

**INTERNATIONAL JOURNAL OF FOOD AND  
NUTRITIONAL SCIENCES**

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**Official Journal of IIFANS**

## FOOD POISONING BY BACILLUS CEREUS

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Received on: 1<sup>st</sup> May, 2017Accepted on: 11<sup>th</sup> October, 2017

*Bacillus cereus* is a Gram positive bacteria, found in a wide variety of food of plant and animal origin. They are normally non-pathogenic but may cause illness when food improperly cooked or stored are consumed. The illness is usually manifested in two forms: emetic syndrome and diarrheal syndrome. The food poisoning caused by *Bacillus cereus* are usually underreported as the disease is self-limiting and usually last for less than 24 hours. Adopting necessary precautions and proper heating of food is imperative for the prevention of the illness caused by *Bacillus cereus*.

**Keywords:** *Bacillus cereus*, Emetic toxins, Enterotoxins, Food poisoning

## INTRODUCTION

*Bacillus cereus* is a Gram-positive aerobic or facultatively anaerobic, motile, spore-forming, rod-shaped bacterium known to cause illness due to consumption of improperly cooked food. They are commonly found in soil and are naturally present in a wide range of food products both of plant and animal origin.

They belong to the genus *Bacillus*, first described and classified by Ferdinand Cohn in 1982. The genus *Bacillus* has more than 60 species most of which are considered non-pathogenic. *Bacillus cereus* have close phenotypic and genetic (16S rRNA) relationships to several other *Bacillus* species, especially *anthracis*. The spores of *Bacillus cereus* are resistant to heat, cold, radiation, desiccation and disinfectants.

They can grow in food within a wide range of temperature and pH with the optimum being 30-40 °C and 6 to 7 pH, respectively. As mentioned earlier they are normal component of microflora of foods such as meat, milk, rice, vegetables, etc. Although their presence is seen in a wide range of food, they normally do not impose health risk but

cause illness when food improperly cooked or stored are consumed.

## TOXINS PRODUCED BY BACILLUS CEREUS AND THEIR ASSOCIATED SYMPTOMS

The food poisoning due to *Bacillus cereus* are underreported as the illness is mild and self-limiting and usually last for less than 24 hours (Granum and Lund, 1997). Two type of food poisoning are reported: Diarrhoeal type and emetic type. A special surface structure of *B. cereus* cells, the S-layer, has a significant role in the adhesion to host cells, in phagocytosis and in increased radiation resistance (Kotiranta, 2000). Other potential virulence factors include secreted phospholipases, haemolysins, proteases, and other degradative enzymes. *Bacillus cereus* produces one emetic toxin (ETE) and three different enterotoxins: HBL, Nhe and CytK.

Emetic toxin (ETE) is a ring-shaped structure of three repeats of four amino acids with a molecular weight of 1.2 kDa. It is highly resistant to pH between 2 and 11, to heat, and to proteolytic cleavage. It is not antigenic but stimulate the vagus afferent by binding to 5-HT<sub>3</sub>. Cereulide dose of

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approximately 9.5 µg/kg BW is required to cause onset of emetic syndrome (Finlay *et al.*, 1999). The emetic toxin is pre formed in the food such as rice, pasta, pastry and noodles and is characterized by relatively short incubation period of 0.5 to 5 hours. Symptoms of the illness include nausea, vomiting and malaise and last for less than 24 hours.

Two of the three enterotoxins are involved in food poisoning which are produced within the host body. They both consist of three different protein subunits that act together. HBL the primary virulence factor is also a hemolysin. Nhe is not a hemolysin but is the most common while CytK is a single component protein, not involved in food poisoning. All three enterotoxins are cytotoxic and cell membrane active toxins that will make holes or channels in membranes. The infective dose to cause diarrhoeal symptoms is about  $10^5$  to  $10^7$  cells. The incubation period is comparatively longer than the emetic type, i.e., about 8-16 hours. Consumption of improperly cooked meat products, milk, fish, vegetables, soup, etc., cause the illness characterized by abdominal pain, watery diarrhea and occasional nausea.

#### NON GASTRO-INTESTINAL INFECTIONS

*Bacillus cereus* is also known to cause non gastrointestinal infections like endophthalmitis, respiratory tract infections, CNS infection, gas gangrene like infection, cutaneous infection, endocarditis, osteomyelitis and urinary tract infection. *B. cereus* produces a potent β-lactamase conferring marked resistance to β-lactam antibiotics (Bottone, 2010).

#### DETECTION AND ISOLATION

Isolation of *Bacillus cereus* in selective agar can be done from suspected food, faeces and vomitus of the patients. Advance techniques like multiplex PCR, MLST, AFLP and LAMP can also be used for its detection. Detection of the toxins can be done using cell culture (vero cells) where it produces vacuolation activity, ELISA, RPLA and bioassay such as Boar Spermatozoa Test. Further, test kits for their detection are also available commercially (Bacillus Diarrhoeal Enterotoxin Visual Immunoassay (TECRA International Pty Ltd., Australia and BCET-RPLA Toxin Detection Kit (Oxoid).

#### PREVENTION AND CONTROL

Since the organism is commonly found in food of plant and animal origin, it is imperative that they are destroyed by proper heating. Food if not consumed immediately, should

be chilled or hold at appropriate temperature to prevent the spore germination and multiplication of the vegetative cells. In any case, holding the food at room temperature for extended period should be avoided.

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