Global Prebiotic Association Young Researcher Awards - Entry #338

Name

Xin Tang

Your Title

PhD student

Your Affiliation

University of Groningen; University Medical Center Groningen

Email

x.tang@umcg.nl

Phone

+31613479008

Please indicate which category you're applying for:

GPA Young Researcher Award for Fundamental Research (100 points possible)

Please provide a link to your published paper (if open access) or abstract:

https://pubs.rsc.org/en/content/articlelanding/2023/fo/d3fo01436c

Please provide a summary of your research(limit 250 words)

This study investigated the protective effects of specific pectin types on gut barrier disruption, focusing on varying glucose concentrations. The gut epithelium, a glucose sensor, is linked to disruptions in the intestinal barrier associated with conditions like hyperglycemia, diabetes, and inflammatory bowel diseases. The effectiveness of pectins was compared with metformin, a known barrier-protective agent. Notably, certain pectins demonstrated efficacy at both low and high glucose concentrations, unlike metformin, which primarily acted at high glucose levels. Pectins' protective effects were attributed to their ability to stabilize cell membranes by preventing excessive calcium influx, independent of glucose levels. The study highlighted that the efficacy of pectins in preventing gut barrier disruption at high glucose levels depended on the degree of methylation (DM) and branching (DB) of the pectin molecules. Low DM and intermediate DM pectins with higher DB exhibited stronger rescuing effects. These effects were associated with changes in the expression of tight junction proteins, enhancing resistance against barrier disruption. Importantly, both metformin and pectins demonstrated significant impacts on preventing gut barrier disruption at high glucose concentrations, particularly affecting the glucose transporter SGLT-1. This suggests a potential link between the protective effects of these substances and the

regulation of glucose transporters in gut epithelial cells. The study underscores the potential of pectins as a strategy to prevent gut barrier dysfunction and associated diseases, especially in diabetic conditions.

Please provide a summary of methods (limit 250 words)

Initially, we conducted structural characterization of lemon pectin samples, confirmed through liquid-state NM analysis. Subsequently, we examined and compared the effects of pectins with varying degrees of methylation (DM) and branching (DB) on the Trans-Epithelial Electrical Resistance (TEER) of T84 cell barriers using the Electric Cell-substrate Impedance Sensing system. Metformin, employed to regulate glucose uptake in Type 2 diabetic patients and known to influence gut barrier function, served as a benchmark for assessing the impact of pectins on gut barrier function. The experiments were conducted under both low (5 mM) and high (20 mM) glucose concentrations to discern the effects of hyperglycemia and evaluate the efficacy of pectins under these distinct conditions. Subsequently, we investigated the gene expression of the tight junction proteins, including claudin1, claudin3, occludin, and ZO-1 in T84 cells, crucial for barrier function. Lastly, we explored whether pectins had an influence on glucose transporters in T84 cells through Immunofluorescence staining.

Please provide a summary of your results (limit 250 words)

Pectins tested here exhibited similar monosaccharide ratios and molecular weights but varied in DM (18 to 88) and DB (33 to 94). Testing under low (5 mM) and high (20 mM) glucose conditions revealed pectins had no impact on gut epithelial barrier integrity in unstressed cells but protected against disruption induced by A23187. Metformin was effective under hyperglycemia, while pectins' rescuing effects were DM and DB-dependent. Pectin pretreatment demonstrated a protective effect on epithelial barrier function by enhancing the gene expression of Claudin-1 and ZO-1, dependent on the DB and DM. A23187-induced gut epithelial barrier disruption was effectively countered by metformin and specific pectins. Gene expression analysis revealed at 20 mM glucose, pectins, especially those with lower DM and higher DB, significantly increased Claudin-1 expression. Similar patterns were observed for Claudin-3, Occludin, and ZO-1, highlighting the DB and DM-dependent regulatory effects of pectins on tight junction gene expressions.
Pectins were found to reverse the translocation of SGLT1 induced by the barrier disruptor A23187 in gut epithelial cells. The study focused on the expression and dynamics of SGLT-1 in response to different pectins. At 5 mM glucose, A23187 increased basolateral SGLT-1 expression, reduced by metformin and more significantly by lower DM and higher DB pectins. Higher DM pectin decreased basolateral SGLT1 expression. Interestingly, at 5 mM glucose, higher DB pectins reduced apical SGLT-1 expression, emphasizing the potential of pectins to modulate glucose transporter dynamics.

Please provide a statement about what, in your opinion, makes this paper outstanding and why it fits into the grant category you selected. (limit 250 words)

This paper standout feature lies in dissecting how these pectin attributes influence gut barrier integrity and glucose transporter dynamics. Notably, the study uncovers DM and DB-dependent rescuing effects of pectins on disrupted barriers, especially under hyperglycemic conditions. This research aligns with the grant's mission: Increase public awareness about the science of prebiotic products and understanding of the solid science supporting newfound benefits. The paper's focus on tight junction gene expressions underscores its translational relevance, making it a valuable contribution to advancing our understanding of dietary components for potential therapeutic interventions in gut health within the grant's scope.

By typing your full name below and completing this application, you verify that you are the first author of this research and that this paper is original research.

Xin Tang

Global Prebiotic Association