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ENHANCEMENT IN QUALITY OF MEAT PATTIES WITH NATURAL MARINATION INGREDIENTS

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I. INTRODUCTION

The era of rapid urbanization has served as a driving force, leading to an increased preference among modern consumers for convenient prepared foods [1]. Among these, prepared meat patty is one of the most popular choices due to its ease of convenience and palatability, making it highly accepted and consumed worldwide [2]. However, industrial meat patties often suffer from significant juice loss, poor texture, and weak original flavor, which bring huge economic losses to enterprises.

This work presents four new natural ingredient proportioning strategies based on *Lentinula edodes* (LE) powder, yeast extract (YE), germinated brown rice (GBR) powder, and chicken soup (CS), aiming to improve the flavor of meat patties. To achieve this, the effects of formulated combinations of these ingredients were systematically investigated. Furthermore, their potential for industrial application in prepared meat patty production was evaluated, leading to the identification of the optimal combination.

II. MATERIALS AND METHODS

2.1 The grouping of meat patties

The concentration of four ingredients was determined on the basis of a large number of pre-experimental results: 0.50% (w/w) LE, 6.60% (w/w) CS, 0.40% (w/w) YE, 0.2% (w/w) GBR**.** Five different marinating formulations of meat patty were tested, with each formulation replicated five times on different days: 1) Con: Basic formulation only, without four natural ingredients; 2) non-LE: Formulation without LE; 3) non-CS: Formulation without CS; 4) non-YE: Formulation without YE; 5) AI: All ingredients included.

2.2 Meat patties preparation

The cleaned beef and backfat (fat to lean ratio: 2.5:7.5) were minced using a meat grinder and mixed with salt (1.24%, w/w), ice water (7.37%, w/w), composite phosphate (0.44%, w/w), and D-sodium erythorbate (0.07%, w/w). Subsequently, according to the concentration of the four ingredients determined in the pre-experiment, the ingredients used in each treatment were added and stirred at low speed (1, 420 rpm) for 1 min. The minced meat was marinated at 4 °C for 12 h, and shaped into meat patties (diameter 7 cm, thickness 1.8 cm). The raw meat patties were baked at 200 °C for 12 min. Finally, the cooked meat patties were vacuum sealed, and stored at -20 °C.

2.3 Assessment of key physical and chemical attributes in meat patties

To evaluate the quality and flavor characteristics of prepared meat patties formulated with four natural ingredients, reheating loss, water distribution, free fatty acids (FFAs), and volatile compounds were determined using established methods previously developed in the laboratory [3-4].

2.4 Statistical analysis

The results were expressed as means ± standard deviation (SD) with five replicates (n = 5). Data differences between each tested group were analyzed by one-way analysis of variance with IBM SPSS Statistics 22 (IBM Corp., Armonk, NY, USA).

III. RESULTS AND DISCUSSION

3.1 Impact of natural ingredients on reheating loss and water distribution in meat patties

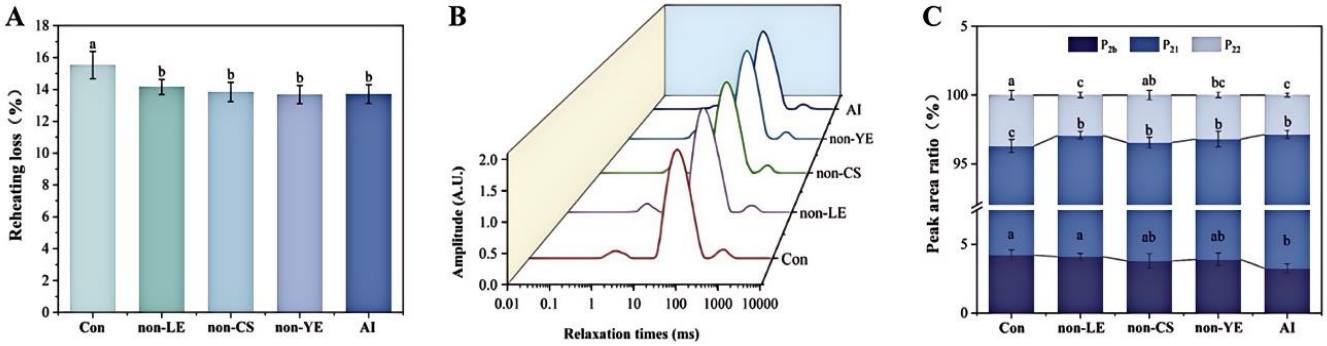


Figure 1. (A) Reheating loss. Water distributions (B) amplitude and (C) peak area ratio.

The common ingredient in all four treatment groups, GBR, played an important role in reducing the reheating loss (Figure. 1A). Three characteristic peaks were observed in the T_2 relaxation time distribution of prepared meat patties, including T_{2b} (1-10 ms), T_{21} (10-300 ms), and T_{22} (100-2000 ms), indicating that the natural ingredients facilitated the binding of water molecules within the protein gel network more effectively (Figure. 1B). The corresponding proportion of the three water fractions (P_{2b}, P_{21}, P_{22}) in each group was observed in the analysis, further indicating that natural ingredients contributed to the retention of immobile water, preventing its conversion into free water and thus improving water-holding capacity (Figure. 1C).

3.2 Analysis of FFAs and volatile compounds

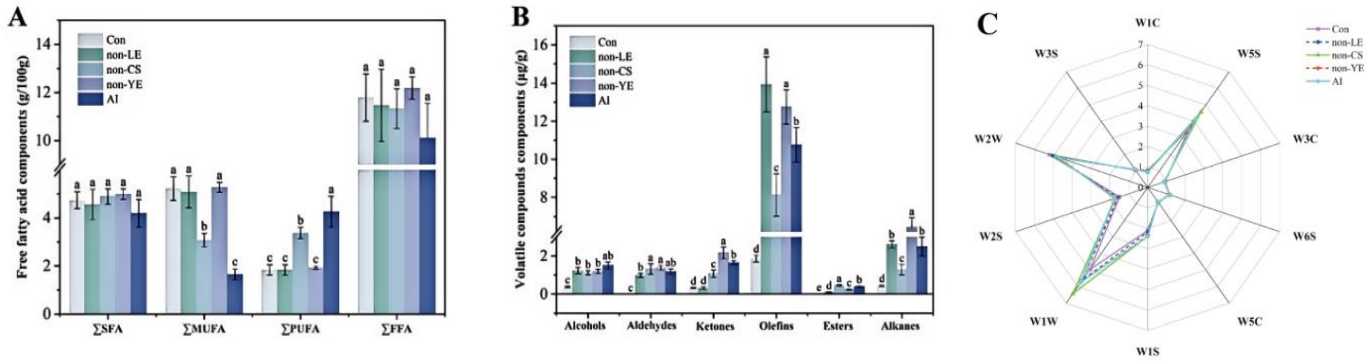


Figure 2. (A) FFAs. Volatile compounds (B) gas chromatography-mass spectrometry (GC-MS) and (C) electronic nose.

YE and LE could effectively alter the composition of FFAs in the prepared patties (Figure. 2A). The natural ingredients greatly enriched the volatile compounds (alcohols, aldehydes, ketones, olefins, esters, and alkanes) of prepared meat patties (Figure. 2B). The response of 5 groups of conditioned meat patties to sensors W1C (sensitive to benzene compounds, aromatic hydrocarbons), W3S (sensitive to alkanes), W2W (sensitive to aromatic hydrocarbons, organic sulfides), W2S (sensitive to alcohols, short chain fatty acids), W1W (sensitive to sulfur-containing compounds, terpenes, pyrazines), W1S (sensitive to methane derivatives), W5C (sensitive to olefins, polar compounds), W6S (sensitive to hydrides), W3C (sensitive to amines), W5S (sensitive to nitrogen oxides) has similarity (Figure. 2C). All groups are sensitive to specific sensors W1W, W5S and W2W.

IV. CONCLUSION

This study demonstrated the effects of all four ingredients on the physicochemical quality of prepared meat patties, particularly in terms of FFAs and volatile compounds. Compared with the Con group, the water holding capacity of the four treatment groups were equally enhanced, which was mainly attributed to their common ingredient, GBR powder. Notably, the inclusion of YE played a key role in modulating the composition of taste-related compounds in the non-LE, AI, and non-CS groups. The presence of YE and LE powder also affected the profile of volatile compounds in the non-CS and AI groups, potentially contributing to flavor modification. These changes were primarily linked to the taste-active molecules and flavor precursors present in the natural ingredients, as well as alterations in protein functionality within the minced meat matrix.

Considering these results, it can be concluded that the non-CS group is the most suitable choice for producing prepared meat products. The findings of this study hold promise for addressing current deficiencies in prepared meat products and further advancing the deep processing industry of meat products.

ACKNOWLEDGEMENTS

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