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New Insights from Bovine Liver Commensal Microbes: Probiotic Vitamin-A Producing Bacteria

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Abstract

Introduction: Prioritizing Vitamin A deficiency disorders, many countries are looking for viable alternative strategies. In this study, we investigated whether the commensal bovine liver (one of the top sources of vitamin A) bacteria is capable of synthesizing β-carotene and or retinoids. This hypothesis is experimented with biochemical and metagenomic approaches to find probiotic bacteria with human gut-friendly properties.

Methodology: Around 42 potentially probiotic bacteria were isolated from the liver, intestine, and ruminal fluid of the free-range cattle. To delink the metabolic connections, intensive non-culture-based 16s rRNA amplicon sequencing of these three bovine organs with distinct vitamin A composition was performed. The functional capacity (carotenoid and retinoid metabolism) of the microbiome of these three organs were compared through functional annotation of the metagenome with EC and KEGG database. The microbial β-carotene (pro-vitamin A) and retinol were quantified through an ultra-performance liquid chromatography-tandem mass spectrometer (UPLC–MS/MS). The tolerance of isolated bacterial strains to bile salt, HCl, NaOH, temperature, ethanol, pH, and gastric juice was evaluated through OD_{620} nm in a double beam spectrophotometer.

Results and Discussion: We identified the bovine liver (the storage site with 18.81 ± 1.10 µg/g β-carotene), and intestine (the bioconversion site with 20.37±0.10 µg/g β-carotene) showed a notable increase in the relative abundance of Firmicutes, in particular, the probiotic lactic acid bacteria. Interestingly, the strains VLL1 (111.95±3.10 µg/g dry cell weight) and VECI1 (44.77±2.08 µg/g dry cell weight) are found to produce β-carotene in anaerobic conditions, a reflection of the gut environment (Provisional patent no. P86361ZP00 CR/LG). Further, these bacteria are characterized by acid and bile tolerance, marked antagonism against pathogenic bacteria, and good survivability in variable salt, ethanol, and temperature ranges. This report is the first-of-its-kind in cattle-based probiotic bacteria with the capacity to synthesis β-carotene and retinol, characterized for its manufacturability in functional probiotic formulations.

Conclusion: A one-off probiotic therapy for children at risk of vitamin A deficiency is not so far. The results obtained will act as a proof-of-concept to establish human gut-friendly bacteria from an animal source that could make vitamin A.

Biography: Dr Srinivasan Krishnamoorthy

Dr. Srinivasan Krishnamoorthy (Srini in short), Adjunct Faculty, Indian Institute of Food Processing Technology, India undergone his postdoctoral research under Prof. Elna M Buys, through Vice-chancellors post-doctoral fellowship at the University of Pretoria during 2018 – 2019. The research work "Biosynthesis of vitamin A through probiotic bacteria" during his postdoctoral research work is the first study demonstrating the potential of bovine commensal bacteria to synthesis ß-carotene and retinol in human gut environment. This work was applied for patent with provision patent no. P86361ZP00 CR/LG. Srini published 17 research and review articles in peer reviewed publications and a fellow of Tuks Young Research Leader Programme of Future Africa.