



Cereal - based functional foods for gastrointestinal health



Peter Purslow

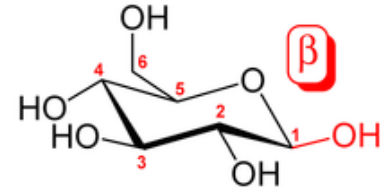
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CHANGING LIVES
IMPROVING LIFE

Beta glucans – varied family of polymers of D-glucose units with β -glycosidic linkages

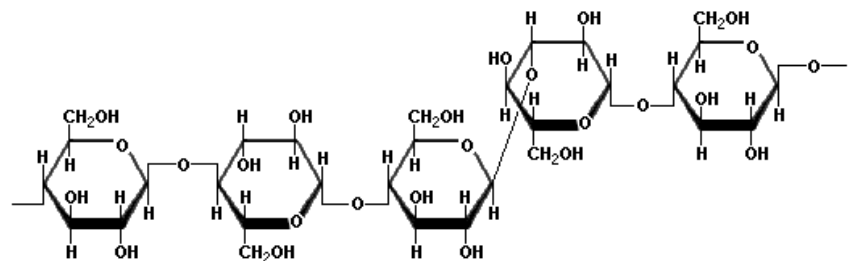


Glucose monomer showing C numbering and β -orientation

Potential health benefits of soluble dietary fibres such as β -glucan include:

- reduced bowel transit time
- prevention of constipation
- reduced risk of colorectal cancer
- promotion of growth of beneficial gut microflora (i.e. prebiotic)
- production of short-chain fatty acids
- ➔ • lowered blood cholesterol
- ➔ • regulation of blood glucose levels (especially important for diabetes management)

**Beta-glucans derived from
oats & barley**
(MW of up to 1-2 million g/mol)



mixed-linkage (1→3), (1→4)-beta-D-glucan

How do these beta glucans do this?

Wood et al. (1994)

- inverse relationship between the viscosity of the oat β -glucan solution and subsequent levels of both glucose and insulin in the blood.

79–96% of the changes in blood glucose and insulin are statistically “explained” by the inverse correlation with viscosity (which in turn is dependent on concentration and molecular weight of the added β -glucan)

Tosh et al. (2008)

- the molecular weight of β -glucans in oat bran muffins has a strong relationship with glycemic response





*Supposed mechanism:
changes in gut content viscosity cause changes
in nutrient absorption by GI tract epithelial
cells (GITECs)*



“Although most studies suggest that viscosity (of β -glucans) is important for bioactivity, few make measurements that would relate to the potential for viscosity development in the lumen of the gut”

.....**There is a need for in vitro methods to be developed which can be related to physiological response.”**

Wood (2007)

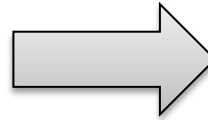




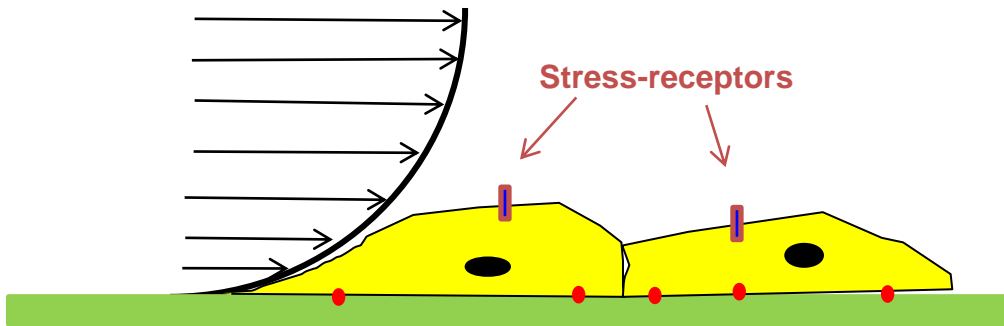
Our current research measures direct mechanical effects of altered gut flow on absorption by epithelial cells



Fluid shear stress
from gut lumen flow



Mechanical signalling causes
changes in cell expression,
absorption



Our cell culture models of GI cell mechanostimulation

Challenges

Mechanical deformation

Fluid shear stress

Chemical signals...

Human gut epithelial cells

Caco-2, H-29

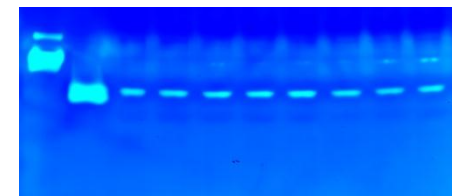
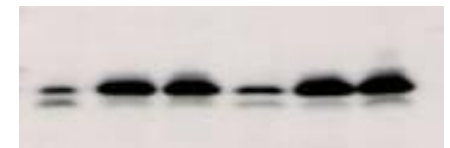
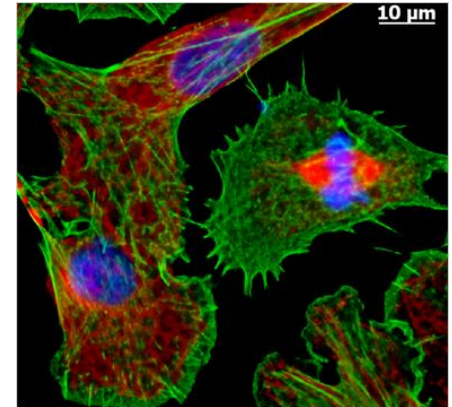
*Non-carcinoma derived rat
GITEC cell line*

**Absorption of nutrients
and immune reactions**

*cytokine activity
signaling activity*

Cell models

Outcomes



Inflammatory Bowel Disease

- principally Crohn's Disease & Ulcerative Colitis
 - *Immunological reactions*
 - *Ulceration and GI blockage*
 - *No known dietary triggers*
 - *Gut emptying/flow rate affected*

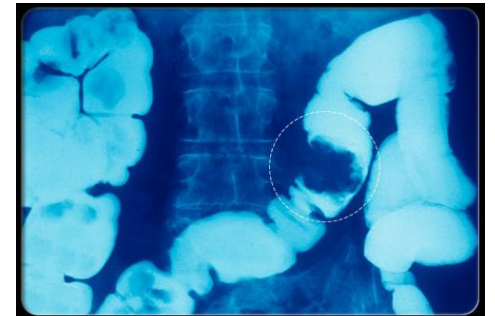


Currently applying to CCFC to study effects of shear stress in gut on immune reactions of epithelial cells – and possible amelioration by cereals-based polysaccharide moieties




Crohn's and Colitis
Foundation of Canada

Fondation canadienne des
maladies inflammatoires
de l'intestin







Relevance to product development



If health benefits of beta-glucans from altered cell expression and nutrient absorption are due to physical (viscosity) effects alone (and not due to specific molecular interactions):

- 
- 
- can induce same changes in epithelial cell behaviour with other high viscosity molecules?
 - can “design” novel polysaccharide moieties to maximise effects?

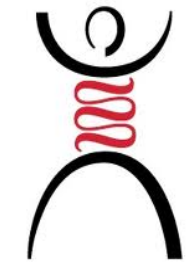


The aim of our growing program in GI health:

- from knowledge of the precise mode of action

-design functional foods and/or novel polysaccharide fractions with the ability to

- **increase health benefits**
- **ameliorate disease states**





What we are looking for at this stage:

**Interactions with cereal-based foods
manufacturers with an interest in health
benefits**

Exploration of possible collaborations



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