Quality of Slavonian hams on the third national ham festival

SUMMARY

Slavonian ham is a traditional Croatian cured meat product. There were 19 hams registered for evaluation, produced by different and mostly commercial producers. Except for organoleptic (sensory) characteristics, the pH-value of ham meat (M. semimembranosus) has been determined by the pH-meter Mettler Toledo, as well as meat color parameters (“L” and “a” value), which have been determined by the chromo meter Minolta CR-410. Evaluation results indicate the variability of quality of Slavonian ham. High and significant correlations have been determined among sensory characteristics of ham (appearance, cross-section appearance, consistency, smell, taste), both mutually and with average grade of

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INTRODUCTION

Slavonian ham is a national Croatian dry-cured product. The quality of this product hasn’t been standardized yet, i.e. it is quite variable in comparison with some other pork ham products (Istrian dry-cured ham, Drniš dry-cured ham). There are no information about Slavonian ham in professional literature. Vuković et al (2005) have pointed out some characteristics of Syrmian ham. Many factors affect the ham quality and they can be divided on factors of fresh ham quality (raw material) and factors of fresh ham processing technology (ham). Factors of fresh ham quality are pig genotype (breed, hybrids, sex, etc.), technology of pig fattening (breeding manner, feeding, weight, accommodation conditions, etc.) and treatment of pigs before slaughter. Factors of fresh ham processing technology (hams) are: technique of ham processing, texture of brine and techniques of pickling, techniques of smoking (drying), microclimatic conditions during processing, conditions of ham ripening, etc. It follows from above that ham production is a complex process which is far from being simple. For the purpose of quality improvement and promotion of Slavonian ham, a competitive manifestation takes place in Stari Mikanovci near Vinkovci and it is the national ham festival. Regarding the lack of information about Slavonian ham in professional literature, this review points out the results of analysis of Slavonian ham quality on this year’s national ham festival.

METHOD OF EVALUATION

There were 19 hams registered for evaluation, produced by different, and mostly commercial producers from the Slavonian area (twelve producers from the County of Vukovar-Srijem, four producers from the County of Osijek-Baranya, two producers from the County of Slavonski Brod-Posavina, and one producer from the County of Požega-Slavonia). Professional commission of five
members carried out the ham evaluation. The following indicators of ham quality were being evaluated: appearance (1-7 points), cross-section appearance (1-8 points), smell (1-10 points), consistency (1-10 points) and taste (1-15 points). Ranking of hams was carried out according to the average total points score by five evaluators in the following classes: gold medal (46-50 points), silver medal (41-45 points) and bronze medal (35-40 points). This method of ham evaluation is original and it was used for the first time on the second ham festival in Stari Mikanovci in 2006. Except for organoleptic (sensory) characteristics evaluated in the competitive manifestation, and for the purpose of defining some objective parameters of quality, pH-value of ham meat (M. semimembranosus) was determined by the pH-meter Mettler Toledo, as well as parameters of meat color ("L" and "a" value) by the chromometer Minolta CR-410.

**HAM EVALUATION RESULTS AND DISCUSSION**

Average values and dispersion measures of indicators of Slavonian ham quality are shown in Chart 1.

Values of the analyzed physico-chemical indicators (pH, "L" and "a" values) of ham meat were satisfying. It is normal for pH-values of hams, dry-cured hams and other smoked and cured meats to increase because of accumulation of alkaline proteolytic products. Chizzolini and associates (1996) determined that pH-value of *M. semitendinosus* in ripe Parma dry-cured ham was 5.83. Martin and associates (1999) specified that pH-value of *M. biceps femoris* of ripe Iberian dry-cured ham was 5.94. Average values of sensory characteristics of hams resulted in average grade of 32.80 points, which means that it hasn’t reached lower limit for bronze medal (35 points). One gold, two silver and two bronze medals were awarded at the competitive manifestation. The highest variability (28.06%) was for the grade for appearance, and the lowest was for consistency (19.10%). Variability causes of ham quality are very different: uneven masses of hams and uneven quality of hams for processing, non-standard technology of pork ham processing, and mistakes in processing technology (salting, smoking-drying, ripening). Uneven quality of hams for processing is a consequence of slaughtering pigs of different genotypes, at different times, i.e. with different weight, sex, feeding manners and kinds of food, treatment of pigs before slaughter, etc.

The following mistakes in ham quality were recorded: unsatisfying shape, pale, brown or other unwanted color, rather fat layer of subcutaneous fat tissue, unpleasant smell, putrefaction, smelly ripening, sedimentation of tyrosine crystals, too soft consistency, insufficient or over saltiness, uncharacteristic taste, etc.

**Appearance** of hams wasn’t homogenous. It was noticed that not all hams were symmetrically semi circularly shaped in a way that their lower edge is of about 6 cm away from the femur (picture 1). Hams sometimes have some cuts and larger accumulations of mould on their surface, or mould has been washed. Some hams were skinned (picture 2). A ham should be properly and primarily processed and properly shaped. It has to be without

![Figure 3. Depositions of tyrosine crystals on the ham cross section](image_url)
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Sacrum and hip bones and with the whole femur. Edges of ham should be properly trimmed, i.e. fresh ham should be semi circularly shaped so that the lower edge is approximately 6 cm away from head of the femur. Ham mustn’t have any cuts or holes. It should be completely covered with skin from the outer side, and inside it is partly covered with skin and the other part are muscles, with completely visible head of the femur. Skin must be clean, dry, light to dark brown and of homogenous color, without any cuts, and without or with very little mould on it. Brown mould on hams is connected to lower air humidity during ripening, and good hams are accompanied by it, whereas white mould is a result of high air humidity (85-95%) in rooms for ripening of hams. There mustn’t be any noticeable traces of cleaning and washing ham mould. Skin on ham mustn’t be wrinkled or with hairs.

Cross-section appearance was sometimes inhomogeneous considering the structure and color. Appearance of pale, brown or any untypical meat color and white crystals of tyrosine amino acid were noticed (picture 3), as well as thicker subcutaneous fat tissue (picture 4), sometimes of yellow color. Cross-section appearance of ham should be homogeneous considering the structure and color. Ham mustn’t have too many deposits of fat tissue, but it should have as much subcutaneous fat tissue as necessary to enable gradual ham drying and ripening. It is known that hams of male castrates are greasier than hams of female pigs, i.e. they have a fatter layer of subcutaneous fat tissue and a better marble-like appearance (Gou and associates, 1995). A light saturation of muscles with fat (marble-like appearance) is desirable because it positively affects the organoleptic characteristics of ham. This characteristic depends on pig genotype and feeding manner. Meat color can vary from light red to dark red (depending on genotype, oldness and feeding of pigs) and fat tissue color should be white. The color of muscular and fat tissue must be homogenous. The unwanted changes of ham meat color are: brown, green and untypical. Brown meat color in cross-section appearance of ham is connected to dehydration, when pigment myoglobin from muscular tissue becomes metmyoglobin. Low relative air humidity

Table 2. Correlations between (r) physico-chemical and sensory indicators of quality of Slavonian hams (n=19)

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>$X_1$ pH</th>
<th>$X_2$ „L“</th>
<th>$X_3$ „a“</th>
<th>$X_4$ Appearance</th>
<th>$X_5$ Cross-section appearance</th>
<th>$X_6$ Smell</th>
<th>$X_7$ Consistency</th>
<th>$X_8$ Taste</th>
<th>$X_9$ Average value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$X_1$ pH</td>
<td>-</td>
<td>-0,113</td>
<td>-0,193</td>
<td>0,166</td>
<td>0,293</td>
<td>0,387</td>
<td>0,385</td>
<td>0,313</td>
<td></td>
</tr>
<tr>
<td>$X_2$ „L“</td>
<td>-0,410</td>
<td>0,213</td>
<td>0,120</td>
<td>0,068</td>
<td>0,145</td>
<td>0,068</td>
<td>0,015</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$X_3$ „a“</td>
<td>-0,484*</td>
<td>0,410</td>
<td>0,213</td>
<td>0,427</td>
<td>0,357</td>
<td>0,394</td>
<td>0,404</td>
<td>0,433</td>
<td></td>
</tr>
<tr>
<td>$X_4$ Appearance</td>
<td>-</td>
<td>0,759**</td>
<td>0,756**</td>
<td>0,721**</td>
<td>0,757**</td>
<td>0,840**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$X_5$ Cross-section appearance</td>
<td>-</td>
<td>0,932**</td>
<td>0,771**</td>
<td>0,834**</td>
<td>0,912**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$X_6$ Smell</td>
<td>-</td>
<td>-0,894**</td>
<td>0,935**</td>
<td>0,969**</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>$X_7$ Consistency</td>
<td>-</td>
<td>-0,950**</td>
<td>0,945**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$X_8$ Taste</td>
<td>-</td>
<td>-0,974**</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

** Figure 4. Ham with pronounced subcutaneous fat tissue
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in rooms for ham ripening contributes to that appearance, but also too large amounts of added nitrates. Green meat color is caused by bacterial impact and high temperatures during the salting of fresh hams. It occurs during rotted and smelly ham ripening. Light color of meat is a consequence of insufficient smoking, or processing pale, soft or exudative meat (PSE). PSE- meat appears more often with some markedly bacon- type pigs (e.g. Pietren) or it is a consequence of pigs’ stress before slaughter. Pale meat color can also be a consequence of smaller quantity of myoglobin in pigs’ muscles or poor oxidation of myoglobin to light red oxymyoglobin.

Yellow color of fat tissue in hams, with the taste of rustiness, appears because of oxidation of fat acids in conditions of high temperature, high air humidity and exposure to light during ham ripening.

There are sometimes white sediments of crystals of tyrosine amino acid (precipitation), which is a consequence of more intensive proteolysis or of freezing fresh hams before processing. It appears more often with high- bred, markedly bacon- type pigs and with hams which have been longer in storage. The etiology of this appearance hasn’t yet been completely scientifically explained. Some breeds, like Belgian landrass and Pietren, which are highly stress sensitive, often have the occurrence of PSW meat and tyrosine sediments in hams (Guerrero et al., 1996).

Smell of hams was sometimes smoky, or even unpleasant, because of rotted process (picture 5). The smell of ham must be specific and pleasant. It is affected by factors of processing, but also enzymatic meat composition (endopeptidase and exopeptidase, lipases and esterases) which is affected by a pig genotype. Therefore, for example, the meat of hybrids with Belgian landrass breed has a low level of exopeptidase and it is not prone to creating precursors of characteristic smell and taste (Amor et al., 1999a, 1999b, 1999c). Proteolytic and lipolytic activity in fresh hams, which finally affects the smell of hams, also depends on weight of pigs (Toldrá, 1998). Fresh hams of heavy pigs have a higher level of peptidase than proteinase activity, a higher activity of lipases and pyrogulutamic aminopeptidases. Fresh hams of light pigs, on the other hand, contain more water, more cathepsin B and cathepsin B+L, and a lower activity of peptidases. A high activity of cathepsin B, with low concentrations of added salt, increases proteolysis, and a consequence can be over softness and occurrence of tyrosine crystals on hams’ cut surface (Sarraga et al., 1993). Hams mustn’t have too intensive smell of smoke, ammonia, rustiness, fish, urine (sex), etc. A specific smell of urine appears when processing fresh hams of boars and a smell of fish appears because of feeding pigs with fish flour in the final stage of fattening. Meat can also absorb smells of other substances during feeding of pigs with different by- products. Ham rotting appears because microorganisms break through in the meat during animal’s life (disease) through blood, during slaughterhouse- processing and fresh ham processing (dirty knives and wiping cloths, and generally, bad hygiene). Bacteria disintegrate proteins, so different compounds of unpleasant smell arise. If disintegration of organic substance happens anaerobic, rotting happens slower and a really smelly rotting appears (Rahelic et al., 1980). Smelly ripening, on the other hand, appears because of accelerated enzymatic decomposition of proteins, during which appear the products (ammonia, sulfur hydrogen and other) which give the meat an unpleasant smell. Meat has gray- green to dark green shade on cross section, while its consistency is softly elastic to dough- like. Meat reaction is extremely sour. Smelly ripening appears because of unfavorable ham ripening conditions under the activity of its own enzymes. Meat is a suitable environment for development of groups and types of microorganisms. Bacteria (Pseudomonas spp., Micrococcus spp., Proteus spp., and other) dissolve proteins and transform meat amino acids, so ammonia, sulfur hydrogen, amines, diamines, indole, skatole, cresol, phenol, mercaptans and other compounds of unpleasant smell appear. Some types of bacteria (Salmonella spp., Staphylococcus pyogenes, Clostridium botulinum) can cause poisoning of people because they produce toxins. Among biogenic poisonous amine, which appear by decomposition of proteins,
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Evaluation results point to variability of quality of Slavonian ham. High and significant connection of sensory characteristics of ham (appearance, cross-section appearance, consistency, smell, taste) has been determined mutually, as well as with the average grade of hams. The average pH-value of ham meat (5.84) and color parameters ("L" = 39.66 and "a" = 18.44) were satisfying. Mistakes in quality of some hams (unsatisfying shape, occurrence of mould, inadequate color of meat and fat tissue, tyrosine sediments, soft consistency, rotting, etc.) have been noticed, which is the reason that makes it necessary to work on standardization of ham quality.

Standardization of quality assumes the following procedures:
- defining an adequate pig genotype, i.e. creating a pig type for the purpose of producing Slavonian ham,
- developing technology for specified purpose of pig fattening,
- standardizing technology for pork ham processing,
- defining physico-chemical and organoleptic characteristics of Slavonian ham, based on research,
- organizing a national association of Slavonian ham producers that would start the procedure of registering Slavonian ham as an autochthonous Croatian product,
- legal protection of product name on the levels of Republic of Croatia and the European Union (protected designation of origin and/or protected geographical designation).

ZUSAMMENFASSUNG
QUALITÄT DES SLAWONISCHEN SCHINKENS AUF DER 3. NATIONALEN SCHINKENRIADE

Identification of histamine content in fish samples

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SUMMARY

Histamine is biogenic amine, which is developed in food rich in proteins as a result of histidine decomposition. The decomposition is caused by growth of certain types of bacteria.

Samples of imported fish from B&H market were analyzed for the presence and quantity of histamine by ELISA (RIDASCREEN® Histamine). The results should repre-