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Characteristics of muscle fibers of breast and leg muscles of grey partridges *Perdix perdix*

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Abstract: *Characteristics of muscle fibers of breast and leg muscles of grey partridges Perdix perdix*. The experimental material included grey partridges *Perdix perdix* L. planned for re-introduction into the natural habitat, reared at the Game Breeding Center on the area of Mazovia Province. 10 females and 10 males were selected for slaughter. The birds were slaughtered in poultry abattoir and specimens of their pectoral superficial muscle (*pectoralis superficialis*) and biceps femoris muscle (*biceps femoris*) were sampled. A greater diameter of fibers was determined for breast muscles. The study did not show any effect of sex on muscle fiber diameter of breast and leg muscles of grey partridges *Perdix perdix*.

Key words: grey partridge, muscle fiber, game

INTRODUCTION

Muscle fibers are the main components of skeletal muscle tissue. According to Damez and Clerjon (2008), the number, size and type of muscle fibers as well as their biochemical, physiological and histological characteristics may lead to changes in muscle quality. Many authors emphasize that the histological structure is reflected in the sensory assessment of meat products made by consumers (Ozawa et al. 2000, Nam et al. 2009, Lee et al. 2012). In turn, Sajdakowska et al. (2011) emphasize that the quality of food is not an easy notion to define and depends, to a large extent, on its subjective evaluation. In addition, food quality means meeting expectations of consumers, bearing in mind that contemporarily consumers are increasingly demanding. Their growing requirements regarding food refer not only to its nutritional and health-promoting value, but also its sensory traits, which extorts the improvement of food products quality (Krupiński et al. 2011). Increasingly often, the anxious consumers not only express their interest in foods produced under the extensive conditions (Połtowicz et al. 2003, Tuyttens et al. 2005, Hughner et al. 2007, Pouta et al. 2010, Napolitano et al. 2013), but also search for alternative species of meat (Nuernberg 2011). Meat of the game have for ages played the most important role among meat courses. According to Hoffman and Wiklund (2006), consumers are aware that game meat is healthy and characterized by low fat content. In some countries, courses prepared from wild fowl are a local delicacy, are perceived as a luxury course often claimed a tourist attraction. They are, at the same time, a valuable dietary

complement and dietetic variety (Wójcik et al. 2010). Undoubtedly, game meat of grey partridge is highly appreciated by consumers as the most delicate and the most tasty meat of all game birds (Łebkowska and Łebkowski 1995). According to Choi and Kim (2009), a high number of fibers with small and medium diameters affects meat quality improvement.

The aim of study was to characterize muscle fibers of breast and leg muscles of grey partridge *Perdix perdix*.

MATERIAL AND METHODS

The experimental material included grey partridges *Perdix perdix* L. planned for re-introduction into natural habits, reared at the Game Breeding Centre on the area of Mazovia Province.

Complete the feed mixtures were applied in the rearing period. In the first 4 weeks of birds life, the mixtures contained: 29% of total protein, 11.5 MJ of metabolizable energy and 3.6% of crude fiber, whereas since the 6^{th} till the 10^{th} week of birds life the mixtures contained 23% of total protein, 11.5 MJ of metabolizable energy and 4% of crude fiber. From the 10^{th} week of birds life till the end of rearing, the birds were fed diets, with a daily feed ration including up to 50 g of wheat and maize grain and ad libitum grass which included a mixture of maize, sunflower, alfalfa, grasses and marrows stem kale.

For the first 4 weeks, 3500 partridges were kept indoors. Since the 4^{th} week of age, they had free access to rearing aviaries that were partly roofed, with the roof covered with an electric cord to protect against predators. The aviaries with gravel-sand bottom were planted with vegetation and possessed natural hideaways in the form of rootstocks and large stones.

10 females and 10 males with body weight about average in 14-weeks old were selected for slaughter. The birds were slaughtered in poultry abattoir and the specimens of their pectoral superficial muscle (*pectoralis superficialis*) and biceps femoris muscle (*biceps femoris*) were sampled. Samples in size of $0.5 \times 0.5 \times 1$ cm were collected within 15 min since slaughter after appropriate exsanguination of the birds and subsequently subjected to 24-hour fixation (in a Bouin solution). The samples were then washed in ethanol to remove the fixing agent and dehydrated by a series of increasing ethyl alcohol concentrations. Dehydrated samples were saturated with paraffin. Paraffin saturation was carried out in the incubator at the melting point of paraffin. Saturation duration was adapted to muscle samples collected and amounted to a few hours. Paraffin blocks were formed after completion of the saturation process. Microtome Leica RM 2265 (Leica Microsystems, Nussloch, Germany) was used to cut paraffin sections. Muscle cross sections had the thickness of 5 μm. Standard H&E staining was performed. The diameter and area of 200 muscle fibers was measured in each slide using a Nikon Ellipse E200 light microscope equipped with a Nikon DS-Fi2 camera and COOL view 2.7 software.

Results achieved were elaborated statistically with the use of Student's t-test in SPSS 19.0 PL software IBM Corp. Released (2010). Differences were found significant at $p \leq 0.05$ and $p < 0.01$.

RESULTS AND DISCUSSION

As reported by Tumova and Teimouri (2009) and by Lefaucheur (2010), the diameter of muscle fibers may range from 10 to 100 µm. According to Papinaho et al. (1996) and Geyikoglu et al. (2005), in the case of chickens, the mean thickness of muscle fibers depends on the type of muscle and reaches 60.0 µm for *m. pectoralis major*, 51.6 µm for *m. biceps femoris*, 59.8 µm for *m. extensor*

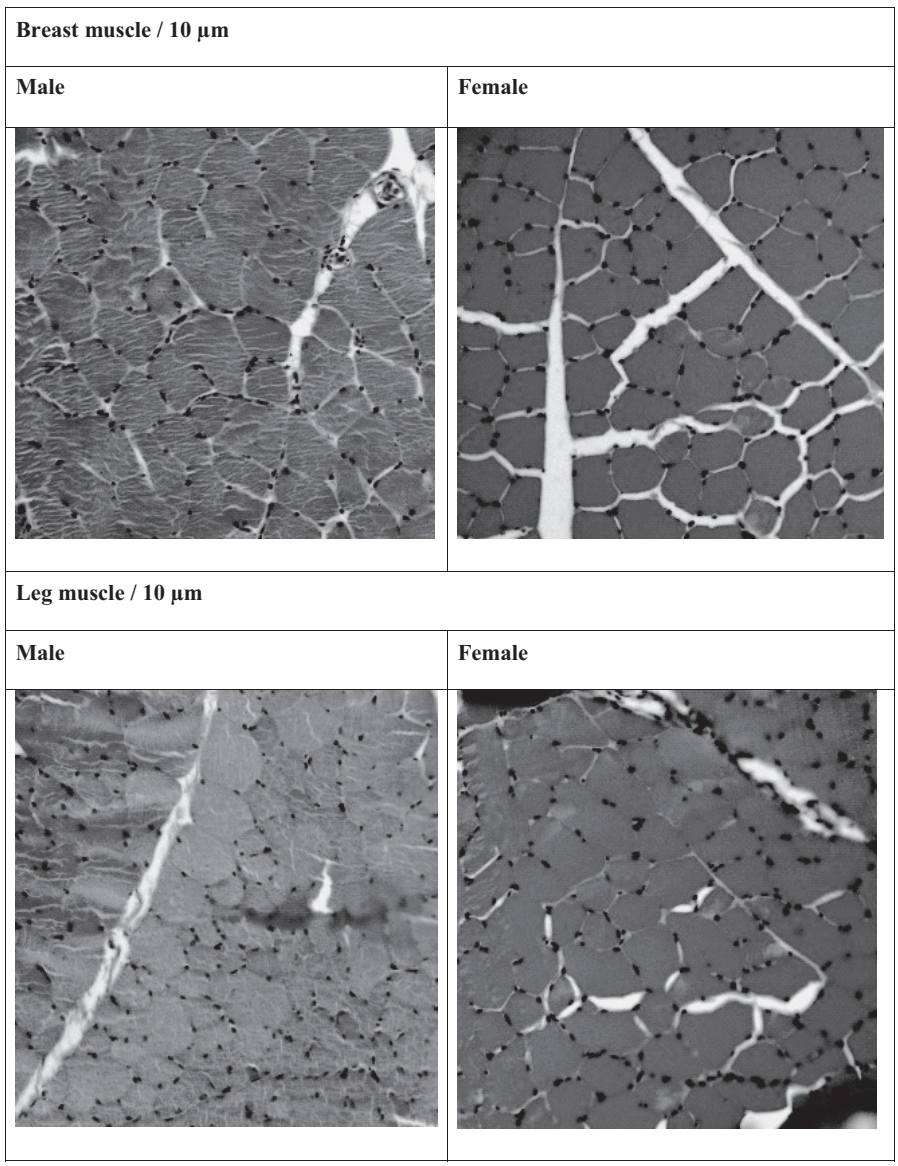

FIGURE 1. Cross-section of breast and leg muscles of grey partridges

TABLE 1. Fiber diameter of breast and leg muscles of grey partridges

Group	Muscles			
	breast		leg	
	$\bar{x}$	SE	$\bar{x}$	SE
♂♂	60.71	14.54	45.69	10.67
♀♀	56.22	12.35	40.16	5.00

hallucis longus and 60.45 µm for *m. gastrocnemius*. In the case of grey partridge, the diameter of muscle fibers ranges from 25.7 to 97.95µm (58.53 on average) for pectoral muscles as well as from 19.33 to 68.18µm (42.93µm on average) for leg muscles (Wnuk et al., 2013b). Similarly small diameters of breast muscle fibers accounting for 37.86–39.11µm and these of leg muscle fibers accounting for 63.55–66.54 µm were reported for Białe Kołudzkie geese (Biesiada-Drzazga et al. 2006) as well as for Silkie hens, i.e. 32.23 and 28.73 µm, respectively (Łukasiewicz et al. 2013). Along with the selection of livestock for a high growth rate, problems emerge with their muscle fibers which result in hyperplasia and the appearance of the so-called giant fibers, the diameter of which is usually threefold greater than that of normal fibers (Dransfield and Sosnicki 1999).

No giant fibers were observed in the analyzed muscles of grey partridges, that were characterized by a high contribution of fibers with small and medium diameters (Fig. 1). In addition, greater diameters of fibers of breast muscles (60.71 µm) and leg muscles (45.69 µm) were determined in the case of roosters compared to hens (Table 1). In the group of males, diameters of breast muscle fibers were relatively equal, 70–90% of the fibers in particular bundles had diameters in the range of 50–60 µm, and 10–30% of the fibers had diameters in the range of 25–40 µm. In the group of females, diameters of breast muscle fibers were more equalized and reached 55–60 µm in ca. 80–90% of the fibers and less than 25 µm in 10–15% of the fibers.

The same tendency was observed in case of leg muscles – larger diameters were demonstrated in males. Diameters of leg muscle fibers in the group of males were relatively equalized, i.e. 80––90% of fibers in particular bundles had diameters of 45 µm, and 10–30% of fibers had diameters in the range of 25–40 µm. In the group of females, the diameters of leg muscle fibers, likewise these of breast muscles, were more equalized compared to the males because 80–90% of fibers in particular bundles had diameters in the range of 35–40 µm, and in 10% of the fibers diameters were lesser than 20 µm.

Similar tendencies were observed for Hubbard JA 957 and Ayam Cemani chickens and their hybrids (Łukasiewicz et al. 2014), as well as for Cobb × Zk hybrids (Wnuk et al. 2013a), which simultaneously indicated the effect of sex on muscle fiber diameter and thereby confirmed results of earlier study by Khoshoii et al. (2013). According to Candek-Potokar et al. (1998), sex is one of the factors which affect the histological structure of muscles. A completely different opinion was expressed by Mobini et al. (2013) who did not demonstrate any effect of sex on muscle fiber diameter. It does not change the fact, however, that the presence of a high number of fibers with a small diameter may be indicative of meat tenderness. Fanatico et al. (2007) found that the selection for fast growth and high yield

have negatively impacted the sensory and functional qualities of the meat, pushing muscle fibers to their maximum functional size constraints.

CONCLUSIONS

The study showed no effect of sex on the diameter of muscle fibers of breast and leg muscles of grey partridge *Perdix perdix*. Generally, greater fiber diameters were determined in breast muscles. Worthy of notice is a small diameter of the fibers of the analyzed muscles, which is indicative of a delicate structure of grey partridge meat.

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Streszczenie: Charakterystyka włókien mięśniowych mięśni piersiowych i nóg kuropatwy polnej *Perdix perdix*. Materiał badawczy stanowiły kuropatwy polne *Perdix perdix* L. przeznaczone do wsiedlenia do środowiska naturalnego, odchowywane w Ośrodku Hodowli Zwierzyny na terenie województwa mazowieckiego. Do uboju wybrano po 10 kur i 10 kogutów. Ptaki ubito, a następnie pobrano próbki mięśni piersiowych (*pectoralis superficialis*) oraz mięśni nóg (*biceps femoris*). Większą średnicą włókien charakteryzowały się mięśnie piersiowe. Nie wykazano wpływu płci na średnicę włókien mięśni piersiowych i mięśni nóg kuropatwy polnej *Perdix perdix*.

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