PE4.10 Effect of immersion chilling on the color of yellow-feathered broiler carcasses 32.00

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***Abstract*— In this study, the effect of immersion chilling on the color of yellow-feathered broiler carcasses was investigated with air chilling as reference method. After chilled, water uptake was determined. Then the carcasses were stored at 2 □C. The L*, b* and a* value of the skin and breast were determined using the Chroma Meter at 24 h postmortem. Percent purge, pH_{24h}, TBARS value were determined as well. Compared with air chilled carcasses, the skin and the breast of immersion chilled carcasses had significantly ($P < 0.01$) higher L* value and lower b* value. Water uptake had significant relations to L* value ($r = 0.52$), b* value ($r = –0.50$), TBARS value ($r = –0.69$), and percent purge ($r = 0.94$) ($P < 0.05$). Correlations between percent purge and L* value ($r = –0.60$), b* value ($r = –0.46$), TBARS value ($r = –0.66$) were also significant ($P < 0.05$). TBARS value had positively significant correlations with b* value ($r = 0.47$). Therefore, immersion chilling improved the color of yellow-feathered broiler carcasses. As a result, immersion chilled carcasses had a better appearance and breast color.**

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***Index Terms*—Immersion chilling; TBARS; Water uptake; Yellow-feathered broiler chickens**

I. INTRODUCTION

The color of poultry carcasses and poultry products are critical food quality attributes. Appearance and meat color are critical for consumers' initial selection of poultry products in the marketplace [1, 2]. Many factors, including chilling process, affect the appearance of poultry carcasses and meat color. Some studies have focused the effect of different chilling systems on the appearance of poultry carcasses and meat color [3-5]. However, few data are available on both attributes. Yellow-feathered chicken, a Chinese native breed, has a unique taste and texture, is regarded as a delicacy, and is popular in Hong Kong and southern China. However, few studies have investigated chilling process in yellow-feathered chicken industry and how the chilling process affected the appearance of the carcasses. Immersion chilling and air chilling are two most common chilling methods for poultry carcasses, which could result in different quality status [6]. The objective of this study was to investigate the effect of immersion chilling on the appearance and breast color of the yellow-feathered broiler carcasses in terms of pH_{24h}, TBARS, water uptake and percent purge.

II. MATERIALS AND METHODS

Materials

Ninety-six commercially reared, mixed-sex, 42-d-old broilers were stunned and slaughtered as the methods described by Young and Smith [7].

Forty-eight carcasses were chilled in cold water (two chilling steps, the temperature of water in the first step was at 11 ± 2 □C, and 0.5 ± 0.1 □C in the second step.), and 48 were chilled in the cold air (–13 ± 1.5 □C, 0.2 ms^{-1}). Internal temperature of the breast was tracked using a needle-tipped thermometer during chilling. When temperature of internal breasts was 2 to 4 □C, all the carcasses were stored at 2 ± 1 □C for 24 h.

Methods

Each carcass was weighed (w, g) before chilled. After chilled in water or air, the carcasses were then weighed again (w_0, g). Before weighed, the carcasses chilled in water were allowed to drain for 10 min. Water uptake (wu) was calculated as a percentage of the difference in carcass weight before and after chilling. Each carcass was weighed at 24 h postmortem (w_1, g), and percent purge (pp) was determined as Young and Smith did [7].

$$\text{wu} = \frac{w_0 - w}{w} \times 100\% \,;\ \text{pp} = \frac{w_1 - w}{w} \times 100\%$$

The color of the skin and breast was evaluated at 24h postmortem using a Chromameter (Model CR-200, Minolta Camera Co. Ltd., Osaka, Japan), according to Jaturasitha *et al.* [8]. The pH of samples was determined using the method described by Ngapo *et al.* [9]. Thiobarbituric acid concentrations expressed as milligrams of malonaldehyde per kilogram of sample were determined using the methods by Lo Fiego *et al.* [10] and Du *et al.* [11].

III. RESULTS AND DISCUSSION

As figure 1 shows, immersion chilled carcasses had significantly higher L* value ($P < 0.01$) and lower b* value ($P < 0.01$), which agreed with the previous data [3, 12-14]. No significant differences ($P > 0.05$) existed in a* value between the two treatments.

For immersion chilled carcasses, water uptake, percent purge and TBARS value had significant influences on the breast color. Table 1 shows the significant correlations between breast color and water uptake, percent purge as well as TBARS value. L* value was positively correlated with water uptake ($r = 0.52$) and percent purge ($r = 0.60$). The b* value had negatively significant correlations with water uptake ($r = -0.50$), percent purge ($r = -0.46$) and positively significant correlations with TBARS value ($r = 0.47$).

Carcasses lost weight during air chilling but gain in immersion chilling process (table 2). Water uptake differences between air chilling and water chilling were significant ($P < 0.01$) (table 2). Carcasses gain water that enters in the intercellular spaces created during the rigor mortis. Table1 shows the percent purge of immersion chilled carcasses had positively significant correlations with water uptake ($r = 0.94$). This might explain the percent purge of immersion chilled carcasses was still 3.75% (table 2) after 24 h of storage. Water absorbed by carcasses entered in the intercellular spaces, caused reflecting of light and prevented the meat from oxidation, and led a significant lower TBARS value (figure 2), which involved a higher L* value and a lower b* value in the immersion chilled breast meat. During immersion chilling, higher L* value ($P < 0.01$) and lower b* value ($P < 0.01$) of skin could be related to the water absorbed in the skin and surrounding fat as well [6]. The pH_{24} of breast had little effect on breast color at 24 h postmortem between the two chilling methods, for the mean pH_{24} of breast did not differ ($P > 0.05$) in our study.

IV. CONCLUSION

Chilling methods affect the appearance and breast color of the yellow-feathered broiler carcasses. In our study, yellow-feathered broiler carcasses chilled by immersion system had a lighter and less intense yellow color both in the skin and breast. The results indicated that immersion chilled yellow-feathered broiler carcasses had a better appearance and breast color. Analysis indicated that immersion chilling was the commended method for yellow-feathered broiler chicken industry in China, when only appearance of the carcasses and breast color were considered.

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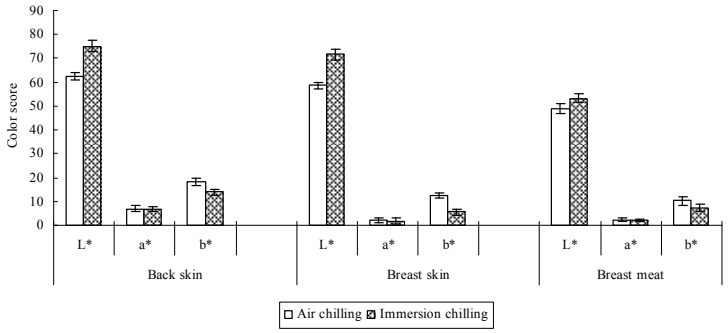

Figure 1: Comparative skin and breast color of air chilled and immersion chilled carcasses.

Table 1: Coefficients of correlation among L* value, a* value, b* value of breast, Water uptake and Percent purge of immersion chilled carcasses.

	L*	a*	b*	Water uptake	Percent purge
a*	0.11				
b*	-0.53*	-0.24			
Water uptake	0.52*	0.24	-0.50*		
Percent purge	0.60**	0.26	-0.46*	0.94***	
TBARS	-0.69**	-0.11	0.47*	-0.69**	-0.66**

* $P < 0.05$, ** $P < 0.01$, *** $P < 0.0001$, n=48.

Table 2: Effect of chilling method on pH_{24h}, Water uptake, Percent purge (mean ± s. d.).

Variables	Air-chilling	Water-chilling
pH_{24h}	5.72 ± 0.04^{a}	5.74 ± 0.03^{a}
Water uptake (%)	-0.16 ± 0.11^{a}	7.63 ± 0.69^{b}
Percent purge (%)	-0.65 ± 0.22^{a}	3.75 ± 0.38^{b}

[a-b] Means in the same row with differing superscripts differ significantly ($P < 0.01$), n=48.

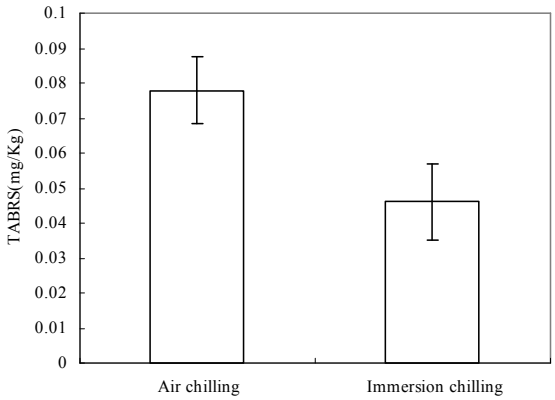

Figure 2: Breast of air chilled and immersion chilled carcasses with a significant difference for TBARS value.