

HISTOCHEMICAL CHARACTERISTIC OF *BICEPS FEMORIS* OF RHODE ISLAND RED AND GREENLEG PARTRIDGE HENS¹

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Abstract: On one hundred and seventy four hens of two different breeds (Rhode Island Red and Greenleg Partridge) histochemical investigation of the m. biceps femoris were done. The histochemical results from this experiment have shown that genotype affected the percentage of the muscle fibres. The significantly higher percentage of red fibre, and a lower percentage of white fibre together with higher body weight in R11 genotype can suggest an effect of higher mobile activity of R11 on their muscle physiology. The size of red and white fibres did not show any statistically significant differences between both examined groups.

Key words: histochemical characteristics, biceps femoris, Rhode Island Red and Greenleg partridge hens

Introduction and literature review

Muscle size is determined by number and size of the fasciculus composed of myofibres with different histochemical properties (*H. Iwamoto et al., 2002*) what based on enzymatic activity can define two types of fibres: type I – red fibres of very high activity, type and type II– white fibres of low activity (*Brook and Kaizer 1970*). According to *Ono et al* (1993) postnatal growth of skeletal muscle is accompanied by growth of individual muscle fibres, because the number of muscle fibres does not increase after hatching. Many works suggested that

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histochemical profile of muscle fibres is genetically determined and changes can depend from age, nutrition, sex and activity (Kłosowska, 1984). Huge improvement in meat production of birds has been made in the last 20 years by improving birds genotypes and nutrition. Improvements in carcass quality are associated with some less desirable characteristics of the meat. That from improved broilers lines tend to be of lesser quality (colour, water binding capacity, pH and sensory properties) than that from native breeds (Warriss, 2000).

Therefore, our study was undertaken to determine histochemical properties of muscle fibres and fibres type composition in two genetically different native poultry breeds.

Materials and methods

Study was carried out on 148 hens divided into 2 groups: 74 Rhode Island Red (R11) and 74 Greenleg Partridge hens (Z11). Birds from both groups were feed *ad libitum* with the same complete feed (starter, grower and finisher) for broiler chicken. All birds were kept on liter (wooden shaves) in groups with stocking density 12 birds/m² with free access to the water till 14 weeks of age. Body weights were measured 1 day before slaughtering and weight of leg muscle was calculated after slaughter.

Fragments of the *m. biceps femoris* tissue were taken immediately after slaughtering of animals and immediately frozen in liquid nitrogen. The activity of diaphorase was detected using specific histochemical tests (Dubovitz *et al.*, 1973) for distinguishing muscle fibre kinds. Frozen tissues were cut at 10 µm on a cryostat Slee MEV (Germany) at -25°C. Sections were incubated in medium contained nicotinamide adenine dinucleotide (NADH₂ – Sigma Chemical Co, St. Louis MO, USA) and nitro blue tetrazolium (Sigma Chemical Co, St. Louis MO, USA) at 37°C for 1 hour. Percentage distribution of fibre types was calculated from the 10-muscle bundles. All sections were observed and examined under a light microscope NIKON E600 (Nikon Corporation, Japan). The fibres sizes were determined according to Brooke and Kaiser (1970) using Multi Scan Base98. The data were analyzed by Student's *t*-test ($p \leq 0,05$). Data were presented as means \pm SE.

Results of investigations and discussion

Average body weight of 14 weeks old chicken for Rod Island Red was 1567.12 g and for Greenleg Partridge 1266.38 g, and weight of leg muscles respectively 221.30 g and 175.00 g. These differences are resulted by different origin and type of use.

Percentage distribution and diameter of muscle fibres are shown in table 1 and figures 1, 2.

Table 1. Percentage and diameters of muscle fibres in the *m. biceps femoris* ($\bar{x} \pm SE$)

Tabela 1. Procenat i prečnik mišićnih vlakana u *m. biceps femorisu* ($\bar{x} \pm SE$)

| Traits/osobine | Percentage of fibres/Procenat vlakana $\bar{x} \pm SE$ | | Diameters of fibres/Prečnik vlakana $\bar{x} \pm SE$ | |
|------------------------------|---|-------------------------------|---|-------------------------------|
| | Z11 | R11 | Z11 | R11 |
| White fibres/ Bela vlakna | 74.18 \pm 1.24 ^a | 69.92 \pm 0.95 ^b | 50.32 \pm 1.56 ^a | 54.17 \pm 1.49 ^a |
| Red fibres/ Crvena vlakna | 25.8 \pm 1.24 ^a | 30.08 \pm 0.95 ^b | 34.20 \pm 0.83 ^a | 35.96 \pm 0.94 ^a |

a, b – means with different letters differ at $p \leq 0.05$ / a,b – srednje vrednosti sa različitim slovima se razlikuju na nivou $p \leq 0.05$

In the current study significant differences in the percentage of fibre types between the three genotypes were observed. Muscles from R11 genotype had a lower percentage of white fibres, and a higher percentage of red fibres ($P \leq 0.05$), than muscles from Z11 animals. The size of red and white fibres was unaffected by genotype.

There are only few studies in the literature on the comparison of muscle fibre type composition of *m. biceps femoris* between different breeds. The histochemical profile of muscle from native breeds of hen is largely unknown. Several reports of work done in chickens, pigs and cattle have indicated that increases in the total muscle fibre numbers and muscle cross-sectional area are related to the age and weight of slaughter animals, and also to breed (Kłosowska 1984; Remignon *et al.*, 1994; Ruusunen and Puolanne, 1996). Berri *et al.* (2002) pointed out that the muscle fibre type composition and diameter can be influence by genotype and growth rate. It was found that fibre size and fibre

composition differed also between meat and egg-type chickens (*Sams and Janky, 1990*).

The histochemical results from this experiment have shown that genotype affected the percentage of the muscle fibres. The significantly higher percentage of red fibre, and a lower percentage of white fibre together with higher body weight in R11 genotype can suggest an effect of higher mobile activity of R11 on their muscle physiology (red fibre are slow twitch oxidative and they are mobilised with a slow and sustained motion). The size of red and white fibres did not show any statistically significant differences between both examined groups but we can observed a tendency that body weight at slaughter and type of growth can influence a diameter of white fibre.

Conclusion

Type of genotype affected the percentage of the muscle fibres. The significantly higher percentage of red fibre, and a lower percentage of white fibre together with higher body weight in R11 genotype can suggest an effect of higher mobile activity of R11 on their muscle physiology (red fibre are slow twitch oxidative and they are mobilised with a slow and sustained motion).

HISTOLOŠKO - HEMIJSKE KARAKTERISTIKE *BICEPS FEMORISA* KOD RHODE ISLAND RED I GREENLEG ŽENKI JAREBICA

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Rezime

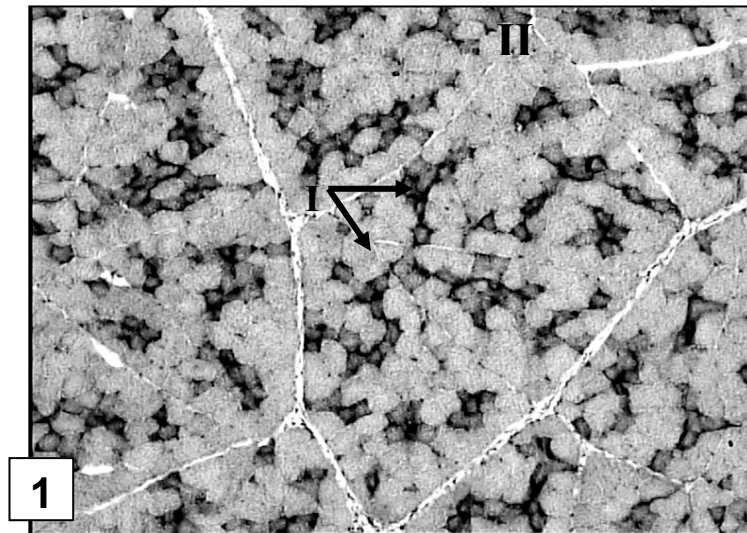
Cilj ovog ispitivanja je bio određivanje histološko-hemijskih osobina mišićnih vlakana i sastava tipova vlakana kod dve autohtone rase živine koje se genetski razlikuju. Ispitivanje je urađeno na 148 ženki koje su bile podeljene u dve grupe: 74 Rhode Island Red (R11) i 74 Greenleg ženke jarebice (Z11). Histološko-hemijski rezultati ogleda su pokazali da je genotip uticao na procenat mišićnih tkiva. Signifikantno veći procenat crvenih vlakana i niži procenat belih vlakana zajedno sa većom telesnom težinom kod R11 genotipa ukazuju na uticaj veće pokretljivosti i aktivnosti R11 na fiziologiju njihovih mišića (crvena

vlakna su spora oksidativna i mobilišu se samo u sporim i smanjenim pokretima).

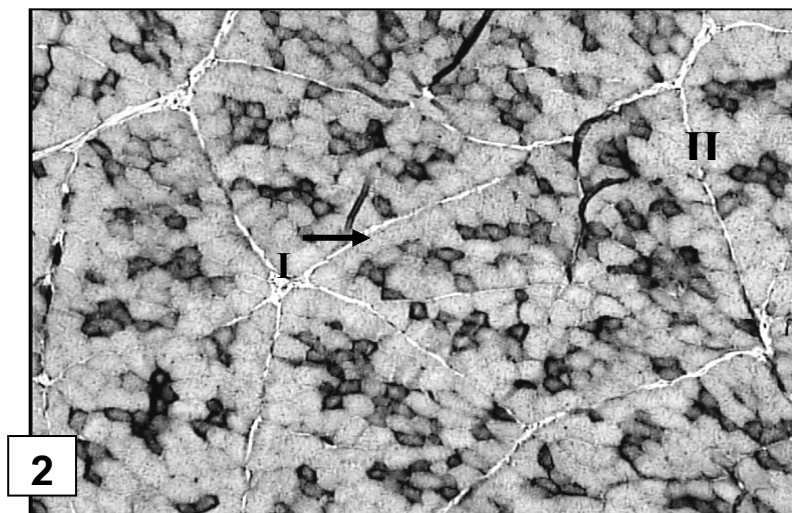
Ključne reči: histološko-hemijske karakteristike, biceps femoris, Rhode Island Red i Greenleg ženke jarebice

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*Figure 1. Cross section of the m. biceps femoris in Z11 group.
Diaphorase activity reaction: I-red fibres, II- white fibres*
*Slika 1. Presek m. biceps femoris u grupi Z11. Reakcija na aktivnost
diaforeze: I-crvena vlakna, II-bela vlakna*



*Figure 2. Cross section of the m. biceps femoris in R11 group.
Diaphorase activity reaction: I-red fibres, II- white fibres*
*Slika 2. Presek m. biceps femoris u grupi R11. Reakcija na aktivnost
diaforeze: I-crvena vlakna, II-bela vlakna*