THE INFLUENCE OF THE SLAUGHTER AGE ON THE HISTOLOGICAL PARTICULARITIES ON GRAY GUINEA FOWL (*NUMIDA MELEAGRIS*)

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Abstract

Nowadays, more and more producers and processors around the world are concerned about ways in which they can make high quality food, in economic conditions. The aim of the research consists in studying elements related to the morphology and structural aspects of some muscles taken from the pectoral musculature of the guinea fowls males, traits that directly affect the trophic-biological properties of the poultry meat.

In Pectoralis major muscle cells for the samples issued from the birds slaughtered at 77 days thickness varied between 38.21 µm and 60.33 µm, resulting an average diameter of 48.55±0.40 µm. The values for the next group of samples (84 days), ranged from 40.03 µm to 62.39 µm resulting an average of 51.18±0.38 µm. The 3rd of samples (91 days-slaughter), provided us an average of 53.88±0.43 µm, based on a minimum value of 42.93 µm and a maximum value of 68.55 µm. The bundle cross section area of the 1st order muscle showed us values of 56343.48±1658.49 µm^2 on the samples collected on day 77, followed by a bit higher value of 59597.76±1638.76 µm^2 on the samples colleted on day 84; the highest value was recorded on day 91, more precisely, 62911.75±1790.08 µm^2.

The histological findings suggest that the meat of Pectoralis major muscles from guinea fowls slaughtered at the age of 77 days had a better texture, with thinner cells and less connective tissue, therefore a better sensorial quality.

Key words: guinea fowl, density, muscles, pectoralis, myocites

INTRODUCTION

Poultry meat consumption is increasing gradually due it's low price, popularization of intensive production systems on different [8] .Nowadays, more and more producers and processors around the world are concerned about ways in which they can make high quality food, in economic conditions. Data on a number of qualitative indices of poultry meat, which would contribute to the formation of an overview of the nutritional and dietary properties of this product, are becoming less and less frequent. [9]

Textural properties (tenderness, juiciness) were always considered key point quality and consumer acceptance indicators, because they directly influence the sensory and thirst traits of the meat [3],[4].

The quality of guinea fowl poultry is often compared to chicken poultry, but consumers appreciate its special qualities that resemble the meat of the "wild" birds in flavour [5].

Baézaet al. (2001) compared different guinea fowl types and concluded that the carcass weight is considerably affected by age, sex, genotype and rearing conditions [2].

The profile of muscle fibre types is genetically determined. The distribution of muscle fibre types may depend on age, nutrition and also physical activity [4]

Therefore, the purpose of the research consists in studying elements related to the morphology and structural aspects of some muscles taken from the pectoral musculature of the biblical males, traits that directly affect the trophic-biological properties of the poultry meat.

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MATERIAL AND METHOD

Twenty samples of *Pectoralis major* and *Pectoralis minor* muscles, issued from 30 individuals of guinea fowl *(Numida Meleagris)* (conventional farming system, slaughtered at 77, 84 and 91 days) were submitted to shaping in 1.5 x 1.5 x 0.3 cm blocks and included in histological processing plastic cassettes to be immerged in formaldehyde 10%, 4°C, 30 days, for fixation. The paraffin infiltration technique was used to process the tissue using a THERMOSCIENTIFIC STP-120-2[1] line, following a 3 stages protocol:

- ✓ dehydration in 5 consecutive ethyl alcohol baths (from 70% to absolute ethanol concentrations);
- ✓ immersion in clearing agent (2 consecutive baths of Xylene);
- ✓ paraffin impregnation (2 successive baths at 58°C).

After impregnation, the samples were transferred into stainless molds, filled in priory with melted paraffin (58°C), then cooled down. The blocks were passed to a THERMOSCIENTIFIC HM355S rotary microtome to produce serial slices of 5µm thickness. The slices were mounted on glass smears then submitted to a trichromic Masson staining protocol (iron hematoxylin, acid fuchsin, aniline blue), using an automatic tissue stainer - histology line-Varistain Gemini AS– THERMOSCIENTIFIC.

After staining, the smears were sealed with square glasses and resin then they were analyzed by microscopic measurements (Motic M230 with camera, calibrated with the default objective micrometric scale for 10 x 10 and 10 x 40 ocular x objective associations) and computations (Motic Image 3+ software after image acquiring at 100X and 400X magnification factors) to assess myocytes and 1st order muscular fascicles diameters (µm) and cross section areas (sqµm).

Myocytes density (number of muscle cells per sqmm of muscle) and proportion of main tissue categories (% pure muscular tissue and % connective tissue) were also calculated. Muscle cells density was obtained using the relation [7]:

$$\text{Myocytes density} = \frac{\text{myocytes amount in MFI} \times 1000000}{\text{cross section area of MFI (sqµm)}}$$

where: MFI = 1st order muscle fascicle

1000000 = multiplication factor (1 sqmm=1000000µm)

The proportions of pure muscular and connective tissues in muscle structure were calculated using the relation (Radu-Rusu et al., 2007):

$$P_{MT}(\%) = \frac{\Sigma \text{ myocytes cross section areas (sqµm) in MFI}}{\text{cross section area of MFI (sqµm)}}$$

$$P_{CT}(\%) = 100 - P_{MT}(\%)$$

The acquired data were statistically processed to obtain the main descriptors (mean, standard deviation, coefficient of variation - CV%) and running of comparisons between the used methods (one-way ANOVA) [1].

RESULTS AND DISCUSSIONS

Breast myocytes dimensional properties are presented as a comparative analysis between all 3 ages (77, 84 and 91 days).

In Pectoralis major muscle cells for the samples issued from the birds slaughtered at 77 days thickness varied between 38.21 µm and 60.33µm, resulting an average diameter of 48.55±0,40 µm. The values for the next group of samples (84 days), ranged from 40.03 µm to 62.39 µm resulting an average of 51.18±0.38 µm. The 3rd set samples (91 days-slaughter), provided us an average of 53.88±0.43 µm, based on a minimum value of 42.93 µm and a maximum value of 68.55 µm. This characteristic showed good homogeneity. The values of the coefficient of variation were below 10%.

The cross-section area showed us values of 2108.12±21.28 µm, with a minimum of 1634.92 µm and a maximum of 2696.80 µm (77 days); On the second age of slaughter after analyzing the samples, the mean value was 2223.08±21.99 µm, with values that ranged from a minimum of 1712.81 µm to a maximum of 2864.39 µm. The last set of samples (91 days) indicated an average of 2340.20±23.65 µm, based on a minimum of 1829.42 µm and a maximum of 3000.62 µm.

The coefficient of variation oscillated around 11.80%, so the homogeneity of the analyzed trait could be considered low (Table 1).

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Table 1 Dimensional features of the fibers (myocites) in the *Pectoralis major* muscles (Guinea fowl males)

Histological trait	Slaughter age (days)	X	±sx	V%	Min	Max
Muscle fibers thickness (µm)	77	48.55	0.40	9.70	38.21	60.33
	84	51.18	0.38	8.86	40.03	62.39
	91	53.88	0.43	9.36	42.93	68.55
	ANOVA testing: 77 vs. 84 days: highly significant, $\hat{F}$ (22.62)>Fα0.001(11.06); *P*=3.18^{-6} *** 77 vs. 91 days: highly significant, $\hat{F}$(83.47)>Fα0.001(11.06); *P*=1.39^{-17} *** 84 vs. 91 days: highly significant, $\hat{F}$ (22.21)>Fα0.001(11.06); *P*=3.85^{-6} ***					
Muscle fibers cross section area (µm^2)	77	2108.12	21.28	11.95	1634.92	2696.80
	84	2223.08	21.99	11.71	1712.81	2864.39
	91	2340.20	23.65	11.96	1829.42	3000.62
	ANOVA testing: 77 vs. 84 days: highly significant, $\hat{F}$(14.11)>Fα0.001(11.06); *P*=0.00021 *** 77 vs. 91 days: highly significant, $\hat{F}$(53.20)>Fα0.001(11.06); *P*=3.15^{-12} *** 84 vs. 91 days: highly significant, $\hat{F}$(13.15)>Fα0.001(11.06); *P*=0.00034 ***					

The bundle thickness of the 1st order muscle revealed the highest values of 1492.69±42.80 µm on the samples provided by the chest of the guinea fowls aged 91 days, with a minimum value of 1315.44 µm and a maximum of 1584.74 µm. The lowest values were highlighted by the youngest birds, more exactly the ones aged 77 days, the mean value being 1337.36±42.87, with results that ranged between 1187.82 µm (minimum) and 1481.48 µm (maximum). The values of the coefficient of variation are below the 10% therefore, indicates a good homogeneity of this attribute.

The bundle cross section area of the 1st order muscle showed us values of 56343.48±1658.49 µm^2 on the samples collected on day 77, followed by a bit higher value of 59597.76±1638.76 µm^2 on the samples collected on day 84; the highest value was recorded on day 91, more precisely, 62911.75±1790.08 µm^2.

In this case too, the coefficient of variation had values below 10%, correspondingly to a good homogeneity (Table 2).

Table 2 Dimensional features of 1st order muscular bundles and main tissue descriptors in the *Pectoralis major* muscles (Guinea fowl males)

Histological trait	Slaughter age (days)	X	±sx	V%	Min	Max
Ist order muscle bundle thickness (µm)	77	1337.36	42.87	8.48	1187.82	1481.48
	84	1414.68	43.23	8.08	1261.36	1572.33
	91	1492.69	42.80	7.59	1315.44	1584.74
	ANOVA testing: 77 vs. 84 days: not significant, $\hat{F}$(1.61)<Fα0.05(4.75); *P*=0.228 77 vs. 91 days: significant, $\hat{F}$(6.57)>Fα0.05(4.75); *P*=0.024 * 84 vs. 91 days: not significant, $\hat{F}$(1.64)<Fα0.05(4.75); *P*=0.224					
Ist order muscle bundle cross section area (µm^2)	77	56343.48	1658.49	7.79	50540.58	61064.39
	84	59597.76	1638.76	7.28	53103.42	64351.64
	91	62911.75	1790.08	7.53	57427.45	69781.61
	ANOVA testing: 77 vs. 84 days: not significant, $\hat{F}$(1.95)<Fα0.05(4.75); *P*=0.189 77 vs. 91 days: significant, $\hat{F}$(7.24)>Fα0.05(4.75); *P*=0.019 * 84 vs. 91 days: not significant, $\hat{F}$(1.86)<Fα0.05(4.75); *P*=0.197					

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Muscle fibers density was higher on the samples issued from the birds slaughtered on the 77th day of life (802.88±23.87 fibers/mm^2 of muscle) compared to the ones provided on day 84 (758.58±21.35 fibers/mm^2 of muscle) and the ones from the 91 day, so the fibers are thicker on the samples from the 77 day. The differences between means did not pass the α 0.05 significance threshold.

The proportion of muscular tissue out of whole muscle reached very similar values, more precisely, for the samples taken from birds slaughtered at 77 days the average value was 74.83±0.16%, for the ones slaughtered at 84 days, the mean value was about 74.61±0.14%, and the samples provided by the birds slaughtered at 91 days the average value was 74.39±0.13%. The coefficient of variation (V=0.13-0.14%) had very low values, which denotes a very good homogeneity of the analyzed characteristic.

The proportion of connective tissue out of whole muscle, also showed very similar values, the lowest value was 25.17±0.16% (day 77), followed by 25.39±0.14% (day 84) and finally the day 91 with a mean value of 25.61±0.13% (Table 3)

Although these differences were not found as statistically significant (p>0.05), the histological findings suggest that the meat of *Pectoralis major* muscles from guinea fowls slaughtered at the age of 77 days had a better texture, with thinner cells and less connective tissue, therefore a better sensorial quality.

Table 3 Density of fibers and the proportion of muscular and connective tissue

Histological trait	Slaughter age (days)	X	±sx	V%	Min	Max
Density of fibers (fibers/mm^2 of muscle)	77	802.88	23.87	7.87	736.93	890.37
	84	758.58	21.35	7.45	699.28	847.40
	91	718.78	20.51	7.55	644.87	644.87
	ANOVA testing: 77 vs. 84 days: not significant, $\hat{F}$(1.91)<Fα0.05(4.75); *P*=0.192 77 vs. 91 days: significant, $\hat{F}$(7.14)>Fα0.05(4.75); *P*=0.020 * 84 vs. 91 days: not significant, $\hat{F}$(1.81)<Fα0.05(4.75); *P*=0.203					
Proportion of muscular tissue (%) out of whole muscle	77	74.83	0.16	0.55	74.18	75.34
	84	74.61	0.14	0.50	74.03	75.12
	91	74.39	0.13	0.47	73.87	74.94
	ANOVA testing: 77 vs. 84 days: not significant, $\hat{F}$(1.12)<Fα0.05(4.75); *P*=0.309 77 vs. 91 days: not significant, $\hat{F}$(4.65) <Fα0.05(4.75); *P*=0.052 84 vs. 91 days: not significant, $\hat{F}$(1.30)<Fα0.05(4.75); *P*=0.277					
Proportion of connective tissue (%) out of whole muscle	77	25.17	0.16	1.64	24.66	25.82
	84	25.39	0.14	1.46	24.88	25.97
	91	25.61	0.13	1.37	25.06	26.13
	ANOVA testing: 77 vs. 84 days: not significant, $\hat{F}$(1.12)<Fα0.05(4.75); *P*=0.309 77 vs. 91 days: not significant, $\hat{F}$(4.65) <Fα0.05(4.75); *P*=0.052 84 vs. 91 days: not significant, $\hat{F}$(1.30)<Fα0.05(4.75); *P*=0.277					

CONCLUSIONS

The histological findings suggest that the meat provided by guinea fowls slaughtered on day 77had a better texture, with thinner cells and less connective tissue, so we can say that there will be a better sensorial quality.

Taking into account the presented results, it is recommended to consume the meat of the guinea fowl, because the analyzed muscles indicated a fine texture, therefore a more pronounced fragility.

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