Enteric infection is the major cause of mortality and associated complications in the growth and subsequent development of the children below the age of five. The alarming mortality rate of four fifty thousand deaths per year in the developing Asian countries has captured special attention towards preventive strategies and biotherapeutic intervention which is sustainable. The enteric infection by pathogens causes associated complications like antioxidant stress in the colon leading to inflammatory condition and leaky gut which causes poor absorption of nutrients which in turn leads to malnutrition and poor response to conventional therapeutic drugs. Our current research work is focussed towards identifying the niche beneficial bacterial species from the human gut microbiome of Rourkela region, Odisha, India towards the development of biotherapeutic probiotic strains which could alleviate enteric infection and associated complications through the modulation of the gut microbiota and production of beneficial metabolites, which helps in the recovery and rejuvenation of the damaged gut associated with enteric infection. In our study we have attempted to isolate probiotic strains which produces short chain fatty acids and antioxidants under simulated colonic conditions. The ability of the strains *Lactobacillus plantarum strains SAE33a and MI89* to inhibit the growth of the enteric pathogen *Salmonella enterica* subsp., *enterica* serovar *typhimurium* (KCTC 2514) is investigated by co-culturing them in the simulated colonic conditions. The reduction of pathogen count and associated lipopolysaccharides (LPS) reduction upon co-culturing and the production of beneficial amount of short chain fatty acids and increased antioxidant profile under simulated colonic conditions hold the promise of the strains to be used in therapeutic intervention after in-vivo efficacy studies.

**Keywords:** Biotherapeutics, Simulated Colonic Model, short chain fatty acids, lipopolysaccharide
Biotherapeutic propensity of the probiotic strains isolated from human gut microbiota against enteric infection by *Salmonella typhimurium* KCTC 2514

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• Infection of intestinal tract by pathogens – impairs intestinal function and causes dehydrating diarrhea
• Children < 5 years age – vulnerable in developing countries (high mortality rate)
• Repeated infections – poor nutrient absorption, weaker immune response, stunted growth and impaired cognitive development
• Enteric pathogens – *Vibrio cholerae*, *Shigella* spp., *Salmonella* spp., Enteropathogenic *E. coli*, Rotavirus – spreads through contaminated food and water
FACTS ABOUT ODISHA STATE, INDIA

Distribution of Schedule Tribe (62 TYPES) Population in Odisha

Large tribes: Santal, Munda, Oram and Gond

Alarming fact: High prevalence of Gastroenteritis among tribes in Odisha

Reasons: Lack of safe drinking water, open defecation, contaminated water (drinking water from open ponds and wells), Poor environment hygiene, Improper disposal of human excreta, low socioeconomic status coupled with blind cultural belief, lack of access to medical facilities encouraging faeco-oral transmission of enteric pathogens
<table>
<thead>
<tr>
<th>References</th>
<th>Reports on Gastroenteritis in Odisha</th>
</tr>
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<tbody>
<tr>
<td>Odisha State Water Plan 2004</td>
<td>High level prevalence of water borne infections (gastroenteritis, cholera and hepatitis)</td>
</tr>
<tr>
<td>ICMR bulletin Vol 33, No. 10 October 2003 Health status of primitive tribes of odisha</td>
<td>Water borne communicable diseases like gastrointestinal disorders including diarrhoea are responsible for higher morbidity and mortality. 0.23% Salmonella and 39.2% Escherichia coli</td>
</tr>
<tr>
<td>Citran Consulting Pvt Ltd, Bhubaneswar, TMST Orissa health support Plan Feb 24, 2009</td>
<td>Diarrhoea – single most common causes of death among children under age five worldwide. 12% children under five have diarrhoea. Rural areas 12% (than urban areas 10.3%)</td>
</tr>
<tr>
<td><a href="http://www.dnaindia.com">www.dnaindia.com</a> 7 Oct 2009</td>
<td>Sundargarh district Kendughati village in remote Gurundia block: Two persons died of gastroenteritis in Odisha</td>
</tr>
<tr>
<td>New Indian Express (Bhubaneswar) 19/07/2010 (India Environmental Portal)</td>
<td>Gastroenteritis outbreak in Sundargarh villages</td>
</tr>
<tr>
<td>Census of India 2011, Economic Survey 2010-11 Government of Odisha, Annual plan 2011-12 Odisha, Odisha. Human Development Report 2004 and UNICEF &amp; KIIT University information on Water and Sanitation</td>
<td>Infant mortality rate stands at 65 out of every 1000 live brithers (as of 2011). 80% of the instances of morbidity and mortality cases in rural areas are caused by water borne diseases (as of 2004). 42% of rural households have access to basic sanitation facilities and only 26% of rural house holds have access to piped water / hand pumps (still water quality of drinking water is very low) as of 2010</td>
</tr>
<tr>
<td>Gram Vikas Annual report 2012-2013</td>
<td>Odisha ranks among the lowest in India with regard to health indicators. The death rate for people in Odisha is much higher and life expectancy is lower than at the national level. Child mortality is due to diarrhoea, gastroenteritis, anaemia and jaundice (35.4% of total child’s death)</td>
</tr>
<tr>
<td>Balgir. Tribal Health problems, Diseases Burden and Ameliorative challenges in tribal communities with special emphasis on Tribes of Orissa. Proceeding of national Symposium on Tribal health 161-176</td>
<td>Gastroenteritis is high among the tribals. Water borne diseases like gastrointestinal disorders including acute diarrhea are responsible for high morbidity and mortality</td>
</tr>
<tr>
<td>The national medical journal of India. Medicine and Society Volume 18, Number 4</td>
<td>Malnutrition and gastrointestinal disorders are common among tribal populations</td>
</tr>
<tr>
<td>Health/Epidemics-2015 (Jan to Dec 2015) Compiled by Fr. Paul G Documentaion Centre</td>
<td>Open defeacation causes gastroenteritis, amoebiasis, typhoid, viral hepatitis, parasitic infections. Huge problem of communicable diseases in our country</td>
</tr>
</tbody>
</table>
China, Europe, Denmark (etc) banned antibiotics as growth promoters.

ANTIBIOTICS MAY BE BANNED IN FUTURE FOR HUMAN USE ALSO
Goals of the present study

Development of population specific probiotic strains from healthy human gut microbiome as biotherapeutic to fight enteric bacterial pathogens

- Therapeutic benefits of probiotics
  - Reduction in the load of enteric pathogenic bacteria in the gut
  - Production of metabolites favoring healthy gut
  - Reducing the ill effects caused by pathogens in the gut.
Screening of gut microbial isolate – Healthy female volunteer from Oram Tribe (faeces)  
Probiotic characterization and Safety assessment through *invitro* studies  

**Different from other studies:**  
*In situ* production of antioxidants in gut from microbial fermentation of undigested fibres of food items  

**SCF composition**  
KCl, NaCl, Potassium PO₄ (mono and dibasic), Proteose peptone  
Digested fibers – lyophilized; 2% dry weight basis  
Nitrogen sparged
CONCLUSIONS

*L. plantarum* SAE33a + wheat = biotherapeutic combination against *Salmonella typhimurium*

Production of $\text{H}_2\text{O}_2$ by *L. plantarum* SAE33a – reason for reduction in *Salmonella* growth in coculturing model

Antioxidants and Short chain fatty acids produced by *L. plantarum* SAE33a – Fight against oxidative stress and heal the damaged colon to bring back to normal condition

Wheat based non-dairy probiotic drink with microencapsulated *L. plantarum* SAE33a – Population specific synbiotic biotherapeutic formulation
Acknowledgement

• Mr. Eldin M Johnson, PhD student
• Dr. Sanghamitra Satpathi, Ispat General Hospital, Rourkela
• Prof. Joo-Won Suh & Prof. Seung Hwan Yang, Myongji University, Republic of Korea
• NIT Rourkela
• DBT, Govt. of India (BT/PR6486/GBD/27/433/2012)
• DST, Govt. of India (SERB/F/5150/2012-13)
Whole grain Wheat Probiotic Product

Strain: $10^6 L.\ plantarum\ SAE33a / mL$

Claim: Protective against Enteric pathogen

FSSAI Approved

2025

THANK YOU