71st ICoMST
GIRONA - CATALONIA - SPAIN
3rd-8th August - 2025

PERILLA LEAVES MITIGATE OFF-ODOURS IN ROASTED CHICKEN: DYNAMIC FLAVOUR CHANGES REVEALED BY GC–O–MS, HS–GC–IMS AND ELECTRONIC NOSE

Ke Bi[1,2], Yue Liu[1], Dong Han[1], Ping Yang[1], Chunhui Zhang[1*], Marie-Laure Fauconnier[2]

[1] Key Laboratory of Agro-Products Processing, Ministry of Agriculture and Rural Affairs, Institute of Food Science and Technology, Chinese Academy of Agricultural Sciences, Beijing, China.

[2] Laboratory of Chemistry of Natural Molecules, Gembloux Agro-Bio Tech, University of Liège, Gembloux, Belgium

*Corresponding author email: zhangchunhui@caas.cn

I. INTRODUCTION

Raw meat often exhibits bloody, metallic, and salty tastes that are generally unacceptable to consumers [1]. Roasting enhances the sensory appeal of meat by promoting lipid oxidation and Maillard reactions, which generate complex volatile compounds responsible for desirable flavors and attractive colors [2]. However, off-odors such as rancid, sulfurous, or bloody notes may still persist even after roasting, compromising the overall aroma quality and consumer acceptance [3]. Marination is a widely adopted strategy to mitigate such undesirable odors by improving the sensory characteristics of meat.

Perilla leaves (*Perilla frutescens*, PL), a traditional medicinal herb and culinary ingredient, are known for their strong aromatic properties and ability to reduce fishy or oxidized off-flavors in meat and seafood. Their deodorizing effect has been attributed to both direct aromatic masking and antioxidant activity that inhibits the formation of volatile sulfur- and aldehyde-based off-odors [4,5]. Despite the widespread culinary use of PL, limited research has focused on their impact on the characteristic flavor and dynamic volatile profile of roasted chicken following marination.

Therefore, this study aimed to investigate the dynamic changes in the flavor profile of roasted chicken marinated with perilla leaves, using E-nose, GC–O–MS, and HS–GC–IMS, complemented by sensory evaluation. This work seeks to uncover the mechanisms underlying off-odor reduction and flavor enhancement by PL, offering theoretical guidance for the development of natural deodorization strategies in roasted meat products.

II. MATERIALS AND METHODS

Fresh chicken breasts (average weight 180 ± 10 g) were purchased from a local supermarket in Beijing, China. Visible fat and connective tissue were removed, and the meat was cut into uniform cubes (1 × 1 × 1 cm). Perilla leaves (PL) were obtained from a certified herb supplier, homogenized, and used for marination. Samples were divided into two groups: control (unmarinated) and treatment (marinated with 10% PL extract, w/w). Both groups were roasted at 200 °C for 20 min in a preheated oven.

Volatile compounds were extracted using solvent-assisted flavor evaporation (SAFE) and analyzed by gas chromatography–olfactometry–mass spectrometry (GC–O–MS) with a DB-WAX column. Headspace gas chromatography–ion mobility spectrometry (HS–GC–IMS; FlavourSpec®, G.A.S., Germany) was used to monitor changes in volatiles. An electronic nose (PEN3, Airsense, Germany) equipped with 10 metal oxide semiconductor sensors assessed overall aroma profiles. Instrument settings followed validated protocols with minor modifications.

The sensory evaluation protocol was approved by the Ethics Committee of Chinese Academy of Agricultural Sciences, and all participants gave written informed consent prior to participation. Sensory evaluation was conducted by a trained panel (n = 12) using a 9-point hedonic scale and aroma descriptors including roasted, metallic, bloody, and herbal. Statistical analysis was performed using SPSS 26.0 (IBM, USA). One-way ANOVA and principal component analysis (PCA) were applied, with significance considered at $p < 0.05$.

III. RESULTS AND DISCUSSION

PL marination significantly enhanced roasted chicken aroma by increasing herbal and caramel notes while reducing fishy and bloody odors, as shown by QDA (Figure 1A). E-nose results (Figure 1B) indicated stronger responses in PL-treated samples, particularly for sensors associated with alcohols and sulfides. PCA (Figure 1C) revealed distinct clustering between marinated and control groups, confirming aroma profile differences.

HS–GC–IMS identified 55 volatiles, with higher levels of terpenes (e.g., geraniol, citral) and reduced sulfur compounds in PL-marinated chicken. GC–O–MS and OAV analysis confirmed key aroma-active compounds were enhanced post-treatment. These findings suggest that PL not only masks off-odors but also promotes formation of

pleasant volatiles during roasting. Overall, PL marination enhanced the complexity and richness of roasted chicken aroma, confirming its dual role in deodorization and flavor improvement.

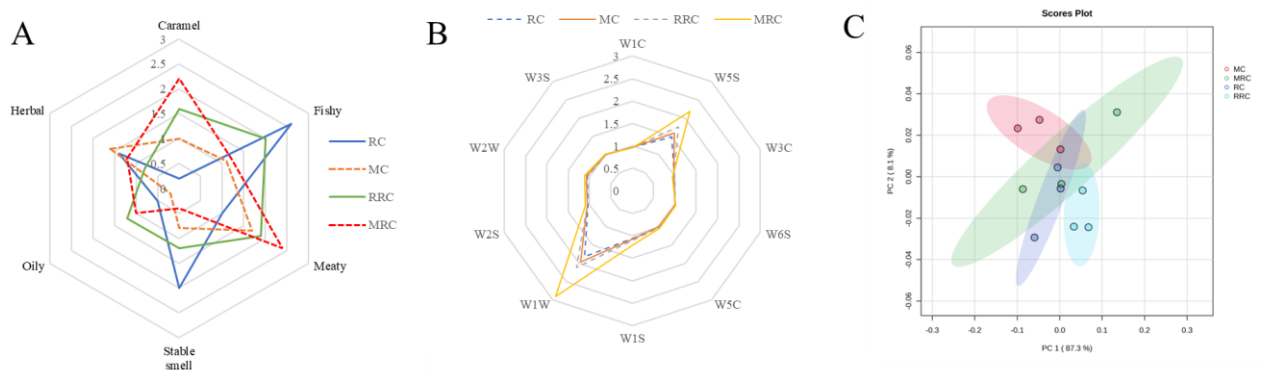


Figure 1. Sensory and electronic nose analysis of chicken under different treatments: (A) QDA radar chart; (B) E-nose sensor response radar; (C) PCA plot.

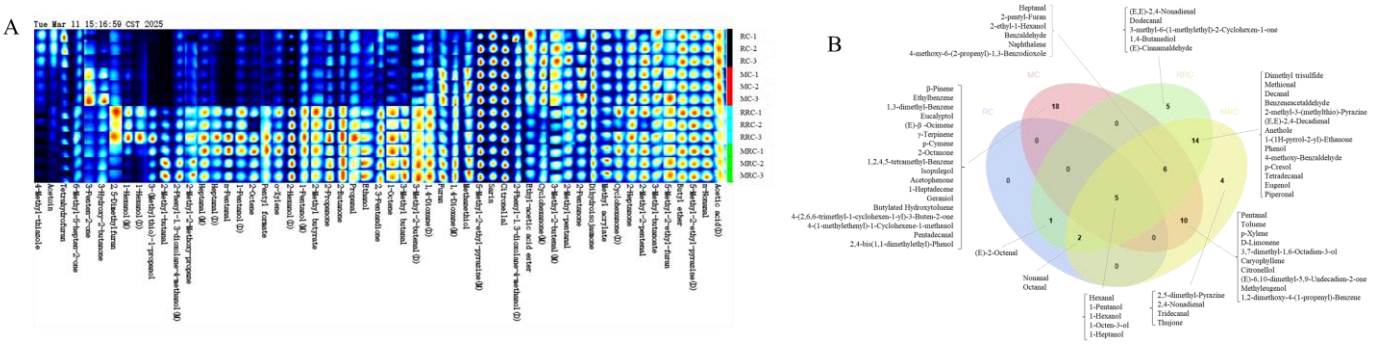


Figure 2. (A) HS-GC-IMS fingerprint of volatile compounds in chicken; (B) GC-O-MS Venn diagram of volatile compounds in chicken.

IV. CONCLUSION

This study demonstrated that PL marination effectively reduced off-odors and enhanced the overall aroma complexity of roasted chicken. Combined analytical and sensory approaches revealed that PL not only masked undesirable notes but also promoted the formation of pleasant volatiles. These findings provide theoretical support for the application of natural deodorizing agents in meat processing. Future research may explore the molecular pathways involved in PL-induced aroma transformation and their potential interactions with different meat matrices.

ACKNOWLEDGEMENTS

This work was financially supported by the project "Xinjiang specialty roasted marinated chicken industrial conversion technology research and development and industrialization demonstration" (Grant No. 2023B02033).

REFERENCES

1. Jayasena, D.D., Ahn, D.U., Nam, K.C., Jo, C. (2013) Flavor chemistry of chicken meat: A review. Asian-Australasian Journal of Animal Sciences, 26, 732–742.
2. Wang, B., Li, H., Huang, Z., Kong, B., Liu, Q., Wang, H., et al. (2021) Dynamic changes in the qualities and heterocyclic aromatic amines of roasted pork induced by frying temperature and time. Meat Science, 176, 108457.
3. Beltrán-Cotta, L.A., Passos, R.S.F.T., Costa, N.P., Barreto, B.G., Veloso, A.C., Da Silva, M.C.A., et al. (2023) Use of yellow mombin (Spondias mombin L.) in marination: Effect on quality properties of Boston butt pork during refrigerated storage. Meat Science, 204, 109257.
4. Kasahara, K., Osawa, C. (2008) Combination effects of spices on masking of odor in boiled sardine. Fisheries Science, 64, 415–418.
5. Chen, J., Wang, W., Jin, J., Li, H., Chen, F., Fei, Y., et al. (2024) Characterization of the flavor profile and dynamic changes in Chinese traditional fish sauce (Yu-lu) based on electronic nose, SPME-GC-MS and HS-GC-IMS. Food Research International, 192, 114772.