Correlation between some quality parameters and bleeding status of poultry meat

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ABSTRACT

A study was undertaken to investigate the effect of two different slaughter methods i.e traditional method (unilateral neck cut) and decapitation on the colour, pH, total heme pigments (THP) and water holding capacity (WHC) of the poultry meat. Fresh drumsticks (30 from conventionally slaughtered and 30 from slaughtered by decapitation method) of broiler birds (6 weeks of age; 2 hrs postmortem) were procured from retail meat shops located in different regions of the Ludhiana, Punjab, India. L* value (53.55) of conventionally slaughtered meat samples was significantly (P<0.01) higher than the decapitated method (47.97) but a* and b* values for conventionally slaughtered samples (7.86 and 12.62, respectively) were significantly (P<0.01) lower than the decapitated samples (11.42 and 15.90, respectively). These effects were due to the fact that the decapitated birds lost the least amount of blood compared to the conventionally slaughtered birds. pH of the conventionally slaughtered meat samples (6.02) were significantly (P<0.01) lower than the decapitated meat samples (6.32). The mean total heme pigments were significantly (P<0.01) higher in decapitated meat samples (2.20 mg/gm of meat sample) than the conventionally slaughtered meat samples (1.84 mg/gm of meat sample). Similarly WHC was significantly (P<0.01) higher of decapitated meat samples (52.91%) than the conventionally slaughtered meat samples (43.18%). Malachite Green test in 86.36% conventionally slaughtered meat samples showed perfect bleeding and 100% decapitated meat samples showed imperfect bleeding.

Key words: Color, Heme pigments, Malachite Green Test, Slaughter method, Water holding capacity.

INTRODUCTION

Quality of meat is vital for the general well being of the human society and for the longer shelf-life of the meat and meat products. The first impression consumers have of any meat product is its color and thus color is of utmost importance. It is regarded as an indicator of meat freshness by many consumers, being probably the main attribute that influences consumer’s purchase decision. Meat color is determined by the concentration of pigments, the reactions of the pigments with gaseous elements or compounds, and the structural properties of muscle proteins. Bleeding influences the final total pigment concentration since myoglobin appears to represent a small portion of the total pigment concentration (Boulianne and King, 1998). Thus the concentration of hemoglobin is the main determiner for meat color development; and slaughter method is one of the contributory factors for hemoglobin contents remaining in meat.

MATERIALS AND METHODS

Fresh drumsticks (30 from conventionally slaughtered and 30 from slaughtered by decapitation method) of broiler birds (6 weeks of age; 2 hrs postmortem) were procured from meat retail shops located in different regions of the Ludhiana. These were chilled at 4±1°C for 12 hrs. The meat was cleaned of adhering facia, visible fat, ligaments, tendons and nerves. The meat samples were analyzed for Color, pH, Water Holding Capacity (WHC), total heme pigment (THP) and malachite green test (MGT). Color of drumsticks was measured immediately upon arrival in the lab by Hunter Lab system using MiniScan XE Plus (Model No. 45/0-L) with illuminants D65 and the results were expressed in terms of color coordinates CIE L* (lightness), a* (redness) and b* (yellowness). The readings were taken at three places of the thigh from the areas free from blood discoloration, blood spots etc.

pH was measured with digital pH meter equipped with a combined glass electrodes. The method of Wardlaw et al. (1973) was used to determine the WHC of meat samples.

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Method of Fleming et al. (1960) was modified to determine heme pigments in muscle extracts. Duplicate 10 gram samples were weighed and then blended for 5 minutes in a blender with 26 ml cold distilled water. After centrifuging the slurry at 5000 rpm for 15 minutes, the supernatant was filtered into a flask through a small wad of cotton and the extract retained. Upon extracting the resultant residue by
blending for 3 minutes with 16 ml water, the extracts were combined, filtered through Whatman No. 3 filter paper into a 50 ml volumetric flask and diluted to volume.

Five ml extract was treated with potassium ferricyanide and sodium cyanide to provide final concentrations of the compounds after dilution of 0.6 and 0.8 millimole per liter, respectively. Drabkin’s molar extinction coefficient of 11.3 x 10³ for cyanmethemoglobin (CNMMb) at a wavelength of 540 nm was used to determine total molar concentration of pigments. Molar concentrations were converted to milligrams of pigment by the formula:

\[
\text{Total pigments (mg/gm tissue)} = \frac{\text{O.D.} \times (17,000 \times (0.050+d) \times 1000)}{11,300 \times \text{gm. of sample}}
\]

where OD/11300 = molar concentration of pigment, OD= optical density at 540 nm, 11300 = molar extinction coefficient of CNMMb at 540 nm, 17000 = equivalent weight of the pigment, 0.050= volume of the extract in liters, and d= volume increase due to the addition of the cyanides. The equation was multiplied by 1000 to convert grams of pigment to milligrams.

Status of bleeding was established qualitatively by malachite green test (Thronton and Gracey, 1974). 0.7 ml of clear meat extract was taken in a test tube. One drop of malachite green solution was added and mixed. One drop of hydrogen peroxide was added and the tube was shaken until foam developed. Then the test tube was left to stand for 20 min for color development. Cloudy green indicated imperfect bleeding and clear blue indicated the normal bleeding. Data were analyzed by independent samples t-test with 95% confidence of interval.

RESULTS AND DISCUSSION

In respect to color, the \( L^* \) value (53.55) of conventionally slaughtered meat samples was significantly (P<0.01) higher (Table 1) than the decapitation method (47.97) but \( a^* \) and \( b^* \) values for conventionally slaughtered samples (7.86 and 12.62, respectively) were significantly (P<0.01) lower than the decapitated samples (11.42 and 15.90, respectively). \( pH \) of the conventionally slaughtered meat samples (6.02) were significantly (P<0.01) lower than the decapitated meat samples (6.32). The mean total heme pigments were significantly (P<0.01) higher in decapitated meat samples (2.20) than the conventionally slaughtered meat samples (1.84). Similarly \( WHC \) was significantly (P<0.01) higher of decapitated meat samples (52.91%) than the conventionally slaughtered meat samples (43.18%). Malachite Green test in 86.36% conventionally slaughtered meat samples showed perfect bleeding and 100% decapitated meat samples showed imperfect bleeding.

The higher \( L^* \) values of conventionally slaughtered meat samples were due to higher blood loss from the carcasses which led to the lighter color of the muscles. This finding is in accordance with the McNeal et al. (2003) who reported that decapitated birds lost the least amount of blood compared to the conventionally slaughtered birds.

The low \( a^* \) values for conventionally slaughtered meat samples than decapitated meat samples were similar to the finding of McNeal et al. (2003) who reported that the \( a^* \) value showed that breast meats from the decapitated birds were significantly more red (2.6) than the breast meats from the conventionally killed birds (2.4).

The decrease in \( a^* \) value could be explained by the fact that the raw meat presents red color because of the myoglobin (Terra et al. 2009) and as a result, by removing myoglobin, decreased \( a^* \) values were observed. These findings are also supported by Boulianne and King (1998) who reported that there is a strong positive correlation between total pigment concentration and \( L^*/a^* \) values.

The higher \( pH \) values obtained in this study for decapitated meat samples than the conventionally slaughtered meat samples was supported by the results of McNeal et al. (2003) who reported that decapitation resulted in significantly greater \( pH \) values than the conventional killing at 2 and 24 hrs, 6.25 vs. 6.07, and 5.92 vs. 5.83, respectively. Fletcher (1999) reported that the color had a strong correlation with muscle \( pH \), darker muscle having higher \( pH \) and lighter muscle having lower \( pH \).

The mean \( WHC \) of conventionally slaughtered meat samples was significantly lower than the decapitated meat samples. The results were on the expected line because the relationship between \( pH \) and \( WHC \) is being well established. The extent of the postmortem \( pH \) fall affects the \( WHC \) and higher the ultimate \( pH \) the less is the diminution in \( WHC \) (Lawrie, 1998).

The mean total heme pigment (mg/gm of meat sample) was significantly (P<0.01) higher (Table 1) in decapitated meat samples (2.20) than the conventionally slaughtered meat samples (1.84). The increase in pigment concentration was probably responsible for the dark coloration of broiler chicken pectoral muscle (Boulianne and King, 1998). They further reported that bleeding would

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Conventional</th>
<th>Decapitation</th>
<th>Significance Method</th>
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<tbody>
<tr>
<td>( L^* )</td>
<td>53.55± 5.57</td>
<td>47.97± 7.03</td>
<td>**</td>
</tr>
<tr>
<td>( a^* )</td>
<td>7.86± 2.06</td>
<td>11.42± 2.54</td>
<td>**</td>
</tr>
<tr>
<td>( b^* )</td>
<td>12.62± 3.27</td>
<td>15.90± 3.13</td>
<td>**</td>
</tr>
<tr>
<td>( pH )</td>
<td>6.02± 0.13</td>
<td>6.32± 0.14</td>
<td>**</td>
</tr>
<tr>
<td>( WHC (%) )</td>
<td>43.18± 5.46</td>
<td>52.91± 3.84</td>
<td>**</td>
</tr>
<tr>
<td>THP (mg/gm of tissue)</td>
<td>1.84± 0.13</td>
<td>2.20± 0.21</td>
<td>**</td>
</tr>
</tbody>
</table>

Values are mean±SD; n=30; WHC-Water Holding Capacity; THP-Total Heme Pigment. **P<0.01

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influence the final total pigment concentration since myoglobin appears to represent a small portion of the total pigment concentration. Niewiarowicz et al. (1986) found that normal broiler chicken leg muscles contained 1.83 mg/g tissue total heme pigments. Boulianne and King (loc. cit) reported that the total pigment concentration in the dark-colored and normal pectoral muscles were 1.47 and 0.96 mg/g of muscle respectively.

About 86.36% of the conventionally slaughtered meat samples showed perfect bleeding and 100% of the decapitated meat samples showed imperfect bleeding when

<table>
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<th>TABLE 2: Effects of two different methods of slaughter on malachite green test (MGT) of broiler drumstick meat.</th>
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<tr>
<td><strong>Malachite Green Test</strong></td>
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<tr>
<td>Perfectly Bled (%)</td>
</tr>
<tr>
<td>Imperfectly Bled (%)</td>
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MGT test was applied (Table 2). Decapitation leads to poor bleeding (McNeal et al. 1998). The higher blood contents in the decapitated carcasses were responsible for samples showing imperfect bleeding.

REFERENCES