

## Do consumers from Međimurje region recognize their autochthonous Turoš cheese?

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### Summary

The aim of this study was to determine whether consumers from the Međimurje region recognise and distinguish the autochthonous cheese called Turoš from similar cheeses like Prgica and Kvargl originating from regions neighbouring to Međimurje. Chemical, textural and microbiological properties of all three cheeses were given. Preference tests with 200 consumers using a face-to-face survey and a two-step procedure were performed. The blind taste test showed that 97 % of the respondents recognised differences between the tasted samples, and almost half of them preferred the Turoš cheese. Similarly, the informed test showed that a significantly higher number of the respondents preferred the Turoš cheese in comparison to Kvargl and Prgica. Statistical analyses showed no significant differences between respondents' preferences in the blind and the informed tests.

*Key words:* Turoš cheese, Kvargl cheese, Prgica cheese, consumer blind taste test, informed taste test

### Introduction

Over the past few decades information related to the food production and the product origin became very important to consumers due to serious concerns of the food safety (Capmany et al., 2000; Cerjak et al., 2011). Additionally, in the context of globalised markets, consumers prefer traditional products, especially those with a known origin (Mesić et al., 2010). Pillonel et al. (2005) stated that food authenticity and traceability of its origin have become subjects of a great interest during the last decade. A growing tendency towards the quality rather than the quantity of food products has created a growing market for products with strong designation of geographic region. As a result, the pro-

tected designation of geographical indication (GI) has emerged as one of important instruments in the agricultural policy in many countries. A protected geographical indication (GI) is, generally speaking, a sign used on goods with a specific geographical origin possessing qualities or a reputation stemming from that place of origin. A GI commonly consists of the name of the goods' place of origin (Bourgoing, 2003). From the consumers' perspective, geographical indications provide useful information about products identity and quality (Oliva, 2007).

GI has a positive influence on producers, consumers and the rural community. It protects product names from misuse and imitation, helps the producers to obtain a premium price for their products and thus

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Figure 1. North-western part of Croatia

improve their income. GI's help consumers by providing information concerning the specific character and the origin of the products. Finally, GI's encourage diverse agricultural production and rural sustainability, create local jobs and prevent rural exodus, as well as bring value to the land of origin (Falla, 2003; O'Connor and Company, 2005; Soeiro, 2005).

Croatia has also recognised the importance of protecting the autochthonous agricultural products and foodstuff. The recent regulation (Official Gazette No. 84/08, 75/09 and 20/10) was adjusted with the current EU regulations and adopted in 2008, and introduced two schemes: the protected designation of origin (PDO) and the protected geographical indication (PGI).

There are a large number of autochthonous cheeses in Croatia that attract consumers with their specific characteristics and origin. Most of these cheeses have a potential for the PDO/PGI protection. However, in order to protect a product with a geographical indication it is necessary to confirm its authenticity, which serves to consumers as a guarantee of safety and quality (Karoui et al., 2004).

Among the Croatian cheeses with a PDO/PGI potential, Turoš cheese originating from the Međimurje region deserve to be recognized. Turoš belongs to a group of dried, acid, salted, cone-shaped cheeses with and the addition of milled dry red pepper, produced in a traditional way in a wide area of the north-western part of Croatia (Figure 1). Turoš cheese is produced from fresh cow milk without added dairy cultures. The milk is poured into a glass jar of an average volume from 2.5-5 L and left in a warm place (about 25 °C) until it sours. Afterwards, the cream is skimmed from the surface. One part of whey is removed from skimmed, soured milk into a pot by heating it (about 42 °C) for 3 h (without stirring) until the curd rises to the surface. The curd is then poured into a cheesecloth and left to drain for a day. The fresh cheese is spiced with salt and red pepper, stirred and shaped into cones by hands. Cones of Turoš cheese are dried in the sun or above a stove for about seven days. Prgica cheese produced in Podravina region and Kvargl cheese produced in Bjelovar region are produced in a similar way and belong to the same group of cheeses (Kirin, 2004).

According to Kirin (2004), Turoš, Prgica and Kvargl are considered as a same cheese which appears under different local names. Due to their similarity these cheeses could easily confuse the consumers (Figure 2). In order to protect the Turoš cheese with the PDO/PGI, it is necessary to determine whether it differs from the other two above mentioned similar cheeses. This could be accomplished by comparing technological and quality parameters of cheeses and by examining the consumers' ability to recognize and differentiate a



Figure 2. Turoš, Prgica and Kvargl cheeses

particular cheese from the similar ones. Therefore, the aim of this study was to determine whether consumers from Međimurje region can recognize and differentiate the Turoš cheese (autochthonous cheese from Međimurje region) from similar cheeses from neighboring regions (Prgica and Kvargl) and to evaluate preferences towards these three cheeses. The results of this research will contribute to protection of the Turoš cheese with the PGI.

## Materials and methods

### *Products*

Thirty cheese samples of each type produced on farm level (Turoš, Prgica and Kvargl) were evaluated. The cheese samples were collected from three randomly selected cheese-makers originating from three different regions (Međimurje, Podravina, Bjelovar). All of the collected cheese samples were produced for local markets.

### *Physicochemical analysis of cheeses*

Chemical analysis of cheese was performed in the Reference Laboratory of the Dairy Science Department of Faculty of Agriculture, University of Zagreb, whereas the textural analysis of cheese was performed in the Institute for Adriatic crops and Carst Reclamation. One cheese sample from each type was taken and sent for the analysis to the external laboratory. Fat content in cheese samples was determined using the Van Gulik methodology 3433 (ISO 2009), protein content by the Kjeldahl method 8968-2 (ISO 2003), the total dry matter by drying at  $102 \pm 2$  °C according to the method 5534 (ISO 2008). Salt content in cheese samples was determined by the method of Mohr 935.43 (AOAC 2000). The pH was measured by a pH-meter (Mettler Toledo, Seven Multi, according to manufacturer's instructions).

### *Textural analysis of cheeses*

A Texture Analyser (model TA Plus) equipped with a 500 N load cell (model XLC -0500-A1) was used to determine the texture parameters of cheese samples. The instrument was connected to a personal computer with installed software to analyse the experimental data (Nexygen Plus 3).

Three cone shaped cheese samples from each batch were broken by the hand into small irregular samples (5-10 mm). Ten bladed Kramer shear cell (model FG/KSC) was used to evaluate the texture characteristics of cheese samples. The Kramer shear blades were attached to the load cell and a rectangular container was inserted in central locator whole of base table of texture analyser. Prior to each test, Kramer shear blades were slowly lowered into the rectangular container through the base slots. It was necessary to ensure a good clearance around the blades and slots in order to avoid the frictional effects. The 50 g of cheese sample was placed in a rectangular container. Ten parallel steel shear blades are driven down at crosshead speed of 10 mm/min through guide slots into a rectangular container where cheese sample was sheared, compressed and extruded through the bottom openings. The hardness as a maximum shear force (N) and the work from preload to maximum force (N/mm) were calculated from the force compression curves. Three replicates were used and average results were reported.

### *Microbiological analyses of cheeses*

Two cheese samples of each type were used for microbiological analysis. Cheese samples were analysed for: *Salmonella* spp. according to the method 6785 (ISO 2001), *E. coli* according to the method 11866-1 (ISO 2005), *S. aureus* according to the method 6888-1 (ISO 2004a), *sulphur-reducing Clostridium* according to the method 15213 (ISO 2004b) and *L. monocytogenes* according to the method 11290-1 (ISO 1999).

### *Consumers*

A face-to-face survey with a sample of 200 consumers was organized in collaboration with ME-SAP (Fair Enterprise and Agriculture) fair visitors in Nedelišće (Međimurje region). Respondents were fair visitors (mainly from Međimurje region) who were willing to participate in the research. Together with the hedonistic tests, a questionnaire asked about the frequency of purchase and consumption, the attributes influencing purchasing decisions, and the socio-demographics of the respondents.

### *Test procedure*

The ability of respondents to recognize and distinguish Turoš from Prgica and Kvargl as well as their acceptance of tasted cheeses was examined in a two-step procedure. In the first step, the participants of the blind taste test had to taste three different cheese samples (Turoš, Kvargl, Prgica) coded with three different letters, and to indicate if they recognize differences between the samples, to specify the preferred sample, as well as to evaluate their overall liking of three tasted cheeses.

Respondents were asked to view, smell and finally to taste cheese samples that were cut into small cubes (approximately 1x1x1 cm) and served at room temperature on a white plate. Additionally, whole cheeses of all three tasted samples were shown to the respondents. The participants were allowed to take as many cubes as needed to make their judgments and white bread was available between cheese samples for taste recovery. Respondents were asked to indicate whether they perceived differences between the tasted cheese samples and to describe the perceived differences. A 5-point hedonistic scale, which is commonly used scale among the Croatian consumers, (1 = dislike very much, 2 = dislike, 3 = neither like nor dislike, 4 = like, 5 = like very much), was used to measure the overall acceptability of the samples on the basis of their overall taste, smell and appearance (perceived liking). The order of tasted cheese samples was randomized.

In the second step, the respondents tasted three additional cheese samples (not seen during the first evaluation) marked with their actual names representing regions they come from. The respondents again were asked to evaluate three cheese samples tasted on the same 5-point hedonistic scale (actual liking). The consumers were not informed that the cheese samples in the two taste tests were the same.

Before the second, informed testing, the respondents were asked if they had heard of Prgica and Kvargl cheese, and if so, to express their opinion which cheese is better when compared to Turoš cheese.

### *Data analyses*

Frequencies of answers were calculated to determine whether the respondents differed for the three tasted cheeses in the blind test. The analysis of

variance (ANOVA) was used to test the differences in the acceptance testing of three cheese samples in the same test procedure, A paired t-test was used to compare the differences in the taste evaluations between the same product under different information conditions (tasting only, tasting with information) with  $H_0$ : evaluation difference = 0. The difference between percentages of respondents preferring each cheese sample under different testing conditions was tested by the Chi-square test. All analyses were conducted by the SPSS (SPSS Statistic, 2003).

### **Results and discussion**

Chemical composition, textural properties and microbiological analyses of cheese samples which were included into the sensory analysis are shown in Table 1. The main features of the subjects participating in the research panel are depicted in Table 2.

According to the Regulations About Cheeses and Products Made of Cheeses, Turoš, Kvargl and Prgica belonged to the group of semi-hard cheeses with moistures in total solids non fats between 54% and 69 % (for Turoš 58.4 %, for Kvargl 66.67 % and for Prgica 68.32 %). Considering the milk fat in the total solids, which was 25.68 % for Turoš cheese, 33.11 % for Kvargl cheese and 21.15 % for Prgica cheese; Turoš and Kvargl belonged to a group of fat cheeses with fat in total solids contents between  $\geq 25$  % and  $< 45$  %, while Prgica belonged to a group of semi-fat cheeses with fat in total solids content between  $\geq 10$  % and  $< 25$  % (Official Gazette No. 20/09) (Table 1). The fat contents in those kinds of cheeses were reduced by skimming the sour milk during production. Milk fat removal was the most efficient during Prgica cheese manufacturing. This resulted in the lowest content of fat in Prgica cheese (8.5 %) in relation to Turoš cheeses (14.5 %) and Kvargl cheeses (16.5 %). Sour cream is a by-product and it is not used in the production of these types of cheeses. The pH values were similar for all cheese samples, in opposite to salt contents which varied depending on the cheese type (Table 1).

The texture influences the customers in making the right choice when buying cheese (Antonou et al., 2000). The similarity in structures on hardness and work from preload to maximum load were determined for Kvargl cheese and Prgica cheese

Table 1. Mean values of the chemical composition, textural properties and microbiological analyses of cheese samples included into the sensory analysis (n=5 per cheese)

Parameter	Turoš	Kvargl	Prgica
Fat (g/100 g)	14.50	16.50	8.50
Proteins (g/100 g)	27.23	23.92	24.02
Total solids (g/100 g)	56.46	49.84	40.18
Salt (g/100 g)	4.45	3.09	2.46
pH	4.45	4.46	4.46
Water content in the total solids-non fat (%)	58.04	66.67	68.32
Solids non fat (%)	25.68	33.11	21.15
Hardness (N)	81.42	64.68	62.91
Work from preload to Maximum Load (Nmm)	353.65	219.27	204.16
<i>Salmonella spp.</i> (0 cfu/25 g)*	0	0	0
<i>Escherichia coli</i> (<10 <sup>3</sup> cfu/g)*	<10	<10	<10
<i>Staphylococcus aureus</i> (<10 <sup>3</sup> cfu/g)*	<10	<10	<10
<i>Listeria monocytogenes</i> (0 cfu/25 g)*	0	0	0
<i>Sulphur-reducing clostridium</i> (<10 <sup>2</sup> cfu/g)*	<10	<10	<10

whereas Turoš cheese was distinguished from these two cheeses (Table 1). The hardness and elasticity of cheeses mainly depend on the quantity of proteins in cheese (Prentice, 1993). The protein content was the highest for Turoš cheese (27.23 %), comparing to Kvargl cheese (23.92 %) and Prgica cheese (24.02 %). Water content in the protein matrix contributes to “plastic” texture of cheese, making cheese less elastic. Less elastic cheeses show tendency to cracking during the compression (Fox et al., 2000). Water content in non-fat dry matter of Turoš cheese was the lowest (58.04 %) in comparison to Kvargl cheese and Prgica cheese that showed similar values of the water content (66.67 % and 68.32 %, respectively). Therefore, the chemical parameters are related to the texture values (Table 1). Similar relations between the chemical composition and the textural values have been determined for Dhaka cheese. Higher content of proteins and dry matter resulted in higher texture values (Raihan et al., 2012a; 2012b). Turoš cheese differed from Kvargl and Prgica cheeses in textural values due to differences in the drying period. Turoš cheese was dried for seven days, while Kvargl and Prgica cheeses were dried for two days. The differences between these three cheeses might be also associated to different contents of the added ingredients like dry, red pepper, causing a more intense orange colour of the Turoš cheese (Picture 2). Producers from the Bjelovar region usually dry cheese by smoking, while producers from the Varaždin re-

gion usually use garlic as the spice which is not the case in Turoš cheese manufacturing.

The texture analysis of deformation and forces are similar to first bite during the cheese consumption, but they cannot completely imitate the sensor analysis (Rosenthal, 1999). The sensory perception mainly determines the consumer preference of the product. The cheese flavour, which is determined by the cheese-making process, is the main characteristic which influences the acceptance of cheese by consumers. It has an important role when they evaluate the quality and judge to accept the cheese (Drake, 2007).

Before performing sensory analysis, two cones of Turoš cheese, Prgica cheese and Kvargl cheese were taken from the same batch and sent for microbiological analysis to detect whether pathogenic bacteria were present in cheeses. The microbiological cheese controls were necessary to protect consumers included in the test, taking into consideration the fact that cheese were produced from raw milk. According to the Guide to Microbiological Criteria for Foods (2010), all cheeses should be tested on following micro-organisms: *Salmonella*, *Escherichia coli*, *Staphylococcus aureus*, *Listeria monocytogenes* and *sulphur-reducing Clostridium*. All tested cheeses were in compliance with the microbiological criteria and could be used in the experiment for organoleptic testing (Table 1).

Table 2. Socio-demographic features of the respondents and their frequency of Turoš cheese consumption

Features	Levels	Percentage
Sex	Male	56
	Female	44
Age	<25	10.5
	25-40	35.5
	41-55	41
	>56	13
Place of living	Urban	31
	Rural	69
Familiarity with Turoš cheese (self- evaluation)	Familiar	85
	Partially familiar	8
	Not familiar	7
Turoš purchase frequency	Every week	14
	Several times a month	27
	Less often	32
	Never	27
Turoš consumption frequency	Every week	32
	Several times a month	31
	Less often	37
	Never	0

Importance of Turoš characteristics to consumers and consumers' preferences towards their modalities are shown in Table 3. Prior to the informed tasting, respondents were asked whether they have ever heard about Prgica and Kvargl cheeses and to compare the quality of these cheeses with Turoš cheese. Half of the respondents have had heard about the Prgica cheese but only 12 % of them have had heard about the Kvargl cheese. The possible reason might be the fact that industrial Prgica cheese

is sold in all supermarkets. About a half of the respondents that have heard about Prgica cheese considered Turoš and Prgica as the same cheeses, while one quarter considered these cheeses as different mostly due to their intrinsic characteristics (added spices, consistency and taste). The rest of respondents did not know whether these cheeses differed among the tasted samples. One third of respondents that have had heard about Kvargl considered it as the same cheese as Turoš, 37 % did not know if these were the same cheeses and the rest of respondents believed these cheeses were different (mostly by their origin).

#### *Discrimination test and consumers' preferences in blind and informed test*

Before delivering the overall evaluation of the three tasted cheeses, respondents answered whether they perceived differences among the tasted samples and were asked to indicate which of the tested cheese samples were the best one. Almost all respondents (97 %) answered that there were differences between the tasted samples. About 75 % of them stated that all three cheeses differed from each other while other respondents considered that they had tasted only two different cheeses (Table 4). This confirmed that consumers perceived differences among the three cheeses, which is opposite to the previous opinion about similarities of these three cheeses (Kirin, 2004). High percentage of respondents stated that they were familiar with the Turoš cheese and had answered that all three tasted cheese samples were different ( $P < 0.01$ ).

According to the respondents' answers to an opened-ended question asking to indicate the taste differences among the three tasted cheeses ( $n = 200$ ), the cheeses differed in their spiciness (128), the

Table 3. Importance of Turoš attributes and consumers' preferences towards their modalities

Attributes and modalities	Importance (%)	% of respondents
Production origin	Traditional	97.0
	Industrial	3.0
Piquancy	Spicy taste	49.2
	Less spicy	50.8
Saltiness	More salty	45.5
	Less salty	54.5
Price	10.6	

Table 4. Perceived differences among cheeses

Which tasted cheeses differ?	n	Valid percent
A differs from C and B	18	9.0
C differs from A and B	16	8.0
B differs from A and C	12	6.0
All are different	147	73.5
No answer	7	3.5
Total	200	100.0

A = Turoš, B = Prgica, C = Kvargl

Table 5. Preferred cheese in the blind and the informed tests

Test conditions	Turoš	Kvargl	Prgica
	% of respondents		
Informed	53.3	25.9	20.8
Blind	44.6	31.3	24.1
Average difference	8.7	-5.4	-3.3
p - value <sup>a</sup>	0.225		

<sup>a</sup>Chi-square test

amount of garlic (49), their saltiness (35), smokiness (27) and dry intensity (19).

Almost half of the respondents preferred Turoš cheese, one third of the respondents preferred Kvargl cheese and the lowest percentage of respondents preferred Prgica cheese in a blind test (Table 5). When information about cheese names were presented to the respondents, even higher number of the respondents expressed their preference towards Turoš cheese. The share of respondents preferring

Kvargl cheese was somewhat higher compared to the share of respondents preferring Prgica cheese (Table 5). Despite the higher number of respondents preferring Turoš cheese in the informed test when compared to the blind test, the Chi-square test showed that there were no statistically significant differences between respondents' preferences in the blind and the informed tests (Table 5).

#### Acceptance test

Respondents evaluated all three cheese samples in the blind test with high scores (above the central point) indicating a good sensory quality of all three tasted cheese samples. However, the highest overall score was given to Turoš cheese (4.20 out of maximal 5-point hedonic scale) and its evaluation outputs were significantly higher compared to Kvargl and Prgica scores ( $P < 0.005$ ; Table 6). The result might be explained by the fact that the majority of respondents came from the Međimurje region and they are familiar with the tasted traditional Turoš cheese. Hence, they recognised Turoš cheese as the best one because they were used to consume Turoš cheese as a local traditional cheese.

Scores indicating the actual liking of all three tasted cheese samples based on cheese name were also above the central point. Participants showed a significantly higher preference ( $P < 0.001$ ) towards Turoš (4.37) compared to Kvargl (3.87) and Prgica (3.83) in the informed taste test (Table 6). Even 87 % of respondents confirmed that they liked or liked very much Turoš cheese, while the share of such respondents for Prgica cheese was 67 %, and for Kvargl cheese 65 %.

Table 6. Sensory evaluations of three cheese samples (n=200)

Sensory evaluation (5-point hedonistic test)	Turoš	Kvargl	Prgica	ANOVA*
	Means $\pm$ sd			(P - value)
Blind - perceived liking	4.20 $\pm$ 0.86 <sup>a</sup>	3.90 $\pm$ 1.00 <sup>b</sup>	3.97 $\pm$ 0.95 <sup>b</sup>	<0.005
Informed (cheese name) - actual liking	4.37 $\pm$ 0.79 <sup>a</sup>	3.87 $\pm$ 1.01 <sup>b</sup>	3.83 $\pm$ 1.04 <sup>b</sup>	<0.001
Average difference	-0.17	0.03	0.13	
Paired t-test (P - value)	<0.001	>0.5	<0.05	

5-point hedonistic scale: (1 = dislike very much, 2 = dislike, 3 = neither like nor dislike, 4 = like, 5 = like very much), was used to measure the overall acceptability of the samples on the basis of their overall taste, smell and appearance

\*Means with the same row and not sharing the same superscript letter are significantly different

The results confirmed that information about the cheese name significantly changed the sensory evaluation of Turoš and Prgica cheese ( $P < 0.001$ ), but did not influence the sensory evaluation of Kvargl cheese. Information about the cheese name increased the acceptance of Turoš and decreased the acceptance of Prgica cheese. Two thirds of the respondents evaluated Turoš with the same score in the blind and the informed test, 23 % of them evaluated Turoš with higher scores in the informed test and 11 % marked lower scores in the informed compared to the blind test. On contrary, 13 % of respondents evaluated Prgica cheese with higher score in the informed test compared to the blind test, 64 % evaluated it with the same score and 23 % increased their score. Regarding Kvargl, the same number of respondents (19 %) evaluated it with higher or lower score in blind testing compared to the informed taste test, resulting in an almost unchanged average score (Table 6).

## Conclusion

The extrinsic product attributes such as information about origin slightly affected consumer's choice. The similarities of Turoš, Kvargl and Prgica cheeses might easily confuse consumers by considering them as the same product. Autochthonous cheeses are often produced mainly for local markets and therefore it is important that local consumers recognize and chose these products. Sensory analysis confirmed that consumers from local region of Međimurje preferred and distinguished the local autochthonous Turoš cheese from other similar, but not identical, cheeses (Kvargl and Prgica). Such findings were also confirmed by results obtained from textural and chemical analysis of these three cheeses. That was in opposite to the overall accepted earlier opinion.

The results of this study could be used by Turoš cheese producers for the development of marketing strategies, but also as a starting point for the process of protecting the Turoš cheese with the designation of the protected geographical indication (GI).

## Prepoznaju li potrošači Međimurja svoj autohtoni sir turoš?

### Sažetak

Cilj rada je utvrditi razlikuju li i prepoznaju li potrošači s područja Međimurja autohtoni međimurski sir turoš od kvargla i prgice koji se proizvode u susjednim regijama. U radu su prikazana kemijska obilježja, tekstura i mikrobiološka obilježja turoša, kvargla i prgice. Test preferencija je proveden izravnim ispitivanjem 200 ispitanika u dva koraka. Test na slijepo pokazao je da 97 % ispitanika prepoznaje razliku između kušanih uzoraka te da gotovo polovica ispitanika preferira turoš. Značajno veći udio ispitanika preferirao je turoš i u informiranom testu u usporedbi s kvarglom i prgicom. Statistička analiza pokazala je da ne postoje značajne razlike između rezultata potrošačkog testa na slijepo i informiranog testa.

*Ključne riječi:* turoš, kvargl, prgica, potrošački test na slijepo, informirani potrošački test

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