SENSORY PROPERTIES OF SMOKED PORK LOIN
AS DETERMINED BY APPLIED ADDITIVES

D. Živković¹, Marija Perunović¹, Jovanka Popov-Raljić²,
A. Bulatović³ and Mirjana Ivanović⁴

Abstract: Authors examined the effects of SUPRO 595 and GRINSTED™
Carrageenan CC 250 addition on selected sensory properties of smoked pork loin.
Sensory evaluation of products included an estimate of cut appearance,
texture, odor, taste and color. Using photoelectric tristimulus colorimeter (the
MOM Color - D) determination of color characteristics in pork loin samples was
carried out. The values for psychometric lightness (L*), psychometric hue -
redness (a*) and psychometric chrome - yellowness (b*) were expressed based on
the CIELAB system. Tenderness and firmness of samples were instrumentally
measured on an "INSTRON" – 4301, under the given working conditions.
The variants of smoked pork loins with soy isolate were better evaluated
compared to the variants with carrageenan.
The results of instrumental determination of color characteristics of the
products showed that between the variants with soy isolate and the variants with
carrageenan there existed insignificant deviation in the values of psychometric
lightness (L*), in the presence of redness (a*) and in the presence of yellowness
(a*).
Instrumentally measured tenderness and firmness showed that the samples
with carrageenan were characterized by somewhat greater tenderness and firmness
compared to the samples with soy isolate.
Key words: SUPRO 595, GRINSTED™ Carrageenan CC 250, smoked pork
loin, sensory properties.

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Intensive development of technology, especially in the production of semi-durable meat products, is mostly based on curing processes and additives utilization. Because of the tendency to reduce the time of processing as well as losses during thermal treatment, mechanical treatment during curing becomes necessary (Petrović and Šibalić, 1980).

That is why the composition and quantity of some components of brine, must be adapted to the regime and duration of mechanical treatment. Brine must contain ingredients, which influence speed and flow of the process as well as sensory properties of end product (Modić et al, 1980).

Injecting a relatively large amount of brine (25-40%), shorter curing process, and damages of muscle stroma during mechanical treatment can cause less desirable sensory properties of the products (Stamenković, 1985). Usual problems occurring in the production of semi-durable meat products, especially smoked pork loin, are wet cross section and less desirable appearance and texture (flaky, tender or plastic). Defects are, as a rule, more frequent, when the water content in the product is higher as a result of injecting a large amount of brine.

To reduce the losses during thermal treatment and to preserve satisfactory sensory quality of the products, it is usual to add soy isolate as an ingredient of brine. The uses of soy isolate contribute to better water binding and texture properties (Vomberger Blanka et al, 1988).

In products produced from musculature with very delicate connective tissue stroma, such as pork loin it is, sometimes difficult to reach a desired connection of muscle structure and to obtain the product with desirable structure and cut appearance only with usual additives, such as salt, polyphosphates and protein preparations, but also by using hydrocolloids (Stamenković, 1994; Līsicin et al, 1997).

Hydrocolloids are high-molecular weight biopolymers that belong to two different classes: polysaccharides and proteins. They have the ability to thicken or gel aqueous systems. These properties are the basis for their use in food and for other applications (Pedersen, 1980).

Polysaccharides such as carrageenans, alginates, galactomannans and xantans are polymers of plant origin made up of at least two different monosaccharides. Physical properties of polysaccharides (solubility, thickening, stabilizing or gelling properties) depend on the size and structure of the macromolecules, their shape, flexibility, capacity to self-associate, presence of sulfates, methyl ethers, acetyl esters or pyruvate groups (Wallingford and Labuzza, 1983).

Carrageenans are obtained from red and brown seaweeds. They are made up of sulfated galactose units in D form. They contain little or no pyruvic or methyl groups and their sulfate contents are between 15% and 40%. The carrageenan family is extremely diverse, and it can be broadly classified into 4 main types, split into two groups: gelling carrageenans and thickening carrageenans (Ray and Labuzza, 1981; Lewicki, 1978).
In gelling carrageenans, alternation of 4C1 and 1C4 allows carrageenans chains to form a double helix. This structure is stabilized by hydrogen bonds, which are easily disrupted by heating, so carrageenan gels are thermally reversible.

Due to their excellent water binding properties and ability to form very firm gel at low concentrations, carrageenans have been recently successfully used in the production of canned ham and similar products (Stamenković, 1994; Liscin et al., 1997).

Considering high hydration demands in the production of semi-dry meat products, and knowing that muscle structure could be injured during mechanical treatment, which could lead to texture and appearance defects of products, we have decided to investigate the possibilities of using carrageenan in the production of smoked pork loin instead of soy isolate.

**Materials and Methods**

Pork loin (M. longissimus lumborum et thoracis, M. spinalis et semispinalis thoracis et cervicis, M. trapezius and Mm. multifidi), obtained from farm pigs (average mass 130 kg) was used for this research.

Brine made of nitrite - 14%, polyphosphate preparation – 1.2%, dextrose -2% and Na-ascorbate – 0.2%, was added in the amount of 25% regarding muscle mass. In 60% of prepared brine, carrageenan GRINSTED™ CC 250 (0.25%, 0.40% and 0.55%), or soy isolate SUPRO 595 (0.75%, 1.0% and 1.25%), related to the raw material mass, was dissolved, and that amount was injected with two-needle hand injector. The rest of the brine was added in tumbler. Mechanical treatment lasted 6 hours, and thermal treatment was accomplished by usual method and lasted 5 hours. After thermal treatment and smoking, pork loins were held for 12 hours at 5-10°C.

Sensory evaluation of products was performed by 6 assessors applying the five-point scoring system (Joksimović, 1977).

Using photoelectric tristimulus colorimeter (the MOM Color - D) determination of color characteristics in pork loin samples was carried out. The values for psychrometric lightness (L*), psychrometric hue - redness (a*) and psychrometric chrome - yellowness (b*) were expressed based on the CIELAB, 1976 system (Robertson, 1977).

Tenderness and firmness of samples were instrumentally measured on an "INSTRON" – 4301 under the given working conditions.

**Results and Discussion**

Regarding the results obtained by sensory evaluation of smoked pork loin (Table 1), it can be seen that the cut appearance of all tested concentrations was
almost identical. The cross-section of products showed consistent texture, with light gray colored fields of gelled carrageenan, which resulted in somewhat lower scores compared to samples with soy isolate. Samples with soy isolate had smaller damage of muscle structure. In all examined samples, except one with soy isolate (0.75%), water was adequately fit, and product cross-section wasn’t wet.

The samples with carrageenan compared to the samples with soy isolate with respect to texture were somewhat firmer and harder and less juicy, while the sample made with 0.55% of carrageenan was extremely firm and rubber-like while chewing. The texture of products prepared with 1% and 1.25% of soy isolate were very good and scored 4.7 and 4.0 points.

<table>
<thead>
<tr>
<th>Quality index</th>
<th>Carrageenan</th>
<th>Soy isolate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cut appearance (3)</td>
<td>3.4 3.7 3.6 3.6 4.6 4.0</td>
<td>3.2 3.7 3.1 3.6 4.7 4.2</td>
</tr>
<tr>
<td>Texture (5)</td>
<td>3.0 3.7 3.1 3.6 4.7 4.2</td>
<td>3.2 4.1 4.0 4.4 4.5 4.5</td>
</tr>
<tr>
<td>Odor (3)</td>
<td>3.2 4.1 4.0 4.4 4.5 4.5</td>
<td>3.2 4.0 4.2 3.9 4.2 4.3</td>
</tr>
<tr>
<td>Taste (5)</td>
<td>3.7 4.2 4.3 3.9 4.5 4.1</td>
<td>3.2 3.9 3.8 3.8 4.49 4.21</td>
</tr>
<tr>
<td>Ponderous average score</td>
<td>3.28 3.94 3.83 3.84 4.49 4.21</td>
<td></td>
</tr>
</tbody>
</table>

The odor of all the samples was typical for the specified product and very agreeable but more expressive in products with soy isolate. The taste of products was also very agreeable, and it was observed that increase in additive concentration improved the taste. The products made with 0.55% carrageenan and 1.25% soy isolate appeared to be the best.

The color of all products was very good and it scored above 4 points, except for the sample made with the lowest concentration of both additives. Therefore, the increase in additive concentration improved the color of the product.

The results of instrumental determination of color characteristics of the products are shown in Table 2. The values for psychometric lightness (L*) were very alike in samples produced with soy isolate and carrageenan, respectively, so that it can be concluded that both additives had very similar effect on this color characteristic. A slight increase of the product lightness caused by increase in the additive concentrations was noticed.

The presence of redness (a*) was also slightly higher in the products with lower concentration of both additives; nevertheless, it is most likely to be related with a non-uniform distribution of the pigment material (raw material color). The presence of yellowness (b*) was almost identical, in all the investigated products, except in the samples with 1% of soy isolate, where it was somewhat lower.

The data of testing color characteristics of smoked pork loin were mostly correlated with the results of sensory evaluation, and led to the conclusion that the
additive used in applied concentrations did not essentially affect the product color.

<table>
<thead>
<tr>
<th>Additive</th>
<th>L'</th>
<th>a'</th>
<th>b'</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carrageenan</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.25%</td>
<td>71.51</td>
<td>9.34</td>
<td>16.84</td>
</tr>
<tr>
<td>0.40%</td>
<td>71.43</td>
<td>9.81</td>
<td>16.75</td>
</tr>
<tr>
<td>0.55%</td>
<td>72.61</td>
<td>8.21</td>
<td>16.83</td>
</tr>
<tr>
<td>Soy isolate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.75%</td>
<td>71.43</td>
<td>9.81</td>
<td>16.75</td>
</tr>
<tr>
<td>1.00%</td>
<td>71.57</td>
<td>7.14</td>
<td>15.85</td>
</tr>
<tr>
<td>1.25%</td>
<td>72.58</td>
<td>8.32</td>
<td>16.72</td>
</tr>
</tbody>
</table>

L*: values of psychometric lightness
a*: presence of redness
b*: presence of yellowness

In table 3 are presented the results of tenderness and firmness evaluation. Samples produced with carrageenan had higher firmness and tenderness compared to the samples with soy isolate. Penetration force was significantly higher (30-39 N) for samples with carrageenan, while for samples with soy isolate it was 20-27 N. Shear force was higher for samples with carrageenan too (50.2-57 N) compared to samples with soy isolate (40.2 – 48.9 N). It can be noticed that the results are directly proportional to the additive concentrations, which means that with the increase of additive content, yields increase in the firmness and decrease in the tenderness of the products.

<table>
<thead>
<tr>
<th>Additive</th>
<th>Firmness (N)</th>
<th>Tenderness (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carrageenan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.25%</td>
<td>30</td>
<td>50.2</td>
</tr>
<tr>
<td>0.40%</td>
<td>33</td>
<td>54.0</td>
</tr>
<tr>
<td>0.55%</td>
<td>39</td>
<td>57.0</td>
</tr>
<tr>
<td>Soy isolate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.75%</td>
<td>20</td>
<td>40.2</td>
</tr>
<tr>
<td>1.00%</td>
<td>23</td>
<td>47.0</td>
</tr>
<tr>
<td>1.25%</td>
<td>27</td>
<td>48.9</td>
</tr>
</tbody>
</table>

Conclusion

On the basis of presented data obtained by instrumental determination of color characteristics, as well as firmness and tenderness of product, we can conclude the following:
In the production of smoked pork loin it is possible to use both of the examined additives; addition of carrageenan had a positive effect on binding of the product and its cut appearance, which is an advantage compared to usually utilized soy isolate; samples produced with the addition of soy isolate have somewhat better odor; higher additive concentration effects favorably the taste of the product;

None of the applied additives in the examined concentrations has essential effects on the color of products, which was confirmed by instrumental determination of color characteristics.

Samples produced with the addition of carrageenan are characterized by increase of firmness and decrease of tenderness compared to samples with soy isolate, which was confirmed by instrumental analysis.

REFERENCES


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SENZORNA SVOJSTVA DIMALJENE SVINJSKE PEČENICE U ZAVISNOSTI OD PRIMJENJENIH ADITIVA

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REZIME

Intenzivan razvoj tehnologije, naročito u sferi polutrajnih suvomesnatih proizvoda bazira se uglavnom na primeni aditiva i intenzivnim režimima mehaničke obrade tokom salamurenja. Posledice injektovanja relativno velikih količina salamure (25-40%), skraćenog procesa salamurenja i oštećenja mišićne strome tokom mehaničke obrade mogu biti lošija senzorna svojstva proizvoda. Uobičajeni problemi koji se javljaju u proizvodnji polutrajnih suvomesnatih proizvoda, naročito dimljene svinjske pečenice, najčešće su vlažan presek i njegov lošiji izgled i tekstura (sipka, meka ili plastična).

Imajući u vidu ove, specifične zahteve u proizvodnji dimljene svinjske pečenice, postavili smo zadatak da ispitamo kakvi se efekti posle uobičajenog - izolata soje. Senzorno vrednovanje obuhvatio je ispitivanje izgleda preseka, konzistencije, mirisa, ukusa i boje. Instrumentalno je određena boja preseka uzorka na fotoelektričnom tristimulusnom kolorimetru "MOM Color D", pri čemu su rezultati izraženi u CIELab sistemu. Mekoća i čvrstoća uzoraka instrumentalno je određena na "INSTRON" – 4301.

Korišćenjem karagenana dobija se proizvod vrlo dobro povezane strukture, što je prednost u odnosu na uobičajeno korišćen izolat soje. Proizvodi izrađeni sa izolatom soje imaju nešto prijatniji miris. Povećanje koncentracije aditiva povoljno se odražava na ukus proizvoda. Varijante pečenice sa sojinim izolatom su dobile veću ponderisanu srednju ocenu u odnosu na varijante sa karagenanom.

Rezultati instrumentalnog određivanja boje proizvoda pokazuju da između varijanti sa sojinim izolatom i karagenanom postoji neznatno odstupanje u svetloći (L'), učesću crvene (a') i žute (b') boje.

Instrumentalnim određivanjem čvrstoće i mekoće konstatovano je da su uzorci sa karagenanom, u odnosu na uzorke sa sojinim izolatom, bili neznatno tvrdiji i čvršći.


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