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An Evaluation of Meat Characteristics and Fatty acid Composition of Chicken and Duck Breast and Leg Meat

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Introduction

Chicken and duck both include in poultry species. Again, duck is a waterfowl and has a different physiology to that of chicken. Duck is still very popular and in strong demand in many area of the world, especially in Asia. However, duck meat has received little attention by the researcher compare to other poultry. This is somewhat surprising considering the increasing consumption of this meat type in recent years through greater availability of ethnic foods offer through restaurants and retail outlets as well as seasonal changes in preference for duck over other poultry species. The breast meat lipids of ducks have a high level of polyunsaturated fatty acids (Baeza, 1995). More recently duck cuts, such as breast and legs have become more available, which offer more options for diet conscious consumers. However, duck had higher red muscle fiber in breast compare to chicken breast (Smith *et al.*, 1993) and consider as red meat. Therefore, the objective of this study was to evaluate the meat characteristics and fatty acid composition of duck and chicken breast and leg meat.

Materials and Methods

1. Sampling Procedure

Five chickens (Ross broiler, 35 days, average weight 1.5 kg) and 5 ducklings (Cherry berry, 45days, average weight 3.5 kg) were killed, dressed and deboned manually at processing plant of Gyseonsang National University in Korea. The breast and leg meat were harvested and stored at 4℃ in a cold storage room for the experiment on next day.

2. Proximate Composition and Meat Characteristics

Proximate analysis was done by the standard procedures of AOAC (1990). The pH meat

Table 1. Proximate composition and meat characteristics of chicken and duck

Parameters	Chicken		Duck	
	Breast	Leg	Breast	Leg
Proximate components (%)				
Moisture	75.47±1.44	75.69±0.83	76.41±0.70	76.64±0.74
Crude protein	22.04±0.48^{A}	19.79±0.41^{B}	20.06±0.52^{B}	19.74±0.56^{B}
Fat	1.55±0.30^{C}	2.38±0.25^{B}	1.84±0.08^{BC}	4.02±1.09^{A}
Total Ash	1.07±0.04^{A}	1.12±0.03^{A}	0.92±0.11^{B}	0.94±0.05^{B}
Color values (CIE*)				
L*	56.67±4.47^{B}	59.75±4.38^{A}	40.32±1.48^{D}	43.47±2.71^{C}
a*	1.61±0.96^{D}	3.20±1.73^{C}	18.41±1.21^{A}	16.92±2.49^{B}
b*	5.29±3.23^{B}	4.33±2.18^{B}	5.24±1.01^{B}	6.75±1.81^{A}
pH	5.98±0.10^{C}	6.17±0.06^{B}	6.22±0.07^{AB}	6.30±0.13^{A}
Cooking loss (%)	29.33±0.75^{B}		34.39±1.14^{A}	
Shear force (%)	3.60±0.34		3.73±0.44	

$^{A\sim D}$ Means within a variable and row with no common superscript differ significantly ($P<0.05$).

samples were measured using a pH-meter (MP230, Mettler, Switzerland). The surface color (CIE L*, a*, b*) of chicken and duck breast and leg meats were measured using a Minolta Chromameter (Minolta CR 301, Tokyo, Japan). To measure cooking loss, breast meat samples were broiled to an internal temperature of 70 ℃ for 20 minutes, surface dried, and weighted. Shear force was measured by using the Instron Universal Testing Machine (Model 3343).

3. Fatty Acid Analysis

Lipids were extracted with chloroform and methanol and the fatty acid methyl esters were analyzed on a gas chromatography (Agilent, 6890, USA) equipped with an on column injector port and flame-ionization detector. A fused silica capillary column was used for the separation of the fatty acid methyl esters.

4. Statistical Analysis

The data in this experiment were analyzed by analysis of variance using GLM procedure of Statistical Analysis Systems Institute (SAS) and a Duncan's procedure was used to determine the significant differences among means (SAS, 1997).

Table 2. Fatty acid composition of chicken and duck breast and leg meat

Fatty acid	Chicken		Duck	
	Breast	Leg	Breast	Leg
C14:0	0.37±0.07^{B}	0.40±0.12^{B}	0.82±0.15^{A}	0.93±0.30^{A}
C16:0	19.48±2.77	20.19±2.19	21.49±0.54	21.74±1.89
C 16:1	2.12±0.36^{B}	2.21±0.73^{B}	3.59±0.97^{A}	3.37±0.92^{A}
C 18:0	16.78±3.03^{A}	15.74±2.13^{A}	11.38±1.88^{B}	12.42±1.74^{B}
C 18:1	33.15±4.32	32.91±6.04	35.01±3.79	33.16±3.58
C 18:2	15.06±1.09^{B}	15.44±0.91^{B}	18.55±1.12^{A}	18.02±1.96^{A}
C 18:3	0.54±0.03^{B}	0.56±0.10^{B}	0.78±0.16^{A}	0.66±0.11^{AB}
C 20:4	10.90±2.61^{A}	10.78±3.42^{A}	6.79±2.90^{B}	7.73±2.32^{AB}
C22:5	0.81±0.21	0.86±0.18	0.81±0.32	1.00±0.41
C22:6	0.80±0.30	0.91±0.16	0.75±0.33	0.94±0.34
SFA	36.62±1.72	36.33±2.80	33.70±1.43	35.10±2.73
USFA	63.38±1.72	63.67±2.80	66.30±1.43	64.90±2.73
MUSFA	35.26±4.67	35.12±6.76	38.61±4.64	36.54±4.39
PUSFA	28.11±3.10	28.54±4.17	27.69±3.37	28.36±3.13
MUSFA/SFA	0.97±0.18	0.98±0.26	1.15±0.17	1.05±0.19
PUSFA/SFA	0.76±0.06	0.78±0.07	0.82±0.07	0.81±0.10

SFA, saturated fatty acid; USFA, unsaturated fatty acid; MUSFA, monounsaturated fatty acid; PUFA, polyunsaturated fatty acid. ^{A,B} means within a variable and row with no common superscript differ significantly ($P<0.05$).

Results and Discussion

Proximate composition and other meat characteristics of chicken and duck meat are presented in Table 1. No significant differences were found in moisture content between leg and breast meat of two species. Significant differences were found in crude protein, fat and total ash content among the meat samples from 2 species. Crude protein content was highest in chicken breast meat, although no significant differences were found among chicken leg, duck breast and duck leg. Fat content was highest in duck leg and lowest in chicken breast. No significant differences were found between chicken and duck breast

meat, and chicken leg and duck breast meat. Total ash content was significantly higher in chicken breast and leg compare to duck breast and leg. Smith *et al.* (1993) stated that duckling breast meat contained significantly more moisture and lipid, but lower protein, ash and calories than chicken breast meat. Although, no significant differences in chicken breast and duck breast in moisture and fat content, the value is higher in duck breast. Mazanowski *et al.* (2003) also found higher fat content in duck leg meat (3.9%) compare to duck breast meat (1.7%).

Significant differences were found in lightness (L*) and redness (a*) values among meat samples individually, as well as with in species. The highest L* value was found in chicken leg followed by chicken breast, while it was lowest in duck breast. On the other hand, the highest a* value was performed by duck breast followed by duck leg and the lowest was in chicken breast. However, the yellowness (b*) was highest in duck leg meat. No significant differences were found in respect of b* value among chicken breast, chicken leg and duck breast. The higher a* value in duck meat compare to chicken meat is related with higher red muscle fibers in duck meat compare to chicken, as Smith *et al.* (1993) stated that duckling breast muscle contained approximately 16% white fibers and 84% red fibers compared with 100 % white fibers in the chicken breast. The higher a* value of chicken leg meat compare to chicken breast also related with higher red fibers of leg meat compare to chicken breast (Nakamura *et al.*, 2004).

The pH values showed significant differences among meat samples. It was highest in duck leg and lowest in chicken breast, although no significant differences ($p>0.05$) were found between duck leg and duck breast, and chicken leg and duck breast meat. Xiong *et al.* (1993) stated that the pH of breast muscle was lower ($p<0.05$) than that of thigh muscle in broilers. In our results also higher pH was found in chicken leg meat compare to chicken breast. The pH value of duck leg is higher compare to duck breast also found by Kisiel and Książkiewicz (2004) and in our experiment the pH value is high in duck leg compare to duck leg, although no significant differences found. Cooking loss was significantly higher in duck breast compare to duck leg. However, no significant difference was found in shear force value between chicken breast and duck breast. Alvarado and Sams (2000) also found higher cooking loss in duck breast compare to chicken breast at different post-mortem deboning time.

Significant differences in C14:0, C16:1, C18:0, C18:2, C18:3 and C20:4 were found among meat samples, although no significant differences were found between leg and breast meat within each species with these fatty acids. The fatty acids (%) C14:0, C16:1, C18:2 and C18:3 were significantly higher while C18:0 and C20:4 were significantly lower in duck meat compared to chicken.

Conclusion

From this research it may be concluded that crude protein was significantly higher in

chicken breast, while fat was significantly higher in duck leg compared to other meat samples from chicken and duck. Total ash content was significantly higher for the chicken meat than for duck meat. Redness (a*) was highest in duck breast followed by duck leg and lowest in chicken breast. The higher amount of redness in duck meat compare to chicken implies that duck has more red muscle fibers than chicken. The pH value was significantly higher in duck leg compared to other meat samples. Cooking loss was significantly higher for duck breast than for chicken breast. Significant differences were found in some fatty acids between species, although no significant differences found in breast and leg meat of same species.

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