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THE PREVALENCE OF *SALMONELLA* INFECTIONS IN LAYING HEN FLOCKS PRODUCING EGGS AND THEIR IMPACT ON THE PUBLIC HEALTH

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ABSTRACT

Since 2008, Slovakia has implemented the National control program of *Salmonella* infections in laying hen flocks. This program requires the farm operators to monitor and investigate the invasive types of *Salmonella* (*S. Enteritidis* and *S. Typhimurium*) according to STN ISO 6579. The aim of this study was to perform a microbiological examination of dust and chicken droppings samples of laying hens in the Trenčín region for the presence of *Salmonella* by Horizontal method according to STN ISO 6579: 2002, to compare results with the statistics across Slovakia and selected EU countries and to evaluate the impact of official controls of salmonellosis in animals and humans. In the years 2009 – 2013 in the Trenčín region, 730 samples of dust from the conveyor belts and droppings of laying hens were taken to determine the prevalence of *Salmonella* in individual rearings. In these years, the incidence of positive samples was found from 0% to 29.17%. For the period from 2009 till 2013 was reported 22833 salmonellosis cases in human population of Slovakia, while in the Trenčín region it was 2636. Five-year EU-trend (2009 – 2013) showed a statistically significant decrease of salmonellosis occurence (with a mean reduction of 12% per year). The Wilcoxon signed-rank test was performed in order to provide in-depth epidemiological assessment of salmonellosis cases in Trenčín region in relation to selected characters: etiological agens, transmission mechanism, age, location as well as seasonality of infection.

Keywords: *Salmonella spp.*; laying hens; eggs; salmonellosis; legislation

INTRODUCTION

The safety of eggs and egg products is at present time one of the priorities of the institutions that deal with health risks and foodborne diseases. **Angelovičová et al. (2012, 2013 a,b)** and **Medveď and Angelovičová (2010)** examined hygienic, nutritional and health quality aspects of broiler chickens, laying hens as well as eggs.

Microbial contamination on the shell eggs is one of the major factors to indicate egg quality, affecting the level of exogenous microbial contamination in the egg contents **(Englmaierová and Tůmová, 2007)**. **Cwiková and Nedomová (2014)** assessed the microbiological quality of egg liquid products. Statistical analysis showed (p >0.05) no correlation between seasons and microbial counts for any of the egg substances investigated.

It poses a fundamental problem in the production of eggs intended for consumers **(Dev et al., 2013)**, particularly regarding the total aerobic count and contamination with Gram-negative bacteria from the family *Enterobacteriaceae* **(Németh et al., 2011)**. *Salmonella* has long been recognised as an important zoonotic pathogen of economic significance in animals and humans. More than 2500 serovars of zoonotic *Salmonella* exist and the prevalence of the different serovars changes over time (e.g. *S.* Typhimurium). Non-typhoidal *Salmonella enterica* infection is one of the leading causes of gastrointestinal illness, responsible for several million human cases and thousands of deaths worldwide each year **(Clarkson et al., 2010).**

Today, reliable identification of many serotypes is performing by different analytical methods, from microbiological and biochemical ones **(Mirmomeni et al., 2009)** up to the DNA based **(Žiarovská et al., 2013)**.

The common reservoir of *Salmonella* is the intestinal tract of a wide range of domestic and wild animals which result in a variety of foodstuffs covering both food of animal and plant origin as sources of infections **(Latimer et al., 2008)**.

When specific control programs are performed, variations in the progress of these programs might follow a geographic pattern, leading to spatial heterogenity. However, climate may affect maintenance and transmission of *Salmonella*, and wildlife may act as a source of infection. Under these circumstances and considering that information on geographical location is available, spatial analysis can be considered as a key step in epidemiology. The objectives include generating hypotheses on the risk factors and on processes underlying the transmission of infections **(Nabila et al., 2010)**.

In this regard, since 1 January 2008 Slovakia has implemented the National control program of *Salmonella* infections in laying hen flocks (*Gallus gallus*) producing eggs for human consumption. It monitors the incidence of *Salmonella* in rearings and their possible transfer to table eggs. This program is mandatory throughout the territory

of Slovakia at all commercial rearings of laying hens of domestic fowl (*Gallus gallus*) producing eggs for human consumption and those eggs placed on the markets. The aim is to reduce the incidence of *Salmonella Enteritidis* and *Salmonella Typhimurium* (including monophasic *Salmonella Typhimurium* strains with the antigenic formula 1,4, [5], 12: i:-) in adult laying hens of *Gallus gallus*, which is determined as an annual reduction of positive flocks of adult laying hens by at least 10%, if the prevalence in the preceding year was less than 10%. Eradication program is evaluated annually.

The legal basis of the national control program are: **Act**. **39/2007 Coll**. **on veterinary care**, **Regulation (**EC) **No 2160/2003, Government Regulation No 626/2004, Commission Regulation (EU) No. 517/2011, Commission Regulation (EC) No. 1177/2006**.

Slovakia is actively involved in the Early Warning Response System (EWRS) in the case of epidemiological situation emergency in the EU. The aim of the system is a rapid exchange of information on the incidence of infectious diseases and epidemics that have the potential to spread beyond countries where they start respectively, or may be a threat to the population of the EU or are rare and interesting in professional view. Slovakia cooperates in international activities in the area of foodborne diseases and zoonoses with the WHO, EFSA, and also in particular with the European Centre for Disease Prevention (ECDC) in Stockholm at the European level. In addition to sending data to the TESS (The European Surveillance System) is managed as the task under a special program of the European Food and Waterborne Diseases (FWD). Based on the FWD program, European network of special Epidemiological Information System (EPIS, since 2006) for the FWD was established in Slovakia. EPIS network is involved in the solutions of so-called "urgent inquires," what is a signal of possible threats of international epidemics. ECDC teams distribute the data to all member states including Slovakia. FWD monitors the surveillance of 6 priority diseases (salmonellosis, campylobacteriosis, VTEC-*E. coli*, yersiniosis, listeriosis and shigellosis) and partially 10 other diseases.

MATERIAL AND METHODOLOGY

The aim of the study was to perform the microbiological examination of dust and chicken droppings samples of laying hens in the Trenčín region for the presence of *Salmonella* by Horizontal method according to STN ISO 6579: 2002, to compare results with the statistics of Slovakia and selected EU countries and to evaluate the impact of official controls of salmonellosis in animals and humans. In the Trenčín region during the years 2009 – 2013, totally 730 samples of dust from the conveyor belts and droppings of laying hens were taken to determine the prevalence of *Salmonella* in individual rearings.

Epidemiological analysis of reported cases of salmonellosis was based on factual material that was obtained from the following sources:

- The Epidemiological Information System (EPIS) in Slovakia
- The Community Summary Report on Trends and Sources of Zoonoses and Zoonotic Agents in the European Union by EFSA.

We performed epidemiological analysis of reported cases of salmonellosis in the Trenčín region (Slovakia) for the period from 2009 till 2013, resp. 2000 till 2014 in relation to the selected characters: etiological agent, transmission mechanism, age, location and seasonality of infection.

Statistical evaluation of the results were performed in the program *Tanagara 1.4.43*. (Rakotomalala, Lyon, France). Based on the parameters arised from our results we chosed the Wilcoxon signed-rank test which is a non-parametric statistical hypothesis test.

RESULTS AND DISCUSSION

Since 2008, Slovakia has implemented the National control program of *Salmonella* infections (*S. Enteritidis* a *S. Typhimurium*) in laying hen flocks (*Gallus gallus)* producing eggs for human consumption by the **Regulation (EC) No. 2160/2003**. Control programs consist of effective measures to prevent, detect and control *Salmonella* on whole production line in processing of eggs mainly at the level of primary production to reduce the prevalence of *Salmonella* and risk to public health.

Table 1 summarizes the prevalence of *Salmonella* in laying hen flocks in selected EU countries in the period 2009 – 2013. The study of *Salmonella* prevalence focuses mainly on the serotypes of *S.* Enteritidis and *S.* Typhimurium. Since during the period 2008 – 2010 went three-year period, after which the results were evaluated, we present only the results of 2010.

In the following section is described a detailed overview of the samples examined in the context of the National control program for *Salmonella* infections in laying hen flocks of domestic fowl (*Gallus gallus*) producing eggs for human consumption in the Trenčín region and Slovakia during the years 2009 – 2013.

In 2009, the prevalence of *Salmonella* at laying hens in the Trenčín region was 29.17%, due to the low number of samples taken (24), of which 7 samples were observed positive. In Slovakia, 263 samples were taken and positive prevalence was found at 7.60%. In 2010 in the Trenčín region was taken 623 samples and only 5 of them were positive (0,80%). A similar prevalence was detected in Slovakia, among collected 1491 samples, in 14 positive cases the prevalence was determined 0.94%.

In 2011, in the Trenčín region under self-control of farmers and official controls of hens producing eggs for human consumption among 13 samples observed, no positive case of *Salmonella* occurred. In this year a slight decrease in the number of human infections in zhe Trenčín region was shown. Slovakia confirmed the occurrence of *Salmonella* at two rearings, being 1.14% increase compared to 2010. The number of samples taken was up to five times lower than in the previous year, which could affect the results. The situation in the EU in 2011 improved, the prevalence of *Salmonella* in laying flocks was 4.2%. Prevalence of serotypes *S.* Enteritidis and *S.* Typhimurium was 1.5%. Compared to 2010, it represents a decrease of 1.7% incidence of all serotypes of *Salmonella* spp. and decrease of 0.4% of two most common serotypes of flocks **(EFSA Journal, 2012)**.

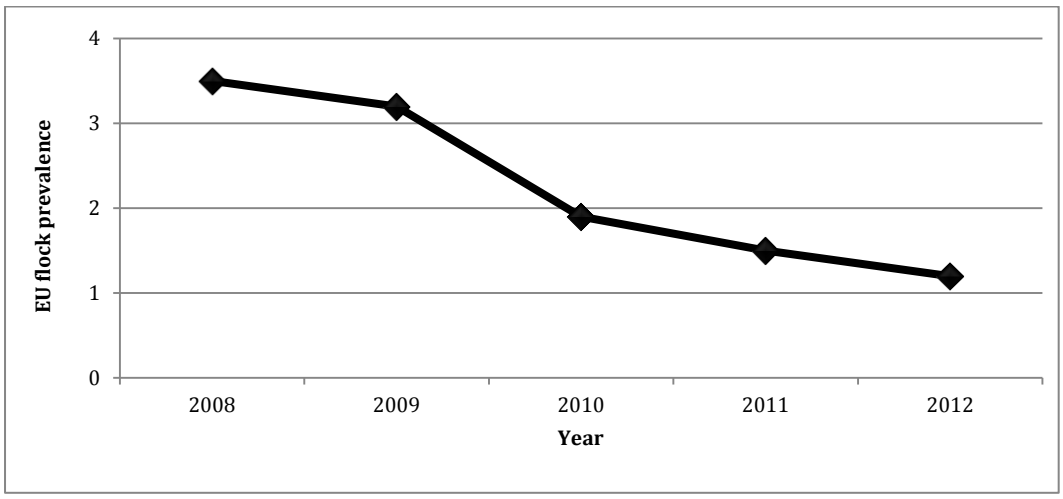

Figure 1 Prevalence of *S.* Enteritidis and *S.* Typhimurium-positive laing hen flocks of *Gallus gallus* during the production period in the EU (2008 – 2012) **(EFSA Journal, 2014)**

The overall prevalence of positive samples at laying hen flocks in Slovakia in 2012 was 4.68%. Compared to previous year, incidence increased of 2.6% depending on the number of samples. According to the EFSA report on zoonoses in 2012 the prevalence of *Salmonella Enteritidis* and *Salmonella Typhimurium* was 1.8%. Compared to previous year in Slovakia by the EFSA report on zoonoses in 2011, it's an increase.

The overall prevalence of positive samples at laying hen flocks in Slovakia in 2013 was 1.06%. Compared to previous year, this represents a decrease of 3.62% depending on the number of samples.

In the Czech Republic, according to the EFSA, prevalence of Salmonella in rearings of laying hens was detected in 2012 at around 2%, of which 1.5% were *S. Enteritidis* and *S. Typhimurium* and 0.5% were other unspecified serotypes. This means a total decrease since 2005, when the study was done based on the prevalence of Salmonella in laying hen flocks in the European Union and the Czech Republic ranked the fourth with the percentage of Salmonella in laying hen flocks with 65.6% of prevalence and 62.5% of serotypes *S. Enteritidis* and *S. Typhimurium*. Larger percentage of positive occurrence of Salmonella spp. in laying hen flocks was in this study recorded in Portugal (79.5%), Poland (77.2%), Estonia (73.2%) **(EFSA Journal, 2013).**

In Poland, from where the most often eggs are imported to Slovakia **(Jamborová, 2013)**, was in 2012 the situation in the breeding of layer hen similar to the trend of the EU. The incidence of *Salmonella* spp. was 4.3%, and of monitored two serotypes was 2.8%, that means a decrease in the incidence of 0.9% compared to 2011 **(EFSA Journal, 2013).**

As it is shown, in recent years in the Trenčín region has been observed the overall decrease in the incidence of *Salmonella* infections in laying hens flocks, but in Slovakia as well. The most important role showed the adoption of eradication programs and good cooperation of the veterinarians, medical doctors and food producers.

In terms with the above described trend of decreasing incidence of S*almonella* in rearings of laying hens and by the implementing of national control programs for *Salmonella* infection in broiler chickens and laying hens, the next section will be focused on the epidemiological analysis of reported human salmonellosis cases in the Trenčín region and Slovakia.

Salmonellosis (A020) belongs to the diseases with the highest morbidity in Slovakia. In the Trenčín region from 2009, situation with the incidence of human salmonellosis is relatively stable and has a decreasing tendency. However, when comparing the period before the introduction of control programs, such as 2004 – 2007 and the current situation, we can see a large decrease in occurrence of these infections. While in 2004 there were found about 260 cases of salmonellosis per 100000 inhabitants, in 2013 only 75 cases of salmonellosis per 100100 inhabitants were confirmed. Total number of salmonellosis cases in the Trenčín region, but also in

Table 1 Overview of *Salmonella* prevalence (**%**) in laying hen flocks in selected **EU** countries **(EFSA Journal, 2014)**

	2009	**2010**	**2011**	**2012**	**2013**
Trenčín region: *Salmonella* spp.	29.17	0.80	0	2.63	6.25
Slovakia: *Salmonella* spp.	7.60	0.94	2.08	4.68	1.06
Czech republic: *Salmonella* spp.	12.80	3.20	3.20	2.00	
Poland: *Salmonella* spp.	12.90	7.00	5.50	4.30	
EU: *Salmonella* spp.	6.70	5.90	4.20	3.20	

Table 2 Overview of the samples examined in the context of the National control program for *Salmonella* infection in laying hen flocks of domestic fowl (*Gallus gallus*) producing eggs for human consumption in the Trenčín region and Slovakia in the years 2009 – 2013 (own processing).

Year	Trenčín region			Slovakia		
	Samples	Positive samples / %		Samples	Positive samples / %	
2009	24	7	29.17	263	20	7.60
2010	623	5	0.80	1491	14	0.94
2011	13	0	0	289	6	2.08
2012	38	1	2.63	534	25	4.68
2013	32	2	6.25	282	3	1.06
Total	730	15	7.77	2 859	68	3.27

Slovakia is shown in Figure 2.

The latest findings published by the EFSA regarding zoonoses in the European Union (EU) corroborate the fact that salmonellosis remains the most frequently reported zoonoses in the EU **(Pires et al., 2009; Lahuerta et al., 2011)**. Within Europe in 2012 it was reported 91034 human salmonellosis cases, it is decrease of 4.7% compared to 2011. A statistically significant decreasing trend in the European Union was seen in the period of 2008 – 2012 as well.

Zeleňáková et al. (2012) analyzed the changes in the epidemiology of salmonellosis and campylobacteriosis diseases in Slovakia over the past 10 years and evaluated them in the context of epidemiological changes comparing to the EU. For the period from 2001 till 2010 was reported 109304 salmonellosis cases in human and 3 327 cases of *Salmonella* carriage in Slovakia. They focused on more in-depth epidemiological analysis of salmonellosis cases in Slovakia in relation to the infection agent and the outbreak of disease transmission mechanism, age and gender, location and seasonality of disease.

The epidemiologic report mapping the year 2014 is still not reported and published in the annual Community Summary Report, which covers 15 diseases. It can be assumed that the number of human salmonellosis cases in the EU reported via BSN (Basic Surveillance Network) has decreased since 2004. However, there were member states with specific variations in trend. Although ten countries showed a significant decreasing trend (the greatest average annual decline of 28% was observed in the Czech Republic), there was still one MS, Malta that showed a significant increasing trend. Trends were not significant in the rest of 14 countries that reported data on *Salmonella* for the five consecutive years.

The incidence of salmonellosis in the Trenčín region is not different from those reported by other regions within Slovakia. The current situation is due to a strong activity of *S.* Enteritidis, which dominates in the etiology of salmonellosis and the number of cases has increased since the beginning of the last decade. The second most frequently occurring serotype of *S. Typhimurium* accounted for 3% and *S. Infantis* was 1%. Other serotypes occurred only sporadically and usually represent only a fraction of a percentage of a total (8%). As it was already mentioned, the number of salmonellosis illnesses since 2001 is gradually declining, but new serotypes of *Salmonella* are still isolated.

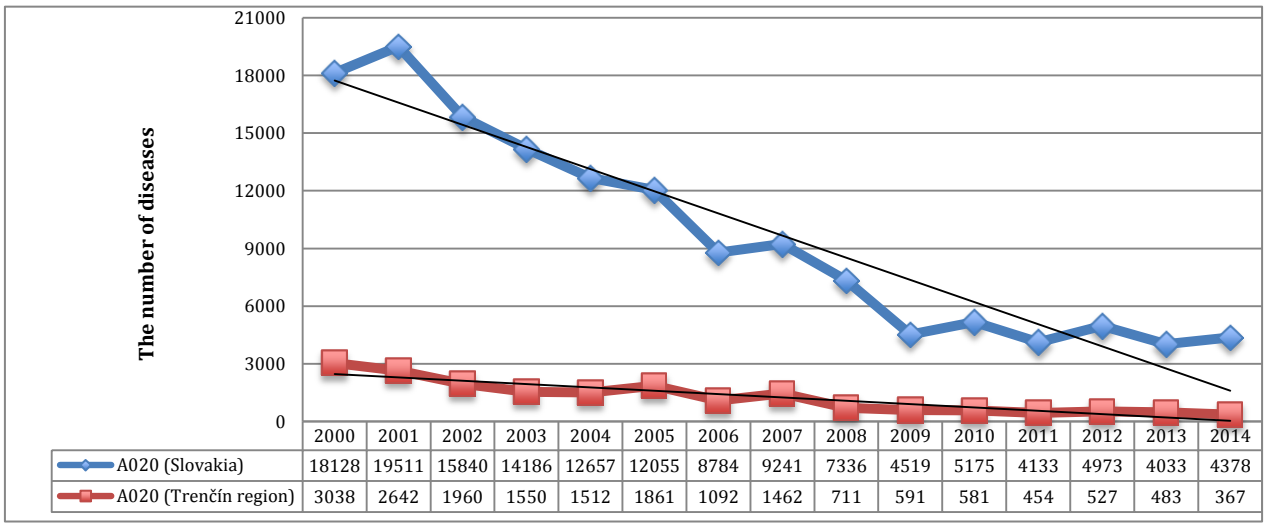

Figure 2 The trend of the human salmonellosis incidence in Slovakia as well as in the Trenčín region (2000 – 2014) (own processing)

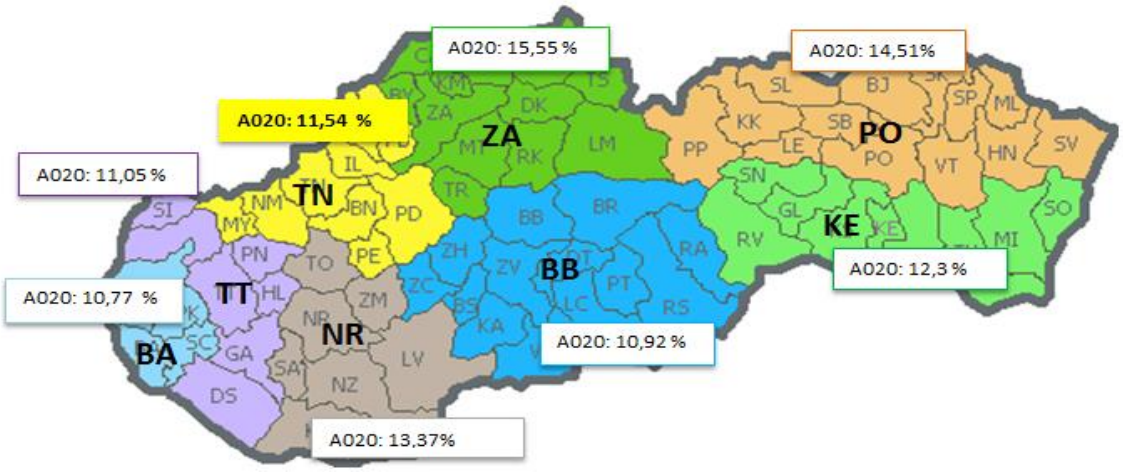

Figure 3 Regional expansion of human salmonellosis in Slovakia (2009 – 2013) (own processing)

Note. The percentages show the proportion of the number of diseases in various regions to the total number observed in Slovakia. Regions: BA – Bratislava; TT – Trnava; NR – Nitra; TN – Trenčín; BB – Banská Bystrica; KE – Košice; PO – Prešov; ZA – Žilina

The common reservoir of *Salmonella* spp. is the intestinal tract of a wide range of domestic and wild animals which result in a variety of foodstuffs covering both food of animal and plant origin as sources of infections **(Montserrat and Yuste, 2010).**

Salmonella spp. is an enteric pathogen associated with animal and slaughter hygiene. In the EU, eggs and egg products are the most frequently implicated sources of human salmonellosis. Meat is also an important source, with poultry and pork implicated more often than beef and lamb **(EFSA Journal, 2008).** *S. Enteritidi*s is associated primarily with poultry and eggs. It has been observed that *Salmonella* spp. usually persists during chilling **(D'Aoust-Maurer, 2007; Voetsch et al., 2004).**

The analysis of single epidemics in the Trenčín region according to the place of occurence shows that the most salmonellosis cases was detected in private (usually within the family celebrations) but also at firms, schools and open forms of catering (inadequate storage temperatures, inadequate cooking or cross contamination of ready-to-eat food). The most common factors of *Salmonella* transmission were eggs, home and business networks, egg products inadequately treated, unpasteurised milk, water from individual sources, blended food, confectionery, cheese and poultry. Transfer factor has been proven by laboratories, but also by epidemiological investigation.

Overall, in the EU, *S. Enteritidis* and *S. Typhimurium* are the serovars most frequently associated with human illness. Human *S. Enteritidis* cases are the most commonly associated with the consumption of contaminated eggs and poultry meat, while *S. Typhimurium* cases are mostly associated with the consumption of contaminated pig, poultry and bovine meat **(EFSA Journal, 2011).**

Salmonella was rarely detected in other foodstuffs, such as dairy products, fruit and vegetables. Products non-compliant with EU *Salmonella* criteria were mainly observed in minced meat and meat preparations as well as in live molluscs (**EFSA Journal, 2014).**

Table 3 The most frequent factors of *Salmonella* transmission in the Trenčín region (2009 – 2013) (own processing).

Age	Agens - *Salmonella*	Factors			
		1	2	3	4
2009	*Enteritidis, Typhimurium*	Domestic eggs	Poultry, meat products	Fast food	Confectionery
2010	*Enteritidis, Typhimurium*	Eggs from the supermarket	Meat products	Mixed food	Ice cream
2011	*Enteritidis*	Egg products	Poultry	Fast food	Ice cream
2012	*Enteritidis, Typhimurium*	Domestic eggs	Meat products	Fast food	Confectionery
2013	*Enteritidis, Bovismorbificans*	Domestic eggs	Milk products	Milk products	Fast food

Table 4 Verification of differences in the incidence of salmonellosis in the Trenčín region (2000 – 2014) for the factor „Age“ with the Wilcoxon signed-rank test (own processing).

Age	65+	55-64	45-54	35-44	25-34	20-24	15-19	10-14	5-9
65+	-	-	-	-	-	-	-	-	-
55-64	**	-	-	-	-	-	-	-	-
45-54	NS	**	-	-	-	-	-	-	-
35-44	*	**	***	-	-	-	-	-	-
25-34	**	**	***	**	-	-	-	-	-
20-24	*	NS	***	***	***	-	-	-	-
15-19	NS	*	**	***	***	**	-	-	-
10-14	NS	*	NS	**	***	**	*	-	-
5-9	***	***	**	*	*	***	**	***	-
0-4	***	***	***	***	***	***	***	***	***

NS – non significant different, *p <0.05 - significant different, ** p <0.01 - high signifficant different, *** p <0.001 - very high significant different

Investigations of geographical localization of infections show that salmonellosis was reported in all regions of Slovakia (Fig. 3). However it should be noted that slightly higher incidence of salmonellosis has been reported in the Eastern Slovakia. It can be assumed that it is due to more traditional rural way of life regarding the preference of eggs produced in the local farms. **Zeleňáková et al. (2012)** analyzed occurence of human salmonellosis in Slovakia (2001 – 2010) from geographical aspect and by the Sheffe´s analysis observed homogeneous groups with statistically significant differences.

Salmonellosis infections in the Trenčín region (2009 – 2013) were reported in each age group (Table 4), while the highest number of 662 was recorded for 0 – 4 year old (age-specific morbidity 477/100000). For more in-depth statistical analysis was used the Wilcoxon signed-rank test (Table 4). At the age range of 0 – 4 years, it was found very high statistically significantly difference compared to other categories. The results confirmed that the formation of salmonellosis is higher in risk groups - newborns, infants and people with lower immunity, respectively people with decreased gastric acidity, whose infection is sufficient due to substantially lower amount of micro-organisms (the infection dose is 10^6 – 10^9 of live microorganisms in 1 g of contaminated food).

Considering the year occurence, salmonellosis occurred with the highest incidence from May to September over the period of 2003 – 2009 in the Trenčín region. We focused on more in-depth epidemiological analysis of salmonellosis cases in Trenčin region during years 2000 – 2014 in relation to seasonality. The existence of differences in the incidence of salmonellosis in different

Table 5 Verification of differences in the incidence of salmonellosis in the Trenčín region (2000 – 2014) for the factor Seasonality with the Wilcoxon signed-rank test (own processing).

Month	January	February	March	April	May	June	July	August	September	October	November
January	-	-	-	-	-	-	-	-	-	-	-
February	**	-	-	-	-	-	-	-	-	-	-
March	NS	*	-	-	-	-	-	-	-	-	-
April	NS	***	*	-	-	-	-	-	-	-	-
May	***	***	**	**	-	-	-	-	-	-	-
June	***	***	**	***	NS	-	-	-	-	-	-
July	***	***	**	***	NS	NS	-	-	-	-	-
August	***	***	***	***	*	*	*	-	-	-	-
September	***	***	**	***	*	*	*	NS	-	-	-
October	***	***	**	**	NS	NS	NS	*	***	-	-
November	**	**	**	*	NS	*	*	*	**	*	-
December	NS	NS	NS	*	**	***	***	***	***	***	**

NS – non significant different, *P<0.05 - significant different,

months of the year we performed using the the Wilcoxon signed-rank test (Table 5). We can state that the months of May, June, July and August were very high statistically significantly different compared to others.

By **Zeleňáková et al. (2012)** during the years 2001 – 2010 in summer months, the incidence of *Salmonella* spp. ranged from 54% (2009) to 65.07% (2010) in Slovakia. Very interesting was the year of 2008, when the most infected cases were detected in February and March that was associated with rapid warming and favorable conditions for multiplication of microorganisms.

Regarding the EU situation, the number of human salmonellosis was stable over the five-year period, but the incidence was always higher during the summer months. This could be due to a seasonal effect that has not been addressed through traditional *Salmonella* control programs for food and animals **(Lahuerta et al., 2011).** The incidence of salmonellosis especially in the warmer months is conditional upon the most food-borne zoonotic diseases benefiting fom the higher temperatures. Their optimum growth temperature is around 37 °C. In the summer season comes to faster food spoilage, especially in non-compliance with time and temperature during transportation and storage. When supplying raw materials to processing services the time plays an important role. Food contamination can be caused by humans too when a poor personal hygiene is observed **(Kangas et al., 2007)**.

Ambient temperature may influence people's behaviour, which in turn may affect the chance of a foodborne illness occurring. For example, increased temperature may lead to elevated consumption of raw foods such as fruit and salad (at risk of cross-contamination), and higher temperatures may encourage riskier cooking practices such as barbecuing. Finally, warmer temperatures may lead to increased outdoor recreational activity which may make it more likely that people will be exposed to environmental sources of the relevant gastrointestinal pathogens. Although these illnesses are not strictly 'foodborne', routine surveillance data cannot readily distinguish between these illnesses and those which are foodborne **(Tam et al., 2003)**.

CONCLUSION

Over the past 20 years, there has been a major change in the epidemiology of salmonellosis. A lot of factors have contributed to the change, including genetic factors, host susceptiblity, antimicrobial resistance and a substantial increase in international travel and in globalization of food trade. Common reservoir of *Salmonella* is the intestinal tract of a wide range of domestic and wild animals which result in a variety of foodstuffs covering both food of animal and plant origin as sources of infections. Transmission often occurs when organisms are introduced in food preparation areas and are allowed to multiply in food, e.g. due to inadequate storage temperatures, inadequate cooking or cross contamination of ready-to-eat food. In the EU, eggs and egg products are the most frequently implicated sources of human salmonellosis.

Although in all EU countries, since 2008, health programs have been established to reduce the number of *Salmonella* positive laying flocks, eggs and poultry meat are the most common sources of human salmonellosis. In recent years in the Trenčín region the overall decrease in the incidence of *Salmonella* infections in laying hen flocks has been observed, and in Slovakia as well. The most important role showed the adoption of eradication programs and good cooperation of the veterinarians, medical doctors and food producers. In Slovakia with 5424925 inhabitants (as reported in 31.12.2009), the epidemiological situation in the incidence of human salmonellosis is relatively favorable, but still is important very close collaboration between human and veterinary health authorities. There is a need to maintain effective surveillance and control programs, including reliable and sufficiently discriminative methods with rapid turn-around times, for providing epidemiological information on foodborne illness outbreaks and so reducing the prevalence of pathogens. This requires a collective effort by public health authorities.

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