

Coliform Bacteria – Indicators in Food & Water

Definition & General Description

Coliform bacteria are most often defined as “aerobic and facultatively anaerobic, Gram-negative, non-spore-forming rods that ferment lactose with the production of acid and gas within 48 hours at 35°C.” Coliform bacteria are organisms detected by “coliform tests” or selective differential growth media based on the above definition. A variety of media are used to detect coliform in water and foods, including:

- violet red bile agar
- m-endo agar/broth
- lauryl tryptose broth
- brilliant green bile broth



Some strains of coliform bacteria are classified as “fecal coliforms,” which are defined as coliforms that can grow at 44.5–45.5°C and produce acid and gas from lactose within 48 hrs. *Klebsiella pneumoniae*, *Citrobacter freundii*, certain *Enterobacter* spp., and most *E. coli* strains meet this definition.

Indicator Organisms & Coliform Bacteria

Indicator organisms provide insight to the history of a sample or to potential associations with other organisms or conditions. Coliform bacteria have been used to indicate unsanitary conditions for over a century. For indicator organisms to be useful, they should be:

- Easily distinguishable from other microorganism common to a sample.
- Easily detected & enumerated.
- Directly or indirectly associated with reduced safety or loss of quality.
- Able to survive along with the organism(s) in the sample tested.

Indicators of product safety are generally associated with common pathogen(s) that originate from similar environments. Indicators of fecal contamination should a) be organisms specific to the intestinal tract, b) be present in high enough numbers in feces to be easily detected in sample after dilution, and c) be easily detected, even in low numbers. *E. coli* meets these criteria. Indicators of product quality are generally product specific, though general indicators are often used. One of the most common applications of coliforms as indicators in heat processed foods as they are killed by most heat processing conditions.

Coliforms and Foodborne Illness

Most coliform bacteria are not associated with foodborne illness. However, there are coliforms that do cause illness, most of which are strains of *E. coli*.

Enterohemorrhagic E. coli (EHEC) – includes O157:H7 as well as others (e.g., O6:NM, O104:H21, O111:NM).

- Produce Shiga-like toxins; affect primarily the large intestines
- Hemorrhagic Colitis – bloody diarrhea, severe abdominal cramps, fever rare
- Hemolytic Uremic Syndrome (HUS) – toxins in blood, kidney disease; young & old at risk (can be fatal)

Enteroinvasive E. coli (EIEC) – multiplies inside intestinal epithelial cells, spreads to adjacent cells.

- No enterotoxins, bloody or non-bloody diarrhea caused by cell damage

Enteropathogenic E. coli (EPEC) – adheres to intestinal mucosa, destroying or modifying cells.

- No enterotoxins, diarrhea, most common in children under 1 year old

Enterotoxigenic E. coli (ETEC) – attaches to and colonizes small intestines.

- Traveler's diarrhea; sudden, acute, non-bloody, very watery
- May be severe, often fatal in infants in developing countries

Alternative Testing Procedures

Methods have been developed based on detecting enzymes that are specific for coliform bacteria and for *E. coli*. These methods have been applied in rapid screening and confirmation procedures for food and water:

- a) Detection of Beta-galactosidase using synthetic substrates (e.g., chromogenic substrate = yellow):
 - Colilert, Colisure, E*Colite, and others used for water testing
- b) Detection of Beta-Glucuronidase (β -GUD-based *E. coli* tests):
 - β -GUD commonly produced by *E. coli* (92-99% of strains tested; not produced by O157:H7)
 - Variety of β -glucuronic acid-based substrates; reaction occurs only if β -GUD *E. coli* is present



Want more information on [coliform bacteria](#) and the MQIP? Contact Nicole Martin (nhw6@cornell.edu) in the Milk Quality Improvement Program or visit our website <https://foodsafety.foodscience.cornell.edu/mqip/>

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