Human Microbiome and Health—Targeting Microbiota: A new science in nutrition
Research Highlights from India

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The Gut Microbiota — a Super Organ

Microbes colonize all of the surfaces of the human body that are exposed to the environment, with the majority residing in the intestinal tract.


Based on 8903 representative 16S r RNA gene sequences

Representation of the diversity of bacteria in the human intestine

Bacteroides dominated enterotypes

Prevotella dominated enterotypes

Ruminococcus dominated enterotypes

What about our microbiota?

Enterotype 1

Enterotype 2

Enterotype 3

Abundance

The Intestinal Microbiota

- Gut microbiota is typically dominated by bacteria – members of the division Bacteroidetes and Firmicutes
- Despite huge range of variations, the microbiota of most individuals can be categorized into one of three variants or "Enterotypes"
- The Enterotypes are based on three dominant genera (Bacteroides, Prevotella or Ruminococcus)
- These clusters are characterized as a ratio of the abundance of Bacteroides and Prevotella, with the Ruminococcus enterotype folded into Bacteriodes group
- These broad patterns are driven primarily by dietary effects


Sichuan, Yunnan, Beijing, Tokyo, Lanzhou, Fukuoka, Taipei, Bangkok, Khon Kaen

High meat, fat & cereal, Low vegetable

Mongolia, Florence

High meat, fat & cereal, High vegetable

USA, Korea

Beijing, Tokyo, Lanzhou, Fukuoka, Taipei, Bangkok, Khon Kaen

Bacteroidaceae

Bifidobacteriaceae

Low meat, fat, High vegetable & cereal

Ruminococcaceae

Lachnospiraceae

Prevotellaceae

Diversity in gut bacterial community of school-age children in Asia. Scientific Reports| 5 : 8397 | 2015


Challenges for Gut Microbiota studies in India

- Geographic distribution
- Heterogeneity of Indian population
- Ethnicity and genetic diversity
- Diversity in dietary habits
- Disease risks of Indian population

Gut Microbiome studies in India

- Mode of Obstetric Delivery
- Bacterial Transition with Age
- Over-nourishment and Under-nourishment – Obesity and Malnourishment
- Ulcerative Colitis and Crohn’s Disease

Background:
Two Indian Families

- Families of three generations staying under one roof.
- Three healthy Indian joint families with three successive generations staying under one roof.
- Families with an increase in age.

Results:

- Difference in anaerobic bacterial diversity with age within individuals in a family.
- Difference in gut flora composition of individuals of different age belonging to the same family.
- Family S: Fecalibacterium and Roseburia in T1 (age 14 years), Dialister, Prevotella in T2 (age 42 years) and Prevotella in T3 (age 62 years).
- Two healthy Indian joint families (T and S) with three successive generations staying under one roof.

Conclusions:

- Conclusion
  - Isolates from samples of S1 (age 26 years) and S3 (age 60 years) belonged to the genus Streptococcus and Weisella in S1 (infants) and Fecalibacterium and Roseburia in S2 and S3.
  - Fecalibacterium and Roseburia in T1 (age 14 years), Dialister, Prevotella in T2 (age 42 years) and Prevotella in T3 (age 62 years).
  - 22 strict anaerobic bacteria isolates were obtained from fecal samples of three healthy volunteers.

Percentage of children under age 5 who are moderately or severely stunted

- Village in South India
- 130 healthy children and adolescents (2-17 yrs.) and 30 healthy adults (median age 42 yrs.)

Details:
- Lactobacillus and Bifidobacterium species predominant in 2-3 years of age but were found to be decreased in adults.
- Increase in Bacteroides, Faecalibacterium and Streptococcus in childhood.

Other information:

- Taxonomic composition of the 20 gut microbiomes
- Box-plots showing the abundance of the taxonomic groups significantly differing across the three groups (AH, BL, SM) of gut microbiomes

Conclusion:

- Required nutritional status: not only due to abnormalities of pediogroal nutritional groups but also a result of depletion of faecal commensal genera.
- Higher number of virulence genes in children with lower nutritional index.
Role of subsets of bacteria in the pathogenesis of CD and UC may be different.

Differential change in a subset of bacterial population may be associated with Ulcerative Colitis and Crohn's Disease.

Conclusion

- No difference between the two groups with respect to any other bacteria
- Relationship between Lactobacilli and Fe deficiency needs to be explored
- Further studies in a larger number of individuals are recommended.
Probiotic Studies in India

Occurrence of Diarrhoea and Protective Efficacy

<table>
<thead>
<tr>
<th>Strain</th>
<th>Randomized Study (n=1783)</th>
<th>Intention to treat (n=1864)</th>
<th>Protective efficacy of probiotic (95% CI)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nutritional group</td>
<td>409/621</td>
<td>414/629</td>
<td><strong>0.88</strong> (95% CI: 0.86-0.90)**</td>
</tr>
<tr>
<td>Probiotic group</td>
<td>474/629</td>
<td>480/629</td>
<td><strong>1.029</strong> (95% CI: 1.01-1.04)</td>
</tr>
</tbody>
</table>

* p<0.01 for the comparison between random group and control group

Conclusion

- Equivalent to reduction of diarrhoea risk or protective efficacy of 14% (P<0.01)
- Reduction of Aeromonas and Cryptosporidium in the probiotic group

- PROBIOTICS ARE USEFUL IN THE PREVENTION OF DIARRHOEA IN INDIAN CHILDREN

Probiotic Market in India

Growing at CAGR of 25% during 2014 - 2019

http://www.digitaljournal.com/pr/1829000
Regulatory Framework in India

INVITRO TESTS TO SCREEN POTENTIAL PROBIOTIC STRAINS (NOT FOR STRAINS WITH ESTABLISHED DOCUMENTATION)

IN VIVO STUDIES IN VALIDATED ANIMAL MODELS FOR SAFETY AND EFICACY (NOT FOR STRAINS WITH ESTABLISHED DOCUMENTATION)

INVIVO STUDIES IN HUMANS FOR CLINICAL EVALUATIONS: Phase 1 (safety), Phase 2 (efficacy), Phase 3 (Effectiveness)

EFFECTIVE DOSAGE OF THE PROBIOTIC STRAIN/STRAINS – minimal effective dosage or level of viable cells in terms of CFU/day in the carrier food that demonstrates the health claim to be clearly indicated.

SPECIATION OF THE GENUS, SPECIES AND STRAIN – PHENOTYPIC AND GENOTYPIC TESTS TO BE CONDUCTED USING VALIDATED STANDARD METHODOLOGY (NOT FOR STRAINS WITH ESTABLISHED DOCUMENTATION)

Thank you for your attention