DIFFERENCIATION OF KOREAN NATIVE CHICKENS AND BROILERS USING VOLATILES PROFILING

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Abstract – **The possibility of differentiation between commercial Korean native chicken (KNC, (Woorimotdag™) and broilers using volatiles profiling of their meats was tested. Two hundred 1-day-old Woorimotdag™ and Ross were randomly assigned in pens (3 m x 2 m) with 20 birds per pen. At market weights (5 wk for broilers and 13 wk for KNC), 10 chickens were slaughtered and the breast and leg meat were separated, and frozen at -50°C. After 48 hrs of thawing, a half of samples were cooked and both raw and cooked meats were analyzed using a solid phase microextraction GC/MS. Pearson's correlation coefficient was used for the distance measure among clusters and found that cooked and raw meat were clustered primarily and broiler and KNC were secondly. The development patterns of volatiles were different among the treatments, which indicate that this method can be used as differentiation of meat samples from different origins.**

Key words - **chicken, differentiation, volatiles profiling, clustering**

I INTRODUCTION

Chicken meats in many countries over the world, including Korea, have been produced using a well-commercialized breed which have benefits in growth and feed efficacy. Native chicken is known to be unpopular to the producers because it has some disadvantages in productive aspects such as slower growth, worse feed efficacy, and less edible-parts compared to commercialized chicken [1]. However, because the consumers in each countries prefer to their native chicken for its flavor, taste, and texture, in recent years, the consumers' interest in native chicken has been increased so native chicken tends to be sold at the price as 2-3 times as commercialized broilers [2,3].

Korean native chicken (KNC) was restored from a national project of the Rural Development Administration, Korea. Then, a commercial meat-type breed was developed. The developed KNC has higher essential fatty acids, collagen contents, and darker and more characterized red appeared in color. Besides, KNC also tends to have lower fat contents and higher protein contents compared to commercialized chicken so this gives scientific evidence to KNC as health-oriented product [4,5].

KNC is popular and considered as health-oriented product however, the price is high due to low productivity. For this reason, there are some possibilities for illegal circulation like the case happened in Hanwoo and imported cattle. A lot of studies and patents have been filed including DNA marker for differentiation Hanwoo and imported cattle and it is expected to be used for KNC as well. However, DNA marker is not simple nor cost-effective so the development in alternative method is needed. Therefore, the objective of this study was to see the possibility of the differentiation between KNCs and broilers by clustering and profiling of volatile compounds analyzed by SPME-GC-MS.

II. MATERILAS AND METHODS

A. SPME-GC-MS

KNCs and broilers (each 10) were obtained from a local store. Breast and leg were prepared and half of the samples were cooked in boiling water for 45 min to achieve the internal temperature of meat to 75°C. The other half was used as fresh. Sample (3 g) was

weighed into 20 mL vial and sealed with a silicon/PTFE septum and an open top cap. A solid-phase microextraction (SPME) fiber (Supelco, Bellefonte, Pa., U.S.A.) coated with carboxen/polydimethylsiloxane (Carbboxen/PDMS, 75-μm thickness) was used to adsorb headspace volatiles. Before extracting volatiles, the fiber was cleaned at 250°C for 5 min in the GC injection port and used immediately to prevent possible contamination.

Samples were preheated for 10 min at 40°C in a heating block, and the SPME fiber extracted the headspace volatiles for an additional 50 min; the fiber was then injected into the GC and remained for 5 min for desorption. A Varian Star 3400CX GC with Varian Saturn 2000 MS and HP-5 column (crosslinked 5% diphenyl and 95% dimethylpolysiloxane, 30 m × 0.32 mm, 0.25 μm film thickness) was used to quantify VC. The flow rate of carrier gas (helium) was adjusted to 1 mL/min. The temperature of the injection port was 250°C.

The column was held at 40°C for 2 min and raised to 250°C at 3.5°C /min. The temperature of ion source, manifold, and transfer line in mass spectrometry (MS) were 180, 50, and 180°C, respectively. The VC were identified by a mass spectrum database (WILLY Library (Registry of mass spectral data, 6th edition, USA) or NIST Library (Mass spectral search program, version 4.5, USA), and the total ion counts were presented.

B. Volatiles profiling and statistical analysis

In order to investigate whether there are differences in volatile compounds (VC) profiles among the samples (i. e. cooked breast from KNC; C_K_b, cooked thigh from KNC; C_K_t, cooked breast from broiler; C_B_b, cooked thigh from broiler; C_B_t, raw breast from KNC; R_K_b, raw thigh from KNC; R_K_t, raw breast from broiler; R_B_b, and raw thigh from broiler; R_B_t), the triplicate measurements of VC in the samples were averaged and profiled for the hierarchical clustering analysis. Only compounds that detected in at least two of the three replicates of any sample were used in the subsequent analysis. Before the clustering analysis, the values for each VC were standardized to have a mean close to zero and a standard deviation of one. The hierarchical clustering analysis was conducted for identifying closely related samples on the basis of VC profile using the R statistical package [6]. Pearson's correlation coefficient was used for the distance measure among clusters. The result from the analysis was presented using a heatmap.

III. RESULTS AND DISCUSSION

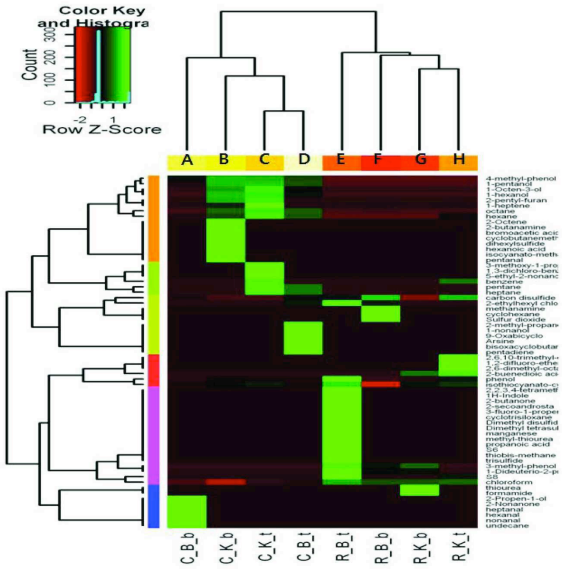

Figure 1. Hierarchical clustering of volatile compounds produced from different breeds.

Volatile profiles between cooked (A-D) and raw chicken (E-H) were differentiated very easily from the result of clustering. High similarity was found in leg meat of cooked KNCs (C) and broilers (D) (Fig. 1). The volatile profile of these two leg meats (C-D) were similar to that of breast meat of cooked KNC (B). The breast meat of cooked broilers (A) and KNC (B) also had high similarity. These similarities indicate that breast and leg meat have different composition of volatile compounds and the differences are bigger than those between KNC and broiler. However, despite of the similarities, all treatments were differentiated by volatiles profiling.

High similarities in breast (G) and leg meat (H) of KNC were showed in raw meat followed by breast (F) and leg meat (E) of broilers. In addition, it was found

that breast and leg meat of KNC had similar compositions as the amount of volatile compounds of raw meat was less than those of cooked meat. No significant difference found between breast and leg meat. However, like cooked meat, the differences between raw KNC and broilers were found and breast and leg meat were also differentiated by volatile profiling analysis.

IV. CONCLUSION

The profiling of volatile compounds had a possibility to be used for differentiation method between KNC and broilers. This may employed to other meats including beef and pork.

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