RESEARCH ON CHARACTERIZATION OF SENSORY PARAMETERS OF NUTRIA MEAT

I.A. Iosub[1*], M.M. Ciobanu[1], R. Lazăr[1], P.C. Boişteanu[1]

[1]*Iasi University of Life Sciences, Faculty of Food and Animal Sciences, Iasi, Romania*

Abstract

The aim of the study is to highlight some sensory characteristics of nutria meat. Three anatomic portions provides from males and females (back, thigh and longissimus dorsi muscles) were analyzed in terms of meat color and tenderness. Determination of the color of the meat samples was performed with the Minolta CM-2600d. In order to determine the tenderness of the nutria meat, the samples were boiled at 75 ℃ for 45 minutes and sectioned perpendicular to the length of the cylindrical fiber. Shear forces (N) and shear energy (J) were detected using the TaPlus Series texturometer and the Warner Bratzler (V-blade). In order to interpret the analytical results obtained, we analyzed the statistical significance of the differences between the studied means using the statistical test (Fisher). Following the analysis of the statistical results obtained in males, in terms of meat color, significant distinct differences were obtained between the three categories of muscles studied, while in females significant differences were obtained only in the muscles lungissimus dorsi. Analyzing the texture of the nutria meat samples between the three muscle categories, we notice that no significant differences were obtained between the muscle groups or between the sexes. in conclusion The analysis of the obtained results allows the classification of nutria meat in the category of meats with firm consistency.

Key words: color, meat, nutria, sensory qualities, tenderness

INTRODUCTION

Strictly speaking, meat means the striated muscle tissue of mammals. Meat is usually understood to mean muscle tissue along with all the tissues with which it is found in direct natural adhesion (bones, tendons, aponeurosis, fascia, blood vessels, lymph nodes, nerves). From a commercial point of view, the notion of meat includes any edible part of the animal's body, namely the carcass consisting of the four quarters and the other edible parts that make up the "fifth quarter" (head, legs, compact fatty tissue, organs and other viscera). Meat consumption can ensure a rational diet, providing a sufficient amount of nutrients [1]. The consumption of nutria meat has become an opportunity with the spread of this species in Argentina, USA, Europe and China. In general, otter was raised mainly for fur production. This changed when the fur market underwent major changes, which led to meat being the main nutrient product. The quality of meat is a complex notion, which encompasses all its sensory, nutritional, technological and hygienic properties to meet the multidimensional needs of man. Also known as organoleptic characteristics, the sensory qualities of meat include the properties perceived by the consumer's senses. Sensory analysis of meat aims to assess the sensory properties of meat [5]. Color - the color is observed on the outside and in the section. It is appreciated if the color is characteristic of the species. The color of the flesh can vary from pale pink to dark red, depending on the type of muscle [2,6] The intensity and hue of the color is given by the content in myoglobin, hemoglobin and the chemical state of the muscle pigment. Within the same species, the color is influenced by age, health, physiological condition before slaughtering the animal, but also by the storage conditions of the meat [3]. The tenderness is determined by the content of the meat in the connective tissue, as well as by the quantity and quality of the adipose tissue that gives the meat a certain degree of marbling and perselation [4], but

*Corresponding author:
enacheioana89@yahoo.com
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also by the quality of the muscle fiber. In young animals, the connective tissue being less developed, and the sarcolemma of the muscle fiber thinner, the tenderness of the meat is more accentuated than in adult animals [8]. There is a positive correlation between the tenderness of the meat and the ability to retain water.

MATERIAL AND METHOD

The color of the nutria meat samples was determined with the Minolta CM-2600d portable spectrophotometer, in three different areas of each muscle sample, at a temperature of 8 ÷ 10°C, being set to view at the standard angle of 10° with a D65 illuminating beam in space colorimetric CIE Lab.

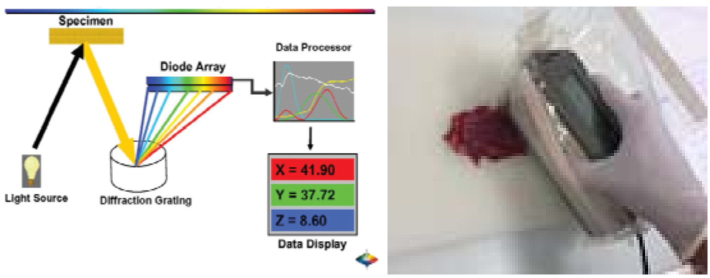

Fig. 1 Color measurement with spectrophotometer Minolta CM-2600d

Color is the result of the perception of incident light by the retina, in the visible region of the spectrum [7,9], with wavelengths between 400 and 700 nm. The CIE system (developed by CIE - Commission Internationale d'Eclairage) expresses psychosensory appreciation through three numerical components which are the numerical coordinates of the color space. Among the systems currently used for color expression and rendering are: CIE XYZ, CIE xyz, CIE L * a * b *, CIE L * C * h * etc.

The color of the flesh was performed on the muscles of Longissimus dorsi, the muscles of the thigh and the muscles of the back, from males and females.

In order to assess the color of the meat samples, the muscle samples were vacuum packed under polyethylene film and subjected to freezing at a temperature of -20° C until colorimetric measurements were performed. Prior to determinations, muscle samples were maintained for 24 hours at a refrigeration temperature of 2°C for thawing.

Fig. 2 Sample processing by vacuum

Freezing meat samples - the values obtained were transformed and processed using the software SpectraMagic v.3.30. Chromometer calibration was performed before each series of measurements with the CM – A32 Minolta calibration device, which was based on a “black standard” and a “white standard”.

Appreciation of the tenderness of the meat through the forces of Warner Bratzler - in order to determine the tenderness of the nutria meat, the samples were boiled at 75°C for 45 minutes and sectioned perpendicular to the length of the cylindrical fiber.

Shear forces (N) and shear energy (J) were detected using the TaPlus Series texturometer and the Warner Bratzler (V-blade). The results were obtained using the integrated NEXYGEN Ondio Software.

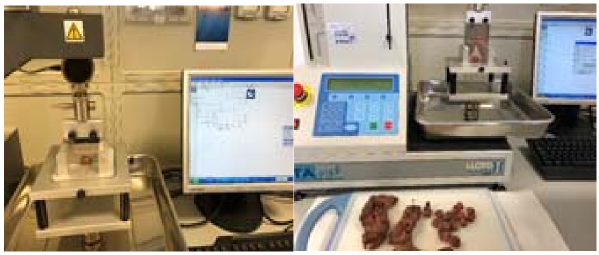

Fig. 3 Determination of Warner Bratzler forces

Methods of statistical-mathematical analysis - in order to interpret the analytical results obtained, we analyzed the statistical significance of the differences between the studied means using the statistical test (Fisher) at the probability levels of p = 0.05, p = 0.01, p = 0.001, method included in the ANOVA calculation algorithm Single Factor.

RESULTS AND DISCUSSIONS

Regarding the interpretation of the color of the meat from the nutria, determinations were made on the back muscles, the leg muscles and the Longissimus dorsi muscle, the data being recorded in the tables. The results on the color of the flesh on the back muscles were recorded in the table 1.

Table 1 Variation in the color of the back muscles in males and females

Specifications	**L*(D65)**		**a*(D65)**		**b*(D65)**	
	M	**F**	**M**	**F**	**M**	**F**
1	27.01	25.98	8.22	11.57	10.43	13.45
2	28.54	29.65	9.13	12.08	11.88	13.16
3	25.88	26.62	8.62	9.26	10.66	11.17
4	27.77	28.13	8.67	11.82	10.54	12.31
5	27.21	26.31	8.42	10.41	11.27	13.3
n	**5**	**5**	**5**	**5**	**5**	**5**
±M	27.282 ± 0.43	27.338± 0.68	8.612± 0.15	11.028±0 .52	10.956± 0.27	12.678± 0.42
SD	0.983	1.532	0.339	1.176	0.610	0.951
min	25.88	25.98	8.22	9.26	10.43	11.17
max	28.54	29.65	9.13	12.08	11.88	13.45
ANOVA	**L^*_M vs L^*_F p=0.94 > 0.05 →ns** **a^*_M vs a^*_F p= 0.002 < 0.05 →**ds** **b^*_M vs b^*_F p= 0.009 < 0.05 →**ds**					

± M = mean and standard deviation of the mean, SD = standard deviation, L * M = brightness in muscles from males, L * F = brightness in muscles from females, a * M = red-green coordinate in muscles from from males, a * F = red-green coordinate to muscles from females, b * M = yellow-blue coordinate to muscles from males, b * F = yellow-blue coordinate to muscles from females, ∗ ∗∗P <0.001, ∗P <0.05, ns P> 0.05

Analyzing the obtained results we notice that in terms of L * brightness the average values are almost equal, 27.14 for males and 27.41 for females. The values recorded for the red-green coordinate (a *), had higher values in females 10.97, higher comparative values were identified, also in females and in the yellow-blue coordinate (b *).

The significance test showed insignificant differences in the brightness parameter and distinctly significant differences in the expression for position on the red-green and yellow-blue coordinates.

Table 2 Variation of the color of the thigh muscles in males and females

Specifictions	L*(D65)		a*(D65)		b*(D65)	
	M	F	M	F	M	F
1	25.31	26.11	9.48	10.85	10.13	12.42
2	25.52	30.36	11.11	16.36	12.51	15.92
3	25.73	35.23	9.51	9.91	9.74	13.95
4	25.41	28.23	10.29	13.61	11.32	14.17
5	25.62	32.79	10.31	13.13	11.21	14.93
n	5	5	5	5	5	5
±M	25.518±0.07	30.544±1.61	10.14±0.30	12.772±1.13	10.982±0.48	14.278±0.57
SD						
min	0.65	11.81	6.661	19.803	9.943	9.059
max	25.31	26.11	9.48	9.91	9.74	12.42
ANOVA	**L^*_M vs L^*_F p=0.014 < 0.05 →**ds** **a^*_M vs a^*_F p= 0.054 > 0.05 →ns** **b^*_M vs b^*_F p= 0.002 < 0.05 →**ds**					

± M = mean and standard deviation of the mean, SD = standard deviation, L * M = brightness in muscles from males, L * F = brightness in muscles from females, a * M = red-green coordinate in muscles from males, a * F = red-green coordinate to muscles from females, b * M = yellow-blue coordinate to muscles from males, b * F = yellow-blue coordinate to muscles from females, ∗ ∗∗P <0.001, ∗P <0.05, ns P> 0.05.

Analyzing the results regarding the expression of color in nutria meat at the level of the leg muscles, higher values are observed in the expression of brightness in females, 30.56 compared to males 25.51. Increased differential values were found at the b * coordinate of females of 42.27 compared to males of 32.38.

Following the significance test, significant differences were observed in the expression of brightness and parameter b *.

Table 3 Color variation in Longissimus dorsi muscles in males and females

Characteristics	L*(D65)		a*(D65)		b*(D65)	
	M	F	M	F	M	F
1	31.21	33.38	10.74	12.18	11.38	14.19
2	32.22	33.55	12.86	12.87	14.91	14.11
3	31.74	31.23	12.86	11.86	15.12	14.23
4	31.98	33.46	11.81	12.52	13.14	14.15
5	31.71	32.39	12.86	12.36	15.01	14.17
n	5	5	5	5	5	5
±M	31.772±0.16	32.802±0.44	12.226±0.42	12.358±0.16	13.912±0.73	14.17±0.02
SD						
min	1.182569	3.036177	7.745662	3.049485	11.73869	0.315606
max	31.21	31.23	10.74	11.86	11.38	14.11
ANOVA	**L^*_M vs L^*_F p=0.06 >0.05 →ns** **a^*_M vs a^*_F p= 0.779 > 0.05 →ns** **b^*_M vs b^*_F p= 0.733 > 0.05 →ns**					

± M = mean and standard deviation of the mean, SD = standard deviation, L * M = brightness in muscles from males, L * F = brightness in muscles from females, a * M = red-green coordinate in muscles from males, a * F = red-green coordinate to muscles from females, b * M = yellow-blue coordinate to muscles from males, b * F = yellow-blue coordinate to muscles from females, ∗ ∗∗P <0.001, ∗P <0.05, ns P> 0.05

In expressing the color of the Longissimus dorsi muscle, the values obtained were close between males and females regarding the three coordinates followed, which led to the application of the significance test to distinguish insignificant differences between males and females in all three parameters studied.

Table 4 Comparison of the average values obtained regarding the color of the meat between the three categories of muscles studied in males

Specifications	**The type of muscle studied**			
	Back muscles	**Thigh muscles**	**M.*Longissimus dorsi***	Significan of tearms
L*	27.282±0.43	25.518±0.07	31.772±0.16	**L*s vs L*p = 0.004 <0.05→**ds**
a*	8.612±0.15	10.14±0.30	12.226±0.42	**L*s vs L*l = 0.0002<0.05→**ds**
b*	10.956±0.27	10.982±0.48	13.912±0.73	**L*p vs L*l = 0.004 <0.05→**ds**

L * M = brightness in male muscles, L * F = brightness in female muscles, a * M = red-green coordinate in male muscles, a * F = red-green coordinate in male muscles from females, b * M = yellow-blue coordinate to muscles from males, b * F = yellow-blue coordinate to muscles from females, ∗∗∗P <0.001, ∗P <0.05, ns P> 0.05

A problem that arose from the statistical analysis of the results obtained on the color of nutria meat, was whether there are differences, at the same sex, between the categories of muscles studied [11]. Comparing the three color parameters L *, a *, b *, distinctly significant differences were obtained.

Table 5 Comparison of the average values obtained regarding the color of the meat between the three categories of muscles studied in females

Specifications	**The type of muscle studied**			
	Back muscles	**Thigh muscles**	**M. *Longissimus dorsi***	
L*	27.338±0.68	25.518±0.07	32.802±0.44	**L*s vs L*p = 0.104 >0.05→ns**
a*	11.028±0.52	12.772±1.13	12.358±0.16	**L*s vs L*l = 0.001<0.05→**ds**
b*	12.678±0.42	14.278±0.57	14.17±0.02	**L*p vs L*l = 0.214>0.05 →**ds**

L * s = brightness in the back muscles, L * p = brightness in the thigh muscles, L * l = brightness in the Longissimus dorsi muscle ∗∗∗P <0.001, ∗P <0.05, ns P> 0.05.

Analyzing the data from table 2.5 we notice that insignificant differences were obtained in the expression of the parameter L * between the thigh muscles and the back muscles and distinctly significant in their comparison with the Longissimus dorsi muscle.

Consumers use color as an indication of the freshness and quality of all types of meat, not only in the case of red meats but also in rabbit, pork, poultry, nutria [10].

Following the study of the specialized literature, we were able to compare with the analysis two researches on the color of nutria meat carried out by Migdal et al (2013) and Tumova et al (2017), these using the CIELab system. Comparing the results obtained on the average values of the parameter L * which were between 25.5 and 32.8 with those in the literature we can say that these values correspond to red meats compared to monogastric non-ruminants such as rabbits, birds and pigs (Gy, Eiben, Toth, & Schmidt, 2008; Lindahl, Lundstrom, & Tornberg, 2001; Migdal et al., 2013).

The average results for parameter a * were between 8.61 and 12.77, indicating that we can consider nutria meat as red meat. This result could be explained by a quantitative level of heme pigments similar to that of muscle tissue in beef.

For interpretation, we referred to the values of the parameter a * in the literature obtained for poultry, values between 1.73 and 2.54 (Kralik, Djurkin, Kralik, Skrtic, & Radisic, 2014).

The average results for the b * parameter were between 10.95 and 14.27, which places the nutria meat below that of the pork, which has values between 15 and 16 (Lindahl et al., 2001) and above the rabbit meat, which has values between 3 and 9 (Gy et al., 2008; Migdal et al., 2013).

The tenderness of the meat is one of the main characteristics of the meat that expresses the ease with which the muscle fiber is chewed or sectioned in order to appreciate its quality.

Table 6 Results on the application of WBF forces to the pulp muscles to nutria

Specifications	Shear force (N)	Shear energy (J)	Shear force (N)	Shear energy (J)
	M		F	
1	23.25	0.239	18.932	0.189
2	16.896	0.152	11.945	0.139
3	13.133	0.144	13.741	0.143
4	13.056	0.123	19.07	0.227
5	23.146	0.211	22.346	0.288
n	**5**	**5**	**5**	**5**
±M	17.896±2.27	0.173±0.02	17.206±1.90	0.197±0.02
SD	5.082	0.048	4.259	0.062
min	28.401	28.156	24.752	31.591
max	13.056	0.123	11.945	0.139
ANOVA	WBF_M vs WBF_F p= 0.822 >0.05→ns			

∗∗∗P <0.001, ∗P <0.05, ns P> 0.05, WBFM - Warner – Bratzler forces in males, WBFF - Warner – Bratzler forces in females

Analyzing the data in Table 7, it is observed that the average values of Warner – Bratzler forces in males, 17,896 N are close to those obtained in females 17,206 N. Following the statistical interpretation, no significant differences between sexes were obtained in the thigh muscles.

Table 7 Results on the application of WBF forces to the back muscles to nutria

Specifications	Shear force (N)	Shear energy (J)	Shear force (N)	Shear energy (J)
	M		F	
1	15.371	0.149	16.234	0.169
2	23.584	0.231	33.298	0.336
3	14.141	0.165	18.137	0.187
4	17.965	0.215	22.089	0.208
5	15.692	0.177	12.816	0.131
n	**5**	**5**	**5**	**5**
±M	17.350±1.676	0.187±0.015	20.514±3.529	0.206±0.034
SD	3.748469	0.03445	7.892069	0.077876
min	14.141	0.149	12.816	0.131
max	23.584	0.231	33.298	0.336
ANOVA	WBF_M vs WBF_F p= 0.441 >0.05→ns			

∗∗∗P <0.001, ∗P <0.05, ns P> 0.05, WBFM - Warner – Bratzler forces in males, WBFF - Warner – Bratzler forces in females

Table 8 presents the results on the application of WBF forces to the back muscles in males and females, noting that there were no significant differences between the two sexes.

Table 8 Results on the application of WBF forces to Longissimus dorsi muscles in nutria

Specifications	Shear force (N)	Shear energy (J)	Shear force (N)	Shear energy (J)
	M		F	
1	15.490	0.143	19.954	0.212
2	16.415	0.139	22.288	0.163
3	12.415	0.120	18.277	0.144
4	8.429	0.089	23.856	0.252
5	15.327	0.166	15.222	0.139
n	**5**	**5**	**5**	**5**
±M	13.615±1.45	0.131±0.01	19.919±1.514	0.182±0.02
SD	3.264244	0.028798	3.386419	0.048616
min	8.429	0.089	15.222	0.139
max	16.415	0.166	23.856	0.252
ANOVA	WBF_M vs WBF_F p= 0,017<0.05→*ds			

∗∗∗P <0.001, ∗P <0.05, ns P> 0.05, WBFM - Warner – Bratzler forces in males, WBFF - Warner – Bratzler forces in females

Analyzing the texture of the nutria meat samples by the action of Warner – Bratzler forces between the three muscle categories, we notice that no significant differences were obtained between the muscle groups or between the sexes.

Nutria meat can be classified as a firm meat, which is very important for consumers who prefer this type of meat [14].

The increased hardness is related to the low amount of fat and the high level of collagen.

CONCLUSIONS

Following the analysis of the statistical results obtained in males, regarding the color of the meat, distinctly significant differences were obtained between the three categories of muscles studied.

Analyzing the data on color in the muscles from females, we observe that insignificant differences were obtained in the expression of the l * parameter between the thigh muscles and the back muscles and distinctly significant in comparison with the longissimus dorsi muscle.

The results obtained regarding the average values of the parameters that characterized the color interpretation, allow the inclusion of nutria meat in the category of red meats.

Analyzing the texture of the nutria meat samples by the action of Warner – Bratzler forces between the three muscle categories, we notice that no significant differences were obtained between the muscle groups or between the sexes.

The analysis of the obtained results allows the classification of nutria meat in the category of meats with firm consistency.

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