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INFLUENCE OF SLAUGHTERING TECHNOLOGICAL PARAMETERS ON SENSORIAL QUALITY OF REFRIGERATED POULTRY MEAT

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Abstract

A short review of literature on sensorial analysis of avian products demonstrate a great diversity of sensorial procedures, such kind of different approaches impending realisation of comparisons between studies. To optimize technological parameters involved on slaughtering technological flow and to achieve the proposed aims, was elaborated an experimental protocol, designed for optimization of slaughtering technology into a processing unit from perspective of technical parameters applied at stages with impact on resulted carcasses, the effects being examined by sensorial qualitative parameters. For realization of study were formed three experimental batches, slaughtering technological line being the logistic base which allowed modification of technological parameters in stunning, bleeding, scalding and chilling stages. After thermal treatment, aroma intensity for muscular samples at chest level was described by mean values into interval 5.22±0.449 points (L3) and 7.77±0.375 points (L2), metallic aroma being the most pronounced one, given by means between 2.13±0.443 points (L1) and 3.37±0.593 points (L2), followed in a descendant way by the descriptive score for fried aroma. At the opposite pole, descriptive points for rancid aroma were sub-unitary, fact which shows the incipient stage of oxidation reactions for the adherent fat to analyzed muscular tissue.

Key words: *slaughtering, technological, sensorial, poultry.*

INTRODUCTION

Sensorial analysis is the science which uses human perceptions to realize a characterization of a product in an objective and reproducible way. Measuring instruments are represented by humans, an essential role in analysis being given to description into an exhaustive and detailed way of the utilized methodology for reducing the intrinsic error, which is commonly presented in such kind of measurement (Perlo et al., 2006).

In poultry meat case, to obtain real sensorial descriptors is important to realize the tasting of samples gathered from birds differentially from musculature point of view, parameters which are different applied in processing stages and storage method because lipids’ oxidation was associated with unfavourable modifications for aspect, aroma and texture (Jensen et al., 1998).

A short review of literature on sensorial analysis of avian products demonstrate a great diversity of sensorial procedures, such kind of different approaches impending realisation of comparisons between studies (Vermein et al., 2006; Chartrin et al., 2006; Kennedy et al., 2005; Rababah et al., 2005; Liu et al., 2004).

In refrigerate state, poultry meat present an own taste, thermal processing conferring to meat samples a taste specific to recipe (Northcutt et al., 2001). Literature describes refrigeration influence on poultry meat taste (Mielnik et al., 1999), loosening of aromatic compounds taking place, mainly, during chilling by immersion (Barham, 2001; Lawless and Heymann, 2010). The research aimed to evaluate the qualitative parameters for broiler chicken meat from sensorial perspective, determining being the implied factors in slaughtering process from stunning, bleeding, scalding and chilling carcasses stages.

MATERIALS AND METHODS

Research was focused on a single anatomic region, respectively chest, being realised three experimental batches, and in which were modified the parameters of slaughtering process, as follows: For experimental batch L1, technical parameters for each slaughtering process stage were: Stunning – was realised at 70 V power voltage, 180 mA intensity and 360 Hz frequency. Conveyer's speed was de 0.16 m/s, and time covered in stunning bath was 22 s/bird.

Bleeding – necessary time for bleeding was 185 s, at a conveyers' speed of 0.16 m/s.

Scalding–water temperature in scalding device was 52^{o}C, for a period of 180 s. Conveyer's speed at scalding were 0.16 m/s.

Chilling of carcasses– air temperature in refrigeration tunnel was 2–4^{o}C, with a 3.5 m/s flow speed of air currents. Also, chilling water temperature had values between 3 and 5^{o}C. Initial temperature of carcasses, at entrance in chilling tunnel, was 35–39^{o}C, and after 105 minutes to reach values of 3–4^{o}C.

In case of experimental batch L2, current voltage in stunning basins was 85 V, at an intensity of 160 mA and a frequency of 380 Hz. Conveyer's speed at stunning was 0.24 m/s, and transition time through stunning bath was 15 s/bird.

The bleeding period of carcasses was 130 seconds at a conveyer' speed of 0.24m/s.

Water temperature in basins for realisation of scalding stage was 54^{o}C for 120 s, at a conveyer's speed 0.24 m/s.

Chilling of carcasses was realised both in cold air flow, at a temperature of 0–3^{o}C and a 3.5 m/s speed for air currents, as well as by pulverization with water at a temperature of 2–4^{o}C. Time duration for chilling of carcasses from 35–39^{o}C to 2–4^{o}C was of 105 minutes.

Regarding experimental batch L3, stunning was realised by immersion in basins with water and the current voltage was 100 V, at an intensity of 150 mA and a frequency of 400 Hz. Conveyer's speed at stunning was 0.28 m/s, and transition time through stunning bath was 13 s/bird.

Bleeding stage was realised on duration of 112 seconds, and at conveyer's speed of 0.28 m/s.

Carcasses'scalding were realised in water at a temperature of 58^{o}C, by immersion of carcasses in basins for 100 seconds, conveyer's speed being 0.28m/s. Air temperature in refrigeration tunnel was 0–2^{o}C, air currents speed was 2.5m/s, carcasses being pulverized with water at the temperature of 1–3^{o}C. Initial carcasses temperature was 35–39^{o}C, and after 90 minutes reached values between 1 and 2^{o}C.

Each experimental batch was constituted by 25 ROSS 308 chicken broiler individuals, aged 42 days. The utilised methodology in sampling was based on own experience corroborated with methodologies mentioned in other studies, sensorial evaluation taking place on chest samples, gathered at 24 h after slaughtering (Sebranek et al., 1979; Civille and Lyon, 1996). Portioning of meat samples and further technical processing of them into a preheated oven at 120°C for 20 minutes aimed to reach a frying temperature of 75°C in centre of each sample, monitoring being realised with K type thermocouple, at taking out from oven, samples were identified, coded and warm served to tasters in ceramic bowls utilised also during thermal treatment.

To balance the samples' presentation order was utilised the model described by McFie et al., 1989. Establishing the score for analysed characteristics, tasters used a cube from analysed sample for descriptive parameters of aroma and a cube for the texture ones, analysis of sensorial perception being realised in controlled light conditions.

Working methodology imposed rinsing of oral cavity with sparkling water before beginning of sensorial analysis and between samples' tasting. After a preliminary selection and validation phase (method adapted after Meilgaard et al., 1991) were chosen 17 parameters for aspect, aroma and texture characteristics.

Sensorial evaluation took place into a sensorial tasting chamber, equipped with devices for a constant maintaining of air pressure, individual boxes and lights designed to mask the obvious colour differences (ISO, 1988), excluding visual evaluation. The analyses were effectuated in Sensorial Analysis Laboratory UNI-ISN 8589 belonging to Department of Agricultural Sciences and Environment from University of Udine – Italy, for argumentation of sensorial profile being involved 8 qualified tasters. Each of them tasted 3 samples in 5 sessions (repetitions), and their answers being related to a linear scale with 10 points (Ruiz et al., 2001).

Significance of differences between the established means for the samples gathered from those three batches (L1, L2, L3) was calculated with statistic programme IBM SPSS 20.0 using T test with two variables (**T-Test** (2-tailed)).

RESULTS AND DISCUSSIONS

On a 10 points scale, aspect of meat samples gathered at the level of pectoral musculature from slaughtered chickens' carcasses was described by means situated in interval 1.29±0.301 points (L3) and 2.72±0.428 points (L2). Mean uniformity of colour for analysed samples was characterized by an interval between 7.26±0.457 (L3) – 9.46±0.299 points (L1).

In case of colour aspect, the results of hedonic analysis show a certain uniformity between batches, while colour uniformity enlightened a visual declassification of chest from batch L3 by a difference greater than 2 points between batches L3 and L1, respectively L3 and L2 (Table 1).

Table 1. Sensory descriptive parameters for poultry meat colour (chest muscles) subjected to chilling, depending on technological slaughter regime

Specification		Exp. batch	n	$\overline{X} \pm s_{\overline{x}}$	V%	Min. – Max.	Interpretation of differences T-Test (2-tailed)	
COLOUR	Aspect of colour	L1	25	**1.56**±0.227	56.240	0.40 – 3.70	**L1-L2**	t = -2.211; p = 0.044*
		L2	25	**2.72**±0.428	61.009	0.40 – 5.80	**L1-L3**	t =0.683; p = 0.506$^{ns.}$
		L3	25	**1.29**±0.301	90.724	0.20 – 4.70	**L2-L3**	t = 3.287; p = 0.005**
	Uniformity of colour	L1	25	**9.46**±0.299	12.258	5.40 – 10.00	**L1-L2**	t = 0.397; p = 0.697$^{ns.}$
		L2	25	**9.31**±0.223	9.280	6.70 – 10.00	**L1-L3**	t = 3.709; p = 0.002**
		L3	25	**7.26**±0.457	24.379	3.40 – 9.60	**L2-L3**	t = 3.602; p = 0.003**

T- test (2-tailed)– for each analysed character, comparative on experimental batches:
$^{ns.}$insignificant differences (p>0.05); *significant differences (p<0.05);**distinct significant differences (p<0.01).

At the end of thermal treatment, intensity of aroma for chest muscular samples was described by means into interval 5.22±0.449 points (L3) and 7.77±0.375 points (L2), metallic aroma being the most pronounced one, having means between 2.13±0.443 points (L1) and 3.37±0.593 points (L2), followed in a descendant way by the descriptive score for fried aroma. Opposite, the descriptive points for rancid aroma were much sub-unitary, fact which shows the incipient stage of oxidation reactions for the adherent fat to analyzed muscular tissue.

The obtained results for sensorial analysis of aromatic profile of pectoral musculature gathered from the carcasses of chickens which were subjected to slaughtering enlightened the aromatic superiority of samples from batch L2 due to maximal means for aroma intensity, fried aroma and peanuts aroma, corroborated with sub-unitary values for rancid aroma, followed in descendant way by musculature samples from batch L1 and L3 (Table 2).

Table 2. Sensory descriptive parameters for poultry meat flavour (chest muscles) subjected to chilling, depending on technological slaughter regime

Specification		Exp. batch	n	$\overline{X} \pm s_{\overline{x}}$	V%	Min. – Max.	Interpretation of differences T-Test (2-tailed)	
AROMA	Intensity of aroma	L1	25	**6.15**±0.426	26.801	3.20 – 8.70	**L1-L2**	t = -3.428; p = 0.004**
		L2	25	**7.77**±0.375	18.688	5.10 – 9.60	**L1-L3**	t = 1.472; p = 0.163$^{ns.}$
		L3	25	**5.22**±0.449	33.317	2.30 – 7.50	**L2-L3**	t = 4.335; p = 0.001**
	Fried aroma	L1	25	**1.49**±0.238	61.710	0.30 – 3.24	**L1-L2**	t = -2.083; p = 0.056$^{ns.}$
		L2	25	**2.63**±0.405	59.538	0.30 – 6.20	**L1-L3**	t = -1.468; p = 0.164$^{ns.}$
		L3	25	**2.16**±0.334	59.939	0.20 – 4.30	**L2-L3**	t = 1.424; p = 0.176$^{ns.}$
	Peanuts aroma	L1	25	**0.85**±0.278	126.379	0.00 – 4.30	**L1-L2**	t = -1.858; p = 0.084$^{ns.}$
		L2	25	**1.32**±0.346	101.630	0.00 – 4.80	**L1-L3**	t = 1.152; p = 0.269$^{ns.}$
		L3	25	**0.56**±0.242	167.352	0.00 – 3.50	**L2-L3**	t = 3.302; p = 0.005**
	Rancid aroma	L1	25	**0.11**±0.031	108.311	0.00 – 0.40	**L1-L2**	t = 1.821; p = 0.090$^{ns.}$
		L2	25	**0.05**±0.027	198.769	0.00 – 0.30	**L1-L3**	t = 3.233; p = 0.006**
		L3	25	**0.03**±0.021	238.298	0.00 – 0.30	**L2-L3**	t = 1.193; p = 0.253$^{ns.}$

Metallic / blood aroma	**L1**	25	**2.13**±0.443	80.669	0.40 – 5.80	**L1-L2**	t = -2.028; p = 0.062$^{ns.}$
	L2	25	**3.37**±0.593	68.240	0.60 – 7.50	**L1-L3**	t = -0.983; p = 0.342$^{ns.}$
	L3	25	**2.95**±0.569	74.747	0.00 – 6.80	**L2-L3**	t = 0.671; p = 0.513$^{ns.}$

T- test (2-tailed)– for each analysed character, comparative on experimental batches:
$^{ns.}$insignificant differences (p>0.05); * significant differences (p<0.05);** distinct significant differences (p<0.01).

After thermal treatment, pectoral musculature from chickens' carcasses of experimental batches was described by a relatively intense sweetish taste, evaluated by means which are into interval 4.93±0.404 (L1) – 5.63±0.485 points (L3) on a 10 points scale. Umami sensation, described by means in interval 1.75±0.283 (L3) – 2.96±0.578 points (L2) is a clue for proteins' presence, this basic taste being especially conferred by monosodium glutamate and ribonucleotides. The results of evaluation show a ranking for batches, sweet taste corroborated with umami one, non-bitter and salty environment placing in favourable zone the muscular samples of chickens' carcase from batch L2, on the second place being chicken meat samples from batch L1, followed by the ones belonging to batch L3 (Table 3).

Table 3.Sensory descriptive parameters for poultry meat taste (chest muscles) subjected to chilling, depending on technological slaughter regime

	Specification	Exp. batch	n	$\bar{X} \pm s_{\bar{x}}$	V%	Min. – Max.	Interpretation of differences **T-Test** (2-tailed)	
TASTE	**Sweet taste**	**L1**	25	**4.93**±0.404	31.733	2.50 – 7.20	**L1-L2**	t = -0.726; p = 0.480$^{ns.}$
		L2	25	**5.37**±0.520	37.482	3.10 – 8.90	**L1-L3**	t = -1.064; p = 0.305$^{ns.}$
		L3	25	**5.63**±0.485	33.370	2.90 – 8.50	**L2-L3**	t = -0.324; p = 0.751$^{ns.}$
	Umami taste	**L1**	25	**2.01**±0.434	83.405	0.00 – 7.10	**L1-L2**	t = -1.686; p = 0.114$^{ns.}$
		L2	25	**2.96**±0.578	75.649	0.00 – 9.20	**L1-L3**	t = 0.632; p = 0.538$^{ns.}$
		L3	25	**1.75**±0.283	62.649	0.00 – 4.20	**L2-L3**	t = 2.218; p = 0.044*
	Salty taste	**L1**	25	**0.52**±0.109	81.352	0.00 – 1.20	**L1-L2**	t = 0.980; p = 0.344$^{ns.}$
		L2	25	**0.41**±0.053	50.190	0.12 – 0.73	**L1-L3**	t = 0.414; p = 0.685$^{ns.}$
		L3	25	**0.43**±0.163	148.103	0.00 – 2.10	**L2-L3**	t = -0.097; p = 0.924$^{ns.}$
	Acid taste	**L1**	25	**0.68**±0.239	136.399	0.10 – 3.60	**L1-L2**	t = -0.159; p = 0.876$^{ns.}$
		L2	25	**0.72**±0.172	92.754	0.00 – 2.00	**L1-L3**	t = -1.117; p = 0.283$^{ns.}$
		L3	25	**1.05**±0.130	47.765	0.11 – 2.09	**L2-L3**	t = -1.653; p = 0.121$^{ns.}$
	Bitter taste	**L1**	25	**0.03**±0.015	170.610	0.00 – 0.20	**L1-L2**	t = 1.505; p = 0.154$^{ns.}$
		L2	25	**0.01**±0.009	263.899	0.00 – 0.10	**L1-L3**	t = -2.199; p = 0.045*
		L3	25	**0.08**±0.014	70.567	0.00 – 0.21	**L2-L3**	t = -4.149; p = 0.001**

T- test (2-tailed)– for each analysed character, comparative on experimental batches:
$^{ns.}$insignificant differences (p>0.05); *significant differences (p<0.05);**distinct significant differences(p<0.01).

Muscular samples gathered from chicken carcasses belonging to batch L2 obtained the most favourable mean scores, meat being described by an intermediary granulosity, fibrosity, succulence and unctuosity and a minimal adhesiveness. Second place was occupied by texture of muscular samples from carcasses of batch L1, followed by the ones obtained for batch L3, which even if presented means in the inferior zone for granulosity and fibrosity, minimal succulence and maximal adhesiveness countered and cancelled their positivity (Table 4).

Table 4. Sensory descriptive parameters for chilled poultry meat texture, depending on technological slaughter regime (L1, L2, L3 experimental batches)

	Specification	Exp. batch	n	$\bar{X} \pm s_{\bar{x}}$	V%	Min. – Max.	Interpretation of differences T-Test (2-tailed)	
	0	1	2	3	4	5	6	7
TEXTURE	Granulosity	**L1**	25	**5.89**±0.487	32.007	2.30 – 8.60	**L1-L2**	t = 1.904; p = 0.078$^{ns.}$
		L2	25	**4.65**±0.542	45.193	1.40 – 8.20	**L1-L3**	t = 3.156; p = 0.007**
		L3	25	**3.47**±0.417	46.573	0.80 – 6.30	**L2-L3**	t = 1.942; p = 0.073$^{ns.}$
	Adhesiveness	**L1**	25	**1.46**±0.302	80.077	0.20 – 4.20	**L1-L2**	t = 1.926; p = 0.075$^{ns.}$
		L2	25	**0.85**±0.298	136.348	0.00 – 3.10	**L1-L3**	t = -0.719; p = 0.484$^{ns.}$
		L3	25	**1.84**±0.349	73.470	0.40 – 4.80	**L2-L3**	t = -2.245; p = 0.041*
	0	1	2	3	4	5	6	7
TEXTURE	Succulence	**L1**	25	**2.44**±0.364	57.737	0.20 – 5.10	**L1-L2**	t = 1.882; p = 0.081$^{ns.}$
		L2	25	**1.79**±0.332	71.953	0.40 – 4.00	**L1-L3**	t = 1.743; p = 0.103$^{ns.}$
		L3	25	**1.56**±0.363	90.254	0.10 – 5.20	**L2-L3**	t =0.452; p = 0.658$^{ns.}$
	Fibrosity	**L1**	25	**6.15**±0.475	29.941	3.40 – 8.90	**L1-L2**	t = 1.249; p = 0.232$^{ns.}$
		L2	25	**5.48**±0.558	39.466	2.20 – 8.70	**L1-L3**	t = 2.244; p = 0.041*
		L3	25	**4.73**±0.526	43.083	2.20 – 8.20	**L2-L3**	t = 1.054; p = 0.310$^{ns.}$
	Unctuosity	**L1**	25	**0.09**±0.041	175.933	0.00 – 0.60	**L1-L2**	t = -0.482; p = 0.638$^{ns.}$
		L2	25	**0.12**±0.064	203.466	0.00 – 1.00	**L1-L3**	t = -1.278; p = 0.222$^{ns.}$
		L3	25	**0.19**±0.058	121.986	0.00 – 0.90	**L2-L3**	t = -0.768; p =0.455$^{ns.}$

T- test (2-tailed)– for each analysed character, comparative on experimental batches:
$^{ns.}$insignificant differences (p>0.05); *significant differences (p<0.05);**distinct significant differences(p<0.01).

CONCLUSIONS

The research results represent comparison data regarding quality parameters for poultry meat which is commercialized in East area of Romania with the ones presented in literature and are exact data which could be utilised by units' management to adopt some changes regarding productive and qualitative efficiency. Aiming the general view of analysed sensorial characters we could appreciate the qualitative superiority of pectoral musculature from chickens' carcasses belonging to experimental L2 due to favourable scores for colour and uniformity, corroborated with aroma intensity, the fried and peanuts one, completed by sweet and savoury taste, umami, almost imperceptibly salty, acid and bitter and by intermediary textural parameters. Second place was occupied by meat samples from chicken carcasses belonging to L1, followed by the ones from batch L3.

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