Risk Assessment Represented by Pathogenic Microorganisms Regarding the Incidence of Foodborne Illnesses in a Representative County During 2013

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Abstract:

The interest of the competent authorities regarding foodborne illnesses is increasing these days, although recently the combined effort of the food industry was managed through the monitoring system conducted by the state and the decreasing of the prevalence of pathogens in foods of animal origin, and thus the incidence of food poisoning. Despite the progress acquired in analytical techniques, undiagnosed cases often remain, thus not knowing the true incidence of these diseases. The aim of this paper was to assess the microbiological risk represented by the pathogenic germs in different foods of animal origin, associated with the incidence of foodborne illnesses in a representative County during 2013. The research material was represented by 10.947 samples of animal origin products: fresh meat, fresh poultry meat, poultry carcasses, minced meat, meat products, pasteurized liquid milk products, cheese manufactured from pasteurized and unpasteurized milk, butter, ice-cream, eggs, ready to eat foods and seafood, collected according to national surveillance program during 2013. In order to identify the main pathogenic microorganisms, usually involved in outbreaks of foodborne illnesses (*Salmonella enteritidis*, *Salmonella typhimurium*, *Campylobacter jejuni/coli*, *Escherichia coli*, *Staphylococcus aureus* and *Listeria monocytogenes*, the samples were processed through standardized methods. Based on the obtained results we identified in 214 samples *Salmonella enteritidis/typhimurium*, 191 samples *Escherichia coli* 18 samples *Staphylococcus aureus*. We mention that no *Campylobacter* and *Listeria* germs were identified. According to the data gathered from the Infectious disease Hospital, during 2013 33 foodborne illnesses were confirmed associated with *Salmonella enteritidis/typhimurium* and 18 with *Escherichia coli*. Microbial risk in case of *Salmonella enteritidis/typhimurium* was increased in the case of poultry meat. Dairy products, respectively cheese manufactured from unpasteurized milk were the most unsafe food of animal origin regarding the risk with *E. coli*. Reducing the incidence of food borne illnesses is a multifactorial process that requires a comprehensive approach to food safety, along the entire food chain, in which farmers, industry, distributors, retailers, consumers, and the competent control authorities must be involved.

Keywords: *bacterial pathogens, foodborne illnesses; risk assessment*

INTRODUCTION

Global consumer trend is oriented in this century towards a large food processing units coming at the expense of those from conventional production, mainly due to lower costs of

processed food industry. However, in recent years it was found that some consumers (mainly those with higher incomes), with access to food information on food quality, began to focus more and more towards traditional foods obtained by

small producers, many of them in the category of heat-treated foods. It is also growing the food consumption in restaurants, pizzerias and fast food, and during the summer there is an increased consumption of ice cream and cake products based on creams containing milk and eggs. All these products of animal origin may be contaminated with various pathogens, which, after consumption, can cause various food-poisoning in humans. Contamination with pathogens can occur during or after the processing or their marketing. Cross-contamination can occur from improper handling and therefore cross-contamination but most commonly occurs after their unsafe storage and preparation when pathogens are able to survive and multiply, making possible the emergence of true epidemic diseases with serious consequences. The interest of the competent authorities regarding foodborne illnesses is increasing these days, although in the last decades it was managed by the combined effort of the food industry and the monitoring system conducted by the state, the decreasing of the prevalence of pathogens in foods of animal origin, and thus the incidence of food poisoning (Quinlan, 2013). Food poisoning were and are some of the most common diseases found in humans, yet often remain undiagnosed, not knowing the true incidence of these. Recent studies show that these food epidemics are in fact 300-350 times more than the reported cases. In the last 20-25 years it was tried the raising of the awareness regarding the public health and the development of surveillance programs (Barbara Lund et al., 2000). This paper aims to assess the risk posed by pathogens (*Salmonella enteritidis* / *typhimurium*, *Escherichia coli*, *Listeria monocytogenes*, *Staphylococcus aureus*) in different foods and their occurrence in food poisoning in a regional area during the year 2013. It was also aimed to establish a relationship between the prevalence of different pathogens and food poisoning cases diagnosed in the Infectious Diseases Hospital in the same county, to determine the risk that consumers are exposed too when consuming animal origin products.

MATERIALS AND METHODS

In order to achieve the objectives, information on the prevalence of pathogens in the period January to December 2013, in foodstuffs of animal origin were processed based on the data provided

by the laboratory of the Sanitary-Veterinary and Food Safety Authority, Cluj-Napoca. Information on the incidence of food poisoning that have evolved in the same time period, were processed by using the data provided by the Infectious Diseases Hospital clinics in the studied county. The methods for determining pathogens are standardized in accordance with Regulation (EC) no. 2073/2005 on microbiological criteria for foodstuffs. The samples' processing through classical methods were made in the DSVSA laboratory (*Salmonella* spp. SR EN ISO 6579/2003 AC/2006, *Campylobacter* spp. SR EN ISO 10272/2006 and *Listeria* spp. SR EN ISO 11290/2000/A1/2005, *E. coli* SR ISO 16649/2007 and *Staphylococcus aureus* SR EN/ISO 6888-1, 2).

RESULTS AND DISCUSSIONS

The results regarding the prevalence of Salmonella enteritidis/typhimurium

After processing the results, it was found that for fresh meat, out of 825 samples analyzed, 75 were positive, i.e. 9.09%, issues presented in the graph in Fig. 1.

Regarding the situation of the year 2013, published by the Administration for Inspection and Food Safety (Food Safety and Inspection Service) of the United States, it was shown that of the 17,161 analyzed fresh beef samples, over 170 were positive, representing 1.6%. Samples were randomly taken by the competent authorities during that year and the poor sanitation units were specifically targeted, while in our case, the samples were represented by the ones taken during the strategic programs for the year 2013 and self-control samples done by these units.

In 2013, a total of 400 samples of fresh poultry meat were analyzed. Of these, 110 were positive

Fig. 1. Prevalence of *Salmonella enteritidis/typhimurium* in fresh meat samples during the year 2013

for pathogenic *Salmonella* serotypes representing 20.5%, as it can be seen in fig. 2. These results were lower than the ones reported by the Inspection and Food Safety Administration of the United States of America in poultry samples taken at random which showed 3.9% positive cases out of a total of 11.124. In the case of processed meat only 0.7% of the total 2850, were positive for *Salmonella enteritidis* / *typhimurium*. Note that of the 20 positive samples, four samples are represented

Fig. 2. Prevalence of *Salmonella enteritidis*/ *typhimurium* in fresh poultry during the year 2013

by the sausages, which shows that if the heat treatment is insufficient, a situation quite common for these types of products, the risk of *Salmonella* food poisoning increases. At the analysis of the 46 samples of poultry carcasses, it was found that 9 samples respectively 19.6% were positive and 37 (80.4%) were negative.

Values that were much more lower than the prevalence of *Salmonella* spp. were mentioned by the Administration and Food Safety Inspection of the USA, where out of 2,955 samples collected, only 2.6% were positive for *Salmonella enteritidis* / *typhimurium*.

This study was conducted also on more than 3,000 ground meat, but none of these samples confirmed the presence of *Salmonella enteritidis*/ *typhimurium*. A similar situation was found in the samples of food ready for consumption, in which all samples (n=1,500) were negative.

Following the interpretation of the results in the identification of *Salmonella* spp., it was found that out of 10,339 samples analyzed during 2013, 2.92% were positive (214 samples), as shown in Figure 4. In the decreasing order of their *Salmonella* spp. prevalence, the poultry meat are 1.08%, fresh meat 0.74%, processed meat 0.2%

Fig. 3. Prevalence of *Salmonella enteritidis*/ *typhimurium* in poultry carcasses during the year 2013

and poultry carcass samples 0.09%. From these results it is shown that the main product with the highest prevalence of pathogenic *Salmonella* serotypes is the carcass and the deboned poultry meat, issues similar to those mentioned in the literature.

Fig. 4. Prevalence of *Salmonella enteritidis*/ *typhimurium* in the meat samples compared to the total amount of samples examined

The results regarding the prevalence of E. coli

During 2013, 59 samples were analyzed in order to identify *Escherichia coli* in minced meat, of which 10 were positive, representing 16.95% (fig. 5). Lower levels were reported by Karma (2013), for a period of three years (2006-2008), in a study of 117 samples of minced meat, of which 13 samples were positive (11.11%).

In order to identify *E. coli* in foods ready for consumption, 58 samples were subjected to microbiological examination. Of these, 15 were positive, representing 25.86% of the samples analyzed for *E. coli*. Lower values have been reported by the Food Safety

and Inspection Administration of the United States, when 100 samples of ready to eat foods have been tested and *E. coli* was identified in only one sample.

54 samples of pasteurized milk cheeses were tested during 2013 in order to detect *E. coli*, of which 25 were positive, representing 46.3 (Figure 6). Quinto et al. (1996) in a comparative study on 296 samples of cheese made from pasteurized milk (221

pasteurized milk cheese (6.79%), ready-to-eat food (4.08%), minced meat (2.72%) and the liquid dairy products (0.54%). It is noted that the main products identified for *E. coli* presence are the cheeses made from unpasteurized and pasteurized milk, especially unpasteurized milk.

The results regarding the prevalence of Staphylococcus aureus

Fig. 5. Prevalence of *E. coli* in the minced meat samples during the year 2013

samples) and from unpasteurized milk (75 samples) reported values much lower for *E. coli* prevalence. Thus, in pasteurized milk cheeses, *E. coli* was not identified, and in the samples of unpasteurized milk cheese only 3 samples (1.4%) tested positive.

130 samples of unpasteurized milk cheeses were collected and analyzed for *E. coli* prevalence. Of these, 120 were positive (92.3%) and 10 negative. Similar results were reported in a study made in Brazil in 2003 where 50 samples of cheese tested made from unpasteurized milk, showed the percentage of positive samples of 96.01%.

During the year 2013, 23 samples of liquid dairy products were analyzed in order to identify *E. coli*, of which only two samples were positive (8.7%). We did not identify the presence of *E. coli* in the following products: minced chicken meat, processed poultry meat, meat products, mechanically separated meat, fishery products, butter and unpasteurized milk.

Following the interpretation of the results obtained on the presence of *E. coli* in samples of animal products, out of 368 samples, we found a prevalence of 46.73% (172 positive samples), (fig. 7). The samples positive for *E. coli* in descending order of their values were taken from: unpasteurized milk cheese (32.61%),

Fig. 6. Prevalence of *E. coli* in pasteurized milk cheese samples during the year 2013

During 2013, we determined the prevalence of *Staphylococcus aureus* in 130 samples of animal products. 18 samples (13.8%) were positive (Fig. 8). In the positive samples, coagulase positive staphylococci load not has exceeded the limits stated by Reg. 1441 (EC)/2007 (<100,000 CFU/g). No testing of samples were required to identify staphylococcal enterotoxin.

Similar results have been reported by Van Loo et al. (2006), in a number of 2217 assays for *Staphylococcus aureus*, finding that 11.9% of the samples were positive (264 positive), as follows: beef (10.6%), veal (15.2%), pork (10%), poultry (16%), turkey (35.3%), mutton (6, 2%) and rabbit (6.7%).

For the identification of *Listeria monocytogenes* 1558 samples were analyzed from the ready to eat food, all samples being negative.

The incidence of food-borne poisonings in the Cluj county during the year 2013

Most samples of animal origin food collected in order to identify pathogens, potential triggers of food poisoning, were from lots that were not subject to veterinary restrictions; as a result, they were delivered to various recipients, where they were purchased by the final consumer. In the case of positive samples for pathogens' presence, until

Fig. 7. Prevalence *E. coli* in food products examined during the year 2013

the identification of the lots and withdrawal from the market, a variable number of packing units of the respective products have been purchased by consumers, which could cause a food poisoning outbreak, when superficial cooking, or contamination of other food products in the kitchen. For products not requiring heat treatment: the case of cheese made from pasteurized or unpasteurized milk, ready to eat food, pasteurized liquid dairy products, food poisoning outbreak risk is higher, especially for people in the category of risk: infants, children, the elderly or those with poor immune system.

From the data collected from the Infectious Diseases Hospital, it was found that over 5,400

people were investigated with food poisoning-like symptoms: most patients have accused abdominal cramps, dizziness and nausea status, followed by those which were added with vomiting and diarrhea episodes of varying intensity. Based on common epidemiological investigations conducted by joint teams epizootological specialists (physicians and veterinarians), only 45 cases were diagnosed as food poisoning. In these cases, the same pathogen strains were confirmed both in food and the excreta of patients. Thus, in 33 cases the food poisoning with *Salmonella* was confirmed and the other 12 confirmed the presence of *E. coli* (fig. 8).

Although the incidence of confirmed food poisoning is about 0.9% lower than in Europe, the actual incidence of these types of diseases might be increased among consumers of animal products. This is due on the one hand particularly to the self-limiting nature of food poisoning. On the other hand, low interest in food provenance and their ignorance to the potential severity of the disease, they prefer not to go the doctor and choose to treat themselves at home, sometimes using medicinal products based on antibiotics purchased from pharmacies without having a prescription. This leads, unfortunately, most of the times to the onset of antibiotic resistance, sometimes with fatal consequences. From talking to some groups of patients, it was found that approximately 10% of patients choose to come to the infectious diseases clinic for specialist advice,

Fig. 8. Prevalence of *Staphylococcus aureus* in the samples examined during the year 2013

the rest choose to treat themselves at home. Of these, about 90% are healed, considering the self-limiting nature of some food poisoning, but the remaining 10% come at the hospital with different complications, usually serious.

Another reason that may explain lower food poisoning episodes is represented by the fact that, unfortunately, sometimes in the Infectious Diseases Clinics, the standard protocol for identifying and confirmation of these morbid entities is not respected. The cases are treated as ordinary indigestion or gastro-enteritis without announcing the Department of Public Health which notifies the Sanitary Veterinary and Food Safety Authority, in pursuit of the two institutions specialists to conduct surveys. Comparative analysis of the prevalence of pathogens identified in the animal origin products examined during 2013 (3.67%), with the food poisoning episodes confirmed to be caused by *Salmonella* and *E. coli* (0.82%), an acceptable correspondence was found regarding the cause-relationship effect, given the issues mentioned above.

Fig. 9. Incidence of food poisonings with *Salmonella* and *E. coli*, during the year 2013, from the total suspected cases

CONCLUSION

The microbiological risk regarding *Salmonella enteritidis* / *typhimurium* presence is significant in the case of poultry meat. Dairy products, namely cheese from unpasteurized milk proved to be the most unsafe food of animal origin regarding the *E. coli* risk, which shows major deficiencies related to the compliance with hygiene, throughout the production process flow of these products. The presence of *Staphylococcus aureus*, the microbiological risk is high for cheeses made from

sheep's milk (curd cheese and fermented), although the load of coagulase-positive staphylococci was below the limit, requiring testing on detection of staphylococcal enterotoxin (below 10^5 CFU/g).

Although the incidence of confirmed food poisoning during the time period under study is low, the actual incidence may be increased, given the multitude of situations that reduce the actual incidence of these morbid entities. The risk related to the possibility of triggering food poisoning is significant, leading to mandatory continuing and thorough analysis of the products that are likely to contain pathogens. The reducing in number of food poisoning episodes is a multifactorial process that requires a comprehensive approach to food safety, the food throughout the supply chain, the need to involve farmers, manufacturers, distributors, retailers and consumers, and the competent control authorities.

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