

# SEASHELL SPECIALTIES AND FOOD HANDLING IN SLOVENE ISTRIA RESTAURANTS

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Received November 24, 2014; accepted December 12, 2014.  
Delo je prispelo 24. novembra 2014, sprejeto 12. decembra 2014.

## *Seashell specialties and food handling in Slovene Istria restaurants*

The purpose of the research was to evaluate the offer of seashell specialties in Slovene Istria restaurants, and to assess food safety knowledge (gained through formal and informal education) as well as to assess the behaviour of food handlers in preparing shell dishes. A self-administered questionnaire was designed that included four sections: a demographic section, a general section, a restaurant menu offer, and a food safety section related to preparation of seashell specialties. Seashell specialties were offered in 41 restaurants, of which the employed food handlers 24 attended formal education and 17 informal education. Seashells specialties and seashell menus are commonly part of the culinary and gastronomic specialties along the Slovene coast, with the most frequently offered main dish being "Blue Mussels alla Busara". Results the questionnaire indicated poor food safety knowledge and poor behaviour regardless of the (in)formal education of those who prepared the dishes. We propose that formal education for catering workers preparing shell dishes should be much more emphasized.

**Key words:** food / seashells / seashell specialties / seashells handling / HACCP / restaurants / education / questionnaires / Slovenia

## 1 INTRODUCTION

The Adriatic Sea is part of the north Mediterranean Sea half-enclosed by the Italian and Balkan peninsulas, with extending to the farthest north the Gulf of Trieste of which the south eastern section is the Slovene sea. The Gulf of Trieste is a shallow part with an average depth amounting to less than 20 m (Gosar, 2000), providing interactions in fishing, maritime traffic, tourism, recreation and sea breeding culture (MKGPRS, 2012).

## *Jedi iz školjk in njihovo rokovanje v prehranskih obratih v slovenski Istri*

Namen raziskave je bil ovrednotiti ponudbo jedi iz školjk v restavracijah slovenske Istre in oceniti znanje, pridobljeno s formalno ali neformalno izobrazbo ter navade rokovanja zaposlenih pri pripravi jedi iz školjk. Izdelali in uporabili smo vprašalnik, ki je zajemal štiri vsebinska področja: demografski del, splošni del, ponudbo jedi na jedilnem listu in vsebino o varni pripravi jedi iz školjk. V 41 restavracijah, kjer ponujajo jedi iz školjk, je zaposlenih 24 ljudi s formalno in 17 ljudi z neformalno izobrazbo. Na jedilnih listih in menijih so jedi iz školjk običajen del kulinarčne ponudbe na slovenski obali. Kot glavna jed so najpogosteje ponujeni »pidoči na buzaro« ali klapavice na buzaro. Rezultati anket so pokazali slabo znanje in neprimerno rokovanje zaposlenih pri pripravi jedi iz školjk ne glede na (ne)formalno izobrazbo. Predlagamo, da izobraževalne ustanove dajo večji poudarek vsebinam in izvajanju vsebin, ki obravnavajo varno pripravo jedi iz školjk.

**Gljučne besede:** živila / školjke / jedi iz školjk / rokovanje s školjkami / HACCP / prehranski obrati / izobrazba / vprašalniki / Slovenija

Despite the scanty extent and shallowness, the sea capture of seashells and snails from the Slovene sea amounted to 2.782 kg in the year 2011 (SURS, 2011), not a negligible quantity in alimentation. Besides, in Slovenia a considerable amount of seashells is imported from neighbouring countries, which should also be taken into account when addressing the total amount of seashell consumption in Slovenia. Seashells are generally prepared and served in restaurants. However, Slovene restaurants are not only regularly visited by local inhabitants

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and tourists, but also by Italian guests from nearby towns and villages.

The quality and safety of seashells specialties depends most of all on the quality of the sea environment in which they live, and the correct handling of seashells during all stages of storage, as well as of the proper preparation of dishes. Since seashells purify large amounts of seawater, extended numbers of microorganisms remain within them. Thus similar microorganisms as in the sea can be found in seashells: Bacteria from the family of *Pseudomonas*, *Flavobacterium*, *Achrombacter*, *Salmonella*, *Clostridium* and viruses of infective hepatitis. It is thus of vital importance to carry out monitoring and classification of seashell culture nurseries (Raspor, 2002). The monitoring of the quality of the superficial strata of seawater and their adequateness for the life and growth of seashells is part of state monitoring based on an edict (URL RS 52, 2007), and on the Regulations on Monitoring Seawater Quality for the Life and Growth of Sea Shells And Sea Snails (URL RS 71, 2002). The sea sections that are adequate as regard to sea water quality for the life and growth of seashells, are defined by Regulations on Determining Sea Sections where Seawater Quality Suits the Life and Growth of Sea Shells and Sea Snails (URL RS 84, 2007). According to the above mentioned regulations, Slovenia has introduced the Directive 2006/113/EGS (EPS, 2006) into its home legislation, and the quality of water for the life and growth of seashells is determined each year, based on regular water sampling as well as of the analysis of the flesh of the various seashells (URL RS 52, 2007; MOP RS, 2010).

If we assume that raw meat is safe and of adequate quality, the storage and/or preparation of food may still carry some risks. The next step in the prevention of food-borne illness is the correct handling of shells during all stages of storage and preparation. Consequently, the knowledge and working habits of food handlers thus play an important role.

In Slovenia, hazard analysis and critical control point (HACCP) and adequate procedures have been introduced in all phases of food handling (Seward, 2000; Worsfold, 2001; Raspor, 2002; Hulebak & Schlosser, 2002), yet many studies have found that the knowledge of food handlers tends to be unsuitable (Martins, Hogg & Otero, 2012; McIntyre, Vallaster, Wilcott, Henderson & Kosatsky, 2013; Seaman & Eves, 2010; Ansari-Lari, Soodbakhsh & Lakzadeh, 2010). Insufficient knowledge and unsuitable hygiene behaviour may result in food-borne disease (Jevšnik, Hlebec, & Raspor, 2008a). Of the total 5262 food-borne outbreaks reported in the EU in 2011, 8.5 % were attributed to crustaceans, shellfish, molluscs and products thereof (EFSA, 2012). The numbers are relatively high, despite the fact that shell consumption is

not widely spread. Besides, shells are a highly perishable victual, are often consumed raw, can be treated thermally inappropriate, thus generating a high risk for infection (EFSA, 2009). We were therefore interested in the knowledge of Slovene Istrian food handlers: the presence of adequate education and whether that education offers sufficient knowledge for the safe preparation of shell dishes.

The Slovene market offers a great variety of shells: the great scallop (*Pecten maximus*), colloquially named »kapesanta«; blue mussel or thorny oyster (*Mytilus spp.*) – »pidoči«; venerids or the Venus clams (*Veneridae*) – »vongole«; hard shelled clams (*Mercenaria mercenaria*) – »dondole«; mud oysters or »kamenice« (*Ostrea edulis*) and others (URL RS 94, 2002). Various dishes are prepared from these shells and offered in restaurants in Slovene Istria. The most popular ones are Blue Mussels alla Busara, Grilled Scallops, Mixed Seashells alla Triestina, Clamps alla Busara, Gratinated Scallops, Mixed Busara, Gratinated Mussels, Grilled Clams, Cockles, Baby Clams, Gratinated Gnocchi with Scallops and Canestrelli.

Alimentation has long become more than just the provision of nourishment for humans: with increasing hedonism, pleasure in food consumption is turning into a universal sign for quality of life. As such, the food partaken needs to be hygienically faultless, and of adequate composition and excellent gastronomic quality. According to The Development Strategy of Slovenia's gastronomy (ZIRR UM, 2006), Slovenia plans to increase its visibility as a tourist destination with the strategic slogan »Tasting Slovenia«. The tip of the gastronomic pyramid of Slovene dishes in the Mediterranean area (Slovene Istria), is represented by grilled anchovy and »pedoči«.

Mostly because shells and related dishes are part of an interesting gastronomic offer in coastal tourist destinations, it is important to raise awareness of the proper preparation of these culinary specialties. Consequently, the purpose of the present research was to assess which shell dishes are offered in the restaurants of the Slovene coast, and also to what degree »pedoči« dishes are included in the menus. At the same time, we assessed both the food safety knowledge and the preparation behaviour of seashell specialties by food handlers. This in order to establish whether employers were acquainted with the procedures and criteria for ordering and receiving shells (HACCP), the nature of the accompanying documentation on the adequateness of shells for health, as well as with the managing of the documentation. Further, we wanted to investigate the knowledge of the personnel about appropriate shell storage temperatures, and the concrete temperatures and adequate preparation time or the thermal handling of shells. Finally, we were also interested whether the level of education influences the knowledge and the handling of the shells.

## 2 MATERIALS AND METHODS

### 2.1 THE SAMPLE

The sample comprised 160 restaurants in Slovene Istria, found on the web page of the Agency of the Republic of Slovenia for Public Legal Evidence and Services (AJPES – APLES) that included catering plants, hotel restaurants, independent restaurants and rural tourism establishments. Of the contacted establishments, only 82 restaurants were willing to cooperate in the survey, of which only 41 offered shell dishes. The 41 responding establishment holders comprised out of 31 males and 10 females. The study was carried out from September 1<sup>st</sup>, 2011 to November 15<sup>th</sup>, 2011. Most catering plants were personally visited, and where this was impossible, the inquiry was carried out as telephone interviews.

### 2.2 THE SURVEY QUESTIONNAIRE

A questionnaire was designed to obtain information on the seashell specialties offered and on the food safety knowledge and procedures. The questionnaire was divided into four sections: (a) a demographic section, (b) a general section, (c) the restaurant menu offer, (d) a food safety section. The demographic section included basic data on gender, education, job position of the interviewee and the postal code of their residence. The general section included information about the identity of the main supplier of shells, the approximate quantity of shells delivered, and the norms for the rations. The restaurant menu offer section included questions about the main offered dishes, hot and cold hors d'oeuvres. The food safety section included: 17 behaviour questions which the interviewee answered with »yes«, »no« or »I do not know«. Example: Do you examine the accompanying documentation on the receipt of seashells? The second section on food safety consisted out of 6 questions. Example: At what temperature are frozen seashells stored? The correct answer had to be circled by the interviewee:  $-20^{\circ}\text{C}$  and less, from  $-20^{\circ}\text{C}$  to  $-18^{\circ}\text{C}$ ,  $-18^{\circ}\text{C}$  and more, and »I do not know«. The answers from the last section of the questionnaire were evaluated in two ways: The first enabled to assess whether education level affected the answers given, whereas the second determined the average knowledge span as related to education levels. The second part of the questionnaire was consisted with right or wrong answers for all questions. The right answers were evaluated with one point (1), the wrong ones with zero points (0). All the answers »I do not know« were treated as incorrect. The maximum sum of points for the first section of the questionnaire was 17 and for the second,

6 points. The percentage of correct answers below 70 % was defined as poor food safety. The answers were then compared to (in)formal education.

### 2.3 DATA PROCESSING

The results of the survey were analysed using the statistical program SPSS 19.0. In the descriptive variables, absolute and relative frequencies were calculated while in the numerical variables, the arithmetic mean with the standard deviation, and the minimum, and maximum were determined. The descriptive statistics and frequency distribution of the following variables are shown: education, gender, number of restaurants, shellfish consumption and norms between seasons, monitoring documentation from suppliers and store shellfish monitoring concerning temperature and storage time, heat treatment of seashells and hot appetizers, as well as the main offered dishes. To analyse the effect of formal education on the correctness of answers in the food safety behaviours section, a chi-squared test was used. The same test was also used to determine the effect of formal education on the correctness of answers in the food safety knowledge section. As regard to the statistical conclusion, P-values under .05 were considered statistically significant.

## 3 RESULTS

### 3.1 DESCRIPTION ANALYSIS

Of the 41 persons interviewed that were working in restaurants in Slovene Istra and preparing shell dishes, 31 were male and 10 were female. Of these 41 interviewees 24 proved to have formal (58.5 %) and 17 informal education (41.5 %). The criterion formal education included being educated as catering technicians, cooks and catering business organisers. Their catalogues on expert knowledge and skills or their exam catalogues comprehend contents and study objectives, namely: knows the adequate quality of victuals, masters the procedures of mechanical and heat handling of victuals as well.

Regarding education, most people employed in the catering plants were educated catering technicians (Table 1), yet other profiles could be found (architect, economist, high school graduate, economy technician).

### 3.2 SHELLS' OFFER

In the main season (June, July, August), the usage of shells in studied restaurants amounted to an average

**Table 1:** Education profile of the interviewees  
**Preglednica 1:** Izobrazbeni profil intervjuvancev

Formal / Informal education	Education	Number
Formal education	Catering technician	19
	Catering business organizer	3
	Cook	2
Informal education	Waiter	3
	Primary school	3
	Degree in tourism	2
	Bachelor of Economics	2
	Tourism technician	2
	Electrical technician	2
	Architect	1
	Economics	1
	High school graduate	1

quantity of 286.1 kg ( $\pm$  310.1), whereas out of the season (from September to May) 48 % less, which is 135.1 kg ( $\pm$  165.1). The quantity of consumed and prepared shells ranged from 5 kg to 1000 kg in the main season, and from 2 kg to 500 kg out of the prime season.

The norm for the hors d'oeuvre contains an average of 276.5 g ( $\pm$  115.0) of shells, whereas for the main course, 403.3 g ( $\pm$  103.3); nevertheless, the range is very large here ( Table 2).

In the forty-one restaurants the main dishes mostly offered are »pedoči (blue mussels) alla busara« offered in 73.2 % of the restaurants, and grilled »kapesante« (great scallops) offered in 70.7 %. Gratinated gnocchi with jacobinias and fan mussels is offered as a main dish only in 9.8 % of the restaurants. As cold hors d'oeuvre, most often salads from seafood (58.8 %) and »pedoči« or thorny oysters (blue mussels – 48.7 %) are offered, while the least offered are raw oysters – only at 26.8 % of restaurants. As warm hors d'oeuvre, mostly risotto with seafood (75.6 %) and a plate of mixed shells (63.4), whereas in the least cases (4.9 %), oyster's cream soup can be found. The results are shown in Table 3.

**Table 2:** Seashell consumption in Slovene-Istria restaurants during the main season and off-season in kilograms, and the rate of standard for food in grams

**Preglednica 2:** Potrošnja školjk v restavracijah v slovenski Istri v času glavne sezone in izven sezone v kg in velikost porcij v g

Question	N	Min.	Max.	Mean	SD
What is the total quantity of shells ordered in the main season (kg)?	27	5	1000	286.1	310.1
What is the total quantity of shells ordered off-season (kg)?	21	2	500	135.1	165.1
What is the quantity of shells in an appetizer (g)?	34	100	500	276.5	115.0
What is the quantity of shells in a main course (g)?	30	300	700	403.3	103.3

Min = minimum; Max = maximum; N = number of responders

The results of the first section of the questionnaire on the subject of food safety are presented in Table 4. Among the interviewees with a formal education, 56.1 % examine documentation at the receipt of victuals and have the supplier's declaration that seashells comply with HACCP. Among the interviewees with an informal education, this percentage amounts to 39 %. Among the interviewees with a formal education, 48.8 % demand a registration document and 56.1 % have a list of suppliers. The persons with an informal education obtained a result of 39.0 % and 34.1 % respectively. All the interviewees are in possession of coolers and freezers, equipped with thermometers and run documentation on controlling

the temperatures. On average, the food handlers with formal education answered the questions from the first part of the food safety questionnaire correctly in 82.6 % of the cases (14/17 questions), while food handlers with informal education answered 78.5 % of the questions correctly (13/17 questions).

From the questionnaire section on food safety 29.3 % of the interviewees with a formal education were familiar with the temperatures for storing frozen shells, while this was 14.6 % of those with an informal education (Table 5). On the knowledge of storing living shells 14.6 % of persons with a formal education knew the right temperature and only 4.9 % of the persons with an informal education were familiar with the right temperature for storing living shells. The answer about how long frozen shells can be stored was answered correctly by 24.4 % of the interviewees with formal education and by 22.9 % with informal education. The knowledge on how long living shells can be stored was better among persons with formal education (51.2 %) compared to 34.1 % with informal education. The middle temperature for heat handling of shells is being measured by 26.8 % of inter-

**Table 3:** Categorisation of the systematic hot and cold hors d'oeuvres dishes served among Slovene-Istria food establishments (N = 41)  
**Preglednica 3:** Kategorizacija toplih in hladnih jedi na osnovi školjk in rakov v restavracijah v slovenski Istri (N = 41)

Systematics dishes	Name of the dish	Percentage of food establishments (%)
Main dishes	Mussels alla Busara	73.2
	Grilled Scallops	70.7
	Mixed Seashells alla Triestina	68.3
	Clamps alla Busara	65.9
	Gratinated Scallops	63.4
	Mixed Busara	61.0
	Grilled Mussels	51.2
	Gratinated Mussels	48.8
	Grilled Clams	43.9
	Cockles	43.9
	Baby Clams	36.6
	Gratinated Gnocchi with Scallops and Canestrelli	9.8
Cold appetizers	Seafood Salad	58.8
	Mussels	48.8
	Scallops	39.0
	Raw Oysters	26.8
Hot appetizers	Seafood Risotto	75.6
	Mixed Seashell Plate	63.4
	Spaghetti alle Vongole (small clams)	58.5
	Spaghetti with Mussels	58.5
	Seared Scallops	51.2
	Steamed Mussels	43.9
	Oyster Cream Soup	4.9

viewees with formal education and only by 7.3 % with informal. Yet, when the interviewees were asked about concrete numbers and time for heat handling, only 4.9 % of persons answered correctly, regardless education.

On average, food handlers with formal education answered the knowledge part of the food safety questionnaire in 37.5 % of the cases correctly (2.25/6 questions), while food handlers with informal education answered 38.2 % of the questions correctly (2.29/6 questions).

#### 4 DISCUSSION

From the 41 restaurant in Slovene Istria that were investigated in this study we confirmed that shells and shell specialties represent an interesting gastronomic offer in Slovene Istria, with the most characteristic shell of the area the "pedoč" also known as the blue mussel. "Pedoči alla busara" as a main dish are offered in 73 % of the restaurants, meanwhile, dishes from pedoči as a cold

hors d'oeuvre are offered in almost half of the restaurants (48.8 %), and as a warm hors d'oeuvre at 43.9 % of the restaurants. Among the least offered dishes are oysters. This was not surprising, since oysters are very specific in their appearance and texture; many people are even disgusted by their viscose structure and for eating the alive (Debucquet, Cornet, Adam, & Cardinal, 2012). The norm for hors d'oeuvre contains on average 276.5 g of shells, and for the main dishes 403.3 g, yet the range is very wide. For hors d'oeuvre, the maximum norm reached was 500 g, and for the main dishes 700 g. Wide ranges were also found in other European studies; e.g., a survey reported by the United Kingdom indicates a mean mussels' meal size of 114 g and a maximum of 239 g (Henderson, Gregory, & Swan, 2002), while a Dutch study reported a mean portion size of 136 g of shellfish and a maximum of 480 g (Kistemaker, Bouman, & Hulshof, 1998). The portions were much scatter nevertheless and did not refer to restaurant portions, but to those consumed in general. From

**Table 4:** Percentage (%) of correct answers regarding Food Safety Behaviour and the influence of formal and informal education  
**Preglednica 4:** Odstotek (%) pravih odgovorov glede vedenja za zagotavljanje prehranske varnosti in vpliv formalne in neformalne izobrazbe

Question	Percentage of correct answers (%) as regard to education		Statistical difference P
	Formal	Informal	
Do you examine the accompanying documentation at the receipt of victuals?	56.1	39.0	1.000
Are you in possession of a statement by each supplier in compliance with HACCP, or of a piece of evidence declaring that the victuals and the raw flesh supplied by the supplier are medically faultless?	56.1	39.0	1.000
Do you run all the necessary documentation and evidence on rebuttals or irregularities at receipt (e.g. expired product, inadequate temperature at receipt, damaged packaging)?	53.7	36.6	1.000
Do you demand a registration document from the supplier?	48.8	39.0	0.382
What methods of storage preventing any damage of packaging and pollution of victuals do you use?	46.3	31.7	1.000
Do you store raw and prepared victuals separately?	56.1	39.0	1.000
Are you in possession of a list of suppliers of victuals, stating the type of victual, the supplier, the name and surname of the responsible person and his or her GSM?	56.1	34.1	0.290
Are you in possession of enough coolers and/or freezers?	56.1	36.6	0.560
Are all the coolers and freezers equipped with thermometers?	56.1	36.6	0.560
Do you run notes and adequate documentation on the surveillance of thermometers in coolers/freezers?	56.1	39.0	1.000
Do you examine if the received shells have been cleaned?	48.8	36.6	1.000
Do you use separate storage for frozen shells, as compared to other victuals?	39.0	29.3	1.000
Do you use separate storage for fresh shells, as compared to other victuals?	51.2	34.1	0.679
Do you measure mid temperatures at the handling of shell dishes?	26.8	7.3	0.096
Do you also store dishes handled with heat for the following meal?	56.1	39.0	1.000
Do you check temperature regeneration with a thermometer?	7.3	2.4	0.629
Does the placement of wash-hand basins prevent the crossing of clean and unclean passages?	51.2	34.1	0.679

\* P Statistical differences in the distribution of answers with significance  $P < 0.05$

the data, it is rather unclear, whether those refer to hors d'oeuvre or to main dishes.

The origin of shells is most important; and restaurants should be convinced of good raw meat to exclude poisoning. Therefore, seashells should be bought only at registered plants, since these are under official supervision, within the frame of which sampling of toxins is carried out (VURS, 2011). Meanwhile, after interviewing the employed restaurant personnel, we suspected that seashells were not always bought at registered plants. In our case, 14 out of 41 employed in catering plants replied that raw shell suppliers came from the region of the Littoral

(Primorska) without naming them, as they were unable to remember, or they did not wish to tell the names. Thus, it can be concluded that still large quantities of seashells are supplied from the so called illegal »black market«.

After the analysis of results from both sections of the questionnaire, a satisfying working practice was noticed. However, it is rather alarming that only a scarce half (48.8 %) of the interviewees with a formal education actually examine the documentation on shell cleansing. The percentage with the interviewees with an informal education is even lower (36.6 %). Besides, we established very bad knowledge on the safe preparation of shell

**Table 5:** Percentage (%) of correct answers regarding Food Safety Knowledge and the influence of formal and informal education  
**Preglednica 5:** Odstotek (%) pravih odgovorov glede poznavanja prehranske varnosti in vpliv formalne in neformalne izobrazbe

Questions	Percentage of correct answers (%) as regard to education		Statistical difference P
	Formal	Informal	
How long do you keep registration documents?	7.3	9.8	0.421
What is the temperature for storing frozen shells?	29.3	14.6	0.524
What is the temperature for storing living shells?	14.6	4.9	0.433
How long do you store frozen shells?	24.4	22.0	0.537
How long do you store fresh shells?	51.2	34.1	0.679
What is the middle temperature at heat handling of shell dishes?	4.9	4.9	1.000

\* P statistical characteristics  $P < 0.05$

dishes among all the employed restaurant personnel. On average food handlers with formal education, answered the behaviour part of the food safety questionnaire correctly in 82.6 % of the cases (14/17 questions), and food handlers with informal education answered 78.5 % of the questions correctly (13/17 questions). Nonetheless, the results of the second section on the subject of food safety, the data on temperatures and the methods of storing, were alarming (Table 5).

On average, food handlers with formal education answered the knowledge part of the food safety questionnaire in 37.5 % of the cases correctly (2.25/6 questions), and food handlers with informal education answered 38.2 % of the questions correctly (2.29/6 questions). If we take a look at the overall result of the food safety questionnaire, it was found that the safety is generally bad, since on average, correct replies were given in 60.1 % of the cases by those with formal education and in 58.3 % by those with informal education. Similar findings were reported for Portuguese cases: 56.5 % reported by Martins, Hogg, & Otero (2012) and 62.9 % reported by Gomes-Neves, Araújo, Ramos, & Cardoso (2007).

After examining individual questions, we discovered major shortcomings in the knowledge of adequate temperature regimes. Shells need to be adequately stored and protected from contamination after receipt. Living shells are transferred as fast as possible from the transport vehicle to the storehouse, with high levels of moisture and to the temperatures ranging from 2 to 10 °C (Watson & Denton, 2007). The survey revealed that only 14.6 % of the interviewees with formal education and only 4.9 % of those with informal education are familiar with appropriate temperatures. It can thus be concluded that only a low percentage of restaurants stores living shells adequately, and that others store living shells at lower temperatures, which represents a major stress factor for the shells and consequently lower quality. The time of preserving shells depends on the temperatures

of storage. If they are stored at temperatures from 2 to 5 °C, the furthest recommended expiry date is after 10 days, and if they are stored at temperatures from 5 to 10 °C, the expiry time span shortens to a half, that is 5 days (Watson & Denton, 2007). In our case, 51.2 % of the interviewees with formal education and 34.1 % with informal education are familiar with the information on how long at the most living shells be stored. Lifeless shells should be stored at -18 °C at the least and for six months at the most, they are thawed in a fridge overnight or in cold water for approximately one hour (BC CDC, 2012). The results of the survey showed that 24.4 % of the interviewees with formal education and 22.0 % with informal stored the shells in a fridge for an excessive amount of time. These data showed that the knowledge on storing temperatures, storing time, and the adequate methods of storing was insufficiently among the personnel employed in Slovene Istrian catering. Besides, the personnel was hardly acquainted with HACCP, which represents major risks for the development of microorganisms, and consequently for food poisonings.

Much attention should be given to planning and setting up room and equipment for cooking shells to decrease the risks of cross contamination. Cooking is a critical point of surveillance for the safety of products and an important surveillance point for their quality. The catering plants should introduce a protocol of cooking shells, which would determine the temperature, time and pressure of cooking regarding the species and sizes of the shells. The time span for cooking begins when the middle part of the shell reaches the desired temperature, and it can be very short. One should measure this particular mid temperature of the dish whilst cooking, which nowadays represents a rare event in practice. The survey showed that the mid temperature was measured by only 26.8 % of the interviewees with formal education and 7.3 % with informal education. The remaining did not perform this procedure or it was not known whether

it was performed. For the destruction of the viruses and bacteria, the mid temperature of 90 °C should be reached for 90 seconds. If shells are cooked in boiled water, the assumed time for cooking is 4–9 minutes after the opening of shells, for frying the temperature is 190 °C for 3 minutes, and for baking in the oven, 230 °C for 10 minutes (BC Centre of Disease Control, 2012). The results of the survey demonstrated that only 4.9 % of the interviewees, regardless (in)formal education, are familiar with the correct temperature for heat handling. A similar knowledge gap was shown by other researchers from Portugal (Martins, Hogg, & Otero, 2012), South Africa (Marais, Conradie, & Labadarios, 2008), and Slovenia (Jevšnik, Hlebec, & Raspor, 2008b). These findings may be the probable cause for numerous poisonings with shells and other victuals. The National Institute for Public Health (IVZ RS, 2011) reported 121 food infections in the year 2010, while one should be aware of the possibility of even greater numbers, as people with milder symptoms decide not to search for help. Provided that dishes are not served warm, the shells should be cooled as fast as possible to a temperature lower than 5 °C and thus we can prevent the growth and multiplication of microorganisms. Such cooling also has an effect on the quality of the product, as it is easier to remove the shell from the flesh after the cooling. In Slovenia, not enough information is available on proper handling of shells in catering plants. The proper delivery of shells, the temperature and time of storing in plants, the temperature and time of handling shells, cooling and regeneration of dishes are all equally important. Only by an adequate approach and consideration of guidelines, as well as proper education of the employees in the catering establishment, can we ensure healthy and safe dishes. We found that the habits and the knowledge on handling shells are insufficient, and therefore education programmes and the nutritional legislation should more actively emphasize the importance of appropriate education for catering workers (Egan *et al.*, 2007), including the staff preparing shell dishes. The management is usually aware of these facts, yet not enough stimulation and sustainment are given to regular and day-to-day education of workers (Seaman & Eves, 2010). It would be reasonable to consider the more recent proposals on learning as described by Mullan and Wong (2009) and Chow and Mullan (2010) in their works, where they emphasize the importance of the most common habits of the workers, as these are passed on to their working environments. Some researchers emphasize that active learning is more effective and has a longer duration (Rennie, 1994; Niode, Bruhn, & Simonne, 2011). Therefore, with the finding in the present study we suggest to include interventions aimed at increasing safe food handling, such intentions should focus on the impact of normative influ-

ences and perceptions of control over the food handling environment; whereas interventions to change the actual behaviour should attempt to increase hygienic food handling as a habitual behaviour.

## 5 CONCLUSIONS

Our study shows that despite the small area of the Slovene coast, seashell dishes are rather often consumed in the Slovene Istria coastal sites. »Pedoči« or blue mussels are the most commonly offered main dish in restaurants. The education of the employees at the catering plants varies considerably and, regardless (in)formal education, their knowledge of handling seashells proved to be rather poor. That the influence of having attended formal education was positive, yielding somewhat better knowledge, yet there were no significant differences as regards to informal education on the particular items reviewed. The survey showed the worst result in the field of examining mid temperatures of shell dishes and in being familiar with safe temperatures for heat handling of seashell specialties. As seashells are a highly perishable victual, it is of essential importance that the shells are handled correctly to eliminate health complications. We propose that education programmes and nutritional legislation should emphasize more the importance of formal education for catering workers preparing shell dishes.

## 6 ACKNOWLEDGEMENTS

*Source of funding:* Funding was received from the Slovene Research Agency (Research Projects 5.9.13), within the aimed research project “Slovenia’s Competitiveness 2006–2013”, with the project “Viral and Microbiologic Contamination of Mussels and the Presence of Sea Toxins In Mussels”. *Conflict of interest:* The authors certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript. *Authors’ contributions:* TPV, TJ and MB designed the study and the questionnaire; TPV analysed the data and prepared the results; TPV, TJ and MB interpreted the data, and contributed in writing the manuscript. All authors made substantial contributions and gave final approval of the preliminary versions, drafting, and final version. All authors met the criteria for authorship as established by the International Committee of Medical Journal Editors and believe that the paper represents honest work. *Acknowledgements:* The authors would like to thank all the staff in the restaurants for the given answers in this study. We thank Dr. Cécil J.W. Meulenber for proofreading and useful suggestions.



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