

NUTRITION & MICROBIOME



BALAMURUGAN RAMADASS

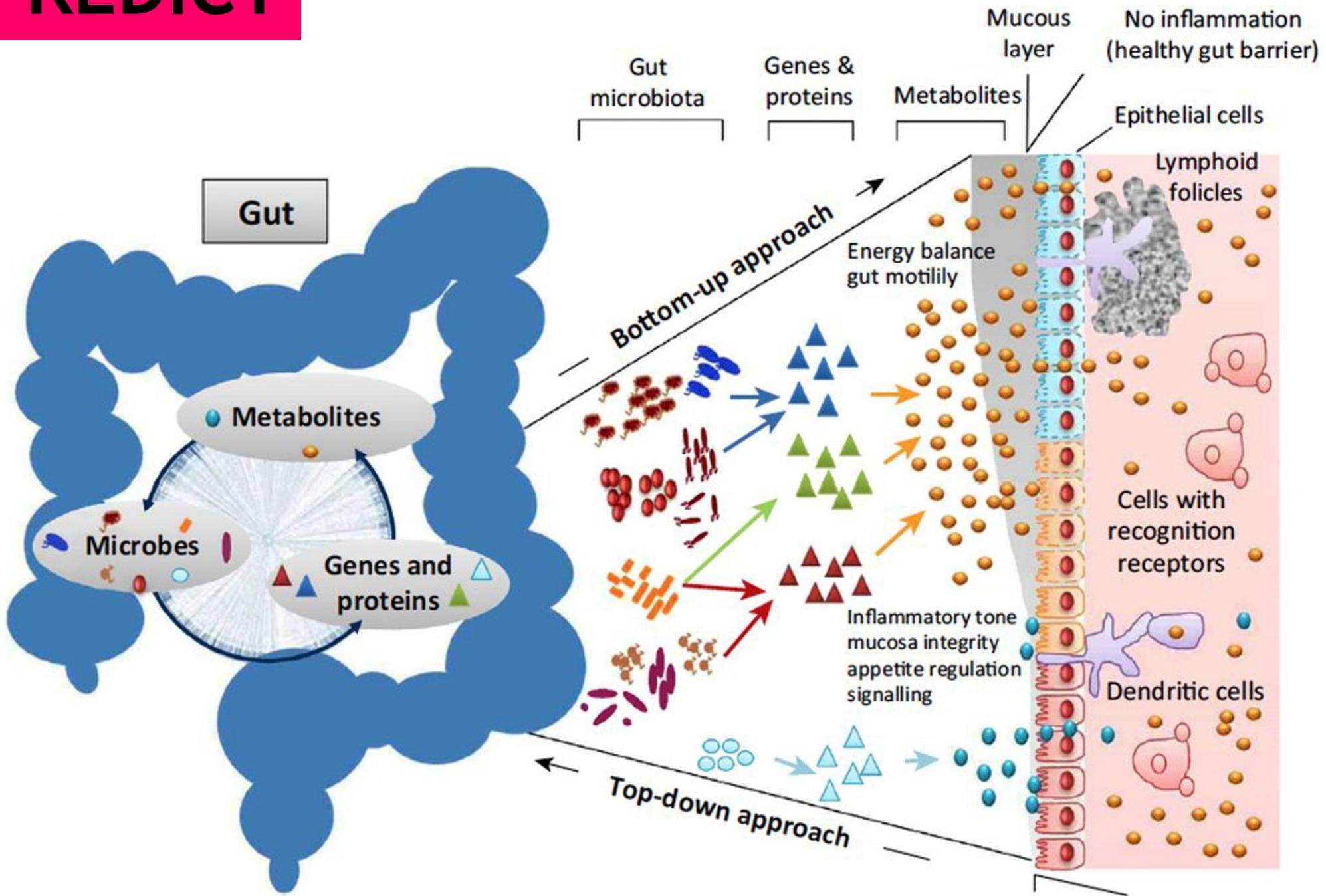
DISORDERS OF 'DYSBIOSIS'

**MICROBIOME IMBALANCE NOT AN
INFECTION**

PREDICT

INTERVENE

PREDICT

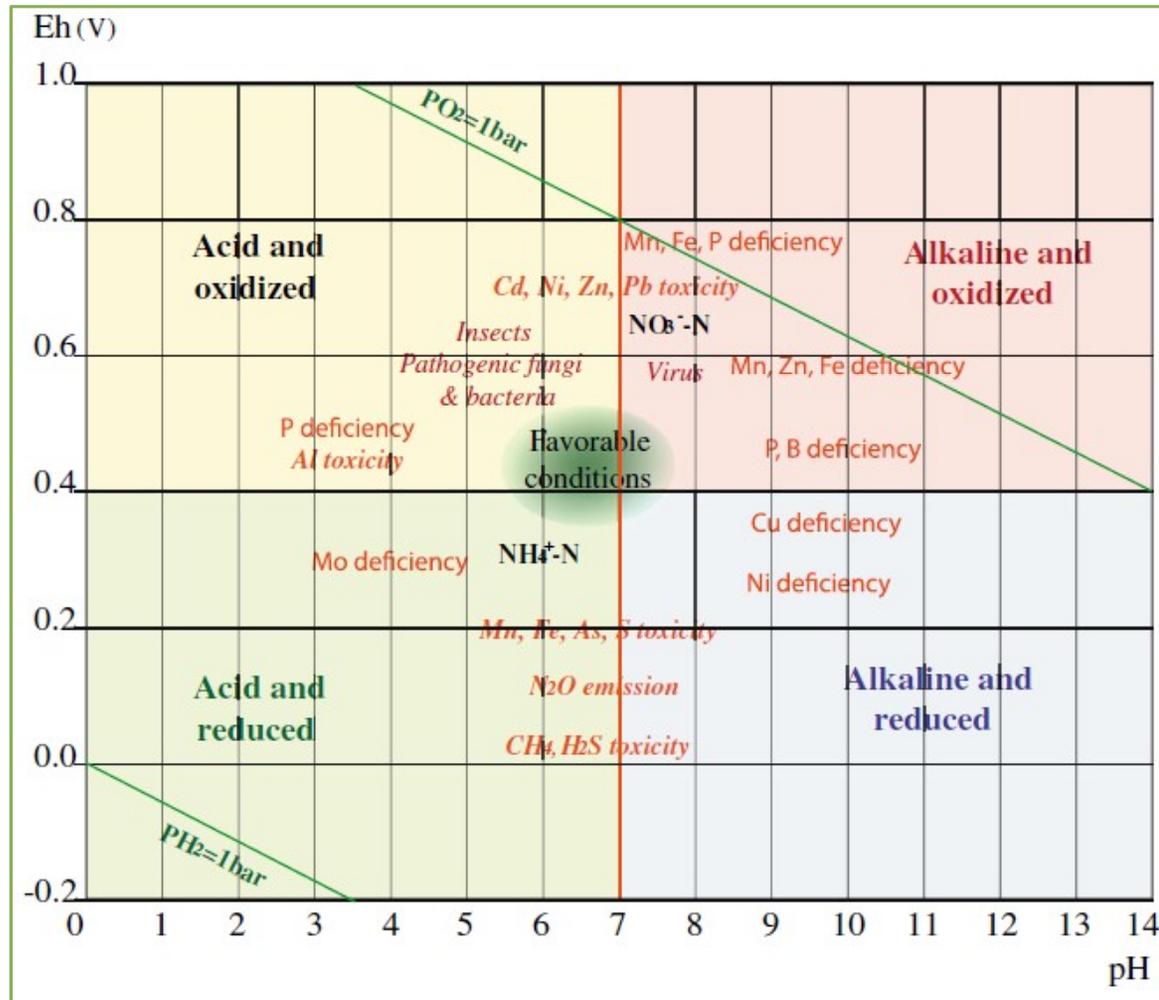


PREDICT

THE POURBAIX PLOT (Eh vs pH)

Evaluating soil health

Managing soil remediation

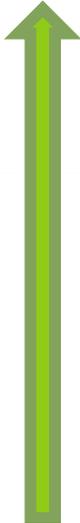


**Solubility,
Availability
Toxicity of
Nutrients**

Linking to plant physiology

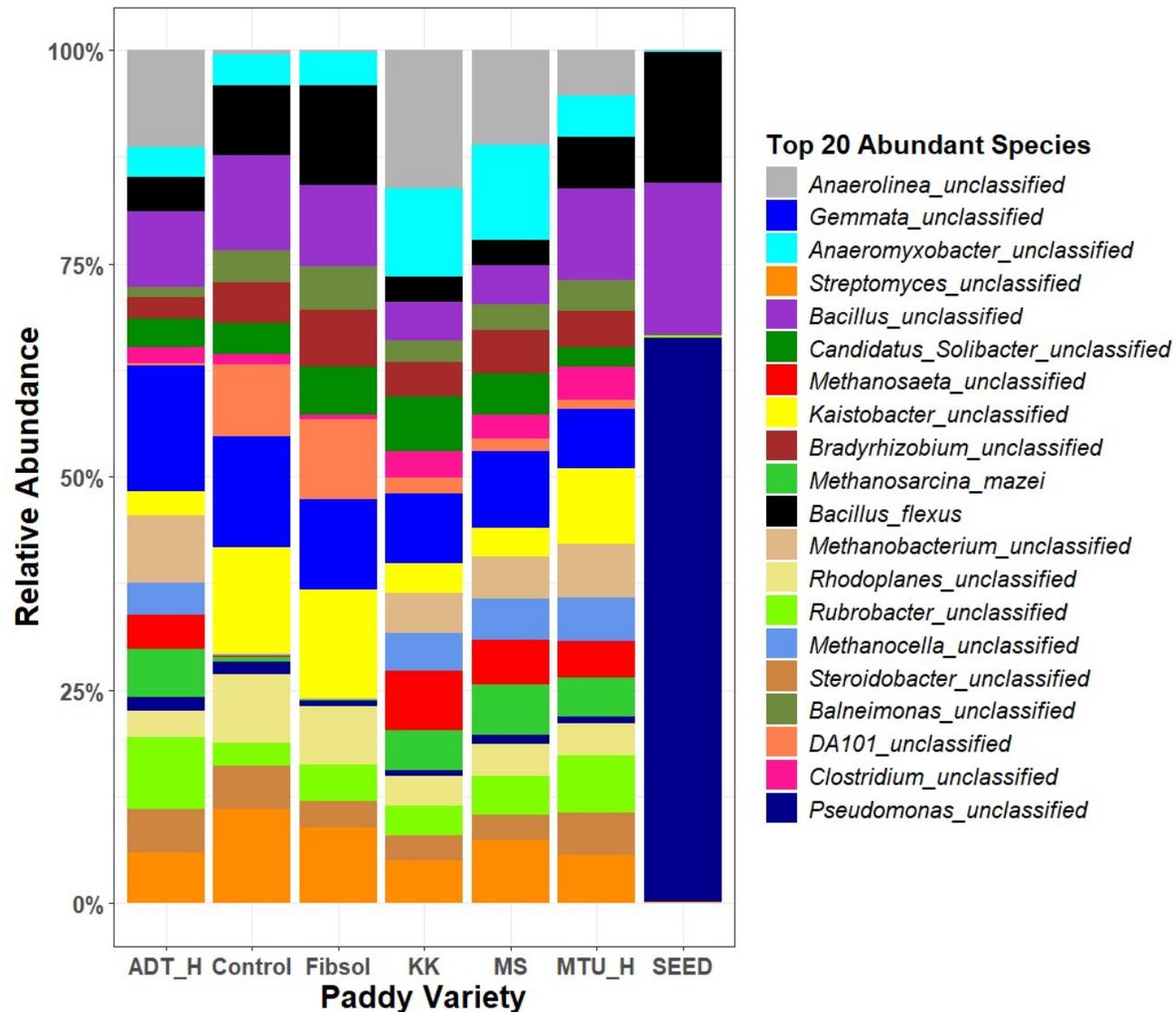
Guiding fertilizer strategies

Redox potential

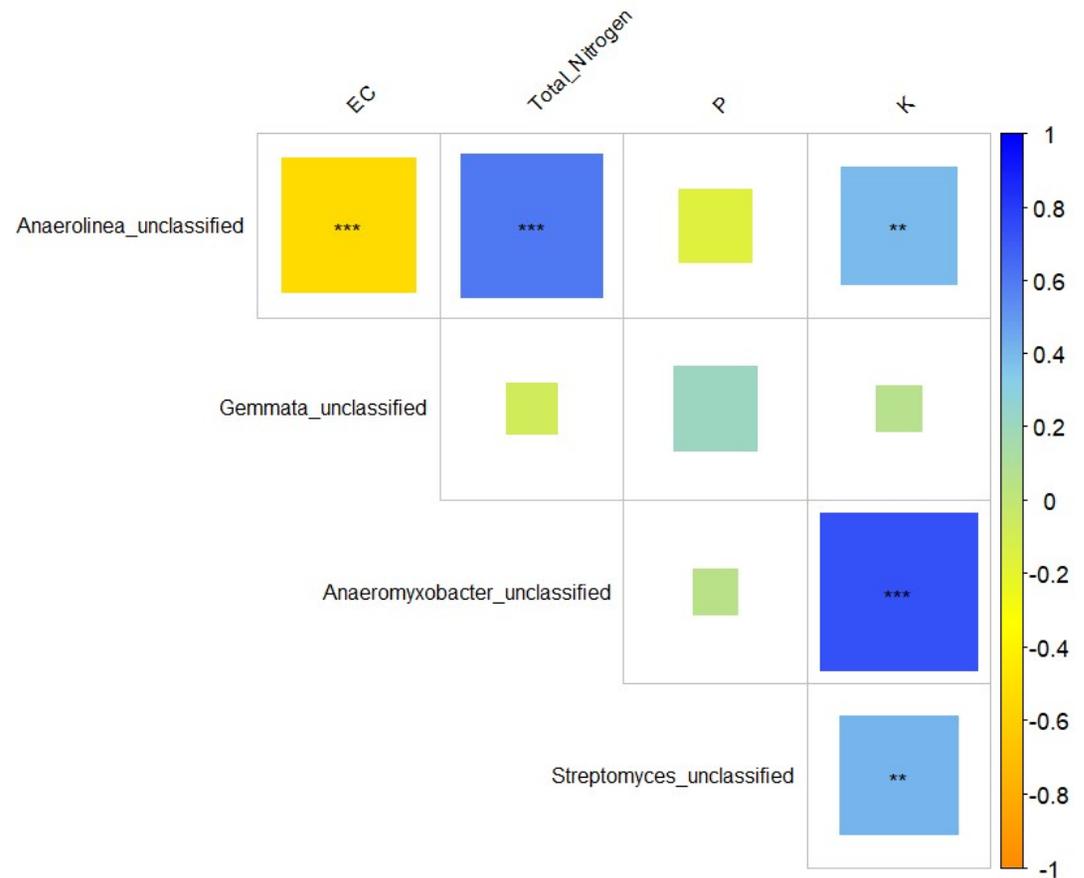
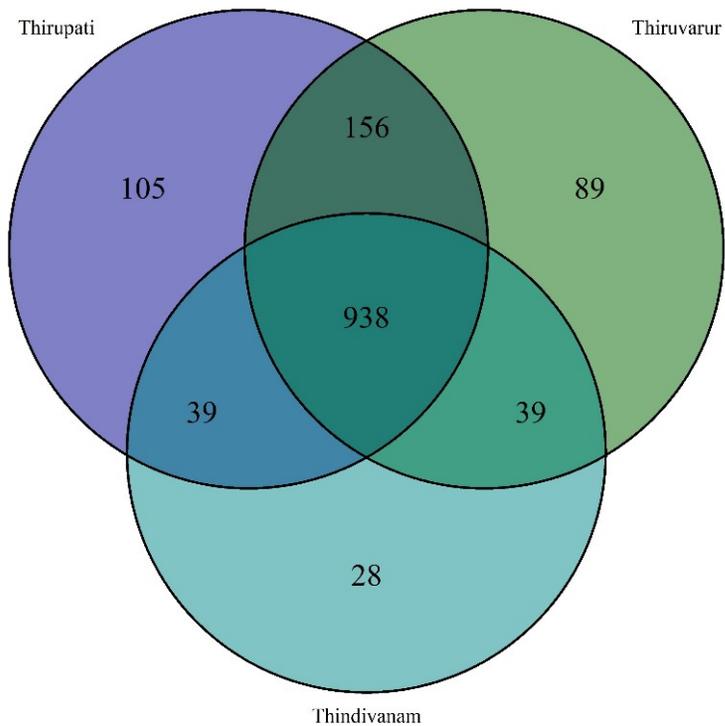


pH

SOIL MICROBIOME COMPOSITION ACCORDING TO PADDY VARIETY & NON PADDY MATERIAL



MICROBIAL ASSOCIATION WITH PHYSIOCHEMICAL PARAMETERS



INTEGRATION WITH PARRY AGRO IRRIGATIONAL PRACTICES

- ◎ FIB-SOL NPK gel @ 250 ml /hectare each
- ◎ FIB-SOL SOIL GEL , BB GEL and META-GEL @62.5 ml/hectare each

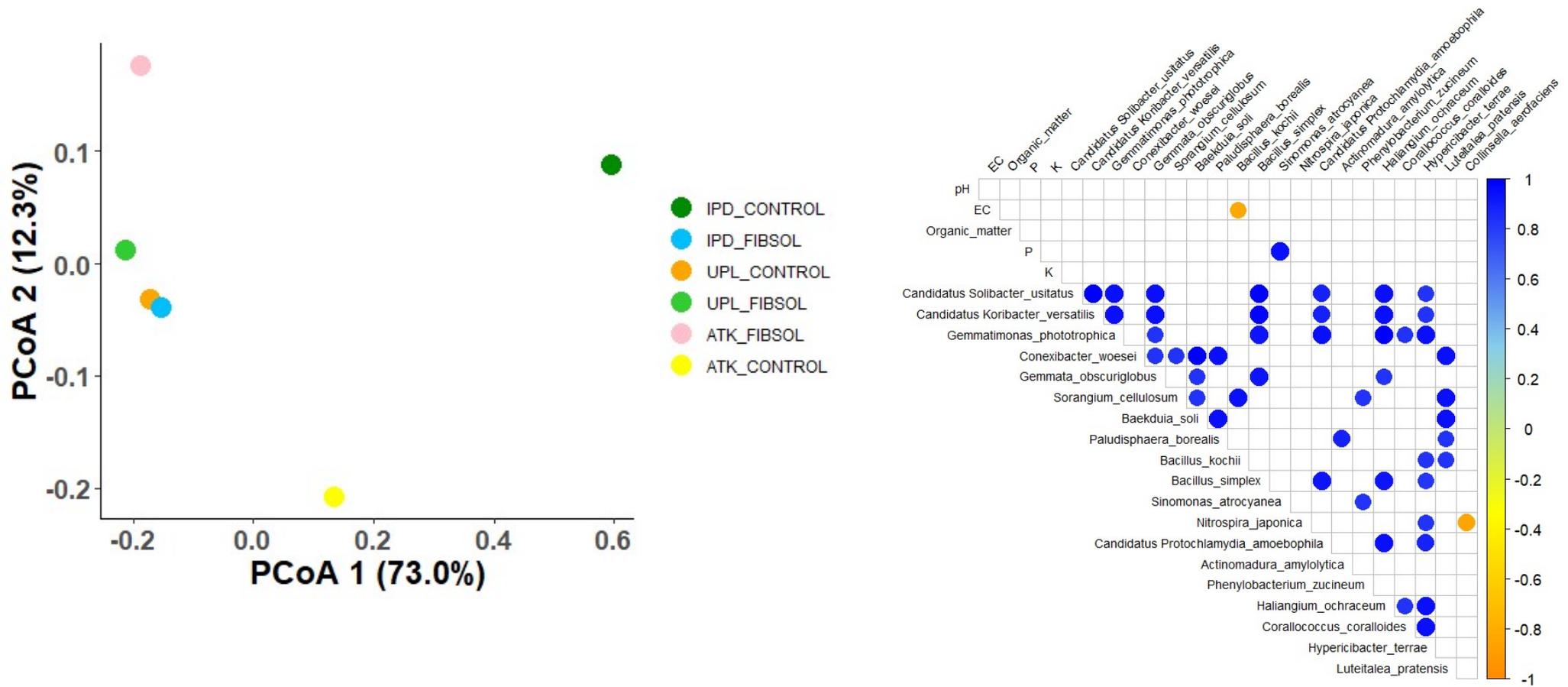


APPLICATION

- ◎ NPK and SOIL gel: **Soil drenching** 450L/hectare (Estate practice volume) using High volume sprayer
- ◎ BB and META: **Foliar** 90Ltrs/hectare. Power sprayer

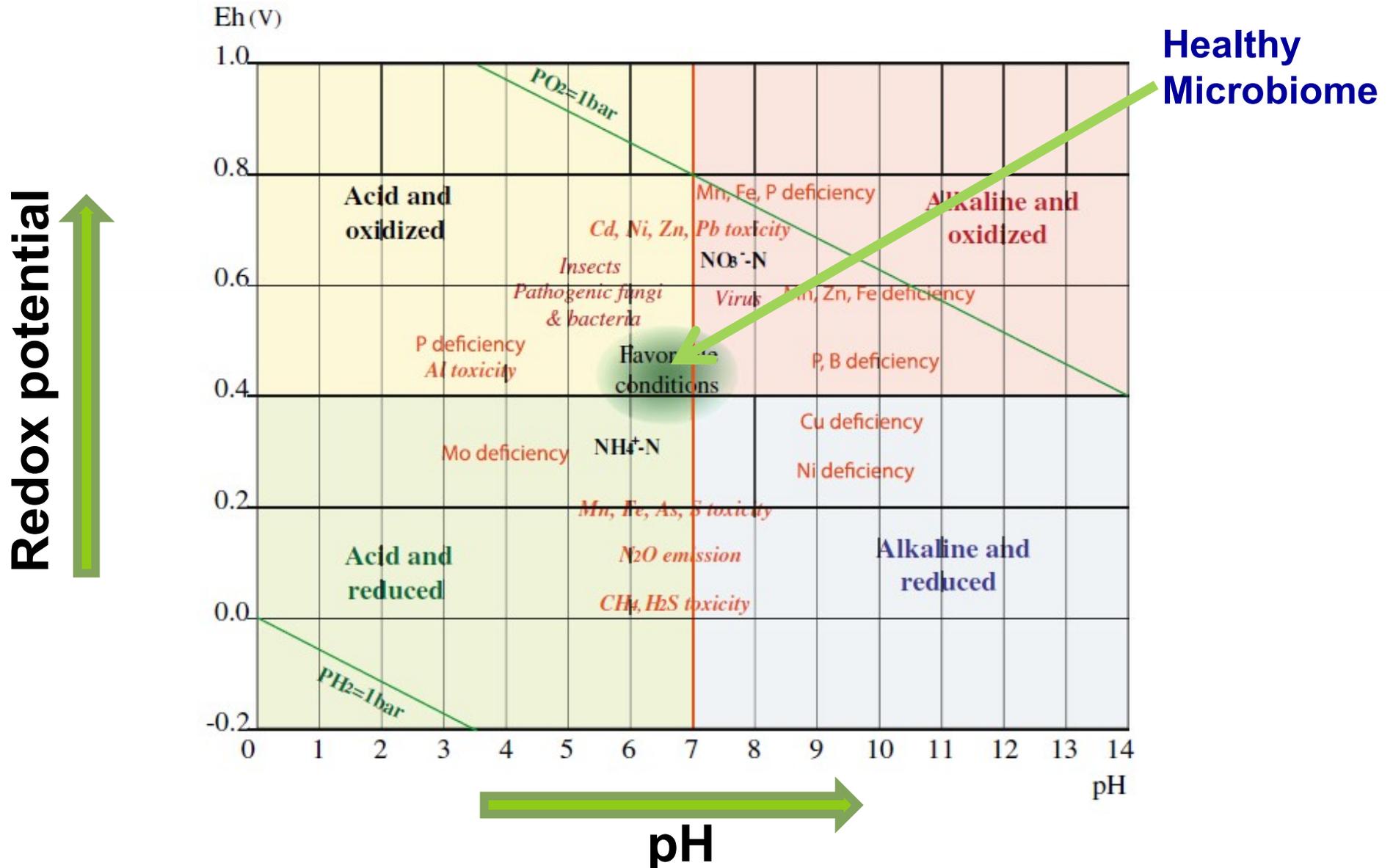


FIB-SOL TREATED CHEMICAL PLOTS SHOWS PATTERN SIMILAR TO ORGANIC PLOTS



FIB-SOL can retrieve natural ecosystem

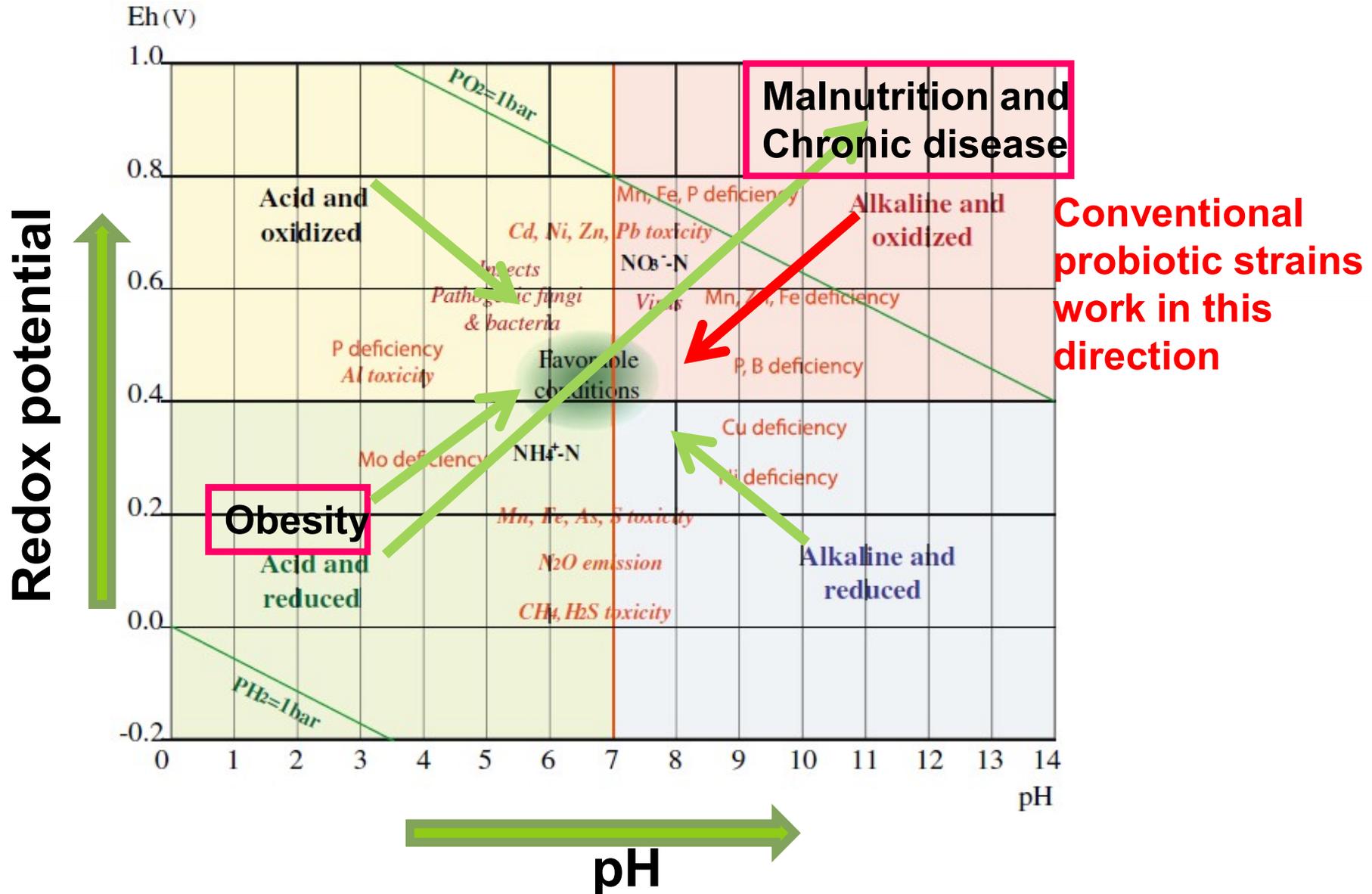
POURBAIX DIAGRAM: EXTENSION!



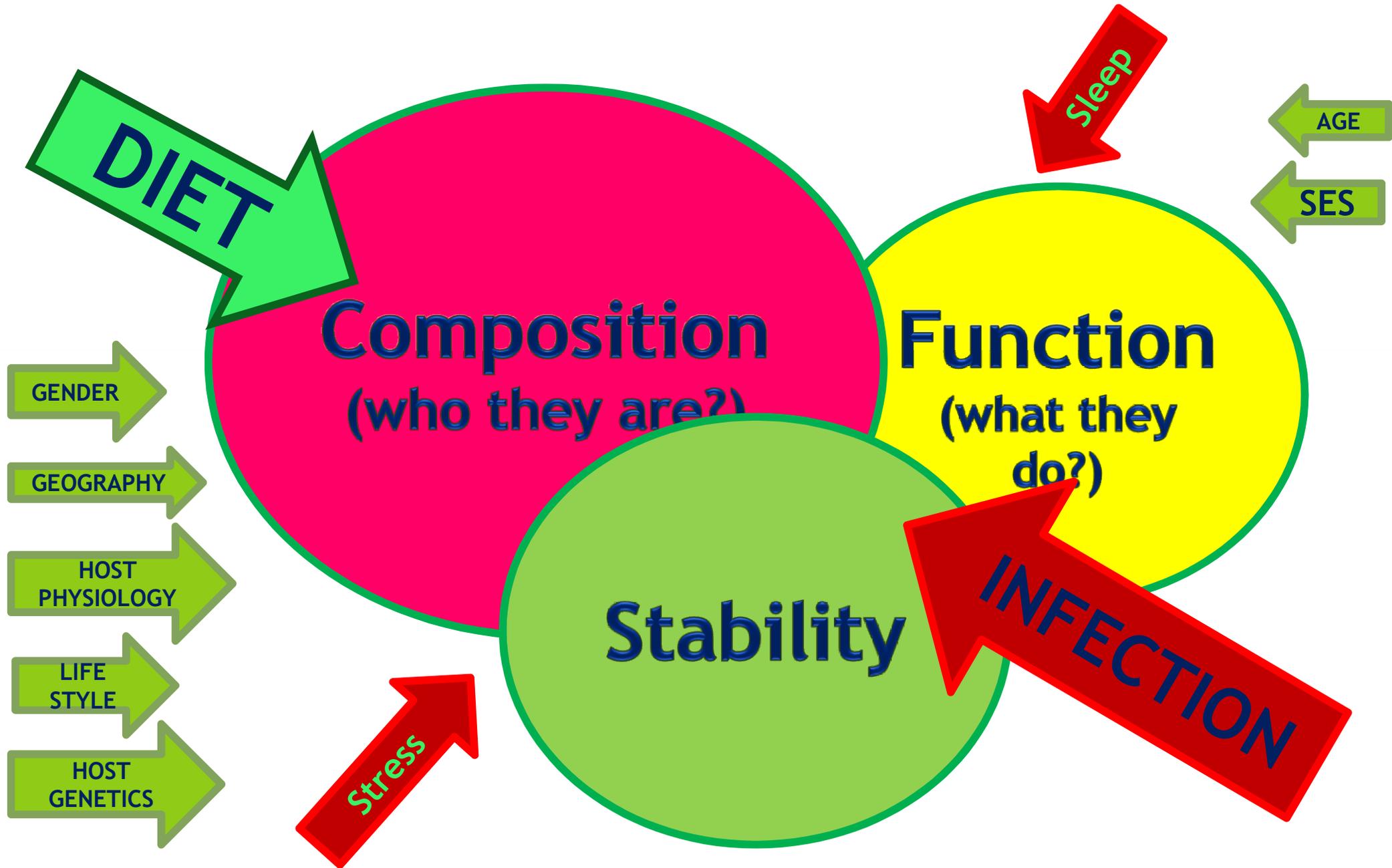
POURBAIX DIAGRAM: EXTENSION!



PERTURBATION USING SPECIFIC PROBIOTIC STRAINS TO FORCE THE SYSTEM INTO EQUILIBRIUM

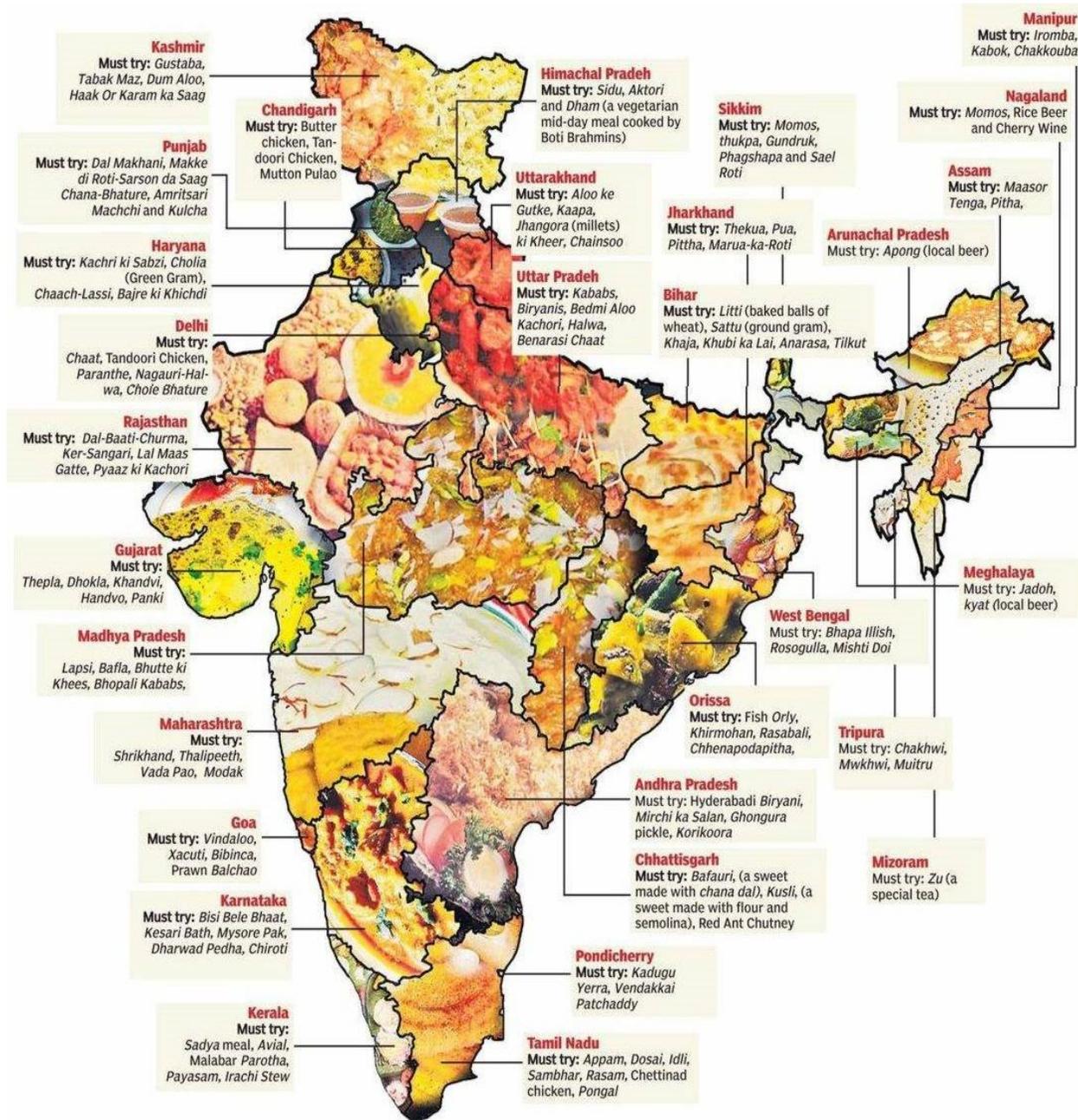


GUT MICROBIOME IN HEALTH



FOOD MAP OF INDIA

Highly Diverse
Dietary Habits!



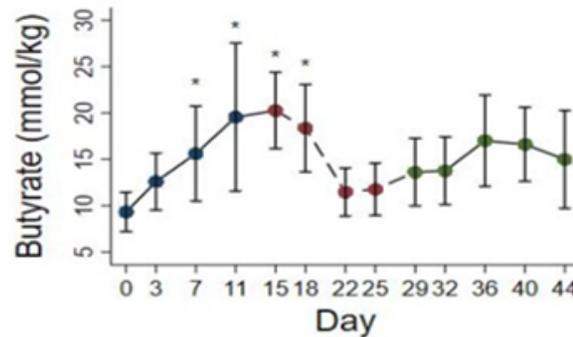
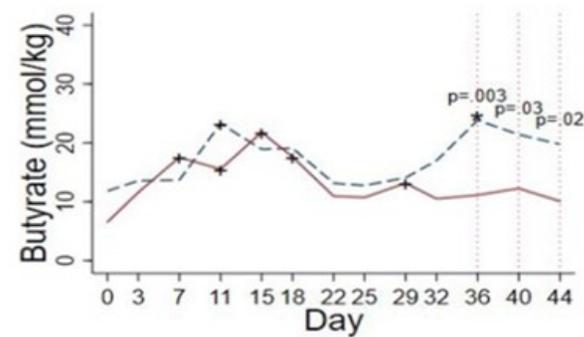
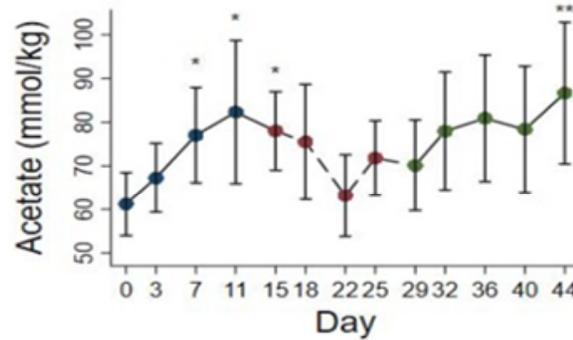
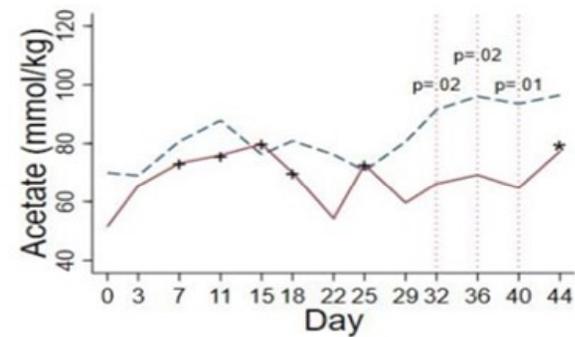
1. Spice
2. Fermented foods
3. High fiber diet



Article

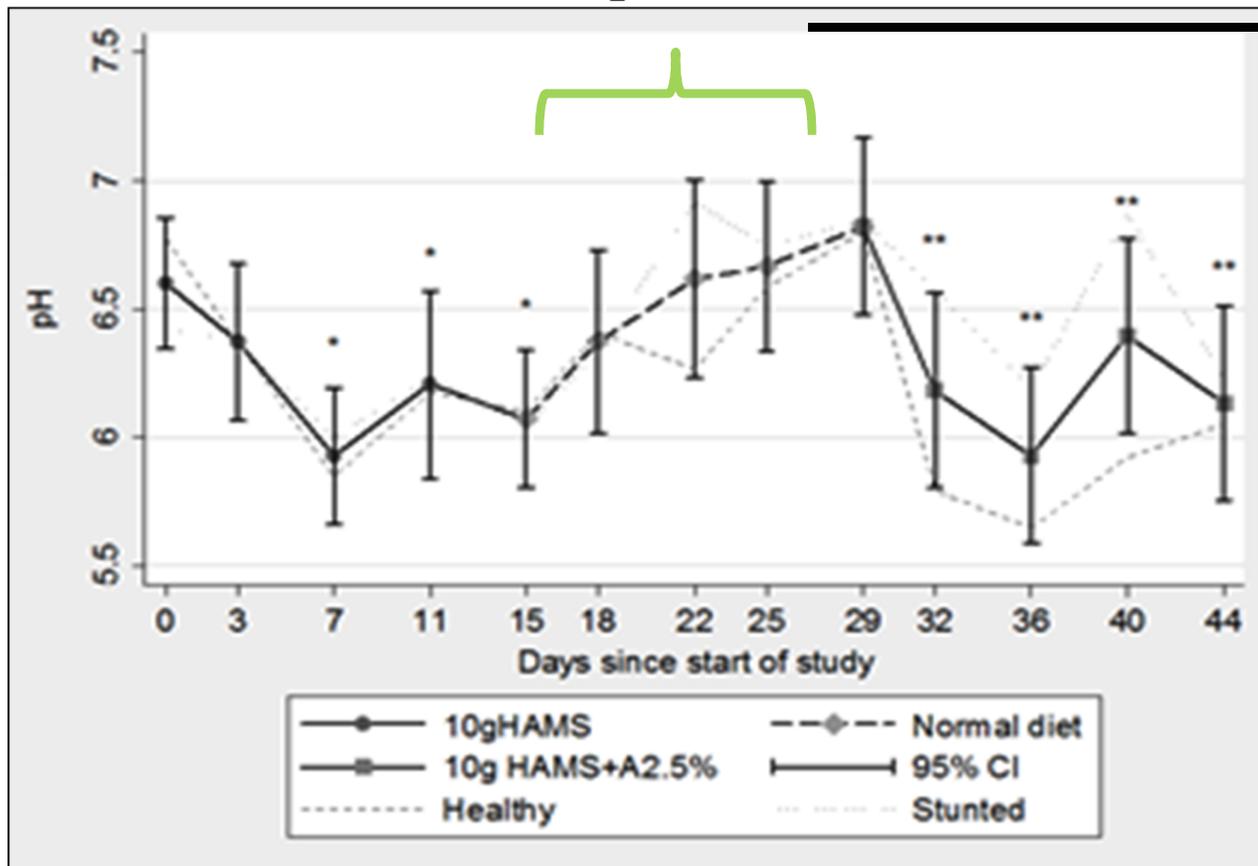
Effect of Native and Acetylated Dietary Resistant Starches on Intestinal Fermentative Capacity of Normal and Stunted Children in Southern India

Ramadass Balamurugan ^{1,†} , Srinivasan Pugazhendhi ¹, Gowri M. Balachander ^{1,†},
Tamilselvan Dharmalingam ¹, Elissa K Mortimer ² , Geetha L. Gopalsamy ²,
Richard J. Woodman ² , Rosie Meng ², David H. Alpers ³, Mark Manary ³, Henry J. Binder ⁴,
Ian L. Brown ⁵, Graeme P. Young ² and Balakrishnan S. Ramakrishna ^{6,*}



PREBIOTIC ON FECAL pH: OUR STUDY

Effect of HAMS and HAMS+A2.5% on Fecal pH



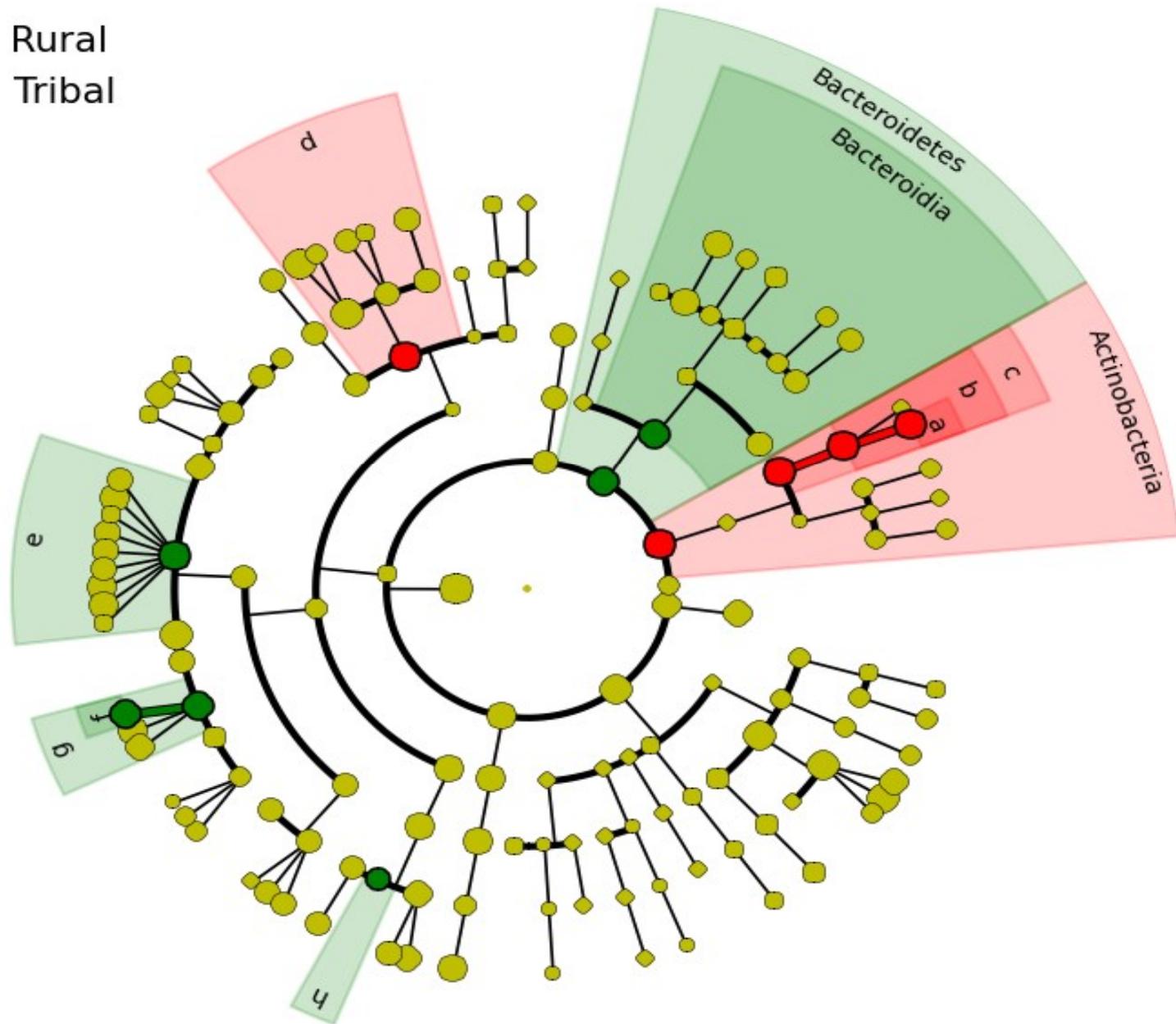
Withholding prebiotic days 15-28):
pH reverts back to high values.

LOW FECAL pH:
an indicator of healthy colonic microbiome

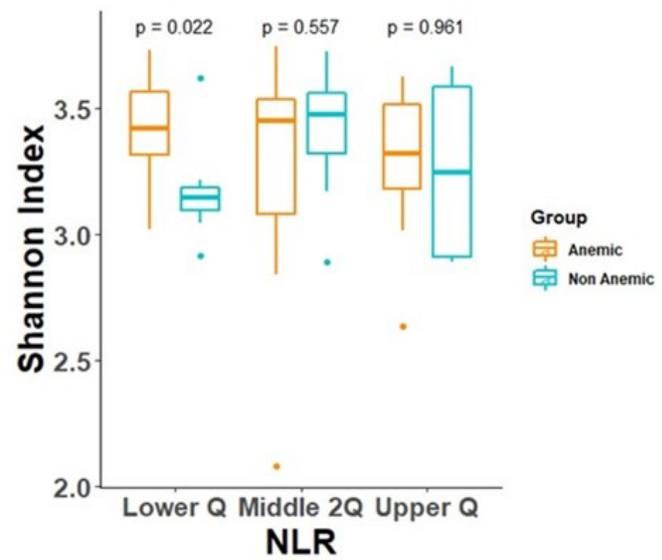
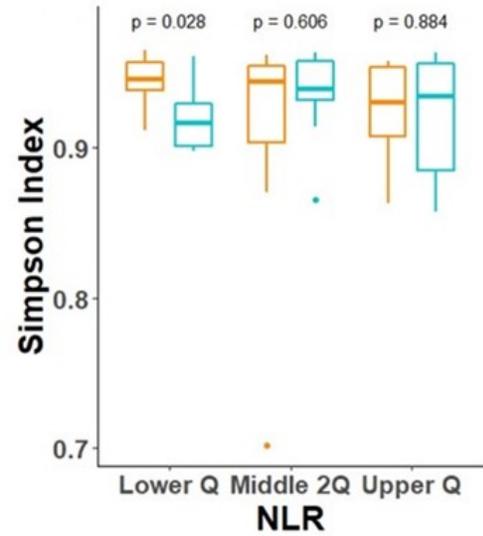
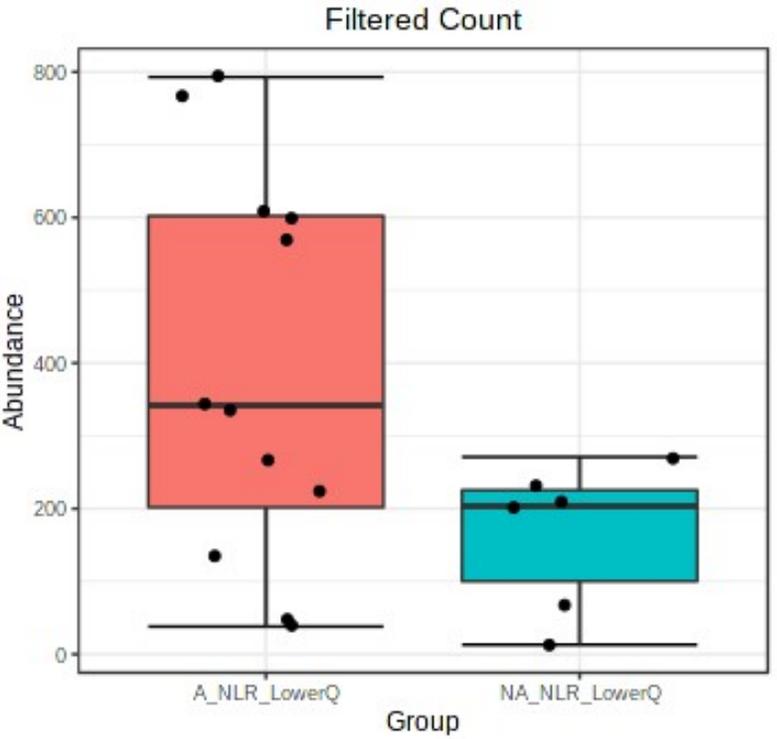
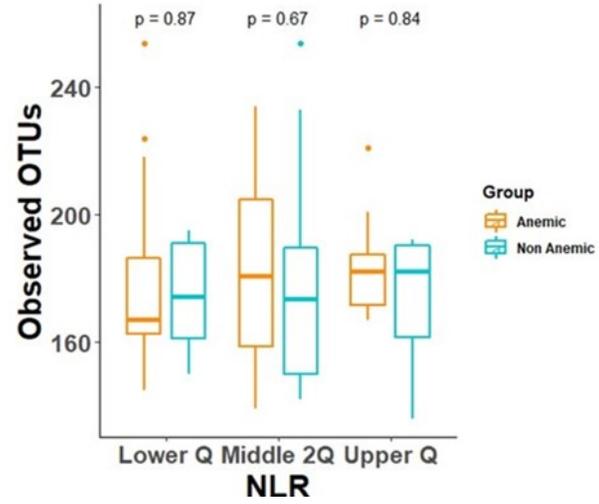
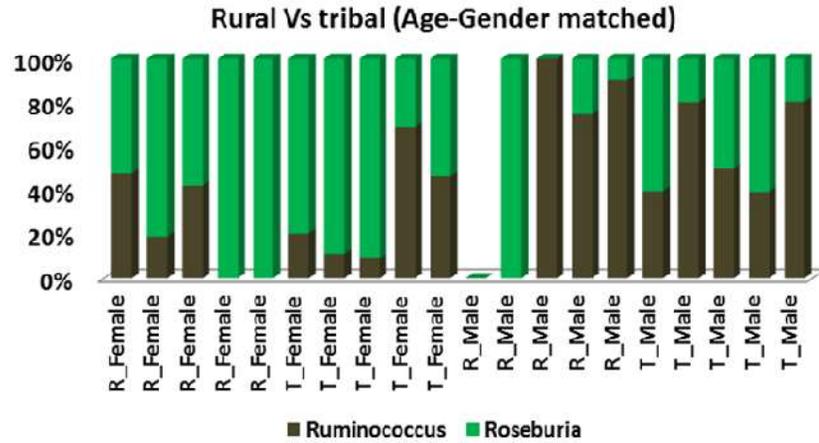
* Significantly lower versus day0:p<0.05,** Significantly lower versus day 29:p<0.05

LONG TERM DIET IN ADULTS

■ Rural
■ Tribal

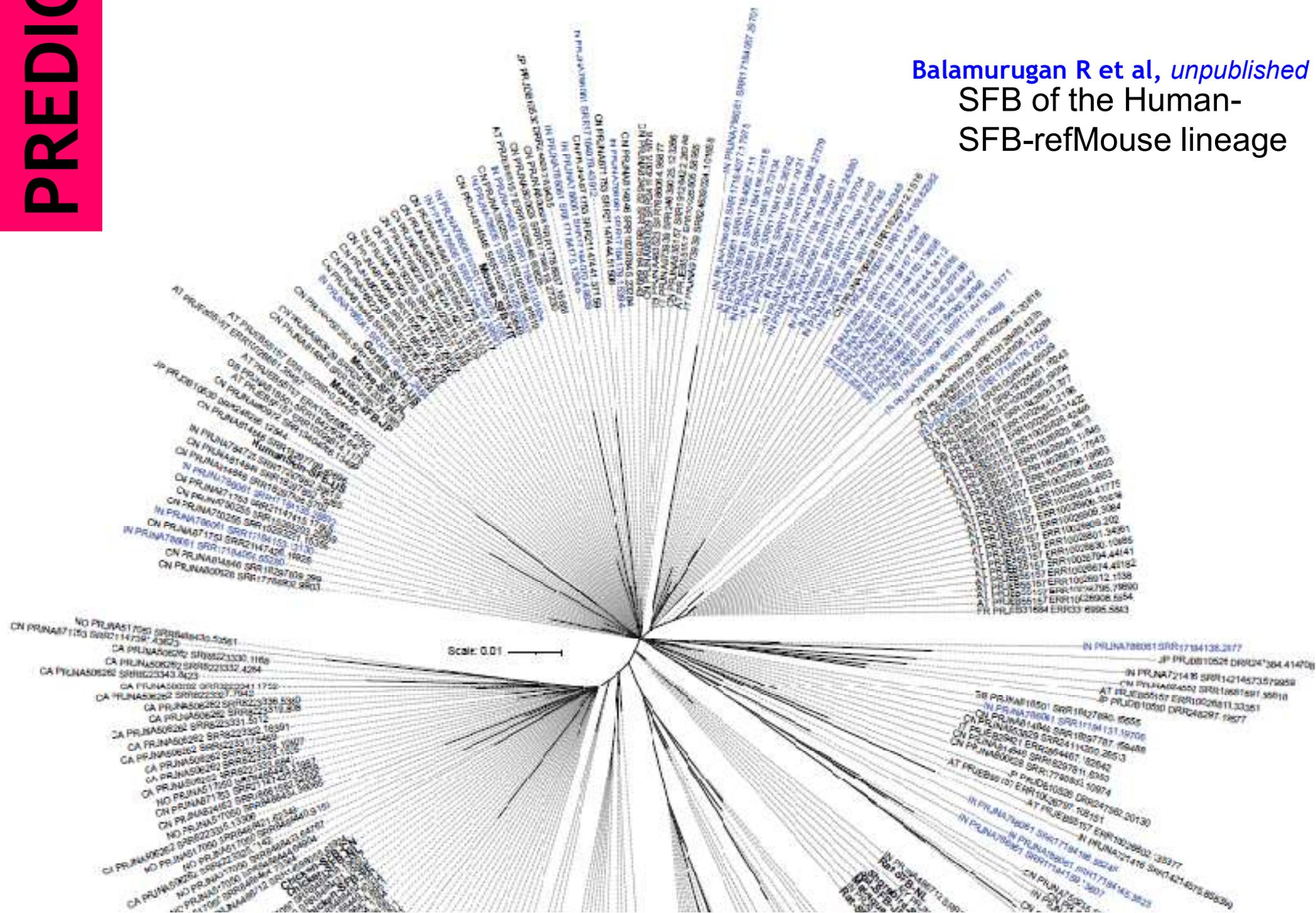


ROSEBURIA FAECIS AND NLR PREDICTIVE OF ANEMIA AMONG LMICs.

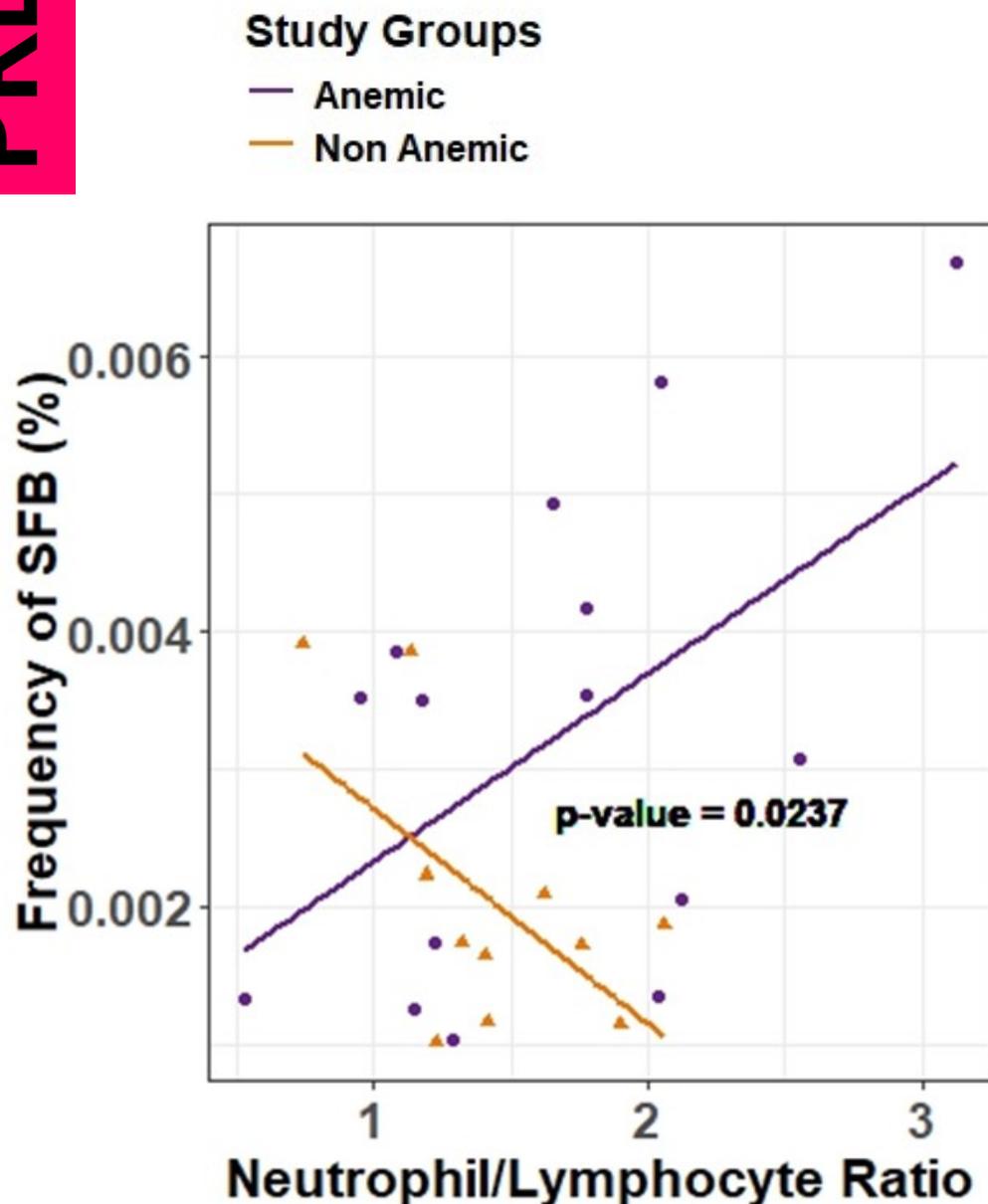


SFB IN ANEMIC AMONG LMIC

Balamurugan R et al, *unpublished*
SFB of the Human-
SFB-refMouse lineage



SFB IN ANEMIC AMONG LMIC



- NLR is not different: Anemic and non-anemic.
- Correlate anemia with a higher SFB frequency.
- Trend of increased SFB frequencies with increased systemic inflammation in the context of anemia.
- SFB closely interacts with the host.

LOSS OF REGULATORY ROLE OF THE ENTEROCYTE IRON TRAP: THE "TRIPLE-PATHWAY" PARADOX

The Standard View (The "Outside" Problem)
For decades, Iron Deficiency Anemia (IDA) was treated as just an "empty tank."

Your labs show severe iron deficiency. Just take more iron! Your blood levels are low.

But I've been taking it for 6 months... why am I still exhausted? Nothing's working!

Zooming into the Duodenum (Microbiota & Redox Shift)
In health, an **Obligate Anaerobic Brake** maintains a **Balanced Redox** environment. In IDA, this **Ecological Control** is lost ($p=0.009$), creating an **Oxidizing Niche**.

HEALTHY
Obligate Anaerobic Brake (Groups Va/Vb)
Microbial Redox Index
We restrict diversity and maintain stability!
Anaerobes > Pathobionts. Healthy Barrier.

IDA
Oxygen-Tolerant "Bully" Bacteria
MRI
The brake failed! Oxygen is here! Take over the niche!
Pathobionts > Anaerobes. Leaky Barrier.

The Starving Enterocyte ("Apical Desperation")
The cell is starving. It desperately upregulates **both** apical and basolateral iron importers.

I'm empty! Open all the doors! Grab iron from food AND blood!

DMT1 (Apical Desperation) ↑2.2-fold

TfR1 (Futile Import) ↑1.58-fold

STARVATION

The Enterocyte Iron Trap (Post-Translational Block)
This is the **Enterocyte Iron Trap**. Iron enters hyperactively but is sequestered due to a **post-translational block**, creating a functional 'one-way door.'

I'm stuffed with iron... but the exit is broken! It can't get to the blood!

Iron Overload (Oxidative Damage)

NO FERROPORTIN

NORMAL:
Iron enters → exits → bloodstream

IDA:
Iron enters → TRAPPED → no bloodstream delivery

Systemic Iron Deficiency Persists

The Central Hub (The lncRNA Regulator)
A previously unknown "**Central Regulatory Hub**"—lncRNA LOC124902620—links the dysbiosis to the iron trap genes, coordinating the entire process. *Mechanism requires further validation.

I am the master coordinator. As long as I integrate these dysbiotic signals, the trap stays shut.

Links 12 Indices & Microbiota

Dysbiotic Bacteria

lncRNA LOC124902620 (Central Regulatory Hub)

SLC40A1 (Ferroportin)

SLC11A2 (DMT1)

TFRC

Inflammatory Genes

Discovered through integrated microbiome-transcriptome network analysis.

Breaking the Trap (Targeted Therapeutics)
To cure refractory IDA, we must hit the specific targets to **Break the Trap**.

Target the ROOT CAUSE:
Dysbiosis → Inflammation → Ferroportin Degradation
Restore Ecology → Dampen Pathway → Iron Flows

First, we restore the barrier and dampen the triple-pathway. Then, personalized iron can finally flow.

So my gut needs healing first! It's not just about the iron!

RESTORATOR RIT: BREAKS THE TRAP

Clinical trials needed to validate microbiome-targeted therapies for IDA.

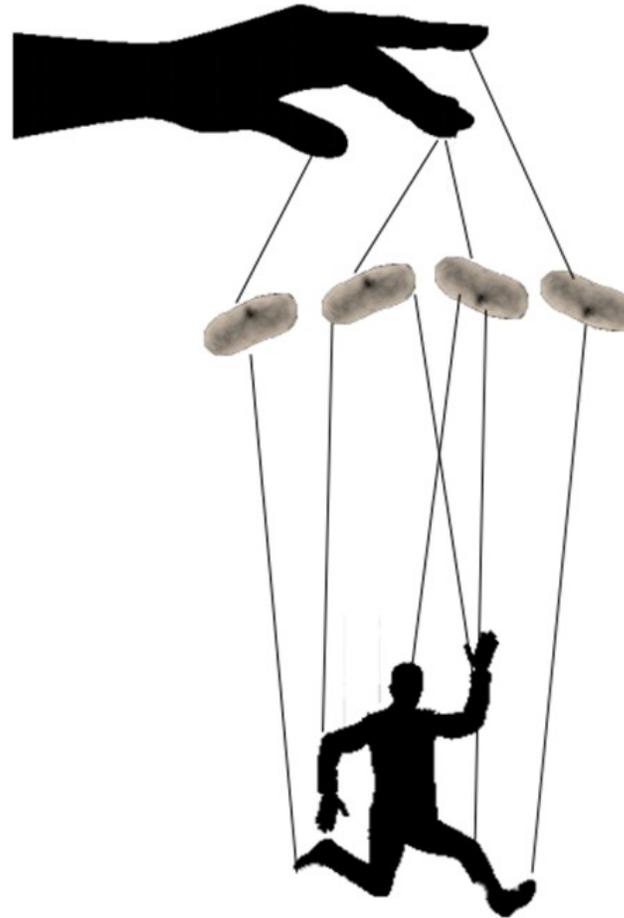
Breaking the Enterocyte Iron Trap: A new frontier in treating refractory IDA

*Research ongoing - clinical applications under development

ASSOCIATION OF POST REDOX STATUS WITH MICROBIAL DIVERSITY AND GENE EXPRESSION

INTERVENE

How can we manipulate the gut microbiota to improve health?



probiotic

prebiotic

Dietary interventions

Fecal Transplant
or Fecally Derived
Microbes

Fermented foods

LOCAL SUPERFOODS

Probiotics + Postbiotics



Photographed by Sharmilee | © Sharmis Passions

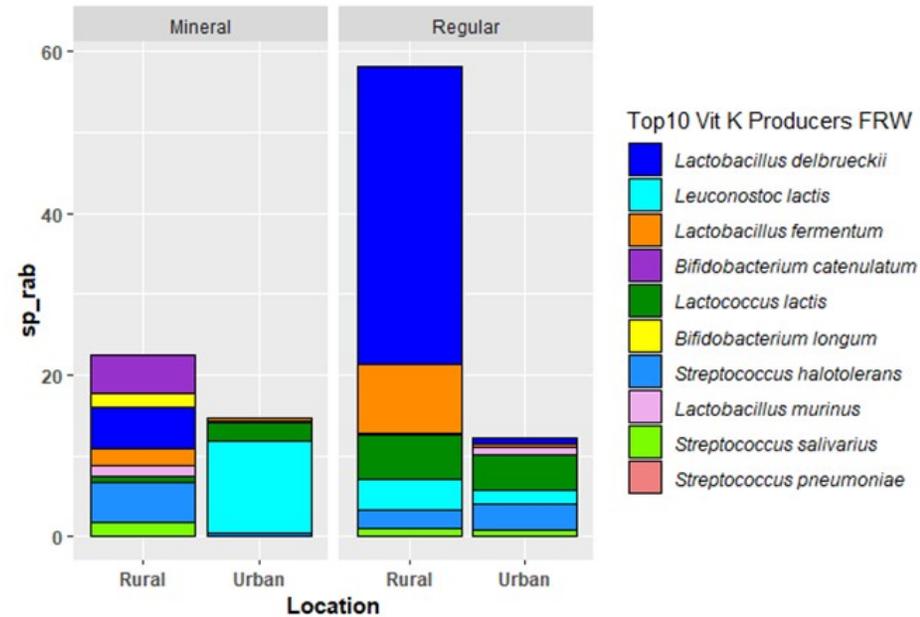
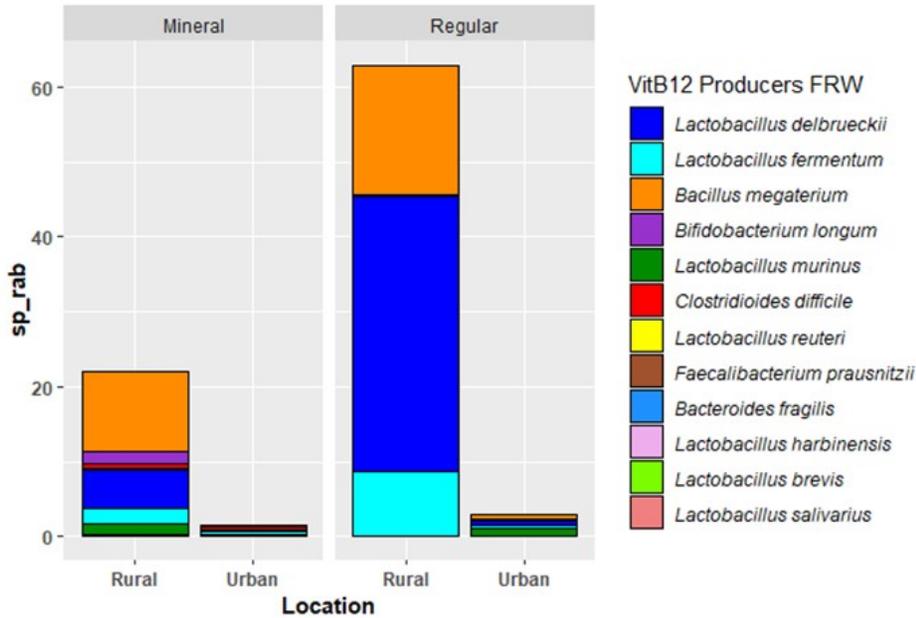
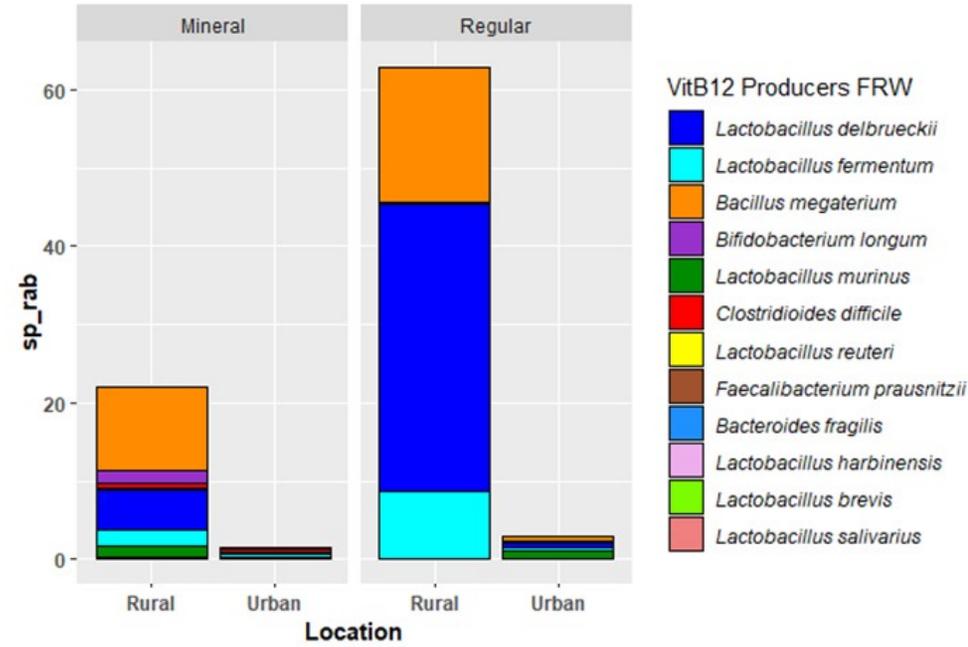
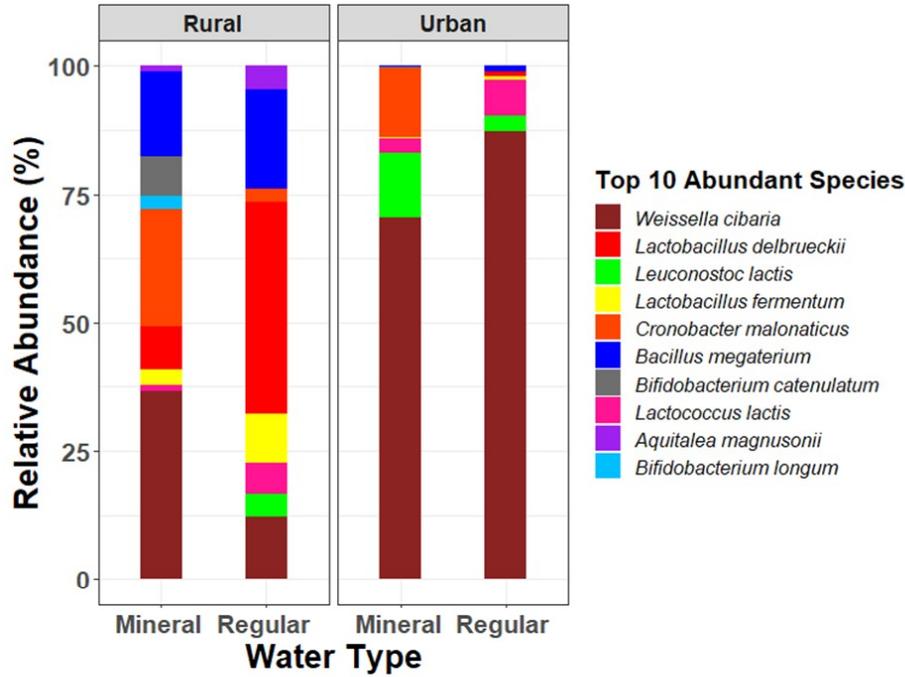
Prebiotic



Postbiotics



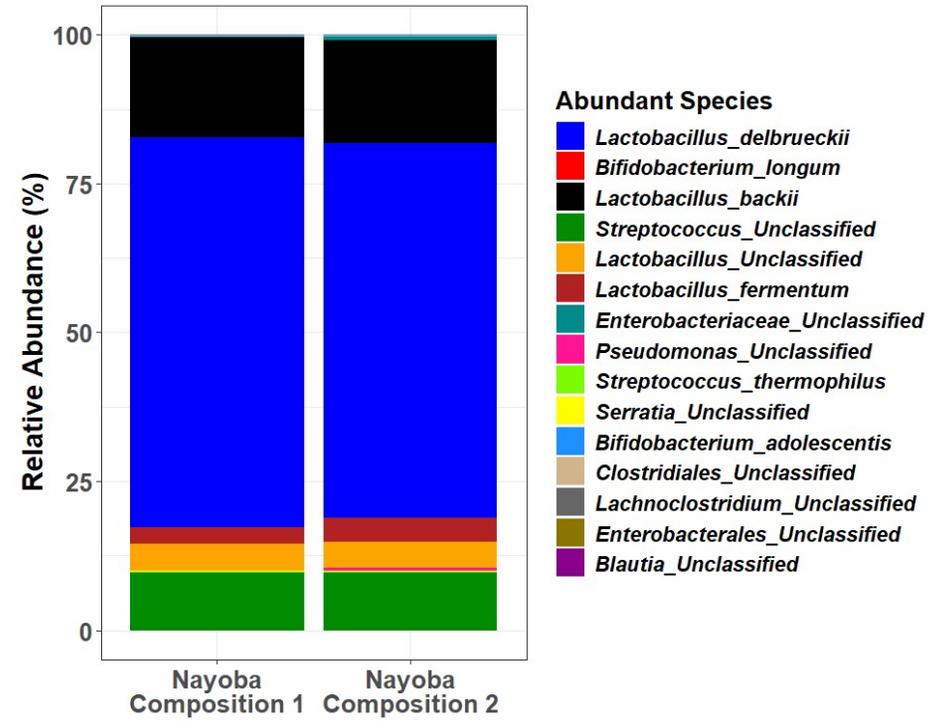
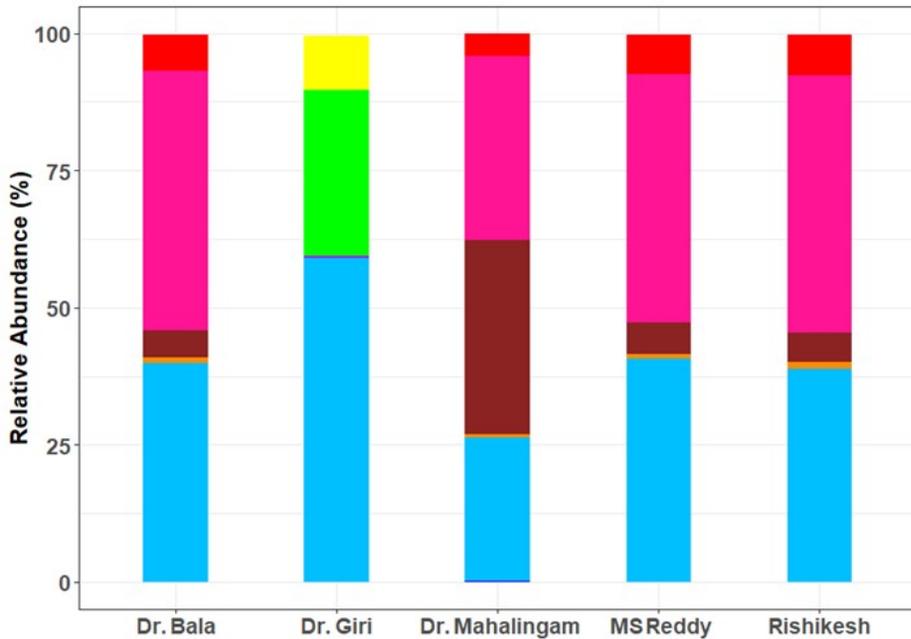
DIET-MICROBIOME-FRW



INTERVENE

DIET-MICROBIOME

Panchamrutham

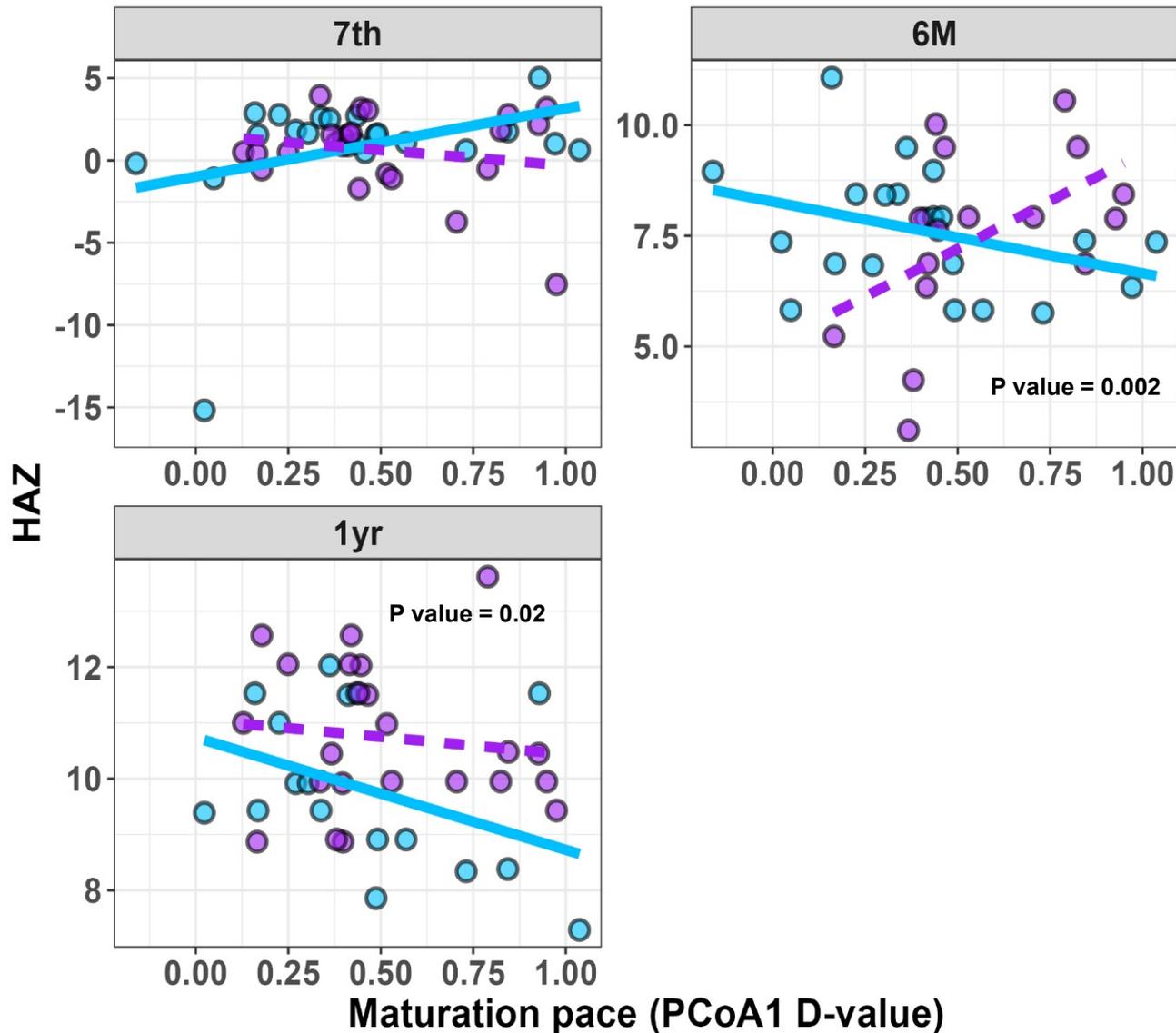


Top 10 Abundant Species

- Lactobacillus delbrueckii*
- Streptococcus mutans*
- Lactobacillus fermentum*
- Lactobacillus backii*
- Clostridium perfringens*
- Clostridium butyricum*
- Lactococcus lactis*
- Weissella cibaria*
- Clostridium tyrobutyricum*
- Streptococcus halotolerans*

FROM MICROBES TO METRICS: GUT PACE PREDICTS INFANT HEIGHT

Nayoba Intervention ● Control ● Intervention

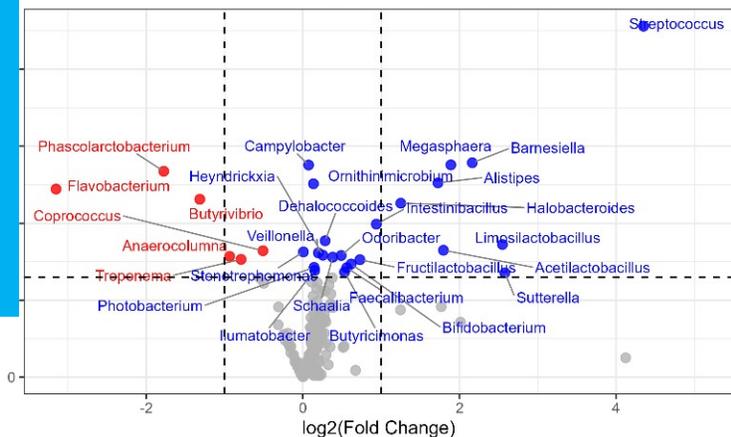


HAZ ~ Maturation pace * age * Nayoba Intervention + Mode of Delivery + Gestational Age + sex + (1 | infant)

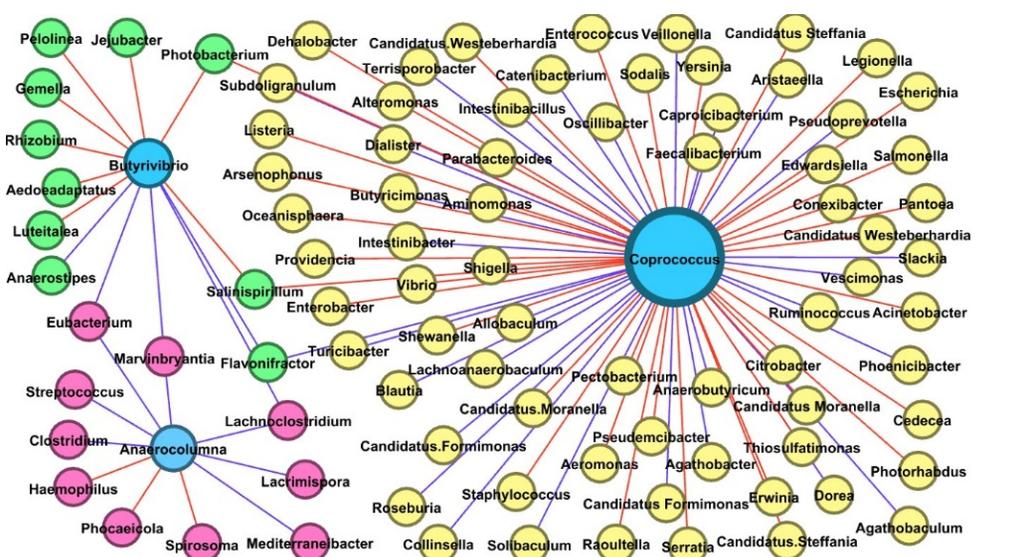
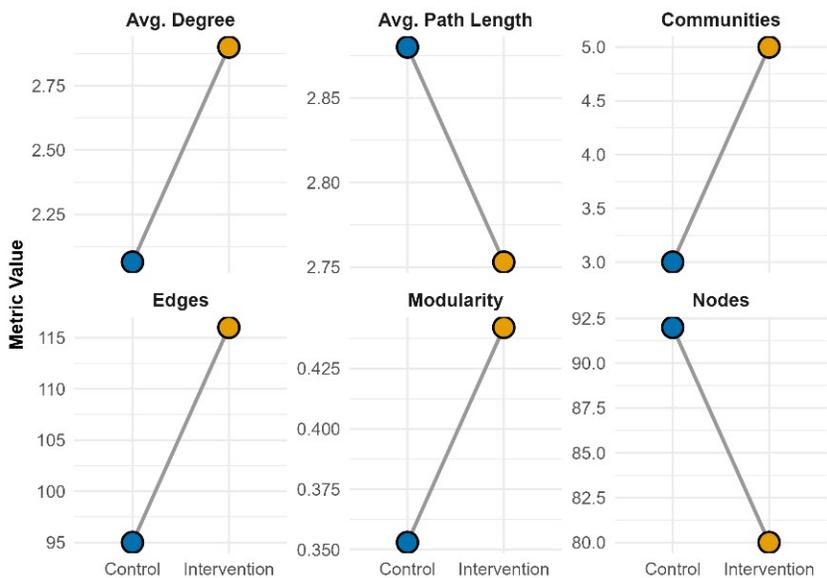
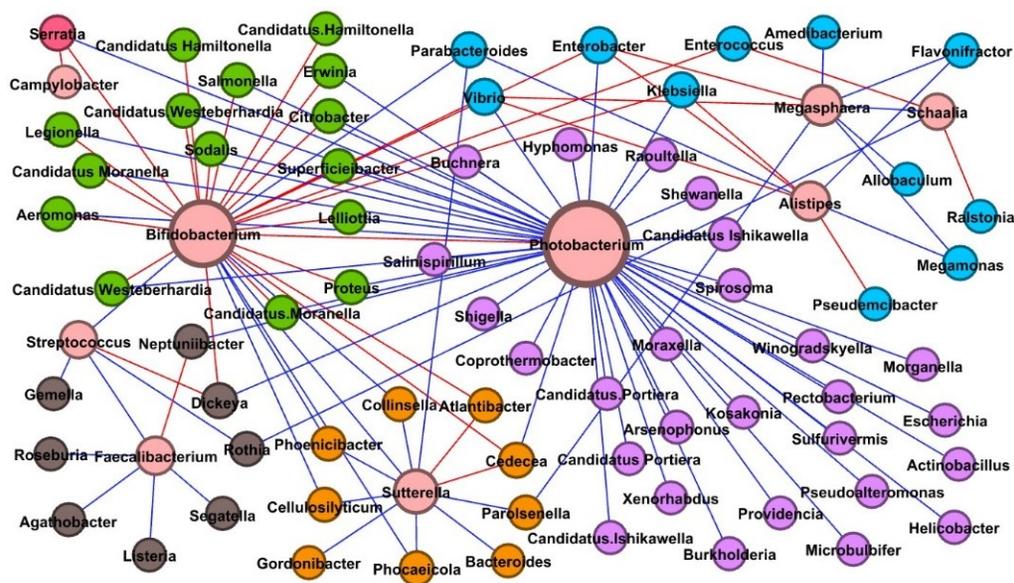
NAYOBA INTERVENTION ON MILK MICROBIOME

INTERVENE

Volcano Plot: Intervention vs Control



Significance
 ● Not significant
 ● Up in Control
 ● Up in Intervention



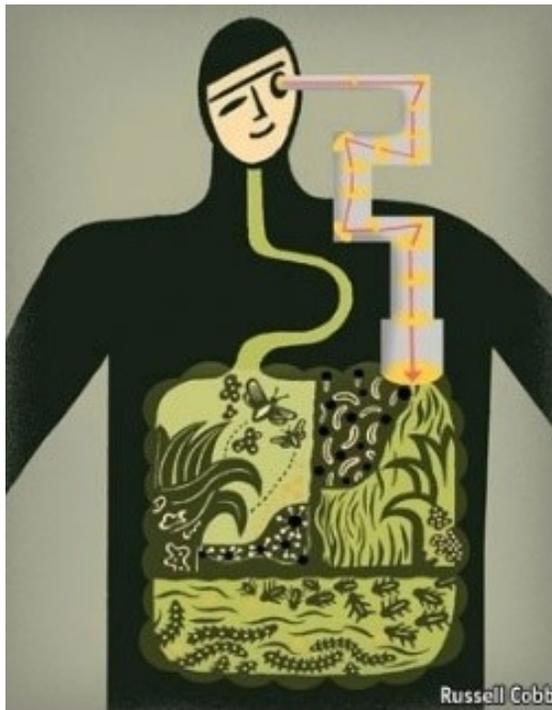
PREDICT

WE FEED THE MICROBES

INTERVENE

Diversity

Functions



probiotic

prebiotic

Dietary interventions

Fermented foods

Signatures

Fecal Transplant
or Fecally
Derived
Microbes

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AIIMS,
BHUBANESWAR

DBT
ICMR
**Indo-France Science
Program**
Gates Foundation
SERB
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