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The effects of meat pigments and amino acids on the color properties of cooked ground chicken breast (#116)

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Introduction

The pink color defect in fully cooked, uncured meat products is a major problem in the poultry industry. Previous studies revealed various processing conditions that influenced the specific biochemical conditions, structure, and reactivity of the pigments in cooked meat (Claus & Jeong, 2018; Holownia et al., 2003). Myoglobin is the sarcoplasmic heme protein primarily responsible for the color of meat. However, hemoglobin, cytochrome, and other pigments may also be present in meat at low levels and contribute to its color (Suman & Joseph, 2014). Recently, Claus and Jeong (2018) found that a pink color defect (natural pink) could be reproduced without adding a pink color-generating ligand in cooked ground turkey breasts when ground turkey was pre-salted and stored for 7 days. In order to understand the mechanism of the sporadically developed pink color problem, interactions between meat pigments and amino acids in ground chicken under processing conditions related to pink color were needed. Therefore, the objective of this study was to investigate the effects of added meat pigments and amino acids on natural pink color development in cooked ground chicken breasts.

Methods

Fresh chicken breasts (1 day postmortem) were obtained from a local processor and ground using a grinder (a 0.3-cm plate). The ground chicken trimmings were assigned as a 2 × 7 factorial, which was dependent on meat pigments (absence or presence) and amino acids (control; no amino acid added, cysteine, histidine, methionine, phenylalanine, pyridine, or tyrosine). The ground meat was mixed with 2.0% sodium chloride (meat weight basis, MWB) for 5 min. Each batch was either mixed with 1.0% amino acids as the acid form with/without 0.11% meat pigments (0.05% myoglobin, 0.05% hemoglobin, and 0.01% cytochrome c) in water (15% MWB). Each treatment was mixed for 10 min, vacuum packaged (2-3°C), and then stored for 7 days. Following storage, all treatments were stuffed into tubes (50 g each) and centrifuged to remove air pockets. All samples were cooked to an internal temperature of 75°C in a 90°C water bath. The samples were cooled on ice and were stored (2-3°C) in the dark until further analysis. Data were analyzed as a completely randomized split plot design, where meat pigments (absence or presence) were the whole plots, and the control and 6 amino acid treatments were the split plot. All results were analyzed using the Proc Mixed Model of SAS program to determine main effect. Mean values of the dependent variables were separated ($P < 0.05$).

Results

Added meat pigments influenced all the variables ($P < 0.05$) tested on cooked ground chicken, except for oxidation-reduction potential (ORP). When meat pigments were added to ground chicken meat, pH, CIE a* values, rNIT (reflectance estimator of nitrosyl hemochrome, %*R*650nm/%*R*570nm), rNIC (reflectance estimator of nicotinamide hemochrome, %*R*537nm/%*R*553nm), and total pigment were higher ($P < 0.05$) in comparison to samples without meat pigments. The addition of meat pigments particularly increased the pink color in cooked ground chicken breast (CIE a* values, 11.48 VS 4.38 in the presence VS absence of meat pigments; $P < 0.05$). Total pigment contents were also higher ($P < 0.05$) in the chicken products (42.78 ppm) with adding meat pigments when compared to those without meat pigments (12.99 ppm). These findings are similar to those of Ahn and Maurer (1989), who reported that the addition of myoglobin or combination of myoglobin and cytochrome c significantly increased the redness and total pigment contents in cooked turkey breast. Interestingly, the incorporation of amino acids to ground chicken meat affected all the variables, regardless of whether meat pigment was added or not. Compared to the control, samples with histidine, pyridine, or tyrosine showed higher pH values ($P < 0.05$), while samples with cysteine showed lower pH values ($P < 0.05$), which probably could be due to the pH effects of added amino acids. Out of all the added amino acids, pyridine increased the redness of the cooked ground chicken breast the most when compared to the control (CIE a* value increase of 63.6%; $P < 0.05$). Contrastingly, the addition of tyrosine to the ground chicken meat reduced the CIE a* value the most when compared to the control (reduction of 8.6%, $P < 0.05$). Samples with pyridine had lower rNIT and total pigment contents when compared to the control ($P < 0.05$), but higher rNIC ratio. Compared to the control, the ORP of the cooked products reduced by the addition of pyridine compared to the control ($P < 0.05$), but increased by the incorporation of cysteine, histidine, or methionine ($P < 0.05$). Claus and Jeong (2018) found that higher pH values in cooked turkey breasts promoted reducing conditions (more negative ORP values). Furthermore, Holownia et al. (2004) reported that a more negative ORP was favorable for increasing the pink color without adding sodium nitrite.

Conclusion

In conclusion, the added meat pigments increased the natural pink color associated with hemochrome formation in cooked ground chicken breast. Furthermore, higher pH values and increased reducing conditions via pyridine addition may contribute to the pink color of cooked ground chicken breasts.

Notes

References

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