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EFFECTS OF CULTURED TISSUE ON PROPERTIES OF HYBRID CULTURED MEAT USING WET-SPINNING

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I. INTRODUCTION

Plant-based meat alternatives are growing in popularity [1,2], but many consumers remain dissatisfied with their taste and quality [3]. To address this, hybrid meat products—combining traditional meat with sustainable proteins like plant-based and cultured meat—have been explored [4–7]. Hybrid meats are seen as a solution for food security and balanced diets [8]. However, conventional hybrid meats are often processed at high temperatures, leading to nutrient loss and poor texture [8,9]. Wet-spinning, a technique adapted from the textile industry [10,11], offers better fiber control at lower temperatures. Previous studies demonstrated that wet-spun plant protein fibers can mimic real meat [12], but the combination of cultured meat tissue (CMT) with plant proteins has not been reported. This study aims to develop hybrid cultured chicken meat by incorporating different levels of CMT into a composite plant protein matrix using wet-spinning, improving both nutritional and sensory qualities while controlling costs.

II. MATERIALS AND METHODS

Chicken satellite cells were isolated from hindlimb muscles (animal experiments were conducted under IACUC approval (GNU-231017-C0196)), expanded in growth media, and harvested after 3D culture using Cytodex 1 microcarriers. The cultured meat tissue (CMT) was freeze-dried and stored at –70°C. Plant-based solutions were prepared using 4% pea protein isolate, 4% wheat protein, and 2% sodium alginate. CMT was incorporated at 10%, 20%, and 30% levels to form hybrid cultured chicken meat (HCCM) samples. Imitation muscle fibers (IMFs) were fabricated via wet-spinning into a calcium chloride bath and wrapped with electrospun cellulose membranes to mimic muscle structure. Color (CIE L*, a*, b*), pH, shear force (WBSF), texture profile (TPA), and amino acid composition were measured. Sensory properties were evaluated using an electronic tongue. Data were analyzed using ANOVA and principal component analysis (PCA).

III. RESULTS AND DISCUSSION

The addition of cultured meat tissue (CMT) to the plant-based protein matrix significantly affected the quality of hybrid cultured chicken meat (HCCM). Increasing CMT levels lowered pH and Warner-Bratzler shear force, indicating improved tenderness. Texture properties such as hardness, chewiness, and cohesiveness were enhanced at higher CMT concentrations. Color measurements showed that CMT addition resulted in a brighter, redder, and more yellow appearance, improving the visual similarity to conventional meat. Essential amino acid levels were significantly increased with CMT incorporation, enhancing the nutritional profile. Sensory analysis using an electronic tongue revealed decreased sourness and increased bitterness and richness, contributing to a more complex flavor profile. Principal component analysis (PCA) confirmed distinct quality differences based on CMT levels. These results suggest that CMT supplementation can improve both the nutritional and sensory properties of hybrid cultured meat produced by wet-spinning.

IV. CONCLUSION

The incorporation of cultured meat tissue (CMT) into a plant-based protein matrix using wet-spinning significantly improved the physical, nutritional, and sensory qualities of hybrid cultured chicken meat. CMT addition enhanced tenderness, texture, color, and essential amino acid content while enriching the flavor profile. These findings demonstrate that CMT supplementation can effectively overcome the limitations of plant-based meat alternatives and provide a promising strategy for developing next-generation hybrid meat products.

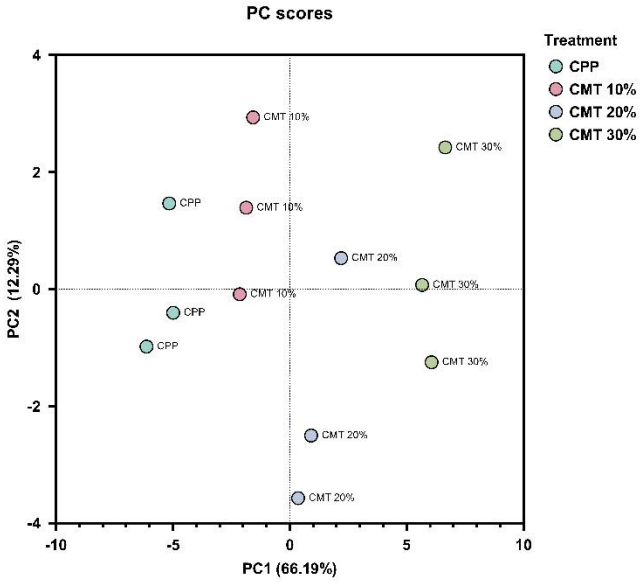


Fig. 1. Principal component analysis of quality characteristics of hybrid cultured chicken meat (HCCM). CPP, composite plant-based protein; CMT 10%, cultured meat tissue 10%; CMT 20%, cultured meat tissue 20%; CMT 30%, cultured meat tissue 30%.

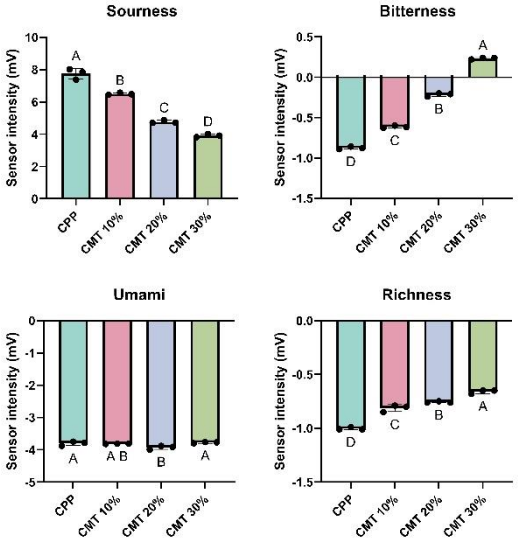


Fig. 2. Effects of cultured meat tissue (CMT) addition to a composite plant-based protein (CPP) on taste characteristics of hybrid cultured chicken meat (HCCM) evaluated by electronic tongue. A–D Different superscripts indicate significant difference ($p<0.05$).

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REFERENCES

1. Ismail, I., Hwang, Y. H., & Joo, S. T. (2020). Meat analog as future food: A review. *Journal of Animal Science and Technology, 62*(1), 111–120.
2. Kumari, S., Alam, A. N., Hossain, M. J., Lee, E. Y., Hwang, Y. H., & Joo, S. T. (2023). Sensory evaluation of plant-based meat: Bridging the gap with animal meat, challenges and future prospects. *Foods, 13*(1), 108.
3. McClements, D. J., & Grossmann, L. (2021). The science of plant-based foods: Constructing next-generation meat, fish, milk, and egg analogs. *Comprehensive Reviews in Food Science and Food Safety, 20*(5), 4049–4100.
4. Hoek, A. C., Elzerman, J. E., Hageman, R., Kok, F. J., Luning, P. A., & de Graaf, C. (2013). Are meat substitutes liked better over time? A repeated in-home use test with meat substitutes or meat in meals. *Food Quality and Preference, 28*(1), 253–263.
5. Alam, A. N., Kim, C. J., Kim, S. H., Kumari, S., Lee, S. Y., Hwang, Y. H., & Joo, S. T. (2024). Trends in hybrid cultured meat manufacturing technology to improve sensory characteristics. *Food Science of Animal Resources, 44*(1), 39–50.
6. Molfetta, M., Morais, E. G., Barreira, L., Bruno, G. L., Porcelli, F., Dugat-Bony, E., Bonnarme, P., & Minervini, F. (2022). Protein sources alternative to meat: State of the art and involvement of fermentation. *Foods, 11*(14), 2065.
7. Grasso, S., & Jaworska, S. (2020). Part meat and part plant: Are hybrid meat products fad or future? *Foods, 9*(12), 1888.
8. Grasso, S. (2024). Opportunities and challenges of hybrid meat products: A viewpoint article. *International Journal of Food Science & Technology, 59*, 8693–8696.
9. Chandler, S. L., & McSweeney, M. B. (2022). Characterizing the properties of hybrid meat burgers made with pulses and chicken. *International Journal of Gastronomy and Food Science, 27*, 100492.
10. Dekkers, B. L., Boom, R. M., & van der Goot, A. J. (2018). Structuring processes for meat analogues. *Trends in Food Science & Technology, 81*, 25–36.
11. Kyriakopoulou, K., Dekkers, B., & van der Goot, A. J. (2019). Plant-based meat analogues. In C. M. Galanakis (Ed.), *Sustainable meat production and processing* (pp. 103–126). Academic Press.
12. Kumari, S., Kim, S. H., Kim, C. J., Chung, Y. S., Hwang, Y. H., & Joo, S. T. (2024). Development and comparative evaluation of imitated fiber from different protein sources using wet-spinning. *Food Science of Animal Resources, 44*(6), 1156–1166.