

# ***Gut Microbiome and Human Health***



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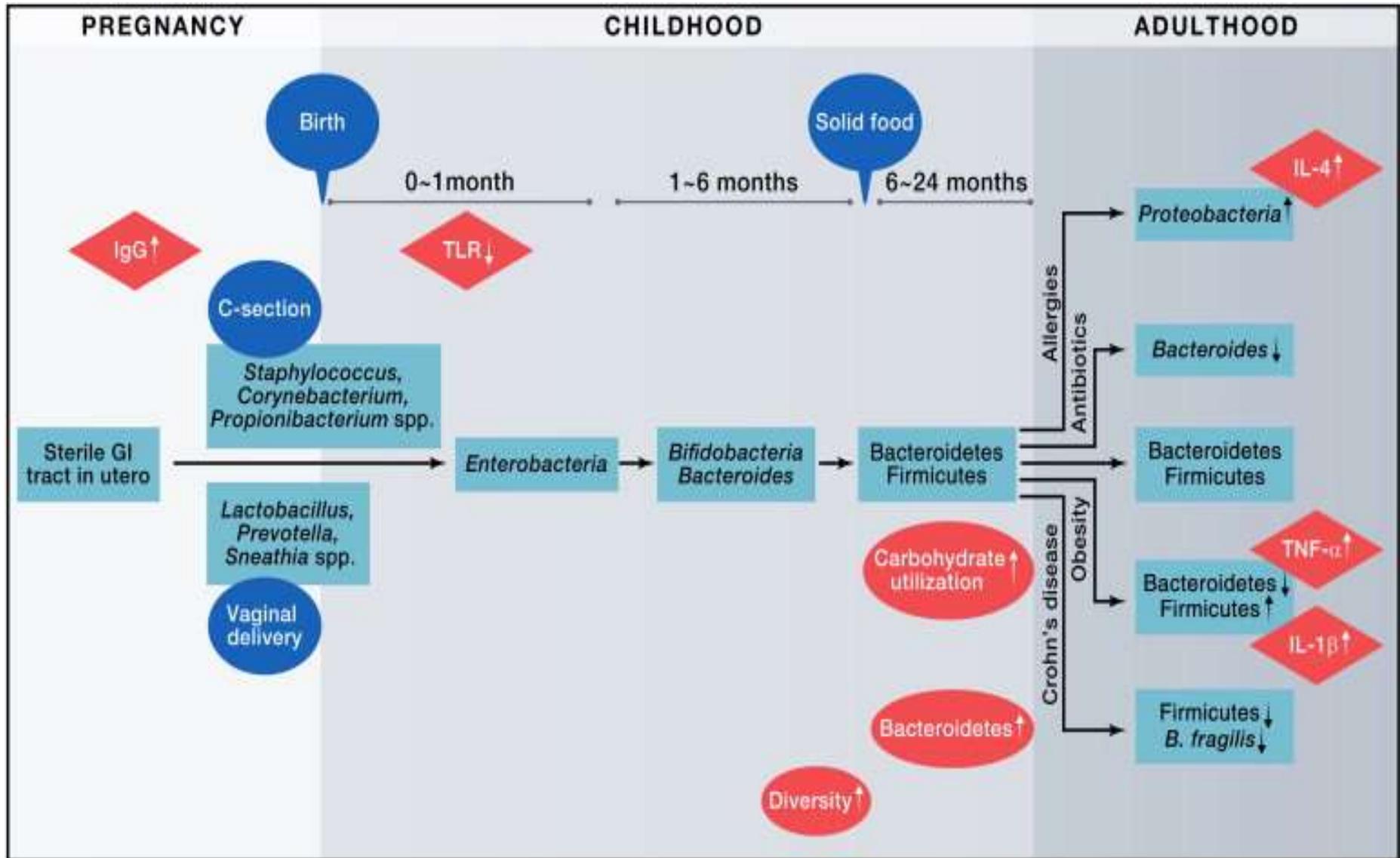
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# **What is Gut Microbiome?**



- **Bacteria, viruses, fungi and other microorganisms live in gut, but bacteria are the most dominant.**
- **Approx. 1,000 species of bacteria in the human gut microbiome, each plays a different role, most extremely important for your health, while some cause diseases.**
- **Approx. 40 Trillions of these microbes exist mainly inside your intestines and on your skin (10 times more than the human cells which are estimated to be 30 Trillions)**
- **Most of the microbes in intestines form "pockets" in the large intestine called the cecum, and these are referred to as the gut microbiome.**
- **Altogether, these microbes may weigh as much as 2–5 pounds (1–2 kg), which is roughly the weight of your brain.**
- **Together, they function as an extra organ in your body and play a huge role in your health, your body functions are not only the expression of your genome but also the gut microbiome.**

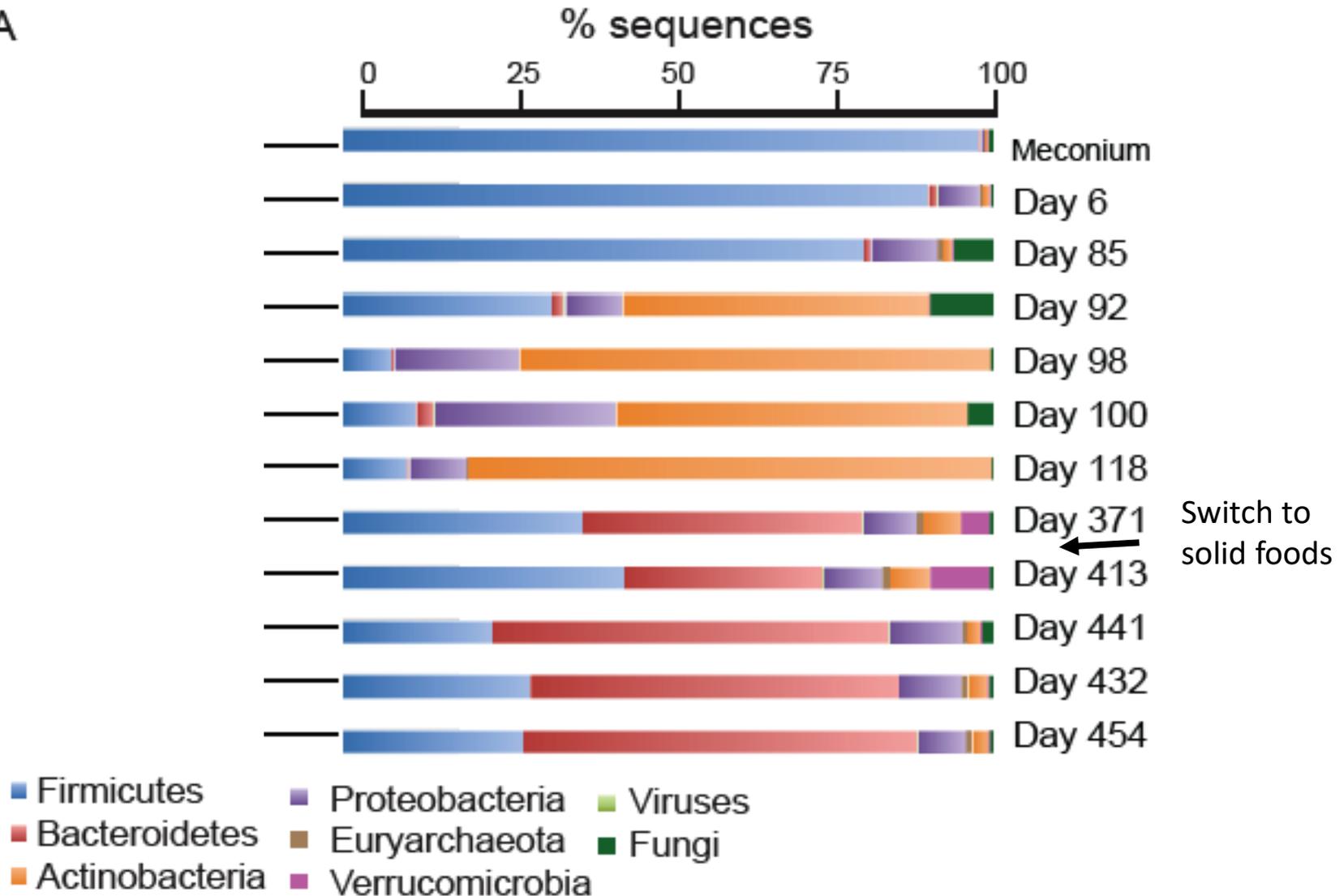
# Development of Gut Microbiome



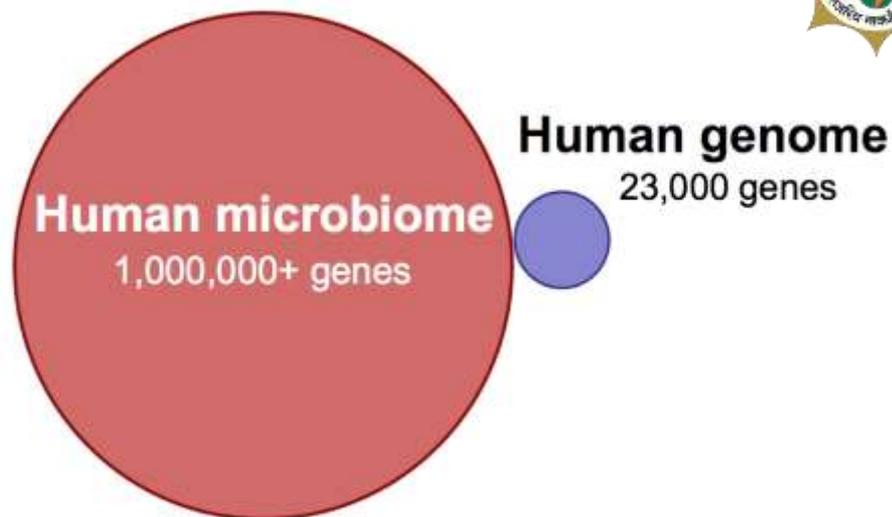
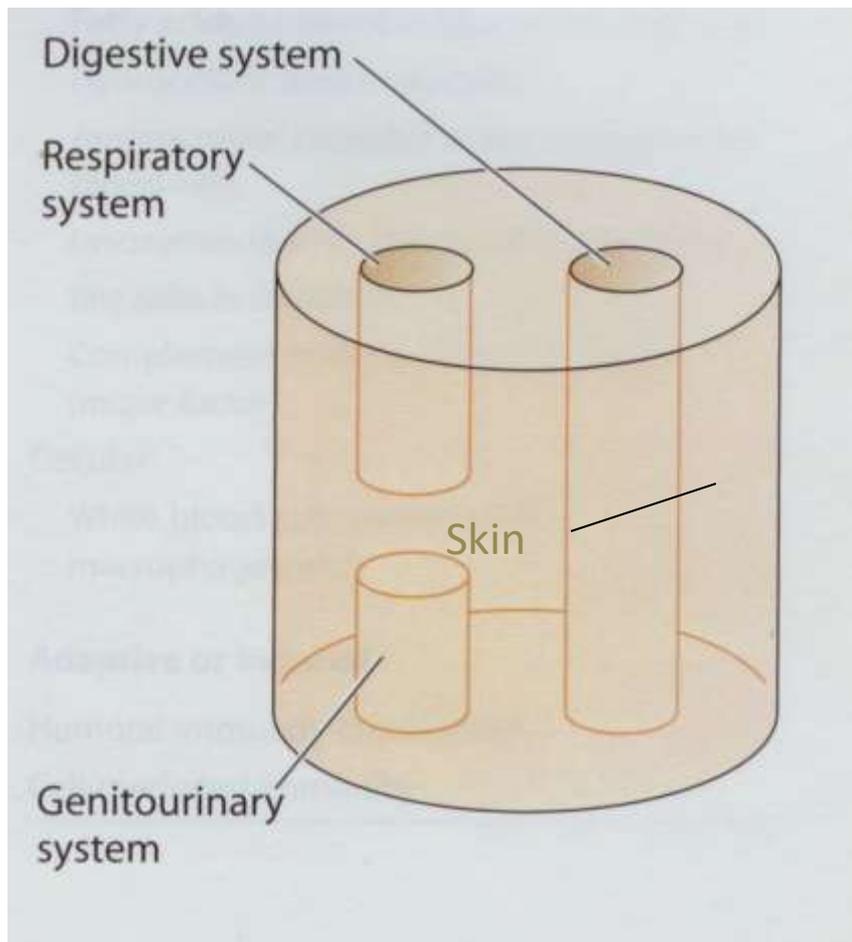
# Succession of Microbial Communities in Gut



A



# ***A Microbe's view of us***



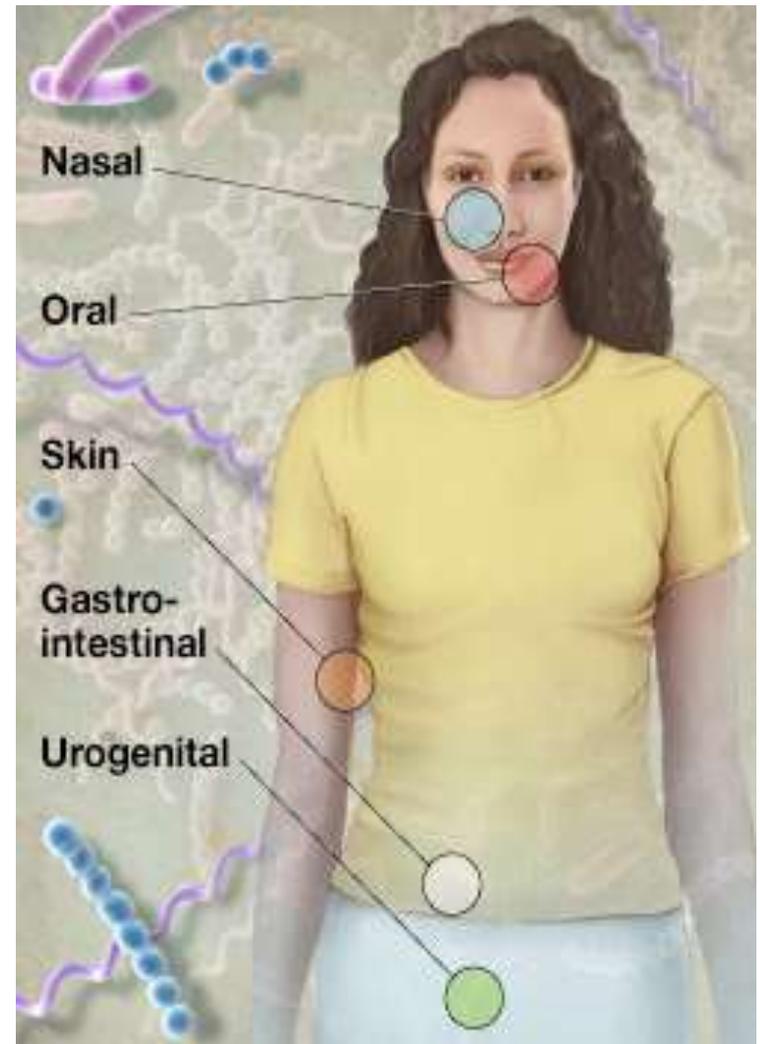
***Human Characters are also determined by microbes living in/on our body***

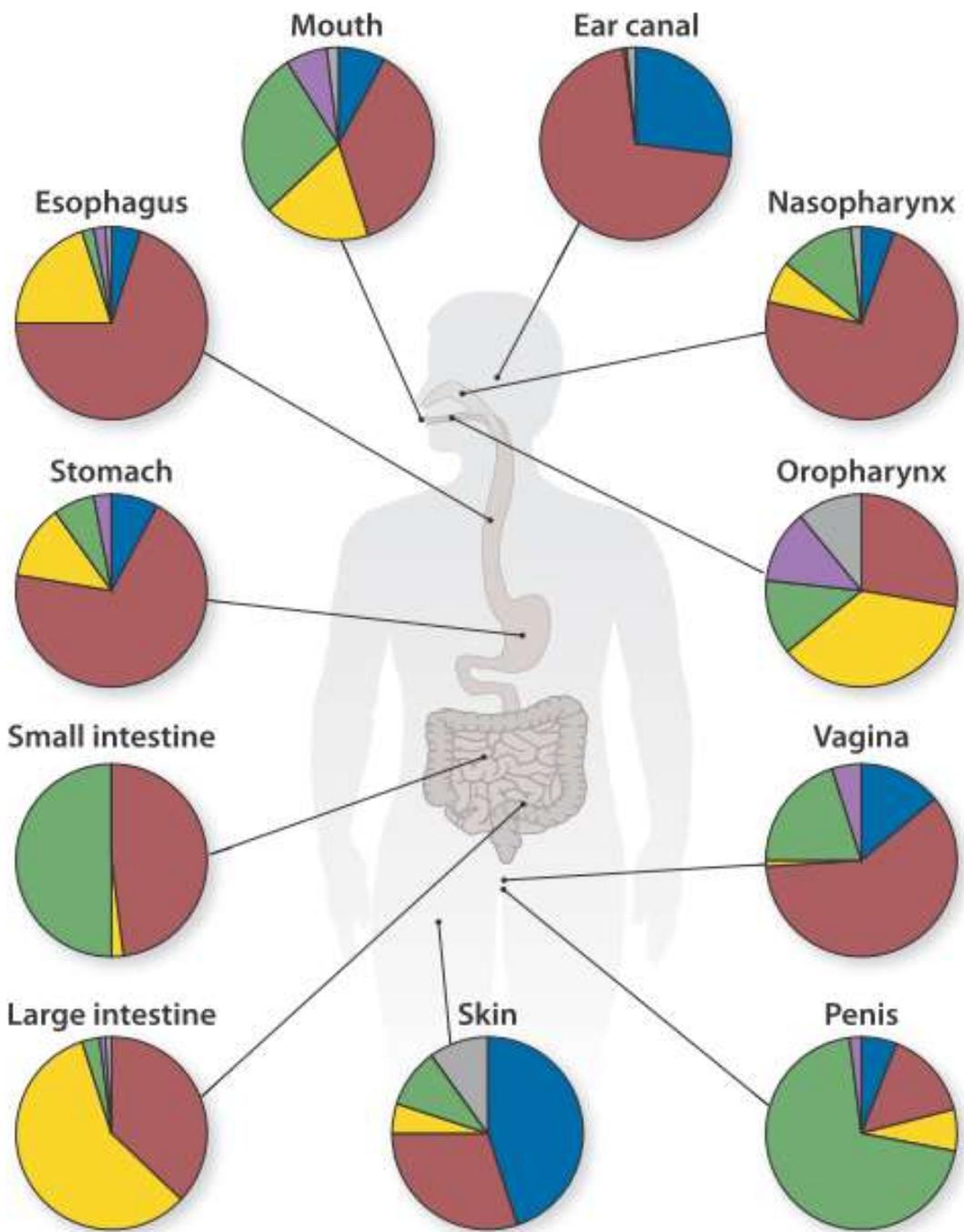
***Bacterial cells outnumber our body cells 10:1***

***Comprise up to 2-5 lbs of your body mass***

## ***Sites that harbor a normal flora:***

- Skin and mucous membranes***
- Upper respiratory tract***
- Gastrointestinal tract***
- Outer opening of urethra***
- External genitalia***
- Vagina***
- External ear canal***
- External eye (lids, conjunctiva)***

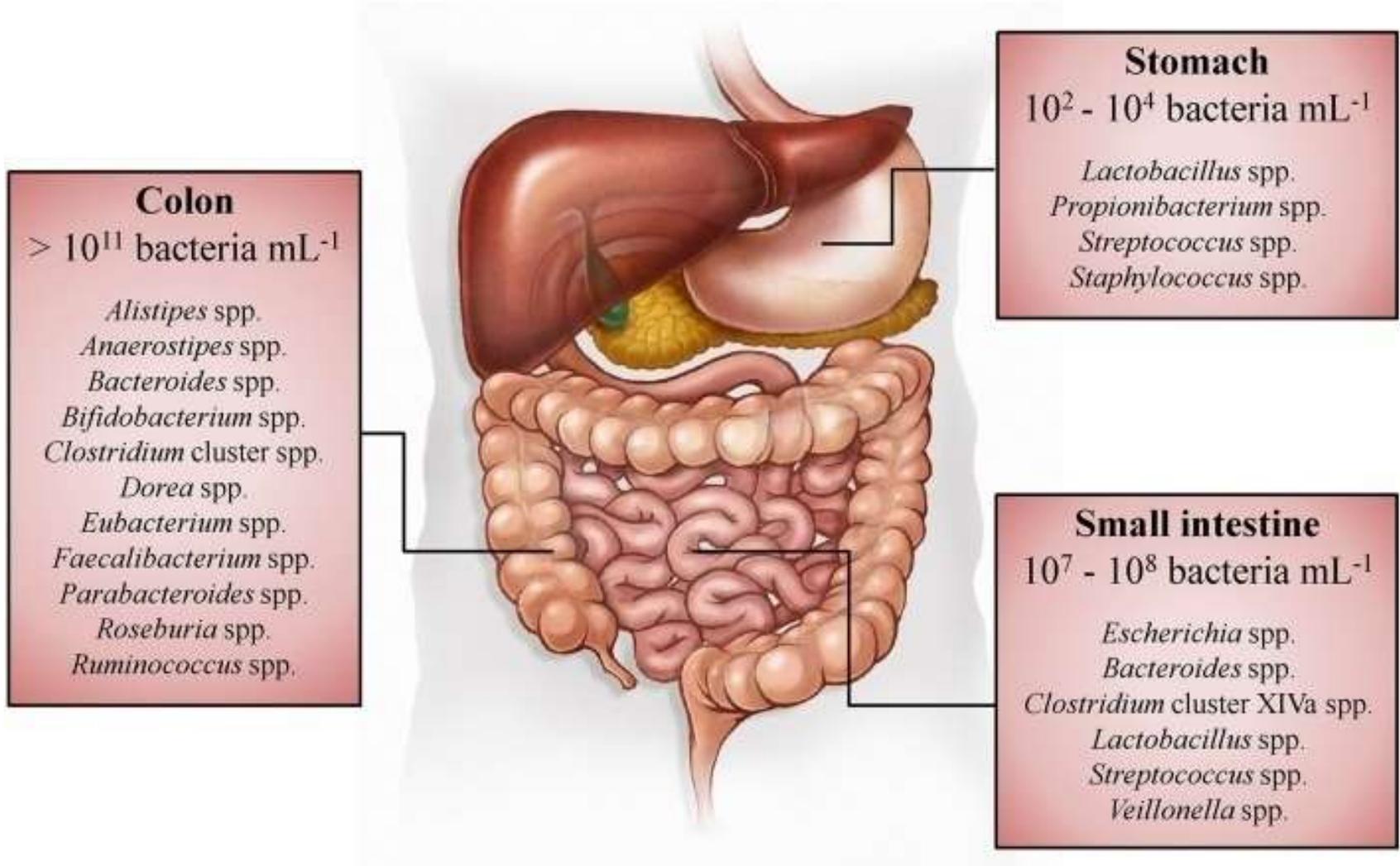




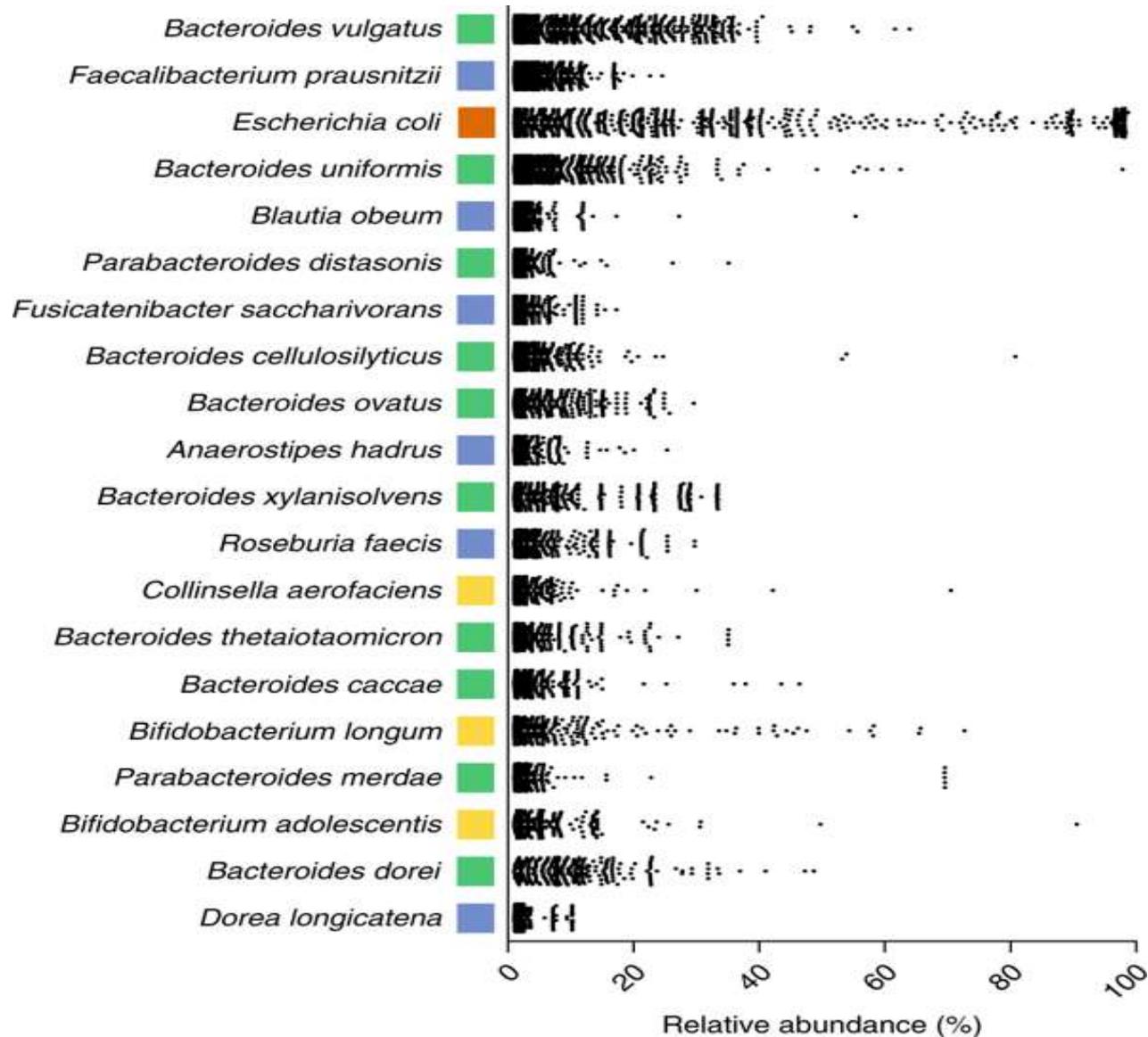
***Microbial Diversity in Different Parts of the Body***

***(Fierer et al. 2012)***

# Quantitative Distribution of Bacteria in Gastrointestinal Tract of Humans (Tuohy and Scott, 2015)



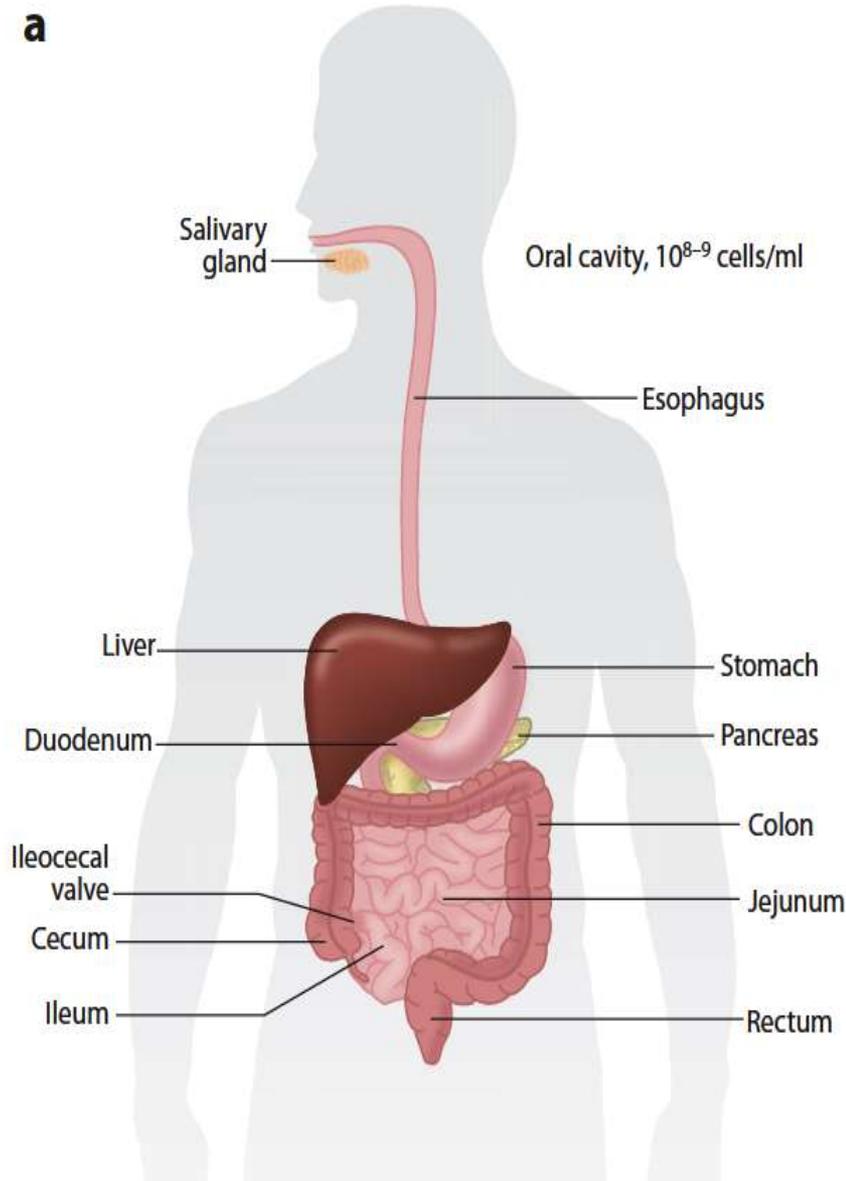
# Dominant Bacterial species within the human gastrointestinal tract (Nature Biotechnology, 2019)



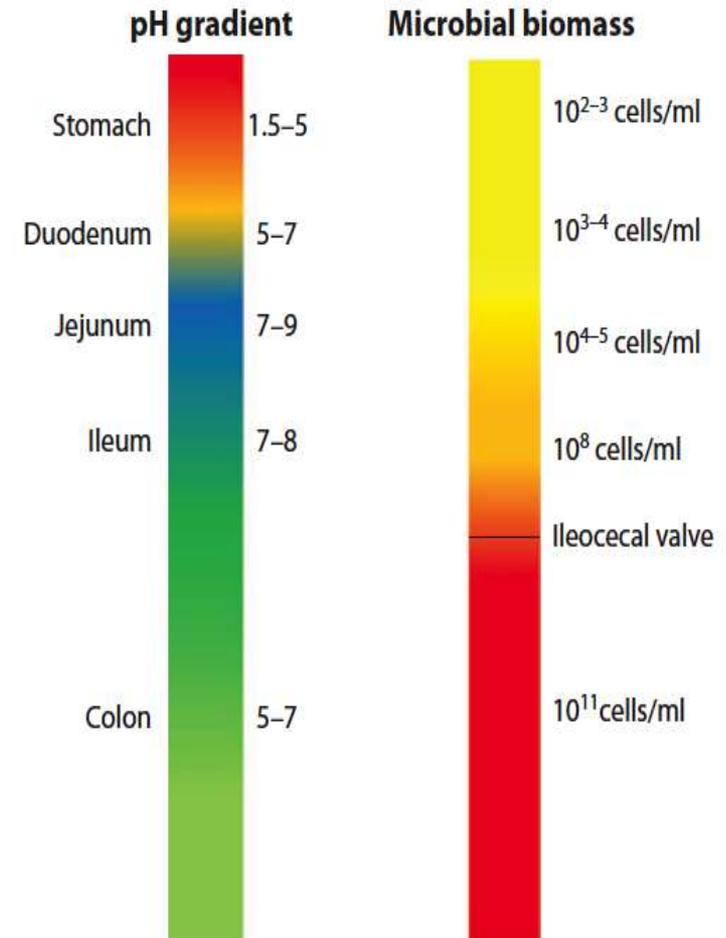
# Relationship between Microbial Biomass and pH



a



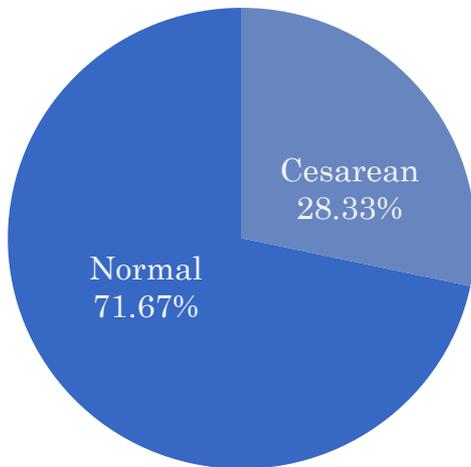
b





# Human Colostrum-Collection of Samples

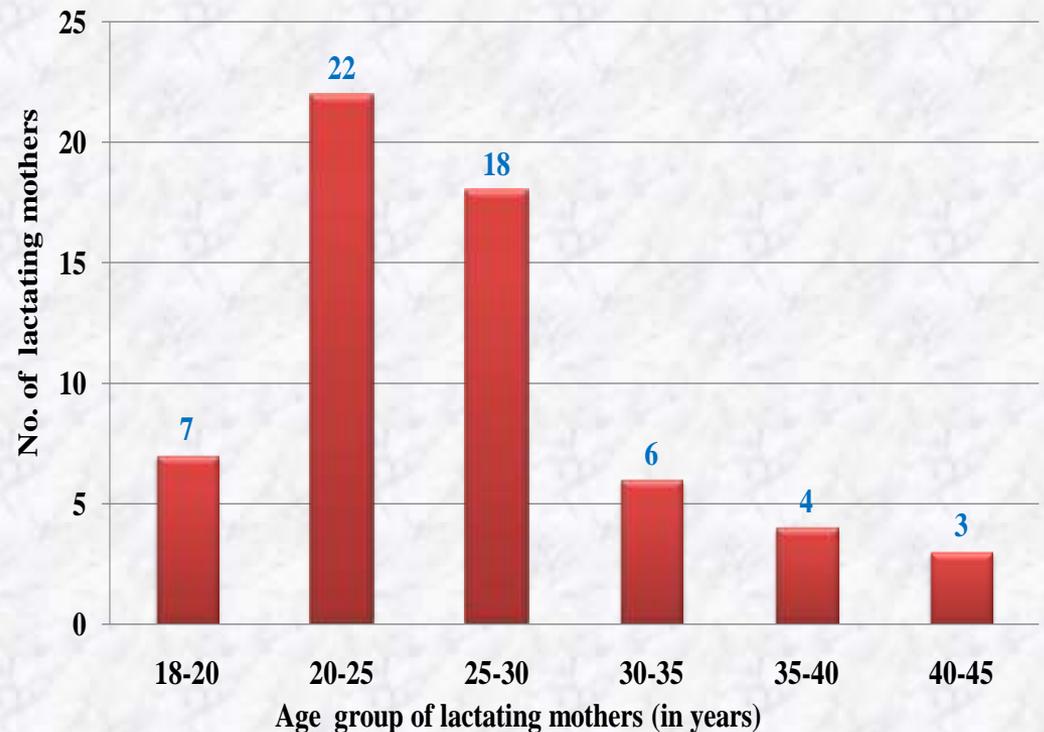
❖ **60 HC samples**



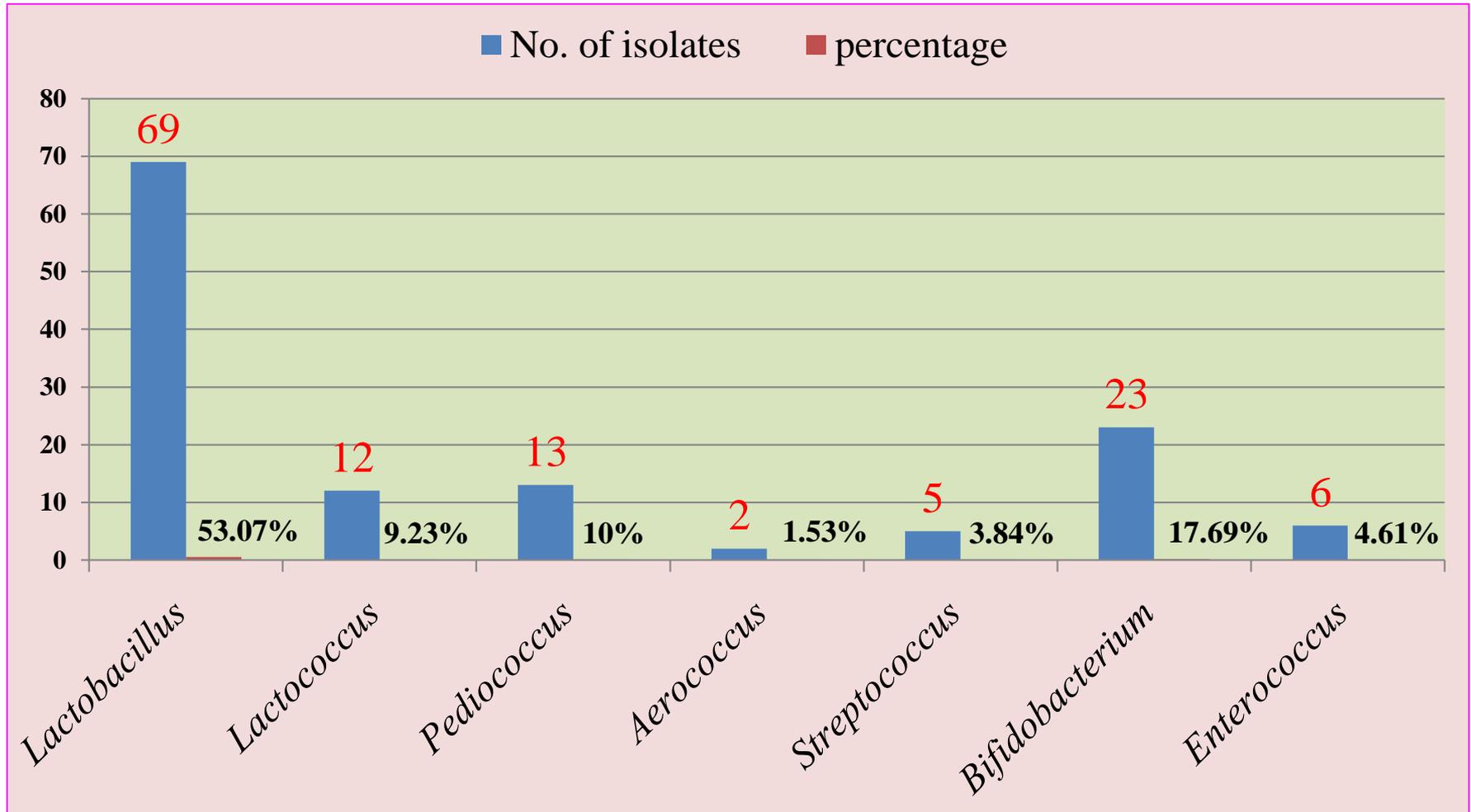
■ Cesarean    ■ Normal

***Distribution of Samples based on Mode of Delivery***

## Distribution of Samples Based on Age



# Isolation of Different Genera from Human Colostrum



# **Impact of Diet on LABs Concentration**



- ❖ **CFU/mL of LAB were compared with the diet of lactating mothers.**
- ❖ **CFU/mL of 8 lactating mothers was found low in those lactating mothers who were fed with poor diet during pregnancy.**
- ❖ **HC of 18 lactating mothers was found to be very rich in those lactating mothers who were fed with rich diet whereas the others were found to be moderate.**



**CFU/mL of mother - Rich diet**



**Poor diet**

# ***Isolation of LAB from Lactating Mothers***



***Total 130 isolates from 60 different lactating mothers were isolated and identified using biochemical and morphological tests.***



***Isolated from HC on MRS agar plates.***

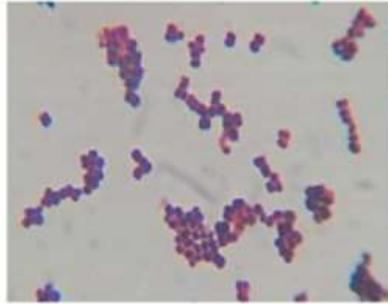


***Sub-culturing of LAB***

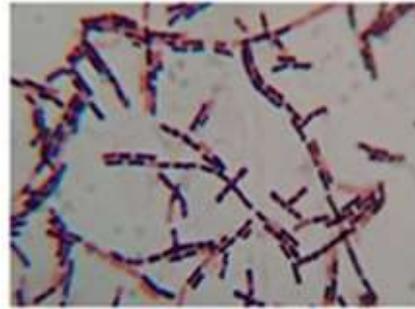
# Photomicrographs of LAB Isolated from HC



*Lactobacillus sakei* (I0401)



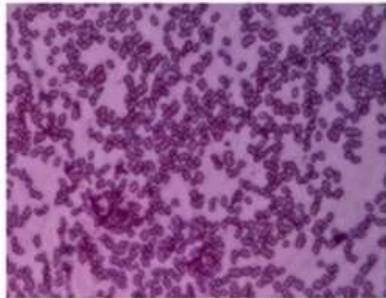
*Enterococcus faecium* (I5201)



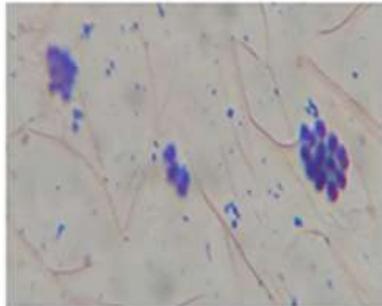
*Lactobacillus agilis* (I3103)



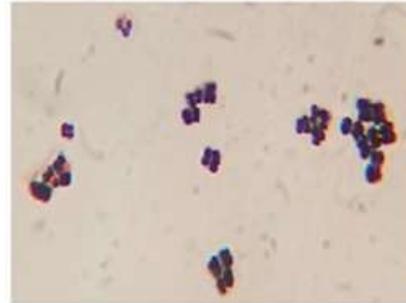
*Pediococcus pentosaceus* (I2801)



*Lactococcus lactis* (I4601)



*Lactococcus formosensis* (I2202)



*Lactococcus hircilactis* (I3803)



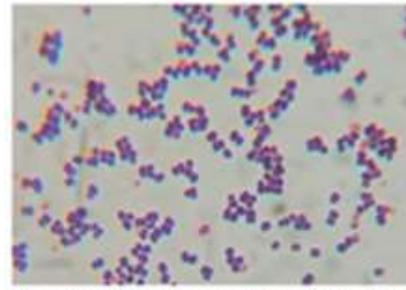
*Lactobacillus buchnerii* (I0302)



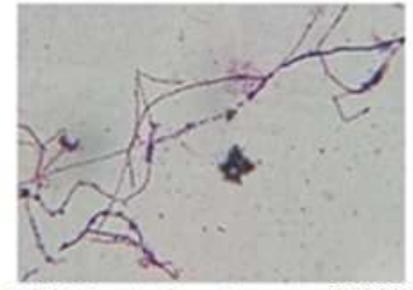
*Lactobacillus acidophilus* (I1902)



*Lactobacillus brevis* (I2401)



*Aerococcus sanguinicola* (I5202)



*Bifidobacterium longum* (I5902)



Babies fed mother's faecal matter (a small amount mixed with breast altered gut bacteria in babies by C-section) – Clare Wilson (New Scientist International-2020)



www.shrideviuniversity.ac.in

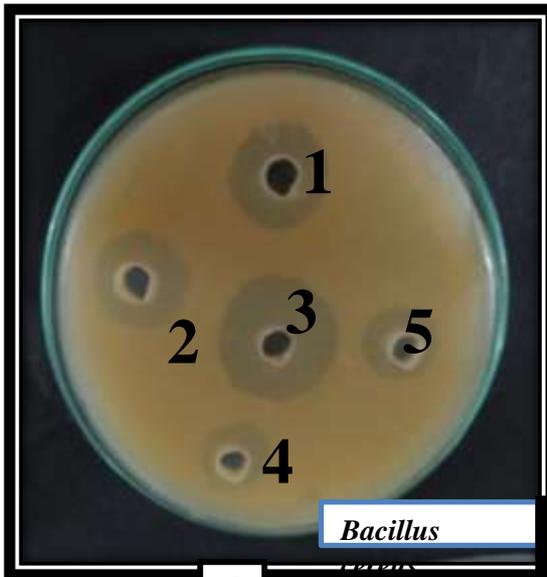
# Antagonistic Activity against Pathogens



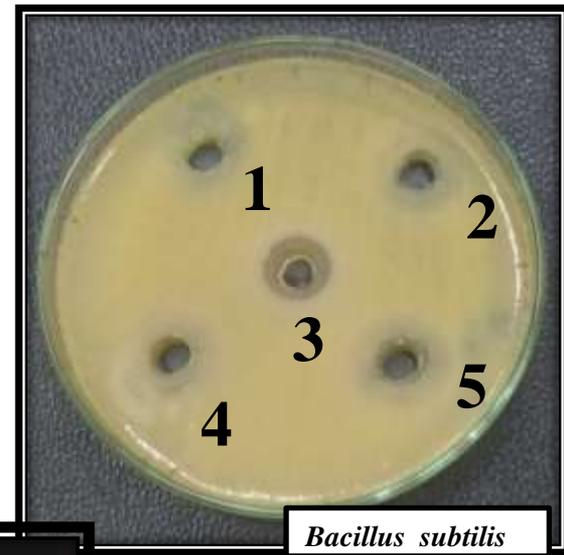
- ❖ **Six best isolates were screened on the basis of their resistance against antibiotics and their anti-microbial activity against pathogens was tested.**

Isolate no.	Name of Test Pathogen					
	<i>S. aureus</i> ATCC25923	<i>P.vulgaris</i> ATCC33420	<i>E.coli</i> ATCC25922	<i>K.pneumonia</i> MTCC3384	<i>S.typhi</i> MTCC733	<i>Paeruginosa</i> ATCC27853
I4601	24mm	8mm	12mm	09mm	16mm	13mm
I0502	21mm	7mm	14mm	06mm	18mm	18mm
I5201	21mm	8mm	10mm	04mm	14mm	16mm
I5601	23mm	6mm	06mm	07mm	10mm	10mm
I0601	20mm	7mm	09mm	06mm	06mm	09mm
I5502	18mm	5mm	07mm	05mm	06mm	08mm





**A**

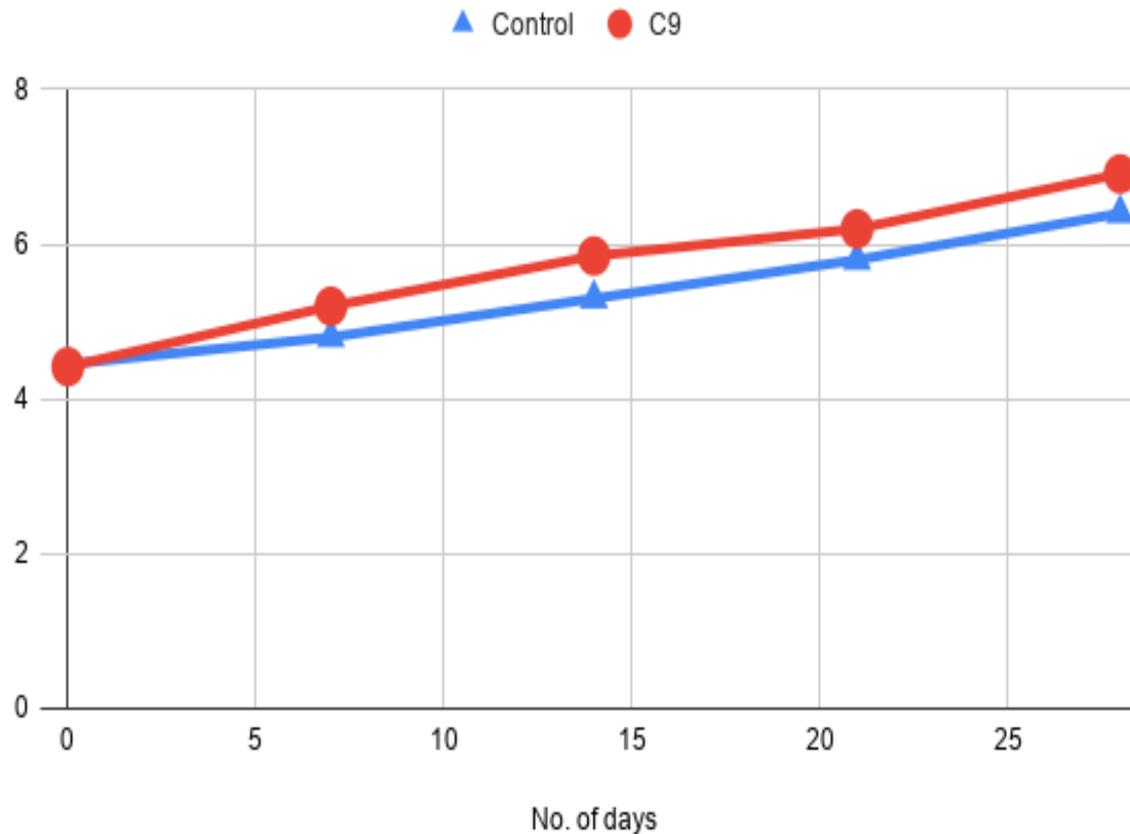


**B**



**C**

**Antagonistic activity of five isolates (A) against *Bacillus cereus* (B) against *Bacillus subtilis* (C) against *Pseudomonas aeruginosa* (where 1= G4, 2= C28, 3= C9, 4= Cu20, 5= P37) represent different isolates.**



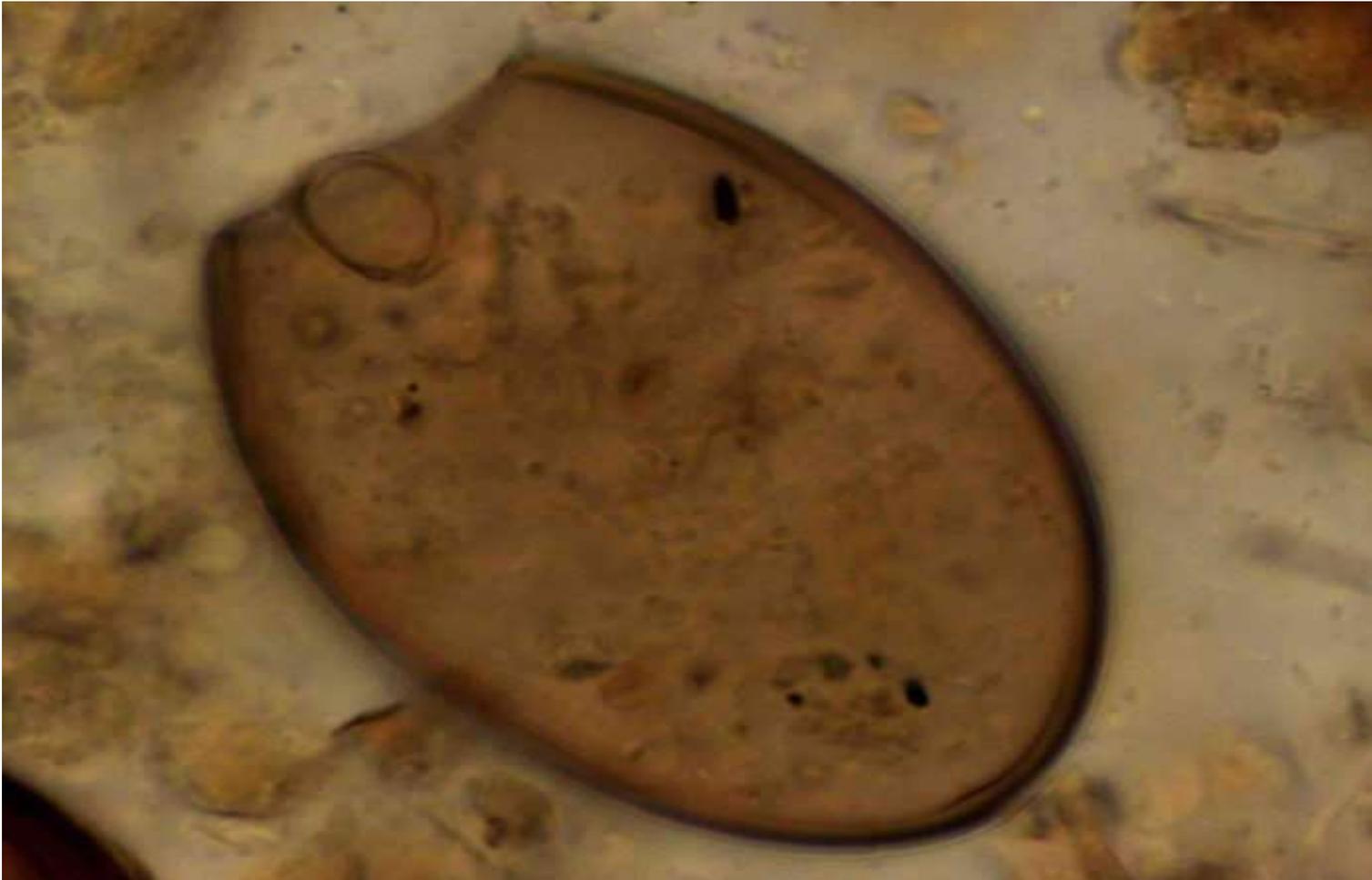
**Mean length (cm) of fingerlings of Rohu fish (*Labeo rohita*) in a 28 days experiment recorded on weekly interval after feeding with diet containing (1% w/w) probiotic culture of *Lactobacillus fermentum* C9 and control ( diet lacking the test probiotic cultures)**



***Butyrate Producing Faecalibacterium and Coprococcus are always associated with good life living people while these are absent in depressed patients along with Dialister (Nature Microbiology 4:2019)***

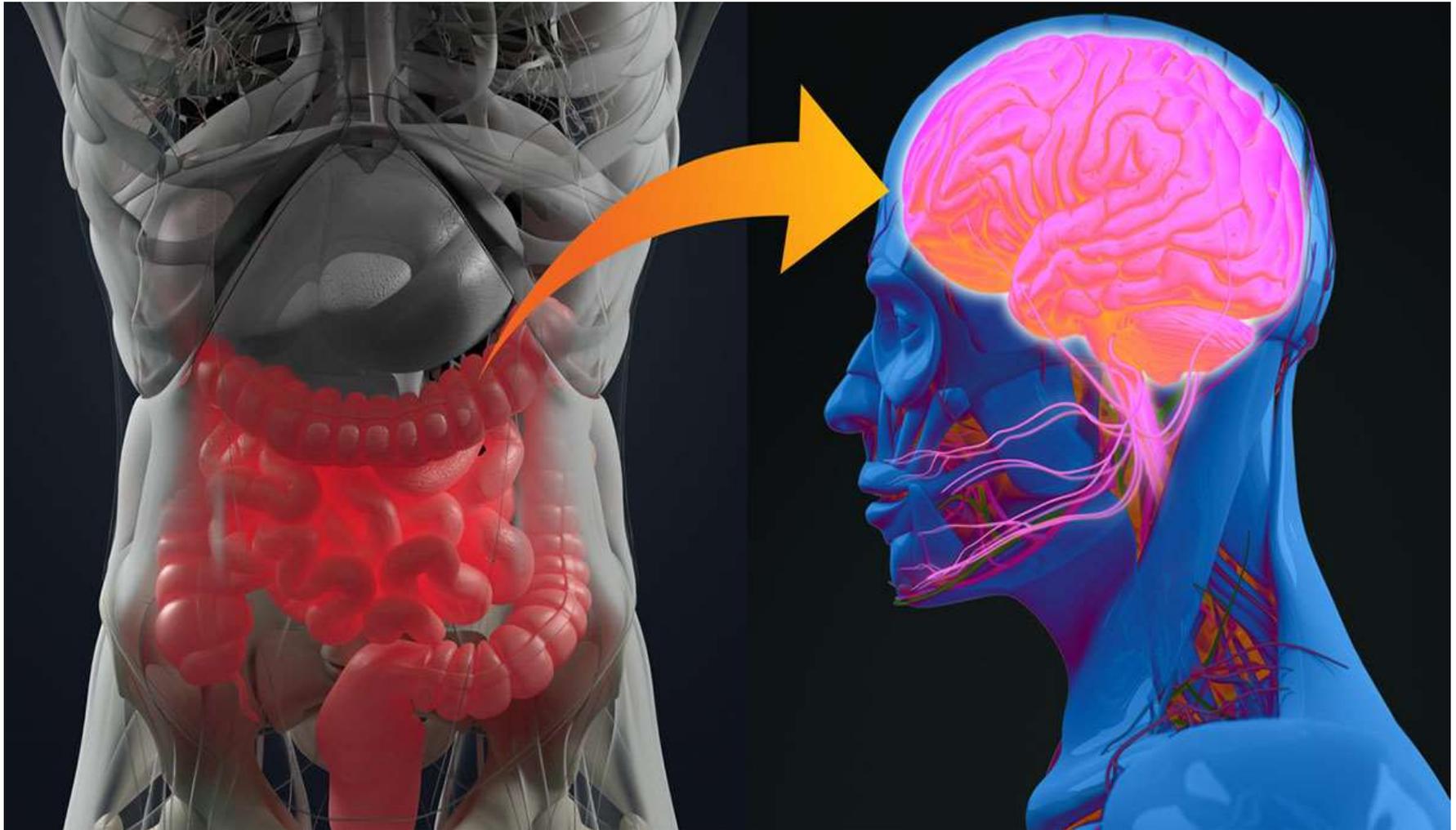


An analysis of fecal metagenome data also showed that better mental health was associated with the gut microbiome's ability to produce a metabolite of the human neurotransmitter dopamine called DOPAC.



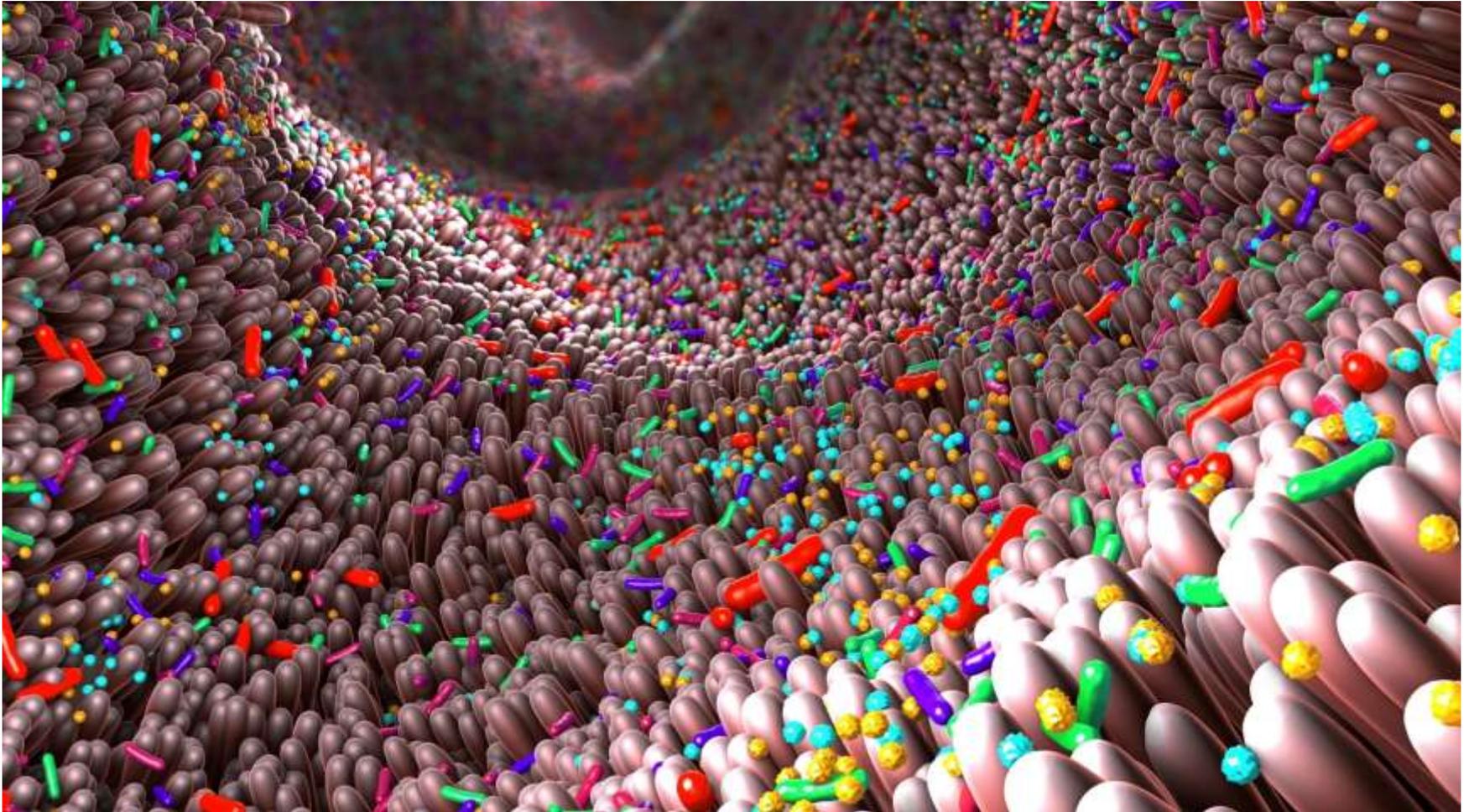
Fish tapeworm Egg from the medieval latrine at Riga (Ivy Yeh)  
(<https://www.genengnews.com/wp> October 6, 2020)

# ***Gut Permeability and Depression***



- Leaky gut leads to inflammation that results in depression.
- 70% of our immune system lies in gut,
- Gastrointestinal epithelium prevents free movement of toxicants, microbes, antigens

Obstructive Sleep Apnea (OSA) related sleep disturbance affect gut microbiome in mice



<https://www.genengnews.com/wp-content/uploads/2020/09/GeettyImages-1205739105.jpg>

Credit:CHRISTOPH BURGSTEDT/SCIENCE PHOTO LIBRARY

# ***Metagenomic datasets used for comparative analysis (meta-analysis) of the microbiome and a metagenome-wide association study***

<b>Dataset</b>	<b>No. of samples</b>	<b>Sequence data (GB)</b>	<b>No. of genes</b>
INDIA	110	110	4,809,378
USA	74	441	6,521,885
DENMARK	85	103.87	7,141,214
CHINA	71	180.78	5,464,702

# ***Why should You Know Your Gut Microbiome?***



## ***BECAUSE-***

- ***Gut microbiota dysbiosis leads to gastrointestinal disorders, obesity, cardiovascular diseases, allergy and central nervous system related diseases***
- ***Constipation, diarrhea, & irritable bowel syndrome***
- ***Gas/bloating/cramps/abdominal pains***
- ***Trouble in digesting foods***
- ***Chronic fungal infections***
- ***Fatigue***

# **ROLE OF GUT MICROBIOME**



- **Normal development**
- **May benefit heart health**
- **Controls blood sugar and lower risk of diabetes**
- **Bio-synthesize and excrete of Vitamins B, K and B12**
- **Bifidobacterium, Faecalibacterium, Coprococcus, Dialister are butyrate producing bacteria and affect brain health and can improve symptoms of depression**
- **Synthesis of dopamine and 3,4-dihydroxyphenylacetic acid by gut bacteria**
- **Prevent colonization by pathogens by competing for attachment sites or for essential nutrients**
- **May antagonize other bacteria by the production of substances which inhibit or kill non-indigenous species (nonspecific fatty acids, peroxides, bacteriocins).**
- **Stimulate the development of certain tissues i.e. intestines, certain lymphatic tissues, capillary density**
- **Stimulate the production of cross-reactive antibodies and prevent infections or invasions.**
- **Provide Immunity**

# **Benefits of LAB on Human Health**



- ❖ **Prevent heart diseases and lower blood pressure.**
- ❖ **Prevent risk of Colon Cancer.**
- ❖ **Reduction of Helicobacter pylori infection.**
- ❖ **Reduction of allergic symptoms.**
- ❖ **Managing Lactose Intolerance.**
- ❖ **Control and boosting of Immune System by communicating with immune cells, the gut microbiome can control how your body responds to infection \_**
- ❖ **Reduction of Inflammation.**
- ❖ **Reducing of Cholesterol.**
- ❖ **Prevention of urogenital infections.**
- ❖ **Antimicrobial effects on pathogenic microorganisms.**
- ❖ **Prevention of osteoporosis.**
- ❖ **Beneficial Effects on mineral metabolism.**
- **Digesting breast milk :Bifidobacteria – digest healthy sugars**
- **Digesting fiber – produce short chain fatty acids that are important for gut health, prevent weight gain, diabetes,**
- **Help in control of brain health: gut microbiome affect the central nervous system, which controls brain function**

# Foods, Good Fats, and Therapeutic Foods that stimulate Gut Microbiome



1. Foods with long ingredients,
2. Whole, simple foods
3. Fresh fruits and vegetables, including root vegetables.
4. Pastured meats, wild fish, eggs, nuts, and seeds.
5. Traditional fats like olive oil, coconut oil, or grass-fed ghee
6. Avoid gluten-containing grains.
7. Quinoa, buckwheat, white rice, and white potatoes may ultimately be fine

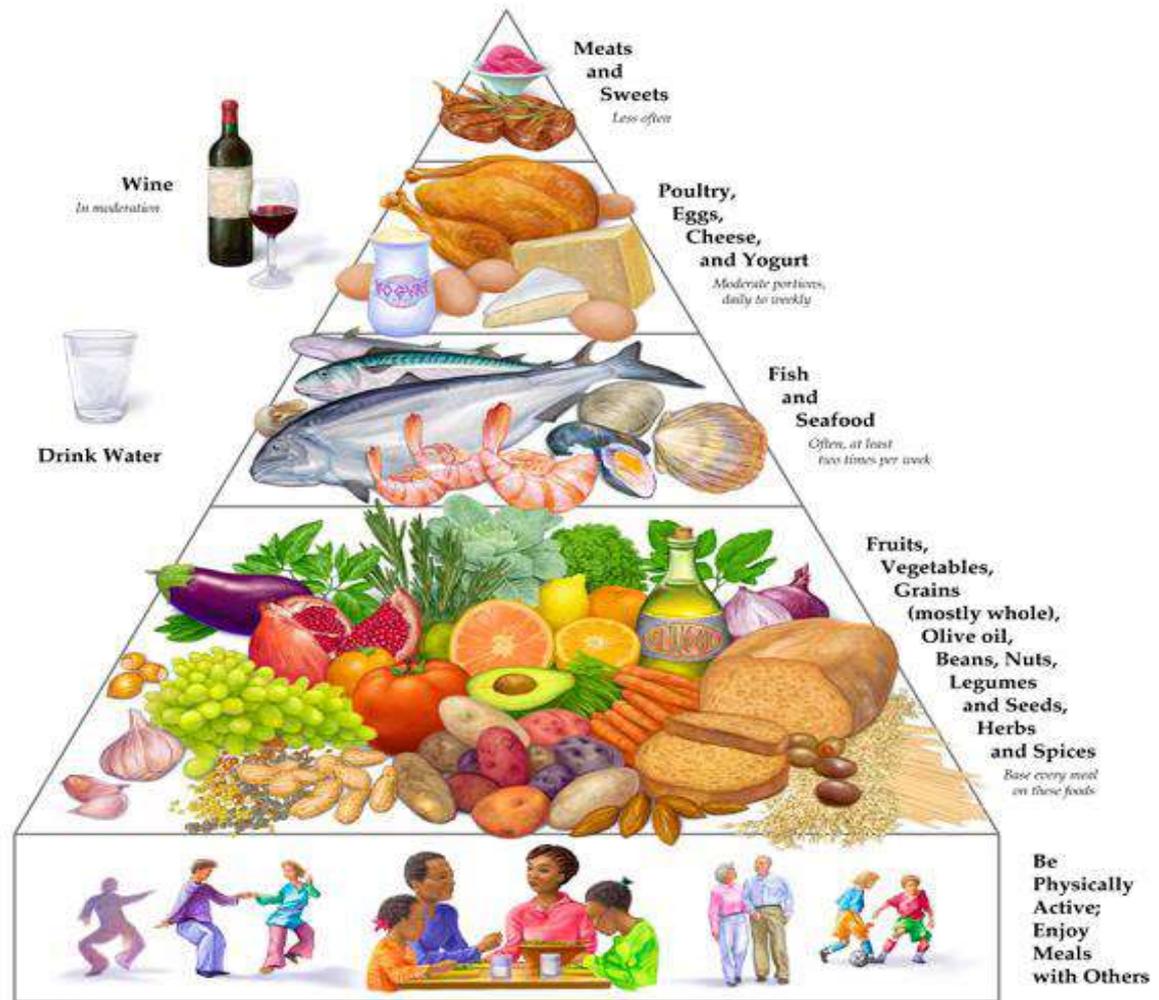


Illustration by George Middleton

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# **Fermented Foods can Restore and Balance Your Gut Flora - PREBIOTICS AND PROBIOTICS ARE ESSENTIAL TO GUT HEALTH.**



- 1. Prebiotics are food for probiotics.**
- 2. Probiotics are the good, beneficial live bacteria that help to keep the ecology of your gut in balance.**
- 3. Probiotics can actually reverse psychiatric symptoms.**
- 4. Fermented foods are simply probiotic foods.**
- 5. Most people enjoy fermented food supplements from health food stores**
- 6. Healthy bacteria through wholly natural sources, such as: Sauerkraut, Pickles, Kimchi and other fermented vegetables, Coconut kefir.**
- 7. Fermented foods are delicious and flavorful. They are relatively easy to make on your own, too.**





## **Research questions to be answered**

- **How stable and resilient is an individual's microbiota throughout one day and during his/her lifespan?**
- **How similar are microbiomes between members of a family, community or across communities in different environments?**
- **Do all humans have an identifiable "core" microbiome and how is it acquired and transmitted?**
- **What affects the genetic diversity of the microbiome and how does this diversity affect adaptation by the microorganism and the host to markedly different lifestyles and to various physiological or pathophysiological states?**
- **What are the qualitative and quantitative differences in gut microbiome of people living under different environments, life style and eating different diets**
- **How best the gut microbes can be cultured, and commercially exploited for treatment of various disorders**



# ***ACKNOWLEDGEMENTS***



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**Ms. Shama Siddique**



Thanks

