INFLUENCE OF SEASON ON PIG CARCASS AND
M. semimembranosus QUALITY

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Partial dissection method showed significantly higher (P<0.05) meat yield in carcasses of pigs fattened in the winter (57.5%), comparing with the meat yield of pigs fattened in the autumn (55.2 %), but not significantly higher comparing to the meat yield of pigs fattened in spring (56.4 %) (P>0.05).

On the basis of technological parameters (pH\textsubscript{i}, pH\textsubscript{u}, colour\textsubscript{u} – L* and water-holding capacity) and our own criteria for evaluating the technological quality of meat, it was determined that the incidence of PSE (pale, soft, exudative) meat M. semimembranosus was the highest in the spring (51.4%), lower in the autumn (29.8%), and the lowest in the winter (28.9%). The greatest incidence of RSE (reddish, soft, exudative) and RFN (reddish, firm, non-exudative) meat M. semimembranosus was found in winter (33.3%). The incidence of PFN (pale, firm, non-exudative) meat M. semimembranosus was the greatest in autumn (40.5%), while in winter and spring it was quite low, and approximately the same (2.0%). The lowest incidence of DFD (dark, firm, dry) meat (M. semimembranosus) was in winter (2.2%), and in autumn and spring it was 4.8% and 5.8%, respectively. The protein content in M. semimembranosus from the halves of pigs, in different seasons, was higher than 21%, and this is the demand that has to be fulfilled in modern breeding of pigs. The average free fat content in M. semimembranosus was very low, ranging from 0.75% in spring to 0.94% in autumn and winter.

KEY WORDS: pig, season, carcass quality, M. semimembranosus quality

INTRODUCTION

A number of factors influence the courses and intensity of post mortem changes in muscles, and these factors can be divided in two primary groups. This means that the changes of muscle quality and quality of meat depends on genetics (endogenous factors), and are activated by the impacts of the environment (exogenous factors). Two main defects are: “Pale Soft and Exudative” (PSE) meat and “Dark Firm and Dry” (DFD) meat. PSE meat occurs when the pigs suffer acute stress before slaughtering (1).

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When there are sufficient energy reserves in the muscles, the initial pH (pH$_i$) can drop very fast post-mortem due to the production of lactic acid. This pH drop causes a denaturation of the myosin and sarcoplasmic proteins and results in pale meat with a low "water-holding capacity" (2-4). On the other hand, the DFD meat occurs when the animals suffer chronic stress and skeletal muscles deplete their energy stores. As a result, there is almost no lactic acid production after slaughter, and DFD meat is therefore characterized by a high final pH value 24 h after slaughter (pH$_u$), a dark colour and a high water-holding-capacity (5). Consequently, the greatest improvement in pork quality can be achieved by decreasing stress in the immediate preslaughter period (6).

Pigs are particularly sensitive to high temperature (7,8). According to Briskey (9) Ludvigsen has found that the incidence of PSE muscle is higher in warmer periods. Patricia Barton-Gade (10), in Denmark, found more PSE meat in summer and autumn than in winter. As pigs do not have working sweat glands, they are sensible to high temperatures, hence, abattoirs should be very careful in summer, when the risk on PSE meat is much higher than in winter (11). In contrast, the probability of occurrence of DFD pork is higher in winter than in summer (12). Krzecio et al. (13) investigated different HAL genotypes in different seasons and pointed to higher incidence of PSE meat in spring-summer compared to autumn-winter. However, Scheper (14), in Germany, found PSE and DFD meat incidences to be higher in autumn and summer than in spring and summer. Manjlović and Rahelić (15) found almost two times higher incidence of PSE meat in the period when the climate factors are changing, e.g. spring and autumn than in summer and winter. Warriss (16) found greater water loss, and more pale M. longissimusdorsi in the carcases of pigs slaughtered when t > 18.3°C, comparing to slaughtered when t < 18.3°C. Okanović et al. (17) showed that the highest incidence of PSE meat, regarding total mass of ham, is in spring. Džinić et al. (18) reported a higher incidence of PSE meat (according to the quality criterion pH$_i$< 5.8) non-depending on genotype of three-race hybrids at spring (31.25 %), than in winter (7.7%). The investigated M. semimembranosus, of three-race hybrids, at autumn, winter and spring were on the average of PSE quality regarding criteria for "water-holding capacity", e.g. and RSE regarding criteria for colour $L^*$. The occurrence of PSE and DFD meat might have important economic implications. PSE trait is internationally recognized as a major economic risk factor for fresh and processed pork (19). Therefore, it is very important that meat quality can be predicted early in the slaughter line in order to match the observed quality with the right application.

Meat quality or “fitness for use” can be defined by the application of different measurements, including pH, Pork Quality Meter (PQM), temperature, sensory characteristics, colour and "water-holding capacity“. Generally, PSE/DFD meat is identified on the base of pH value, colour ($L^*$ value) and drip loss (20). However in some cases PSE meat is identified only on the basis of colour and drip loss (21). Nevertheless, there is no golden standard to define PSE/DFD meat.

Therefore, the objective of this study was to investigate the influence of seasons on the quality of carcasses and pork determining the meat yield (%) and technological, sensory and nutritive quality of M. semimembranosus, and incidence of different M. semimembranosus quality (RFN, RSE, PSE, PFN, DFD) on the basis of technological parameters: pH$_i$, pH$_u$, "water-holding capacity“ and $L^*$ and our own criteria for quality estimation (18, 22-25).
EKSPERIMENTAL

The investigations included 164 pigs from the same farm in Serbia. The pigs were slaughtered and investigated in autumn (n=84), winter (n=45), and spring (n=35). The pigs were fed standard feed during fattening, and heads of approximately uniform age and mass were transported to the slaughterhouse. After a night rest, the pigs were stunned, debleeded and processed by the standard technological procedure.

Meat yield (%) was determined by partial dissection method (26) of cooled left halves.

The pH_i was determined on right halves 45 min post mortem, and pH_u 24 hours p.m. in the caudomedial part of muscle M. semimembranosus (MSM) using the pH-meter ULTRA X, type UX 390, Gronert (Germany) INGOLD penetrating electrode. Samples (200 – 300 g) MSM were used 24 hrs p.m. for the determination of technological, sensory and nutritive quality of meat. The colour was determined sensorially (1 – very pale; 7 – very dark) and with Minolta Chroma Meter CR-400. The colour characteristics were expressed in CIE L*a*b* system (lightness L*). “Water-holding capacity” (WHC_u) was determined by filter paper press method and expressed in % of hold water (28). Marbleness was determined sensorially, applying the analytical descriptive test (1 – without marbleness; 10 – very expressed marbleness).

Basic chemical composition of meat was estimated by the determination of moisture (29), protein (30), free fat (31) and total ash (33) contents.

The incidence of different MSM quality in different seasons was determined on the basis of the parameters and criteria for MSM quality (18, 22, 23, 25):

PSE (Pale, Soft, Exudative): pH_i < 5.8, pH_u < 6.2, WHC_u<50 %, L* >50;
RSE (Reddish, Soft, Exudative): pH_i< 5.8, pH_u< 6.2; WHC_u<50 %, L*= 43-50;
RFN (Reddish, Firm, Non-exudative): pH_i> 5.8, pH_u< 6.2, WHC_u>50 %, L*=43-50;
PFN (Pale, Firm, Non-exudative): pH_i> 5.8, pH_u< 6.2, WHC_u>50 %, L*>50;
DFD (Dark, Firm, Dry): pH_i> 5.8, pH_u> 6.2, WHC_u>50%, L* <43.

Statistical analysis

Analysis of variance (one-way ANOVA) was used to test the hypothesis about differences among more mean values. The software package STATISTICA 8.0 (STATISTICA, 2008) was used for the analysis.

RESULTS AND DISCUSSION

Meat yield for pigs (Table 1) in the winter (57.5 %) was significantly higher (P < 0.05) comparing with the meat yield of pigs in the autumn (55.2 %), but not significantly higher comparing to the meat yield in spring (56.4 %) (P > 0.05).
Table 1. Meat yield in pig halves determined in different seasons by partial dissection

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Season</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Autumn</td>
</tr>
<tr>
<td>Mass of halves (kg)</td>
<td>38.3 ± 2.6</td>
</tr>
<tr>
<td>Meat yield in halves (%)</td>
<td>55.2b ± 4.1</td>
</tr>
</tbody>
</table>

Table 2. Effect of seasons on technological, sensory and nutritive quality of *M. Semimembranosus*

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Season</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Autumn</td>
</tr>
<tr>
<td>pH&lt;sub&gt;i&lt;/sub&gt;</td>
<td>6.20&lt;sup&gt;a&lt;/sup&gt;±0.30</td>
</tr>
<tr>
<td>pH&lt;sub&gt;u&lt;/sub&gt;</td>
<td>5.80&lt;sup&gt;a&lt;/sup&gt;±0.24</td>
</tr>
<tr>
<td>WHC&lt;sub&gt;u&lt;/sub&gt; (%)</td>
<td>49.69&lt;sup&gt;a&lt;/sup&gt;±2.87</td>
</tr>
<tr>
<td>L*</td>
<td>52.10&lt;sup&gt;a&lt;/sup&gt;±5.02</td>
</tr>
<tr>
<td>Colour (sensory)</td>
<td>3.88&lt;sup&gt;a&lt;/sup&gt;±1.31</td>
</tr>
<tr>
<td>Marbleness</td>
<td>4.10&lt;sup&gt;a&lt;/sup&gt;±1.62</td>
</tr>
<tr>
<td>Protein (%)</td>
<td>22.23&lt;sup&gt;a&lt;/sup&gt;±0.89</td>
</tr>
<tr>
<td>Moisture (%)</td>
<td>75.73 ±0.94</td>
</tr>
<tr>
<td>Free fat (%)</td>
<td>0.94±0.41</td>
</tr>
<tr>
<td>Total asch (%)</td>
<td>1.13±0.10</td>
</tr>
</tbody>
</table>

Mean values within a row with different superscripts differ (P < 0.05)
The protein content in MSM (Table 2) from the halves of pigs in different seasons, was higher than 21%, and this is the demand that has to be fulfilled in modern breeding of pigs (37). This parameter was ranging from 21.94% in MSM in winter to 22.35% in MSM of the halves in spring. Significant differences (P < 0.05) of protein content in MSM of the halves of pigs, in different seasons, were estimated. The average free fat content in MSM was very low, ranging from 0.75% in spring to 0.94% in autumn and winter. The differences in the free fat of MSM in autumn-spring and winter-spring were (P< 0.05)significant.

The highest occurrence of PSE meat was in the spring (51.4 %), slightly lower in the autumn (29.8 %) and the lowest in the winter (28.9 %) (Fig. 1). Furthermore, the greatest incidence of RSE meat was in the winter (33.3 %), comparing to muscles from the pigs carcass analysed in the spring (25.7 %) and autumn (9.5 %). These results are in accordance with the findings of Manojlović and Rahelić (15), Okanović et al. (17) and Džinić et al. (18).

The incidence of RFN meat (normal quality) was small, and was higher in winter (33.3 %), than in autumn (15.5 %) and spring (14.3 %). The incidence of PFN meat was the highest in autumn (40.5 %), while in winter and spring it was quite low, and approximately the same (2.2 %; 2.3 %). The lowest incidence of DFD (dark, firm, dry) meat (*M. semimembranosus*) was in winter (2.2%), and in autumn and spring it was 4.8% and 5.8%, respectively.

![Figure 1. Incidence(%) of different *M. semimembranosus* quality, in different seasons, based on the criteria and parameters of pHᵢ, pHₑ, L* and WHCₑ](image)

CONCLUSION

Summarising the results of carcass and meat quality of pigs in different seasons, it can be concluded that the best carcass quality was in the winter (57.5%). On the basis of parameters (pH_i, pH_u, L* and WHC_u) and criteria for the evaluation of technological meat quality, it was found that the poorest quality of MSM was in the spring (RFN = 14.3%; PSE = 51.4%) and autumn (RFN = 15.5%; PSE = 29.8%). Meat quality, on average, was slightly better in the winter with 33.3% incidence of RFN (normal quality) meat.

Acknowledgements

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УТИЦАЈ ГОДИШЊЕГ ДОБА НА КВАЛИТЕТ ПОЛУТКИ И МЕСА (M. semimembranosus) СВИЊА

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Методом парцијалне дисекције утврђен је сигнификантно (P < 0,05) већи принос mesa у полуцкама свиња храњених у зиму (57,5%), у поређењу са приносом mesa у полуцкама у јесен (55,2%), као и приносом mesa у полуцкама у пролеће (56,4 %) (P > 0,05). На основу технолошких параметара (pHl, pHk, боје L* и способности везивања воде) и наших критеријума за квалитет mesa, утврђено је да је учесталост БМВ mesa (блед, мек, водњикав) M. semimembranosus највећа у пролеће (51,4%),
нешто нижа у јесен (29,8%), а најнижа у зиму (28,9%). Највећа учесталост РСЕ (црвеноружичаст, мек, водњакав) и ЦЧН (црвеноружичаст, чврст, неводњикав) меса (*M. semimembranosus*) утврђена је у зиму (33,3%). Највећа учесталост БЧН (bled, чврст, неводњикав) меса *M. semimembranosus* је у јесен (40,5%), док је у зиму и пролеће ниска и износи око 2%. Најнижа учесталост ТЧС (tamно црвен, чврст, сув) меса (*M. semimembranosus*) утврђена је у зиму (2,2%), а у јесен и пролеће износи 4,8% и 5,8% респективно. Садржај протеина у *M. semimembranosus* са полутки свиња у различитим годишњим добима је већи од 21% и одговара захтевима савременог узгоја свиња. Садржај слободне масти у *M. semimembranosus* је веома низак и у распону је од 0,75% са полутки у пролеће до 0,94% са полутки у јесен и зиму.

**Кључне речи:** свиње, годишње доба, квалитет полутки, квалитет *M. semimembranosus*

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