Human Microbiome
The Human Microbiome Project was one of the spin offs of the Human Genome Project. The HMP project started in 2007 with the overall goal of **Characterizing the Human Microbiome and determine its role in human health and disease.**

*HMP is lead by NIH but is an International Consortium.*
We are described as a *Superorganism*
- We are made up of 3-5X more microbial cells (mostly bacterial) then human cells
- There are approximately 100X more bacterial genes then human genes in this Superorganism.
- About 8% of our genome is made up of viral DNA
- Fungal DNA also plays a role
How do we detect and differentiate between all the different types of Bacteria in the Microbiome?

- 16 S rRNA PCR

How many different types have been identified?
- more than 10,000

Why didn’t we know there were this many before?
- Many are not cultivable
Where do they live on our bodies?

How does our everyday life effect them? What do we put on our skin and in our stomachs? What do we encounter on a daily basis that may have an effect on the other living organisms that are part of us?
Our Focus for the past 80 years has been to get rid of the “Bad” Microbes

This has lead to two major problems
1. Antibiotic resistance
2. Damage to our Microbiome
Hygiene Hypothesis: theory that suggests a young child's environment can be "too clean" to effectively stimulate or challenge the child's immune system to respond to various threats during the time a child's immune system is maturing.


-Allergies
-Asthma
-Autoimmune Diseases
The birth delivery method has an impact on our Microbiome

**C-section vs. Vaginal delivery**

C-section babies gut microbiomes resemble the microbiomes of their mother’s skin, health care workers skin and father’s skin. In time they do recover but they show a significantly higher likelihood to suffer from - allergies
- asthma
- diabetes
Recent study shows that over 350 regions of the genome in C-section babies have genes turned off (epigenetics) that are involved in immune response. This is thought to occur in babies where C-sections are performed before mother is in labor. This may be passed on to future generations.

http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3110651/
Seventy percent of the total Human Immune System is the gut lymphoid tissues
- Research suggests that the microbiome regulates the inflammatory response. Disturbances to microbiome especially early in life may lead to chronic inflammation which is the root of many diseases including Chron’s, IBS, Cancers, Diabetes and Alzheimer's to name a few.

There is current research being done to replace the microbiome of C-section babies immediately at birth by swabbing mother’s Vagina and giving it to baby.
Diseases that have been shown to have an association to the make up of the microbiome

- Obesity
- Acne
- Depression
- Diabetes
- IBS and Chron’s Disease
- Autism
Obesity: Several studies out showing a definite correlation with Microbiome and obesity or inability to maintain a healthy weight. Several bacterial types have been shown to be associated with obesity vs. lean.

Mouse and rat studies have been done using fecal transplants from obese to thin and this to obese animals resulting in weight changes corresponding to origin of transplanted microbiome.

Human studies have found individuals who went through Gastric bypass surgery for weight loss had a significant change in their microbiome associated with non-obese microbiomes.
Is eating behavior manipulated by the gastrointestinal microbiota? Evolutionary pressures and potential mechanisms

![Diagram](image_url)
Depression
A study done on the town of Walkerton (Canada) showed that after their water source was contaminated with *E. coli* and *Campylobacter* many of the residents developed gastrointestinal problems. What was unexpected was that a significant number of these same individuals developed depression in the following year.

Many studies have been done now in mice, rats and humans that show a definite connection between the make up of the microbiome and depression (also autism and schizophrenia).

Transplant studies and probiotics in both mice and humans have shown an impact on depression. Complex bi-directional communication between the Central Nervous system and the GI tract impacted by gut inflammation, chronic abdominal pain syndromes and eating disorders. Several specific bacterial species known to make and transmit molecules involved in behavior and mental health.
Food Preservatives and the Microbiome
- Artificial Preservatives in Food not widespread until the 20th century.
- Regulation and Testing of the preservatives done only on pathogens and food spoilage bacteria/fungi.
- Similar standards found in Canada, EU and Australia (however all confusing).
Sabbatical work on Preservatives effects on Microbiome at the Buck Institute in Novato California (2014)

- Tested Drosophila by feeding them food with and without preservatives
- Observed a significant decrease in diversity of gut bacteria (i.e. unhealthy gut)
Work continuing at UHMC through the INBRE program Grant

Four bacteria known to be beneficial to human health and found in most recommended Probiotics were selected for preservative testing:

*Lactobacillus rhamnous, Lactobacillus casei, Lactobacillus plantarum and Steptococcus thermophilus*

- Several Preservatives (natural and artificial) will be tested for effects on beneficial bacteria in-vitro.
Preservatives are being evaluated for ability to move through human digestive system without losing activity. Project is teaming up with Dr. Mahavir Chougule at the UH Hilo School of Pharmacy.

Preservatives will be tested for activity after passage through
- Stomach
- Small intestine
- Large intestine

Conditions

Tests will include
- HPLC
- Tests on Bacteria
What Can we do to help improve our Microbiome?
- don’t take antibiotics unless necessary and take them correctly.
- Probiotics
- Avoid preservatives
- Avoid processed food
<table>
<thead>
<tr>
<th>Product</th>
<th>Bacteria/Yeast (#of cultures per serving)</th>
<th>Dosage/Serving</th>
<th>Form</th>
<th>Storage</th>
<th>Claims</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. Ohira Probiotics</td>
<td>1. Bifidobacterium breve ss. breve</td>
<td></td>
<td></td>
<td></td>
<td>• Manage lactose intolerance</td>
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<td></td>
<td>2. Bifidobacterium infantis ss. infantis</td>
<td></td>
<td></td>
<td></td>
<td>• Prevents colon cancer</td>
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<td></td>
<td>3. Bifidobacterium longum</td>
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<td></td>
<td>• Lowers cholesterol</td>
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<td></td>
<td>4. Enterococcus faecalis TH 10</td>
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<td></td>
<td></td>
<td>• Lowers blood pressure</td>
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<td></td>
<td>5. Enterococcus acidophilus</td>
<td></td>
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<td></td>
<td>• Improves immune system</td>
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<td>6. Lactobacillus acidophilus</td>
<td></td>
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<td>• Prevents infections</td>
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<td>7. Lactobacillus bulgaricus</td>
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<td></td>
<td>• Reduces inflammation</td>
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<td>8. Lactobacillus casei ss. casei</td>
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<td></td>
<td>• Prevents harmful bacteria growth</td>
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<td>9. Lactobacillus fermentum</td>
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<td></td>
<td>10. Lactobacillus helveticus ss. jagurti</td>
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<td></td>
<td>11. Lactobacillus plantarum</td>
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<td>12. Streptococcus thermophiles</td>
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<td></td>
<td>(N/A)</td>
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<tr>
<td>Culturelle Digestive Health Probiotic</td>
<td>1. Lactobacillus Rhamnosus GG ATCC3103 (10 Billion cultures per capsule)</td>
<td>1 capsule daily (Max 2)</td>
<td>Capsule</td>
<td>Room temp or lower (cool/dry)</td>
<td>• Able to survive stomach acid</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Tablets</td>
<td></td>
<td>• Boost digestive health</td>
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<td></td>
<td></td>
<td>• Support immune system</td>
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<td></td>
<td></td>
<td>• Helps with digestive problems including bloating, gas, diarrhea, and up</td>
</tr>
<tr>
<td>Product</td>
<td>Contents</td>
<td>Formulation</td>
<td>Storage</td>
<td>Benefits</td>
<td></td>
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<tr>
<td>Yakult</td>
<td>1. Lactobacillus casei Shirota (8 Billion cultures per bottle)</td>
<td>1-2 bottles daily</td>
<td>Liquid</td>
<td>Refrigerate</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>• Balance digestive system</td>
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</tbody>
</table>
| Jarrow Formulas: Jarrow-dophilus | 1. Bifidobacterium breve R0070  
2. Bifidobacterium longum BB536  
3. Lactobacillus casei R0215  
4. Lactobacillus helveticus (L. acidophilus) R0052  
5. Lactococcus lactis ssp. lactis R1058  
6. Lactobacillus rhamnosus R0011  
7. Lactobacillus plantarum R1012  
8. Pediococcus acidilactici R1001 (5 Billion cultures per capsule) | 4 capsules daily | Capsule   | Room temp or refrigerate                                                   |
|                  |                                                                            |              |           | • Resists stomach acid                                                   |
|                  |                                                                            |              |           | • Survives inside the small intestines                                   |
|                  |                                                                            |              |           | • Positively influence the composition of intestinal microflora          |
|                  |                                                                            |              |           | • Promote intestinal health                                               |
|                  |                                                                            |              |           | • Support immune response                                                |
| Dr. Mercola: New Complete Probiotics | 1. Bifidobacterium bifidum  
2. Bifidobacterium lactis  
3. Bifidobacterium longum  
4. Lactobacillus acidophilus DDS-1  
5. Lactobacillus brevis  
6. Lactobacillus casei  
7. Lactobacillus plantarum  
8. Lactobacillus salivarius  
9. Lactobacillus rhamnosus  
10. Streptococcus thermophilus (35 Billion cultures per capsule) | 2 capsules daily | Capsule   | Room temp                                                                |
|                  |                                                                            |              |           | • Stomach acid and intestinal bile resistant                             |
|                  |                                                                            |              |           | • Supports immune system health                                           |
|                  |                                                                            |              |           | • Aids in the breakdown and removal of harmful toxins                    |
|                  |                                                                            |              |           | • Helps maintain blood pressure levels                                   |
Microbiome Projects

http://www.hmpdacc.org/

http://humanfoodproject.com/

http://www.human-microbiome.org/
How much influence do you think these organism’s have on our emotional and physical health?

Viral Genes Found to be crucial in development of Human embryos

Placenta Bacteria

Missing Microbes
Some Suggested Probiotics

VSL#3  (the most tested that I know of, but usually not used unless fairly severe gastrointestinal problems occurring.)

Align : tested but used primarily for problems with Diarrhea


**NOW Foods Clinical GI Probiotic**

**Renew Life Ultimate Flora Critical Care Probiotic** (these seem to have really helped some people with weight loss and depression/anxiety)