Comparison of the amounts of taste-related compounds in raw and cooked meats from broilers and Korean native chickens

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ABSTRACT This study was aimed at comparing the taste-related compound content in the breast and leg meat from 100-d-old Korean native chickens (KNC-100) and 32-d-old commercial broilers (CB-32) and determining the changes in these compounds during cooking. Cocks from certified meat-type commercial broiler (Ross) and Korean native chicken (Woorimatdag) strains were raised under similar standard commercial conditions, and a total of 10 birds from each breed were slaughtered at 32 and 100 d of age, which represents their market ages, respectively. Raw and cooked meat samples were prepared separately from the breast and leg and analyzed. The KNC-100 showed significantly higher concentrations of inosine 5′-monophosphate, reducing sugars, glutamic acid, linoleic acid, arachidonic acid, and docosahexaenoic acid than CB-32 did. Additionally, significantly higher inosine 5′-monophosphate, cysteine, arachidonic acid, and docosahexaenoic acid concentrations were observed in the breast meat, whereas the leg meat had higher concentration of glutamic acid, oleic acid, and linoleic acid ($P < 0.05$). Significant depletions in the concentration of all taste-related compounds occurred during the cooking process, except oleic and linoleic acids. We suggest that the higher levels of taste-related compounds present in KNC-100 meat compared with CB-32 meat may result in the unique taste of the former meat, as has been previously reported. In addition, the results of this study may provide useful information for selection and breeding programs.

Key words: broiler, cooking, inosine 5′-monophosphate, reducing sugar, Korean native chicken

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INTRODUCTION

The increasing demand for chicken meat in Korea is mainly fulfilled by a few fast-growing commercial broiler (**CB**) strains, whereas the contribution from the indigenous slow-growing Korean native chicken (**KNC**) is known to be small (Choe et al., 2010). However, KNC are highly preferred over CB by Korean consumers because of their unique flavor and texture (Jayasena et al., 2013b). Meat flavor, one of the most important eating quality parameters, is primarily composed of taste and aroma (Sasaki et al., 2007; Jayasena et al., 2013a). The major taste-related compounds in meat include nucleotides, sugars, amino acids, peptides, organic acids, and several fatty acids (Liu et al., 2007; Sasaki et al., 2007; Jayasena et al., 2013a).

The Maillard reaction, which is a chemical reaction between reducing sugars (e.g., glucose, ribose) and free amino acids, generates many important flavor compounds and thereby intensifies the taste of cooked meat (Aliani and Farmer, 2002; Meinert et al., 2009). For instance, ribose reacts with cysteine to produce 2-methyl-3-furanthiol, which is considered to be a vital chemical compound for chicken flavor development (Jayasena et al., 2013a). In addition, the umami taste that is associated to chicken meat is derived from water-soluble precursors such as inosine 5′-monophosphate (**IMP**) and glutamic acid (Fujimura et al., 1996; Liu et al., 2007; Sasaki et al., 2007; Jayasena et al., 2013a). Thus far, however, there have been no reported studies concerning the identification and quantification of sugars in indigenous chicken meat.

Williamson et al. (2014) reported that the lipid fraction of meat is responsible for the species-specific tastes and characteristic aromas. Shi and Ho (1994) reported that the most abundant aldehydes (25.6 and 5.2 mg/kg, respectively) identified in cooked chicken

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meat contributing to its taste—hexanal and 2,4-decadienal—are the primary oxidation products of linoleic acid (C18:2). Furthermore, higher percentages of arachidonic acid (C20:4) have been shown to contribute to better sensory attributes of chicken meat (Jeon et al., 2010; Kiyohara et al., 2011). Oleic acid (C18:1) is also a popular taste-related fatty acid in meat (Choe et al., 2010). Docosahexaenoic acid (**DHA**; C22:6) has been shown to suppress sourness and bitterness and to increase sweetness and umami characteristics (Koriyama et al., 2002).

Jayasena et al. (2013a) reported that the content of taste-related compounds in chicken meat is affected by factors such as the breed/strain of chicken, bird diet, and cooking conditions. As the meat flavor is thermally derived (Jayasena et al., 2013a), cooking can be considered to be the most influential factor in the taste of meat. A few studies have elucidated the effect of cooking on the content of several taste-related compounds in meat (Chikuni et al., 2002; Liu et al., 2007; Sasaki et al., 2007; Alfaia et al., 2010); however, to the best of our knowledge, no quantitative studies to date have compared the taste-related compounds in cooked meat from CB and indigenous chickens such as KNC.

Therefore, the objective of this work was to determine the effects of the breed at their respective market ages and the cooking process on different taste-related compounds in chicken breast and leg meats.

MATERIALS AND METHODS

All the experimental procedures followed the recommendations described in The Guide for the Care and Use of Laboratory Animals, published by the Institutional Animal Care and Use Committee of the National Institute of Animal Science (2012) in Korea.

Birds and Processing

A certified meat-type commercial strain of KNC (Woorimatdag) and a CB strain (Ross) were raised under similar standard conditions at a commercial chicken farm (Gimcheon, Korea). A total of 160 one-day-old male chicks from each breed were obtained from a local hatchery and allotted to 10 floor pens separately (32 chicks of same breed/pen) within a single house. Chicks were fed commercial starter (3,100 kcal of ME/kg, 23% CP during first 7 d), grower (3,200 kcal of ME/kg, 20% CP from 8 to 21 d), and finisher (3,200 kcal of ME/kg, 18% CP from 22 d to respective age) diets ad libitum, and had free access to water.

Two birds each from CB and KNC were randomly selected from each pen at 32 and 100 d of age, which represents their market ages, respectively (5 replications for each breed). After a 10-h feed-withdrawal period, the birds were euthanized by conventional neck cut and exsanguinated for 2 min. The carcasses were then manually defeathered and eviscerated, chilled at 4°C for 24 h, and split into 2 halves.

Preparation of Raw and Cooked Samples

Raw meat samples were obtained by dissecting both breast and leg meat from the left half of each carcass. After trimming the visible skin, fat, and connective tissues, the raw meat samples were minced (CH180, Kenwood, Shenzhen, China) separately and used for the subsequent analysis.

The remaining 10 halves from each breed were separately boiled in water (1:1.5 wt/vol) for 40 min until a core temperature of >72°C was reached, which represents the domestic boiling conditions for chicken meat. The temperature of the meat was measured using a digital thermometer (YF-160A Type-K, YFE, Hsinchu City, Taiwan). The carcasses were then vacuum-packed and cooled under running water. Finally, the cooked breast and leg meat samples from each half of the carcasses were dissected, deboned, minced separately, and used for analysis.

IMP Content

The IMP content of each meat sample was measured according to the method described by Jung et al. (2013). Briefly, the nucleic acids were extracted from the meat samples (5 g each) using 25 mL of 0.7 *M* perchloric acid. The extract was then adjusted to pH 7 with 5 *N* KOH and brought to a final volume of 100 mL with 0.7 *M* perchloric acid. After 30 min of cooling, the mixture was centrifuged (Union 32R, Hanil Co. Ltd., Incheon, Korea) at 1,130 × *g* (4°C), and the supernatant was analyzed using an ACME-9000 HPLC system (Younglin Instruments Inc., Seoul, Korea) and a Waters-Atlantis dC18 reverse-phase column (4.6 × 250 mm, 5 μm particles; Millipore Co-Operative, Milford, MA). The injection volume was 10 μL and the elution time was 25 min, with a mobile phase of 0.1 *M* triethylamine in 0.15 *M* acetonitrile (pH 7.0) at a flow rate of 1.0 mL/min. The column temperature was maintained at 35°C, and the detection was monitored at a wavelength of 260 nm. The quantity of IMP was calculated from a standard curve obtained using an IMP standard (Sigma-Aldrich Co., St. Louis, MO).

Taste-Related Fatty Acid Composition

Lipids were extracted from the meat samples using chloroform/methanol (2:1, vol/vol), according to the procedure of Folch et al. (1957). Fatty acid methyl esters were prepared from the extracted lipids using boron trifluoride-methanol (Sigma-Aldrich), followed by separation in a gas chromatograph (HP-7890, Agilent Technologies, Santa Clara, CA) according to the method of Jung et al. (2010) with some modifications. A split inlet (split ratio, 100:1) was used to inject the samples into a capillary column (30 m × 0.32 mm; 0.25 μm; Omegawax 320, Supelco, Bellefonte, PA), and the sample components were separated using a gradually increased oven temperature (150°C for 5 min, tempera-

ture increased to 170°C at 5°C/min and maintained for 8 min, then increased to 190°C at 5°C/min and maintained for 15 min and finally increased to 220°C at 5°C/min and maintained for 30 min). The inlet temperature was 210°C, and N_2 gas served as the carrier at a constant flow rate of 0.7 mL/min.

Glutamic Acid and Cysteine Content

Glutamic acid and cysteine quantities were analyzed with modification of the method by Hughes et al. (2002). Meat samples (5 g) were mixed with 20 mL of 2% trichloroacetic acid and homogenized at 13,500 rpm for 1 min [T25b, Ika Works (Asia), Sdn, Bhd, Malaysia]. The homogenate was centrifuged at 17,000 × *g* for 15 min (4°C; Hanil) and filtered through a 0.45-μm membrane (Whatman International Ltd., Maidstone, UK). The filtrate was derivatized using AccQ-Tag (Waters Corp., Milford, MA) according to the manufacturer's protocol, and 5 μL of the reaction was injected into a reverse-phase HPLC system (3.9 × 150 mm; AccQ-Tag column, Waters) using a mobile phase consisting of buffers: A (Waters AccQ-Tag eluent) and B (60%, vol/vol, acetonitrile). The column temperature was 37°C and a Waters 2475 fluorescence detector was used with excitation and emission wavelengths of 250 and 395 nm, respectively. Individual amino acids were identified by comparison of their retention times with those of the calibration standards (Sigma-Aldrich). Peak areas were calculated using Millennium 32 software, and the concentrations of glutamic acid and cysteine were expressed as milligrams per 100 g of fresh sample.

Reducing Sugar Content

Sugars were extracted from the meat samples (1 g) twice using 5 mL of hot 80% ethanol (50°C) per extraction. The extracts were then centrifuged at 1,130 × *g* for 10 min (4°C; Hanil), and the supernatants were filtered (filter paper no.1, Whatman International Ltd.) separately into 15-mL tubes and evaporated using N_2 gas (99.999%). The dried sugars were dissolved in distilled water (2 mL), and this solution was centrifuged at 10,000 × *g* for 10 min (4°C; HM-150IV, Hanil). Subsequently, the reducing sugar content of each extract was measured by a dinitrosalicylic (**DNS**) acid method, as described by the Korean Society of Food Science and Nutrition (2000). Briefly, 1 mL of each extract was mixed with 2 mL of DNS solution (0.5 g of DNS acid, 8.0 g of NaOH, and 150 g of Rochelle salt in 500 mL of distilled water) in a 15-mL test tube and heated in a water bath (90°C) for 10 min. The mixture was then cooled under running water for 5 min and the absorbance was measured at 550 nm using a spectrophotometer (DU 530, Beckman Coulter Inc., Brea, CA). Finally, the amount of reducing sugar in each sample was calculated from a standard curve produced using a glucose standard (Sigma-Aldrich) and expressed as a percentage (wt/wt) of the fresh raw meat sample.

Statistical Analysis

The data of the birds from the same pen were averaged for each parameter. The effects of the breed of chicken at respective market ages, cooking, and the meat portion were estimated using 3-way factorial ANOVA and the GLM procedure within a completely randomized design. After grouping the data according to the state of meat (raw or cooked) with each meat portion, the data were analyzed by 1-way ANOVA and the GLM to confirm the associations and effects of the breed, meat portion, and state of meat. Mean separation was conducted using Tukey's multiple range test ($P < 0.05$). All the tables indicate the mean values and SEM. The SAS software (version 9.3, SAS Institute Inc., Cary, NC) was used for all the statistical analyses.

RESULTS AND DISCUSSION

The results of the 3-way ANOVA are given in Table 1 and showed that the average taste-active compound contents of chicken meat are affected by the breed at their respective market age, meat portion, and cooking.

Umami-Related Compound Content

Pre- and postcooking concentrations of IMP and glutamic acid in breast and leg meat from 100-d-old KNC (**KNC-100**) and 32-d-old CB (**CB-32**) are shown in Table 2. According to the pooled data, the IMP and glutamic acid content in chicken meat was dependent on the breed at their respective market ages, the cooking process, and the meat portion (breast or leg meat), in this order of significance (Table 2). The KNC-100 had a significantly higher IMP concentration (226.4 mg/100 g) than did CB-32 (94.4 mg/100 g), in both raw and cooked meat and irrespective of the portion (Table 1). Previous studies have shown similar differences between slow-growing breeds and CB; Wenchang and Xianju (China), Hinai-jidori (Japan), and KNC have been shown to display higher IMP concentrations than CB (Tang et al., 2009; Rikimaru and Takahashi, 2010; Jayasena et al., 2013b). Hence, the difference in IMP content between KNC-100 and CB-32 may be explained by the effect of breed and age (Tang et al., 2009). Furthermore, it has been shown that IMP content in meat increases with the age of the chicken (Chow and Jacobson, 1968; Rikimaru and Takahashi, 2010). It is worth noting that, in the present study, KNC were slaughtered at older ages than were CB.

Breast meat had a significantly higher concentration of IMP compared with leg meat, regardless of the breed of chicken and the cooking state (Tables 1 and 2). This may be attributable to the distinct composition of muscle fibers in the 2 muscles (Jaturasitha et al., 2008); breast meat is mainly composed of more than 90% white muscle (type IIB) fibers, whereas leg meat contains red muscle (type I) fibers (Jung et al., 2013). Other studies have shown that a higher accumulation

Table 1. Average taste-active compound content of chicken meat as affected by the breed at their respective market age, meat portion, and cooking (n = 5)

	Breed[1]		Meat portion		State of meat		
Compound	KNC-100	CB-32	Breast	Leg	Raw	Cooked	SEM[2]
Inosine-5′-monophosphate	226.4[a]	94.4[b]	223.3[a]	97.5[b]	223.6[a]	97.2[b]	4.5
Glutamic acid	24.9[a]	15.1[b]	18.8[b]	21.2[a]	24.7[a]	15.3[b]	0.6
Cysteine	1.8	2.0	2.2[a]	1.6[b]	3.2[a]	0.6[b]	0.2
Reducing sugar	0.11[a]	0.05[b]	0.07	0.09	0.11[a]	0.05[b]	0.004
Oleic acid	27.0[b]	37.3[a]	30.9[b]	33.4[a]	31.3[b]	33.0[a]	0.5
Linoleic acid	23.1[a]	17.2[b]	18.7[b]	21.6[a]	19.9	20.4	0.5
Arachidonic acid	8.3[a]	2.4[b]	6.9[a]	3.8[b]	6.1[a]	4.5[b]	0.4
Docosahexaenoic acid	3.1[a]	0.4[b]	2.4[a]	1.1[b]	2.1[a]	1.4[b]	0.1

[a,b]Mean values in the same row with different superscript letters within each effect differ significantly ($P < 0.05$).

[1]KNC-100 = 100-d-old Korean native chickens; CB-32 = 32-d-old commercial broilers.

[2]Mean separation was conducted using Tukey's multiple range test.

of IMP in type II fibers as opposed to type I fibers occurred in rat skeletal muscle (Arabadjis et al., 1993). Moreover, Tullson and Terjung (1999) demonstrated that type I fibers display greater 5′-nucleotidase activity (which catalyzes the degradation of IMP to inosine) compared with type II fibers in rat skeletal muscle. Furthermore, our results are similar to those reported by several other authors who also have demonstrated that breast meat contains more IMP than leg meat (Kavitha and Modi, 2007; Jung et al., 2013).

Cooking had a significant effect on the umami-related compound content of chicken meat, irrespective of the breed and the meat portion ($P < 0.05$; Tables 1 and 2). IMP and glutamic acid content markedly decreased after cooking ($P < 0.05$), with average values of 97.2 and 15.3 mg/100 g in cooked meat compared with average values of 223.6 and 24.7 mg/100 g in raw meat, respectively (Table 1). The observed changes in IMP and glutamic acid content after cooking were comparable with those reported for pork (Chikuni et al., 2002; Sasaki et al., 2007) and duck meat (Liu et al., 2007). The depletion of the umami-related compounds during cooking are likely due to 1) leaching from muscles into cooking juice due to their high water solubility (Sasaki et al., 2007), 2) degradation of IMP into inosine and hypoxanthine (Kavitha and Modi, 2007) or reaction of IMP with cysteine during cooking (Shi and Ho, 1994), and 3) reaction of glutamic acid with inosinic acid, resulting in umami notes in meat (Jo et al., 2012).

Our data show that KNC possess a significantly higher concentration of glutamic acid than do CB in both meat portions, irrespective of the state of meat, when they are slaughtered at their respective market ages (Tables 1 and 2). These results are consistent with previous reports using raw meat showing that indigenous chickens contain higher amounts of glutamic acid compared with CB (Ahn and Park, 2002; Wattanachant et al., 2004). The effect of meat portion on the glutamic acid content was only observed in cooked KNC-100 meat (Table 2); the cooked leg meat had a substantially higher concentration of glutamic acid than the cooked breast meat did. Unfortunately, no previous reports on the glutamic acid content of cooked chicken meat were available for comparison. The pooled data showed a significant difference in glutamic acid content between meat portions; again, the leg meat had a substantially

Table 2. Umami-related compound content (mg/100 g) of the raw and cooked meat from Korean native chickens and commercial broilers at their respective market ages (n = 5)

		Raw meat			Cooked meat			Analyzed value		
Item (mg/100 g)	Breed[1]	Breast	Leg	SEM[2]	Breast	Leg	SEM[2]	Breed	Meat portion	Cooking
Inosine-5′- monophosphate	KNC-100	446.3[a,x]	224.1[a,y]	13.3	180.4[a,x]	54.8[a,y]	5.3			
	CB-32	153.9[b,x]	70.2[b,y]	7.5	112.6[b,x]	40.9[b,y]	3.2			
SEM[2]		16.2	4.3		5.5	3.8				
P-value								<0.0001	<0.0001	<0.0001
F-value								425.6	386.5	390.6
Glutamic acid	KNC-100	28.2[a]	30.8[a]	1.6	18.0[a,y]	22.7[a,x]	1.1			
	CB-32	18.8[b]	21.1[b]	0.9	10.1[b]	10.4[b]	0.4			
SEM[2]		1.6	1.5		0.9	1.1				
P-value								<0.0001	0.0106	<0.0001
F-value								111.9	7.0	102.3

[a,b]Mean values in the same column with different superscripts within the same compound differ significantly ($P < 0.05$).

[x,y]Mean values in the same row with different superscripts within the same state of meat differ significantly ($P < 0.05$).

[1]KNC-100 = 100-d-old Korean native chickens; CB-32 = 32-d-old commercial broilers.

[2]Mean separation was conducted using Tukey's multiple range test.

higher level of glutamic acid (21.2 mg/100 g) than the breast meat (18.8 mg/100 g; Table 1). This observation is in agreement with several previous findings regarding the content of glutamic acid in CB and indigenous chicken meats (Ahn and Park, 2002; Wattanachant et al., 2004). Taken together, these results suggest that the effect of meat portion on the glutamic acid content of chicken meat is influenced by the breed at respective market age and cooking.

Cysteine Content

The cysteine concentrations in breast and leg meat from KNC-100 and CB-32, both in raw and cooked meat, are presented in Table 3. The cooking process had a significant effect on the cysteine content (Table 1; $P < 0.05$), with average concentrations of 0.6 and 3.2 mg/100 g in cooked and raw meat, respectively. Similarly, raw duck meat has been shown to contain a significantly higher concentration of cysteine than that present in its cooked form (Liu et al., 2007). The decrease in cysteine content after cooking can be linked to the formation of volatile compounds (Liu et al., 2007). For example, cysteine reacts with reducing sugars or IMP during cooking to form 2-methyl-3-furanthiol, the volatile compound responsible for the meaty flavor of chicken broth (Jayasena et al., 2013a). In addition, oxidation of the thiol group of cysteine can lead to the formation of dimethyl disulfide compounds during cooking (Toldrá et al., 2000). It has been shown that cysteine content of meat decreases with increased cooking temperature (Bæch et al., 2003).

The breed of chicken had no significant effect on the cysteine concentration in raw meat and cooked leg meat (Tables 1 and 3). In contrast, the cysteine concentration in cooked breast meat was higher in CB-32 than in KNC-100 (Table 3). Consistent with these observations, no difference in the cysteine content was observed between raw meat from indigenous chickens and CB (Wattanachant et al., 2004; Choe et al., 2010). The effect of meat portion on the cysteine concentration in raw chicken was significant (Table 3); raw breast meat had a higher cysteine content than raw leg meat, irrespective of the breed. Similarly, Wattanachant et al. (2004) found slightly higher cysteine levels in raw breast meat compared with raw leg meat of indigenous chicken, but similar levels between the corresponding meat portions from CB. Furthermore, it was found that breast meat from both KNC and CB contains higher cysteine levels compared with the respective leg meat (Choe et al., 2010).

Reducing Sugar Content

Pooled data from this study revealed that the breed of chicken at their respective market ages and the cooking process significantly influenced the reducing sugar content of chicken meat, in this order of significance (Tables 1 and 4). As shown in Table 1, the reducing sugar content of chicken meat was significantly higher in its raw state (0.11%) than in its cooked state (0.05%) in both meat portions, regardless of the breed. Consistent with our data, the glucose content of chicken and duck meat was found to decrease during cooking (Liao et al., 2010). The observed decrease in reducing sugar content during cooking is likely due to: (1) the involvement of reducing sugars in the Maillard reaction, which generates degradation products responsible for the formation of heterocyclic compounds, and (2) thermal alteration or degradation of ribose as it is the most heat-labile sugar (Shi and Ho, 1994; Liao et al., 2010; Jayasena et al., 2013a; Williamson et al., 2014).

A significant difference in the reducing sugar content was detected between the 2 chicken breeds (Table 1) at their respective market ages; KNC-100 had significantly higher concentrations (0.11%) than did CB-32 (0.05%). Although we were unable to find any reports comparing the reducing sugar content of different breeds of chickens, previously published results from 2 groups allow us to put this data in some context. The average reducing sugar content of raw CB-32 meat observed in the present study was comparable with that of a commercial chicken breed reported by Aliani and Farmer (2002). In contrast, KNC-100 had a higher average reducing sugar content in their raw meat compared with that observed by Aliani and Farmer (2002) during their study to de-

Table 3. Cysteine content (mg/100 g) of the raw and cooked meat from Korean native chickens and commercial broilers at their respective market ages (n = 5)

	Raw meat			Cooked meat			Analyzed value		
Item	Breast	Leg	SEM[2]	Breast	Leg	SEM[2]	Breast	Meat portion	Cooking
Breed[1]									
KNC-100	4.1[x]	2.3[y]	0.2	0.0[b]	0.8	0.6			
CB-32	4.1[x]	2.4[y]	0.2	0.7[a]	0.8	0.4			
SEM[2]	0.3	0.1		0.2	0.8				
P-value							0.5069	0.0404	<0.0001
F-value							0.4	4.4	75.3

[a,b]Mean values in the same column with different superscripts differ significantly ($P < 0.05$).

[x,y]Mean values in the same row with different superscripts within the same state of meat differ significantly ($P < 0.05$).

[1]KNC-100 = 100-d-old Korean native chickens; CB-32 = 32-d-old commercial broilers.

[2]Mean separation was conducted using Tukey's multiple range test.

Table 4. Reducing sugar content (%) of the raw and cooked meat from Korean native chickens and commercial broilers at their respective market ages (n = 5)

	Raw meat			Cooked meat			Analyzed value		
Item	Breast	Leg	SEM[2]	Breast	Leg	SEM[2]	Breed	Meat portion	Cooking
Breed[1]									
KNC-100	0.13[a]	0.16[a]	0.011	0.06[a,y]	0.08[a,x]	0.006			
CB-32	0.05[b,y]	0.10[b,x]	0.010	0.03[b]	0.04[b]	0.004			
SEM[2]	0.007	0.014		0.004	0.007				
P-value							<0.0001	0.08	<0.0001
F-value							84.2	3.2	81.9

[a,b]Mean values in the same column with different superscripts differ significantly ($P < 0.05$).

[x,y]Mean values in the same row with different superscripts within the same state of meat differ significantly ($P < 0.05$).

[1]KNC-100 = 100-d-old Korean native chickens; CB-32 = 32-d-old commercial broilers.

[2]Mean separation was conducted using Tukey's multiple range test.

termine reducing sugar content in commercial chicken meat.

Analysis of pooled data revealed that the reducing sugar content in the chicken meat was comparable between the breast and leg meats ($P > 0.05$; Table 1). However, individual comparisons demonstrated that the leg meat contained significantly higher reducing sugar content than the breast meat in raw CB-32 and cooked KNC-100 meats (Table 4). Higher reducing sugar content in leg meat might be attributable to IMP being more extensively degraded in leg meat than in breast meat (Tullson and Terjung, 1999). In contrast, raw breast meat from a commercial chicken breed had significantly higher ribose and glucose content than leg meat (Aliani and Farmer, 2002). Based on these results, it can be postulated that the effect of meat portion on reducing sugar content is influenced by the breed at respective market age and cooking process. Nevertheless, further investigations are needed to clarify the apparently contradictory results observed in the 2 studies.

Taste-Related Fatty Acid Composition

Tables 1 and 5 shows the effect of the breed of chicken at their respective market ages, the meat portion, and cooking on the taste-related fatty acid composition of meat. According to the pooled data, the breed of chicken had a dominating effect on the fatty acid composition at their respective market ages, followed by the meat portion and the cooking process ($P < 0.05$). Cooking had no effect ($P > 0.05$) on the linoleic acid content of chicken meat (Table 5); average linoleic acid percentages of raw and cooked meat were 19.9 and 20.4%, respectively (Table 1).

The CB-32 had a significantly higher oleic acid composition (37.3%) compared with KNC-100 (27.0%), irrespective of the meat portion and the state of the meat (Tables 1 and 5). However, the percentages of linoleic acid, arachidonic acid, and DHA in KNC-100 (23.1, 8.3, and 3.1%, respectively) were markedly higher than those in CB-32 (17.2, 2.4, and 0.4%, respectively; Table 1). The fatty acid composition can be influenced by breed, feeding, and slaughter age (Orellana et al., 2009). Results similar to ours regarding the effect of chicken breed on taste-related fatty acid composition have been previously reported (Jeon et al., 2010; Jayasena et al., 2013b). Additionally, Wattanachant et al. (2004) found a similar effect of chicken breed on the oleic acid and DHA profiles; indigenous chickens contain a higher percentage of DHA and a lower level of oleic acid compared with CB.

The oleic acid percentage was significantly higher in the cooked meat (33.0%) compared with the raw meat (31.3%; Table 1). On the other hand, the arachidonic acid and DHA levels in raw meat (6.1 and 2.1%, respectively) were significantly higher than those in the cooked meat (4.5 and 1.4%, respectively; Table 1). Echarte et al. (2003) and Alfaia et al. (2010) found similar cooking-induced changes in taste-related fatty acid profiles of chicken patties and beef, respectively. Apparent decreases in the percentages of arachidonic acid and DHA might be attributable to the higher susceptibility of these unsaturated fatty acids to oxidative degradation, relative to oleic and linoleic acids, under relatively high-temperature cooking conditions (Alfaia et al., 2010).

Pooled data revealed that the percentages of oleic and linoleic acids were higher ($P < 0.05$) in the leg meat (33.4 and 21.6%, respectively) than in the breast meat (30.9 and 18.7%, respectively) of chicken (Table 1). However, similar oleic and linoleic acid compositions were found between the breast and leg meat of CB-32 ($P > 0.05$; Table 5). Therefore, the effect of meat portion on oleic and linoleic acid content could be affected by the breed. The breast meat had significantly higher levels of arachidonic acid and DHA (6.9 and 2.4%, respectively) than did the leg meat (3.8 and 1.1%, respectively; Table 1). A similar trend was observed in previous comparisons of fatty acid compositions in breast and leg meat of KNC (Jeon et al., 2010; Jayasena et al., 2013b).

To summarize the data intensity, IMP, glutamic acid, oleic acid, arachidonic acid, and DHA content of chicken meat were affected by the breed of chicken at their respective market ages, the meat portion, and cooking ($P < 0.05$). However, the breed of chicken at their

Table 5. Taste-related fatty acid composition (%) of the raw and cooked meat from Korean native chickens and commercial broilers at their respective market ages (n = 5)

		Raw meat			Cooked meat					
Item (%)	Breed[1]	Breast	Leg	SEM[2]	Breast	Leg	SEM[2]	Breed	Meat portion	Cooking
Oleic acid	KNC-100	24.6^{b}	25.7^{b}	1.3	26.6^{b,y}	31.0^{b,x}	0.8			
	CB-32	36.4^{a}	38.7^{a}	1.0	36.2^{a}	38.1^{a}	1.0			
SEM[2]		1.2	1.1		1.19	0.68				
P-value								<0.0001	0.0030	0.0393
F-value								189.5	10.4	4.6
Linoleic acid	KNC-100	19.4^{y}	25.3^{a,x}	1.1	21.4^{a,y}	26.2^{a,x}	0.3			
	CB-32	16.8	18.1^{b}	1.4	17.0^{b}	16.8^{b}	0.7			
SEM[2]		1.0	1.7		0.7	0.5				
P-value								<0.0001	0.0004	0.5440
F-value								63.9	15.8	0.4
Arachidonic acid	KNC-100	12.6^{a,x}	7.3^{a,y}	1.6	9.2^{a,x}	4.0^{a,y}	0.3			
	CB-32	2.7^{b,x}	1.8^{b,y}	0.2	2.9^{b}	2.00^{b}	0.3			
SEM[2]		1.2	0.7		0.4	0.2				
P-value								<0.0001	<0.0001	0.0044
F-value								135.0	35.4	9.5
DHA[3]	KNC-100	4.9^{a,x}	2.6^{a,y}	0.57	3.6^{a,x}	1.4^{a,y}	0.09			
	CB-32	0.5^{b,x}	0.2^{b,y}	0.05	0.6^{b,x}	0.2^{b,y}	0.07			
SEM[2]		0.40	0.23		0.11	0.03				
P-value								<0.0001	<0.0001	0.0010
F-value								254.4	59.1	13.2

^{a,b}Mean values in the same column with different superscripts within the same fatty acid differ significantly ($P < 0.05$).

^{x,y}Mean values in the same row with different superscripts within the same state of meat differ significantly ($P < 0.05$).

[1]KNC-100 = 100-d-old Korean native chickens, CB-32 = 32-d-old commercial broilers.

[2]Mean separation was conducted using Tukey's multiple range test.

[3]DHA = docosahexaenoic acid.

respective market ages, the meat portion, and cooking had no significant effect on the concentrations of cysteine, reducing sugar, and linoleic acid, respectively. In general, KNC-100 can be considered to be a better source of IMP, reducing sugar, glutamic acid, linoleic acid, arachidonic acid, and DHA compared with CB-32. In contrast to leg meat, the breast meat had significantly higher concentrations of IMP, cysteine, arachidonic acid, and DHA, but lower concentrations of glutamic acid, oleic acid, and linoleic acids. Substantial losses in the content of all the taste-active compounds, except oleic and linoleic acids, took place during the cooking process. We suggest that the higher concentrations of taste-related compounds present in KNC-100 meat compared with CB-32 meat may result in the unique taste of the former meat, which would be consistent with previous reports (Jeon et al., 2010; Jayasena et al., 2013b).

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