Serotypes, Virulence Factors and Antibiograms of *Escherichia coli* Isolated from Diarrhetic Calves in Egypt: A review

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**ABSTRACT**

Colibacillosis is the main trouble confronted in cattle outputting, causing considerable economic losses. The infected or carrier calves and cows shed the bacteria in the feces and causing the transmission of pathogenic *E. coli* to calves at the environment. Diagnosis of *E. coli* infection in calves relies on history, clinical signs, the culture of bacteria, and serotyping of bacteria. Colibacillosis requires immediate response to colibacillosis is variable, centered on isolation and treatment of dehydration & antimicrobial therapy. Parental antibiotics can give a good result if given in the early stage, but not without rehydration therapy. The prevalence of colibacillosis differs from 5.4 to 100%, and it is roughly estimated that calf mortality connected with colibacillosis of 20% may reduce net profit to 40%. The emergence of multi-drug resistant *E. coli* isolated from diarrhetic calves has been raised as a new concern for public health and food safety authorities. Routine monitoring of *E.coli* isolated from diarrhetic calves will help reduce the transmission to humans and help select the most effective antibiotics. In conclusion, dam vaccination before calving, improve hygiene around calving and proper colostrum administration considered the main factors to control and prevent the disease. In addition, vigilant monitoring of *E. coli* isolates recovered from diarrhetic calves for antimicrobial sensitivity pattern will help choose the appropriate antibiotic and decrease the transmission of these isolates to humans.

**Keywords:** *E. coli*, calves, serotype, virulence.

**INTRODUCTION**

Diarrhea in newly born calves is one of the more generic diseases affecting calves after birth and even till three months old (Svensson, *et al.*, 2003). Calf diarrhea did not perceive it a trouble by beef producers while in dairy producers was considered as minor trouble (Roderick, and Hovi, 1999), and still the main cause of economic and productivity loss to cattle producers and like previously leading to high morbidity and mortality in the cattle industry worldwide (Uhde, *et al.*, 2008; Bartels, *et al.*, 2010). There are many infectious agents causing diarrhea in newly born calves (Smith, 2009) including bacteria (*E. coli*, *Salmonella*, and *Clostridium*), viruses (*bovine coronavirus*, *bovine viral diarrhea virus*, and *bovine rotavirus*) and protozoa (*Cryptosporidium*) (Bhat, *et al.*, 2012; Bhat, *et al.*, 2013; Singla, *et al.*, 2013). *E. coli* and *Salmonella* are the main pathogens isolated and characterized in scouring calves (Acha, *et al.*, 2004), leading to severe intestinal lesions, alterations in nutrient transport mechanisms and modification in enzyme activity. *E. coli* has been
emerged as a major infectious agent of diarrhea in newly born calves (Nguyen, et al., 2011), and usually associated with considerable economic wastage, involving elevation morbidity and mortality rates, dwindled growth rate, altitude treatment costs, and wasted the time for mangement with the diseased animals (Ok, et al., 2009). E. coli is gram-negative bacteria, facultative anaerobic, rod-shaped, non-sporulating, and flagellated bacterium of the family Enterobacteriaceae (Conway, 1995). There are many types of pathogenic E. coli as enteropathogenic E. coli (EPEC), enterotoxigenic E. coli (ETEC), enterohaemorrhagic E. coli (EHEC) and Shiga-toxin producing E. coli (STEC) (Nagy, and Fekete, 2005; Andrade, et al., 2012; Aref, et al., 2018). Enterotoxigenic E. coli ETEC has been characterized as a the main cause not caused of diarrhea in calves, while the others are isolated from diarrhea as well as normal feces (Nagy, and Fekete, 2005; Nguyen, et al., 2011; Andrade, et al., 2012; Kolenda, et al., 2015 ). STEC produces Stx1 toxins and Stx2 toxins, which were known as Vero toxin or Shiga-like toxin because of their similarity to the Shiga toxin produced by Shigella dysenteriae and Shigella sonnei. The Stx1 and Stx2 can prevent protein synthesis and outputted apoptosis in target cells also Stx1 produces 10-fold more powerful cytotoxic effect than does Stx2 in Vero cells (Melton-Celsa, 2014). The role of the STEC as a causative agent of diarrhea in calves is not yet determinative. There are reports of cases of fatal STEC incidence in cattle (Kolenda et al., 2015). In humans, it causes hemolytic uremic syndrome (HUS) and hemorrhagic colitis (Fakih, et al., 2017; Griffin, et al., 1991). STEC carried by healthy cattle may be forming a potential hazardous to humans. Molecular identification of virulence factors assists in E. coli classification, depending on the existence of virulence markers is vital for the differentiation of E. coli pathotypes employing the widely using multiplex PCR (Vidal, et al., 2005; Müller, et al., 2007; Nguyen, et al., 2011). Additionally, identification of virulence factors can help expect the prognosis based on the pathogenicity of each type that varies significantly according to the integrated virulence factors. The STEC, EPEC, and NTEC are opportunistic pathogens, which are isolated from non-diarrhetic calves (Osek, 2001; Mainil, 2000; Herrera-Luna, et al., 2009). The objective of the present study was to show the most important serotypes of E. coli isolated from diarrhetic calves and the antibiotic resistance patterns of these isolates with the reference to the isolates recovered from diarrhetic calves in Egypt.

TRANSMISSION

fecal-oral contact, fecal aerosol are the main sources of infection due to the presence of the organism in these secretions which excretion during the preclinical bacteremic phase. The transmission in groups of calves can occur by urinary and respiratory aerosols, fecal-oral contact and direct nose-to-nose contact (Gruenberg, 2014). The feces of infected animals encompass the healthy neonates, healthy dams, and newborn animals suffering from diarrhea which is considered complications of the organisms. The incursion of E. coli through oropharyngeal mucosa and nasal mucosa and also, through intestine trans umbilical veins and the umbilicus. Infection with E. coli (Septicemic strains) leading to shock and rapid death due to the release of endotoxin. Subclinical bacteremia is characterized by the speedy development of septicemia and endotoxemic shock leading to death. within a long time of course occur localization of infection, meningitis, polyarthritis and may be leading to nephritis and uveitis appear with less virulent strains (Bashahun, and Amina, 2017).

EPIDEMIOLOGY OF COLIBACILLOSIS IN CALVES

Epidemiological investigators revealed that different species of animals may act as a reservoir of E. coli O157: H7 (Nelson, et al., 1998) E. coli O157: H7 was a dominant VTEC serotype in many parts of the world (Karamali, 1989). In addition E. coli O157: H7 was isolated from feces of young cattle in dairy farms associated with two cases of haemolytic uremic syndrome (HUS) (Wells, et al., 1991). Divergences prevalence of E. coli has been observed by many studies. Masud, et al., (2012) reported 22 (44%), Dereje, (2012) reported 25 (43.1%) and also, Paul et al., (2010) reported 76 (76%). This high and low occurrence of E. coli may be due to the difference in the study area, age of calves, farm size, and sample size, management, and hygiene
measurements. For example, in the study conducted by Nabila (1995), who collected rectal fecal samples from 343 diarrhetic cattle calves and 245 diarrhetic buffalo calves, 29.2% and 33.9% were positive for E. coli respectively. Perez et al., (1998) studied the infectious agents associating with diarrhea of calves. They found that E. coli was detected in 94% of the examined fecal samples, but only 3 (1.83%) of the isolates from diarrhetic calves contained the K99 antigen. Another study, where out of bacteriologically examined 38 faecal swabs collected from calves aged 5 – 25 days (30 with diarrhea and 8 was clinically healthy) 40% were positive for E. coli either alone or in association with Proteus spp., or Klebsilla spp., or Pseudomonas spp. or Campylobacter spp. and/or Salmonella spp. (Sadiek, and Sohair, 1999). Singla et al., (2013) recorded that 850 (15.6%) of calves died before 6 months of age was due to E. coli infection. The overall postnatal mortality with colibacillosis was higher in males (17.21%) than in females (15.21%). E. coli mortality was 4.5% up to one month, 3.5% between 1 and 2 months, 2.9% between 2 and 3 months, 1.4% between 4 and 5 months and 1.8% between 5 and 6 months of age.

**SEROTYPES OF E. COLI.**

Regarding the prevalence of E. coli isolation in several Middle Egypt Governorates, in El-Fayoum (71.4%) due to highly intensive calves rearing systems, in Giza (66.7%) and Beni-Suef Governorate (57.1%) due to the lower intensive calf rearing and production systems. Regarding the prevalence of serogroups O26 (21.1%), O103 (18.4%), O86 (13.2%), O111 (10.5%). Serogroups O119, O127, O157 (5.3%) while serogroups O18, O44, O158 (2.6%), and untyped E. coli (13.2%) (Abed, and Menshawy, 2019). The prevalent E. coli serotypes in Egypt which were isolated from calves suffering from diarrhea were O26, O103 and O119 (23.52%), (19.6%) and (17.64%) followed by O86, O157, and O111 (5.88%); O44, O128, and O125 (3.92%) while O78 (1.96%) finally untyped E. coli (7.84%) (Aabd-Elrahman, 2013). In another study, O26 and O103 (17.7%), O127 (14.6%), O119 (13.6%), O86, O111, O157 (5.2%), O44, O158 (4.2%), O78 (3.1%) and untyped E. coli isolates (9.4%) (El-Seedy, et al., 2016). Badouei et al., (2010) recovered serotypes from diarrhetic and non-diarrhetic calves O157:H7, O111, and serogroup O26 (18.4%). The Data presented in Figure 1 summarizes the serotypes of E.coli commonly isolated from calves suffering from diarrhea in Egypt during the period from 2011 till 2020.


Serotypes of E. coli commonly isolated from calves suffering from diarrhea in Egypt (2011-2020) were O151(75%), O1(75%), O115(50%), O146(50%), O19(21.64%), O44(21.43%), K99(21.1%), O26(20.76%), O142(20.69%), O159(16.78%), O55(16.50%), O103(13.84%), O111(13.8%), O27(12.3%), O111(11.93%), O153(11.62%), O118(11.11%), O91(10.1%), O25(10%), O128(9.60%), O45(8.9%), O125(8.76%), O86(8.72%), O127(7.61%), O157(7.35%), O78(6.34%), O18(5.96%), O8(5.51%) and O158(5.5%).
Serotypes of *E. coli* commonly isolated from calves suffering from diarrhea in countries other than Egypt during 2010-2020 were O15 (23.5%), O111(19.03%), O145(19%), O157(16.18%), O56(14.28%), O82(11.9%), O91(11.9%), O8(10.52%), O103(10.49%), O26(10.16%), O164(9.52%), O128(9.35%), O119(8.6%), O20(6.38%), O45(5.5%), O169(4.76%), O3(4.76%), O4(4.76%), O16(4.76%), O66(4.76%), O131(4.76%), O132(4.76%), O100(4.76%), O171(4.76%), O97(4.76%), O48(4.76%), O17(4.76%), O89(4.76%), O5(4.60%), O76(4.53%), O25(4.53%), O9(4.3%), O79(4.3%), O21(4.3%), O53(4.3%), O101(4.3%), O117(4.3%), O1(4.3%), O18(4.3%), O113(3.73%) and O121(3.2%). In conclusion, serotypes O151, O115, O146 and O1 are commonly isolated in Egypt while in O15, O111, O145 and O157 are commonly isolated from other countries.

**PATHOGENESIS AND VIRULENCE FACTORS**

Connecting *E. coli* strains with individual cases or outbreaks of diarrhea among neonatal calves, pigs, lambs, and humans has assisted to restrict specific virulence factors that could use to characterize between commensal strains and pathogenic (Okerman, 1987). Ingestion of contaminated vegetables and fruits with the animal feces leading to the significant numeral of STEC-outbreaks and in humans is mainly associated with hemorrhagic colitis and hemolytic uremic syndrome. STEC has main public health significance, since incrimination in triggering numerous food-borne outbreaks (Nguyen, et al., 2015).

Its pathogenicity is attributed to the expression of fimbrial antigens, such as F5, and amplifying of one or more enterotoxins such heat-labile enterotoxins (LT) and heat-stable enterotoxins (ST) (Welch, 2006). Afterward, EPEC pathotype causing attaching and effacing (AE) lesions on intestinal cells due to the production of the intimin (protein in nature) which causing diarrhea in young calf and dysentery (Moxley, and Smith, 2010; Mainil, and Fairbrother, 2014). Intimin enhances adherence of *E. coli* to the enterocyte, causing obliteration of the brush border microvilli and destroys the gastric microvillus brush border (Franck, *et al.*, 1998; Nataro, and Kaper, 1998). The virulence of *E. coli* determined by the presence of virulence-associated factors (VAFs) and affected by animal numbers, health status, isolate number, VAF prevalence, serotypes, diagnostic methods, and biological assays (Kolenda, *et al.*, 2015).

Virulence factors in *E. coli* involve the competence for resistance phagocytosis, killing by serum, utilization of highly efficient iron acquisition systems, producing colicins and adhering, colonizing, and invading the hosts’ cells. In addition, the secretion systems, producing of cell surface molecules, transmit and siderophore composition were considered as virulence determinants of *E. coli*. Several virulence factors are connected with the pathogenicity of STEC (O157:H7) involving Shiga toxin 1, Shiga toxin 2, enterohaemolysin and intimin (Kang, *et al.*, 2004).

Fimbrial adhesins and enterotoxins are considered the main virulence factors causing diarrhea connected with enterotoxigenic *E. coli*. Fimbrial (pili) antigens are more distinguished virulence factors characterized for ETEC strains which enabling the bacteria to adhere and colonize the luminal surface of the small bowel and elaborating of one or more enterotoxins that influence the secretion of fluids in the intestine (Holland, 1990) through increased cellular concentrations of cyclic AMP (cAMP) or cGMP. Also, the connectively with serotypes or serogroups does not confer virulence, the consequence of many studies have reported that ETEC strains are limited to a few serotypes or serogroups (Soderlind *et al.*, 1988). The main detected fimbriae on ETEC from calves suffered from diarrhea are F5, also named K99 and F41, but strains with F165 fimbriae have also been identified (Contrepois, *et al.*, 1989). K99 antigen is a fimbrial adhesion distinctively from K antigens (capsular polysaccharide) (Orskov, *et al.*, 1975), virulence factors (F5 and F41) have been associated with diarrhea in animals (Kolenda, 2015; Toledo, *et al.*, 2012), also these genes are discovered at the decreased frequency with increasing age. *E. coli*-connected F17 fimbrial adhesions have been characterized from animals and humans with diarrhea with or without septicemia (Le Bouguenec, *et al.*, 1999). On the contrary, STEC is not ordinarily connected with the disease in cattle and is discovered more frequently in healthy animals (Kolenda, 2015). Fimbrial adhesins (F5, F17, and F41) mediate the conjunction of bacteria to epithelial surfaces in the small intestines, and so, facilitation bacterial colonization with both heat-stable (STa and STb) and heat-labile (LT) enterotoxins; the toxins enhancing the excretion of fluids in the intestine (Holland, 1990) through increased cellular concentrations of cyclic AMP (cAMP) or cGMP.
of fluids and electrolytes from the intestinal epithelial cells, which eventually lead to diarrhea (Guler, et al., 2008; Vu-Khac, and Cornick, 2008; Vu-Khac, et al., 2007), and mainly associated with Shiga-toxin producing E. coli in calves (Nagy, and Fekete, 2005).

The most prevalent virulence genes Stx1 and Stx2 connected with STEC, which are responsible for the pathogenesis and assisted by the intimin gene (eaeA) (Sandhu, and Gyles, 2002; Constable, et al., 2017). The LT gene is the more prevalent enterotoxin gene which accompanied the ETEC strains isolated from calf suffering from diarrhea, either alone or with the sta and or the f 41 genes (Algammal, et al., 2020).

Enterohemorrhagic E. coli (EHEC), considered a highly virulent strain of STEC, harbors numerous genes coding for (Stx1 and Stx2) Shiga toxins, the protein intimin (Eae), and the plasmid encoding E. coli hemolysin (hlyA) (Law, 2000; Kamel, et al., 2015). EHEC strains from animals that produce Shiga toxins and induced AE lesions are termed AESTEC (Piérard, et al., 2012; Fakih, et al., 2017; Thiry, et al., 2017). The bacteriophages play an important role in the transmission of stx genes. The stx-phages are sharing an analogous sequence that identical to lambdoid-phages. The existence of stx genes in the phage lysis-portion illustrates the link between the productions of Shiga-toxins, during the lytic growth released of phage. (Aref, et al., 2018; Hashish, et al., 2016).

There are “factors” produced by certain strains of E. coli, which leads to necrosis in rabbit skin tests. These factors was called cytotoxic necrotizing factor (CNF). It has a molecular mass of approximately 115 Kda, the pathogenic countenance of E. coli O157: H7 involve the producing of Shiga toxin 1 (Stx1) and/or Shiga toxin 2 (Stx2), the possession of a locus of enterocyte effacement containing an eae A gene that encodes a protein called intimin, and the possession of an ~ 60 – Mda plasmid that encodes a hemolysin (Ngeleka, et al., 2019).

ANTIBIOGRAM OF BACTERIA CAUSING DIARRHEA IN CALVES

Antibiograms are more dependable for detection of antibiotic resistance than genotypic resistance gene detection (Scaria, et al., 2010). The fear from drug resistance are propagated and transferred of these resistance genes not only to other bacteria but also to other hosts like humans. Therefore, drug resistance can be transferred to bacteria which never exposed to the drug if overusing of antimicrobials for the prophylaxis and treatment of agricultural animals and people (Wellington, et al., 2013; Aly, and Albutti, 2014; Levy, and Marshall, 2004). The modified bacteria with the integrable resistance genes could be infective for new hosts including humans.

High resistance to tetracyclines and streptomycin (penicillin-streptomycin mix) due to use of these broad-spectrum antibiotics by farmers and paramedical people (Sobhy, et al., 2020). None of the isolates was resistant to imipenem, which is not amazing because there is no commerce medicine for veterinary use that contains imipenem as an energetic ingredient in Egypt. (FDA, 2020) reported high resistance to trimethoprim-sulfamethoxazole as Egyptian paramedical people use this drug as a selector to any gut infection. Also there are no veterinary trade drugs that include ceftazidime, nalidixic acid or aztreonam as active components (FDA, 2020), resistance was discovered against them. This may be due to using of human drugs for medicating of diseased animals and moving of human bacteria, in which resistance has really advanced, to animal hosts (Wellington, et al., 2013), excretion of these antibiotics and their metabolites in human sewage and sludge, from which resistant is afterward devolves to animals stub through the using of sludge as a fertilizer or through irrigating with wastewater (Wellington, et al., 2013; Heuer, et al., 2011).

The E. coli isolates were highly sensitive to marbofloxacin, enrofloxacin, chloramphenicol, sulfa trimethoprim and gentamycin. But most of them were resistant to neomycin, streptomycin, amoxicillin and tetracycline (Nasr, et al., 2014). Antimicrobial resistance of E. coli cefotaxime and Ampicillin,(100%) clindamycin,92.3% followed by kanamycin (50%) followed by kanamycin (50%) (Mohamed, et al., 2019). The antimicrobial resistance is ordinarily connected with pathogenic E. coli that could be imputed to the large-scale incorrect using of antibiotics. The multidrug resistance (MDR) is common in E. coli and initially connected with numerous genes as; bla-TEM, blaCTX (B-lactamase genes), and B (aminoglycoside resistance gene) and sul1 (sulfonamide resistance gene) (Algammal, et al., 2020; Yamamoto, et al., 2013).
Nasr, et al., (2014) reported that the antibiotic resistance of *E. coli* isolates to ampicillin (71.4%), amoxicillin (64.3%), sulfa trimethoprim (50%), gentamicin, and kanamycin (42.8%), whereas, the *E. coli* isolates were highly sensitive to trimethoprim-sulfamethoxazole, ciprofloxacin, norfloxacin, and tetracycline (100%), then less sensitive to cephalosporin group and amikacin (71.4%).

**CLINICAL FINDING**

The degree of morbidity and mortality had been changed in a specific flock of animals according to *E. coli* strain (Ahmed, et al., 2013; Nolan, 2013). Calves suffering from a varying degree of diarrhea depending on their hydration case (Naylor, 2002; Radostits, et al., 2007). In mild cases, the animal had good suckling and can be standing without helper, we are observed sternal recumbency and weak suckling in moderate cases, loss of consciousness, lateral recumbency and no suckling in severe cases. The manifestation of eyeball and skin elasticity test helps us in the observed hydration case of calves suffering from diarrhea. In mild case mild skin tenting without considered changes in the eyeball, while in moderate cases obvious skin tenting and mild to moderate sunken eyeball and in severe cases we observed severe losses in skin elasticity and moderate to severe sunken eyeball and noticed cardiac arrhythmia following by dangerous changes as metabolic acidosis, hyperkalemia and hypovolemia. Also, omphalophlebitis, ophthalmitis, polyarthritis and meningitis may occur within the first days of infection (Gruenberg, 2014) and may cause sudden death in calves through the first days of age due to toxemia or septicemia (HMD, 2010). *Salmonella* spp, *Pasteurella*, *Diplococcus* and *Streptococcus* causing acute septicemias may simulate colibacillosis in calves. There are three forms to syndromes connected with colibacillosis (Gay, 1964). The first, colisepticemic form is leading to rapid death of the calves and is associated with an *E. coli* bacteremia. While there are many strains of *E. coli* have been isolated from calves suffering from colisepticemia. The second enteric-toxemic form is also, connected with collapse and rapid death of the animal, but it is connected with the proliferation of certain specific strains of *E. coli* in the small intestine. Without bacteremia. Toxemia leading to death. The third enteric form weakness, dehydration, diarrhea and abdominal distention may be leading to death due to hypovolemic shock (Gruenberg, 2014) or not according to the severity of the physiological disturbance produced.

**DIFFERENTIAL DIAGNOSIS**

**Salmonellosis**

Animal suffering from high temperature, depression, diarrhea characterized by the presence of fibrin and blood. Calves are ordinarily affected at six days of age or oldest. This proximally to the age of the *coronavirus* infection and the infection is dangerous in young or emaciated animals. On necropsy finding in the intestine membrane like coating is strong hypothetic substantiates for presentation of *salmonella* (Hudson, and White, 1982).

**Coronavirus**

The infection in calves by virus occur over five days after birth. Firstly the virus infected the herd, and affect animals suffering from scour up to six weeks of age or oldest. Calves are not as depressed as in case of infection with *rotavirus*, but the fecal material may have the same manifested, fecal material may contain clear mucus that likens the white of an egg, Diarrhea may continue from several hours to several days. The mortality rate from 1 to 25% (Hudson, and White, 1982).

**Rotavirus**

The infection in calves by virus occurs 24 hours after birth. Firstly the virus infected the herd, and affect animals suffering from scour up to 30 days of age or oldest. The diseased animals suffering from terribly depression, drooling of saliva and watery diarrhea yellow to green in colour (Hudson, and White, 1982). Infection with rotavirus alone causes there is no diagnostic gross lesions in the intestine, but present in a large amount in the large and small intestine.

**Bovine Virus Diarrhea**

This virus causing diarrhea from two to three days after infection and may continue for some time and death in young calves. Clinically we are found ulcers in the mouth, lips and tongue (Hudson, and White, 1982).

**Cryptosporidium**

This is a protozoan parasite infected calves from 1 to 3 weeks in age, has the ability to adhere to the cells that comports the small intestine and to damage the microvilli. *Cryptosporidium* is a
protozoan parasite that is much smaller than coccidia. It has the ability to adhere to the cells that line the small intestine and to damage the microvilli. This is discovered in combination with rotavirus, coronavirus, and/or E. coli (Hudson, and White, 1982).

**Coccidiosis**
Coccidiosis can be infected calves at three weeks of age and oldest, normally the infection is due to stress, overcrowding, sudden changes of feed and poor sanitation, it often occurs in calves of 7 to 14 days after they are relocated from the calving lots onto pasture (Hudson, and White, 1982). Sometimes, clinically in the fecal material appear very few parasites with bleeding. Death may occur firstly in the acute period or later from secondary multipliers

**ZOONOTIC IMPORTANCE**
Many studies showed that, diarrhea in livestock is significant because of the public health consequence. Food animals and their products are considered the main sources of infectious pathogens for humans. Healthy and calves suffering from diarrhea harbor STEC in their intestine (Roopnarine, et al., 2007) and shed the bacteria in large amounts for many months (Widirash, et al., 2004).

Diseases in young animals, leading to massive economic and productivity losses to bovine industry worldwide (Cho, and Yoon, 2014). Several infectious agents triggering diarrhea in animals have zoonotic importance and have been connected with food-borne diseases (Trevejo, et al., 2005). Infections in humans are due to consumption of raw or undercooked meat of food animals or any foods polluted by animal faces, raw milk, unpasteurized cheese, unpasteurized juice and foods contaminated by infected food workers via fecal-oral and by contact with STEC-positive animals or with their habitat (Paton, and Paton, 1998; Sabin, 2006).

Primary reservoirs of E. coli O157:H7 were dairy and beef cattle which shed in their feces (Bach, et al., 2002). E. coli and their subtypes (O26, O111, O118 and O157) are firmly associated with apparent food-borne diseases, particularly Shiga toxin-producing E. coli (STEC). In humans, EHEC a sub of STEC is connected with hemolytic-uremic syndrome (HUS), haemorrhagic colitis (HC), and thrombotic thrombocytopenic purpura (TTP), especially in infants, young children and in the elderly (Nataro, and Kaper, 1998).

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