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Microbiological Evaluations of Retail and Refrigerated Chickens in Winter

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겨울철 소매점 및 냉장 닭고기의 미생물학적 평가

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Abstract

Aerobic plate counts (APC), gram-negative bacterial counts (GNC), and sensory evaluations on chicken carcasses during retail and refrigerated storages (3±1℃ and 10℃) were evaluated. APC and GNC on whole chicken in retail store after storage of 7 days at 3±1℃ increased to 3.11 and 3.89 log units compared to the initial controls. APC and GNC on whole chicken after storage of 7 days at 10℃ increased to 5.43 and 5.03 log units. Sensory scores of chicken carcasses obtained from retail store were in the "liked less" category after storage of 7 days compared to fresh controls. These results indicated that chicken carcasses during refrigerated (10℃) storages rapidly allowed the growth of aerobic spoilage bacteria during storage period, which could not be microbiologically acceptable after storage of 7 days.

Key words : chicken, aerobic plate counts, gram-negative bacterial counts, refrigerated storages, sensory evaluation.

INTRODUCTION

Extension of microbial shelf-life in refrigerated meat is associated with low microbial numbers during storage and handling in wholesale and retail stores[1]. Although consumer prefers refrigerated meat to frozen meat, the growth of undesirable microorganisms during refrigerated storage is related to the deterioration of microbiological quality[1~4].

In our previous work, chicken carcasses during wholesale and retail storages should be applied to further suitable washing and sanitizing methods for enhancing microbiological shelf-life[1]. Kim[5] and Rathegeber and Waldroup[6] noted that a water rinsing as well as various sanitizing agents has been used for preventing growth of undesirable microorganisms on chicken and meat carcasses. Researchers[5~8] reported that the general safety and quality of chicken and meat were associated with the growth of aerobic spoilage bacteria and foodborne pathogens during the meat-processing procedures, storage, and handling, which could reduce microbiological shelf-life. Cutter and Siragusa[9] reported that foods of animal origin

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such as milk and meat could become contaminated with the bacteria during processing or slaughtering. They found that the reduction of bacterial populations on lean and adipose tissue of beef carcasses was dependent on the concentration and type of undesirable microorganisms.

The evaluations of microbiological quality during commercial chicken storage would be essential for the hygiene of refrigerated chicken and meat.

MATERIALS AND METHODS

1. Chicken samples

Chicken wings, legs, and breasts and whole chickens were obtained from refrigerator (2±2℃, 3±1℃) in retail store, and put into Whirl-Pak sample bags, respectively. The samples were transported to clean containers containing ice at each sampling day for microbiological analyses.

Chicken carcassess for storage in Animal Science Laboratories of Chonnam National University were randomly selected from the carcasses being processed in a local chicken plant, transported to laboratory on ice, and used within 3hr. The chicken carcasses put individually into the Whirl-Pak sample bags (Fisher Chemical Co., USA) and stored at 10℃ for storage of 7 days. Ten carcasses were used at each sampling day.

2. Microbiological analysis

Chicken carcasses were aseptically transfered to Whirl-Pak bags, weighed, and diluted 1 : 1 with 0.1% (w/v) sterilized peptone water. Samples were shaken for 60 times by using standard rinse method[5]. The liquid from each sample was diluted and plated in volumes of 0.1 ml on standard plate count agar (Difco Laboratories, Detroit, MI) for aerobic plate count (APC) or MacConkey agar for gram-negative bacteria counts (GNC), respectively. The plates were incubated for 48 hr at 37 ℃ before colonies were counted. The number of bacteria was expressed as mean Log_{10} CFU/g for the duplicate treatments.

3. Sensory evaluations

Sensory evaluations of samples were performed by an ten member untrained panels. Odor and appearance of uncooked chicken carcasses were evaluated during storage at wholesale and retailsale. Fresh control chicken (fresh daily) were assigned as a score of 5. Samples liked less than the control were scored 1 to 4, where 1 = disliked most. Samples liked more than the control were scored 6 to 9, where 9 = liked most.

4. Statistical analyses

APC, GNC, and sensory data were analyzed by using ANOVA, and means were seperated by the least significant difference test at $P<0.05$[10].

RESULTS AND DISCUSSION

A steady increase in aerobic plate counts (APC) and gram-negative bacterial counts (GNC) was shown in the retail chickens during the storage period (Table 1).

Fresh chicken wings obtained from a commercial chicken-processing plant had a significantly different ($P<0.05$) APC at initial day compared to whole chickens. After storage of 7 days, all chickens obtained from retail store (3±1℃) rapidly increased APC to 7.0~7.3 log units, which could not be microbiological acceptable.

Results showed that the increase of APC on chicken carcasses in retail store was related to the increase of temperature during storage. Kim[1] mentioned that the current industry practice of washing and sanitizing of chicken carcasses was not the only factor involved in suppressing aerobic spoilage bacteria. He reported that chicken carcasses in wholesale and retailesale stores should be applied to a further suit-

Table 1. APC* and GNC* on chicken carcasses obtained from a retail store (3±1℃ and 2±2℃)

Chicken parts	Log CFU /g					
	APC			GNC		
	0d	4d	7d	0d	4d	7d
Wing	4.73^{c}	6.69^{b}	7.30^{a}	3.40^{ab}	6.54^{b}	7.00^{ab}
Leg	4.41^{b}	6.15^{a}	7.00^{a}	3.00^{a}	5.35^{a}	7.00^{ab}
Breast	4.30^{ab}	6.02^{a}	7.00^{a}	3.00^{a}	5.53^{a}	6.78^{a}
Whole chicken	4.09^{a}	6.49^{b}	7.20^{a}	3.28^{ab}	6.31^{b}	7.17^{c}

* Means of 2 replications. [1] Chickens from retailsale store during storage of 4 days (2±2℃) and 7 days (3±1℃). [a-c] Counts within the same column with different superscripts are significantly different ($P<0.05$).

Table 2. APC* and GNC* on refrigerated (10℃) chicken carcasses obtained from commercial chicken processing plant

Chicken parts	Log CFU /g					
	APC			GNC		
	0d	4d	7d	0d	4d	7d
Wing	4.39^{a}	8.46^{a}	8.90^{b}	3.53^{a}	8.32^{a}	8.15^{a}
Leg	4.52^{a}	8.18^{a}	8.48^{a}	3.69^{a}	8.34^{a}	8.30^{a}
Breast	4.42^{a}	8.53^{a}	9.02^{b}	3.23^{a}	8.09^{a}	8.70^{bc}
Whole chicken	4.65^{a}	8.55^{a}	9.08^{b}	3.62^{a}	8.11^{a}	8.65^{b}

* Means of 2 replications. [a-c] Counts within the same column with different superscripts are significantly different ($P<0.05$).

able sanitizing methods such as organic acid and polyphosphate for enhancing microbiological quality[1].

There were significant ($P<0.05$) differences on GNC between the chicken carcasses obtained from retail store during storage period (Table 1). GNC on chicken wings obtained from retail store increased to 3.6 log units after storage of 7 days compared to initial controls. Results indicated that chicken carcasses of retail store in winter could be rapidly spoiled, which would be resulted in a deterioration of microbiological quality. It is considered that the existence of gram-negative bacteria on chicken carcasses was the indicative factor, which was the major cause of microbial spoilage. Similarly, Kim[1] reported that a commercial chicken carcasses could not promise the microbiological safety under the extended storage in winter when the microbiological contaminations of the tissue were not completely removed.

There was a significantly different ($P<0.05$) APC and GNC on chicken carcasses obtained from a commercial chicken-processing plant during storage at 10℃ (Table 2).

GNC on wing, leg, breast, and whole chicken decreased to 0.86, 0.83, 1.19, and 1.0 at initial day, respectively, compared to APC. GNC on chicken carcasses rapidly increased after storage of 4 days at 10℃. All chicken carcasses were not microbiologically acceptable during storage at 10℃. Therefore, the efficacy of washing and sanitizing procedures should be further studied for suppressing the growth of aerobic spoilage bacteria during refrigerated storage. Researchers[2,3,5,11] reported that hot water washes and both organic acids and phosphates as a antimicrobial surface sanitizer could be used for suppressing the growth of aerobic spoilage bacteria on chicken and meat. In our previous work[11], chicken wings treated with 1.5% acetic acid for 10min suppressed significantly the growth of aerobic spoilage bacteria for storage of 12 days at 4℃. Dorsa *et al.*[4] reported that when a commercial steam vaccum was used sprayed at 125 psi

Table 3. Mean sensory evaluation* on chicken carcasses obtained from a wholesale and a retail stores

Whole Chicken	Odor score			Appearance score		
	0d	4d	7d	0d	4d	7d
A[1]	5.0^{a}	5.0^{a}	5.0^{a}	5.0^{a}	5.0^{a}	5.0^{a}
B[2]	5.1^{a}	4.5^{b}	3.8^{b}	4.9^{a}	4.5^{b}	4.1^{b}
C[3]	5.1^{a}	4.9^{a}	3.4^{b}	4.9^{a}	4.8^{a}	3.9^{b}

*Means of 3 replications. [a-c] Counts within the same column with different superscripts are significantly different ($P<0.05$). [1]Fresh chicken obtained from a commercial chicken-processing plant at each analysis day. [2]Chicken obtained from a wholesale store during storage of 4 days (0±2℃) and 7 days (1±1℃). [3]Chicken obtained from retaile store during storage of 4 days (2±2℃) and 7 days (3±1℃).

after treating with hot water at 72℃ and warm water at 30℃.

Sensory scores showed that chicken carcasses of wholesale and retailesale stores after storage of 4 days or 7 days were in the "liked less" category in odor and appearance compared to the fresh controls (Table 3). For appearance and odor, typical comments were gray and off-odors after storage of 7 days.

요 약

닭고기의 소매점 및 냉장 저장동안 호기성 미생물의 증식에 미치는 영향을 1997년 12월 부터 1998년 1월에 구입한 닭고기를 이용하여 분석하였다.

소매점 (3±1℃ 저장)에서 7일 동안 저장한 통닭의 APC 및 GNC는 3.11 및 3.89 log units 까지 증가하였다. 10℃ 냉장 온도에서 7일 동안 저장한 통닭의 APC 및 GNC는 5.43 및 5.03 log units 까지 증가하였다. 소매점 에서 구입한 통닭의 관능평가 결과 외관 및 냄새는 신선한 대조구 보다 기호성이 낮게 평가되었다. 겨울철 소매점의 닭고기 및 10℃의 냉장닭고기는 저장시 호기성 육부패세균의 급속한 증식을 나타내었다.

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