ORIGINAL ARTICLE

Microbiological quality of meat and ready-to-eat food in Zenica-Doboj Canton in the period 2008-2010

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ABSTRACT

Aim To investigate the microbiological quality of meat, meat products and ready-to-eat food in Zenica-Doboj Canton in order to point out the importance of food monitoring and to provide safe food for consumers.

Methods Using the protocols of bacteriological food analysis the Laboratory for Sanitary and Clinical Microbiology, Cantonal Public Health Institute Zenica, retrospectively analyzed the results of bacteriological testing of all samples of meat, meat products and ready-to-eat food samples submitted in the period 2008 - 2010. The legal regulations of BiH were applied.

Results Out of the total number of 2,534 meat and meat products samples, 66 (2.6%) were relatively satisfactory, 11 (0.4%) did not satisfy. Out of 4,448 ready-to-eat food samples, 133 (3.0%) did not satisfy the requirements of the regulations. The most common cause of contamination of ready–to–eat food samples was total bacterial count> 20 000 in 39 (29.3%) samples; thermotolerant *E. coli* was found in 18 (13.5%) samples. The most common reason for improper quality of meat and meat products was the presence of thermotolerant *E. coli*, in 20 (26%), *Proteus* spp. in eight (10.4%) and *Salmonella* in two (2.6%) samples.

Conclusion The most common cause of food borne diseases is a consequence of mistakes or ignorance in the process of food handling in the manufactures and sales facilities. Supervision and monitoring of food quality is a powerful way to detect new diseases, to determine the specific source, thus contributing to the education of food handlers in order to prevent contamination.

Key words: meat, ready-to-eat food, *Salmonella, Campylobacter*

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INTRODUCTION

Microorganisms which are present in food may cause food contamination and diseases in humans (1). Diseases caused by consumption of food containing pathogenic microorganisms have been an enormous problem worldwide (1). The most common agents of food poisoning are *Listeria monocytogenes*, *Staphylococcus aureus*, *Clostridium botulinum*, *Clostridium perfigens* i *Bacillus cereus*, and *Campylobacter jejuni*, *Salmonella* spp., *Escherichia coli*, *Yersinia enterocolitica*, *Shigella* spp. and *Vibrio* spp (2).
Foodborne diseases are an important cause of illnesses and deaths worldwide (3). Contaminated food products can cause epidemics in many countries at the same time (3). Among outbreaks for which the etiology was determined, bacterial pathogens caused the largest percentage of outbreaks (75%) as well as the largest percentage of sporadic cases (86%). *Salmonella Enteritidis* (SE) accounted for the largest number of outbreaks and deaths (4).
It is estimated that foodborne diseases cause 76 million illnesses and 5,000 deaths in the United States each year (5). Although foodborne diseases are common, only a fraction of these illnesses are routinely reported because of complexity of chain of events which occur before a foodborne infection; a break at any point in the chain will result in a case not being reported (6).
Campylobacter spp. is currently the most common agent of food poisoning in the USA. Most infections caused by campylobacter are sporadic but occur as small family outbreaks (6). Random infections are related to the consumption of insufficiently cooked chicken or other meat, drinking of untreated water or unpasteurized milk, direct contact with animals in farms or pets (6,7).
Continuous monitoring of hygienic quality of food ensures food safety for consumers.
The objective of this paper was to determine bacteriological safety of meat, meat products and ready-to-eat meals in the area of Zenica-Doboj Canton having in mind legal regulations to be complied with when it comes to samples of meat, meat products and ready-to-eat meals.
The objective of the paper was to determine a level of hygienic quality of meat, meat products and ready-to-eat meals that are sold in the area of Zenica-Doboj Canton and to point out the importance of monitoring of such analyses in order to ensure food safety for consumers.

MATERIALS AND METHODS

During the research the retrospective method of collecting data was applied using the data from the Protocol for Bacteriological Analysis of Food at the Laboratory for Sanitary and Clinical Microbiology of the Cantonal Public Health Institute of Zenica.
All samples of meat and meat products (meat chucks, halves and quarters, meat in smaller pieces or confectioned meat, ground meat, shaped ground meat and entrails, cured meat products and sausage products) and ready-to-eat meals received for bacteriological analyses in the period between 01.01.2008 and 31.12.2010 were retrospectively analyzed.
Microbiological analysis of food products was performed routinely at the Laboratory for Sanitary and Clinical Microbiology, according to the standards and legal regulations of the State/Federation of Bosnia and Herzegovina (8).
Salmonella was detected in food products by homogenizing 25 g of food sample in 250 mL selenite broth and incubating overnight at 37 °C, and then subculturing on SS agar. Following the further incubation period overnight at 37°C, colonies were identified and serotyped by conventional microbiological methods (10).
For determination of thermotolerant *E. coli* in the food sample, a certain amount of primary dilution was inoculated into brilliant green-lactose-bile broth, for the detection of *Staphylococcus aureus* and *Proteus* species in 10% saline or nutrient broth, and to determine the *Clostridium species* in *clostridium* agar in the tube (8). After incubation for 18-24h and 72 h at the temperature of 37 °C or 42 °C, broth was inoculated on a rigid substrate, and grown colonies were further identified by standard microbiological methods (8. 9).

RESULTS

According to the data of the Protocol for Bacteriologic Analysis of Food of the Laboratory for Sanitary and Clinical Microbiology, Cantonal Public Health Institute of Zenica, during the period between 2008 and 2010 6,982 good samples were received, 2,534 (36.3%) being meat and meat products and 4,448 (63.7%) ready-to-eat meals.
Out of the total of 2,534 analyzed meat and meat products 66 (2.6%) relatively met the requirements, whereas 11 (0.4%) did not meet

Table 1 Results of microbiological analysis of meat and meat products at retail establishments in Zenica-Doboj Canton in the period 2008 - 2010

	2008		2009		2010		Total	
	Ready-to-eat food	Meet and meet products	Ready-to-eat food	Meet and meet products	Ready-to-eat food	Meet and meet products	Ready-to-eat food	Meet and meet products
Satisfactory	1733 (97.2%)	836 (96.2%)	1664 (97.4%)	859 (97.5%)	918 (95.7%)	755 (96.3%)	4315 (97.0%)	2457 (97.0%)
Unsatisfactory	49 (2.7%)	3 (0.3%)	43 (2.51%)	2 (0.2 %)	41 (4.2%)	6 (0.7%)	133 (3.0%)	11 (0.4%)
Conditionally satisfactory	/	28 (3.2%)	/	20 (2.3%)	/	18 (2.9%)	/	66 (2.6%)
Total	**1782 (40.1%)**	**869 (34.3%)**	**1707 (38.4%)**	**881 (34.7%)**	**959 (21.6%)**	**784 (31%)**	**4448 (100%)**	**2534 (100%)**

the requirements provided for by the law.
During 2008, 869 samples of meat and meat products were analyzed out of which 3 (0.3%) did not meet the legal requirements and 28 (3.2%) conditionally met the requirements; in 2009 out of the total of 881 samples 2 (0.2%) did not meet the requirements whereas 20 (2.3%) met the requirements conditionally and in 2010 out of the total of 784 samples six (0.7%) were not satisfactory, while 18 samples (4.2%) were conditionally satisfactory according to the legal regulations (Table 1).
In the period between 2008 and 2010 there was a total of 133 samples of ready-to-eat meals, which did not satisfy the criteria provided for by the Rulebook. Thermotolerant *Escherichia coli* was isolated from 18 (13.5%), *Proteus spp.* from 2 samples, in 39 (29.3%) samples the presence of 20,000 microorganisms was found and in 25 samples 30,000 microorganisms; in 18 (13.5%) samples there were 50,000 microorganisms,, and in 17 samples there were 100,000 microorganisms (Tabela 2).
From the analyzed meat and meat products in 20 (26%) samples thermotoleerant *E.coli* was isolated, *Staphylococcus aureus* was idolated from 2 (2.6%) samples, and *Proteus* spp. was isolated from 8 (10.4%) samples (Tabela 2). The most common reason for the contamination of samples, which did not meet the requirements of the Rulebook, was the presence of thermotolerant *Escherichiae coli* in 20 (26%) meat and meat products samples. The total number of 20,000 microorganisms was found in 39 (29.3%) samples of ready-to-eat mals. *Salmonellae* was found in 2 samples of meat and meat products.

Table 2. Distribution of unsitisfactory samples according to isolated bacteria

Microorganism/ number isolated	No (%) of samples		
	Ready-to-eat food	Meet and meet products	Total
Escherichia coli	18 (13.5)	20 (26)	38 (18.1)
Proteus spp.	2 (1.5)	8 (10,4)	10 (4.7)
S. aureus	/	2 (2,6)	2 (0.9)
Salmonella	/	2 (2,6)	2 (0.9)
E. coli and 100 000 microorganisms/gr	3 (2.3)	/	3 (1.4 %)
20 000 microorganisms/gr	39 (29.3)	14 (18,2)	53 (25.2)
30 000 microorganisms/gr	25 (18.8)	12 (15,6)	37 (17.6)
50 000 microorganisms/gr	18 (13.5)	5 (6.5)	23 (11.0)
100 000 microorganisms/gr	17 (12,8)	/	17 (8.1)
E. coli and 150 000 microorganisms/gr	1 (0,8)	/	1 (0.5)
E. coli i and 50 000 microorganisms/gr	2 (1,5)	1 (1.3)	3 (1.4%)
25 000 microorganisms/gr	2 (1,5)	7 (9.1)	9 (4.2)
40 000 microorganisms/gr	3 (2,3)	5 (6.5)	8 (3.8)
80 000 microorganisms/gr	1 (0,8)	1 (1.3)	2 (0.9)
150 000 microorganisms/gr	1 (0,8)	/	1 (0.5)
200 000 microorganisms/gr	1 (0,8)	/	1 (0.5)
Total	**133**	**77**	**210 (100)**

DISCUSSION

According to the results of this research 3.01% of samples of meat, meat products and ready-to-ear meals did not meet the requirements of the Rulebook. Aycicek et al. (2003) in their research of microbiological quality of hot meals and salads stated that the strategy for prevention of diseases caused by the consumption of ready-to-eat meals depends on an initial number of microorganisms, and it is based on selection of appropriate thermal processing of

the meals in order to destroy potential microorganisms and prevent their growing by temperature control (11).

In a Turkish study from Ankara, according to the Turkish Food Code (TFC) 91% of main dishes, 68.6% of salads, all of the tested soup and rice samples were of acceptable microbiological quality. *Salmonella* spp., *C. perfringens*, and *B. cereus* were not detected in the samples. Manufacturing/distributing practices, a level of personnel hygiene and cross-contamination precautions should be improved in kitchen/serving units (12).

In 2007 in the United States 1,097 outbreaks of food poisoning were reported, which resulted in 21,244 cases of diseases spread by food and there were 18 cases of death. Laboratory tests confirmed that the most common causes were Norovirus and *Salmonella* (13). Out of 18 reported death cases, 11 had bacteriological etiology (*Salmonella*, *Listeria monocytogenes*, *Escherichia coli* O157:H7 and *Clostridium botulinum*), two cases had viral origin (Norovirus), and one was of chemical origin (mushroom toxin), whereas four cases had unknown etiology (14).

In some countries state, local and territorial medical departments use standard internet forms to report voluntarily on outbreaks caused by food (15). Therefore, such information may be used for the development of strategies targeted at the control and support to promotion of safe food processing among the employees in food industry but also the general population (16).In 2010 497 outbreaks were registered in the United States, with bacteria causing 259 outbreaks (52%). After Norovirus (39%) *Salmonella* is the second most common cause of diseases (27%) originating from contaminated food (17). The presence of pathogenic microorganisms in food indicate the need for continuous monitoring of microbiological quality of food items and the responsibility for permanent training of staff working with food items. (5).

According to the results of this paper, there were two samples with isolated *Salmonella* Enteritidis (SE). In the last decade, *Salmonella* enteritidis has become the predominant serotype in many countries. The illness caused by SE is usually mild and short-lived, but can be more severe in persons who are at the extremes of age, who are immunocompromised, or who have diminished gastric acidity (18). Not all infected individuals develop symptoms severe enough to need medical attention, but even when this is the case, a physician may not send patient's stool for analysis. Thus, many cases of *Salmonella* infection are not reported (19). The figures recorded probably represent only a fraction of the actual number of cases that occurred, as it has been shown in many other countries (20,21) . In Zenica-Doboj Canton most infections with *S.* Enteritidis occur as sporadic cases or limited family outbreaks rather than a part of large common outbreaks. However, sporadic cases may frequently represent unrecognized outbreaks (19).

Campylobacter jejuni and *Campylobacter coli* are the leading causes of bacterial food-borne enteric infection with incidence still increasing in most developed countries (22). Consuming and/or handling poultry meat is the most consistent risk factor, linked to the high prevalence of campylobacters in retail poultry meat (22). *C. jejuni* is responsible for more than 90% of the cases. However, in some south European countries, Croatia and Bosnia and Herzegovina, the clinical implication of closely related thermophilic *C. coli* could be much higher, 30-40% (23-26).

Microbiological quality of food should be improved over time, because all the facilities dealing with food are obliged to introduce the system of Hazard Analysis Critical Control Point HACCP) pursuant to the Law on Food (27). However, due to specific situation in BiH HACCP system has been introduced (or is currently being introduced) only in those facilities which can afford to have it (28). It is a question whether small catering facilities, which are numerous and make majority among such facilities, will be able to introduce it as they are facing not only financial problems but also lack space, and it prevents them from equipping the working space in line with the HACCP (13). Recent risk assessments show that mitigation strategies could be applied at different points from food-animal production to the final consumption of foods. Education of consumers is important, since hygiene remains the critical control point in the final preparation (22).

Research result presented in this paper have shown the importance of providing encouragement and support in the field of microbiological quality of food items – meat, meat products and ready-to-ear meals in order to prevent outbreaks which occur as a result of their contamination. Microbiological analysis of meat, meat products and ready-to-eat me-

als, including other food items, is of great importance for ensuring food safety for consumers. Disease prevention is the main goal of public health, which includes activities even before the disease occurs.

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Mikrobiološka ispravnost mesa, mesnih proizvoda i gotovih jela na području Zeničko-dobojskog kantona u periodu od 2008. do 2010. godine

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SAŽETAK

Cilj Ustanoviti bakteriološku ispravnost mesa, mesnih proizvoda i gotovih jela na području Zeničko-dobojskog kantona s obzirom na zakonske propise kojima se regulira ova oblast. Svrha rada je ukazati na važnost praćenja ovih analiza u cilju obezbjeđenja sigurne hrane za potrošače.

Metode Retrospektivno, koristeći protokole bakteriološke analize hrane Laboratorija za sanitarnu i kliničku mikrobiologiju Kantonalnog zavoda za javno zdravstvo Zenica, analizirani su rezultati bakterioloških analiza svih uzoraka mesa, mesnih proizvoda i gotovih jela, prispjelih u Laboratorij u periodu od 2008. do 2010. godine, a s obzirom na važeće zakonske propise u FBiH (u skladu s važećim Pravilnikom).

Rezultati Od ukupno 2.534 analizirana uzorka mesa i mesnih proizvoda, 66 (2,6%) je uvjetno zadovoljavalo, a 11 (0,4%) nije zadovoljavalo. Od 4.448 uzoraka gotovih jela, 133 (3,0%) nisu zadovoljavali odgovarajuće zakonske propise. Najčešći uzrok kontaminacije nezadovoljavajućih uzoraka bio je ukupan broj bakterija >20.000 (29,3%) kod uzoraka gotovih jela. Termotolerantna *E. coli* pronađena je u 18 (13,5%) uzoraka gotovih jela. Najčešći razlog higijenske neispravnosti mesa i mesnih proizvoda bila je prisutnost termotolerantne *E. coli* u 20 (26%), *Proteus* spp. u osam (10,4%) i *Salmonellae* u dva (2,6%) uzorka.

Zaključak Najčešći uzroci bolesti nastalih trovanjem hranom javljaju se uslijed grešaka ili neznanja u procesu rukovanja hranom u objektima gdje se ona proizvodi i prodaje. Nadgledanje i praćenje je djelotvoran način otkrivanja novih bolesti koje dolaze iz hrane i određivanja specifičnog izvora, a time se doprinosi i edukaciji o načinu čuvanja hrane u cilju sprječavanja kontaminacije.

Ključne riječi meso, spravljena jela, *Salmonella, Campylobacter*