

Comparison of meat quality traits of scalded and non-scalded broiler breast meat

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Abstract

The objective of this study was to investigate the physicochemical and sensory attributes of scalded (SBC) and non-scalded (NSBC) broiler chicken breast meat. Ten carcasses from each type of chicken were randomly selected from the processing line of a commercial broiler processing plant. After dissecting the breast meat, physicochemical parameters such as pH, color, cooking loss, and proximate composition and sensory characteristics were examined. SBC contained higher protein but a lower fat content in breast meat compared to NSBC ($p < 0.05$). CIE L*, CIE a*, and CIE b* values of breast meat have not differed ($p > 0.05$) between NSBC and SBC. Higher pH values were shown by NSBC ($p < 0.05$) and no difference in cooking loss of breast meat from NSBC and SBC was observed ($p > 0.05$). Results of the sensory analysis showed a difference ($p < 0.05$) in the overall acceptability of breast meat between SBC and NSBC. Further studies are suggested to compare the levels of taste active compounds between SBC and NSBC.

Keywords: Breast meat, Broilers, Physicochemical, Scalding, Sensory

INTRODUCTION

Meat is an excellent source of protein and contains many of the vitamins and minerals essential for human consumption. As a white meat, chicken meat contains quite lower contents of fat, cholesterol, and iron than red meat [1]. Chicken meat is rich in protein, and B complex vitamins, and is a good supplier of the essential polyunsaturated fatty acids [2]. Therefore, due to these health benefits, cheaper prices, and fewer religious barriers make chicken meat a popular meat type in the world.

Meat quality is affected significantly by many factors such as genetics, age, body weight, feed, and other environmental conditions [1,3]. Additionally, the reasons for variability in meat quality can be, right along the production chain to the processing plant, in retail outlets and even in the purchaser's home [4]. Omojola and Adeshinwa [5] reported that the post-slaughter

Competing interests

No potential conflict of interest relevant to this article was reported.

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Availability of data and material

Upon reasonable request, the datasets of this study can be available from the corresponding author.

Authors' contributions

Conceptualization: Adhikari A, Nambapana MN, Jayasena DD
Data curation: Iromi T, Nawarathne SR, Jayasena DD
Formal analysis: Nawarathne SR, Nambapana MN, Jayasena DD
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Ethics approval and consent to participate

This article does not require IRB/IACUC approval because there are no human and animal participants.

processing method of animal carcasses in particular the dressing method which includes scalding, singeing, and skinning affect the physical, chemical, and sensory properties of meat.

In the broiler industry, scalding entails dipping the entire chicken carcass into a hot water tank (about 58°C–62°C) for 90 seconds to soften the base of the feathers for easy removal with a de-feathering machine. However, the high temperature used in the scalding tank can cause denaturation of protein and change product appearance, water-binding capacity, and tenderness [6]. Skinning involves complete removal of the skin from a carcass manually with a sharp knife or automatically using a machine. This can be performed after de-feathering or before de-feathering as non-scalded broiler chicken (NSBC).

Both scalding and skinning processes are generally practised in commercial broiler processing lines in Sri Lanka. However, one commercial broiler processing plant in Sri Lanka produces NSBC meat for a niche market as address to the special requirements from customers for unique cuisines. In this regard, birds from the same strain with similar age are processed similarly up to the scalding tank of the processing line. For the production of NSBC meat, carcasses are removed from the line before entering the scalding tank whereas for the production of scalded broiler chicken (SBC) meat, birds are sent through the scalding tank. However, no study so far has been conducted to compare the physicochemical and sensory characteristics between SBC and NSBC meat. Therefore, the present study aimed to investigate the effect of scalding on physicochemical and sensory characteristics of breast meat from broiler chicken.

MATERIALS AND METHODS

Collection of carcasses

Broiler carcasses (Cobb 500) were acquired from a commercial broiler processing plant. During the slaughtering process, ten (10) carcasses each were randomly collected at the scalding tank of the processing line before entering and after sending through the scalding tank (at 56°C for 3 minutes) to produce NSBC and SBC, respectively. NSBC were then manually defeathered and skin was removed completely. All the other processing steps were same during the production of NSBC and SBC meat. Then the selected carcasses were vacuum-packed and stored at chilling conditions (0°C–4°C) overnight. Finally, carcasses were kept under –18°C until further analysis.

Sample preparation

Breast meat from each carcass was dissected and trimmed of visible skin, fat and connective tissues. Half of each of the dissected breast meat samples was then minced separately for chemical analysis. The remaining halves were used for sensory analysis.

Analysis of physicochemical properties

The proximate composition of breast meat from NSBC and SBC was determined as outlined by AOAC [7]. Briefly, moisture content was measured by drying the samples (2 g) at 103°C

for 4 hours. Crude fat and crude protein contents were measured by the Soxhlet extraction system (DZKW-4, Shuli, China), and the Kjeldahl method (KDN-103F, VELP Scientifica, Shanghai, China), respectively. Moreover, crude ash content of the meat was determined by igniting the samples in a muffle furnace at 550°C for 4 hours.

The color values of breast meat from NSBC and SBC were measured using a colorimeter (CR-410, Konica Minolta, Tyoko, Japan) which was calibrated against a white reference tile. The values of lightness (CIE L*), redness (CIE a*), and yellowness (CIE b*) were obtained from different locations on the minced meat using the average value of three repeated measurements.

The pH of breast meat from NSBC and SBC was determined by the method of Kang, Kim [8] with some modifications. One gram of each sample was mixed with 9 mL of distilled water and homogenized with a vortex machine (VM-96B, Jeitech, Daejeon, Korea) at 2,000 rpm for 30 seconds. The homogenate was filtered (No. 4, Whatman International, Maidstone, UK) and the pH was determined using a pH meter (pH 700, Eutech Instrument, Ayer Rajah Crescent, Singapore) after calibration using buffers (pH 4.01, 7.00, and 9.21) at room temperature. The mean value from three repeated measurements of each sample was used.

Cooking loss was determined by the method of Kondaiah et al. [9] with some modifications. Meat samples (30 g) were placed in polyethene bags separately and sealed properly. Samples were then heated in a water bath (LWB-IIID, Daihan Labtech, Namyangju, Korea) at 85°C for 30 minutes until a core temperature of 72°C was reached. After cooling the samples to room temperature, the cooked mass was weighed to determine the cooking loss as expressed below.

$$\text{Cooking loss} = [(\text{Weight before cooking} - \text{Weight after cooking}) / \text{Weight before cooking}] \times 100\%$$

Sensory analysis

The panel consisted of thirty (30) untrained panellists. Breast meat from NSBC and SBC was heated separately in a pot of water (1.5 times the weight of meat) for 30 min until an internal temperature of 72°C reached. Breast meat samples (2 cm × 2 cm × 2 cm) were then placed on coded white dishes and served with drinking water. Samples were evaluated using a 7-point hedonic scale (1 = dislike very much, 4 = neither like nor dislike, 7 = like very much). The sensory parameters tested were color, appearance, taste, odor, tenderness, juiciness, and overall acceptability. All samples were labelled with random 3-digit numbers and presented to panellists in random order.

Data analyses

Analysis of variance (ANOVA) was conducted by the procedure of General Linear Model using SAS program version 9.1 (SAS Institute, Cary, NC, USA). Comparisons of means were done by Tukey's multiple range tests at $p < 0.05$. All tables indicate the mean values of 10 replicates and SEMs.

RESULTS AND DISCUSSION

Studies on the effects of scalding on physicochemical and sensory characteristics of chicken meat are rare. Results from the few available studies were considered in the following sections to add context to our current findings.

Physiochemical characteristics

In the present study, SBC showed lower ($p < 0.05$) pH values than did NSBC (Table 1). This is in agreement with the findings of Maribo et al. [10] who reported that de-hided pigs had higher pH values than scalded pigs. It can be attributed to the fact that the Glycolytic potential improves with the increasing temperature and more lactic acid are produced reducing the ultimate pH of the carcass [11]. This can be the reason for the observed low pH value in breast meat of SBC compared to that of NSBC. Nevertheless, our results are contradicted with the findings of Omojola and Adesehinwa [5], who reported a numerical increment ($p > 0.05$) of pH in scalded rabbit meat (6.07) rather than skinned carcasses of rabbits (5.99) whereas Omojola et al. [4] reported a significant difference in pH value between scalded (5.62) and skinned (5.54) goat meat ($p < 0.05$).

Regarding cooking loss, a difference was not found among the two groups in the present study ($p > 0.05$). The results obtained in this study (Table 1) on cooking loss were following some previous studies. Omojola and Adesehinwa [5] reported cooking loss values of 29.35% and 27.69% in meat from scalded and skinned carcasses of rabbits respectively and that there is no significant difference between the two types. Awosanya and Okubanjo [12] reported no difference ($p > 0.05$) in the cooking loss value of meat from leg, loin, and shoulder cuts of skinned and scalded rabbit carcasses. However, Omojola et al. [4] reported a significant difference ($p < 0.05$) in the cooking loss values between goat meat from scalded (24.92%) and skinned (19.86%) carcasses.

Concerning color values, the CIE L*, CIE a*, and CIE b* values of breast meat were not different ($p < 0.05$) among the two types of chicken used (Table 1). However, previous studies confirmed that CIE a* values of meat from de-hided and scalded pigs had a significant difference

Table 1. pH, cooking loss, and color values of breast meat from scalded and non-scalded broiler chicken

Parameter	Broiler breast meat type		SEM ¹⁾	p-value
	SBC	NSBC		
pH	5.68 ^b	5.82 ^a	0.025	0.006
Cooking loss (%)	25.83	25.43	0.688	0.691
CIE L*	67.49	68.80	0.710	0.239
CIE a*	11.19	12.33	0.577	0.211
CIE b*	17.79	16.87	0.679	0.377

¹⁾Pooled standard error of the means (n = 20).

^{a,b}Values in the same row with different superscripts differ significantly ($p < 0.05$). SBC, scalded broiler chicken; NSBC, non-scalded broiler chicken.

[10]. Also, skinned goat carcasses showed a darker ($p < 0.05$) meat color compared with scalded carcasses [4]. They have mentioned that differences in myoglobin content and nature, the composition and physical state of the muscle and the meat structure can be reasons for color differences in goat meat. Thigh meat can be attributed to their higher contents of red fibres with greater myoglobin levels [13,14] and higher pH values [14,15]. Low pH chicken breasts had the highest reflectance ($p < 0.001$) [14,16] and high pH chicken breasts had the greatest transmittance into their tissues and across individual muscle fibres ($p < 0.001$), which is associated with darker meat [14,17]. However, the trend was not observed in the present study.

Proximate composition

Regarding moisture content, no significant difference ($p < 0.05$) was found among the two groups in the present study (Table 2). Similarly, scalded and skinned rabbit meat showed no significant difference ($p > 0.05$) in moisture content, 71.42% and 68.32%, respectively [5]. SBC and NSBC breast meat had similar ($p > 0.05$) ash contents. A previous study has reported the same result for the ash content in scalded (1.88%) and skinned (2.03%) rabbits ($p > 0.05$) [5]. The fat content has differed ($p < 0.05$) between SBC and NSBC (Table 2). Higher fat content was reported in NSBC than SBC ($p < 0.05$). Omojola and Adeschinwa [5] reported a higher fat content in scalded rabbit (3.58%) than skinned rabbit (1.49%) meat. As a reason, they have mentioned that fat content in the skinned carcass could be attributed to the removal of skin with some of the underlying fat (i.e. naturally, a degree of fat is laid beneath the skin of animals). The different results in the present study can be liquefying of fat in hot water during the scalding process [18] and there was no effect on the skin of the carcass because the fat content was measured in skinless meat of both SBC and NSBC.

Differences ($p < 0.05$) in crude protein content of breast meat were observed in SBC and NSBC (Table 2). SBC showed a higher crude protein content in breast meat than NSBC ($p < 0.05$). Previous studies have reported differences in crude protein content in scalded and skinned rabbit meat (20.64% and 21.05%, respectively), but with no significance ($p > 0.05$) [5]. Maribo et al. [10] has revealed that less protein denaturation in de-hided pig carcass than scalded pig carcass.

Table 2. Proximate composition (%) of breast meat from scalded and non-scalded broiler chickens

Parameter (%)	Broiler breast meat type		SEM ¹⁾	<i>p</i> -value
	SBC	NSBC		
Moisture	71.80	73.27	0.536	0.123
Crude fat	3.83 ^b	4.75 ^a	0.169	0.018
Crude protein	23.56 ^a	21.24 ^b	0.586	0.049
Crude ash	0.78	0.70	0.063	0.405

¹⁾Pooled standard error of the means (n = 20).

^{a,b}Values in the same row with different superscripts differ significantly ($p < 0.05$).
SBC, scalded broiler chicken; NSBC, non-scalded broiler chicken.

Sensory characteristics

No difference ($p > 0.05$) in color and appearance was observed in the present study (Table 3). Giving the same results, no significant difference in color was observed between skinned and scalded goat meat [4]. In contrast, Omojola and Adesehinwa [5] indicated that there was a lower ($p < 0.05$) score for color of skinned rabbit meat than for that of scalded rabbit meat. The present study showed that there was no significant difference ($p > 0.05$) between the two types of chicken concerning color and odour. Similarly, Omojola and Adesehinwa [5] reported that there was no significant difference ($p > 0.05$) in flavor between the scalded and skinned rabbit meat. However, meat from skinned goats had a higher flavor than that from scalded goats [4]. Moreover, no significant difference ($p > 0.05$) in tenderness and juiciness was reported in the current study. In contrast, the panellists rated meat from skinned goat carcasses the highest in tenderness and juiciness, compared to meat from scalded carcasses [4]. As it was mentioned, the reason for this result could be that since the heat was not applied to skinned carcasses there was probably no heat-induced rigour that took place on the carcasses. However, there was a difference ($p < 0.05$) in the overall acceptability of breast meat between SBC and NSBC. Nevertheless, the result of the present study is not in an agreement with those of previous studies. The results of overall acceptability of meat from scalded and skinned goat carcasses were 4.25 and 5.50 [4] and the values obtained by Omojola and Adesehinwa [5] for scalded and skinned rabbit meat were 5.80 and 6.20, respectively.

CONCLUSION

In general, NSBC contained lesser protein, higher fat, higher pH and a higher overall acceptability score than SBC. However, moisture and crude ash content, cooking loss and color value did not differ between NSBC and SBC. Based on the results of this study, it can be concluded that the scalding process has a negative significant effect on the physicochemical and sensory properties of broiler chicken.

Table 3. Sensory evaluation of breast meat of scalded and non-scalded broiler chicken

Parameter	Broiler breast meat type		SEM ¹⁾	p-value
	SBC	NSBC		
Appearance	5.43	5.53	0.212	0.740
Color	5.30	5.53	0.211	0.438
Odor	5.00	5.26	0.237	0.429
Taste	5.46	5.80	0.195	0.232
Juiciness	5.30	5.26	0.222	0.916
Tenderness	5.30	5.43	0.208	0.652
Overall acceptability	5.46 ^b	5.93 ^a	0.154	0.036

¹⁾Pooled standard error of the means (n = 20).

^{a,b}Values in the same row with different superscripts differ significantly ($p < 0.05$).
SBC, scalded broiler chicken; NSBC, non-scalded broiler chicken.

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