

## Microbiology Review Paper

Ensuring microbiological safety of the food products is one of the state healthcare system's priority tasks, the solution of which is directly aimed at protecting public health. Abebe et al. (2020) claim that “*Salmonella* species, *L. monocytogenes*, and *E. coli* are the major zoonotic bacterial pathogens which are the causative agents of food-borne illness and death in the world” (p. 1). All over the world, this problem is gaining special relevance due to an increase in the number of foodborne diseases. Ehache et al. (2017) state that bacterial contamination of low-moisture foods, such as peanut butter, presents a vexing challenge to food safety. The need for a comprehensive study of this problem is obvious and includes a multifaceted assessment of factors impacting human health, such as age, present diseases, comorbidity, pregnancy, specific medical conditions, and many others.

### Escherichia Coli

Escherichia coli is a common inhabitant of the intestines of many mammals, in particular primates, including humans, thus, it is often called *colibacillus*. In the human body, Escherichia coli plays a beneficial role by inhibiting the growth of harmful bacteria and synthesizing certain vitamins. However, there are varieties of Escherichia coli that can cause acute intestinal diseases in humans. Currently, more than 150 types of pathogenic E. coli bacilli are isolated as a health hazard.

### *Salmonella Enteriditis and Salmonella Typhi*

*Salmonella enterica* belongs to the class of gamma-proteobacteria within the *Salmonella* genus. This *Enterobacteriaceae* family is considered one of the most hazardous to human health due to the fact that every type of bacterium of this species is pathogenic. Abebe et al. (2020) note

that “non-typhoidal *Salmonella* are most important zoonotic bacterial food-borne pathogens of humans, and they account around 93.8 million food-borne illnesses and 155,000 deaths per year worldwide” (p. 5). Many serotypes of *Salmonella enterica* are causative agents of human diseases such as typhoid fever, paratyphoid fever, and salmonellosis. In epidemiological terms, however, only a few subspecies of *Salmonella enterica* are significant for humans, with the most hazardous being *Salmonella enteritidis* and *Salmonella typhi*.

### ***Listeria Monocytogenes***

Another hazardous bacteria species that can infiltrate food products is *Listeria monocytogenes*. *Listeria* are small gram-positive bacilli with a characteristically low motility. They are distributed throughout the world in both the environment and the intestines of humans, mammals, birds, arachnids and crustaceans. There are several species of *Listeria*, but only *Listeria monocytogenes* is the main pathogen in humans. Once in the human body, *Listeria* parasitizes inside body cells, where it can cause irreparable harm to the central nervous system or the brain specifically.

### **Methods: A Comparative Table of Pathogenic Bacteria**

<b>Types of Bacterium</b>	<b><i>Escherichia coli</i></b>	<b><i>Salmonella enteritidis</i></b>	<b><i>Salmonella typhi</i></b>	<b><i>Listeria monocytogenes</i></b>
<b>Classification</b>	The genus of <i>Escherichia</i> is part of the <i>Enterobacteria</i> family, the order of <i>Enterobacteria</i> , the class of <i>Gamma-proteobacteria</i> , the type of <i>Proteobacteria</i> , the kingdom of <i>Bacteria</i> .	The subspecies <i>Salmonella enteritidis</i> and <i>Salmonella typhi</i> both belong to the species <i>Salmonella enterica</i> in the genus <i>Salmonella</i> , the family of <i>Enterobacteria</i> , the order of <i>Enterobacteria</i> , the class of <i>Gamma-proteobacteria</i> , the type of <i>Proteobacteria</i> , the kingdom of <i>Bacteria</i> .		According to the modern classification, <i>Listeria</i> belong to the <i>Firmicutes</i> type, the <i>Bacilli</i> class, and the genus <i>Listeria</i> , which includes several species. However, <i>Listeria monocytogenes</i> holds the greatest importance in human pathology among

				other <i>Listeria</i> subspecies.
<b>Size</b>	The cells of <i>Escherichia coli</i> bacteria are rod-shaped, about 2 µm long and 0.25–1.0 µm in diameter. Its cell volume is about 0.6–0.7 µm <sup>3</sup> .	All <i>Salmonella</i> bacteria are quick-moving, gram-negative rods. They are from 1 to 7 µm in length, and 0,3-0,7 µm in width.		<i>Listeria monocytogenes</i> are small gram-positive rods of regular shape. They are 0.5-2x0.4-0.5 microns in size, and are pleomorphic.
<b>Habitat</b>	<i>Escherichia coli</i> is a common inhabitant of mammals' intestines, specifically, humans. Additionally, the bacterium can be found in soil and water bodies.	<i>Salmonella enteritidis</i> is a ubiquitous and resistant bacterium that can survive for several weeks in dry environments, and for several months in water. Enache et al. (2017) add that due to its enhanced thermal resistance in dry environments, <i>Salmonella</i> can survive the drying process and may persist for prolonged periods in low-moisture foods.	<i>Salmonella typhi</i> is a short, motile, bacterial, facultative intracellular parasite that grows well in the presence of oxygen, although it can also exist in its absence. Abebe et al. (2020) add that “primary habitat of <i>Salmonella</i> species is the intestinal tract of the animals such as farm animals, humans, birds, reptiles, and insects” (p. 5).	<i>Listeria</i> are widespread in the surrounding nature – soil, water, plants, as well as in sewage and excrement of humans and animals. <i>Listeria</i> live in a fairly wide temperature range and are capable of active reproduction at low temperatures.
<b>Diseases Caused</b>	Intestinal diseases caused by pathogenic <i>E. coli</i> are collectively called <i>Escherichiosis</i> . According to Koutsoumanis et al. (2020), “the detection of any of Shiga toxin-producing <i>E. coli</i> serogroups in food has been considered to	Salmonellosis is an acute infectious disease, caused by the non-typhoid <i>Salmonella</i> bacteria such as <i>Salmonella enteritidis</i> . According to Abebe et al. (2020), “the disease is of self-limiting nature and does not require specific treatments but can result in serious complication in	One of the most dangerous diseases caused by <i>Salmonella</i> bacteria is the typhoid fever, which occurs through a contamination of the organism with <i>Salmonella typhi</i> . Typhoid fever affects only humans. The disease manifests	Listeriosis, which is caused specifically by <i>Listeria monocytogenes</i> , is a highly contagious infectious disease. It damages the protective cells of the immune system, leading to the development of numerous symptoms such as a septic angina, as well as the pathology of the

	<p>provide an early indication of the potential for serious illness, if there are no further treatment of E. coli” (p. 20). The terms coli-infection, coli-enteritis, travelers' diarrhea, colibacillosis can be also used. Escherichiosis refers to acute intestinal diseases with a fecal-oral transmission mechanism. Each of the above classes of pathogenic E. coli is characterized by certain differences in the course of the disease, which in its symptoms may resemble cholera or dysentery.</p>	<p>young children, old, and immunocompromised individuals” (p. 6). More often the disease occurs in the form of acute gastritis, gastroenteritis or gastroenterocolitis, less often in the form of septicopyemia; however, a long-term illness is also possible.</p>	<p>through fever, symptoms of general intoxication, bacteremia, ulcerative lesions of the small intestine’s lymphatic apparatus, and the hepatolienal syndrome.</p>	<p>nervous system. Mostly, listeriosis is found in wild and farm animals.</p>
<p><b>Hazard Level to Human Health</b></p>	<p>The infectious dose is highly dependent on the type of pathogenic E. coli. Koutsoumanis et al. (2020) state that “Most cases are self-limiting although severe life-threatening complications may occur, especially in developing countries where the host may be malnourished, immune-compromised and without</p>	<p>The number of cases of salmonellosis, including in developed countries, has been increasing in recent years. Nosocomial salmonellosis is one of the major problems of modern healthcare.</p>	<p>Patients with immunodeficiency or those with low acidity of gastric juice have a higher risk of Salmonella-associated typhoid infection, and the disease is more likely to be severe. Moreover, <i>Salmonella typhi</i> is highly resistant to various antibiotics.</p>	<p>The greatest danger the listeriosis poses is the possibility of fetus pathology in pregnant women. Moreover, the elderly people also fall into the high-risk category, since they often have the most severe forms of the disease such as septic and meningoencephalitic ones. In addition, people of all ages with impaired immunity get</p>

	access to adequate treatment” (p. 60). Young children, the elderly and people with immunodeficiency are most susceptible to the disease.			infected with <i>Listeria monocytogenes</i> easily. Abebe et al. (2020) state that “ <i>Listeria</i> is one of the most virulent pathogens, which is associated with the highest case fatality rate of 30%” (p. 9).
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### **Discussion**

This exercise was quite helpful in terms of learning about the various hazards the bacterial food contamination poses. It is important to know the aspects and hazards that pathogenic bacteria present to different parts of society, and recognize the potential risks of food contamination. Another point of interest is the possibility to do a thorough research of the topic to determine current trends in microbiology and food hygiene. Overall, it was an interesting and an insightful task to complete.

### **Conclusion**

The phenomenon of foodborne infections and toxic infections should be considered from the general point of view of the epidemiological ecology of bacteria. The researchers need to primarily study the aspects of bacterial population existence in the environment, which determine the possibility of infectious disease occurrence in humans. At the same time, food production processes must adapt in stride with these studies to ensure the safety of the human health regarding the possibilities of bacterial contamination. The best way to prevent bacterial food diseases on the national level is to study closely the agents that cause them. Moreover, it is of utmost importance to learn how exactly pathogenic bacteria affect the human organism – not

only the healthy one, but impaired as well. Overall, this kind of study is highly recommended for any healthcare worker or student.

## References

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