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RESEARCH ON THE QUALITY OF PHYSICAL INDICATORS OF THE TURKEY MEAT OBTAINED FROM THE BIG BUT 6 HYBRID SLAUGHTERED AT DIFFERENT AGE

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Abstract

In the present paper we set out to carry out a study on the quality of the physical indices of the turkey meat, derived from the Big BUT 6 hybrid slaughtered at 16 weeks of age (group L1) and at 18 weeks (group L2) through the following indices: acidity (pH value) achieved 20 minutes after slaughter, 24 hours and 72 hours, colorimetric parameters of the meat, milling (through Warner Bratzler shear forces) and texture, which was achieved by using objective methods such as Texture Profile Analysis (TPA). Regarding the acidity achieved for the four anatomical regions (chest, upper pulp, lower pulp and wings), no statistical differences were observed following the analysis of the data. Regarding the coordinate of the complementary colors red-green (a) the minimums registered were specific to the pectoral muscles, for both L1 (-0.38 ± 0.09) and for L2 (-0.25 ± 0.12), the calculated maxima being responsible for the upper pulp musculature in both experimental groups (5.10 ± 0.15 ÷ 5.52 ± 0.12). The comparative analysis of the average forces for each muscle group observed the superiority of the fragility of the muscle samples collected from the level of the pectoral muscles and the wings.*

Key words: *meat, quality, turkey.*

INTRODUCTION

Obtaining safe and high quality food is a major condition for ensuring public health and commercial success domestically and internationally. The need to identify the origin of ingredients used in the food industry. As well as knowledge of the origins of food is a supreme factor in terms of consumer protection. especially when products are unsafe (Saeger, 2011).

If until recently the poultry industry was under the monopoly of chicken broiler, lately, turkey meat is gaining more and more ground among consumers not only because it is tasty, but also because it has nutritional and sensory properties that makes it an almost ideal product.

The XX century, especially the second half, saw a real growth in the turkey and turkey production industry (Buddiger and Albers, 2009). Until World War II, turkeys were more traditionally raised, with seasonal breeding and natural as well as artificial incubation. After 1945, the turkey industry developed very productively, along with shelters and production per year of slaughter (EFSA, 2004).

The increase in production volume as well as the efficiency of turkeys have contributed to the continuous development of turkey hybrids (Yilmaz et al., 2011). At the same time, an intense development that took place in the breeding area, focused on the reproduction of turkeys with wide chest, with hypertrophy of the chest and leg muscles (EFSA, 2004).

The world market for turkey hybrid producers is under the monopoly of three large British United Turkeys (BUT) companies. Hybrid Turkeys and Nicholas Turkey, each with its own hybrids that have performed differently and achieved different goals.

The choice of the appropriate hybrid by producers is based on the purpose of marketing and the potential of genetic properties to adapt to a type of feed, to have greater resistance to some common diseases and the availability of a

wide range of breeding practices (Roberson et al., 2004).

Obtaining safe and high quality food is a major condition for ensuring public health and commercial success domestically and internationally. The need to identify the origin of ingredients used in the food industry, food as well as knowledge of the origins of food is a supreme factor in terms of consumer protection, especially when products are unsafe (Abeyesinghe et al., 2007).

For these reasons, through this paper we aimed to realize a study on the quality of the physical indices of the turkey path, derived from the hybrid Big BUT 6 slaughtered at the age of 16 weeks (batch L1) and at 18 weeks, (batch L2) in terms of the following indices: acidity (pH value) achieved 20 minutes after slaughter, 24 hours and 72 hours, colorimetric parameters of the meat. Tenderness (via Warner Bratzler shear forces) and texture, which was achieved by using objective methods such as Texture Profile Analysis (TPA).

MATERIALS AND METHODS

As a biological material, the turkey hybrid Big BUT 6 purchased from the supplier Aviagen Turkeys who is developing a genetic selection program, bringing continuous improvements in the development of body weight and health of birds.

The turkey hybrid Big BUT 6 is a massive, fast-growing breed, being mainly used for intensive production. According to the growth guide at the age of 18 weeks, females (Figure 1) belonging to this hybrid reach an average body weight of 12 kg, and males (Figure 2) at the age of 22 weeks reach 22 kg.

Figure 1. Big BUT 6 broiler female

Figure 2. Big BUT 6 broiler female and male

Sampling and preparation of samples

In order to evaluate the quality of the turkey meat through the traceability analysis, it was necessary to harvest the tissue corresponding to the subsequent analyzes. By observing the experimental protocol that requires monitoring the technological conditions of growth, slaughtering operations, as well as the characterization of meat from a physical-chemical, microbiological and sensory point of view, the collection and sampling of samples required the use of muscle tissue, cecum and neck (Figure 3) from the turkeys previously identified and eared.

Figure 3. Gathering of muscular samples from turkey hens carcasses

The results of laboratory tests may be influenced by the correct application of the sampling and preparation procedure.

Working methods used to determine the physical properties of meat

Determination of meat acidity. The measurement of the pH value was carried out in two stages, as follows: 20 minutes after slaughter, using a deep electrode probe, inserted into the housing in the analyzed areas and 24, 72 hours after slaughter, using the glass electrode by immersion. To perform the examinations, the aqueous extract of 10 g of previously minced meat and 100 ml of distilled water is initially prepared. The mixture was allowed to stand for

15-20 minutes during which time it was stirred several times. After this interval the extract was filtered and further examined.

The working method used to determine the color of the meat. Regarding the color of the meat, it was expressed by the coordinates L*, a*, b* in the colorimetric space CIE Lab (AMSA), being corrected by the equation DIN 99, measured by means of the included spectral component (SCI).

The operating principle of the spectrophotometer applies the specifications given in "CIE Colorimetry Second Edition. Publication 15.2 (1986)". From a conceptual point of view, the color of each sample is represented graphically by the point P in Figure 4, with the following significance of the chromatic parameters:

- the brightness (L*) of the color or the psychometric clarity is the color parameter determined by the intensity of the light waves that define it, this being represented by the vertical axis of Figure 4. More light, means light waves of higher intensity, which determines more colors, intense or brighter, the brightness being able to have values between 0 for an opaque black sample and 100 for transparent colorless samples;

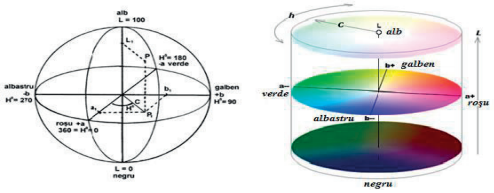

Figure 4. The CIE Lab linear colour space / the colour solid (Source: CIE, 1986)

- the parameter "a*" expresses the color values on the red-green chromatic axis, through which the color stability in time is rendered;
- the parameter "b*" expresses the color values on the yellow-blue color axis;
- hue is the parameter determined by the dominant wavelength in the set of wavelengths that form that color, being defined by the gradation of a color within the visible spectrum. The tint of the color "ho" corresponds to the angle. expressed in sexagesimal degrees. formed by the segment OP_1 and the coordinate "a*", The value of this parameter, theoretically, can vary between 0° and 360°, but for achromatic stimuli it remains undefined. The correlation between the values of the "ho" parameter and the visually perceived colors. inscribed in the $_{a1}Ob_1$ plane of Figure 4 are self-evident: red ÷ 0°. yellow ÷ 90°, green ÷ 180°;

Saturation is the color parameter determined by the color purity, ie by the wavelengths that are combined with the dominant wavelength that defines the color shade, the mathematical definition of chrome and color shade of the analyzed muscle samples being calculated according to the relations:

Color saturation: $\mathbf{C = (a^2 + b^2)^{1/2}}$

The hue (tint) of color: $\mathbf{H= arctg\ (b/a)}$

The appreciation of the color of the meat was made on muscle samples, with a thickness of 1.5-5 cm, these being sectioned perpendicular to the longitudinal axis of the muscles; subsequently, the muscle samples were vacuum packed under polyethylene film and stored by refrigeration at 2-4°C until colorimetric measurements were performed (method adapted from Honikel, 1998; Stevenson et al., 1989). As a method, the actual measurement was performed in three different areas of each muscle sample, at a temperature of 8÷10°C, with the portable spectrophotometer Minolta CM-2600d (Figure 5), being set to view at the standard angle of 10° with a illuminating beam D 65 in the color space CIE Lab.

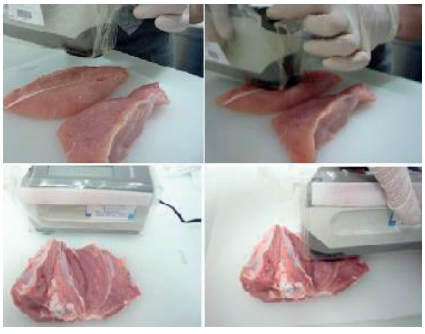

Figure 5. Measurement of muscular samples colour

The working method used to determine the tenderness of the meat by means of Warner Bratzler forces. In order to make this determination, the meat samples were subjected to a heat treatment of boiling on a bain marie for 45 min, at 75°C (in polyethylene bags), then wrapped in aluminium foil, stored for 24 hours at 4°C and sectioned in a cylindrical shape (3

cylinders with a diameter of 1.5 cm and a length of 2 cm) in the direction of the muscle fibers.
The use of a specific blade (60º angle, travel speed 100 mm/min, shear force 1000 N) attached to the TA Plus Lloyd Instruments texturometer aims to determine the forces. The cylindrical muscle samples were sectioned perpendicular to the muscle fibers, the maximum force required to section the sample being the indicator used to describe the tenderness of the meat.
To determine the forces, the device is provided with a rigid flat surface, rectangular in shape, sectioned in the middle and 3 blades in different shapes: one blade in the shape of a square and two in the shape of a "V".
The NEXYGEN Ondio software integrated in the TaPlus Series texturometer allowed the direct calculation of the shear force values according to the cutting-deformation curve, these being expressed in the form of peaks, corresponding to the maximum value recorded (Honikel, 1998). At the same time, the system ensures the operation of the texturometer according to the requirements stated by BS EN ISO 7500: 1999 (Figure 6).

Figure 6. Determination of meat tenderness using Warner Bratzler forces

Working method used to determine meat texture (TPA). In order to analyze the texture of the samples collected from experimental groups L1 and L2, it was necessary to use the Lloyd LFP Plus universal texturometer in order to apply the compressive force on the muscle samples in the form of a cylinder and obtain a final deformation from the initial sample height. This was done with a flat-faced cylinder of Ø = 45 mm which obtained an alternative movement, which mimics the action of the human jaw.
To achieve the texture profile, the meat samples of the experimental batches were previously subjected to a heat treatment of boiling on bain marie. The sectioning of meat samples in cylindrical form with Ø and H of 20 mm was performed at room temperature by pressing the samples with a cylinder, parallel to the direction of the muscle fibers (Figure 7).
In performing the mechanical determination, the Llyod LFP plus dynamometer was used, the meat samples being in the form of cylinders with Ø and H of 20 mm, obtaining the results involving the use of a pressing cylinder with flat faces, with Ø = 45mm. The actual determination involved performing a double compression, with an intermediate pause between compressions of 5 sec. At a speed of 10 mm/min., and a final deformation of 80% of the initial height of the tested meat sample.

Figure 7. Determination of meat texture (TPA)

The analysis of the force-time curve of the TPA instrumental method led to the obtaining of five instrumental parameters (hardness, cohesiveness, gumminess, elasticity and masticability) illustrating a sample of the force-deformation curve and the TPA parameters.
The expression of the results was performed with the help of NEXYGEN Ondio software, integrated in the texturometer, which allowed the recording and direct calculation of the values of each descriptive textural parameter.

RESULTS AND DISCUSSIONS

In the post-slaughter period associated with the prerigor mortis phase, at 20 minutes after slaughter the meat harvested from turkey hybrids from the experimental group L1 recorded average values between 6.23 ± 0.02 (chest) and 6.38 ± 0.02 (lower leg), and for the muscle tissue harvested from turkeys in L2, the representative average values were 6.24 ± 0.01 (chest) and 6.39 ± 0.02 (lower leg). The mean differences obtained for the anatomical portions of the two groups are characterized by the proportion of short-lived white muscle fibers (fast contractions) and reds resistant to prolonged exertion (slow contractions), thus influencing the amount of glycogen and muscle ATP regeneration. In the pectoral muscles the

majority proportion is held by the white fibers, compared to those of the thighs where the red fibers predominate.

By calculating the coefficient of variation, values were obtained below the threshold of 5% (1.01 ÷ 1.47%) corresponding to group L1 and (0.83 ÷ 1.48) L2, which highlights a very good homogeneity of character for all muscle samples during the prerigor mortis phase (Table 1).

At the beginning of the maturation phase, samples collected from muscle tissues representative of turkey and turkey carcasses showed an average pH value between 5.87 ± 0.01 (chest) and 6.08 ± 0.01 (lower leg), recorded on L1 housings. At this time of the biochemical transformations in the meat, the average acidity of the samples taken from the carcases of batch L2 was characterized by the range 5.91 ± 0.01 (chest) ÷ 6.09 ± 0.01(lower leg), the homogeneity being defined by the values of the coefficient of variation below the threshold of 5% (Table 1).

After keeping the muscle samples representative of the two groups for 3 days in refrigeration conditions, average values of acidity were recorded, the minimums obtained were corresponding to the chest muscles of L1 and L2 (6.01 ± 0.01 ÷ 5.99 ± 0.01), and the maximums characteristic of the lower thigh muscles harvested from both groups (6.24 ± 0.01 ÷ 6.25 ± 0.01).

Compared to the literature, the pH values obtained were positively influenced by the stunning of turkeys with CO_2, the birds not being exposed to stress with undesirable effects due to the handling procedure in order to position them on the conveyor line (Bianchi et al., 2006).

Table 1. Estimators and statistical significance of values differences for turkey hen meat acidity

Specification	Time	Analysed bached	n	Calculated statistical indicators				Significance of differences between batch averages (FISHER test)
				$\bar{X} \pm s_{\bar{x}}$	V%	Min.	Max.	
Chest	20 min.	L_1	15	6.23±0.02	1.01	6.12	6.32	$\hat{F}_{0.22} < F_{0.05\%}(4.20)$ → n. s.
		L_2		6.24±0.01	0.83	6.15	6.32	
	24 h	L_1		5.87±0.01	0.48	5.81	5.91	$\hat{F}_{5.92} > F_{0.05\%}(4.20)$ →*
		L_2		5.91±0.01	0.71	5.84	5.98	
	72 h	L_1		6.01±0.01	0.47	5.96	6.06	$\hat{F}_{4.2} < F_{0.05\%}(4.20)$ → n. s.
		L_2		5.99±0.01	0.5	5.94	6.03	
Upper thigh	20 min.	L_1	15	6.35±0.02	1.16	6.23	6.44	$\hat{F}_{0.38} < F_{0.05\%}(4.20)$ → n. s.
		L_2		6.36±0.02	1.31	6.18	6.49	
	24 h	L_1		6.06±0.01	0.37	6.03	6.1	$\hat{F}_{2.58} < F_{0.05\%}(4.20)$ → n. s.
		L_2		6.08±0.01	0.29	6.05	6.11	
	72 h	L_1		6.23±0.01	0.36	6.19	6.26	$\hat{F}_{0.82} < F_{0.05\%}(4.20)$ → n. s.
		L_2		6.22±0.01	0.26	6.2	6.25	
Lower thigh	20 min.	L_1	15	6.38±0.02	1.47	6.23	6.49	$\hat{F}_{0.12} < F_{0.05\%}(4.20)$ → n. s.
		L_2		6.39±0.02	1.48	6.18	6.51	
	24 h	L_1		6.08±0.01	0.32	6.05	6.12	$\hat{F}_{1.46} < F_{0.05\%}(4.20)$ → n. s.
		L_2		6.09±0.01	0.37	6.06	6.13	
	72 h	L_1		6.24±0.01	0.34	6.2	6.27	$\hat{F}_{1.14} < F_{0.05\%}(4.20)$ → n. s.
		L_2		6.25±0.01	0.31	6.22	6.29	
Wings	20 min.	L_1	15	6.28±0.02	1.05	6.12	6.42	$\hat{F}_{0.26} < F_{0.05\%}(4.20)$ → n. s.
		L_2		6.29±0.02	1.01	6.19	6.37	
	24 h	L_1		6.01±0.01	0.56	5.94	5.97	$\hat{F}_{0.91} < F_{0.05\%}(4.20)$ → n. s.
		L_2		6.02±0.01	0.44	5.97	6.05	
	72 h	L_1		6.10±0.01	0.33	6.07	6.14	$\hat{F}_{5.17} < F_{0.05\%}(4.20)$ → n. s.
		L_2		6.11±0.01	0.31	6.08	6.14	

The statistical significance of the differences between the experimental groups L1 and L2 for the specific acidity values during the prerigor mortis and maturation phases corresponding to each muscle group studied showed significant differences for one test (8.33%) of the total of the 12 tests and 91% presenting insignificant differences (Table 1).

The color of turkey meat

The characterization of turkey meat according to age for the muscle samples studied showed average values corresponding to the brightness

of the L1 group, in a range of 44.74 ± 0.72 (upper leg) and 48.44 ± 0.36 (wing) and 44.04 ± 0.3 (lower leg) ÷ 48.35 ± 0.33 (wing) representative of group L2. Between the groups, the wing muscles in the second group were distinguished by the superiority of the brightness compared to the counterparts of the muscles representative of the first group. By calculating the coefficient of variation of the values that describe the brightness of the 4 muscles studied (chest, upper leg, lower leg, wings) specific to each group, the average homogeneity of the character was noted 2.53-6.22 for L1 and 2.63-3.01 specific to lot L2 (Table 2)

Table 2. Estimators for colorimetric parameter values and statistical significance of turkey hen meat

Specification		Analysed bached	n	Calculated statistical indicators				Significance of differences between batch averages (FISHER test)
				$\bar{X} \pm s_{\bar{x}}$	V%	Min.	Max.	
Chest	L*	L_1	15	46.92±0.31	2.53	45.03	49.23	$\hat{F}_{1.41} < F_{0.05\%}(4.20) \rightarrow$ n. s.
		L_2		47.49±0.37	3.01	45.03	50.08	
	a*	L_1		-0.38±0.09	91.74	-0.89	0.15	$\hat{F}_{0.74} < F_{0.05\%}(4.20) \rightarrow$ n. s.
		L_2		-0.25±0.12	191.23	-1.02	0.73	
	b*	L_1		7.60±0.29	14.76	5.39	9.12	$\hat{F}_{1.38} < F_{0.05\%}(4.20) \rightarrow$ n. s.
		L_2		8.06±0.26	12.61	5.32	9.31	
	C	L_1		7.34±0.26	13.51	5.57	9.15	$\hat{F}_{1.45} < F_{0.05\%}(4.20) \rightarrow$ n. s.
		L_2		7.83±0.31	15.35	5.52	9.34	
	h°	L_1		88.37±2.12	9.27	71.21	100.3	$\hat{F}_{0.67} < F_{0.05\%}(4.20) \rightarrow$ n. s.
		L_2		90.49±1.50	6.41	81.25	101.7	
Upper thigh	L*	L_1	15	44.74±0.72	6.22	40.21	48.46	$\hat{F}_{5.09} > F_{0.05\%}(4.20) \rightarrow *$
		L_2		46.55±0.35	2.91	44.24	48.67	
	a*	L_1		5.10±0.15	11.09	4.36	6.49	$\hat{F}_{5.09} > F_{0.05\%}(4.20) \rightarrow *$
		L_2		5.52±0.12	8.10	4.91	6.58	
	b*	L_1		10.77±0.43	15.49	8.33	14.02	$\hat{F}_{1.11} < F_{0.05\%}(4.20) \rightarrow$ n. s.
		L_2		11.31±0.28	9.52	8.23	12.93	
	C	L_1		12.29±0.48	14.98	8.41	14.85	$\hat{F}_{0.054} < F_{0.05\%}(4.20) \rightarrow$ n. s.
		L_2		12.43±0.42	13.06	8.47	14.82	
	h°	L_1		67.94±1.9	10.82	60.02	78.91	$\hat{F}_{5.64} > F_{0.05\%}(4.20) \rightarrow *$
		L_2		70.00±1.72	9.50	54.01	69.09	
Lower thigh	L*	L_1	15	45.40±0.52	4.46	42.95	51.52	$\hat{F}_{5.06} > F_{0.05\%}(4.20) \rightarrow *$
		L_2		44.04±0.3	2.66	42.31	46.95	
	a*	L_1		4.04±0.51	48.60	1.29	7.32	$\hat{F}_{0.002} < F_{0.05\%}(4.20) \rightarrow$ n. s.
		L_2		4.06±0.44	41.74	1.55	7.29	
	b*	L_1		12.23±0.48	15.17	9.73	15.64	$\hat{F}_{0.181} < F_{0.05\%}(4.20) \rightarrow$ n. s.
		L_2		11.98±0.34	10.99	9.56	14.64	
	C	L_1		12.07±0.67	21.62	9.33	17.22	$\hat{F}_{2.88} < F_{0.05\%}(4.20) \rightarrow$ n. s.
		L_2		13.54±0.54	15.37	9.72	17.20	
	h°	L_1		70.50±0.90	4.94	64.79	75.55	$\hat{F}_{7.07} > F_{0.05\%}(4.20) \rightarrow *$
		L_2		66.27±1.31	7.64	56.63	73.31	
Wings	L*	L_1	15	48.44±0.36	2.87	45.95	51.21	$\hat{F}_{0.03} < F_{0.05\%}(4.20) \rightarrow$ n. s.
		L_2		48.35±0.33	2.63	45.95	50.39	
	a*	L_1		1.28±0.40	119.25	-0.37	4.27	$\hat{F}_{1.944} < F_{0.05\%}(4.20) \rightarrow$ n. s.
		L_2		0.61±0.28	177.93	-0.79	2.51	
	b*	L_1		7.40±0.66	34.77	2.45	11.09	$\hat{F}_{0.031} < F_{0.05\%}(4.20) \rightarrow$ n. s.
		L_2		7.24±0.60	32.29	2.46	11.23	
	C	L_1		7.55±0.71	36.47	2.58	11.83	$\hat{F}_{0.41} < F_{0.05\%}(4.20) \rightarrow$ n. s.
		L_2		8.12±0.52	24.65	4.53	11.94	
	h°	L_1		85.62±2.46	11.14	67.45	97.71	$\hat{F}_{0.10} < F_{0.05\%}(4.20) \rightarrow$ n. s.
		L_2		89.27±2.71	11.76	67.72	103.40	

L* = brightness; a* = coordinate of complementary red-green colors; b* = coordinate of complementary yellow-blue colors; C = color saturation; h° = shade of color.

Regarding the coordinate of the complementary colors red-green (a*) the minimums recorded were specific to the pectoral muscles, both for L1 (-0.38 ± 0.09) and for L2 (-0.25 ± 0.12), the

calculated maximums being responsible for the muscles of the upper thigh in both experimental groups (5.10 ± 0.15 ÷ 5.52 ± 0.12). Red-green coordinate variations were associated with the type and proportion of muscle and connective fibers in the muscles, differentiated levels of glycogen stores, the amount of myoglobin, and age at slaughter.

For the yellow-blue color coordinate (b*) the averages obtained on the lower side were specific to the wing muscles in both groups (7.24 ± 0.60 ÷ 7.40 ± 0.66), while the maximums were characterized by the leg muscles, lower (11.98 ± 0.34 ÷ 12.23 ± 0.48).

By calculating the coefficient of variation of the values of the groups L1 (14.76 ÷ 34.77) and L2 (9.52 ÷ 32.29) which describe the yellow-blue coordinate (b*), an average homogeneity of the characters was noticed. As an overview, for the b* coordinate a superiority of the recorded values was found, specific to the muscles taken from the turkey carcasses slaughtered at 18 weeks compared to the one harvested from the turkey carcasses slaughtered at 16 weeks, the oscillation of the values was taken into account, age differences, the proportion of white and red fibers in the muscles, the state of fattening, antesacrification factors.

The degree and intensity of color saturation of the muscles representative of turkeys and turkeys is rendered objectively using the parameter C (chroma). The lower leg muscles taken from birds raised up to 18 weeks had a higher average (13.54 ± 0.54) than the homologous muscles representative of carcasses obtained after slaughtering birds at 16 weeks (12.07 ± 0.67). The lower mean values specific to parameter C for both ages were characteristic of the pectoral muscles (7.34 ± 0.26 ÷ 7.83 ± 0.31).

Following the characterization of the flesh color in terms of the average values recorded by the Hue angle, the muscles of the lower leg harvested from group L2 (66.27 ± 1.31) had a darker shade than the muscles corresponding to group L1 (70.50 ± 0. 90), in the case of the other muscle groups the results were inversely characterized.

The characterization of turkey meat through descriptive coordinates are close to those in the literature (Bihan-Duval et al., 2003) the brightness of the meat as a whole falling within the range 48.6 ± 49.7. The superiority of the values obtained by the literature (3.2 ± 1.4) regarding the a* coordinate for the pectoralis muscle compared to the samples taken in the study is noticeable.

The level of statistical significance of the differences between the values corresponding to the muscle samples taken from the carcasses of turkeys and turkeys (L1 and L2) on colorimetric parameters were noticed significant differences in 5 tests (25%) of the total of 20 performed, the remaining 85% (Table 2).

The tenderness of turkey meat

Primary statistical indicators calculated by means of Warner Bratzler shear forces defining the tenderness of turkey meat reported average values corresponding to the standard error in the range of 0.28 ÷ 0.54, being closely related to a degree of homogeneity of 9.24 ÷ 17.03.

The values of the shear forces were directly proportional to aging, so in the case of birds slaughtered at 16 weeks (L1) values of 10.48 ± 0.41 (chest) were recorded, while in turkeys and turkeys slaughtered at 18 weeks (L2) the values obtained were higher, namely 14.45 ± 0.5 N/cm^2.

Table 3. Estimators and statistical significance of turkey hen meat (Warner Bratzler shear forces)

Specification	Analysed bached	n	Calculated statistical indicators				Significance of differences between batch averages (FISHER test)
			$\bar{X} \pm s_{\bar{x}}$	V%	Min.	Max.	
Chest	L_1	15	10.48±0.41	15.02	7.56	12.59	$\hat{F}_{7.09} > F_{0.05\%}(4.20) \rightarrow *$
	L_2		11.8±0.28	9.24	9.87	13.62	
Upper thigh	L_1	15	12.38±0.54	17.03	9.01	16.42	$\hat{F}_{7.79} > F_{0.01\%}(7.64) \rightarrow **$
	L_2		14.45±0.5	13.45	12.02	18.41	
Lower thigh	L_1	15	12.53±0.5	15.32	10.31	16.41	$\hat{F}_{6.47} > F_{0.05\%}(4.20) \rightarrow *$
	L_2		14.22±0.44	11.97	12.03	17.4	
Wings	L_1	15	10.51±0.31	11.41	8.95	13.85	$\hat{F}_{3.49} < F_{0.05\%}(4.20) \rightarrow$ n. s.
	L_2		11.53±0.45	15.14	8.37	14.48	

These values were in agreement with those obtained by Jukna et al., (2012), (8.72 N/cm^2 or 0.89 kg/cm^2) correlating the obtaining of a product without fragility with the deterioration of collagen by prolonging age and thus obtaining increased resistance.

The comparative analysis of the average forces for each muscle group showed the superiority of the fragility of the muscle samples collected from the pectoral muscles and the wings of the carcasses representative of groups L1 and L2. these being also the lower limits (10.48 ± 0.41 N/cm^2 at L1, respectively 11.53 ± 0.45 N/cm^2 at L2) (Table 3).

By comparing the averages obtained for the muscles representative of the groups slaughtered at different ages. We can say that the muscles from the first group, especially the chest muscles, showed a higher fragility than that obtained in the representative samples of group L2.

The statistical analysis of the existing differences. within the muscle group, between the experimental groups for Warner Bratzler force values showed distinctly significant differences for one (25%) of the 4 tests performed, corresponding to the upper leg, 50% of the tests showed differences significant in the lower chest and thigh, while 25% showed insignificant differences in the wing muscles.

The texture of turkey meat

The results of current research (Table 4) on the hardness of muscle samples representative of turkey meat have shown average values in the range of 15.06 ± 1.31 ÷ 19.07 ± 1.35 N/cm^2 corresponding to group L1 and 18.83 ± 0.91 ÷ 22. 21 ± 1.07 N/cm^2 specific to L2.

The minimum values recorded were characteristic of the pectoral muscles in both groups, and the maximums represented the muscles at the level of the wings (L1) and the lower leg (L2) (tab. 4).

By comparing the average values recorded by each batch, we can see the superiority of the forces that characterize the hardness of batch L2 (22.21 ± 1.07 N/cm^2), compared to the minimum values obtained by L1 (15.06 ± 1.31 N/cm^2). Hardness is associated with decreased muscle mass by reducing the number and size of muscle fiber, being doubled by the accumulation of lipofuscin and increased lipid content. Simultaneously with the reduction of the length of the actin muscle fiber, the extracellular space increases being filled with supporting connective tissue.

By calculating the coefficient of variation of the values that describe the hardness of turkey meat, average values were obtained in the range 19.507 ÷ 34.79% specific to group L1, respectively 12.19 ÷ 20.56% corresponding to group L2, observing the lack of homogeneity of the character studied.

Regarding the texture characteristic represented by cohesiveness, the minimums recorded were specific to the pectoral muscles, both for L1 (0.29 ± 0.01 N/cm^2) and for L2 (0.31 ± 0.01 N/cm^2), the calculated maxima being responsible for the muscles of the lower leg in both experimental groups (0.44 ± 0.04 ÷ 0.51 ± 0.04 N / cm^2).

The averages calculated for the strength of the indicator characterizing the tenderness varied in a lower range 5.22 ± 0.24 N/cm^2, specific to the pectoral muscles corresponding to group L1. and higher 7.26 ± 0.68 N/cm^2 attributed to the muscles of the lower leg indicated to the group L2. The superiority of the values characterizes the slaughtered group at 18 weeks, compared to the slaughtered group at 16 weeks.

The elasticity of turkey meat is indicated by means of the registered forces, so the characteristic interval is defined by minimum average values specific to the pectoral muscles (0.36 ± 0.02 N/cm^2) representative of the L1 group and maximum (65 ± 0.04 N/cm^2) recorded by the muscles of the lower leg in the experimental group L2. Lower mean values specific to elasticity for both ages were characteristic of the pectoral muscles (0.36 ± 0.02 ÷0.42 ± 0.02 N/cm^2). Following the calculation of the coefficient of variation for the values that characterize the elasticity of turkey meat harvested from different anatomical regions specific to both groups (13.51 ÷ 38.15%), the lack of homogeneity of character was noticed (Table 4).

Table 4. Estimators and statistical significance of texture values for turkey hen meat

Specification		Analysed bached	n	Calculated statistical indicators				Significance of differences between batch averages (FISHER test)
				$\bar{X} \pm s_{\bar{x}}$	V%	Min.	Max.	
Chest	D	L_1	15	15.06±1.31	33.702	8.15	22.52	$\hat{F}_{5.56} > F_{0.05\%}(4.20) \rightarrow *$
		L_2		18.83±0.91	18.72	10.67	22.89	
	C	L_1		0.29±0.01	17.870	0.21	0.38	$\hat{F}_{0.91} < F_{0.05\%}(4.20) \rightarrow$ n. s.
		L_2		0.31±0.01	12.419	0.25	0.37	
	G	L_1		5.22±0.24	17.875	3.07	6.33	$\hat{F}_{3.81} < F_{0.05\%}(4.20) \rightarrow$ n. s.
		L_2		5.79±0.16	10.89	4.59	6.79	
	E	L_1		0.36±0.02	21.438	0.26	0.52	$\hat{F}_{5.56} > F_{0.05\%}(4.20) \rightarrow *$
		L_2		0.42±0.02	16.954	0.31	0.53	
	M	L_1		1.98±0.13	25.736	1.06	3.25	$\hat{F}_{5.60} > F_{0.05\%}(4.20) \rightarrow *$
		L_2		2.88±0.15	19.850	1.98	3.77	
Upper thigh	D	L_1	15	16.39±0.83	19.507	10.94	20.93	$\hat{F}_{5.83} > F_{0.05\%}(4.20) \rightarrow *$
		L_2		18.85±0.59	12.19	14.39	21.94	
	C	L_1		0.43±0.03	29.963	0.26	0.72	$\hat{F}_{0.33} < F_{0.05\%}(4.20) \rightarrow$ n. s.
		L_2		0.46±0.03	22.715	0.29	0.74	
	G	L_1		5.77±0.69	46.642	2.16	10.7	$\hat{F}_{0.02} < F_{0.05\%}(4.20) \rightarrow$ n. s.
		L_2		6.19±0.16	37.852	3.24	10.9	
	E	L_1		0.51±0.04	24.206	0.30	0.78	$\hat{F}_{5.31} > F_{0.05\%}(4.20) \rightarrow *$
		L_2		0.62±0.03	19.54	0.32	0.78	
	M	L_1		2.79±0.40	55.238	0.67	5.55	$\hat{F}_{7.91} > F_{0.01\%}(7.64) \rightarrow **$
		L_2		4.10±0.24	22.65	2.87	5.67	
Lower thigh	D	L_1	15	18.12±1.63	34.790	10.06	28.28	$\hat{F}_{4.41} > F_{0.05\%}(4.20) \rightarrow *$
		L_2		22.21±1.07	18.61	12.06	28.23	
	C	L_1		0.44±0.04	38.697	0.24	0.73	$\hat{F}_{1.53} < F_{0.05\%}(4.20) \rightarrow$ n. s.
		L_2		0.51±0.04	28.151	0.32	0.78	
	G	L_1		6.60±0.81	47.737	2.67	11.15	$\hat{F}_{0.38} < F_{0.05\%}(4.20) \rightarrow$ n. s.
		L_2		7.26±0.68	36.526	3.75	11.93	
	E	L_1		0.52±0.05	38.152	0.31	0.92	$\hat{F}_{4.53} > F_{0.05\%}(4.20) \rightarrow *$
		L_2		0.65±0.04	24.5	0.36	0.91	
	M	L_1		2.84±0.42	56.893	0.97	5.54	$\hat{F}_{4.60} > F_{0.05\%}(4.20) \rightarrow *$
		L_2		3.93±0.29	28.596	2.19	5.87	
Wings	D	L_1	15	19.07±1.35	27.385	10.09	29.11	$\hat{F}_{0.44} < F_{0.05\%}(4.20) \rightarrow$ n. s.
		L_2		20.22±1.07	20.566	16.07	29.13	
	C	L_1		0.34±0.02	18.753	0.26	0.50	$\hat{F}_{7.49} > F_{0.05\%}(4.20) \rightarrow *$
		L_2		0.41±0.02	19.594	0.31	0.57	
	G	L_1		6.27±0.60	37.300	2.68	11.33	$\hat{F}_{0.78} < F_{0.05\%}(4.20) \rightarrow$ n. s.
		L_2		7.00±0.55	30.446	3.69	11.95	
	E	L_1		0.44±0.02	21.037	0.31	0.60	$\hat{F}_{7.49} > F_{0.05\%}(4.20) \rightarrow *$
		L_2		0.53±0.02	13.519	0.41	0.66	
	M	L_1		3.19±0.37	44.643	0.83	5.47	$\hat{F}_{4.65} > F_{0.05\%}(4.20) \rightarrow *$
		L_2		4.18±0.27	25.438	2.43	5.91	

D=hardness; **C** = cohesiveness; **G** = tenderness; **E** = elasticity; **M** = chewability.

The force of chewability induced in muscle samples representative of turkey meat was noted by minimum values acquired by the pectoral muscles (1.98 ± 0.13 N/cm^2) in group L1, in discordance with the maximum values reached by the wing muscles in group L2 (4.18 ± 0.27 N/cm^2).

The differences in the values of the forces that characterize the texture of the meat are associated with the age differences between the batches having an influence on the structure of the supporting tissues.

Thus, the connective tissue representative of the intercellular support reduces its content in fundamental substances both in mucopalysis-haride and in fibrous proteins, collagen, elastin and reticular fibers synthesized by fibroplasts.

The maturation process is accompanied by an increase in the density of the hydrated gel, as well as a decrease in the water content of the dry substances. With age, elastin fibers become more rigid and fragment under the influence of continuous stretching, giving rise to pseudoelastine. Young birds are characterized

by a large number of reticular fibers, which tend to be replaced by collagen, a process noted in elastic fibers. Another transformation correlated with aging occurs at the level of enzymatic processes of increasing collagenosis, and functionally to reduce mobility. then a decrease in elasticity. Biochemically, the content of ATP, glycogen and phosphocreatine is reduced, so the elasticity decreases in the absence of ATP.

Compared to the literature, the resulting data are found in accordance with the cited values, so following a study on the correlation between pH value and texture the forces that characterize the hardness were between 16.6 ÷ 22.6 and those specific to cohesiveness ranged from 0.66 to 0.69 (Chan et al., 2011).

Following the statistical significance of the differences between the groups whose slaughter age did not coincide, distinctly significant differences were noted for 5% of 20 total tests, significant differences for 55% and 40% insignificant differences.

CONCLUSIONS

As conclusions we state the following:

✓ statistical significance of the differences between the experimental groups L1 and L2 for the specific acidity values during the *prerigor mortis* and maturation phases corresponding to each muscle group studied showed significant differences for one test (8.33%) of the 12 tests and 91% showing insignificant differences;

✓ through colorimetric characterization of turkey hen meat was observed that those one is influenced in a direct way by muscle type and by the rate of muscular and conjunctive fibres, and also by age at slaughtering;

✓ turkey hen meat luminosity was more intensely observed in the representative musculature of experimental batch slaughtered at 16 weeks in comparison with the luminosity observed at slaughtering of turkey hens at the age of 18 weeks;

✓ pectoral musculature of turkey hen broilers carcasses belonging to batch L1 enlightened lower values for red-greed coordinate (a*) being associated with the lower concentration of haemoglobin from muscles;

✓ by comparing the obtained means for representative musculature for batches slaughtered at different ages we could tell that muscles provided from the first batch, especially breast muscles, presented a superior tenderness to the one obtained for representative samples gathered from batch L2, values of Warner Bratzler shear forces being imposed by slaughtering age and also by higher resistance of conjunctive tissue during aging;

✓ as regarding texture characterization (TPA) for turkey hen meat by hardness, cohesively, elasticity and chew ability, it is observed that representative musculature of carcasses obtained at age of 16 weeks enlightened lower values, influence factors being associated with age differences between batches having also in view the structure of sustained tissues.

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