Topic 1

The Importance of Microbiology

MicroBiome Vs Microbiota

- Microbiomes - functional collection of multiple microbes in a particular enviromental system. (Microbiota + "theater of activity"
- Microbiota - All types of microorganisms present in a microhabitat

BENEFITS

- Biomarkers - predicting diseases
- Designing targeted therapies
- Personalized drug therapies and probiotics

Metagenomics - Study of genetic material from enviromental/clinical samples

Using metagenomic sequencing or metasequencing techniques

major microbial populations in human body

- GI track (Gastrointestinal track) - Stomach, Small intestine, Large Intestine

phylotypes - group of organism by phenetic relationship

Human gut phylotypes :

- Gastric fluid : Firmicutes, Bacteroidetes and Actinobacteria
- Mucus Layer - Firmicutes and Proteobacteria

Stomach - *Helicobacter pylori* - in gastric mucosa

Large Intestine - Small Intestine goes to the ileum empties into the cecum.

- E. coli

microbial communities in the gastrointestinal track

enterotypes - stable clusters of communities co-existing

- 3 types - Bacteroides, Prevotella, Ruminococcus

Products of Metabolites

- Vitamin production
- Modification of steroids
- Amino acid biosynthesis
- Shotgun Metagenomic Sequencing
- 16S rRNA

Development

- Colonization begins - Birth - Source of vitamins and education for immune system

Disorders

- Inflammatory Bowel Disease (IBD) - Dysbiosis - disruption of homeostasis

Antibiotics - decrease microbes in the gut

C. difficile - spore-former, antibiotic-resistant opportunistic pathogen

Probiotics

Prebiotics - carbohydrates, provide nutrition for fermentative gut bacteria

Topic 1 (cont)

Synbiotics - combines both pro and pre-biotics

Human Virome

- RNA virus Genomes - Typically smaller than DNA viruses, Single/double stranded
- Viroids - Naked infectious RNAs that cause plant diseases

The Baltimore Scheme

- 7 classes in relation to its mRNA

= 3 classes of DNA genome

= 4 classes of RNA genome

- Class 1 - double stranded (+/-) - RNA replicase makes (+) strand to be used as mRNA and template
- Class 2 - DNA (+) - produces replicative form
- Class 3 - RNA (+/-) - must carry RNA replicase
- Class 4 - RNA (-) - genome mRNA
- Class 5 - RNA (-) - RNA replicase makes (+) strand to be used as mRNA and template
- Class 6 - RNA (+)
- Class 7 - DNA (+/-) - Uses reverse transcriptase Hepatitis B (HBV)

Genetic Transfer Processes - Transduction and Lysogeny

Lysogeny - Viral genes replicated not transcribed

- Prophage - Lysogenic form of Viral DNA

Transduction: the transfer of host genes from one cell to another by a virus, 2 modes - generalized and specialized

- Generalized - donor genes not part of viral genome and cannot replicate independently, Transducing particle - Particles containing bacterial host DNA

Bacteriophages - protective role in human health, first line of defense against pathogens

Phage - symbiotic relationship

Microbiology of Water

Sources

- Potable Water - Used for drinking and cooking

= Filtration and Chlorination

- Recreational Water - Public ponds, lakes, Swimming pool

Testing

- Indicator organism - signals potential for diseases

Microbiology of Food

Topic 2

Microbial Structure and Function

Microbial Morphology

-Morphology - Cell Shape

- Coccus - Spherical or ovoid
- Rod/bacillus - Cylindrical
- Spirillum - Curved or spiral
- Spirochetes - Tightly coiled

cell membrane and cell wall

Bacterial Membrane

- Hopanoids - Strengthen the membrane (Sterol-like molecules)

Archaeal Membrane

- ether linkages in phospholipids
- Has isoprenes

Bacteria and Eukarya Membrane

- Ester linkages in phospholipids

Bacterial Cell Wall

Gram-negative cell wall - two layers : lipopolysaccharide + peptid-oglycan

- glycan tetrapeptide

Over view - Outer membrane, periplasm, cytoplasmic membrane

Outer - composed of lipopolysaccharide, endotoxin- lipid A - Barrier against antibiotics

Porins - transmembrane protein channels for the entrance and exit of solutes

Periplasm - Located between cytoplasmic and outer membrane

Gram-positive cell wall - One layer of peptidoglycan - interbridges of Gly

can be destroyed by lysozyme

- teichoic acids covalently bound to peptidoglycan - lipoteichoic acids - covalently bound

Archaeal Cell Wall

no peptidoglycan

Pseudomurein - polysaccharide, similar to peptidoglycan

cannot be destroyed by lysozyme or penicillin

cell surface structures and inclusions

- not part of the cell wall
- Slime Layer - Loosely attached easily deformed
- Capsule - Tightly attached matrix, visible with India ink

cell locomotion

eukaryotic microbial