The Who's Who of *E. coli* Strains

By Kelly Ehnes

E. coli may be the world's most recognized bacterial species, but that one species varies tremendously. *E. coli* is found almost everywhere, from soil to raw meat to human intestines. There are plenty of good *E. coli* strains such as those that assist in food digestion in the human intestines. However, there are also a number of harmful *E. coli* strains that cause urinary tract infections, meningitis, and intestinal infections. In recent years there have been a number of *E. coli* outbreaks in the food industry. These outbreaks typically cause intestinal infections which can be severe or even fatal. We hope to outline the who's who of *E. coli* strains to identify why some strains are more deadly than others.

When people think of *E. coli* infections, they often think intestinal infections. The most common symptom of an intestinal *E. coli* infection is diarrhea. The severity and characteristics of the symptoms can assist in classifying which type of *E. coli* strain is present. Intestinal *E. coli* infections are typically classified into five categories. These categories include enterotoxigenic (ETEC), enteropathogenic (EPEC), enteroinvasive (EIEC), enterohemorrhagic (EHEC), and enteroaggregative (EAEC). Enterohemorrhagic *E. coli* strains are the most life threatening due to their shiga-toxin production. Each type of *E. coli* strain varies in its transmission and method of infection.

Enterotoxigenic (ETEC) is the most common cause of traveler's diarrhea when travelling to developing countries. It is also a leading cause of infant infection and death in these countries. Adults living in endemic areas often develop immunity to these strains. The infectious dose for these strains is typically high and transmitted from contaminated food and water. These strains are limited to humans and not typically found in animals. ETEC *E. coli* strains have colonization factor antigens

(CFA) to assist in adherence to intestinal cells and delivery of toxins. These strains produce heat-labile toxins (LT) and/or heat-stable toxins (ST), which facilitate the release of water and electrolytes from intestinal cells, which contributes to the development of watery-diarrhea symptoms.

Enteropathogenic (EPEC) strains are rare in industrialized nations, but still a common cause of infant diarrhea in developing nations. It is thought to be spread via fecal-oral transmission or contaminated water. Immunity and infectious dosage has been difficult to determine. These strains are less likely to cause traveler's diarrhea, and have been found on objects near infected small children, indicating a low infectious does for infants. EPEC strains do not product LT or ST toxins, instead they attach to the intestinal cell wall to form a micro-colony, which alter the intestinal cells. This process is also referred to as the attachment and effacing (AE) lesion. The actual cause of watery-diarrhea is unknown, but likely due to bacterial invasion of host cells and disruption to intestinal absorption.

Enteroinvasive (EIEC) strains are very similar to *Shigella* is regards to their disease causing mechanisms and symptoms of dysentery. EIEC strains enter intestinal cells and multiply, eventually causing cell death, inflammation, and ulcers. Infections are typically limited to children in developing regions; outbreaks in industrialized nations are usually linked to contaminated food or water. EIEC species have only been found in humans and a high infectious dose is typically required to cause illness.

Enterohemorrhagic (EHEC) strains are the most publically recognized strains and include *E. coli* O157:H7 as well as the recently publicized Shiga-toxin producing *E. coli*. These strains have a very low infectious dose and are transmitted through infected food especially meat and unpasteurized beverages. These infections are commonly observed in developed nations where contaminated meat is processed quickly with uninfected meat and then shipped rapidly across the country. EHEC strains differ from other *E. coli* strains in that they primarily target the colon and produce Shiga-toxins as well as AE lesions. The AE lesions directly contribute to symptoms such as non-bloody diarrhea. Shiga-toxins enter eukaryotic cells in the intestines and inhibit protein synthesis, resulting in cell death. The Shiga-toxins cause inflammation, thrombosis, and bloody diarrhea. These symptoms can cause the kidneys to become clogged with red blood cells resulting in kidney failure. This condition is referred to as Hemolytic Uremic Syndrome (HUS), and is life threatening. *E. coli* O157:H7 strains can be differentiated from other *E. coli* strains by the use of MacConkey Sorbitol agar. *E. coli* O157:H7 strains typically do not ferment sorbitol, and therefore give colorless colonies. This is a quick and cost effective measure to detect *E. coli* O157:H7 infections. These samples should be confirmed by the use of O157 antisera or other test methods.

Enteroaggregative (EAEC) strains are commonly found in children in developing countries. The exactly mechanisms of these strains have yet to be fully understood, however it is thought that the

E. coli cells are able to adhere to intestinal cells and create a biofilm. Lesions and inflammation are typically not present. Symptoms include watery and mucoid diarrhea which may last for weeks.

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Biography

Kelly Ehnes holds a Bachelor of Science Degree in Microbiology. Her experience at Microbiologics includes working as a microbiologists and directing one of the quality control laboratories. Currently, she assists sales and marketing with her technical expertise. Kelly has industrial experience with biological and chemical testing of wastewater samples, as well as experience in food quality with bacterial and chemical testing of ingredients and food samples. Through her education and career, Kelly has developed a strong background in microbial testing and identification. She has experience with validations of laboratory equipment and processes, and is also a certified internal auditor for ISO 9001:2008.