	INL NO. B6912	PROJECT Nestle	DESCRIPTION clinical_PHGG

PHGG CLINICAL
DATA SUMMARY

Scientific Information

NestléHealthScience

What is PHGG?

PHGG (Partially Hydrolysed Guar Gum) is a 100% soluble dietary fibre extracted from the guar plant.[1,2]

- PHGG is a well tolerated fiber source[1,2]
- PHGG is a low FODMAP fiber and is associated with less bloating, gas and loose stool than other fibers FODMAP fibers[1,2]
- PHGG promotes and supports good digestive health[1,2]
- PHGG supports normal bowel function[1,2]

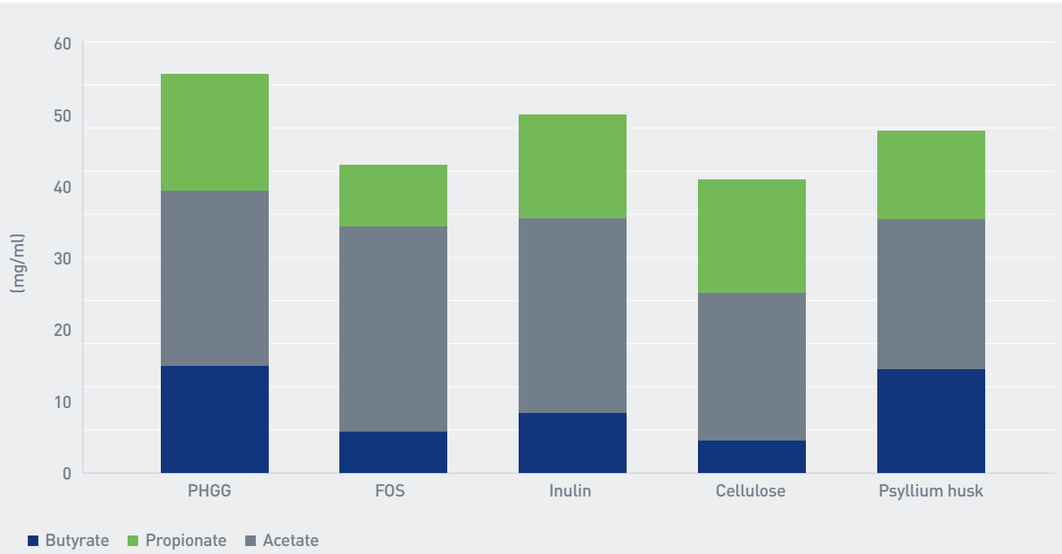
How does PHGG differ from other fiber?

Compared to other fiber sources such as inulin, polydextrose and psyllium, the fermentation of PHGG results in the production of higher amounts of Short Chain Fatty Acids (SCFAs) including butyrate *(figure1)*.[3]

Many of the physiological effects of PHGG are due to its fermentation by colonic bacteria leading to the production of SCFA which exert various positive effects on colonic function.[4]

All the digestive health effects were observed with intake of about 5 to 6 g of guar fiber/day.[2]

Figure 1 In-vitro production of SCFA after 24 hours of fermentation for PHGG and other fiber foods



- PHGG fiber produces a greater quantity of SCFA (mg/ml) after 24 hours compared with other dietary fibers due to slower fermentation.[3]
- Butyrate is the preferred fuel for colon epithelial cells which metabolize 70–90% of the butyrate produced by PHGG fermentation.[4,9]

Key function of PHGG

PHGG as a dietary fiber plays a considerable role in modifying gastrointestinal (GI) microbiota.[8] PHGG promotes the proliferation of beneficial microorganisms, through increased Bifidobacteria and Lactobacillus and maintaining gut physiology.[9,10]

SCFAs normalize water and electrolyte absorption in the colon helping to regulate stool consistency and bowel movements through increased fecal bulk.[5,11]

Ingestion of PHGG aids mineral absorption and improves lipid metabolism.[12] A reduction in serum cholesterol and triglycerides along with a significant lowering of plasma glucose levels further improves acute postprandial plasma glucose and insulin response. (6g of PHGG /each meal)[12]

Recommendation guidelines

- ESPEN recommends the use of PHGG to prevent enteral nutrition induced diarrhoea in post surgical and in critically ill-patients.[25]
- PHGG also showed beneficial effects in children with acute and chronic diarrhea.[25]

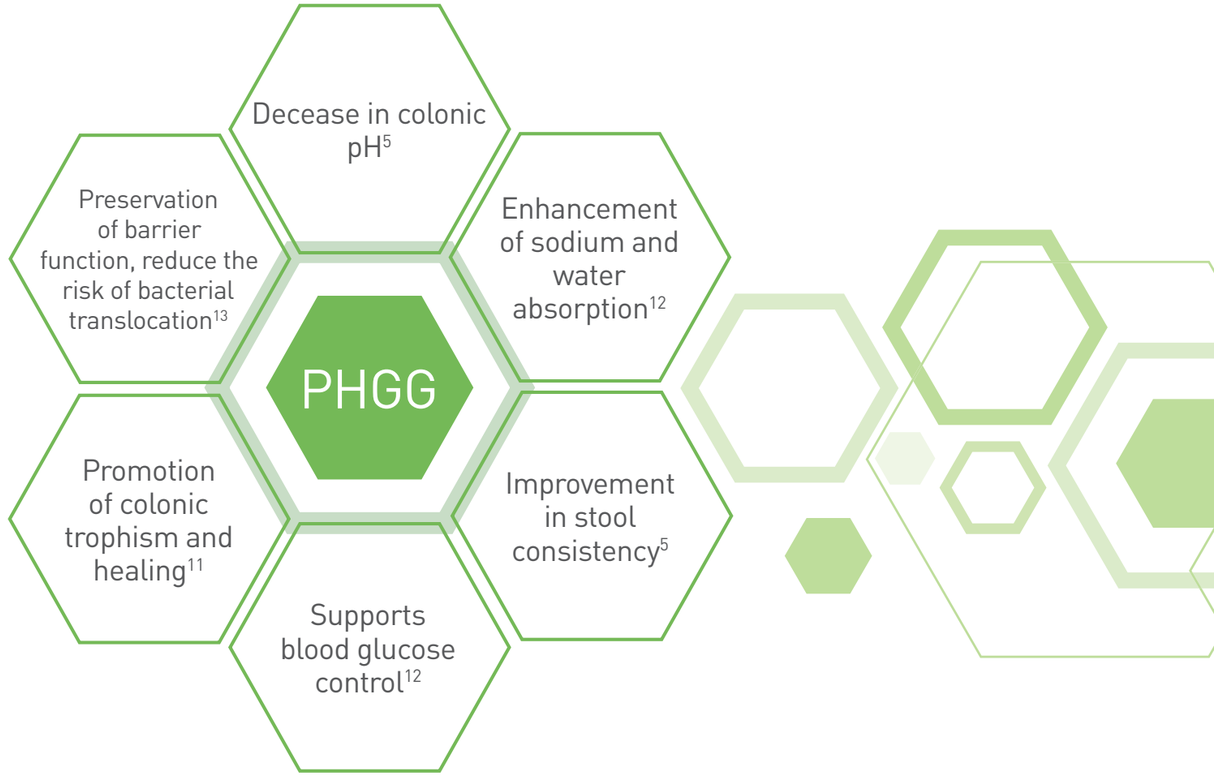


Table 1 Summary of clinical studies on the effects of PHGG on diarrhea

Reference	Title	Participants	Study objective	Intervention groups	Key results
Lampe et al. 1992[14]	Gastrointestinal effects of modified guar gum and soy polysaccharide as part of an enteral formula diet	11 healthy adults	To examine the effects of PHGG supplementation (21 g/L) as enteral nutrition for the improvement of gastrointestinal responses	Patients were randomized to receive the following interventions for 18 days: 1. Fiber-free formula and daily intakes of maltodextrin 2. 15g of total dietary fiber as PHGG (21g/day) 3. 15 g of total dietary fiber as soy polysaccharide (21g/day)	• PHGG group had increased mean stool transit time compared to soy or fiber-free groups • Fecal nitrogen excretion was greater in the PHGG group compared with the fiber-free group
Spapen et al. 2001[15]	Soluble fiber reduces the incidence of diarrhea in septic patients receiving total enteral nutrition: a prospective, double-blind, randomized and controlled trial	25 patients on enteral nutrition with diarrhea	To examine the effect of PHGG supplementation (20 g/L) for the improvement of diarrhea	Patients were randomized to receive the following interventions for 6-21 days: 1. Enteral formula supplemented with PHGG (22g/L) 2. Isocaloric, isonitrogenous, f iber-free control feed	• Mean frequency of diarrhea days was significantly lower in patients receiving PHGG (8.8 PHGG vs 32.0 control, p = 0.001) • PHGG-fed patients had significantly less days with diarrhea per total feeding days (10.8% PHGG vs 31.5% control, p <0.01) • PHGG-fed patients had a lower mean diarrhea score (4.8 PHGG vs 9.4 control, p <0.001) • PHGG-fed patients had less incidences of diarrhea on at least 1 day compared to control group (6 PHGG vs 11 control)
Nakao et al. 2002[16]	Usefulness of soluble dietary fiber for the treatment of diarrhea during enteral nutrition in elderly patients	20 patients with diarrhea	To examine the effect of incremental PHGG usage for the improvement of liquid diet-induced diarrhea	All patients were given an initial dose of 7g of soluble dietary fiber which gradually increased to 28g in 1-wk intervals	• Water content (p <0.05), pH of stools (p <0.05), and bowel movements (p <0.05) were significantly decreased after 4-wk treatment with PHGG compared to baseline • Factors increased again after discontinuation of fiber treatment
Rushdi et al. 2004[17]	Control of diarrhea by fiber-enriched diet in ICU patients on enteral nutrition: a prospective randomized controlled trial	20 patients on enteral nutrition with diarrhea	To examine the effects of PHGG supplementation (20 g/L) as enteral nutrition for 4 days for the improvement of diarrhea	Patients were randomized to receive the following interventions for 4 days: 1. 2% PHGG enriched feed (20g/L) 2. Fiber-free standard feed	• PHGG-fed group had a reduced number of liquid stool episodes after 4 days treatment (Episodes: 1 (4 days) vs 2 (baseline), p <0.01] • Control-fed group had an increased number of liquid stool episodes after 4 days treatment [Episodes: 2.1 (4 days) vs 1.2 (baseline), p <0.05]
Homann et al. 2004[18]	The beneficial effects of PHGG in enteral nutrition in medical and surgical patients	100 medical and surgical patients on enteral nutrition with diarrhea	To examine the effects of PHGG supplementation (20 g/L) as enteral nutrition for the improvement of diarrhea	Medical and post-surgical patients were randomized to receive the following interventions for 5 days: 1. PHGG enriched enteral feeding 2. Standard enteral tube feeding post-surgery	• Incidence of diarrhea occurred was significantly lower in patients on PHGG diet (12% PHGG vs 30 control, p <0.05) • Number of diarrhea days was significantly lower in patients on PHGG diet (10.2 days PHGG vs 40.6 days control, p <0.05) • Discontinuation of enteral feeding was more common in the control group compared to PHGG group
Alam et al. 2005[19]	Partially hydrolyzed guar gum supplemented comminuted chicken diet in persistent diarrhea: a randomized controlled trial	116 male children with a history of watery diarrhea	To examine the effects of PHGG supplementation (20 g/L) with an oral rehydration solution for the improvement of diarrhea	Patients were randomized to receive the following interventions for 7 days: 1. Comminuted chicken diet with PHGG 2. Comminuted chicken diet without PHGG (control)	• Diarrhea was resolved in a significantly greater number of patients on the PHGG diet (84% PHGG vs 62% control, p =0.02) • Duration of diarrhea was reduced in patients on the PHGG diet (p =0.0017) • Stool output was also significantly reduced from day 4 to day 7 in patients on the PHGG diet
Reider et al. 2020[20]	Prebiotic Effects of Partially Hydrolyzed Guar Gum on the Composition and Function of the Human Microbiota-Results from the PAGODA Trial	20 healthy volunteers (19 completed the study) undergoing PHGG supplementation	To investigate the microbiota-modelling effects of the soluble fibre, partially hydrolyzed guar gum (PHGG)	3-week intervention phase (5g PHGG up to t.i.d.) Daily stool diaries and weekly serum/plasma and stool samples reported over 9 weeks	• Participants had significant changes in bowel habit and number of daily stools (p<0.01) which did not persist in the 3-week washout period • Significant effects in stool frequency and consistency, which were gender dependent • PHGG had both suppressing and enhancing effects on specific microbiota abundance which ceased on removal of the PHGG intervention. The majority of effects were more evident in male participants
Yasukawa et al. 2019[21]	Effect of Repeated Consumption of Partially Hydrolyzed Guar Gum on Fecal Characteristics and Gut Microbiota: A Randomized, Double-Blind, Placebo-Controlled, and Parallel-Group Clinical Trial	44 healthy volunteers with a trend of diarrhea	To evaluate how PHGG affects diarrhea symptoms and changes in microbiota	Participants were randomized (PHGG (n=22) vs placebo (n=22) groups) and intervention group ingested 5g PHGG daily over 12 weeks	• Stool form was significantly improved over the 12-week intervention period (p<0.01) with QoL improvement • PHGG consumption significantly increased fecal characteristics data at ≥50% for BSS level 4 with no changes to stool frequency • Normalized gut environment with marked increase in abundance of Bifidobacterium (p<0.05) and a corresponding reduction of Bacteroides in the PHGG group
Ohashi et al. 2015[9]	Consumption of partially hydrolysed guar gum stimulates Bifidobacteria and butyrate producing bacteria in the human large intestine	10 healthy female adults undergoing PHGG supplementation to normal diet	To investigate bacterial contribution to the fermentation of PHGG by analysis of butyrate-producing bacteria and fecal microbiota	Subjects consumed normal diet for 2 weeks (before period), then 6g of PHGG q.d. for 2 weeks (intake period), followed by normal diet for 2 weeks (after period) with collection of fresh feces on the final day of each period	• Bifidobacterium, C. coccoides group, Roseburia/E. rectale group, E. halli, and bacterium SS2/1 were significantly increased with the intake of PHGG (all P<0.05), but not concentrations of fecal organic acids • An increase in butyryl-CoA:acetate CoA-transferase gene with PHGG encourages butyrate-producing bacteria to ferment PHGG in the human large intestine • Roseburia/E. rectale group, Bifidobacterium, and butyrate-producing bacteria may contribute to the fermentation of PHGG in the human large intestine

Table 2 Summary of clinical studies on the effects of PHGG on IBS-D

Reference	Title	Participants	Study objective	Intervention groups	Key results
Parisi et al. 2005[22]	Treatment Effects of Partially Hydrolyzed Guar Gum on Symptoms and Quality of Life of Patients with Irritable Bowel Syndrome. A Multicenter Randomized Open Trial	86 IBS participants	To examine the effects of low-dose (5 g/day) and high dose (10 g/day) of PHGG supplementation for improvement of IBS	Patients were randomized to receive the following interventions for 6 months 1. 5 g/day PHGG 2. 10/day PHGG	• Both groups of PHGG-supplemented patients had significantly reduced mean scores on scales for gastrointestinal symptoms (GSRS, domains: dyspepsia, digestion and intestinal [decreased or increased passage of stools, loose or hard stools, urgent need to defecate, and feeling of incomplete evacuation) syndromes]) after 6 months compared to baseline ($p < 0.05$) • Both groups of PHGG-supplemented patients had significantly improved quality of life (SF-36, domains: role physical, bodily pain, general health, vitality and mental health) after 6 months compared to baseline ($p < 0.05$) • Both groups of PHGG-supplemented patients had significantly improved psychological distress (HADS, domains: anxiety and depression) after 6 months compared to baseline ($p < 0.05$)
Paul et al. 2011[23]	Stool consistency and abdominal pain in irritable bowel syndrome may be improved by partially hydrolysed guar gum	46 children with IBS	To examine the effects of PHGG in the management of IBS in the pediatric population	Patients received Resource Optifibre (Nestlé HealthCare Nutrition, Vevey, Switzerland) containing PHGG for 6-8 weeks	• IBS-D symptoms were improved by 58% with the intake of guar fiber • Abdominal pain associated with IBS was improved by 68%
Furnari et al. 2012[24]	Efficacy of Partially Hydrolyzed Guar Gum in Reducing Methane Excretion and Clinical Manifestation of Subjects Suffering from Irritable Bowel Syndrome	40 IBS patients	To examine the effects of PHGG supplementation (5 g/day) for improvement of GI symptom severity and methane production in IBS	Patients were randomized to receive the following interventions for 4 months: 1. PHGG supplement (5g/day) 2. No supplementation	• Gastrointestinal symptom improvement (as measured using the Gastrointestinal Symptom scale which includes diarrhea) was observed in >50% of PHGG-supplemented patients after 4 months intervention compared to baseline ($p < 0.001$) • Methane reduction was observed in >50% of PHGG-supplemented patients after 4 months intervention compared to baseline ($p < 0.001$)

Notes:

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