ENTEROBACTER

PATHOGEN SAFETY DATA SHEET- INFECTIOUS SUBSTANCES

SECTION *I* - INFECTIOUS AGENT

NAME: *Enterobacter* spp.

SYNONYM OR CROSS REFERENCE: Species include: *E. cloacae, E. aerogenes (previously known as Klebsiella mobilis), E. agglomerans (reclassified as Pantoea agglomerans), E. gergoviae, E. sakazakii* (also *Cronobacter sakazakii*), *E. cowanii, E. hormaechei, E. taylorae , E. asburiae, E. intermedius, E. amnigenus, E. dissolvens, E. kobei, E. pyrinus and E. nimpressuralis*[1] , *E. cancerogenus*[2].

CHARACTERISTICS: *Enterobacter* spp. are in the family Enterobacteriaceae[1]. *Enterobacter* spp. are facultatively anaerobic Gram-negative bacilli, 0.6-1 µm in diameter and 1.2-3 µm long, motile by means of peritrichous flagella and have class 1 fimbriae[1,3,4]. They produce acid upon glucose fermentation, are methyl red negative, and Voges-Proskauer positive, with an optimal growth temperature of 30 °C[1]. 80 % are encapsulated[1].

SECTION *II* - HAZARD IDENTIFICATION

PATHOGENICITY/TOXICITY: *Enterobacter* spp., particularly *E. aerogenes* and *E. cloacae,* have been associated with nosocomial outbreaks, and are considered opportunistic pathogens[1,5]. *Enterobacter* spp. can cause numerous infections, including cerebral abscess, pneumonia, meningitis, septicemia, and wound, urinary tract (particularly catheter-related UTI), and abdominal cavity/intestinal infections[6,7]. In addition, *Enterobacter* spp. have been noted in intravascular device-related infections, and surgical site infections (primarily postoperative or related to devices such as biliary stents)[7]. Many species can cause extra-intestinal infections[6], for example, *Enterobacter sakazakii,* has been associated with brain abscesses in infants and with meningitis[3,7]. Mortality rates for bacterial meningitis range from 40-80%[5].

EPIDEMIOLOGY: Worldwide distribution[4]. *E. cloacae* and *E. aerogenes* are responsible for the majority of *Enterobacter* infections, 65-75% and 15-25 %, respectively[7]. *Enterobacter* spp. are commonly found in intensive care units and are responsible for 8.6 % of nosocomial infections according to the US Centers for Disease Control and Prevention (CDC)[8]. *Enterobacter* spp . are also involved in a considerable proportion of reported bacteremia cases; in one pediatric hospital, *Enterobacter* spp. were noted to be the most common cause of bacteremia, accounting for 14 % of cases[8], while in adults *Enterobacter* spp. are responsible for 1.5-6% of bacteremia cases[1]. From 1970 to 1971, there was an epidemic of septicemia caused by contaminated *IV* products that affected 378 patients across the United States[9].

HOST RANGE: Plants[6], humans, and animals[1]. Enterobacteriaceae are primarily colonizers of the lower gastrointestinal tract of humans and animals[10].

INFECTIOUS DOSE: There is no experimental or epidemiologic evidence of infectious dose or *Enterobacter* spp. available; however, approximately 1000 cells have been considered infectious, similar to the infectious dose of the pathogenic bacteria *Neisseria meningitidis* , *Escherichia coli* O157, and *Listeria monocytogenes* 4b[11].

MODE OF TRANSMISSION: Transmission is through direct or indirect contact of mucosal surfaces with infectious agent (e.g. bacteria can transfer from contaminated hands in neonatal units or

contaminated urinals)[1] or, in the case of endogenous flora, through transfer to adjacent, susceptible, sterile body sites[10]. Enterobacteriaceae can also be spread through the fecal-oral route[12].

INCUBATION PERIOD: Unknown.

COMMUNICABILITY: Person to person transmission can occur through the fecal-oral route[12].

SECTION *III* - DISSEMINATION

RESERVOIR: *Enterobacter* spp. are commonly found in soil and water; *E. cloacae* and *E. aerogenes* can inhabit the intestines of humans and animals and can also be found in sewage[1]. *E. aerogenes* has also been found in dairy products[2].

ZOONOSIS: None.

VECTOR: None.

SECTION *IV*: STABILITY AND VIABILITY

DRUG SUSCEPTIBILITY: Most *Enterobacter* spp . are susceptible to cefepime[7], aminoglycosides, fluoroquinolones, and trimethoprim-sulfamethoxazole[8]. Tigecycline has been shown effective in vitro[7].

DRUG RESISTANCE: *Enterobacter spp.* are resistant to ampicillin; first- and second- generation cephalosporins[7]; and cephalothin[6].

SUSCEPTIBILITY TO DISINFECTANTS: While information specific to *Enterobacter* spp. is not available, most species in the family Enterobacteriaceae are susceptible to 70-80 % ethanol[13] and most vegetative bacteria are also susceptible to 1% sodium hypochlorite, glutaraldehyde, formaldehyde, iodines, hydrogen peroxide, peracetic acid, and quaternary ammonium compounds[14].

PHYSICAL INACTIVATION: *Enterobacter sakazakii* have been shown to be inactivated by pulsed electric fields and high hydrostatic pressure[15,16]. While additional information specific to *Enterobacter* spp. is unavailable, most vegetative bacteria can be inactivated by moist heat (121 °C for 15 min- 30 min) and dry heat (160-170 °C for 1-2 hours)[17].

SURVIVAL OUTSIDE HOST: *Enterobacter* spp. are commonly found in the environment (e.g. soil, water, and sewage)[6]. Many species of the family Enterobacteriaceae survive readily in nature requiring only water and a minimal energy source[10].

SECTION *V* - FIRST AID / MEDICAL

SURVEILLANCE: Monitor for symptoms. Stool specimen should be observed for presence of blood or mucous[3]. *Enterobacter* species can be isolated by plating into MacConkey agar, eosin methylene blue agar or blood agar[6]. PCR assays for the detection and identification of *Enterobacter* spp. have also been developed[6].

Note: All diagnostic methods are not necessarily available in all countries.

FIRST AID/TREATMENT: Administer appropriate antibiotics accounting for local antimicrobial susceptibility patterns[1].

IMMUNIsATION: None.

PROPHYLAXIS: None.

SECTION *VI* - LABORATORY HAZARD

LABORATORY ACQUIRED INFECTIONS: There has been 1 reported case of symptomatic laboratory acquired infection with *E. aerogenes*[18].

SOURCES / SPECIMENS: Infected urine, feces, respiratory secretions, wound exudates, blood, water, soil, and plants[2,6].

PRIMARY HAZARD: Direct or indirect contact of infected specimens with mucous membranes, parenteral inoculation, aerosols, and ingestion[1,10,19,20].

SPECIAL HAZARD: None.

SECTION *VII* - EXPOSURE CONTROLS / PERSONAL PROTECTION

RISK GROUP CLASSIFICATION: Risk Group 2[21]. This risk group applies to the genus as a whole, and may not apply to every species within the genus.

CONTAINMENT REQUIREMENTS: Containment Level 2 facilities, equipment, and operational practices for work involving infectious or potentially infectious materials, animals, or cultures[22]. These containment requirements apply to the genus as a whole, and may not apply to each species/subspecies/clonal isolate/strain within the genus.

PROTECTIVE CLOTHING: Lab coat. Gloves when direct skin contact with infected materials or animals is unavoidable. Eye protection must be used where there is a known or potential risk to splashes[22].

OTHER PRECAUTIONS: All procedures that may produce aerosols, or involve high concentrations or large volumes should be conducted in a biological safety cabinet (BSC). The use of needles, syringes, and other sharp objects should be strictly limited[22]. Additional precautions should be considered with work involving animals or large scale activities.

SECTION *VIII* - HANDLING AND STORAGE

SPILLS: Allow aerosols to settle. Wearing protective clothing, gently cover spill with paper towels and apply and appropriate disinfectant, starting at perimeter and working towards the centre. Allow sufficient contact time before clean up[22].

DISPOSAL: Decontaminate before disposal - steam sterilization, incineration, chemical disinfection[22].

STORAGE: In sealed containers that are appropriately labeled.

SECTION *IX* - REGULATORY AND OTHER INFORMATION

REGULATORY INFORMATION: The import, transport, and use of pathogens in Canada is regulated under many regulatory bodies, including the Public Health Agency of Canada, Health Canada, Canadian Food Inspection Agency, Environment Canada, and Transport Canada. Users are responsible for ensuring they are compliant with all relevant acts, regulations, guidelines, and standards.

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PREPARED BY: Pathogen Regulation Directorate, Public Health Agency of Canada

Although the information, opinions and recommendations contained in this Pathogen Safety Data Sheet are compiled from sources believed to be reliable, we accept no responsibility for the accuracy, sufficiency, or reliability or for any loss or injury resulting from the use of the information. Newly discovered hazards are frequent and this information may not be completely up to date.

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