Histological Analysis of Selected Muscles in Ostrich
(Struthio camelus var.dom.)

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Abstract
We found that the percentage of individual muscle components show statistically significant differences in all analyzed muscles. More α-red fibers were found in m. iliotibialis lateralis and m. femorotibialis externus, while abundance of white (α-white) muscle fibers was very low. Unlike other species of birds (turkey, chicken, geese) in all studied muscles, proportion of all red fibers (α-red and β-red) greatly exceeded the proportion of white muscle fibers (α-white). Adipose tissue content in individual muscles ranged from 0.0% (m. iliotibialis lateralis) to 1.67% (m. gastrocnemius).

Keywords: histological analysis, muscles, ostrich

1. Introduction
While in mammals the complete dominance of one type of muscle fiber occurs rarely, in birds there was a significant separation of white fibers into 'flying (pectoral muscles), which represent the white meat, but they lack of ostrich. Muscles of the pelvis and hind are mixed with a predominance of red fibers and they represent red meat. This is related to embryonic development and the type of muscle innervation [1, 2, 6].

The aim of this study was to describe and evaluate histochemical structure of selected muscles of ostrich.

2. Materials and methods
For histochemical analysis of muscle, were used 6 pieces of Red-footed ostrich (Struthio camelus var.dom.) were used. Ostrich were reared in the Ocova farm. Processed carcass weight ranged from 50.3 kg to 72.5 kg. After slaughtering, samples of muscle tissue were collected. Samples for histochemical examination were collected 20 minutes after the slaughtering from m.femorotibialis medius, m.iliotibialis lateralis, m.iliotibialis cranialis, m.femorotibialis externus and m.gastrocnemius.

Samples for histological evaluation were sectioned into 10-15μm thick slices with MINICRYOSTAT MTC instrument at temperature of -20°C. Sections were stained with oil-red to prove neutral lipids. Single types of muscle fibers were differentiated according to reaction for succinate dehydrogenase (SDH) into three groups: white (αW), intermediate (αR) and red (βR) muscle fibers, on the basis of method by Vacek [9]. Sections were subjectively and quantitatively evaluated. Percentual abundance of muscle fibers, connective and fat tissue and average thickness of single types of muscle fibers were evaluated by microscopic system Nikon Eclipse E 600 and camera Pixelink (PL-A642) in connection with software for image analyse Lucia 4.8. Basal statistical indicators and correlations were

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calculated from obtained data using Microsoft Office and Statgraphics statistical software. Basic variational and statistical characteristics and the observed differences by ANOVA, F-test and Scheffe test were tested.

3. Results and discussion

In all selected muscles, which represents muscles of pelvic limb, thigh and calf, dominated by β-red and α-red muscle fibers over α-white muscle fibers. The different results reached Uhrin [10] in turkeys and chickens, he found that a significantly higher proportion of white fibers in the m. pectoralis major in turkeys and chickens (97% and 95%) compared with the same muscles in geese and pigeons (47% and 18%). Also found that the red fibers in the m. semimembranosus also contain a relatively high percentage of white fibers (70% turkey, 71% chicken, 59% goose and pigeon 61%).

Table 1. Percentage of individual structural components of selected muscles in ostrich (Struthio cam. var. dom.)

<table>
<thead>
<tr>
<th>Muscle</th>
<th>α-white</th>
<th>α-red</th>
<th>β-red</th>
<th>Connective tissue</th>
<th>Adipose tissue</th>
</tr>
</thead>
<tbody>
<tr>
<td>m. femorotibialis medius</td>
<td>22.59</td>
<td>30.37</td>
<td>30.41</td>
<td>15.0</td>
<td>1.63</td>
</tr>
<tr>
<td>m. iliotibialis lateralis</td>
<td>2.67</td>
<td>56.01</td>
<td>23.34</td>
<td>19.78</td>
<td>0.0</td>
</tr>
<tr>
<td>m. iliotibialis cranialis</td>
<td>23.78</td>
<td>19.11</td>
<td>35.33</td>
<td>19.28</td>
<td>2.0</td>
</tr>
<tr>
<td>m. femorotibialis externus</td>
<td>2.67</td>
<td>47.33</td>
<td>30.00</td>
<td>18.52</td>
<td>1.48</td>
</tr>
<tr>
<td>m. gastrocnemius</td>
<td>16.62</td>
<td>30.43</td>
<td>32.10</td>
<td>19.18</td>
<td>1.67</td>
</tr>
</tbody>
</table>

From Table 1 we see that the connective tissue of muscle represents 15 to 19% and adipose tissue an average of 1.5%. These compounds significantly affect the quality and nutritional value of ostrich meat, which can be classified as a dietary meat, its analysis being confirmed by various authors [3, 5, 8]. Botha et al [7] found that the amount of connective tissue of the muscles in the lower leg (calf), m. gastrocnemius and m. fibularis longus had significant effect (P<0.05) for the meat yield of the muscles.

Table 2 shows that significant differences in the thickness of different types of muscle fibers were found in white (α–white) and red (β-red) fibers in all analyzed muscles. Significant differences of the thickness of red and intermediate muscle fibers are found only in m. iliotibialis cranialis and m. femorotibialis externus.

Table 2. The average thickness (µm) of muscle fiber types in selected muscles of the ostrich (Struthio cam. var. dom.)

<table>
<thead>
<tr>
<th>Muscle</th>
<th>α-white</th>
<th>α-red</th>
<th>β-red</th>
</tr>
</thead>
<tbody>
<tr>
<td>m. femorotibialis medius</td>
<td>87.07</td>
<td>79.50</td>
<td>75.78</td>
</tr>
<tr>
<td>m. iliotibialis lateralis</td>
<td>88.50</td>
<td>77.01</td>
<td>75.25</td>
</tr>
<tr>
<td>m. iliotibialis cranialis</td>
<td>72.27</td>
<td>66.83</td>
<td>57.53</td>
</tr>
<tr>
<td>m. femorotibialis externus</td>
<td>87.92</td>
<td>75.29</td>
<td>65.16</td>
</tr>
<tr>
<td>m. gastrocnemius</td>
<td>75.46</td>
<td>62.10</td>
<td>59.67</td>
</tr>
</tbody>
</table>

Conclusion

We found that the percentage of individual muscle components show statistically significant differences in all analyzed muscles. More α-red fibers were found in m. iliotibialis lateralis and m. femorotibialis externus, while abundance of white (α-white) muscle fibers was very low. Unlike other species of birds (turkey, chicken, geese) in all studied muscles, proportion of all red fibers (α-red and β-red) greatly exceeded the proportion of white muscle fibers (α-white), which can be justified by the ostrich mainly "rushed" way of life - running at high speed over long distances [1].
We found that white (α-white) fibers of ostriches are generally thickest, intermediate (α-red), medium thick and red (β-red) muscle fibers were thinnest. Adipose tissue content in individual muscles ranged from 0.0% (m. iliotibialis lateralis) to 1.67% (m. gastrocnemius), which agrees with the findings of other authors [2, 4]. Higher proportion of connective tissue components was found. This fact partially deteriorates the technological quality of meat. In general terms, ostrich meat is considered a dietary very reasonable due to its low fat content.

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References