USING 1H NMR AND MULTIVARIATE DATA ANALYSIS TO STUDY THE CHANGES OF PRECURSOR FLAVOR SUBSTANCE OF WUDING CHICKEN

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Abstract: The aim of this study was to evaluate the age on the chemical composition of precursor flavor substance of Wuding chicken. The metabolic composition of chicken meat was studied by using ^{1}H nuclear magnetic resonance (NMR) spectroscopy. Comprehensive multivariate data analysis showed significant differences about precursor substance including pyruvate, guanosine, malonate, malate and dimethyl sul between the fifth period. These results contribute to a better understanding of changes in chicken meat metabolism as the increase of age.

Key Words: Wuding chicken meat, Age, Nuclear magnetic resonance (NMR)

I.   INTRODUCTION

Wuding chicken is one popular breed in China due to good performance and special flavor. The flavor of meat produced through the heating of precursor flavor substance and the WLOM (water-soluble lower molecular) is the major compound to produce the flavor[1]. NMR is a nondestructive and rapid method to identify and characterize small molecules. To further investigate the effects of age on metabolites, Wuding chicken with the ages of 110, 140, 170, 200 and 300 days were studied using NMR-based metabonomic approaches coupled with multivariate data analysis. In addition to studying the impact of age on the metabolic composition of chicken meat, the comprehensive metabonomic analyses were also conducted to assess the flavor of the meat.

II.   MATERIALS AND METHODS

Forty Wuding chicken were fed in Experimental Chicken Farm of Yunnan Agricultural University. At different rearing period, 4 males and 4 females were chosen randomly from each group with the age of 110, 140, 170, 200 and 300 days. Chicken with similar body weights were weighed and slaughtered by captive-bolt stunning and exsanguination. After slaughter, left breast meat was rapidly sampled and immediately snap-frozen using liquid nitrogen. The 50 mg chicken samples were analyzed using NMR spectroscopy.

III.   RESULTS AND DISCUSSION

The results were analyzed using partial least square-discriminant analysis method (PLS-DA) and the data used log transformation to be normalized. The five period score plot (Figure.1) and loading plot (Figure.2) of the Wuding chicken were obtained by PLS-DA analysis. PCA score plot showed that the 300 day group distinguished among the sample groups of metabolites which was farther away from the center and got more contribution significantly. The PLS-DA loading plot reflected the contribution to distinguish among the sample groups of metabolites, which was farther away from the center to distinguish the sample group. The PLS-DA loading plot showed that the pyruvate, guanosine, malonate, malate and dimethyl sul were distinguished among the samples.
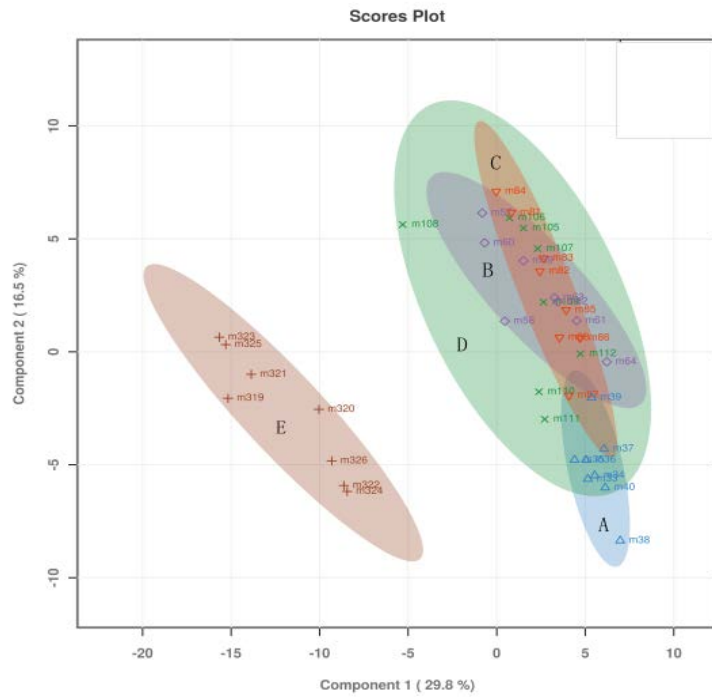
Figure 1. PCA scores plot of Wuding chicken meat extracts associated [A, 110 days(blue △); B，140 days(violet ◇); C, 170 days(red ▽); D，200 days(green ×); E, 300 days(red ＋)].
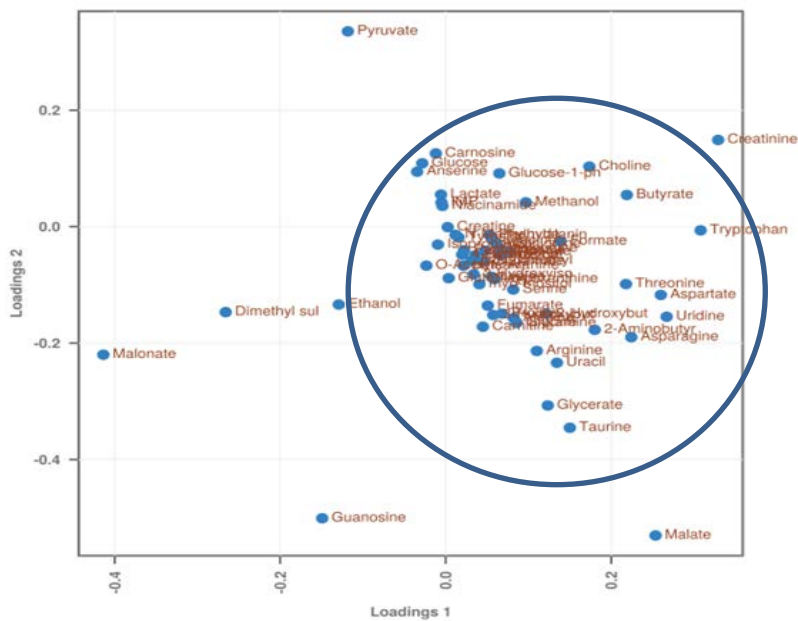

Figure 2: PLS-DA loading plot with age (Pyruvate, guanosine, malonate, malate and dimethyl sul differ from metabolites in cycle)

Few studies have investigated the relationship between metabolites and flavor of chicken meat. Fats and low molecular weight water-soluble compounds constitute the most important precursors of cooked meat flavor [2]. Small peptides and free amino acids play important roles in the formation of flavor during aging or cooking [3][4]. In current research, there were 62 low metabolites to be identified including amino acids, amides, ammoniums, organic acids, alcohols and the relevant derivatives. With the increase of age, the content of pyruvate, guanosine, malonate, malate and dimethyl sul also increased gradually. Liu et al reported that the number of the kinds of volatile flavor compounds was similar but the content differed as the duck age increased.

The NMR results showed significant differences among extracts from ducks that had been aged for four different periods[5][6]. However, the relationship between the precursor flavor substance and the flavor is complicated which needs to be further studied.

IV   CONCLUSION

This study demonstrates that there are significant differences for the precursor flavor substance between the samples of 300 day and other four stages. Pyruvate, guanosine, malonate, malate and dimethyl sul are the major compounds which are distinguished between the samples.

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