THE INFLUENCE OF STUNNING PROCESSING PARAMETERS ON CHICKEN MEAT COLOUR

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Abstract

The aim of this research was represented by the evaluation of the effects on the chicken meat colour determined by the parameters involved in the stunning process. In order to achieve the proposed goals, three experimental batches including ROSS 308 broiler chickens 42 days old, were constituted. The logistic was represented by the slaughtering technological line, allowing both the changing of the technological parameters involved in the stunning process for those three experimental batch constituted by 50 chicken/batch (L1: $v = 360$ Hz, $U = 70$ V, $I = 180$ mA; L2: $v = 380$ Hz, $U = 85$ V, $I = 160$ mA; L3: $v = 400$ Hz, $U = 100$ V, $I = 150$ mA), and for the obtaining of the anatomical cutting main parts. The protocol aimed the measurement of three different areas for each meat specimens at a temperature of 8-10°C with a portable Minolta spectrophotometer CM-2600d. The calibration of the chromameter apparatus was performed before each series of measurements with a calibration device Minolta CM-A32. With respect to the muscle region, a pronounced luminosity was observed in chest meat, followed downwards by the luminosity of the upper and lower legs. For the complementary colours red - green (a*) coordinate, the lower threshold of the calculated averages was recorded in the upper legs of the chickens coming from L1 batch (0.77±0.211 units) and in the chest muscle coming from L2 batch (0.77±0.201 units), while a maximum value was recorded for the chest muscle of the L3 batch (2.54±0.349 units). The variations of redness average index within a range of 1.77 units was characteristic for the muscle with a light colour; the specimens collected from the L3 chicken batch showed a slight numerical superiority for this colorimetric parameter, given the occurring of the uneven PSE flaws.

Key words: stunning, luminosity, meat colour

INTRODUCTION

Meat and meat products visual appearance is the first factor influencing consumer's purchase decision. As a result of the strong psychological impact, meat colour is a sensitive point of view for the manufacturer, as it follows the prevention of the unwanted colour appearance changes, and so there were made some studies, both to clarify meat colour origin and to understand the factors that may influence its change during processing, storage or preparation [4].

The stunning is a step in the technological slaughter that may affect meat colour; the electric current used to stun causes generalized contractions, affecting muscle characteristics. The use of an excessive or low-frequency current can cause increased bleeding or bone fractures [3, 8]. The characteristics of the electricity (voltage, frequency, stunning duration) have little effect on the colour of the chicken breast muscle [7, 1] and turkey breast muscle [6], although some authors' research noted decreases in descriptive values of the chickens breast meat stunned at a high voltage, while the augmentation of the coordinate value for complementary colours red - green was obvious in the poultry meat stunned at a low voltage current [2]; in previous studies, [9] obtained, depending on the stunning time, a slight decrease in chicken brightness along with an augmentation coordinate value of the complementary colours yellow - blue (b*) [4].

MATERIALS AND METHODS

In order to carry on the study and the experiments we have formed three experimental batches, the biological material was represented by the "ROSS 308" broiler, 42 days old. The slaughtering production line was the logistic basis that allowed both changing technological parameters involved in the stunning for the three experimental batches (L1: υ = 360 Hz, U = 70 V, I = 180 mA; L2: υ = 380 Hz U = 85 V, I = 160 mA; L3: υ = 400 Hz, U = 100 V, I = 150 mA) (with 50 chickens/experimental batch) and in obtaining the main anatomical portion (chest, upper thigh, lower thigh).

In the study, colour determination was conducted on samples with 15-50 mm thickness, which is perpendicular sections to the longitudinal axis of the anatomical regions cut from broilers of the experimental batches, sampling is performed at 24 h post-slaughter, meat samples were then vacuum packed in polyethylene films and subjected to chilling until the colorimetric measurements. Prior to these determinations, meat samples were preserved for 24 hours at 2-4°C [5].

As a method, the actual measurement was carried out in three different areas for each meat sample at a 8-10°C temperature using the Minolta portable spectrophotometer CM-2600d. A chromameter calibration was performed before each series of measurements with the Minolta CM-A32 calibration device, the calibration principle was based on a "black standard" and a "white standard". The values obtained were converted and processed using the SpectraMagic v.3.30 software.

RESULTS AND DISCUSSIONS

The first statistical indicators calculated for the three colorimetric descriptive parameters of the chicken meat from the experimental batches showed standard error of mean values that were entered in the following ranges: L* (L1 = 0.79 to 1.24; L2 = 0.86 - 0.97; L3 = 1.00 to 1.66), a* (L1 = 0.19 to 0.51, L2 = 0.17 to 0.21; L3 = 0.31 to 0.38), and b* (L1 = 0.23 to 0.75, L2 = 0.21 to 0.55; L3 = 0.36 to 0.38) (table 1, table 2, table 3).

Table 1 Colour characterization for chicken breast meat from the L1, L2, L3 experimental batches

Specification		Exp. batch	$\overline{X} \pm s_{\overline{x}}$	V%	Differences interpretation T-Test (2-tailed)	
CHEST	L*	L1	54.16±1.242	7.255	L1-L2	t = 0.566; p = 0.55[ns.]
		L2	55.23±0.860	4.922	L1-L3	t = -2.418; p = 0.039[*]
		L3	60.36±1.006	5.268	L2-L3	t = -3.958; p = 0.003[**]
	a*	L1	1.81±0.199	34.779	L1-L2	t = -2.140; p = 0.061[ns.]
		L2	0.77±0.201	82.598	L1-L3	t = -0.577; p = 0.578[ns.]
		L3	2.54±0.349	43.418	L2-L3	t = 1.814; p = 0.103[ns.]
	b*	L1	2.21±0.235	33.675	L1-L2	t = -2.556; p = 0.031[*]
		L2	3.40±0.364	33.795	L1-L3	t = 0.401; p = 0.698[ns.]
		L3	1.28±0.365	90.234	L2-L3	t = 1.767; p = 0.111[ns.]

L* = brightness; **a*** = complementary colours coordinate red - green; **b*** = complementary colours coordinate yellow - blue. **T-test** (two-tailed) - for each cut portion and colorimetric parameters analyzed, compared to the experimental batches: [ns.]insignificant differences (p> 0.05); *Significant differences (p <0.05); **distinct significant differences (p <0.01); *** Really Significant differences (p <0.001).

Table 2 Colour characterization for chicken upper thigh meat from the L1, L2, L3 experimental batches

Specification		Exp. batch	$\overline{X} \pm s_{\overline{x}}$	V%	Differences interpretation T-Test (2-tailed)	
UPPER THIGH	L*	L1	50.02±0.799	5.052	L1-L2	t = -0.413; p = 0.689[ns.]
		L2	53.86±0.972	5.709	L1-L3	t = -4.326; p = 0.002[**]
		L3	55.63±1.660	9.435	L2-L3	t = -2.293; p = 0.048[*]
	a*	L1	0.77±0.211	86.592	L1-L2	t = 1.816; p =0.103[ns.]
		L2	1.77±0.216	38.527	L1-L3	t = 1.643; p = 0.135[ns.]
		L3	2.49±0.382	48.625	L2-L3	t = 0.763; p =0.465[ns.]
	b*	L1	1.22±0.305	78.671	L1-L2	t = -2.341; p =0.044[*]
		L2	2.03±0.212	32.984	L1-L3	t = -4.955; p =0.001[***]
		L3	3.33±0.378	35.877	L2-L3	t = -1.801; p =0.105[ns.]

L* = brightness; a* = complementary colours coordinate red - green; b*= complementary colours coordinate yellow - blue.
T-test (two-tailed) - for each cut portion and colorimetric parameters analyzed, compared to the experimental batches:
[ns.]insignificant differences (p> 0.05); *Significant differences (p <0.05); **distinct significant differences (p <0.01);
*** Really Significant differences (p <0.001).

Table 3 Colour characterization for chicken lower thigh meat from the L1, L2, L3 experimental batches

Specification		Exp. batch	$\overline{X} \pm s_{\overline{x}}$	V%	Differences interpretation T-Test (2-tailed)	
LOWER THIGH	L*	L1	52.77±1.085	6.501	L1-L2	t = -1.096; p =0.301[ns.]
		L2	50.17±0.919	5.795	L1-L3	t = 0.371; p =0.719[ns.]
		L3	53.16±1.306	7.768	L2-L3	t = 1.049; p =0.321[ns.]
	a*	L1	1.75±0.512	92.281	L1-L2	t = 5.600; p =0.000[***]
		L2	1.63±0.177	34.349	L1-L3	t = -1.545; p = 0.157[ns.]
		L3	2.24±0.316	44.575	L2-L3	t = -6.204; p =0.000[***]
	b*	L1	1.93±0.751	122.904	L1-L2	t = -0.941; p =0.371[ns.]
		L2	2.47±0.559	71.501	L1-L3	t = 2.920; p =0.017[*]
		L3	3.38±0.387	36.200	L2-L3	t = 2.697; p =0.025[*]

L* = brightness; a* = complementary colours coordinate red - green; b*= complementary colours coordinate yellow - blue.
T-test (two-tailed) - for each cut portion and colorimetric parameters analyzed, compared to the experimental batches:
[ns.]insignificant differences (p> 0.05); *Significant differences (p <0.05); **distinct significant differences (p <0.01);
*** Really Significant differences (p <0.001).

After calculating the variation coefficient of the values that describe the brightness of chicken muscles from the three experimental batches we observed a high homogeneity (V% <10%). while numeric variations obtained for a* and b* colorimetric parameters described a very heterogeneous character of the meat samples from the same batch (V% <20%).

The comparative description according to the stunning parameters of the technological regime applied to the analyzed muscle samples revealed the following: mean values for the brightness of the cut anatomical regions varied within ± 0.799 50.02 for the L1 chicken drums and 60.36 ± 1.006 in chickens breast from the L3.

Regarding the complementary colours coordinate red - green (a*), the lower threshold was recorded in the L1 chickens drums (0.77 ± 0.211 units) and in the breasts from the L2 batch (0.77 ± 0.201 units) and

the max (2.54 ± 0.349 units) belonged to the L3 chicken breast. Variations of the redness index within 1.77 units were characterized only by a light colour. Muscle samples from the L3 chickens for all cut regions exhibiting a slight numerical superiority of the colorimetric parameters, under the occurrence of the patchy PSE defect.

The means calculated for the complementary colours coordinate yellow - blue (b*) varied within 1.22 ± 0.305 units and were assigned to the thigh muscle of the chickens from the L3 lot and the 3.40 ± 0.364 units corresponded to the breast muscles of the L2 chickens. As an overview, for the b* coordinate we observed a superiority of the values obtained from muscles taken from carcasses of the L3 chickens compared to those harvested from carcasses of the L1 and L2 chickens lots.

CONCLUSIONS

Comparative description of the experimental batches meat according to the stunning regime parameters revealed the following: average brightness values of fresh cut anatomical regions ranged from 50.02 to 60.36 units. The meat of the L3 chickens lot is characterized by brighter colour compared to the corresponding L1 and L2 homologous batches. This parameter changes in the meat of the L3 batch, being influenced by the voltage applied during stunning. In terms of muscle region it was observed a sharper brightness in the breast meat, followed in descending brightness value in upper thighs and lower thighs.

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