Developments in Microbiome Research

By Camellia Hilker

What is a microbiome?

- There is a 1:1.3 ratio of human cells to bacteria in the body[1], with over 1000 species in the colon alone[2]
- Also: viruses, fungi and archaea
- Symbiotic relationships exist between organism and host
- Microbiomes can also affect or be affected by:
  - Obesity[3]
  - Autism[4]
  - Cancer
  - HIV/AIDS[5]

1. The American Microbiome Institute, (2016, January 20). How many bacteria vs human cells are in the body?
2. Sears CL. A dynamic partnership: celebrating our gut flora. Anaerobe. 2005;11(5):247–251.
3. Maruvada P., Leone V., Kaplan L. M., Chang E. B. The human microbiome and obesity: moving beyond associations. Cell Host & Microbe.
4. Vuong HE, Hsiao EY. Emerging Roles for the Gut Microbiome in Autism Spectrum Disorder. Biol Psychiatry.
5. Williams B., Landay A., Presti R. M. (2016). Microreview microbiome alterations in HIV infection a review. Cell Microbiol. 18 645–651.

Abstract data

- PubMed[1] abstracts instead of full text articles
- Entrez API via BioPython package
- PubMed search query “microbiome”
  - last 5 years
  - In English and referring to humans
- Query resulted in ~15,000 abstracts, randomly sampled 2,500

1. A Service of the National Center for Biotechnology Information, U.S. National Library of Medicine

Cell Host Microbe. 2019 Aug 14;26(2):160-162. doi: 10.1016/j.chom.2019.07.018.

The Gut Feeling: GPCRs Enlighten the Way.

Pandey S[1], Maharana J[1], Shukla AK[2].

Author information

Abstract

Host-microbiome interactions affect host physiology, but the underlying mechanisms are not well understood. Recent papers from Chen et al. (2019) and Colosimo et al. (2019) in this issue of Cell Host & Microbe demonstrate that metabolites produced by several members of the gut microbiota can efficiently activate host G protein-coupled receptors and influence host physiology.

Comment on

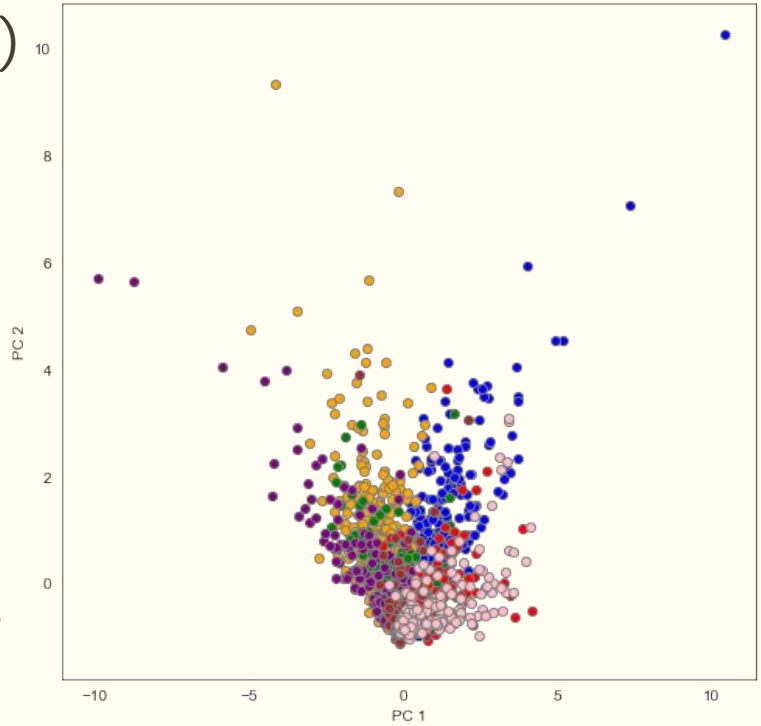
Commensal bacteria make GPCR ligands that mimic human signalling molecules. [Nature. 2017]
Mapping Interactions of Microbial Metabolites with Human G-Protein-Coupled Receptors. [Cell Host Microbe. 2019]

PMID: 31415748 DOI: 10.1016/j.chom.2019.07.018

[Indexed for MEDLINE]

Method of obtaining best results

- Non-negative matrix factorization (NMF)
  - Topics represent weighted sets of co-occurring words
- No stemming or lemmatizing
- Removed stop words
- Included n-grams of 2 and 3
- Doc frequency between 0.5% and 8%
  - Include words that are in at least 12 abstracts, but not in more than 200



Generated topics

- **Metabolism:** acids, bile, liver, metabolites, obesity, fatty, nafld, diabetes
- **Bacterial Diversity:** abundance, skin, individuals, 16s rrna, control, total, groups
- **Antibiotic Resistance:** pathogens, resistance genes, exposure, strains, colonization, therapy
- **Cancer:** gastric, tumor, cancers, fusobacterium, carcinogenesis, colon, progression
- **Mother/Infant Relationship:** human milk, life, strains, preterm, first, feeding
- **C. Difficile Infection:** recurrent, fecal microbiota, therapy, microbiota transplantation,
- **Inflammatory Bowel Diseases:** epithelial, barrier, crohns, genetic, ulcerative colitis

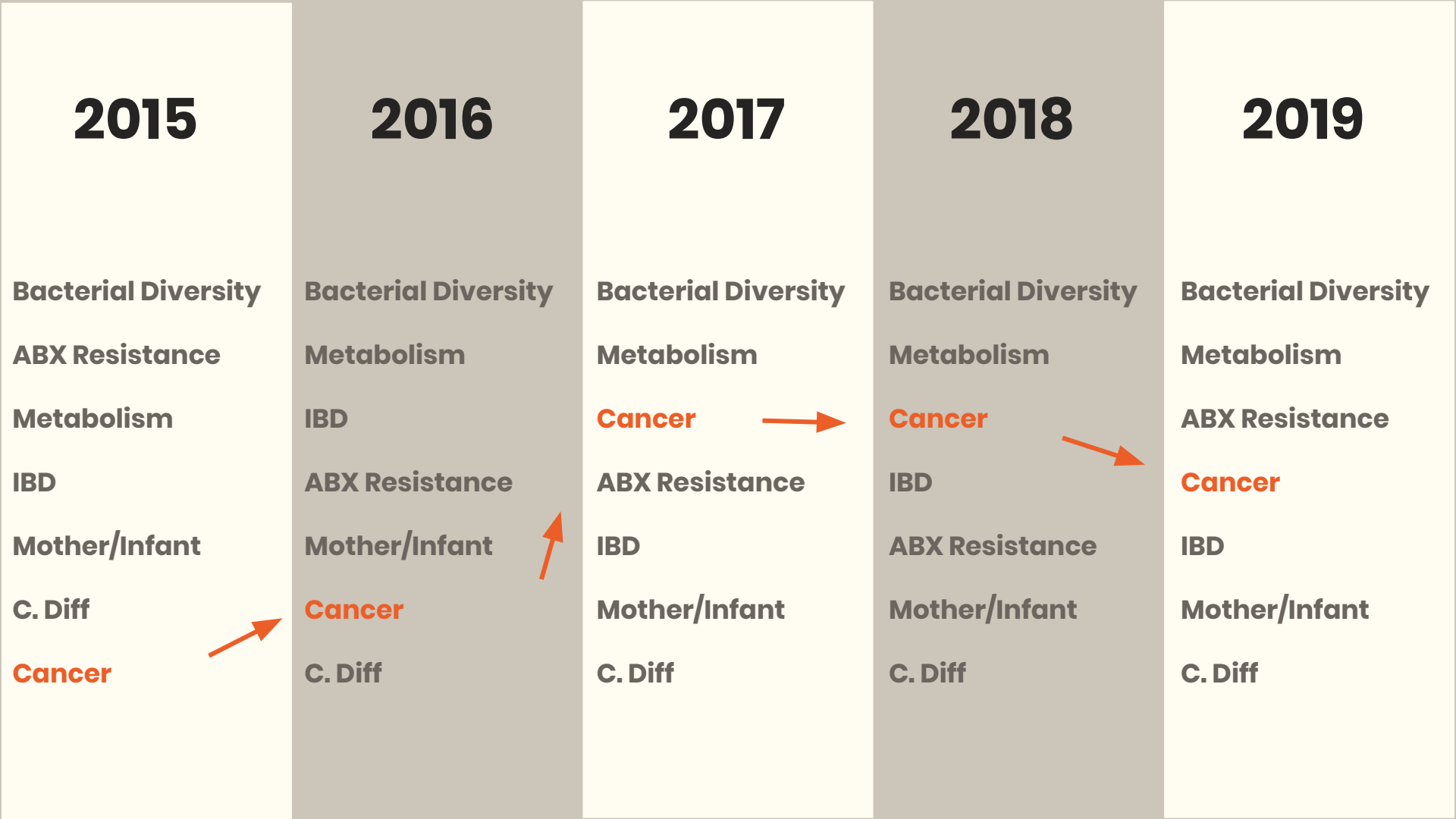
“Although cancer is generally considered to be a disease of host genetics and environmental factors, microorganisms are implicated in ~20% of human malignancies.”

Science - 2015

W. S. Garrett, MD, PhD

Harvard Medical School, Dana Farber Cancer Institute

Cited over 130 times by subsequent articles


2015
Bacterial Diversity
ABX Resistance
Metabolism
IBD
Mother/Infant
C. Diff
Cancer
2016
Bacterial Diversity
Metabolism
IBD
ABX Resistance
Mother/Infant
Cancer
C. Diff
2017
Bacterial Diversity
Metabolism
Cancer
ABX Resistance
IBD
Mother/Infant
C. Diff
2018
Bacterial Diversity
Metabolism
Cancer
IBD
ABX Resistance
Mother/Infant
C. Diff
2019
Bacterial Diversity
Metabolism
ABX Resistance
Cancer
IBD
Mother/Infant
C. Diff

Conclusions

- Interests in microbiome research seem to have changed over the past 5 years
- A similar method could be used by investors to better identify trending areas of research (in any field)
- Can also facilitate in subject-based sharing of information across previously unrelated research groups
- Would this change be more drastic over 10+ years of publications?
- Assess the importance of each publication by the number of times it was cited

Questions?