Partially Hydrolysed Guar Gum & Gut Health: *the latest evidence*

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Our Translational Gastroenterology Lab

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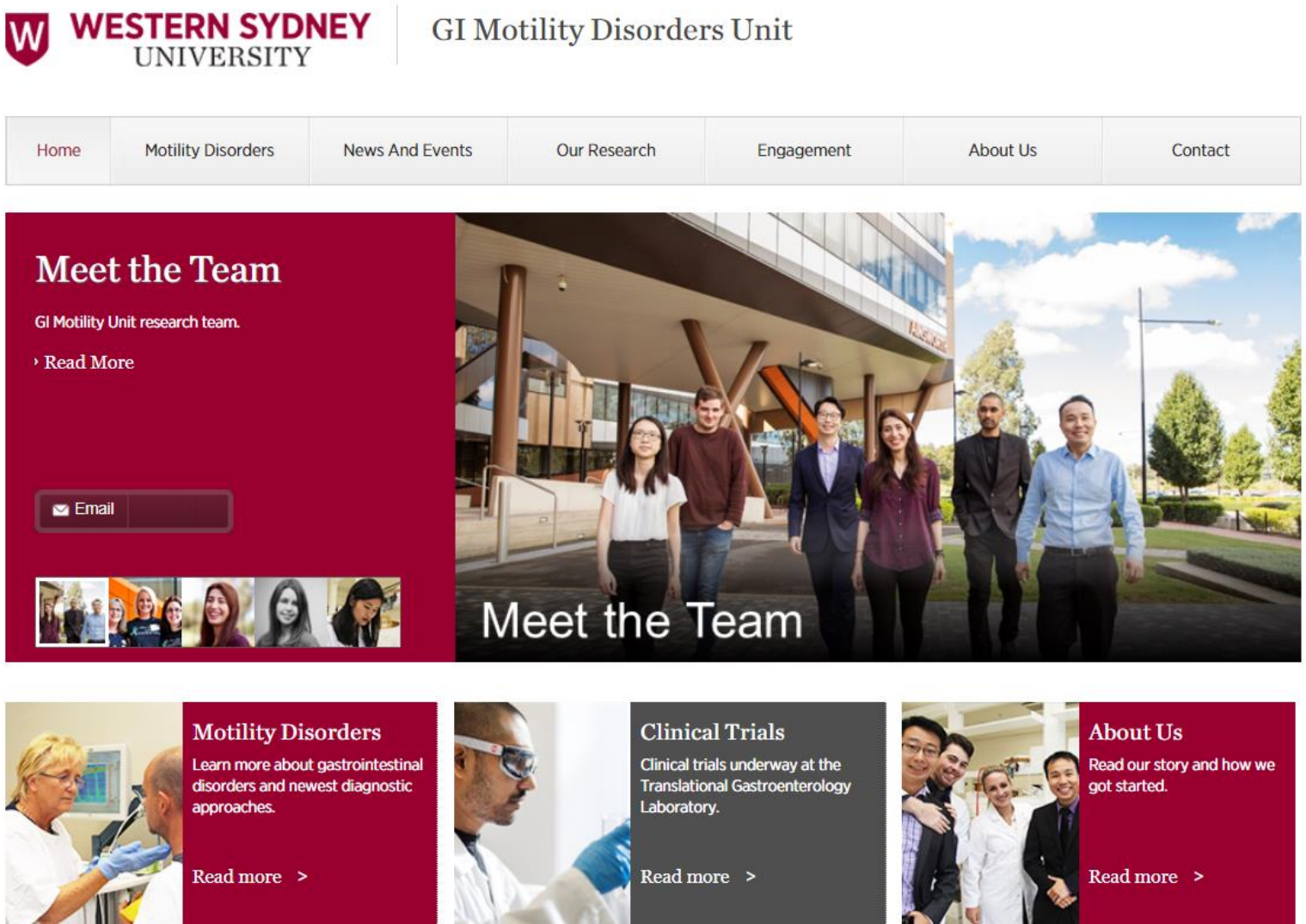

1 DIETARY FIBRES

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A DIETARY FIBRES

Insoluble Fibre

- Stool bulking

Soluble Fibre

- Improve bowel motion
- Microbiota substrate
- Lower serum cholesterol
- Blood glucose modulation

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B GUAR GUM

- Endosperm of the guar/cluster bean
- High viscosity in solution
- Long chains of galactose and mannose (> 200 monomer units)

C PARTIALLY HYDROLYSED GUAR GUM

- Enzymatic hydrolysis of guar gum (β-mannanase)
- Short (3-8 monomers) and medium (9-30 monomers) chains at a 1:7 ratio
- Greatly reduced viscosity but retains the health benefits of guar gum

Photo by Markus Winkler on Unsplash

D PHGG Animal Studies

1. Tolerability

Polysaccharides	Reaction time (hour)	Chain length			Viscosity (cps)	Sensory test
		>200unit (%)	30~200 unit(%)	<30unit (%)		
A	10	96	4	—	990	extremely high viscosity
B	20	47	53	—	45	slight viscosity
C	35	16	83	1	18	not bad swallowability
D	45	2	96	2	11	good swallowability
E	65	1	81	18	7	good swallowability
F	80	—	45	55	3	good swallowability

viscosity:10% by weight aqueous solution of each polysaccharide

2. Glucose Response

Time (min)	Control	Food A	Food B	Food C	Food D	Food E	Food F
0	80	80	80	80	80	80	80
15	240	140	142	145	144	160	190
30	230	145	148	150	151	187	197
60	175	142	143	145	147	162	170
120	120	126	125	127	126	128	118
180	110	100	103	105	109	113	111

Data from Taiyo Kagaku (1992) Limitedly enzyme-hydrolyzed polysaccharide and method for its production European Patent Application EP0557627A1

3. Cholesterol Response

Sample	Serum cholesterol	Liver cholesterol
control	62.3 ± 3.6	4.9 ± 0.5
food A	40.3 ± 1.2	2.2 ± 0.4
food B	41.5 ± 3.3	2.3 ± 0.3
food C	41.7 ± 2.6	2.4 ± 0.1
food D	41.3 ± 2.8	2.4 ± 0.2
food E	46.3 ± 3.1	3.1 ± 0.2
food F	60.0 ± 3.9	4.5 ± 0.2

4. Transit Time

Sample	Digestive tract passage time (hour)
control	15.2 ± 1.7
food A	9.2 ± 1.6
food B	9.4 ± 1.5
food C	9.4 ± 1.7
food D	9.6 ± 1.3
food E	10.4 ± 1.1
food F	14.0 ± 0.8

2 CONSTIPATION

Photo by Lubo Minar on Unsplash

A CONSTIPATION

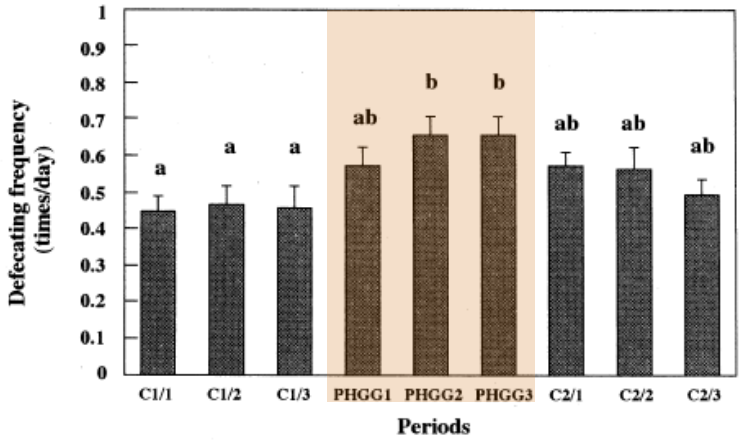
- Prevalence of 14% population
- Fewer than 3 bowel movements per week
- Caused by functional problems or lifestyle
- Fibres help increase the water content to soften stool


Photo by Mark Boss on Unsplash

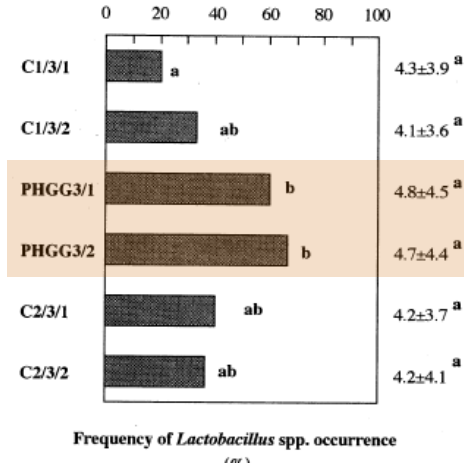
A CLINICAL STUDIES

- Clinical trials (14) with a total of 631 participants on average dosage of 10 g/day
- PHGG improve stool consistency, bowel movement frequency, and stool volume
- Reduced symptoms - abdominal pain, incomplete evacuation or need for digital evacuation
- High tolerability in children and patients with severe mental and physical handicaps compared with laxatives and enema

1. Defecation Frequency



2. Frequency of Lactobacillus spp.



Frequency of *Lactobacillus* spp. occurrence

J Nutr Sci Vitaminol (Tokyo). 1994 Jun;40(3):251-9. doi: 10.3177/jnsv.40.251.

Influence of partially hydrolyzed guar gum on constipation in women

H Takahashi [1], N Wako, T Okubo, N Ishihara, J Yamanaka, T Yamamoto

Affiliations + expand

PMID: 7965214 DOI: 10.3177/jnsv.40.251

3. Stool moisture % and pH

	Periods					
	C1/3/1[1]	C1/3/2	PHGG3/1[2]	PHGG3/2	C2/3/1	C2/3/2
Sample number	15	12	15	12	15	11
pH	6.87±0.09[a**]	6.91±0.13[a]	6.42±0.13[bc]	6.36±0.15[b]	6.66±0.09[ab]	6.79±0.13[ac]
Wet weight (g/sample)	90.4±10.6	87.3±5.9	103.7 ± 10.1	104.4 ± 10.5	92.9±6.1	85.0±11.8
Dry weight (g/sample)	27.7±3.0	27.2±1.8	27.0±2.4	26.4±2.1	26.4±2.5	26.5±2.7
Moisture (%)	70.0±1.4[ab]	68.1±1.5[a]	73.5±1.0[bc]	74.1±1.0[c]	71.5±1.3[ac]	71.0±1.5[ac]

Data from Takahashi H. et al. (1994) J. Nutr. Sci. Vitaminol 40, 251 – 259

C COLONIC TRANSIT

Original Article | Published: 08 April 2014

Partially Hydrolyzed Guar Gum Accelerates Colonic Transit Time and Improves Symptoms in Adults with Chronic Constipation

Dimitrios Polymeros, Iosif Beintaris, Asimina Gaglia, George Karamanolis, Ioannis S. Papanikolaou, George Dimitriadis & Konstantinos Triantafyllou

Digestive Diseases and Sciences **59**, 2207–2214 (2014) | Cite this article

1119 Accesses | **18** Citations | **17** Altmetric | Metrics

- Reduced colonic transit time
- Mechanism not known but speculated due to SCFA production

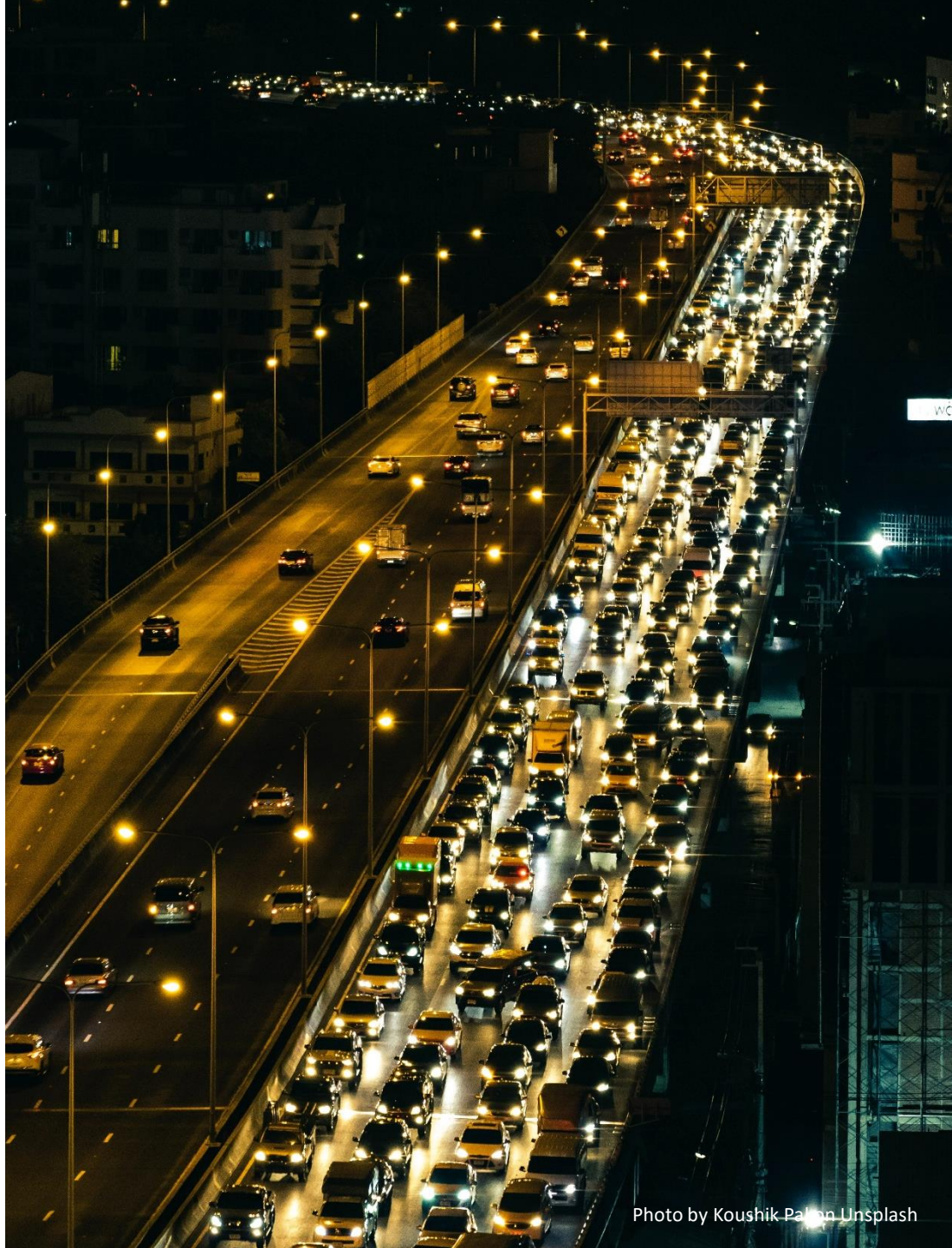


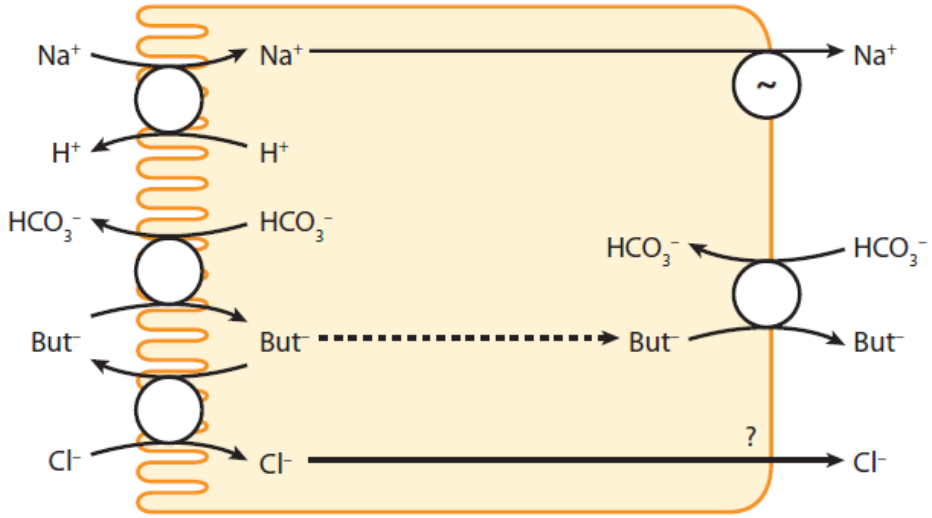
Photo by Koushik Pal on Unsplash

3 DIARRHOEA

Photo by Linus Nylund on Unsplash

A DIARRHOEA

- Monosaccharides and peptides are not readily absorbed in the large intestine due to a lack of transporters
- SCFA are easily absorbed in the colon to stimulate Na and Cl absorption via NHE2 and NHE3 exchangers
- Create a net fluid absorption and restore colonic cell function from butyrate energy source



Binder H.J. (2010) Annu. Rev. Physiol. 72:297-313

B CLINICAL STUDIES

- Clinical trials (7) with a total of 465 participants
- Prevention 10 g/day, reduction of symptoms with dosage of 20 g
- Reduction in liquid stool episodes, duration of total diarrhoea days, and stool volume output

› Nutrition. 2002 Jan;18(1):35-9. doi: 10.1016/s0899-9007(01)00715-8.

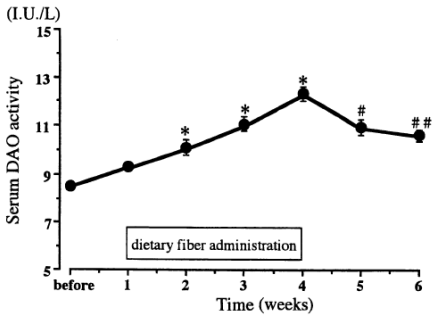
Usefulness of soluble dietary fiber for the treatment of diarrhea during enteral nutrition in elderly patients

Makoto Nakao [1], Yozo Ogura, Syousuke Satake, Izumi Ito, Akihisa Iguchi, Kenji Takagi, Toshitaka Nabeshima

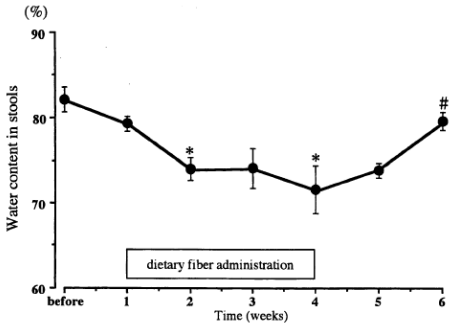
Affiliations + expand

PMID: 11827762 DOI: 10.1016/s0899-9007(01)00715-8

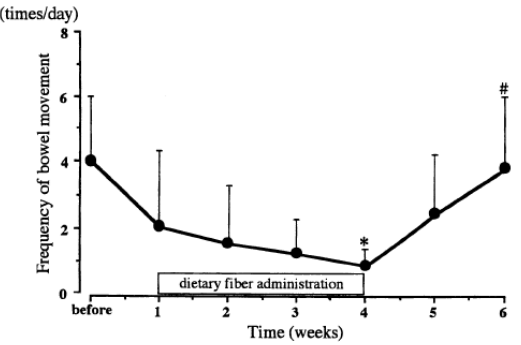
1. Serum diamine oxidase (DAO)



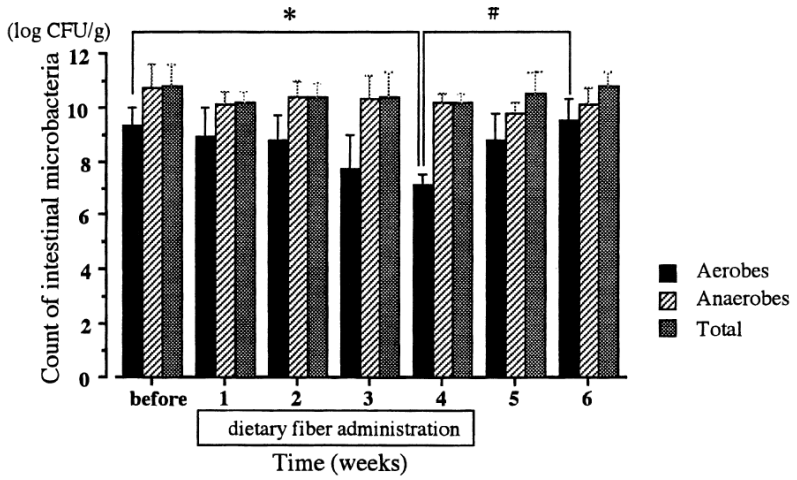
2. Stool Moisture (%)



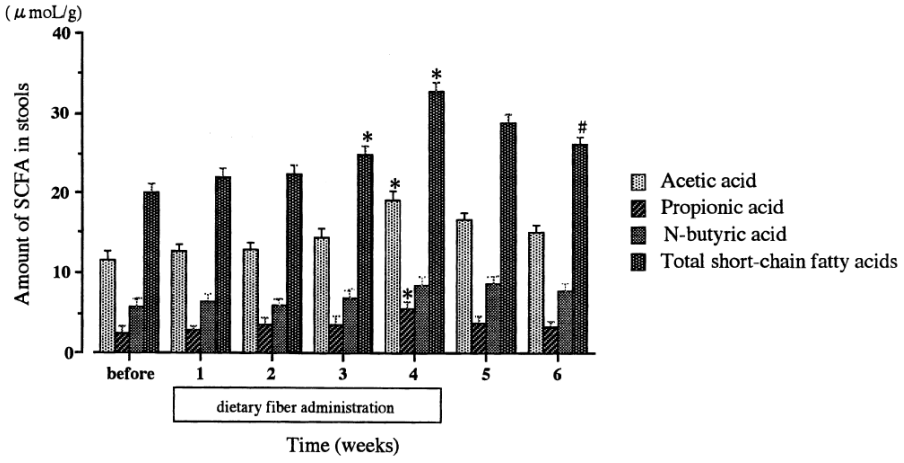
3. Stool Frequency



4. Microbe Count



5. SCFA in Stool



Nakao M. et al (2002) Nutrition 18:35-39

C COLONIC TRANSIT

- PHGG increase colonic transit time (CCT) in diarrhoea patients, correlated with increase cholecystokinin (CCK)
- Allow more time for fermentation and SCFA production
- PHGG not effective in high purging cholera-induced diarrhoea

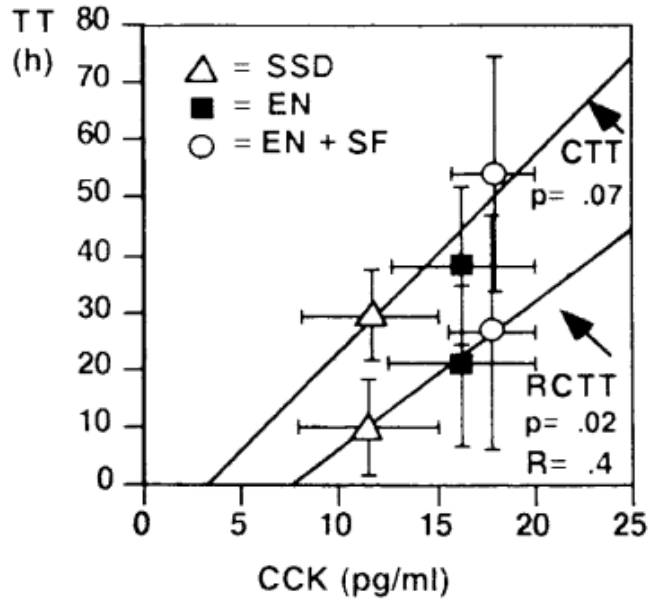
Clinical Trial > JPEN J Parenter Enteral Nutr. May-Jun 1993;17(3):231-5.
doi: 10.1177/0148607193017003231.

Effect of a liquid diet with and without soluble fiber supplementation on intestinal transit and cholecystokinin release in volunteers

R Meier [1], C Beglinger, H Schneider, A Rowedder, K Gyr

Affiliations + expand

PMID: 8389406 DOI: 10.1177/0148607193017003231



4 IRRITABLE BOWEL SYNDROME

Photo by Bret Little on Unsplash

A CLINICAL STUDIES

- Clinical trials (8) with a total of 692 participants on average dosage of 5 g/day
- Functional disorder characterised by symptoms
- Subtypes: diarrhoea, constipation, and alternating
- PHGG effective in alleviating symptoms, reduced gas production, and quality-of-life in the IBS subtypes

Photo by CDC on Unsplash

B MECHANISM OF ACTION

- Slow fermentation prevents production of gases and methane
- Production of SCFAs, increase absorption
- Prebiotic and lower pH, promote growth of *Lactobacillus* and *Bifidobacterium*

C FERMENTATION

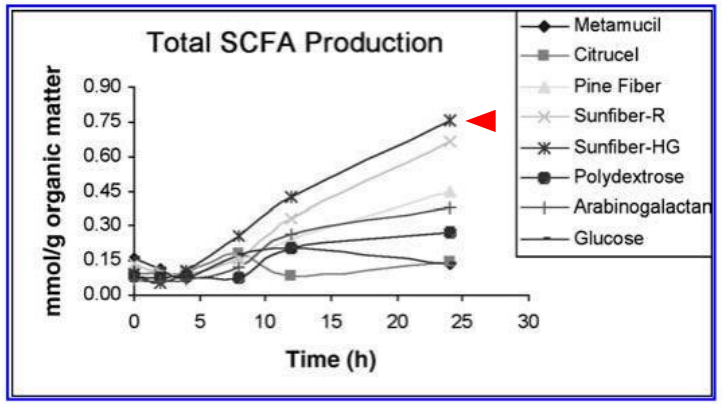
Comparative Study > J Med Food. Spring 2005;8(1):113-6. doi: 10.1089/jmf.2005.8.113.

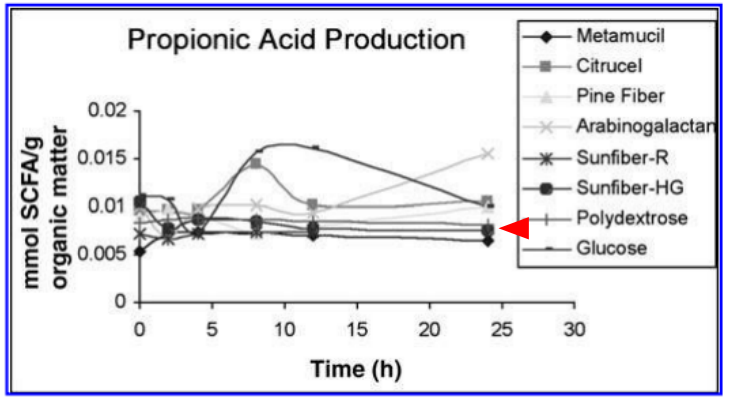
Comparison of different fibers for in vitro production of short chain fatty acids by intestinal microflora

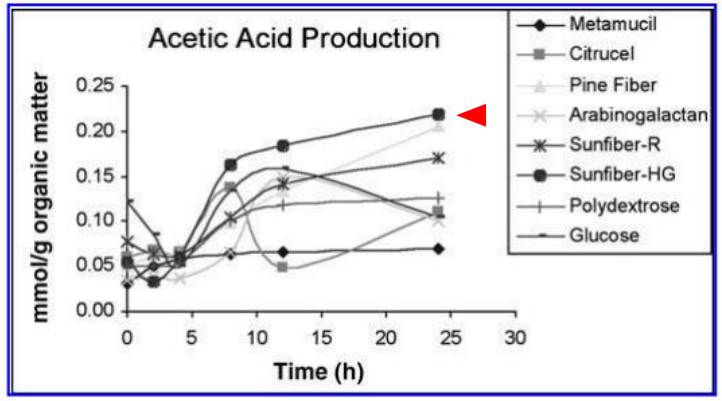
Anne M Pylkas [1], Lekh Raj Juneja, Joanne L Slavin

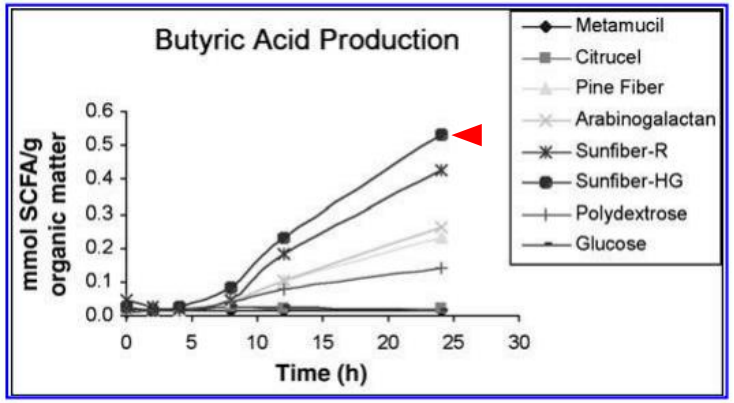
Affiliations + expand

PMID: 15857221 DOI: 10.1089/jmf.2005.8.113









5 GASTROPARESIS

Photo by Михаил Павленко on Unsplash

A GASTROPARESIS

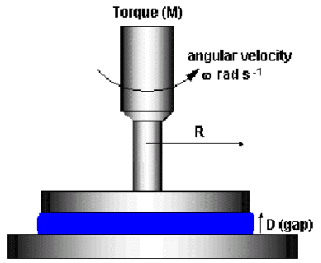
- Functional disorder characterised by delayed gastric transit
- Symptoms managed through dietary restrictions; primarily avoids all types of fibres
- Investigated the tolerability and short-term effects of PHGG in patients with gastroparesis

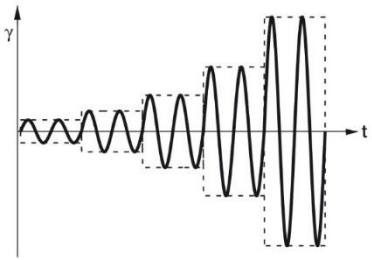
Photo by Alicia Petresc on Unsplash

B RHEOLOGY

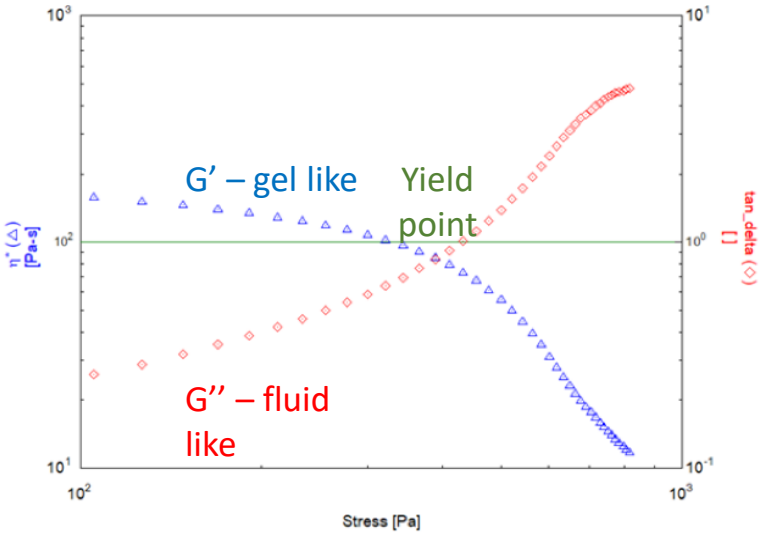
1. Rheometer

2. Frequency sweep





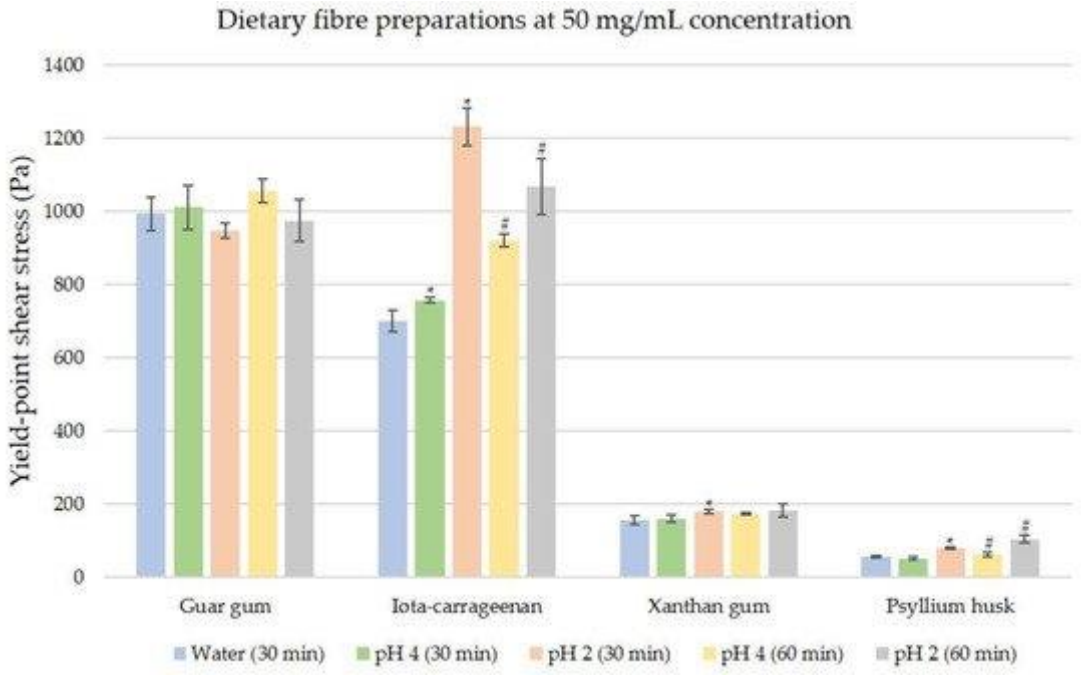
3. Example

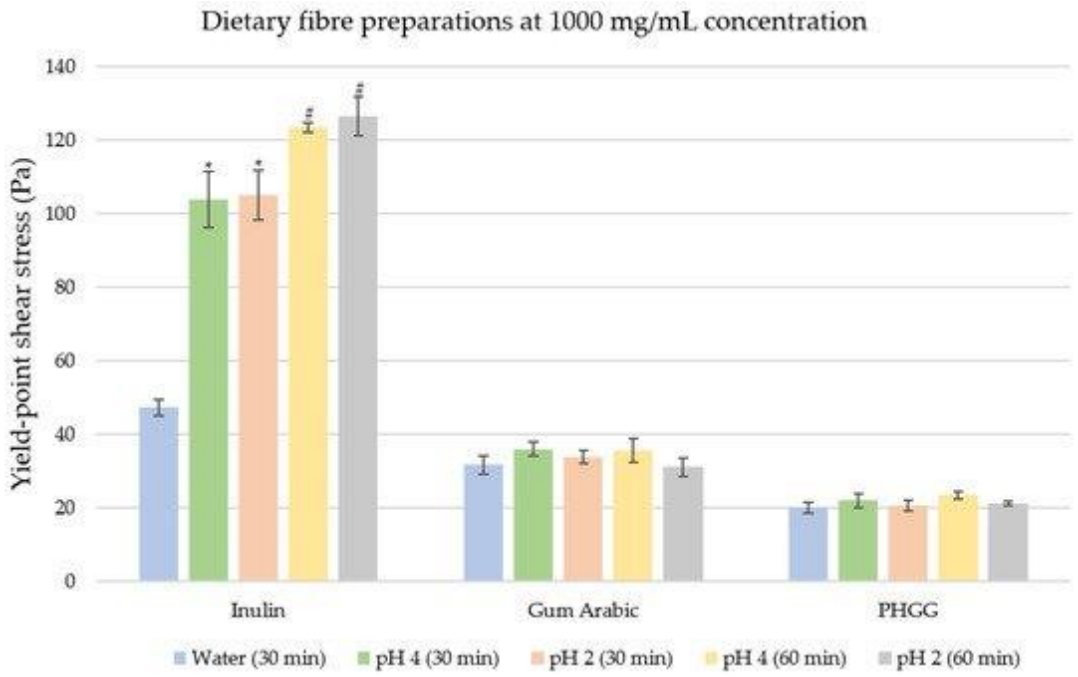


Rheological Characteristics of Soluble Fibres during Chemically Simulated Digestion and their Suitability for Gastroparesis Patients

by Harsha Suresh [1,2], Vincent Ho [1,2,3] and Jerry Zhou [1,2,*]

[1] School of Medicine, Western Sydney University, Campbelltown, NSW 2560, Australia
[2] Gastrointestinal Motility Disorders Unit, Western Sydney University, Campbelltown, NSW 2560, Australia
[3] University Medical Clinic of Camden & Campbelltown (UMCCC), Campbelltown, NSW 2560, Australia
[*] Author to whom correspondence should be addressed.





D CLINICAL DATA

Randomized Controlled Trial > Nutrients. 2021 Nov 28;13(12):4298. doi: 10.3390/nu13124298.

The Short-Term Effects and Tolerability of Low-Viscosity Soluble Fibre on Gastroparesis Patients: A Pilot Clinical Intervention Study

Harsha Suresh [1,2], Jerry Zhou [1,2], Vincent Ho [1,2,3]

Affiliations + expand

PMID: 34959850 PMCID: PMC8704257 DOI: 10.3390/nu13124298

Free PMC article

Table 2. Blood glucose parameters including mean normalized blood glucose values at 30 min intervals, interval area under the curve (iAUC), and time to baseline (TTB) shown for n = 10 participants in the study.

Test Meal (In 200 mL Water)	Average Meal Consumed (g) ± (SD)	Mean Normalized Blood Glucose Differences (mMol/L) ± (SD), Interval Area under the Curve or iAUC (mMol·min/L), Time to Baseline (min)								
		At 30 min	At 60 min	iAUC (1 h)	At 90 min	At 120 min	iAUC (2 h)	At 150 min	At 180 min	TTB
Water (Negative control)	0 (0) *	5.1 (2.8)	5.9 (4.9) **	241.83	2.3 (0.8)	1.5 (1.4)	420.83	0.6 (2.1)	0.1 (1.8)	180 min
Psyllium Husk (Positive control)	4.13 (1.18)	3.9 (0.6) **	3.5 (1.9)	169.13	2.6 (2.2)	1.8 (2.3)	325.50	0.7 (2.1)	0.0 (1.0)	180 min
PHGG (Test fibre 1)	7.99 (1.92)	3.9 (1.5) **	3.5 (1.8)	169.50	2.2 (2.0)	1.5 (1.4)	309.00	0.0 (1.6)	−0.7 (1.2)	150 min
Gum Arabic (Test fibre 2)	7.57 (1.54)	4.1 (1.7) **	4.0 (1.6)	184.93	2.2 (2.1)	0.7 (1.9)	322.29	−0.3 (1.7)	−0.7 (0.6)	150 min

(*) All participants completed the 200 mL water meal (i.e., no test fibre). (**) Indicates the time and mean normalized concentration for the glucose peak in each test meal.

Table 3. Mean normalized ANMS GCSI-DD scores across all time-points for n = 10 participants in the study, with Composite (1) score for (Nausea/Vomiting); Composite (2) score for (Post-prandial Fullness/Early Satiety) and Composite (3) score for Bloating/Distension.

Symptom Subscale (Composite No.)	GCSI-DD (Symptom)	Mean Normalized ANMS GCSI-DD Scores ± (SD) (n = 10)				
		Baseline Mean (Pre-Meal Scores) *	Water (Negative Control)	Psyllium Husk (Positive Control)	PHGG (Test Fibre 1)	Gum Arabic (Test Fibre 2)
Nausea/ Vomiting (1)	Nausea	1.55 (1.15)	0.04 (1.22)	0.90 (0.73)	1.00 (1.41)	0.12 (0.72)
	Retching	0.45 (0.83)	−0.31 (1.03)	0.04 (0.63)	0.71 (1.47)	0.05 (0.13)
	Vomiting	0.40 (0.81)	−0.37 (1.11)	0.60 (1.16)	0.85 (1.33)	0.05 (0.13)
Post-prandial Fullness/ Early Satiety (2)	Stomach Fullness	2.43 (1.91)	0.17 (1.22)	1.40 (1.22)	0.35 (1.04)	0.40 (0.95)
	Early Satiety *	3.35 (0.91)	−0.78 (0.97)	0.88 (0.64) **	−0.38 (1.69)	0.43 (0.98)
	Post-prandial Fullness *	3.83 (0.73)	−0.22 (0.83)	0.25 (0.46)	0.00 (0.53)	0.29 (0.76)
	Loss of Appetite	2.58 (1.82)	−0.41 (0.92)	1.10 (1.51) **	0.63 (1.02) **	1.17 (1.52) **
Bloating/ Distension (3)	Bloating	2.10 (1.68)	−0.17 (0.70)	1.52 (1.14) **	0.44 (0.94)	0.50 (0.64) **, ***
	Belly Visibly Larger	1.88 (1.77)	−0.17 (0.60)	1.27 (1.09) **	0.35 (0.71)	0.12 (0.44) ***
Composite Scores	Composite (1)	0.80 (1.06)	−0.22 (1.10)	0.51 (0.48) **	0.85 (1.30)	0.07 (0.29)
	Composite (2)	3.04 (1.50)	−0.31 (0.65)	0.91 (0.70) **	0.15 (0.75) ***	0.57 (0.64) **, ***
	Composite (3)	1.99 (1.68)	−0.17 (0.56)	1.40 (1.09) **	0.40 (0.82)	0.31 (0.48) **, ***

(*) Reported mean baseline scores (0 min) are patient-rated (n = 10), before each study session and not normalized, with early satiety and post-prandial fullness measured once immediately after the meal. (**) Indicates significant difference ($p \leq 0.05$) vs water (negative control). (***) Indicates significant difference ($p \leq 0.05$) vs psyllium husk (positive control).

6 SUMMARY

D SUMMARY

Disorders	# studies	# participants	Dosage	Outcomes
Constipation	14	631	<10 g/day	• Increased bowel motion and stool bulk • Symptoms improvements • Chronic and slow transit constipation
Diarrhoea	7	465	< 10 g/day Prevention 20 g Reduction	• Reduction in diarrhoea • Reduction in symptoms • SCFA production • Increased absorption
IBS	8	692	5 g/day	• Reduction in symptoms • Improve quality of life • Beneficial bacteria

THANK YOU

Feel free to reach out for collaborations and PhD opportunities

Dr Jerry Zhou

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Photo by Ivy Jiang