**Lec 3:**

**The Role of Toxins in Food borne Disease :**

***Staphylococcus aureus* → Enterotoxins**

***Clostridium botulinum* → Neurotoxin**

***Clostridium perfringens* → Enterotoxin**

***Bacillus cereus* → Diarrheogenic and emetic Toxins**

***Vibrio cholera* → Cholera Toxin**

**Enterotoxigenic *E.coli* (ETEC) → Heat stable and heat labile toxins**

***Shigella sp*. → Shiga toxins**

***Listeria monocytogenes* → Listeriolysin**

***Salmonella sp*. → enterotoxin , cytotoxin**

**Enterohemorrhagic *E. coli* (EHEC)→ Shiga like toxin**

***Vibrio parahemolyticus* → Hemolysin**

***Yersinia enterocolitica* → Enterotoxin**

***Campylobacter jejuni* → Enterotoxin**

***Aeromonas hydrophila* → Multifunction toxin**

***Plesiomonas shigelloides* → Enterotoxin**

**Extracellularly acting toxins :**

* **Non membrane damaging :**

**1. Hyaluronidase ( hyase ) :**

**Hyaluronidase is the term that describe enzyme that is able to breakdown hyaluronic acid ( HA ) .**

**The degradation of HA produces a disaccharide products.**

**Hyaluronidase was reported to be virulence factor that facilitate the spreading of bacteria through hust tissues because it has tissue damaging effects , it is commonly reffersd to as spreading factor .**

**Although all extracellular hyaluronidases are spreading factors , not all spreading factors are hyaluronidases .**

**Hyaluronidase break down the substrate (( hyaluronate ))**

**( hyaluronic acid , hyaluronan ) .**

**Fig.( ): The Structure of hyaluronate and the products of the eliminative cleavage by bacterial hyaluronidase or hyaluronate lyase, the boxed region shows the repeating units of N-acetylglucosamine and glucouronic acid linked β(1-4) that constitute the repeating disaccharide which linked β(1-3).**

**Hyaluronate is a linear polymer MW of ( 10000 KD ) . The polymer is made up of alternating N-acety lglucosamine and glucouronic acid residues linked by glycosidic bonds , it lacks covalently linked peptides .**

**Hyaluronate is found in :**

* **Umbilical cord**
* **Synovial fluid**
* **Cartilage**
* **Brain**
* **Muscles**
* **Soft connective tissue**
* **50% of hyaluronate is found in skin .**

**Hyaluronidase is produced by :**

* **Gram positive organisms such as :**

***Streptococcus***

***Staphylococcus***

***Peptostreptococcus***

***Streptomyces***

***Clostridium***

* **Pathogenic *Treponema* species**
* **Different species of *Candida***
* **Some gram – ve bacteria, but produced as periplasmic and not excreted to the extracellular media .**

**The ultimate products of hyaluronate degradation by hayaluronidase are (( disaccharides )).**

**These can be transported and metabolized intracellularly to supply needed nutrition for a pathogen as it replicate and spread .**

**Perhaps the more significant result of the enzymatic depolymerization of hyaluronate is a decrease in the viscosity of the ground substances . Decreased viscosity results in increased permeability of connective tissues and potentially increased spread of M.O. and toxins through the connective tissue**