Module 1, Lecture 3 – Outline: Assessing the microbiome, part 1

Goals:

1. Discover the Microbiome, basic structure revealed by experiments – part 1

Learning outcomes:

1. Be able to describe the basic structure of a host microbial (bacterial) community
2. Use some measures to compare the structure of two or more communities
3. Explain some of the factors that effect community structure
4. Develop hypotheses about the differences that may change or manipulate community structure/function

**A. 16s theory –**

What criteria make a good molecular target?

Why is 16s a good molecule to target?

* *Universally available, technically simple*
* *Shared vital system*
* *Conserved regions*
* *Variable*

**What do we have for virus?**

Only family specific targets

**For Eukaryotes?**

18s rRNA or ITS spacer region

Two general overall approaches

* Community sampling (16S or other target)
* Metagenomics

From these approaches, we’ve learned a lot already. Much of it from Human (or mouse).

Let’s start with some basics:

What makes up the microbiota (microbiome)?

* Bacteria (and Archaea)
* Viruses
* Eukaryotic organisms

We do know that this work is not necessarily new:

* Arthur Kendell (Scientist in 1909) quotes:
  + “As this food passes through the alimentary canal…at different levels of the tract it is decomposed in part by various types of bacteria. The predominating types of bacteria which take part in the decomposition are determined largely by the nature of the diet…there is a parallelism between the nature of the diet and the character of the bacterial types represented in the intestinal and fecal flora… Hitherto this correlation between diet, intestinal flora and end products has been largely overlooked…”
* His colleague Elia Metchnikoff (1908) coined the term “dysbiosis” to mean a microbial imbalance in the gut.

**What do we know that the microbiota do for us?**

Key examples of functional contributions of the gut microbiota (much gained from the introduction of gnotobiotic mice in the 1960s).

* Harvest of otherwise indigestible components of our diet
* Biosynthesis of vitamins and amino acids
* Metabolism of xenobiotics
* Renewal of gut epithelial cells - germ-free mice renew gut epithelial cells at a slower rate
* Development and activity of the immune system

Anaerobic techniques played a major role in gut microbial research by allowing critical culture of gut microbes

Early organismal work centered around phenotypes connected to GI function – but importantly established the physiological relevance of the microbiota.

Obese (ob/ob) mice versus lean littermates (ob/+)

* ob/ob have higher Firmicutes:Bacterioidetes (Ley 2005)