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HISTOLOGICAL ANALYSIS OF MUSCLES OF LANDES GEESE

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Abstract

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The aim of this study was histological and histochemical analyze of *musculus pectoralis major* (MPM) and *musculus biceps femoris* (MBF) of 12-weeks old Landes geese husbandry by sex from Hruboňovo (Czech Republic). The geese had live weight of 3979.0 g and the ganders had live weight of 4779.0 g. Higher α White fiber percentage representation of *musculus pectoralis major* and *musculus biceps femoris* of 12-weeks old Landes geese histological analyses we followed. Representation of sex identical MBF was 60.0% (gander) and 64.1% (geese) and MPM was 47.6% (ganders) and 51.1% (geese). The lowest α Red fibre percentage content in MPM was 6.7% (ganders) and 4.7% (geese) and β Red fiber in MBF was 10.7% (ganders) and 9.5% (geese). No statistically significant differences ($P \geq 0,05$) among sex in the fat cells thickness of geese were found, but significant differences ($P \leq 0,01$) was found in MBF fat cells between ganders (26.3 μm) and geese (21.9 μm). Highest thickness of α White fibre in muscles breast and femoral were found in both sex and lowest was found in β Red fibre. Muscles fibres thickness was higher femoral muscles in average (59.9 μm – ganders; 58.3 μm – geese) opposite breast muscles (47.7 μm – ganders, 44.9 μm – geese), what is the mean higher consistence of femoral muscles for consumer. In term of lowest musculus fiber thickness of Landes geese in average were 44.9 μm – MPM, 58.3 μm – MBF opposite of ganders 47.7 μm – MPM, 59.9 μm – MBF. Higher α White fibre representation was both muscles (51.1% – MPM, 64.1% – MBF). We recommended for experience used individual rearing of male.

Landes geese, muscle fibers, *m. pectoralis major, m. biceps femoris,* histology

The poultry meat is one of most important kind of meat used for human nutrition, which is after pork on 2nd place by consummation in SR for 1 occupant (Haščík *et al.*, 2004).

The gallinacean and water poultry meat is important source of biological full-value food. This meat has many animal proteins, high taste and high dietary value (Haščík *et al.*, 2005; Horniaková *et al.*, 2006; Bateczko and Lasek, 2008).

The poultry meat production and consumption is growing not only in Slovakia, but in the world too. The biggest part in usage poultry meat has chicken and turkey but very good value in usage has also goose meat (Mindek *et al.*, 2006).

Every species, breed or linia of animal, include poultry has some genetic resources in process of evolution. The genetic potention used for formation of morphological and physiological properties of each organism (Trakovická *et al.*, 2006). It is therefore in the interests of farmers to create optimal conditions for best use of the genetic potential of indigenous breeds. Further develop the best combination for genotypic combinations performance, reproductive characteristics, resistance and animal health (Cooke and Ryder, 1971; Valenta and Stratil, 1978; Kuryl and Gasparska, 1985; Brodacki and Smalec, 2001 etc.).

The animals create every basic tissue, organs and single systems from prenatal period until to birth. For the farmer is important growth of bone tissue like supporting apparatus in postnatal growth. It is relate with growth of muscular tissue in process of coarsening and extension. Thus is creating a valuable product, i.e. meat for the consumer (Makovický *et al.*, 2006).

Coarsening and extension of muscle fibers are influenced by many outside and inside factors. The most important factors are genetics and nutrition. Other are sex, age, movement, weight and ethological factor (Makovický *et al.*, 2006).

Many authors deals about most valuable parts of carcass from histological-histochemical composition of meat in animal body (Hugs, 2001; Cherepanov, 2001; Frickn *et al.*, 2002; Lebret *et al.*, 2002; Cieslak *et al.*, 2003; Monson *et al.*, 2004; Solomon, 2004 etc.).

The structure of muscular tissue has influence of production and quality of poultry and other kinds of meat. It is dependent on thickness and size single types muscular tissues, quantum fatty and connective tissue in muscle (Mindek *et al.*, 2006).

Therefore the aim of this work was evaluating and comparing histological and histochemical structure muscle tissue in muscles *musculus pectoralis major* and *musculus biceps femoris.* We worked with goose Landes breed by contents single muscular tissues and their thickness and size fat cells by sex.

MATERIAL AND METHODS

We used 12-weeks old Landes geese and ganders from a farm named Hruboňovo located in Czech Republic as material for the experiment. Geese after hatching were reared to farm and fed a standard way with preparation of commercial feed mixtures. From 1st day to the 56th day with feed mixture HYD-24 and from 56th to the 84th day with feed mixture HYD-25.

After feeding a population of 10 hens and 10 cocks was chosen, transported in mobile cages, slaughtered immediately after transportation and cleaned. Afterwards the carcasses were ready for taking samples for histological and histochemical analysis.

Samples were isolated from *musculus pectoralis major* and *musculus biceps femoris* for histological and histochemical analysis. The isolated samples of individual muscles of 1 × 1 × 1 cm size (approx.) were fixed in liquid nitrogen (–196°C) after marking were placed into a cryocut. A series of sections of 10 µm thickness were cut and discoloured by haematoxylin-eosine for transparent colouring. The second series of sections were coloured by oil red "0" for detection of neutral lipids.

The third series of cuts have been incubated on activity of succinatedehydrogenase to determine types of muscular fibres (Lojda and Papoušek, 1970). Further, the pectoral muscle being the most valuable part of the carcass was chosen as representative sample for evaluation of geese meat quality.

The percentage area representation of muscular fibres was determined by the morphometric method reported by Uhrín and Kulíšek (1979) using the optical microscope Nikon with Lucia optical analyses. The size of fat cells was measured by Lanameter device (Carl Zeiss, Jena, Germany) with a magnifying power of 500.

Obtained results were processed with the help of the software Statgraphics Plus version 5.1 (AV Trading, Umex, Dresden, Germany) and statistically analysed using Anova (for arithmetic mean, standard deviation and coefficient of variation) and t-test.

RESULTS AND DISCUSSION

The average of live weight by Landes geese breed (Table I) was in ganders 4980.0 g and in geese 4313.0 g before slaughter. The live weight of either gender was at the level of 4646.0 g on average. The ganders had higher weight of 667.0 g compared to geese by sex comparing. It has been confirmed statistically significant in favour of the ganders ($P \leq 0.01$).

We found approximately the same values for both sexes Landes geese breed in muscle *m. pectoralis major* (Table II) by objective morphometric evaluation of the size of fat cells without statistical differences ($P \geq 0.05$). The average-value of the *m. pectoralis major* was 24.2 µm by ganders and 24.1 µm by geese.

I: *Live weight Landes geese breed by sex (g)*

Index	Min.	Max.	mean	S.D.	CV%	Statistical detectability ♂:♀
ganders	4779.0	5187.0	4980.0	9.2	4.2	
geese	3979.0	4674.0	4313.0	14.9	7.8	$P \leq 0.01^{++}$
total average	4379.0	4930.0	4646.0	12.1	6.0	

II: *The size of fat cells Landes geese breed by sex (µm)*

Index	MPM					
	Min.	Max.	x	S.D.	CV%	Statistical detectability ♂:♀
ganders	14.7	42.0	24.2	1.0	28.4	
geese	9.7	46.0	24.1	1.2	31.6	$P \geq 0.05^{-}$
total average	12.2	44.0	24.1	1.1	30.0	
	MBF					
ganders	17.4	36.0	26.3	0.6	17.5	
geese	13.3	36.0	21.9	0.8	28.1	$P \leq 0.01^{++}$
total average	15.4	36.0	24.1	0.7	22.8	

We found different results in the muscle *m. biceps femoris*. The gander had the size of fat cells 26.3 µm and the geese 21.9 µm in MBF. The difference between the sexes was statistically significant ($P \leq 0.01$).

The average-size of fat cells in aspect of comparison were not found significant differences ($P \geq 0.05$) in muscle *m. pectoralis major* and *m. biceps femoris* by both sexes.

The fat cells size was higher in the muscles *m. pectoralis major* and *m. biceps femoris* in 12-weeks old Landes geese breed than describes Mindek *et al.* (2006) by 16-weeks old hybrid combinations Tesedikovska geese (16.5 µm – MPM, 16.9 µm – MBF). Uhrín (1995) found higher value of the average-level 33.8 µm by 10-weeks old geese in hybrid Ivagees.

The average-value of size of fat cells in the muscles *m. pectoralis major* and *m. biceps femoris* are slightly lower in Landes breed geese in compared with values by domestic ducks in experiment of Haščík *et al.* (2006), that found average-value at level of 27.9 µm in muscle MPM and 29.6 µm in muscle *m. biceps femoris*.

Percentage across the board representation of different types of muscle fibers is an important indicator that characterizes the structure of muscles. The histological analysis of breast muscle in Landes geese breed (Table III) shows that the highest representation in ganders (47.6%) as well as in geese (51.1%) has α White fibers and the lowest α Red fibers (6.7% – ganders, 4.7% – geese). We found statistical differences between the sexes in α Red ($P \leq 0.05$) as well as α White fibers ($P \leq 0.01$) by comparing percentage representation of muscle fibers in muscle *m. pectoralis major*.

In the muscle *m. biceps femoris* dominated by board representation α White fibers, as in the *m. pectoralis major*. The ganders were represented in the 60.0% contents and the geese 64.1%.

The lowest representation in muscle *m. biceps femoris* has β Red fiber (10.7% – ganders, 9.5% – goose). The percentage representation of muscle fiber types by sex, we have achieved the same as in the *m. pectoralis major* statistical differences by α Red ($P \leq 0.05$) and α White fibers ($P \leq 0.05$) by statistical comparison.

By comparing the our values with Baeza *et al.* (1998) in the percentage contens of particular types of muscle fibers in the muscle *m. pectoralis major* we found in Landes geese breed lower contents of white fibers (7.2 and 10.9%).

Similarly, we found a lower contens of white fibers in our experiments (*m. pectoralis major)* in comparison with Walasik and Bogucka (2004) in 24-weeks old hybrid of domestic and wild geese, Klosowska *et al.* (1996) in white Italian goose lines WD1 (24.8%), Pudyszak *et al.* (2000) in 17-weeks old Bilgoraj and Koludska white geese and their crosses (10.3 to 14.7%), respectively Mindek *et al.* (2006) in Tesedikovska geese (48.5%).

When we compared with the above mentioned authors (Klosowska *et al.*, 1996; Baeza *et al.*, 1998; Pudyszak *et al.*, 2000; Walasik and Bogucka, 2004; Mindek *et al.*, 2006), we found similar trend of lower percentage contents of white muscle fibers also in muscle *m. biceps femoris*. In our experiment the proportion of white (α White) fibers was 60.0% in ganders, respectively 64.1% in geese.

III: *Percentage surface presentation of muscle fibers in MPM and MBF Landes geese breed by sex*

Index		ganders			geese			Statistical detectability ♂:♀
		x	S.D.	CV%	x	S.D.	CV%	
MPM	β Red	45.7	2.6	21.9	44.2	2.6	2.6	$P \geq 0.05^{-}$
	α Red	6.7	0.9	17.1	4.7	0.5	15.2	$P \leq 0.05^{+}$
	α White	47.6	2.2	18.1	51.1	1.9	17.1	$P \leq 0.01^{++}$
MBF	β Red	10.7	1.1	24.9	9.5	1.2	23.8	$P \geq 0.05^{-}$
	α Red	29.4	1.6	21.3	26.5	1.5	22.1	$P \leq 0.05^{+}$
	α White	60.0	1.8	12.2	64.1	1.8	15.7	$P \leq 0.05^{+}$

IV: *The average thickness of muscle fibers in MPM and MBF Landes geese breed by sex*

Index		ganders			geese			Statistical detectability ♂:♀
		x	S.D.	CV%	x	S.D.	CV%	
MPM	β Red	29.9	0.6	7.8	28.1	0.6	7.4	$P \geq 0.05^{-}$
	α Red	46.3	6.0	29.0	44.5	3.4	17.1	$P \geq 0.05^{-}$
	α White	67.0	2.6	7.7	62.2	3.2	10.6	$P \leq 0.05^{+}$
	Total	47.7	3.1	11.5	44.9	2.4	11.7	$P \geq 0.05^{-}$
MBF	β Red	46.2	1.5	12.7	47.5	1.3	10.3	$P \geq 0.05^{-}$
	α Red	63.1	1.4	10.9	59.2	1.1	7.8	$P \leq 0.05^{+}$
	α White	70.6	1.3	6.6	68.5	1.3	6.5	$P \geq 0.05^{-}$
	Total	59.9	1.4	10.0	58.3	1.2	8.2	$P \geq 0.05^{-}$

We found a higher tendency by the above mentioned authors in deposition of red muscle fibers in muscle *m. pectoralis major* and *m. biceps femoris* in different hybrid combination by comparison with Landes goose breed feeding until the age of 12-weeks in our experiment.

In our experiment we found in the 12-weeks old Landes goose breed is like found Mindek *et al.* (2006) in Tesedikovska geese. He has found that α White fibers has higher contents in thigh muscle compared in breast muscle, although the breast muscle is generally considered as white and thigh muscle for red.

We found higher thickness in all types of muscle fibers (white, red, temporary) compared with geese and ganders by the evaluation of the average thickness of muscle fibers in the muscle *m. pectoralis major*. The highest thickness reached α White fibers (67.0 μm – ganders, 62.2 μm – geese) and the smallest β Red fibers (29.9 μm – ganders, 28.1 μm – geese) by sex.

By statistical comparing of the thickness of the particular types of muscle fibers, statistical differences in muscle *m. pectoralis major* reached between the sexes were only in ganders in fibers α White.

In muscle *m. biceps femoris* as in *m. pectoralis major* highest thickness reached α White fibers (70.6 μm – ganders, 68.5 μm – geese) and the lowest again β Red fibers (46.2 μm – ganders, 47.5 μm – geese). By comparing by sex in 12-weeks old Landes geese breed we found statistical differences only in α Red fiber ($P \leq 0.05$) in ganders. We compared the thickness of muscle fibers in muscle *m. biceps femoris*.

From an overall rating of the thickness of muscle fibers can be note, that the thickness has been higher in geese and in ganders in both muscles, but without statistically significant differences ($P \geq 0.05$). Together with, the thickness of individual muscle fibers reached higher value in muscle *m. biceps femoris* compared with muscle *m. pectoralis major*. The thickness of muscle fibers in muscle *m. pectoralis major* compared with other authors can be note that the 12-weeks old Landes geese of both sexes had a higher thickness than white fibers found by Baéza *et al.* (1998) in 24-weeks old geese of the same breed, as well as the Pudyszak *et al.* (2000) in 17-weeks old Polish bilgoraj geese, White koludska and their crosses (45.7– 48.9 μm), respectively as Mindek *et al.* (2006) in Tesedikovska geese (49.78 μm) and Klosowska *et al.* (1996) in 17-weeks white Italian geese in line of WD1 and WD3, which has on average thickness of 52.9 μm.

The thickness of the red muscle fibers in muscle *m. pectoralis major* by Landes geese breed in our experiment was higher that notes Baeza *et al.* (1998), respectively Pudyszak *et al.* (2000). The thickness of red muscle fibers in muscle *m. pectoralis major* showed balanced value as well as the results of Walasik and Bogucka (2004), respectively Klosowska *et al.* (1996). Mindek *et al.* (2006) found a lower value in different geese hybrid combination.

In MBF muscle was thickness of the white muscle fibers similar tendency like in their thickness in MPM muscle by comparing with the above authors. The thickness of the red muscle fibers in the muscle *m. biceps femoris* our values were higher compared with the values found for the 24-weeks old geese according to the results of the same breed in experiment of Baeza *et al.* (1998), respectively higher than the crosses with 24-weeks old domestic and wild geese (Walasik and Bogucka, 2004) as well as in comparison with the values of white Italian goose lines WD1 and WD3 (Kosowska *et al.*, 1998). The thickness of the red muscle fibers in 12-weeks old goose Landes geese breed was lower in muscle *m. biceps femoris* only when compared with the results of Mindek *et al.* (2006) in Tesedikovska geese (53.4 μm).

CONCLUSION

Higher percentage of α White muscle fibers in *m. biceps femoris* – MBF in both sexes (60.0% – ganders, 64.1% – geese), as in the *m. pectoralis major* – MPM (47.6% – ganders, 51.1% – geese) was found by histological analysis of 12-weeks Landes geese muscles, while the pectoral muscle is considered as white muscle.

The smallest percentage was observed by α Red muscle fibers in MPM (6.7% – ganders, 4.7% – geese) and β Red muscle fibers in MBF (10.7% – ganders, 9.5% – geese). The size of fat cells in the MPM muscle revealed no significant differences between the sexes ($P \geq 0.05$), but in muscle MBF larger fat cells ($P \leq 0.01$) were found in ganders (26.3 μm) compared with goose (21.9 μm).

In breast muscle, like in the thigh muscle has α White fibers showed the highest thickness and β Red fibers the lowest in both sexes. The higher average thickness of the muscle fibers was in the thigh muscle (59.9 μm – ganders, goose – 58.3 μm) compared with pectoral muscle (47.74 μm – ganders, 44.93 μm – geese), which ultimately means for the consumer higher stiffness of thigh muscle.

In terms of a lower average thickness of muscle fibers in Landes geese (44.9 μm – MPM, 58.3 μm – MBF) compared to ganders (47.7 μm – MPM, 59.9 μm – MBF), as well as a higher representation of particular α White fibers as a carrier of animal protein in both muscles (51.1% – MPM, 64.1% – MBF) we recommend separate fattening by sex and prefer fattening of females.

SÚHRN

Histologická analýza svalov husí Landeského plemena

Cieľom našej práce bolo vyhodnotiť a porovnať histologické a histochemické zloženie svalového tkaniva vo svaloch *musculus pectoralis major* a *musculus biceps femoris* u husí Landeského plemena podľa pohlavia z pohľadu zastúpenia jednotlivých svalových vlákien, ich hrúbky a veľkosti tukových buniek. Do pokusu boli zaradené 12-týždňové husi obidvoch pohlaví Landeského plemena z hospodárstva v Hruboňove (ČR). Husi po vyliahnutí boli chované farmovým spôsobom a kŕmené štandardne pripravovanými komerčnými kŕmnymi zmesami od. 1. dňa do 56. dňa KKZ HYD-24 a od 56. dňa do 84. dňa KKZ HYD-25. Po ukončení výkrmu bolo vybraných z chovu po 10 ks gunárov a 10 ks husí. V oblasti prsného a stehenného svalu sa narezala koža a od každého jedinca sa odobrala vzorka svalu *m. pectoralis major* (MPM) a *m. biceps femoris* (MBF) o veľkosti 1 x 1 x 1 cm. Vzorky po označení boli balené do alobalu a fixované v kvapalnom dusíku pri teplote – 196°C. Vlastné vzorky boli zhotovené v zmrazovacom mikrotóme minicryostat pri teplote – 18°C. Z každej vzorky svalov sa narezali sériové rezy v hrúbke 10 µm. Sériové rezy sa následne diferencovane farbili a inkubovali pre stanovanie jednotlivých typov svalových vlákien na aktivitu sukcinát-dehydrogenázy podľa Lojdu a Papouška (1978). Druhá séria rezov bola ofarbená prehľadne hematoxylínom-eozínom a tretia séria rezov olejovou červeňou „0" pre detekciu neutrálnych lipidov. Histologickou analýzou veľkého prsného svalu (*m. pectoralis major*) a dvojhlavého stehnového svalu (*m. biceps femoris*) 12-týždňových husí Landeského plemena sme zistili vyššie percentuálne zastúpenie αWhite vlákien vo svale MBF u oboch pohlaví (60,0% – gunári, 64,1% – husi) ako v MPM (47,6% – gunári, 51,1% – husi), pričom prsný sval sa považuje za biely sval. Najmenší percentuálny podiel vo svale MPM mali α Red vlákna (6,7% – gunári, 4,7% – husi) a vo svale MBF β Red vlákna (10,7% – gunári, 9,5% – husi). Vo veľkosti tukových buniek sa vo svale MPM medzi pohlavím nezistili výraznejšie rozdiely ($P \geq 0,05$), ale vo svale MBF sa zistili väčšie tukové bunky ($P \leq 0,01$) u gunárov (26,3 µm) oproti husiam (21,9 µm). V prsnom svale podobne ako aj v stehennom svale u oboch pohlaví sa najvyššia hrúbka zistila u α White vlákien a najnižšia u β Red vlákien. Hrúbka svalových vlákien bola v priemere vyššia v stehnovom svale (59,9 µm – gunári, 58,3 µm – husi) oproti prsnému svalu (47,7 µm – gunári, 44,9 µm – husi), čo v konečnom dôsledku pre konzumenta znamená vyššiu tuhosť stehenného svalu. Z hľadiska nižšej hrúbky svalových vlákien v priemere u husí Landeského plemena (44,9 µm – MPM, 58,3 µm – MBF) oproti gunárom (47,7 µm – MPM, 59,9 µm – MBF) ako aj vyššieho zastúpenia predovšetkým α White vlákien v oboch svaloch (51,1% – MPM, 64,1% – MBF) ako nositeľa živočíšnych bielkovín odporúčame pre prax využívať oddelený výkrm husí podľa pohlavia pri preferovaní výkrmu samičieho pohlavia.

Landeská hus, svalové vlákna, *m. pectoralis major, m. biceps femoris,* histológia

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