



“BIG SIX” NON-O157 SHIGA TOXIN-PRODUCING *ESCHERICHIA COLI* (STEC) RESEARCH MATERIALS

The global community has been experiencing food-associated outbreaks of non-O157 Shiga toxin-producing *Escherichia coli* for nearly two decades. As a result, six non-O157 STEC strains were classified as adulterants by the Food Safety and Inspection Service (FSIS) branch of the U.S. Department of Agriculture in June 2012, requiring routine verification testing of raw beef manufacturing trimmings for serogroups O26, O45, O103, O111, O121, and O145.

The final decision to implement testing follows CDC recommendations made in 2009 to identify and track infections related to non-O157 STEC. Since that time, CDC has recommended that stools from all patients with community-acquired diarrhea be cultured and tested with an assay, such as rapid enzyme immunoassay (EIA) or a PCR-based assay, targeting Shiga toxin antigens or genetic determinants to allow detection of non-O157 STEC. The CDC also requested that all non-O157 STEC isolates be sent by public health laboratories to CDC for confirmation and further characterization.

The number of non-O157 STEC isolates sent to CDC for serotyping has increased each year. The CDC estimates approximately 113,000 illnesses and 300 hospitalizations are caused by these six STEC serogroups annually in the United States, including severe complications such as hemolytic uremic syndrome (HUS). Infections associated with these six *E. coli* serogroups have been traced back to contaminated raw ground beef, lettuce, and berries.

The table below lists representatives from each of the six non-O157 STEC serogroups, including the location of isolation (if known) as well as ATCC quality control testing for serotype and virulence genes. The virulence genes represented in ATCC testing include: Shiga toxin genes (*stx1* and *stx2*) and the gene that encodes for intimin (*eae*), an adherence protein. A second group of strains lacking almost all STEC virulence genes, serving as representatives of the six serogroups, have also been included for use as experimental controls. Product pages on the ATCC website list additional information pertaining to each strain.

O26 Strains*

ATCC® No.	Description	Designation	Serotype	Presence of Select Virulence Genes	Isolation Location
BAA-2205™	<i>Escherichia coli</i>	2003-3023	O26:H11	<i>stx1</i> +/ <i>stx2</i> -/ <i>eae</i> +	Connecticut
BAA-2196™	<i>Escherichia coli</i>	2003-3014	O26:H11	<i>stx1</i> +/ <i>stx2</i> +/ <i>eae</i> +	Michigan
BAA-2204™	<i>Escherichia coli</i>	2001-3234	O26:H11	<i>stx1</i> +/ <i>stx2</i> -/ <i>eae</i> +	Nebraska
BAA-2181™	<i>Escherichia coli</i>	00-3412	O26:H11	<i>stx1</i> +/ <i>stx2</i> -/ <i>eae</i> +	New Mexico
BAA-2188™	<i>Escherichia coli</i>	99-3301	O26:H11	<i>stx1</i> +/ <i>stx2</i> -/ <i>eae</i> +	Utah
BAA-2186™	<i>Escherichia coli</i>	99-3294	O26:H11	<i>stx1</i> +/ <i>stx2</i> -/ <i>eae</i> +	Massachusetts
BAA-1653™	<i>Escherichia coli</i>	EH1534	O26:H11	<i>stx1</i> +/ <i>stx2</i> +/ <i>eae</i> +	Belgium
BAA-2442™	<i>Escherichia coli</i>	O26	O26	<i>stx1</i> +/ <i>stx2</i> -/ <i>eae</i> +	Unknown
BAA-2443™	<i>Escherichia coli</i>	O26(MI)	O26	<i>stx1</i> +/ <i>stx2</i> -/ <i>eae</i> +	Unknown
BAA-2183™	<i>Escherichia coli</i>	2001-3139	O26:H11	<i>stx1</i> +/ <i>stx2</i> -/ <i>eae</i> +	Unknown

O45 Strains*

ATCC® No.	Description	Designation	Serotype	Presence of Select Virulence Genes	Isolation Location
BAA-2193™	<i>Escherichia coli</i>	2000-3039	O45:H2	<i>stx1</i> +/ <i>stx2</i> -/ <i>eae</i> +	Maine
BAA-2189™	<i>Escherichia coli</i>	99-3303	O45:H2	<i>stx1</i> +/ <i>stx2</i> -/ <i>eae</i> +	Virginia
BAA-2185™	<i>Escherichia coli</i>	99-3291	O45:H2	<i>stx1</i> +/ <i>stx2</i> -/ <i>eae</i> +	Massachusetts
BAA-2202™	<i>Escherichia coli</i>	99-3075	O45:H2	<i>stx1</i> +/ <i>stx2</i> -/ <i>eae</i> +	California
BAA-2198™	<i>Escherichia coli</i>	98-3215	O45:H2	<i>stx1</i> +/ <i>stx2</i> -/ <i>eae</i> +	Virginia
BAA-2191™	<i>Escherichia coli</i>	98-3167	O45:H2	<i>stx1</i> +/ <i>stx2</i> -/ <i>eae</i> +	Georgia

*Distributed only within the United States

O103 Strains*

ATCC® No.	Description	Designation	Serotype	Presence of Select Virulence Genes	Isolation Location
BAA-2210™	<i>Escherichia coli</i>	2003-3112	O103:H2	<i>stx1+/stx2-/eae+</i>	Wisconsin
BAA-2207™	<i>Escherichia coli</i>	2001-3304	O103:H2	<i>stx1+/stx2-/eae+</i>	Connecticut
BAA-2215™	<i>Escherichia coli</i>	2006-3008	O103:H11	<i>stx1+/stx2-/eae+</i>	Idaho
BAA-2200™	<i>Escherichia coli</i>	2001-3225	O103:H11	<i>stx1+/stx2-/eae+</i>	Texas
BAA-2213™	<i>Escherichia coli</i>	2005-3546	O103:H25	<i>stx1+/stx2-/eae+</i>	Virginia
BAA-2199™	<i>Escherichia coli</i>	2000-3281	O103:H25	<i>stx1+/stx2-/eae+</i>	Ohio

O111 Strains*

ATCC® No.	Description	Designation	Serotype	Presence of Select Virulence Genes	Isolation Location
BAA-2201™	<i>Escherichia coli</i>	2002-3092	O111:H8	<i>stx1+/stx2-/eae+</i>	Iowa
BAA-2180™	<i>Escherichia coli</i>	00-3237	O111:H8	<i>stx1+/stx2+/eae+</i>	South Dakota
BAA-184™	<i>Escherichia coli</i>	CDC 2000-3025	O111:H8	<i>stx1+/stx2-/eae+</i>	South Dakota
BAA-180™	<i>Escherichia coli</i>	CDC 1999-3302	O111:H8	<i>stx1+/stx2-/eae+</i>	Utah
BAA-181™	<i>Escherichia coli</i>	CDC 1999-3249	O111:H8	<i>stx1+/stx2+/eae+</i>	South Dakota
BAA-179™	<i>Escherichia coli</i>	CDC 1997-3215	O111:H8	<i>stx1+/stx2+/eae+</i>	Alabama
700840™	<i>Escherichia coli</i>	B99BE001161	O111:H8	<i>stx1+/stx2+/eae+</i>	Texas
BAA-2209™	<i>Escherichia coli</i>	2001-3357	O111	<i>stx1+/stx2+/eae+</i>	Ohio
BAA-2182™	<i>Escherichia coli</i>	2001-3010	O111	<i>stx1+/stx2-/eae+</i>	Virginia
BAA-2440™	<i>Escherichia coli</i>	O111	O111	<i>stx1+/stx2+/eae+</i>	Unknown
BAA-2441™	<i>Escherichia coli</i>	O111(MI)	O111	<i>stx1+/stx2-/eae+</i>	Unknown

O121 Strains*

ATCC® No.	Description	Designation	Serotype	Presence of Select Virulence Genes	Isolation Location
BAA-2219™	<i>Escherichia coli</i>	2002-3211	O121:H19	<i>stx1-/stx2+/eae+</i>	Virginia
BAA-2203™	<i>Escherichia coli</i>	2000-3370	O121:H19	<i>stx1-/stx2+/eae+</i>	Michigan
BAA-2187™	<i>Escherichia coli</i>	99-3300	O121:H19	<i>stx1-/stx2+/eae+</i>	Utah
BAA-2220™	<i>Escherichia coli</i>	10C-3041	O121:H19	<i>stx1-/stx2+/eae+</i>	Iowa
BAA-2221™	<i>Escherichia coli</i>	09C-3857	O121:H19	<i>stx1+/stx2+/eae+</i>	Nebraska

O145 Strains*

ATCC® No.	Description	Designation	Serotype	Presence of Select Virulence Genes	Isolation Location
BAA-2211™	<i>Escherichia coli</i>	2003-3375	O145:H25	<i>stx1-/stx2+/eae+</i>	Minnesota
BAA-2129™	<i>Escherichia coli</i>	TW07865	O145:H28	<i>stx1-/stx2+/eae+</i>	Germany
BAA-1652™	<i>Escherichia coli</i>	EH1533	O145:H48	<i>stx1-/stx2+/eae+</i>	Belgium
BAA-2222™	<i>Escherichia coli</i>	2006-3142	O145:Nonmotile	<i>stx1+/stx2+/eae+</i>	Minnesota
BAA-2223™	<i>Escherichia coli</i>	2005-3287	O145:Nonmotile	<i>stx1+/stx2+/eae+</i>	Unknown
BAA-2208™	<i>Escherichia coli</i>	2003-3054	O145	<i>stx1-/stx2+/eae+</i>	Wisconsin
BAA-2195™	<i>Escherichia coli</i>	2002-3034	O145	<i>stx1+/stx2-/eae+</i>	Georgia
BAA-2194™	<i>Escherichia coli</i>	2001-3022	O145	<i>stx1-/stx2+/eae+</i>	Missouri
BAA-2206™	<i>Escherichia coli</i>	2000-3413	O145	<i>stx1-/stx2+/eae+</i>	New Mexico
BAA-2192™	<i>Escherichia coli</i>	99-3311	O145	<i>stx1+/stx2+/eae+</i>	South Dakota
BAA-2130™	<i>Escherichia coli</i>	TW08087	O145	<i>stx1+/stx2-/eae+</i>	Unknown

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Non-toxicogenic Strains

ATCC® No.	Description	Designation	Serotype	Presence of Select Virulence Genes	Isolation Location
BAA-2212™	<i>Escherichia coli</i>	2003-3055	O26:H4	<i>stx1-/stx2-/eae-</i>	Wisconsin
12795™	<i>Escherichia coli</i>	CDC	O26:K60(B6)	<i>stx1-/stx2-/eae-</i>	Unknown
BAA-2649™	<i>Escherichia coli</i>	04-3529	O45:H10	<i>stx1-/stx2-/eae-</i>	Unknown
23982™	<i>Escherichia coli</i>	NCDC H515b	O103:K:H8	<i>stx1-/stx2-/eae-</i>	Denmark
BAA-2214™	<i>Escherichia coli</i>	2005-3342	O103	<i>stx1-/stx2-/eae-</i>	Virginia
29552™	<i>Escherichia coli</i>	CDC 3250-76**	O111a,111b: K58:H21	<i>stx1-/stx2-/eae-</i>	California
33780™	<i>Escherichia coli</i>	Stoke W	O111:K58(B4):H-	<i>stx1-/stx2-/eae+</i>	Scotland
43887™	<i>Escherichia coli</i>	CDC B170	O111	<i>stx1-/stx2-/eae+</i>	Unknown
BAA-2216™	<i>Escherichia coli</i>	99-3071	O145:H34	<i>stx1-/stx2-/eae+</i>	Minnesota
BAA-2190™	<i>Escherichia coli</i>	98-3306	O121	<i>stx1-/stx2-/eae-</i>	Republic of South Africa

**Positive for CVD432 and *aggR* genes, markers for Enterogaagregative *E. coli*.

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Cover image of *E. coli* O157:H7 courtesy of Janice Haney Carr, CDC, Atlanta, GA

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