PREMILINARY STUDY OF CHARACTERIZATION OF SLOVENIAN PROTECTED DRY MEATS USING A CHEMOMETRIC APPROACH

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Abstract – The purpose of this study was the characterisation of Slovenian protected dry meats. The dry meat samples were obtained from local markets. The physicochemical compositions of the four main types of protected Slovenian meat products are described, together with their sensory characteristics. There was wide variability among the products analysed. The content was analysed for water (rang, 18.42-51.35 mg/100 g), protein (17.95-37.34 mg/100 g), fat (7.61-58.72 mg/100 g), salt (3.08-7.18 mg/100 g), and ash (3.70-8.39 mg/100 g), with the colour indices of L^* (30.0-42.7), a^* (8.4-15.2), and b^* (3.0-8.1). The texture parameters monitored were hardness (3.32-28.07 N), adhesiveness (-1.42 - -0.18 Ns), springiness (0.39-0.70), cohesiveness (0.29–0.64), gumminess (1.60-8.63 N), chewiness (0.81–6.07 N), and resilience (0.08-0.22). Linear discriminant analysis was performed to classify these dry-meat samples according to type. This showed that instrumental texture and chemical composition can provide enough information for the classification and distinction of Kraški pršut, Kraški zašink, Kraška panceta and Prekmurska šunka.

Key Words – Chemical composition, Physicochemical composition, Sensory analyses.

I. INTRODUCTION

Dry fermented meats represent a great variety of aromas and textures and are receiving increased interest from consumers. Most of these products still rely primarily on local, traditional manufacturing processes, as little scientific information is available. However, scientific knowledge has become an important tool to monitor the consistent production of high-quality products. Industrialization of food production, European laws on food safety, and also the development of innovative products, necessitate the characterization of the typical sensory and physicochemical characteristics of the traditional products. In Slovenia there are large numbers of traditional dry meat products, although few of them have Protected Geographic Indication at the national and European levels.

II. MATERIALS AND METHODS

The samples of dry meats produced under Protected Geographical Indication were obtained from regional shops. Three of the dry meat products sampled here are typical of the Karst region of Slovenia: Kraški pršut (11 samples/ 3 producers), Kraški zašink (7/3), and Kraška pancetta (4/2). The fourth product is typical of the eastern part Slovenia (Prekmurje): Prekmurska šunka (4/1).

Kraški pršut is made from the hind leg of the pig (i.e., the ham), which is rubbed with coarse sea salt (without smoking and other additives). For the development of its complete aroma and texture, it undergoes a long maturation period of 12 months to 24 months, or more [1]. This product is characterized by higher salinity (up to 7.4%) and a perceived firmer texture in the mouth. The rate of dehydration and the long period for maturation contribute to the characteristic pinkish red slices that are of a darker shade on the outer edge. A strongly expressed lively aroma is typical of this product, which distinguishes it from other hams.

Kraški zašinek is a dry meat product that is prepared using the pig neck muscle [2]. The meat is salted and massaged with great care, to favour the absorption of the salt (use of nitrite salt is also allowed), pepper, garlic, sugar and, eventually, ascorbate/ isoascorbate. The minimum maturation period is from 12 weeks, according to size, and it is necessary to let its characteristic aroma and taste develop slowly. As thin slices, this should be a

red-pink colour with slightly darker edges, with the white colour of the intermuscular fat, which provides a soft and creamy texture.

Kraška pancetta is generally not smoked, although it can be slightly smoked, and it is dry cured or uncured. It is a flat shaped bacon that is seasoned with some pepper, garlic and sugar, with its production taking at least 10 weeks [3]. During the maturation, the muscle parts of the pancetta take on a characteristic pink colour, and the bacon acquires a creamy white colour. Slices consist mainly of the muscle parts with the thin interstitial layers of fat. As thin slices, it should have a soft texture, with the muscle and fat parts firmly connected, providing a harmonious and salt-sweet taste.

Prekmurska šunka is a dried meat that has a distinctive shape [4] that sets it apart from Kraški pršut. This product is manufactured from pigs from the Prekmurje region, as a specially formed, deboned pork leg, with the skin and subcutaneous fat. It undergoes dry curing (wet curing is also possible), desalting, smoking, and then a longer period of drying and ripening. The end product weighs at least 3 kg to 4 kg. On the outside, the ham is an even reddish-brown, as is typical of strongly smoked products. The bacon is creamy white, to brownish-yellow closer to the skin. The aroma and taste are characteristic of dried meat and bacon, and they are complemented by the smoke aroma.

Water, protein, fat, salt and ash content were determined by the methods described by the Association of Official Analytical Chemists [5]. A Minolta CR 200b colorimeter (Illuminant C, 0° viewing angle) was used to determine the CIE L^* (lightness), a^* ($\pm$, red to green), and b^* ($\pm$, yellow to blue) values on the cut surface, as four parallel measures. TPA was performed as four parallel measures, using a TA.XT Plus texture analyser (Stable Micro Systems Ltd., Surrey, UK) with a 50 kg load cell and a 50-mm-diameter compression plate. The samples were compressed twice to 50% of their original length, perpendicular to the direction of the fibre bundle, at a crosshead speed of 1 mm/s; these sample were shaped into parallelepipeds (dimensions, 20 mm × 20 mm × 15 mm), and analysed at a temperature of 4 °C.

To evaluate the sensory qualities, a panel of nine qualified and experienced panellists in the field of meat products was appointed. The analytical-descriptive test [6] was performed by scoring the sensory attributes according to a non-structured scale from 1 to 7 points, where higher scores indicate greater expression of a given property. Exceptions here were for the intensity of colour, hardness and saltiness, which were evaluated by scoring on a structured scale of 1 to 4 to 7 (1–4–7). Here, a score of 4 points is considered optimal, while scores of 4.5 or more indicate greater (to excess) expression of the property (darker colour, too firm, too salty), and those of 3.5 or less indicate lesser (insufficient) expression of the property (paler colour, too tender, not salty enough) (Table 3). For the sensory evaluation, the samples were cut in 1-cm-thick slices for the panellists to evaluate.

The data were analysed through the UNIVARIATE and GLM procedures (SAS/STAT). Multivariate analysis included principle component analysis (PCA) and linear discriminant analysis (LDA) (SPSS).

III.   RESULTS AND DISCUSSION

The chemical compositions of these Slovenian protected dry meats are presented in Table 1. The product type significantly affected all of the parameters at the 5% level or less (data not shown).

Table 1 Chemical composition (mean ±standard deviation) of the four Slovenian protected dry meat products sampled.

Parameter (g/100 g)	Type of Slovenian protected dry meat			
	Kraški pršut	Kraški zašinek	Kraška panceta	Prekmurska šunka
n	11	7	4	4
Protein	29.12±4.84	31.98±3.20	22.03±4.05	33.80±3.21
Fat	27.69±14.91	26.65±5.63	50.02±9.24	26.82±4.70
Water	36.99±11.77	36.82±2.55	24.05±5.07	34.60±6.31
Salt	5.26±1.17	4.07±1.00	3.45±0.34	4.46±0.97
Ash	6.47±1.40	5.76±0.87	4.02±0.38	5.17±0.65

n- number of samples

Kraški pršut and Prekmurska šunka contain significantly less water, but they have comparable contents of protein and salt to other better known types of European dry-cured hams,

such as Corsican, Bayonne, Italian country-style and Parma (53.3%–60.8%; 26.5%–32.5%; 5.3%–9.2%; respectively) [7]. The type of product affected all of the colour and texture parameters at the 5% level or less, with the exception of springiness (Table 2). On average, higher hardness, cohesiveness, gumminess, chewiness and resilience were found in Kraški pršut, compared to these other dry meats. These data are in agreement with findings in the literature [8,9], where TPA was applied to dry-cured meats with lower moisture content. The water content explains the main texture differences in these dry samples [8].

Table 2 Colour and texture parameters (mean ±standard deviation) of the four Slovenian protected dry meat products sampled.

| Parameter | Type of Slovenian protected dry meat | | | |
	Kraški pršut	Kraški zašinek	Kraška panceta	Prekmurska šunka
L^* meat$_{(fat)}$	34±4	33±3	34±2$_{(74±4)}$	37±4
a^* meat$_{(fat)}$	11±1	13±1	12±0$_{(3±2)}$	11±1
b^* meat$_{(fat)}$	5±1	6±1	6±2$_{(5±1)}$]	5±2
Hardness (N)	14.31±6.55	6.17±2.01	13.60±2.47	4.55±1.07
Adhesiveness (Ns)	-0.34±0.07	-0.35±0.15	-1.07±0.29	-0.24±0.06
Springiness	0.55±0.11	0.55±0.09	0.50±0.05	0.54±0.05
Cohesiveness	0.50±0.14	0.43±0.05	0.36±0.01	0.48±0.05
Gumminess (N)	6.55±1.63	2.61±1.02	4.87±1.04	2.30±0.78
Chewiness (N)	3.59±1.21	1.45±0.67	2.44±0.38	1.29±0.50
Resilience	0.15±0.04	0.11±0.03	0.10±0.01	0.12±0.03

As can be seen from Table 3, these types of dry meats vary widely in appearance, texture, odour and aroma. Compared to the standard form of each of these products, slight defects were noted for Prekmurska šunka. Indeed, Prekmurska šunka showed the worst intensity and homogeneity of the colour in the slice cross-sections, as defined by the visual observations; in contrast, the best evaluations here were given to Kraški pršut.

The minimum marbling and the lowest intermuscular fat for Prekmurska šunka are typical of this product, while Kraška pancetta contains over half a slice of intramuscular fat, which is related to the flank from which the

product is made. All of these four types of product show almost optimal textures; only Kraški pršut was assessed as being slightly harder. Similarities are seen for solubility, saltiness and aroma between Kraška panceta and Kraški zašink, separating them from Prekmurska šunka and Kraški pršut.

Table 3 Sensory traits (mean ±standard deviation) of the four Slovenian protected dry meat products sampled.

| Trait/point | Type of Slovenian protected dry meat | | | |
	Kraški pršut	Kraški zašink	Kraška panceta	Prekmurska šunka
Form of product (1–7)	6.1±0.3	6.1±0.5	6.3±0.3	5.9±0.4
Homogeneity colour (1–7)	5.7±0.4	5.5±0.3	5.5±0.2	4.4±0.2
Intensity of colour (1–4–7)	4.6±0.4	4.8±0.3	4.6±0.2	3.8±0.4
Fat colour (1–7)	5.5±0.4	5.1±0.6	5.4±0.4	5.9±0.1
Intermuscular fat (1–7)	3.2±0.7	3.6±0.5	5.1±0.6	2.1±0.2
Marbling (1–7)	2.5±0.9	2.8±0.4	2.2±0.3	2.1±0.3
Integrity of slice (1–7)	5.5±0.5	5.9±0.2	5.8±0.2	6.1±0.1
Hardness (1–4–7)	4.4±0.5	4.1±0.3	3.9±0.3	4.3±0.2
Solubility (1–7)	5.5±0.3	5.7±0.1	5.8±0.1	5.4±0.1
Odour (1–7)	5.5±0.2	5.5±0.1	5.4±0.1	5.7±0.2
Saltiness (1–4–7)	4.7±0.3	4.3±0.2	4.1±0.0	4.6±0.0
Aroma (1–7)	5.3±0.3	5.4±0.3	5.5±0.2	5.3±0.1

PCA and LDA were performed to classify the dry meats on the basis of their physicochemical properties and sensory profiles. These were based on five chemical contents (water, protein, fat, salt, ash), 10 instrumental parameters (L^*, a^*, b^*, hardness, adhesiveness, springiness, cohesiveness, gumminess, chewiness, resilience) and 12 sensory traits (form of product, homogeneity of colour, intensity of colour, fat colour, intermuscular fat, marbling, integrity of slice, hardness, solubility, odour, saltiness, aroma). PCA was performed to provide a data structure study over a reduced dimension, covering the maximum amounts of the information presented as the basic data. The seven principal components accounted for 89.3% (PC1, 32.6%; PC2, 20.7%; PC3, 10.8%; PC4, 8.6%; PC5, 6.1%; PC6, 5.7%; PC7, 4.7%) of the variation among these types of dry meat samples. Therefore, all of the parameters were included in the linear discriminant analysis.
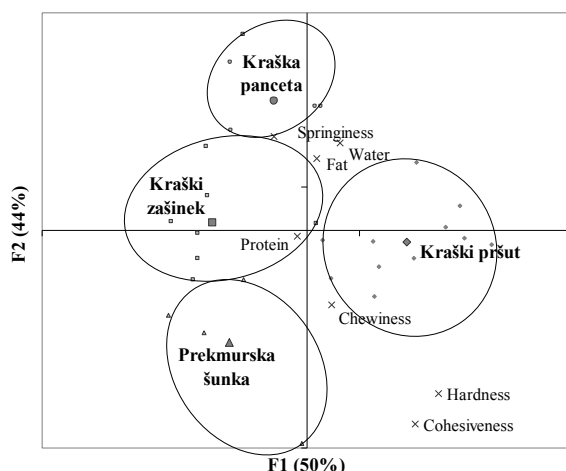
Figure 1 Linear discriminant analysis showing cross-plot of the first two functions for the physicochemical data for the type of Slovenian protected dry meats

Using LDA, eight parameters were selected as the most discriminating variables: hardness, springiness, cohesiveness, gumminess, chewiness, and content of protein, fat and water. The other parameters also contribute to the separation among types, but not significantly. When the LDA was applied to the data (26 samples, 8 variables), three discriminant functions were obtained. Of the total variance, function 1 explains 44%, function 2 explains 50%, and function 3 explains 6%. The scores of the samples for the main two functions are plotted in Figure 1. The dry meat samples are well separated according to the type of product. Overall, the accuracy of the placement of each sample into its corresponding group (type of product) was 100%, with none of the 26 samples misplaced.

IV. CONCLUSION

A total of 26 Slovenian protected dry meat samples from four products were investigated, according their physicochemical and sensory characteristics. The results show wide variability among these analysed types. Additionally, LDA shows that TPA parameters, such as hardness, springiness, cohesiveness, gumminess, and chewiness, as well as content of water, protein and fat can be used for successful differentiation between different types of Slovenian dry meats.

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