Aiming to achieve better determination of meat quality of breast and legs of partridges histoenzymological and histochemical characteristics of muscle fibers of M. pectoralis superficialis and M. sartorius were studied. One year old partridges, five males and five females, were used. The samples of both muscles were frozen by liquid nitrogen. Serial sections of 10 μm were cut and stained with succinidehydrogenase (SDH), Oil red O and Sudan B. The stereological analysis of both muscles was performed by multipurpose test system M42. By following the enzymatic activity of SDH in the muscles mentioned above the presence of all the three types of muscle fibers were shown. A part of intermediary and white muscle fibers was predominant in M. sartorius. The volume density of muscle fibers in M. sartorius was intermediary – 48%, white – 36%, red – 11%, while the connective tissue was 5%. The presence of all the three types of muscle fibers was evident in M. pectoralis superficialis too, but in this case the white muscle was predominant. Volume density of muscle fibers in M. pectoralis superficialis was intermediary – 93%, white – 2%, red – 2%, and the connective tissue was 3%. The presence and distribution of lipid drops in the muscle fibers of the muscles mentioned, indicated the absence of neutral lipids (Oil red O) both in the muscle fibers of M. sartorius and of M. pectoralis superficialis. The lipid drops of phospholipids (Sudan B) were more numerous in the muscle fibers of M. sartorius, where they showed certain regularity of distribution, while these lipids could not be found in the muscle fibers of M. pectoralis superficialis.

Key words: partridge; muscles; histochemistry

Introduction

Partridge is species of our autochthonous avian fauna, typical member of agrobiotop, frequently hunted (Ristić, 1995). This species is also natural regulator of number of insects which have bad influence on agriculture, and that is much important characteristic of this bird, than its quality for hunting. We choose this kind of research, because this bird is more and more the farm bred species, and after that the hunting one. Beside that, there were no researches of this kind in our country, and there is also a few of them in other countries. Muscles have very complex chemical structure, there are a lot of different chemicals in them (proteins, pigments, lipids, glycogen, etc.), which gives high nutritive value of meat. In muscle fibers taking place very complex enzymatic reactions, which streams are different in aerobic and anaerobic conditions, and because of that, they causes post mortal-changes in muscles and take place in forming of meat-quality.

With this research, using appropriate histoenzymological and histochemical methods, we want to point at morphological specifications of breast and leg muscles, following the activity of succinidehydrogenase (SDH), and also the quantity and arrangement of lipids inside muscle fibers. These results, like the results of previous researches (Uscebrka et al., 1996; Uscebrka et al., 1997; Iwamoto et al., 2003), give the full view of meat quality of feathered game.
Material and methods

For this research, one year old partridges of both sexes were used, taken from main flock, bred in farm conditions. After taking out, partridges were transported into the batteries with controlled temperature, where they were 12 days. After the twelfth day, they were transported into voliers. During the breeding, from first day to six weeks, they were fed with standard mixtures for partridges, which contain 28% of proteins. From six weeks until the sacrifice, they were fed with complete feed with 18% of proteins and wheat in proportion 1:1. In each case, they were fed ad libidum.

Just before the transporting, in May, when the partridges were 12 months old, five males and five females, were randomly chosen. After the sacrifice, from each bird were taken the samples of breast muscles *M. pectoralis superficialis* and leg muscles *M. sartorius*, size of 1 cm$^3$, and after that, the samples of both muscles were frozen by liquid nitrogen on temperature of -196°C. In laboratory, they were cut on Cryo-cut (-20°C, sections of 10μm). These sections were fixed on microscopic plates and stained with standard methods for SDH (Gerebtzoff, 1970), neutral lipids (Disbery and Rack, 1970) and phospholipids (Bankroft, 1967). The stereological analysis includes volume density of red, white, intermediary fibers and connective tissue, using M-42 multifunctional test-system (Weibel, 1979). Counting is realized on 20 microscopic field of view on one animal (enlargement 100x). Microscopic analysis were done using Leica DMLS microscope, with digital camera Leica DC 300 and image-analyzer software IM 1000 (Leica Microsystem, Inc.).

Results and discussion

Skeleton muscles are group of various types of muscle fibers, which have different morphological, biochemical and functional characteristics. The differences of various fibers are: diameter, quantity of sarcoplasm and number of myofibers, number and arrangement of mitochondria and quantity of glycogen and myoglobin (Hraste, 1987). Identification of types of muscle fibers of *M. sartorius*, using mitochondrial enzyme SDH, point at all three types of muscle fibers (*Figure 1*).

![Figure 1. Microphotograph of the cross-cut of M. sartorius, one year old partridges; SDH; (10x10)](image-url)

Most of them are intermediary. Stereological analysis point that volume density of intermediary muscle fibers are 48%, white 36%, red 11%, and connective tissue 5% (*Figure 2*).
The basic of reaction is determination of activity of this enzyme, which is product of sedimentation of tetrazolium salt. At the places of high activity of SDH, sedimentation is bigger and those are red muscle fibers, and at the places of small sedimentation, those are white fibers (Gerebtzoff, 1970). The red muscle fibers are much more desirable from technological and meat quality point of view. Pyörnilä et al., 1998, pointed at significance of histochemical profile of *M. pectoralis* of wild partridge and its importance and activity in flying. These fibers have slow contractions, they tired very slowly, the circulation of blood and oxygen is much better in them and because of that they have aerobic transport (Fischer and Hoffman, 1978). These fibers use oxidation of fatty acids and lipids for energy source. Following the presence of various types of muscle fibers in hens of different breeds and sexes (Sijacki et al., 1986), we can conclude that the presence of red muscle fibers in *M. sartorius* in partridges is higher, and the diameter of the same fibers is smaller.

The presence of all three types of muscle fibers in *M. pectoralis superficialis* is evident. SDH is active in all sarcoplasm, but its activity is higher near sarcolemma (Figure 3).

Stereological analysis of this muscle shows that volume density of intermediary fibers were 93%, red 2%, white 2% and connective tissue 3% (Figure 4). Using histochemical staining for ATPase and succinate dehydrogenase (SDH), Pyörnilä et al., 1998, show that the most of breast-muscle fibers (80-90%) are of the fast-twitch glycolytic (FG) type and a smaller portion of the fast-twitch oxidative glycolytic (FOG) type, which is in proportion to our results. The burst power output in *M. pectoralis*
is much higher than it has been measured in other contracting muscles. This is achieved by physiological adaptations and high myofibrillar density, which allow fast production of energy and rapid contractions (Askew and Marsh, 2001; Askew and Marsh, 2002).

![Volume density of muscle fibers and connective tissue](image)

**Figure 4.** The volume density of muscle fibers and connective tissue in the m. pectoralis superficialis

Histochemical staining for neutral lipids showed their absence in myofibers of both muscles, but they were highly present between muscle fibers, especially in M. sartorius. Furthermore, phospholipids were clearly identified intracellular in M. sartorius, where they showed certain regularity in distribution in proportion to types of myofibers (Figure 5).

![Microphotograph of the cross-cut](image)

**Figure 5.** Microphotograph of the cross-cut of M. sartorius one year old partridges; Sudan black B; 10x10

The presence of phospholipids is very hard to identify in M. pectoralis superficialis, except in some single muscle fibers.

**Reference**


