COMPARISON OF WINTER TIME INCIDENCE OF PSE AND DFD IN 3 H AND 24 H P. M. CHICKEN BROILER BREAST MUSCLES

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Introduction

The pre-slaughter poultry handling conditions and post-mortem biochemical and biophysical processes in muscle tissue quite often are resulting in incidence of PSE or DFD meat. The pale breast meat, similar to the defect observed in pig muscles, defined as being pale, soft, and exudative (PSE) is also characterized as having an abnormally low p. m. muscle pH. In contrast, the darker breast meat, compared to dark, firm, and dry condition (DFD) observed for bovine species is characterized as having an abnormally high p. m. meat pH. Such meat has limited technological value (Bianchi et. al., 2005). The L^* value determined by the spectrophotometer light reflectance of breast meat provides an objective relationship to the subjective appearance of lightness, while a^* provides a reliable estimates for redness and b^* for yellowness of meat or of a given anatomic muscle colour.

The season of the year greatly influences the frequency of PSE and DFD defects in chicken broiler breast muscle. Significantly lighter fillets were found in the summer (Bianchi et al., 2007; Petracci et al., 2004) and darker in the winter months (Mallia et al., 2000). However, other studies conducted on broiler chickens (Wilkins et al., 2000; Woelfel et al., 2002) did not outlined clear effects of season on poultry meat colour (L^*). Conditions during transport (length, temperature, air humidity) generally are affecting meat quality (Bianchi et al., 2006). The objective of the study was to determine the influence of winter season and duration of bird's transportation, as a function of the distance from the farm to the plant, on broiler chicken breast muscles color 3 h and 24 h p. m. variation and as its relationship with pH values in one of the commercial processing plant in Poland.

Materials and Methods

Birds from Cobb 500 lineage from different farms located 120 km (A_3); 65 km (B_3, C_3 and E_3); 80 km (D_3) and 160 km (A_{24}); 65 km (B_{24}, C_{24}); 120 (D_{24}); 55 (E_{24}) from the processing plant were slaughtered in a industrial conditions during winter months. Investigations of 10 individual experiments were performed on skinless breast chicken broilers muscles removed from the carcasses 3 h and 24 h p. m. Colour parameters i.e. L^*, a^* and b^* were measured three times along the longitudinal axis of each randomly chosen 50 muscles by spectrometer Minolta CR-400 and using illuminate source C. The pH was determined in duplicate using pH-meter Testo 230, calibrated with pH 4 and 7 buffers, by inserting electrode into the each examined muscle. The data were analysed using Duncan's test and linear regression (STATISTICA).

Results and Discussion

The colour parameters and pH values of broiler breast fillets for A-E individual experiments are presented in Table 1. The values determined 3 h p. m. for the colour lightness (L^*) comprised in the following ranges from dark to pale: 43-52 (A_3); 41-56 (B_3); 44-54 (C_3); 47-53 (D_3) and 44-55 (E_3), and after 24 h p. m.: 45-56 (A_{24}); 45-54 (B_{24}); 41-54 (C_{24}); 46-56 (D_{24}) and 43-53 (E_{24}), respectively. The observed distribution of L^* values after 3 h and 24 h p. m. was lower than that reported by Woelfel et al. (2002) - from 42.0 to 71.0, and by Wilkins et al. (2000) - 45-67, average 55.2 and was similar to findings by Petracci et al. (2004) – from 42-59, and Barbut (1997) - 35.3-55.5, average 47.1, respectively. To relate chicken fillet color to meat condition forms the following ranges are suggested: lighter than normal ($L^*>53$), normal (46 or $48<L^*<53$), and darker than normal ($L^*<46$ or $L^*<48$). It is also suggested that ranges for meat sorting should be established for each processing plant, depending on the processed type of birds and the final product specifications. Taking the boundary values for PSE ($L^*>53$) and DFD ($L^*<48$ / $L^*<46$) after 3 h p. m. in group A_3: 0% and 62% / 20%; B_3: 6% and 68% / 38%; C_3: 10% and 28% / 6%; D_3: 0% and 10% / 0% and E_3: 4% and 64% / 26%; and after 24 h p.m. in group A_{24}: 6% and 18% / 2%; B_{24}: 6% and 18% / 6%; C_{24}: 6% and 22% / 4%; D_{24}: 6% and 22% / 0% and E_{24}: 0% and 34% / 10% of muscles were characterised by PSE and DFD, respectively. The high percentage of DFD meat in experiment A_3, B_3 and E_3 (62%, 68%, 64%) and to the lesser extend in experiment C_3 and D_3 (28% and 10%) and A_{24}-E_{24} (18%, 18%, 22%, 22%, 34%) was predictable, because this abnormality seems to happen more often during winter season. These data are not in agreement with those obtained by Woelfel et al. (2002) who found 47% PSE frequency in broiler chicken fillets (3 h p. m.) and are consistent with those of Bianchi et al. (2007)

who reported the 5.9% PSE incidence with respect to birds processed during winter. The lower average L^* values of muscles 3 h p. m. for experiment A_3, B_3 and E_3 were significantly different than those for muscles A_{24}-E_{24}.

Table 1. Effect of transportation on broiler breast fillets colour parameters and pH after 3 h and 24 h p. m.

Experiment number	Distance from farm to plant	Parameter L^*	a^*	b^*	pH	L^*-pH
A_3	120 km	47.501^{ad} (1.878)	4.342^{a} (0.685)	-2.198^{a} (1.078)	6.208^{a} (0.190)	0.461
B_3	65 km	46.647^{a} (3.511)	4.992^{b} (0.830)	-3.091^{b} (1.144)	5.883^{b} (0.184)	-0.739
C_3	65 km	49.548^{bc} (2.327)	4.408^{a} (0.713)	-0.809^{cd} (0.833)	6.004^{c} (0.264)	-0.369
D_3	80 km	50.017^{c} (1.537)	4.229^{a} (0.513)	-0.867^{cd} (0.913)	6.023^{c} (0.224)	-0.535
E_3	65 km	47.619^{d} (2.211)	1.666^{c} (0.578)	0.619^{e} (1.393)	5.965^{c} (0.204)	-0.282
A_{24}	160 km	49.881^{c} (2.074)	4.310^{a} (0.765)	-2.093^{a} (1.325)	5.862^{bd} (0.234)	-0.482
B_{24}	65 km	49.761^{bc} (2.026)	3.943^{d} (0.778)	-1.462^{f} (1.374)	5.789^{d} (0.144)	-0.348
C_{24}	65 km	49.368^{bc} (2.368)	3.669^{d} (0.685)	-1.098^{cf} (1.478)	5.884^{b} (0.148)	-0.691
D_{24}	120 km	49.639^{bc} (1.985)	4.481^{a} (0.716)	0.449^{e} (1.708)	5.784^{d} (0.112)	-0.815
E_{24}	55 km	48.807^{b} (2.255)	1.325^{e} (0.735)	-0.517^{d} (1.294)	5.968^{c} (0.159)	-0.588

$^{a\text{-}f}$ Means in the same column without a common superscript letter differ significantly ($P<0.05$).

The significant correlations between L^* and pH were found. However, it is difficult to explain the positive correlation between L^* and pH for experiment A_3 and the lowest pH and L^* values for experiment B_3.

Conclusions

The winter season influenced the risk for broiler breast meat becoming DFD. The frequency of DFD was more pronounced in muscles 3 h p. m. than in muscles 24 h p. m. It can be partly explained by fact that with the time p. m. the muscle is getting lighter. For experiments A_3-B_3-E_3 and C_3-D_3 (after 3 h p. m.) and A_{24}-B_{24}-C_{24}-D_{24}-E_{24} (after 24 h p. m.) the influence of the transportation distance of birds from farm to processing plant on DFD meat incidence was not found. It is indicated by the similar frequency of DFD: 62%, 68% and 64% and insignificant L^* values for A_3-B_3 and A_3-E_3 and insignificant L^* values for C_3-D_3 experiments, respectively. For muscles after 24 h p.m. similar frequency of DFD from 28 to 22% correspond with no significant L^* values for A_{24}-B_{24}-C_{24}-D_{24} experiments. Surprisingly, in experiments in which the significant difference in L^* values were found, the longer time of transportation resulted in darker muscle colour and higher pH (A_3-C_3, A_3-D_3) or in reverse the lighter colour and insignificantly different pH or the lower pH (D_3-E_3 or A_{24}-E_{24}), respectively.

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