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Commercial Preslaughter Blue Light Ambience for Controlling Broiler Stress and Meat Qualities

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ABSTRACT

The objective of this work was to study the effect of blue light diffuser on the broiler stress control by measuring the occurrence of PSE meat just before slaughtering. Birds were divided into the following two groups before slaughter at the point of being hung on shackles: broiler group under low intensity blue light ambience (475, 17-20 lx) and control group under white light (550-650nm, 321-332 lx). Birds' stressful conditions were measured by the occurrence of PSE meat. Breast fillets were classified as PSE meat based on pH (<5.8) and lightness (L> 53.0). The fillet samples in the control group had the following characteristics: pH_u=5.77, L* = 54.26 and b*= 6.27. The fillet samples from birds under blue light ambience had the following characteristics: pH_u=5.81, L* = 52.86 and b* = 5.22 ($p \leq 0.05$). These results revealed that the treatment of blue light ambience just before slaughtering contributed to the alleviation of ante mortem stress of the birds, which was observed by a 14% decrease in the occurrence of PSE meat. Exposure to blue light just before slaughtering was shown to have potential to be used in modern slaughterhouses to offer a comfortable atmosphere, thereby maintaining breast meat quality.*

Key words: color, preslaughter handlings, PSE meat

INTRODUCTION

Broiler pale, soft and exudative (PSE) meat is the resultant of an imbalance of muscle Ca^{2+} homeostasis originating from inadequate preslaughtering handling practices, such as how the animals are caught at the farm, exposure to heat and high relative humidity and length of time for transportation, which leads to animal stress resulting in accelerated rigor mortis (Owens and Sams 2000; Olivo et al. 2001; Barbut et al. 2008; Simões et al. 2009). This rapid postmortem glycolysis with low pH values and high carcass temperature promote the denaturation of myofibrillar and sarcoplasmic proteins, thus compromising their functional properties and making them inappropriate for processing characterizing the so-called PSE meat (Olivo et al. 2001; Kissel et al. 2009). Thus, it is feasible to measure the stressful conditions intensity the animals are submitted by determining quantitatively the incidence of PSE meat.

In modern poultry husbandry, artificial illumination has been used to improve avian performance. The light schedule, intensity of illumination and light wavelength are the three

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factors that influence the growth and well-being of broilers (Olanrewaju et al. 2006). Charles et al. (1992) observed that broiler carcasses have a lower percentage of body fat and higher percentage of body protein following exposure to high-intensity light than those exposed to low-intensity light. Studies by Cao et al. (2008) have suggested that the growth and productive performance of broilers are increased under green and blue lights. Other reports have also stated that both blue and green lights are more effective in stimulating testosterone secretion and myofiber growth than increasing the body growth (Rozenboim et al. 1999). Birds, similarly to humans, have a "third eye", which is the chicken pineal gland located just rostrodorsal to the superior colliculus and behind and beneath the stria medullaris, between the laterally positioned thalamic bodies. This gland produces the hormone melatonin, which is responsible for preparing the body for and inducing sleep. The secretion of melatonin follows circadian rhythm release during darkness, and it is inhibited under white light (Classen and Riddell 1989).

Blue light (440-490 nm) has a calming effect on the birds (Harrison et al. 1969), and it has been used in the operation of catching birds and overriding the visual capacity of the birds that remain still, which facilitates the movement of the catcher (Avila and Abreu 2003).

In some Brazilian slaughterhouses, there is a practice of using blue light just before slaughter at the point of the animal being hung on the shackles, and the combination of partially dark ambience with the use of blue light reduces the excitement of the birds, which leaves them immobile. There are, however, few reports on this subject. Therefore, this work was designed to assess the effect of environmental blue light just before slaughtering on the broiler stress by measuring the occurrence of PSE meat in a commercial line.

MATERIAL AND METHODS

Sample preparation

Six hundred and two chickens aged 42 days at the point of being hung on shackles were divided into the following two groups before slaughter: broiler group under blue light ambience and control group under white light. The blue light ambience was produced by placing a blue acrylic diffuser just below the fluorescent lamp. For the control group, the lamp was used without the diffuser. The fluorescent lamp was placed 80 cm above the broilers head. The wavelength of light was measured using the Fiber Optic Spectrometer. The blue light presented wave length peak of 475nm, half-band width between 425 and 525nm and fluorescent white light presented prevalent wavelength in 550-650nm. The illuminance was measured using an illuminometer (Hiseg, model LD 240). The blue light produced 17-20 lx light intensity and the white light produced 321-332 lx. The animals were slaughtered according to the standard industrial practice as previously described by Guarnieri et al. (2004). This practice consisted of electrical stunning, bleeding, scalding, defeathering, evisceration, carcass water cooling, deboning and carcass refrigeration. The length of time from slaughtering the birds until sample collection was approximately 90 min. Fillet meat (*Pectoralis major* m.) samples were collected immediately after slaughter and stored at 4ºC for 24h *postmortem* for further analyses.

pH and color measurement

The pH was measured by inserting electrodes into the breast muscle (Boulianne and King 1995) using a contact pH meter system (Testo model 205). Analysis was performed in triplicate at 24 h postmortem as previously described by Olivo et al. (2001). A colorimeter (Konica Minolta CR400) was used to evaluate the color parameters, including L* (lightness), a* (redness) and b* (yellowness), on the posterior surface of the intact skinless breast muscles at 24 h postmortem. The color values were measured at three different sites on the same sample. These sites were the proximal extremity of the muscle, distal extremity of the muscle and medial side at the halfway point between the proximal and distal extremities (Soares et al. 2003; Soares et al. 2009)

Sample Classification

Fillet meat samples were classified as PSE, or normal based on previously established parameters associated with pH and L* values. pH values less than 5.8 and $L_{24\ h}$* values higher than 53.0 were classified as PSE, and pH values higher than 5.8 and $L_{24\ h}$* between 44.0 and 53.0 were classified as normal (Kissel et al. 2009; Wilhelm et al. 2010).

Statistical Analysis

Statistical analysis was carried out using the STATISTIC 7.0 program. Student's t-test ($p \leq 0.05$) was used to determine significant difference between the control and blue light groups.

RESULTS AND DISCUSSION

Table 1 shows the pH and color measurement values of the control fillet samples and fillet samples from the blue light group at 24 h postmortem. The pH, L* and b* values were significantly different between the two groups. The control fillet meat samples had a pH_c of 5.77, which was lower ($p \leq 0.05$) than the value (pH_u=5.81) found for the samples from the blue light group. The fillet meat samples in the control group had an L* value of 54.26, and the samples from the blue light ambience group had an L* value of 52.86. The L* values of these two groups were significantly different ($p \leq 0.05$). There was no significant difference for the a* values between the two groups. The b* values of the fillets from the control group were significantly higher than those from the blue light group.

Table 1 - Mean pH and color values of control and blue light fillet samples at 24 h postmortem.

Groups	pH	L*	a*	b*
Control (n=300)	5.77^{b} ±0.12	54.26^{a} ±3.08	1.91^{a} ±0.80	6.27^{a} ±1.71
Under blue light (n=300)	5.81^{a} ±0.14	52.86^{b} ±3.29	1.81^{a} ±0.94	5.22^{b} ±1.52

Different letters in the same column differ according to Student's t-test ($p \leq 0.05$).

The pH and L* values of the fillet control group were typical of PSE broiler meat as previously reported (Olivo et al. 2001; Soares et al. 2003; Barbut et al. 2008; Wilhelm et al. 2010). Fillets from the control group exhibited characteristics that were more yellowish than the characteristics of PSE broiler meat (Qiao et al. 2001). The fillet meat samples from the control group had decreased functional properties, which suggested that the birds had higher levels of excitement and stress before slaughter at the point of being hung on shackles than when in the presence of blue light. The antemortem stress led to rapid postmortem glycolysis with decreased pH values and increased L* and b* values.

Figures 1 and 2 show the occurrence of PSE broiler breast meat in the control and blue light groups, respectively, after the classification of breast meat by pH and L* values. These results demonstrated a 53% occurrence of PSE breast meat in the control group as compared to a 39% occurrence of PSE breast meat in the blue light group.

The occurrence of PSE breast meat in the control group (53%) was similar to the occurrence reported by Simões et al. (2009) who reported a 52% occurrence of PSE broiler breast meat in a commercial plant survey in the summer. Thus, exposure to blue light ambience just before slaughter inhibited the occurrence of PSE breast meat by calming the birds, thereby reducing antemortem stress.

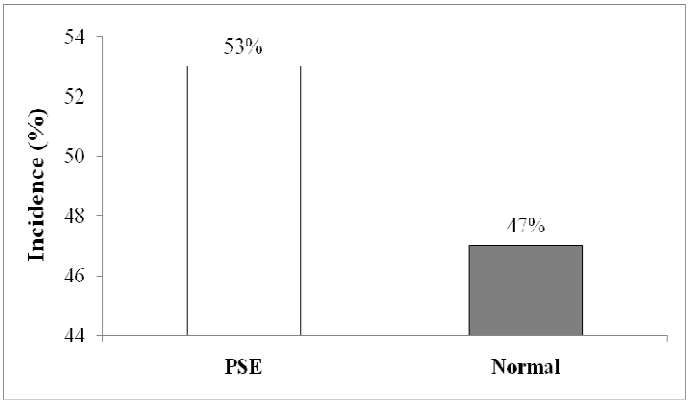

Figure 1 - The occurrence of PSE breast meat in the control group.

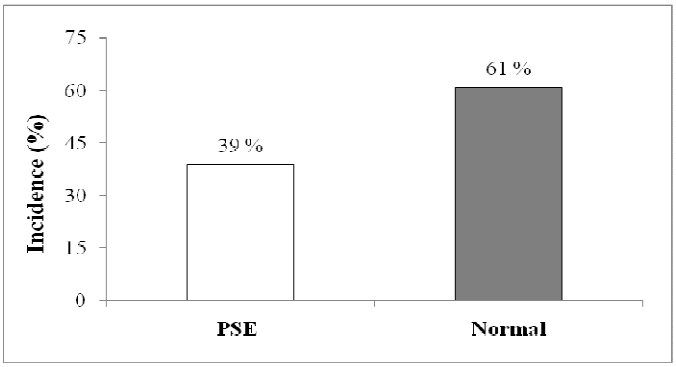

Figure 2 - The occurrence of PSE breast meat in birds exposed to blue light.

CONCLUSIONS

Exposure to blue light just before slaughtering showed potential to be used in modern slaughterhouses to offer a comfortable atmosphere, thereby maintaining the breast meat quality.

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