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COMPARISON OF QUALITY PARAMETERS OF THE COOKED SALAMI „GOTHAJSKÝ“ IN DEPENDENCE ON USED SALT CONTENT AND ADDITIVES

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ABSTRACT

Consumers in Czech Republic have high income of salt from food, therefore, there are efforts to reduce its content in meat products. The subject of this work was to examine differences in sensory evaluation of sliced cooked salami (Gothajský salami), manufactured according to various recipes. This type of meat product is well known primarily to the older generation of consumers, so the aim was to find out the differences in the perception of various samples between generations. The monitoring factors were salt content (1.6% or 2.0%), presence of monosodium glutamate (PG = presence or AG = absence) and group of evaluators (YC = 18 – 26 years old or OC = more than 60 years old). Older sensory panellists (OC; against YC) significantly (p <0.05) evaluated all samples more positively, especially in the taste and odour descriptors. Samples with monosodium glutamate (PG1.6 and PG2.0) were rated in the taste significantly better (p <0.05), regardless of the age of the assessors (YC and OC). Samples with reduced salt, without glutamate (AG1.6) were significantly worst evaluated (p <0.05) by both the groups (YC and OC) than PG2.0 samples.

Keywords: colour; sensory evaluation; saltiness; monosodium glutamate

INTRODUCTION

The content of salt in meat products continues to be of interest to consumer organizations and health professionals **(WHO, 2013)**. Processed meat products and bread including cereals in the group are the largest source of sodium (salt) in the European diet **(Kloss et al., 2015)**. The health consequences of excess sodium in the diet are more serious than consumers admit. with hypertension and leads to an increased risk of strokes and fatal vascular diseases **(He and MacGregor, 2010)**. There are several ways to reduce salt content. The salt content of meat products can be reduced to a level that does not affect the technological or organoleptic properties of the product. By further reducing the sodium content, it may be partly or completely replaced by other substances that do not adversely affect the sensory and technological properties. Potassium, calcium, magnesium, and sodium and potassium lactate are most commonly used **(Desmond, 2006)**. According to **Aaslyng et al. (2014)** that salt reduction from 2.2% to 1.7% did not alter the sensory properties in sausages. It is commonly assumed that sensory impairments occurring with age negatively affect older people's intake of foods in terms of both quality and quantity. Because of anatomical changes in all the senses involved in human food perception, on average seniors perceive a lower flavour intensity than younger adults, are less sensitive to changes in the flavour profile of foods and show a decreased ability to discriminate between different intensity levels of flavour and/or taste attributes. However, despite these differences in their sensory perception of foods, young adults and seniors seem to differ less in their initial hedonic appraisal of food products **(Doets and Kremer, 2016)**. Multidisciplinary approach includes evaluating psychological issues such as attitudes, beliefs, and expectations; sensory properties such as appearance, texture, flavour and odour; and marketing-related aspects such as price and brand **(Font-i-Furnols and Guerrero, 2014)**. Older consumers are more conservative in their preferences. Consumer protection and detecting of adulteration is very important and has a wide societal impact in the economic sphere **(Drdolová et al., 2017)**. Traditional consumer testing provides important information regarding acceptability but may miss important unconscious responses of consumers **(Torrico et al., 2018)**.

Unfortunately, the Czech Republic is in the income of salt content and the occurrence of diseases with this problem associated with the leading countries. However, sodium chloride and sodium nitrite have a key role in meat production. Reducing the salt content in consumers´ of known meat products is a way to rationally reduce sodium in food. Rather than developing new recipes or making a major legislation-regulated adjustment, recommendations should be made for manufacturers. Together with an assessment of such an adjustment, could be a guideline, especially for smaller producers in the regional market. This can better meet the demands of different consumer groups and will not require legislation or major

interventions in large-scale meat production **(Jůzl et al., 2018b)**. Nevertheless, the major issue when using lower salt concentrations in processed meat products is to be able to maintain the product quality characteristics without affecting the shelf-life or the economic viability of the product **(Desmond, 2006)**. Salt is predominantly used to enhance food flavour, making even unpalatable food taste better. However, taste and preservation are not the only reasons for the use of high levels of sodium in foods. The sodium level is generally kept high due to the additional functional roles it provides. The presence of salt (1.5% – 2.5% w/w) in meat products solubilizes meat proteins, activates extraction of proteins, enhancing hydration, and water holding capacity (WHC) **(Ruusunen and Puolanne, 2005)**. Colour and material of surface of packaging are important parameters for consumers **(Géci et al., 2017)**. **Tobin et al. (2013)** wrote about a problem with low-salt meat products. Main reason is that, along with saltiness, reducing sodium will also affect product texture and flavour intensity. However, lowering the salt content to 1.4% NaCl in cooked sausages has been shown to be possible while keeping an acceptable perceived saltiness, firmness, water-binding and fat retention. The meat industry is pushed to the lowest price by the retail chain, which causing meat content reduction in the products **(Fekete et al., 2016)**. One way is following the trends moving towards enhancing hygienic quality using antioxidants **(Bobko et al., 2017)** or antimicrobial agents **(Kročko et al., 2015; Kročko et al., 2017)** in recipes. Therefore, it is an attempt to reduce the use of classically used additives such as flavour enhancers (sodium glutamate), colourants (carmine) or sodium nitrite in salt mixtures **(Jůzl et al., 2018a)**.

Scientific hypothesis

We are expecting the significant effect of salami´s recipes on consumer tests by sensory evaluation. The aim of this study was to examine the importance of reduced the salt content of meat products according to the presence or absence of monosodium glutamate (MSG) for various groups of consumers.

MATERIAL AND METHODOLOGY

The cooked salamis were produced due to in three repetitions according to the quality standard of ON 57 7231 (Gothajský salami, beef H3 or H4, pork V4, pork V5 or V6 and V8 according to Czech Meat Processors Association). Samples were prepared in the pilot plant CZ 22067 (approved by the State Veterinary Administration, Czech Republic) of Mendel University in Brno. This cooked salami named Gothajský salami has name associated with city in Germany. It is delivered for retail use on shop counter where they are sliced. This salami is spiced with paprika, cumin and coriander. Due to Czech legislation, this salami is typical of pieces of pork lard, size predominantly up to 8 mm. The meat content should be min. 40% and a maximum fat content of 40%. The product must not contain mechanically separated meat or poultry mechanically separated meat. It is filled into artificial PE packaging, in our case red BETAN, calibre 75 mm, length 50 cm. For production were used typical standard machines used in industrial production (cutter, filler, smoker). Both spice mixtures from two different companies contained the E450, E451 and E452 stabilizers, spices (paprika, cumin and coriander), antioxidant E300 and E160c (pepper extract), but they differ in presence or absence of monosodium glutamate. Weights of nitrite salt mixture were weighed to produce 2.0% or 1.6% salt in the final samples. So, they were summatically produced four recipe variants PG2.0 or PG1.6 (presence of monosodium glutamate, 2.0 or 1.6% salt) and AG2.0 or AG1.6 (absence of monosodium glutamate, 2.0 or 1.6% salt). After receiving, the raw meat was kept in 2 °C and second day was coarsely ground to obtain meat emulsion in cutter (Seydelmann, Germany). Lard prepared previously to regular cubes was frozen (-18 °C) and during the production incorporated in cutter during production to the desired mosaic. Than were and filled (HTS 150, Germany) in PE casings (75/50) and treated (70 °C, 10 min in the product core) in smoker (Bastramat, Germany).

Quality evaluation of cooked salami

For chemical and sensory analysis were used commonly available methods. For the instrumental measurement of the surface colour, the spectrophotometer and CIE colour space (L*a*b*) were used. Salamis was measured and evaluated in the sixth day after production. Shelf life (in 2 – 4 °C) is set at 3 weeks. The product was sliced on a commercial rotary cutter before sensory evaluation in slices (0.5 mm).

Chemical analysis

The dry matter ($g.100g^{-1}$), the salt content ($g.100g^{-1}$) and the fat content ($g.100g^{-1}$) after homogenization of the sample (250 g) were analysed for each group (PG2.0, PG1.6, AG2.0, AG1.6) **(AOAC, 2005)**. All analysis was undertaken in duplicate.

Colour measurement

Colour space L*, a* and b* was used to determination differences in colour. The CM 3500d spectrophotometer (Konica Minolta, Japan) was used and the samples were measured (D 65, 6500 °K) on the surface in centre of the slices with SCE (Specular Component Exluded) and 30 mm slot in triplicate (3 pairs and in 2 batches). Colour variation was determined as total colour difference ΔE^*_{ab} **(Saláková, 2012)**.

Sensory analysis

Sensory analysis was evaluated by two consistently identical different groups of panellists (n = 48). Selection was based on submitted questionnaires received from trained meat products consumers. To be selected, they had to belong to a group of consumers who ever ate cooked salamis (Gothajský salami) and consumed meat products from 1 to 3 times a week. The number of women and men was not equivalent, so this factor was not evaluated. One group of young consumers (YC) was selected from students (18 – 25 years, n = 24) of course Meat Technology (bachelor study Chemistry and Food Technology, second year, MENDELU). Seniors, older consumers (OC, n = 24) were selected from the class of Institute of Lifelong Learning, members of the University of the Third Age, MENDELU. Both groups of panellists were briefly trained in the basics of sensory evaluation and the use of questionnaires. The evaluation was ongoing

Figure 1 Spice mixture with monosodium glutamate (PG).

Figure 2 Spice mixture without monosodium glutamate (AG).

Figure 3 Minced meat in cutter

Figure 4 Samples after heat treatment.

Figure 5 Samples with monosodium glutamate (PG) 1.6% (left) and 2.0% salt (right).

Figure 6 Samples without monosodium glutamate (AG) 1.6% (left) and 2.0% salt (right).

under ČSN ISO 6658 (560050) condition. Sensory analysis was undertaken at special sensory laboratory with ten chambers (Department of Food Technology).

All panellists buy and consume Czech meat products regularly. For each sample, assessors were asked to indicate their score on a 100 mm line scale. It is ranging from 0 at the left to 100 at the right. Descriptors expressed as the hedonic scores. Minimum was 0 (left) and maximum of pleasure 100 (right side of scale). Analysis were chosen as sensory panel with following descriptors: appearance, colour, texture, fat composition, consistency, odour, saltiness and taste. The samples were presented to panellists randomly and marked with a numeric code. Water and non-salted bread were used as neutralizers.

Statistical analysis

The data has been sorted and processed by analysis of variance (one-way ANOVA) and Tukey´s test to compare groups of samples according to its salt content or presence of monosodium glutamate in cooked salami´s recipes by the groups of panellists in programme STATISTICA 12. Samples were considered significant at 95% confidence level (p <0.05) and data were tested for normality by Shapiro-Wilk test.

RESULTS AND DISCUSSION

Although the recipe was free from substitutes and contained beef, it can be considered as a standard meat product of standard quality. Chemical analysis of the samples showed results that did not exceed the limit set by **Decree No. 69/2016 Collection of Laws** (40% fat) or significantly differ from the values given in the ČSN 57 7231 standard and the corresponding scheme for products of quality category (above 47 to 50% dry matter, 39 to 42% fat, 2.0 ±0.6%). Even though we were based on the norm, the fat content was lower than the standard. The reason is probably lower fat content in pork than in ČSN 57 7231. Fat content in pork has changed since the original calculations and compared to the state more than thirty years ago. There were no differences (p >0.05) in fat and protein content or in dry matter between groups of samples (Table 1). Of course, the salt content of the product varied (p <0.05) in groups with different salinity (PG2.0, AG2.0 versus PG1.6 and AG1.6). It should be noted, results could depend on the type of analysis used. State authorities

Table 1 Basic chemical analysis of cooked salami according to different salt content and presence of MSG.

Content ($g.100g^{-1}$)	Group of samples			
	PG2.0 ($\bar{x}$ ±*SD*)	PG1.6 ($\bar{x}$ ±*SD*)	AG2.0 ($\bar{x}$ ±*SD*)	AG1.6 ($\bar{x}$ ±*SD*)
Dry matter	48.52 ±0.88	48.57 ±0.74	49.09 ±0.64	49.21 ±0.89
Fat	32.52 ±1.28	33.09 ±1.11	33.04 ±1.06	33.27 ±1.15
Proteins	10.07 ±0.35	10.18 ±0.39	10.02 ±0.46	10.21 ±0.41
NaCl	2.09 ±0.09^{b}	1.63 ±0.06^{a}	2.15 ±0.08^{b}	1.68 ±0.07^{a}

Note: PG2.0 or PG1.6 = presence of monosodium glutamate, 2.0 or 1.6% salt; AG2.0 or AG1.6 = absence of monosodium glutamate, 2.0 or 1.6% salt; Means with different superscripts in the same rows show significant differences (p <0.05).

Table 2 Instrumental measurement of cooked salamis colour surface according to different salt content and presence of MSG.

Colour parameter	Group of samples			
	PG2.0 ($\bar{x}$ ±*SD*)	PG1.6 ($\bar{x}$ ±*SD*)	AG2.0 ($\bar{x}$ ±*SD*)	AG1.6 ($\bar{x}$ ±*SD*)
L* (D65)	56.10 ±0.78^{a}	59.78 ±0.98^{b}	55.70 ±0.66^{a}	58.89 ±0.73^{b}
a* (D65)	17.07 ±0.45^{b}	15.24 ±0.57^{ab}	16.39 ±0.67^{b}	14.32 ±0.62^{a}
b* (D65)	18.43 ±0.63^{b}	17.01 ±0.72^{a}	18.28 ±0.49^{b}	16.58 ±0.65^{a}

Note: PG2.0 or PG1.6 = presence of monosodium glutamate, 2.0 or 1.6% salt; AG2.0 or AG1.6 = absence of monosodium glutamate, 2.0 or 1.6% salt; Means with different superscripts in the same rows show significant differences (p <0.05).

Table 3 Sensory analysis of cooked salamis according to different salt content and presence of additives.

Descriptor	Consumer group	Group of samples			
		PG2.0 ($\bar{x}$ ±*SD*)	PG1.6 ($\bar{x}$ ±*SD*)	AG2.0 ($\bar{x}$ ±*SD*)	AG1.6 ($\bar{x}$ ±*SD*)
Appearance	YC	65.3 ±12.3	66.4 ±15.6	65.9 ±14.5	67.2 ±12.7
	OC	78.0 ±11.9	74.1 ±14.7	72.5 ±12.7	75.6 ±14.0
Colour	YC	55.3 ±18.2	50.2 ±18.1	52.6 ±16.1	49.1 ±13.8
	OC	75.0 ±14.9^{b}	59.2 ±14.5^{ab}	78.5 ±13.6^{b}	51.3 ±16.0^{a}
Fat composition	YC	54.4 ±19.1	51.5 ±16.8	55.6 ±17.3	47.1 ±13.3
	OC	70.1 ±14.1	64.2 ±15.4	68.5 ±10.7	63.2 ±12.4
Consistency	YC	59.3 ±15.8	56.2 ±17.3	59.5 ±19.0	57.2 ±14.6
	OC	75.1 ±11.3	68.2 ±12.6	74.5 ±13.3	66.2 ±15.3
Odour	YC	69.0 ±14.5	66.4 ±15.5	65.9 ±14.4	67.2 ±14.3
	OC	78.1 ±13.2	74.1 ±10.9	73.5 ±10.9	71.6 ±10.8
Saltiness	YC	58.1 ±12.9^{b}	60.4 ±13.3^{b}	60.9 ±15.2^{b}	47.2 ±13.6^{a}
	OC	80.4 ±16.8^{b}	70.1 ±14.7^{ab}	73.5 ±13.9^{b}	50.6 ±14.7^{a}
Taste	YC*	64.1 ±13.8^{b}*	52.4 ±14.3^{ab}*	50.9 ±15.0^{ab}*	43.2 ±14.2^{a}*
	OC*	80.1 ±12.2^{b}*	78.1 ±11.9^{b}*	83.5 ±13.8^{b}*	60.6 ±12.6^{a}*

Note: YC – consumers 18-26 years old, OC – consumers more 60 years old; PG2.0 or PG1.6 = presence of monosodium glutamate, 2.0 or 1.6 % salt; AG2.0 or AG1.6 = absence of monosodium glutamate, 2.0 or 1.6% salt; Means with different superscripts in the same rows show significant differences (p <0.05); Means with * designation show significant differences (p <0.05) between panellists groups YC and OC; Descriptors expressed as the hedonic scores, where 0 is the sign minimum and 100 is maximum of pleasure.

responsible for supervision of safety, quality and labelling of foodstuffs in the Czech Republic require sodium analysis, in our case we have used the determination through chlorides. However, it should not be a significant difference.

However, **Kameník et al. (2017)** states in his work that salt level determined by the two methods strongly correlated and did not differ in any meat product. After all, the results presented by **Kameník et al. (2017)** are not different from our chemical analysis.

The appearance of the food, its colour and its stability are essential for meat products to be offered to consumers at the shelves of the shops in a sliced form. This also contributes to the lighting that is in the room. In general, products with a more pronounced colour are better evaluated (higher values for red and * and yellow b *). Table 2 shows the colour values. Lightness of cooked

salamis was measured in the range of L* = 55.19 to 58.10, depending more on the salt content. Also, for parameters a * and b * for red and yellow colour (resp.) was found significantly differences (p <0.05) between groups according to its content of salt. Groups with lower saltiness had higher lightness and lower colour coordinates a* and b*. Lightness L*, it depends on the type of product. Salt, specifically sodium chloride and especially nitrite, is expressed in several ways in the meat product: it contributes to the colouring of the product, to the aroma formation, has a preservative and antioxidant effect **(Saláková et al., 2013)**. It is obvious that the lower salt content has a significant effect (p <0.05) on the colour of the products, but it did not depend on the presence of MSG (Table 2). Results showed similar colour values as at work **Jůzl et al. (2018a)**.

Table 4 shows the sensory assessment of cooked salamis and their comparison between two groups of evaluators. There were not found statistical differences (p >0.05) in appearance between groups of samples according to the content of salt in both groups of panellists. It has been confirmed that the salt content is an important aspect of the acceptability of the meat product. Older evaluators were more receptive to this, although younger evaluators would have sensible senses. It depends on the experience and popularity of the meat product. This shows the greater popularity of this product in the older generation **(Doets and Kremer, 2016)**. Those in the younger generation had the problem of distinguishing the difference in salt content.

Some strategies for innovations can be done by, for instance, not only directly lowering the amount of salt and fat in the recipe, which is the first possibility. However, some authors **(Horita et al., 2016)** describe using a salt substitute (e.g. potassium chloride or herbs), or by using animal fat replacements (e.g. starch or oil from non-animal sources), depends on consumer´s experience. Sensory evaluation has shown significant differences in taste and salinity in a group of younger panelists (YC) compared to older (OC). The presence of MSG shows that the low salt content is not so noticeable. Recent studies have even shown that sodium reduction can be beneficial for a part of the population that is defined as salt-sensitive. Senior consumers are more conservative, and have a more accurate awareness of the standard, at least in this case and cooked salamis has been confirmed. It is true that consumers are generally interested in the content of substances in food hazardous to health. Nitrites are thus negatively perceived by different consumer groups. However, nitrite replacement is a complicated intervention in the product recipe regarding its sensory and microbiological quality **(Jůzl et al., 2018b)**.

CONCLUSION

The results of the model production and analysis of four variants of cooked salamis with different spice mixtures or salt content indicate that the salt content affected the product quality parameters, however they were not considered negatively. Gothajský salami were rated more positively by older panellist group. There were also recorded several differences. From the above, it follows that the choice of seasoning mixture, the presence of other additives influences the sensory quality of the cooked salami. No significant negative result was found in the sensory evaluation, which would not reduce the salt content of the meat product's recipe.

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