

## *Escherichia coli* – Short Report

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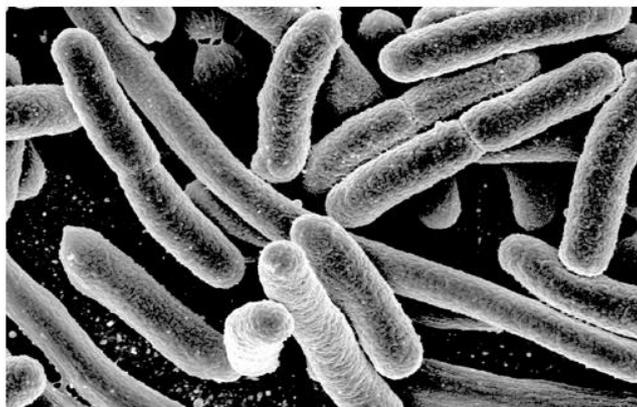
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### Introduction

*Escherichia coli* - Gram-negative relatively anaerobic bacteria belonging to the *Enterobacteriaceae* family [Figure 1]. It is part of the physiological bacterial flora of the human colon and other warm-blooded animals. In the intestine, this symbiotic bacterium

plays a useful role by participating in the breakdown of food and also contributing to the production of B and K vitamins. Under certain conditions, the colon rod is pathogenic for humans, mainly causing diseases of the digestive and urinary systems.



**Figure 1:** *Escherichia coli*, Radoslaw Walkowiak.

The bacterium is named after its discoverer, Austrian pediatrician and bacteriologist Theodor Escherich. *Escherichia coli* is found in the intestines of animals, including humans, as well as commonly in soil and water, where it ends up in secretions and faeces. The presence of *Escherichia coli* in surface waters (the so-called coli titer) is a frequently used indicator of their pollution. *Escherichia coli* bacteria can colonize the skin and mucous membranes of the mouth and respiratory system.

In water, it usually lives for a short time, incl. due to the lack of proper food and the action of ultraviolet radiation. Under experimental conditions imitating the conditions found in the surface waters of the Great Lakes region, low density *Escherichia coli* populations significantly disappear after 6 hours, and high density - after two days. About a month at 18 °C, and at 0 °C as well as 37 °C for two months or more. In the soil, individuals were found after several years without the inflow of animal excrements.

*Escherichia coli* is a gram-negative, relatively anaerobic rod, approximately 2 µm long and approximately 0.8 µm in diameter. Inside the cell of this bacterium there are 1-4 identical DNA strands (depending on its dividing activity) and from 15,000. up to 30 thousand ribosomes. Other cellular organelles of the colon include vacuoles, granules and particles of fatty substances. This bacterium has flagella, fimbriae, pili and sex fimbriae (provided that it has sex plasmids - F +). Clinically important resistance genes are located on plasmids, often including F + plasmids, which favors their horizontal transfer. Cell division under favorable conditions takes about 20 minutes.

The resistance of *Escherichia coli* to environmental factors is relatively low. It dies after 20 minutes of heating at 60 °C, it is sensitive to all known disinfectants. However, in an environment with a lower temperature and adequate humidity, it persists for months. In faeces at 0 °C, it may remain viable for over a year. *Escherichia coli* is a model organism among bacteria. Its structure, genetics and metabolism are well known and used in genetic research. It found particular application in genetic modification in biotechnology, used for industrial purposes (e.g., in the production of the human hormone - insulin).

It is used because of cheap breeding while obtaining a large number of bacteria in a small area. Within 20 minutes, the next generation is obtained, and the resulting mutations are easy to identify and study. The circular chromosome has been sequenced several dozen times. The most studied strain is K-12 with 4,639,221 bp, encoding 4,377 genes. Proteome was found to be 4,303 proteins in 2014. Pan-genome from ~ 25 Mlat accumulated > 16k genes with more than half of the sequence derived from HTG.

Research into the *E. coli* cell has brought to science the understanding of such fundamentally important processes as:

- DNA replication mechanisms
- Transcription regulation
- Mechanisms of the translation process
- Structure of the prokaryotic gene
- The principle of genetic notation

The species of *Escherichia coli* is divided into serotypes based on the diversity of the structure of the antigens.

Bacterial strains are differentiated on the basis of their antigenic features:

- O<sup>2</sup> somatic antigen
- K surface antigen
- ciliary antigen H

There are 171 O antigens, about 80 K antigens and over 50 H antigens, thanks to which over 180 serological types of this microorganism have been identified.

In terms of the impact on the human body and the course of infection, there are 6 strains of *Escherichia coli*:

- Enterotoxigenic strain (ETEC)
- Enteropathogenic strain (EPEC)
- Enteroinvasive strain (EIEC)
- Enteroaggregative strain (EAEC / EAggEC) (formerly: enteroadherent-enteroaggregative strain of *Escherichia coli*)
- Enterohemorrhagic strain, verocytotoxin-producing (EHEC, VTEC) strain
- Adherence strain (DAEC)

Some strains produce exotoxins and a Shiga toxin. Hemolytic strains of bacteria are more pathogenic than non-haemolytic strains.

The pathogenicity of *Escherichia coli* depends on its invasiveness and the possibility of producing toxins. Invasive strains of this bacteria have the ability to penetrate into tissues and cause inflammation, therefore they are the cause of gastrointestinal inflammation and sepsis. Toxic strains produce large amounts of toxins in the intestines, leading to enterotoxaemia. Different serotypes of the germ may also be present in the body of sick animals. Enterotoxin acting on the intestinal mucosa in combination with endotoxin causes intestinal inflammation and poisoning symptoms.

Against *Escherichia coli* bacteria, the following are active:

- Broad fan penicillins and penicillins with an inhibitor
- All generations of cephalosporins
- Aminoglycosides
- Fluoroquinolones
- Tetracyclines

During operations on the large intestine, it is recommended to administer prophylactic antibiotics, e.g., metronidazole with cefazolin. The antibiotic is usually administered 2 hours before the operation (orally) or 2 hours after its commencement (intravenous).

### Acknowledgement

None.

### Conflict of Interest

None.

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