

## INFLUENCE OF CARRAGEENAN ADDITION ON SOME TECHNOLOGICAL AND SENSORY PROPERTIES OF SMOKED PORK LOIN

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*The present study was undertaken to investigate the effects of the presence of different concentrations of GRINSTED™ Carrageenan CC 250 (0.25%, 0.4% and 0.55% related to the mass of raw material) on selected technological and sensory properties of smoked pork loin. Changes in mass during production process and water content were observed. Sensory evaluation included estimation of cut appearance, consistency, odor, taste, color, tenderness, firmness and plasticity. It was found that water retention and muscle structure binding were strongly influenced by carrageenan addition. Depending on applied concentration of preparation, achieved yields varied from 1.08% to 2.06%.*

KEY WORDS: GRINSTED™ Carrageenan CC 250, yield,  
sensory properties, smoked pork loin

### INTRODUCTION

In modern production of semi-dry meat products, there is a tendency to reduce the time of production process and losses while preserving satisfactory sensory quality of the products (1). This can be achieved by using usual additives, salt, polyphosphates, as well as protein preparations, but also by using hydrocolloides (2-6).

Hydrocolloides are high molecular weight biopolymers which 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 (7).

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Polysaccharides such as carrageenans, alginates, galactomanans and xantans are polymers of plant origin made of at least two different monosaccharides. Physical properties of polysaccharides (solubility, thickening, stabilising 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 (8).

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 content is 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 (9,10).

In gelling carrageenans, alternation of 4C1 and 1C4, allows carrageenans chains to form double helix, which can either form junction zones alone or side-by-side association. This structure is stabilized by hydrogen bonds, which are easily disrupted by heating, so carrageenan gels are thermally reversible.

Due to their ability to form very firm gel, carrageenans have been recently successfully used in production of canned ham, where high hydration is demanded (3, 6).

Considering high hydration demands in 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.

## EXPERIMENTAL

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

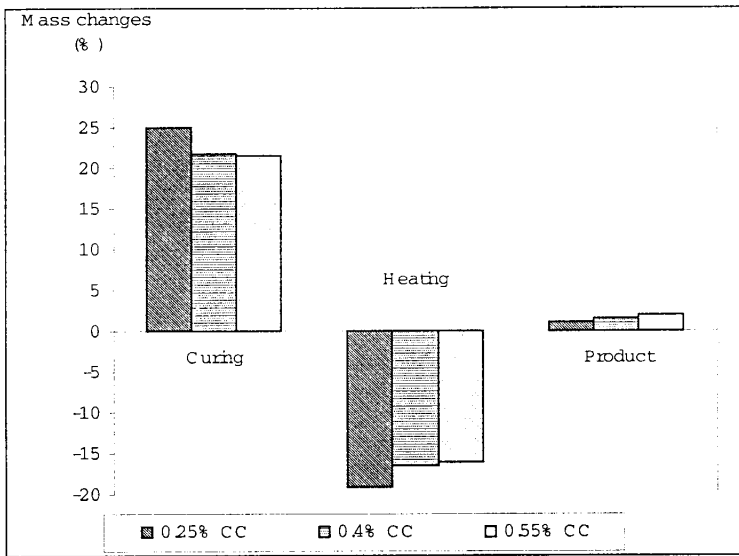
Brine made of nitrite curing salt - 14%, polyphosphate preparate - 1.2%, dextrose - 2% and Na-ascorbate - 0.2%, was added in the amount of 25% regarding muscle mass. In 60% of prepared brine, carrageenan GRINSTED™ CC 250 was dissolved (0.25%, 0.40% and 0.55% related to the raw material mass, and that 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 roasting and smoking, pork loins were held for 12 hours at 5-10°C.

Mass changes of 6 pork loins, as well as water content changes, were observed before and after curing, and also after 12 h of thermal treatment. During the pork loin production process, raw material, mass after curing and mechanical treatment, heating and cooling losses, yields of 6 pork loins were observed. Water content was determined by drying to the constant mass, JUS ISO 1442 (11).

Sensory evaluation of products was performed by 6 assessors applying the five-point scoring system (12). Determination of color characteristics in pork loin samples was carried out by using photoelectric tristimulus colorimeter (the MOM Color - D). The values for psychometric lightness ( $L^*$ ), psychometric hue - redness ( $a^*$ ) and psychometric chrome - yellowness ( $b^*$ ) were expressed based on the CIELAB, 1976 system (13). Tenderness and firmness of samples were instrumentally measured on an "INSTRON" 4301, under the given working conditions.

## RESULTS AND DISCUSSION

On comparing results obtained by analysis of pork loin mass during production process (Fig. 1), it can be seen that mass increase after curing is slightly different between pork loin samples prepared with 0.40% and 0.55% carrageenan, while mass increase in the samples made with 0.25% carrageenan was higher (24.9%). Heating of the samples prepared with 0.25% carrageenan resulted in the highest loss of water.

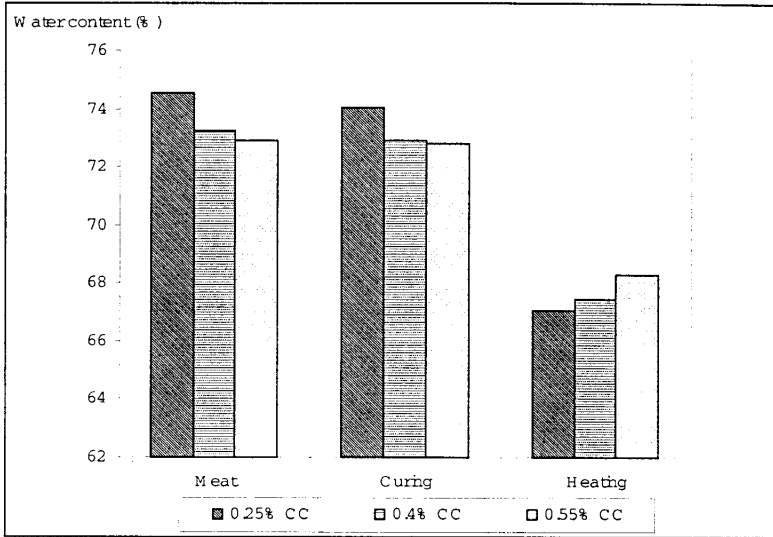


**Fig.1.** Mass changes during production process of smoked pork loin

Mass yields after curing and mechanical treatment, as well as heating loss of pork loin prepared with 0.25% carrageenan, were significantly higher ( $p < 0.01$ ), compared with other samples, while the differences in total mass yield were not significant.

The differences in water content (Fig. 2) in raw material (72.92-74.54%) also induced differences after curing and mechanical treatment. Samples prepared with 0.25% carrageenan had about 2% more water at the beginning and after curing compared with other samples. In the products an opposite trend was observed. The increase in carrageenan concentration caused an increase of water content in the products. Also, it was found that water binding ability (WBA) was not related to water content, and that the meat with larger amount of intramuscular fat tissue had a better water binding ability, probably because of its slack microstructure, yielding increase in the amount of immobilized water (14).

Regarding the results obtained by sensory evaluation of smoked pork loin (Table 1) it can be seen that the cut appearance of all tested samples was almost identical. The cross section of products showed consistent texture, with light gray colored fields of gelled carrageenan.



**Fig. 2.** Water content changes during production process of smoked pork loin

As far as results of texture evaluation is concerned the most favorable product was the one prepared with 0.40% carrageenan, while the product made with 0.55% CC 250 was extremely firm. Odor of all the samples was typical for the specified product and agreeable. Taste of the products was also very agreeable, and it was observed that increase in additive concentration improved the taste. The product made with 0.55% carrageenan appeared to be the best. Color of all the products was very good and it was evaluated with scores above 4, except for the sample made with the lowest concentration of additive. Therefore the increase in additive concentration improved the color of product.

**Table 1.** Results of sensory evaluation of smoked pork loin

Quality index	Carrageenan concentrations		
	0.25%	0.40%	0.55%
Cut appearance (3)	3.4	3.7	3.6
Texture (5)	3.0	3.7	3.1
Odor (3)	3.2	4.1	4.0
Taste (5)	3.2	4.0	4.2
Color (4)	3.7	4.2	4.3
Ponderous average score	3.28	3.94	3.83

( ) - importance coefficient

The results of instrumental determination of color characteristics of the products are shown in Table 2. The values of psychometric lightness ( $L^*$ ) were very similar for all the investigated samples, so that, it can be concluded that the additive did not have any effect on this color characteristic. A slight increase of the product lightness caused by increase in the additive concentration was noticed.

**Table. 2.** Results of instrumental color determination

Carrageenan concentrations	CIELab		
	L	a	b
0.25%	71.51	9.34	16.84
0.40%	71.43	9.81	16.75
0.55%	72.61	8.21	16.83

The presence of redness ( $a^*$ ), was also slightly higher in the products with lower concentration of carrageenan; nevertheless, it is most likely to be related to a non-uniform distribution of the pigment material (raw material color). The presence of yellowness ( $b^*$ ) was almost identical, in all the investigated products.

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. 3.** Results of instrumental texture determination

Carrageenan concentrations	Texture	
	Firmness (N)	Tenderness (N)
0.25%	30.0	50.2
0.40%	33.0	54.0
0.55%	39.0	57.0

In table 3 are presented the results of tenderness and firmness evaluation. 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.

## CONCLUSION

Carrageenan GRINSTED™ CC, applied as component of brine for injection, reduces significantly mass losses during thermal treatment of smoked pork loin. Depending on applied concentration of carrageenan, mass yield of pork loin of 1.08 to 2.06% was obtained.

Addition of carrageenan had a positive effect on banding of product and its cut appearance. Higher additive concentrations resulted in increase of firmness and decrease of tenderness of the product, which was confirmed by sensory and instrumental analysis. The product made with 0.55% carrageenan was too firm. Odor and taste of all the examined products were typical and very agreeable, which leads to the conclusion that increase in additive content effects favorably the taste of the product. Color of the samples was very good and uniform, which was confirmed by instrumental determination of color characteristics.

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## УТИЦАЈ ДОДАВАЊА КАРАГЕНАНА НА НЕКА ТЕХНОЛОШКА И СЕНЗОРНА СВОЈСТВА ДИМЉЕНЕ СВИЊСКЕ ПЕЧЕНИЦЕ

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У раду су испитивани ефекти додавања различитих концентрација карагенана GRINSTED™ СС 250 (0.25%, 0.4% и 0.55% у односу на масу полазне сировине) на одабрана технолошка и сензорна својства димљене свињске печенице. Праћене су промене у маси и садржају воде током процеса производње, док је сензорно вредновање обухватило испитивање изгледа пресека, текстуре, мириса, укуса, боје, мекоће, чврстоће и пластичности. Иако атипичан за ову групу производа, испитивани адитив је ефектно утицао на уклањање воде у производ, као и на повезаност структуре мишића. У зависности од примењене концентрације препарата, остварен је прираст масе печенице од 1.08 до 2.06%.

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