

**Nutrition
Centre**

By TATE & LYLE



PROMITOR[®]
Soluble Fibre

**Soluble Fibre
and mineral
absorption**

PROMITOR® Soluble Fibre and mineral absorption

Dietary fibres are important nutrients for human health. Fibre-rich diets contribute to gastrointestinal health, gut function, positive changes in the gut microbiota, increased satiety, reduced blood glucose and cholesterol markers, and immune health.

Increasing fibre intake is a favourable nutritional strategy for reducing the risk of chronic diseases such as obesity, type 2 diabetes, cardiovascular disease, and cancer.¹⁻⁵

The relationship between dietary fibre and mineral absorption has been studied for many years, yet it remains controversial in the scientific literature.

Although in-vitro (lab-based) studies have presented conflicting outcomes, both animal and human studies have failed to demonstrate negative effects of fibre on the bioavailability of micronutrients. On the contrary, they have highlighted some positive results on the absorption of minerals such as calcium, magnesium, iron and zinc.⁶⁻⁹

Fibre-rich diets contribute to:



Gastrointestinal health



Gut function



Positive changes in the gut microbiota



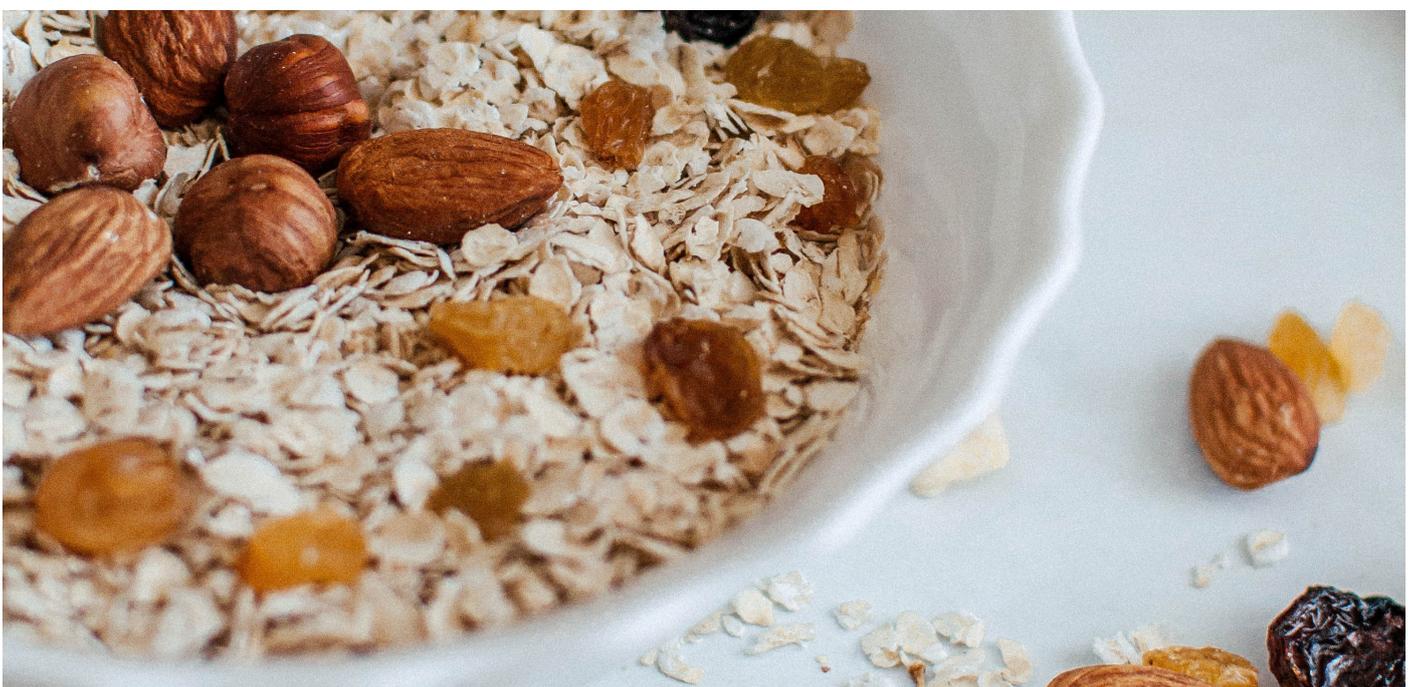
Increased satiety



Reduced blood glucose and cholesterol markers



Immune health



The complexity of mineral absorption

Micronutrient bioavailability is the rate and extent to which micronutrients, such as mineral and vitamins, are absorbed in the gut and enter the bloodstream to be used by the body.¹⁰ Bioavailability mechanisms are complex and depend on many factors that need to be taken into account. In addition to the amount of nutrient present in a food or beverage and the chances that nutrient–nutrient interactions will occur, when it comes to the individual, age, genetics, lifestyle, nutritional status and health status also play a role.¹¹

Antinutritional factors, for example, are substances that interfere with the digestibility, absorption and use of minerals and vitamins and that can negatively affect micronutrient bioavailability.

Also known as antinutrients, these substances include phytates, oxalates, tannins, nitrites, and nitrates. Dietary fibre is sometimes mistaken for an antinutritional factor.¹²

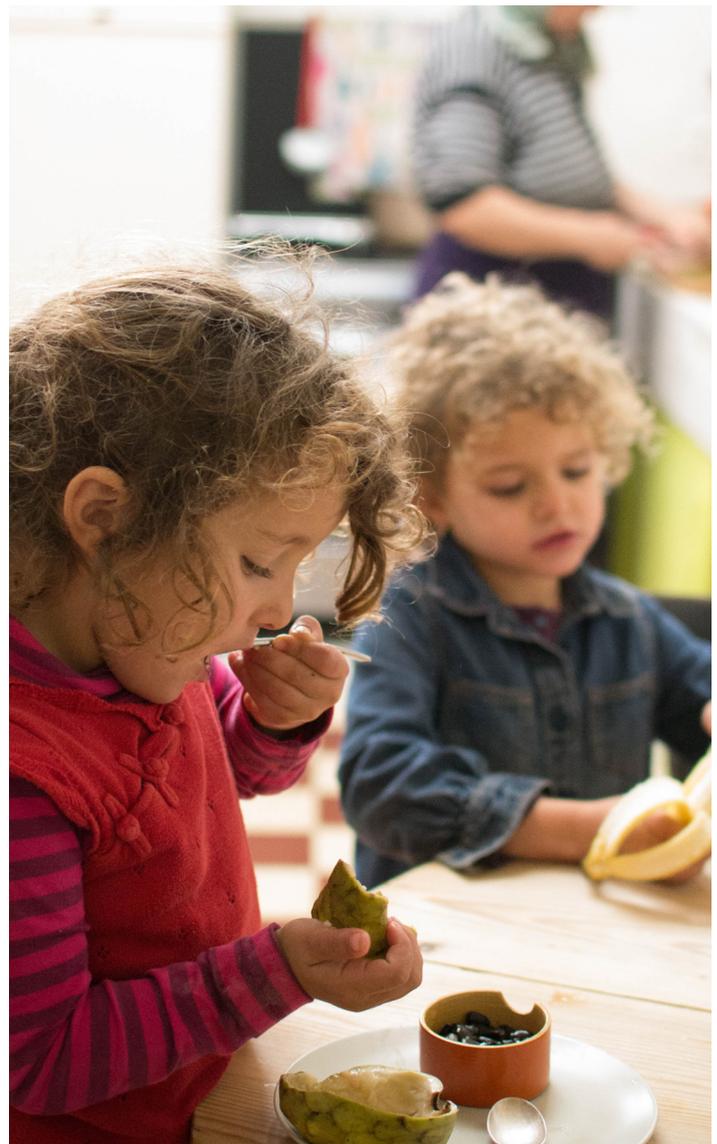
Fibre and mineral absorption

Dietary fibres, categorised by their chemical structure and functional properties, may have different effects on mineral bioavailability.¹³ In the literature, there is still no conclusive evidence of the effects of fibres on mineral absorption and, although several reviews of dietary fibres have been published in the last decade, little emphasis has been placed on the effects of dietary fibres on mineral bioavailability.⁶

Although some early studies, mainly performed in-vitro, have reported negative effects of fibre on mineral absorption, animal and human studies have failed to confirm these results.^{4,6,14} In humans, several studies of fibre interventions have shown positive effects on mineral absorption.^{15–20}

In general, insoluble fibres, those that are not soluble in water and are susceptible to limited fermentation, may bind minerals forming unabsorbable complexes.

Soluble fibres, on the other hand, have a more variable effect, frequently promoting mineral absorption.^{19,21,22}



Prebiotic fibres and the gut microbiota's role in mineral absorption

The gastrointestinal tract houses the largest and most complex community of bacterial species in the human body.²³ There is a growing interest in the role of the gut microbiome in physiological processes that affect health, acknowledging the importance of bacteria for gut barrier function, energy metabolism, nutrient supply, immune and inflammatory responses, and the prevention and treatment of disease.²⁴ Substances generated by bacterial metabolism can also enable communication with peripheral tissues, via gut-brain, gut-bone, and gut-skin axes.²⁵

A prebiotic is defined as a substrate that is selectively utilised by host microorganisms conferring a health benefit.²⁶ This definition covers both dietary fibres and ingredients that are non-carbohydrate-based (e.g. polyphenols and polyunsaturated fatty acids), recognising their efficacy and ability to promote beneficial gut microbiota modulation.²⁴ Changes in the composition of the colon microbiota can increase the number and activity of specific bacteria associated with mineral absorption.²⁴

Dietary fibres are the most studied nutrients in the context of gut microbiota modulation via their prebiotic properties. Prebiotic fibre serves as a substrate for producing short-chain fatty acids (SCFAs) and preserving the gut barrier. Metabolites produced by bacteria in the gut nourish cells and lead to increased crypt depth, intestinal cell density, and cecal blood flow, potentially increasing the absorption surface for minerals such as calcium, magnesium and zinc.^{9,27}

Another potential mechanism explaining the relationship between intestinal microbiota and mineral absorption relates to changes in the gut environment.

Fermentation of prebiotic fibres by certain bacteria that are able to break down carbohydrates, leads to SCFA production and subsequent reduction in the gut pH that could ionize calcium from negatively charged compounds in the colon, thus allowing it to be absorbed into the bloodstream.²⁴

Potential mechanisms of fibre promoting mineral absorption ²⁴



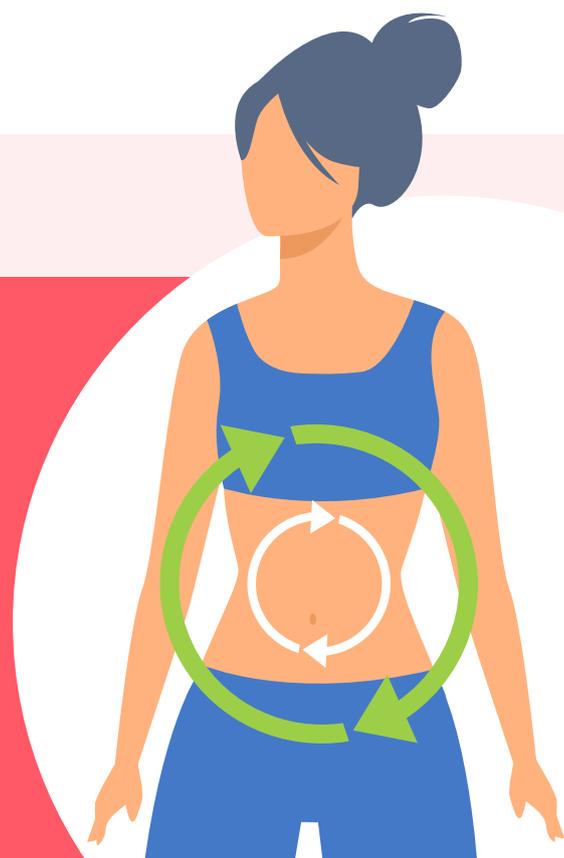
Dietary fibre can alter the composition of the colon microbiota and can increase the number and activity of specific bacteria associated with mineral absorption.



Soluble fibre fermentation can produce short-chain fatty acids (SCFAs) increasing the intestinal absorption surface area, improving the absorption of minerals such as calcium, zinc and magnesium.



Increased SCFAs production decreases the gut pH, increasing the solubilisation of minerals and improving their absorption and use.



Soluble corn fibre: prebiotic potential for improved mineral absorption

Prebiotic fibres beneficially modulate the bacterial composition in the colon, which impacts the gut environment and can lead to benefits in mineral absorption.^{24,28}

Soluble corn fibre increases beneficial bacteria and total faecal SCFAs and demonstrates improved mineral absorption benefits, confirming its prebiotic effects.^{7,24,29-31}

Figure 1.
How calcium absorption can be promoted by prebiotic fibre^{8,9,32,33}



Soluble corn fibre prebiotic effects and mineral absorption

Study Reference	Objectives	Design	Results	Conclusion
MAATHUIS et al., 2009 34	Prebiotic potential of maize-based fibres including soluble corn fibre (SCF) and its influence on the composition and activity of the microbiota	Dynamic, validated, in vitro model of the large intestine.	Increased short-chain fatty acids (SCFAs), showing that fibres were fermentable especially soluble dietary fibre test products with SCF, pullulan and soluble fibre dextrin. Increase of Bifidobacterium and some Lactobacillus species.	Fibres showed prebiotic activity in terms of increases in growth and or activity of beneficial bacteria.
COSTABILE et al., 2016 35	Determine changes to microbiota and fermentation of SCF in healthy adult subjects	Double-blind, randomised, parallel study. 24 healthy adults. 14 days. 8g, 1 g and 21g SCF in 250 ml of drink.	Results indicate a significant increase in Bifidobacterium spp. with the intake of 6g of SCF. With the dose of 14g of SCF, there was a reduction in the pathogenic bacteria C. perfringens gp.	Prebiotic effect of SCF observed during a short-term intervention.
BOLER et al., 2011 31	Digestive physiological outcomes of functional fibre (SCF)	Randomised, double-blind, placebo-controlled, cross over study; 21 days. 21 healthy adult men. 21g/d SCF (3 snack bars).	Bifidobacterium spp. concentrations were significantly greater ($p<0,05$) on the group consuming SCF vs no fibre.	SCF appears to be beneficial to gut health with minimal gastrointestinal upset.
WHISNER et al., 2014 7	SCF effect on Ca absorption and correlation between gut bacterial genera and Ca absorption	Double-blind, cross over, randomized trial. 24 adolescents. 2 x 3-weeks study. 12g/d SCF (fruit snack) vs control (0g/d).	Increased SCFA-producing bacteria in the intervention group. Firmicutes decreased and average proportion of Bacteroidetes was significantly greater with SCF vs control. Ca absorption 12% greater with SCF.	Intake of SCF increased Ca absorption. Increase in Bacteroidetes and a trend towards a greater increase in Bifidobacterium were observed, suggesting SCF stimulated beneficial bacteria capable of fermenting fibres/producing SCFA.
WHISNER et al., 2016 29	SCF effect on Ca absorption associated with shifts in the gut microbiota	Double-blind, cross over study. 28 healthy female adolescents. 4 weeks + 3-4 w washout. Dose response (0, 10g, 20g) SCF (muffin and beverage).	Significant differences in fecal microbial community diversity with SCF intake. Calcium absorption increased significantly with 10g (13.3%) and 20g (12.9%) SCF vs control.	Intervention beneficially changed the composition of the gut microbiota, significantly increasing the number and diversity of bacteria. Increased calcium absorption with two groups of bacteria potentially involved, one directly fermenting SCF and the second fermenting SCF metabolites further.

PROMITOR® Soluble Fibre enhances calcium absorption

The gut microbiome is a key regulator of bone health. The use of dietary fibre is considered an effective method to increase calcium absorption and bone mineral density especially among individuals with inadequate calcium intake.

Adequate calcium intake and absorption is considered an economic and sustainable approach to help improving skeletal health and/or fracture prevention during all stages of life.²⁴

During pubertal growth, when insufficient calcium intake can negatively influence the achievement of peak bone mass, soluble corn fibre increased the absorption of calcium by 6-12%, compared to control treatments.^{7,29,36}

PROMITOR® Soluble Fibre demonstrates prebiotic effects and increases calcium absorption, helping to meet bone health needs, particularly in adolescents.^{7,24,29}



PROMITOR® Soluble Fibre demonstrates prebiotic action increases calcium absorption by 12% in adolescents.⁷

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