pan-fried pork belly was significantly higher on day 10 of storage and showed at 24.78 and 26.75 μg/g, respectively, than those of raw pork belly. On the other hand, moderately pan-fried pork belly reduced CAD content on day 15 of storage. The TYM content of pan-fried pork belly was significantly reduced compared to that of raw pork belly on day 1 of storage. The content of SPD in pan-fried pork belly was increased compared to that in raw pork belly since day 5 ($p<0.05$)regardless doneness.

The change of BAs content in pork belly by the grilling over charcoal method and doneness was shown in Figure 3. The PUT content in moderately grilled pork belly was significantly increased compared to raw pork belly on day 10 of storage ($p<0.05$). On the other hand, moderately grilled and well-done grilled pork belly showed low CAD content in pork belly compared to raw pork belly on day 15 of storage. HIM content of well-done grilled pork belly was significantly increased compared to that of raw pork belly on day 15 of storage. TYM content was not affected by grilling over charcoal method and doneness during storage from day 5 to day 15. SPD content was not influenced by grilling over charcoal method and doneness on both day 10 and day 15.

Conclusion

The results indicated that PUT, CAD, HIM, and TYM of pork belly were significantly increased with increase of storage days at 9ºC. Among three cooking method, boiling with doneness effectively reduced the formation of BAs. These results suggest that boiling is a safe cooking method to control the BAs in pork belly during storage at cold. Further study is needed to evaluate relationship between boiling with different doneness and quality of various meat products when BAs controlled.

Reference

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Notes

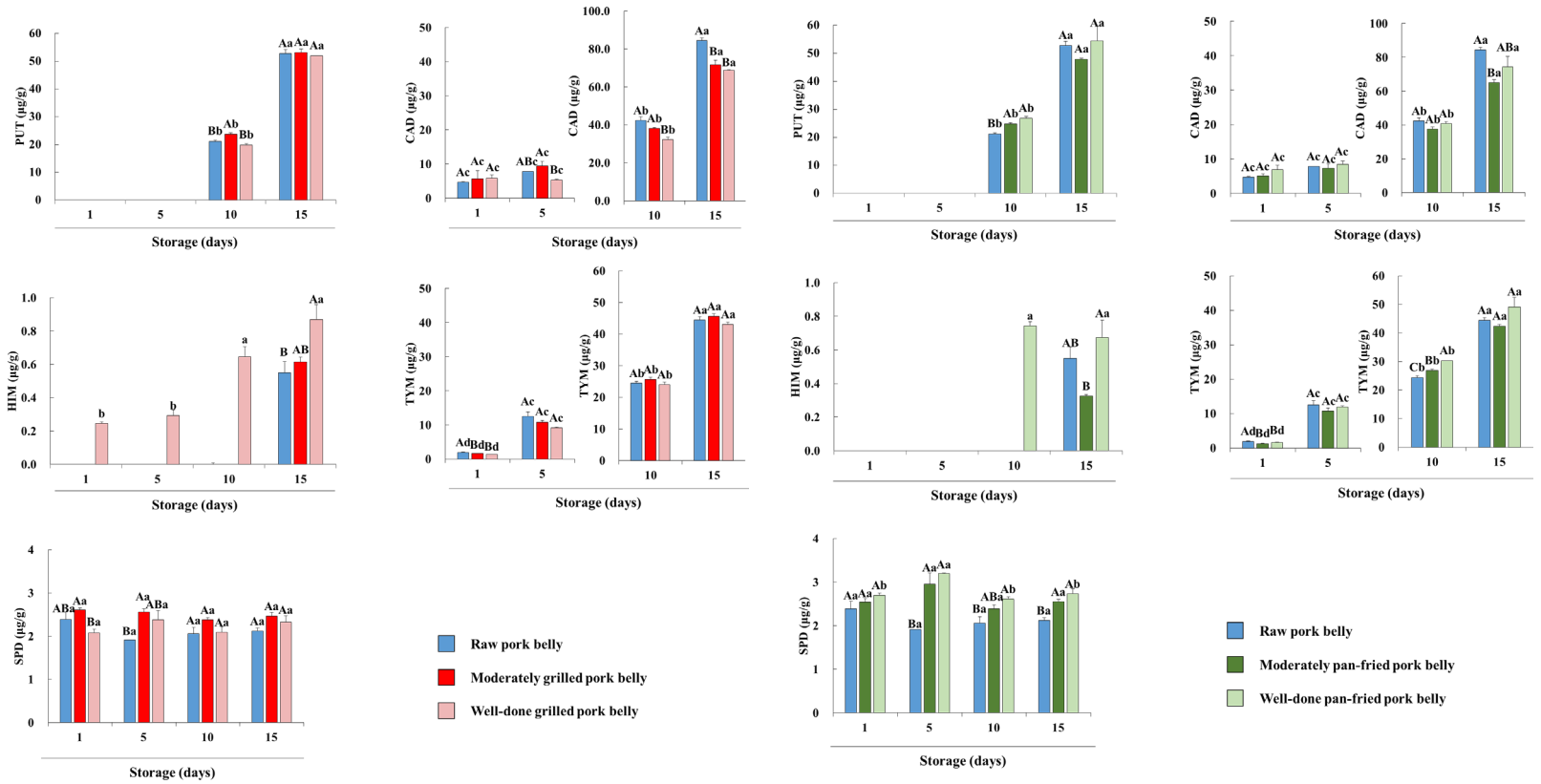

Figure 3. Changes in BAs level in pork belly by grilling and doneness during storage at 9°C.

A-B Values of bar with different superscript among treatment differ significantly at $p < 0.05$. a-d Values of bar with different superscript among storage days differ significantly at $p < 0.05$. PUT, putrescine; CAD, cadaverine; HIM, histamine; TYM, tyramine; SDP, spermidine.

Figure 2. Changes in BAs level in pork belly by pan-frying and doneness during storage at 9°C.

A-C Values of bar with different superscript among treatment differ significantly at $p < 0.05$. a-d Values of bar with different superscript among storage days differ significantly at $p < 0.05$. PUT, putrescine; CAD, cadaverine; HIM, histamine; TYM, tyramine; SDP, spermidine.

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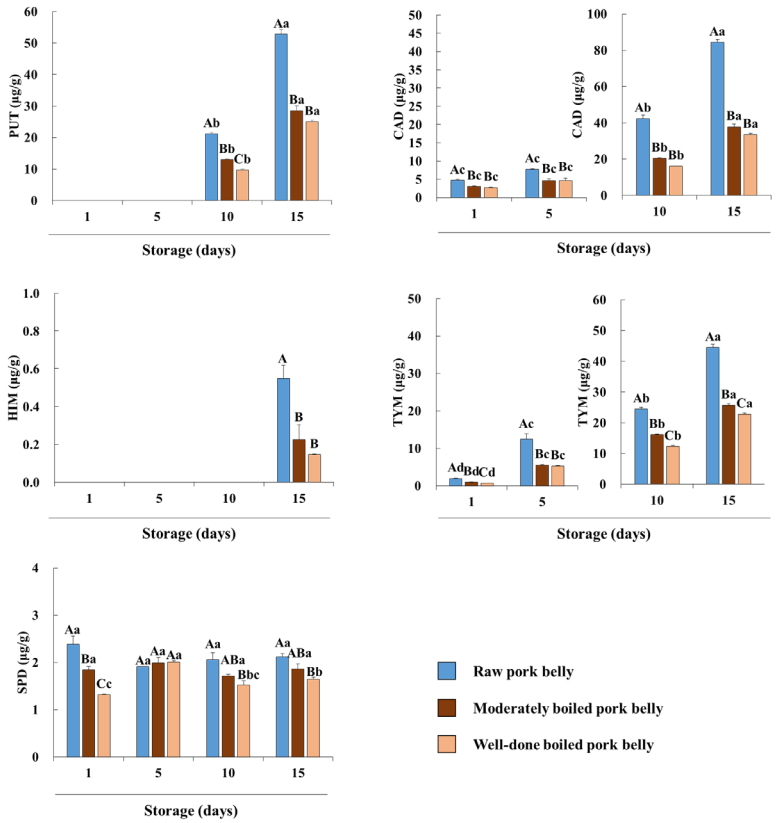

Figure 1. Changes in BAs level in pork belly by boiling and doneness during storage at 9°C.
$^{A-C}$ Values of bar with different superscript among treatment differ significantly at $p < 0.05$. $^{a-d}$ Values of bar with different superscript among storage days differ significantly at $p < 0.05$. PUT, putrescine; CAD, cadaverine; HIM, histamine; TYM, tyramine; SDP, spermidine.

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