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Comparison of quality characteristics breast meat from conventional and animal welfare farm chicken (#240)

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Introduction

The production of poultry meat has increased worldwide significantly and it is predicted to be the largest meat sector at 130.7 million tons by 2023. During last several decades, research on broilers has been focused on mass production, the intensive system of production, feeding, and management to increase productivity. However, an increasing number of consumers demanding health and natural foods have favored welfare farming that is reputed to be environmentally friendly, sustaining animals in good health, with high welfare standards and resulting in high-quality products. However, there is a lack of study on the difference between chicken breast from conventional and animal welfare farm. Therefore, the aim of this study was to compare the quality characteristics and bioactive compounds of chicken breast from conventional and welfare farm during refrigerated storage.

Methods

Chicken breast meat of Abor Acres broilers (29-32 days old, 1.1 kg carcass weight) from the conventional farm (CBC, n = 30) and animal welfare farm (CBA, n = 30) were obtained from a slaughterhouse (Harim Co., Iksan,Korea) just after slaughtering. Then the breast meat was immediately wrapped with low-density polyethylene. The meat was directly stored in a refrigerator at 4°C for 9 days. The pH value of meat was determined using a digital pH meter. The meat color was measured on the meat with a color meter. The Texture Analyzer TA 1 (Lloyd Instruments, Berwyn, USA) with V blade was used to measure the shear force value of breast. Total aerobic bacteria counts were determined using 3M Petrifilm™. Thiobarbituric acid reactive substance (TBARS) was determined using the methods described by Buege and Aust (1978). A micro-diffusion method described by Conway method was modified for the determination of total volatile basic nitrogen (VBN) values in breast. The creatine, creatinine and di-peptide (anserine and carnosine) content were determined with method of Mora et al. (2007). All results of this experiment were analyzed using SAS program.

Results

Meat pH, meat color, and shear force of CBC and CBA were shown in Table 1. The pH in CBC and CBA was not significantly different on day 1, 3, 5, and 7. The pH of CBC was significantly higher than that of CBA at day 9. The L* (lightness) value of the CBC and CBA was maintained from 53.28 to 55.33 during storage and no significant changes occurred during the storage. For 9 days, no significant difference was found in the a* value of CBC and CBA. The b* (yellowness) of CBC was significantly increased after day 5. No significant difference was found in shear force of CBC and CBA on day 1, while the shear force of CBA was significantly higher than that of CBC on day 3, 5, 7, and 9.

Total aerobic bacteria counts, TBARS, and VBN of CBC and CBA during cold storage are shown in Table 2. The initial total aerobic bacteria counts of CBC and CBA was 2.60-2.82 Log CFU/g on day 1, however, it was increased significantly during storage. There was no significant difference was found in total aerobic bacteria between CBC and CBA until day 7. However, total aerobic bacteria of CBC were higher than that of CBA on day 9 and exceeded value of 7 Log CFU/g, considered as no more fresh meat, as defined by the ICMSF (1986). The TBARS values were lower in the CBA than in the CBC at day 1, 7, and 9. TBARS value of the CBC and CBA increased with increase of storage days ($P<0.05$).VBN value of CBC was significantly higher than that of CBA during entire storage days ($P<0.05$).

Creatine, creatinine, and di-peptide contents of CBC and CBA for 9 days storage were shown in Table 3. There was no significant difference in creatine contents between CBC and CBA during storage. Creatinine contents of CBC and CBA showed no significant difference, however, they were significantly high on day 3-9 compared to day 1. Anserine content of CBC was significantly lower than that of CBA during storage except day 5. Carnosine contents between CBC and CBA showed no significant difference. However, carnosine content of CBC and CBA on day 9 was significantly lower than that of CBC and CBA on day 1.

Conclusion

In this study we found that the animal welfare farming system enhances microbial contamination, lipid oxidation or protein decomposition, and shear force value of chicken breast meat. Further study is needed to evaluate if specific condition in animal welfare farming system can change the meat quality and bioactive compounds.

References

1. Buege, J. A., and S. D. Aust. 1978. Microsomal lipid peroxidation. Methods Enzymol. 52:302-310.
2. Mora, L., M. A. Sentandreu, and F. Toldrá. 2007. Hydrophilic chromato

Notes

1. graphic determination of carnosine, anserine, balenine, creatine, and creatinine. J. Agri. Food Chem. 55:4664-4669.
2. ICMSF (International Commission on Microbiological Specifications for Foods). 1986. Sampling for microbiological analysis: principles and scientific applications, 2nd ed., Vol. 2. University of Toronto Press, Toronto. Canada.

Items (mg/100 g)	Treatment	Storage days 1	3	5	7	9	SEM[1)]
Creatine	CBC[2)]	183.18^{Aa}	182.67^{Aa}	171.96^{Aab}	167.51^{Ab}	161.62^{Ab}	3.386
	CBA	178.73^{Aa}	182.82^{Aa}	174.85^{Aa}	176.00^{Aa}	172.91^{Aa}	4.268
	SEM	3.246	3.742	2.682	3.616	5.421	
Creatinine	CBC	1.04^{Ab}	1.50^{Aa}	1.52^{Aa}	1.60^{Aa}	1.54^{Aa}	0.053
	CBA	1.22^{Ab}	1.48^{Aa}	1.44^{Aa}	1.52^{Aa}	1.54^{Aa}	0.051
	SEM	0.054	0.046	0.065	0.056	0.049	
Anserine	CBC	92.60^{Ba}	94.99^{Ba}	104.57^{Aa}	88.36^{Ba}	81.85^{Ba}	6.080
	CBA	130.10^{Aa}	117.54^{Aa}	123.55^{Aa}	129.54^{Aa}	110.19^{Aa}	5.487
	SEM	4.780	6.780	7.376	3.845	5.447	
Carnosine	CBC	63.16^{Aa}	58.01^{Aa}	54.69^{Aa}	55.88^{Aab}	46.38^{Ab}	4.251
	CBA	68.52^{Aa}	65.30^{Aa}	59.29^{Aab}	49.83^{Ab}	48.55^{Ab}	3.214
	SEM	4.658	4.437	3.769	3.209	2.263	

Table 3. Creatine, creatinine, anserine, and carnosine contents of CBC and CBA $^{A-B}$ Means within the same column with different letters are significantly different ($P < 0.05$). $^{a-d}$ Means within the same row with different letters are significantly different ($P < 0.05$).
[1)] SEM, standard error of means
[2)] CBC, chicken breast meat obtained from conventional farm; CBA, chicken breast meat obtained from animal welfare farm

Items	Treatment	Storage days 1	3	5	7	9	SEM[1)]
Total aerobic bacteria (Log CFU/g)	CBC[2)]	2.82^{Ad}	2.82^{Ad}	3.48^{Ac}	5.55^{Ab}	7.01^{Aa}	0.102
	CBA	2.60^{Ad}	2.91^{Ad}	3.38^{Ac}	5.49^{Ab}	6.58^{Ba}	0.096
	SEM	0.102	0.098	0.115	0.093	0.086	
TBARS (mg MDA/kg)	CBC	0.13^{Ae}	0.15^{Ad}	0.18^{Ac}	0.30^{Ab}	0.33^{Aa}	0.005
	CBA	0.11^{Bd}	0.14^{Ac}	0.18^{Ab}	0.19^{Bb}	0.27^{Ba}	0.005
	SEM	0.003	0.005	0.005	0.004	0.007	
VBN (mg/100g)	CBC	9.69^{Ae}	10.61^{Ad}	11.69^{Ac}	16.35^{Ab}	25.07^{Aa}	0.200
	CBA	9.17^{Be}	10.01^{Bd}	10.92^{Bc}	14.32^{Bb}	22.88^{Ba}	0.191
	SEM	0.149	0.112	0.178	0.255	0.244	

Table 2. Total aerobic bacteria, TBARS, and VBN value of CBC and CBA $^{A-B}$ Means within the same column with different letters are significantly different ($P < 0.05$). $^{a-d}$ Means within the same row with different letters are significantly different ($P < 0.05$). [1)] SEM, standard error of means [2)] CBC, chicken breast meat obtained from conventional farm; CBA, chicken breast meat obtained from animal welfare farm [3)] ND, not detected

Notes

Items		Treatment	Storage days					SEM[1)]
			1	3	5	7	9	
pH		CBC[2)]	5.95^{Ab}	6.05^{Ab}	6.07^{Ab}	6.08^{Ab}	6.34^{Aa}	0.035
		CBA	5.92^{Ab}	6.00^{Aab}	6.03^{Aab}	6.07^{Aa}	6.15^{Ba}	0.035
		SEM	0.027	0.034	0.046	0.040	0.024	
color	L*	CBC	54.68^{Aa}	54.19^{Aa}	54.67^{Aa}	53.74^{Aa}	54.03^{Aa}	0.365
		CBA	55.33^{Aa}	54.90^{Aa}	54.79^{Aa}	54.49^{Aa}	53.28^{Aa}	0.511
		SEM	0.444	0.470	0.398	0.534	0.352	
	a*	CBC	1.89^{Aa}	1.78^{Aab}	1.86^{Aab}	1.52^{Ab}	1.69^{Aab}	0.085
		CBA	1.74^{Aa}	1.77^{Aa}	1.79^{Aa}	1.74^{Aa}	1.70^{Aa}	0.101
		SEM	0.113	0.054	0.132	0.068	0.075	
	b*	CBC	2.25^{Ab}	2.79^{Aab}	3.16^{Aa}	3.28^{Aa}	3.56^{Aa}	0.197
		CBA	2.26^{Aa}	3.34^{Aa}	3.53^{Aa}	3.46^{Aa}	3.44^{Aa}	0.149
		SEM	0.092	0.176	0.179	0.139	0.248	
Shear force (kgf)		CBC	2.58^{Aa}	2.30^{Bb}	2.20^{Bb}	2.08^{Bbc}	1.89^{Bc}	0.062
		CBA	2.80^{Aa}	2.59^{Aab}	2.41^{Abc}	2.24^{Ac}	2.14^{Ac}	0.075
		SEM	0.119	0.065	0.048	0.045	0.027	

Table 1. Meat pH, instrumental meat color, and shear force of CBC and CBA $^{A-B}$ Means within the same column with different letters are significantly different ($P < 0.05$). $^{a-b}$ Means within the same row with different letters are significantly different ($P < 0.05$). $^{1)}$ SEM, standard error of means $^{2)}$ CBC, chicken breast meat obtained from conventional farm; CBA, chicken breast meat obtained from animal welfare farm

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