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Review Article

Role of psyllium husk in metabolic disease management: A review

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Abstract
The carbohydrate-rich plant-based dietary fibres, commonly known as roughage, are indigestible in the human intestine. Fruits, vegetables, cereal grains, nuts, and legumes are the most common sources of dietary fibers. An adequate intake of natural dietary fibre is linked to improved intestinal health and reduced metabolic conditions, such as diabetes, obesity, and cardiovascular disease. Psyllium husk is a plant-based dietary fibre source with potential health benefits. It is a derivative of seeds of *Plantago ovata* from Plantaginaceae family. This review examines the botanical origin, biochemical properties, health benefits, role in managing various diseases, safety, and recommended dosages. Psyllium enhances gastrointestinal health by alleviating constipation, regulating bowel movements, controlling diarrhoea, and promoting a balanced gut microbiota through its excellent gelling properties. As a prebiotic, it stimulates digestion and reduces inflammation by promoting the growth of gut-beneficial bacteria such as Lactobacillus and Bifidobacterium. It is a valued dietary supplement that helps manage metabolic syndrome, including obesity, diabetes, and heart disease. Psyllium increases satiety, decreases hunger, and reduces caloric intake, all of which are beneficial in weight management. It contributes to reducing postprandial peaks by enhancing insulin sensitivity and regulating blood glucose levels. It binds bile acids in the intestine and minimizes the levels of Low-Density Lipoprotein (LDL), thus favouring cardiovascular health while eliminating the possibility of atherosclerosis. Psyllium's efficacy in addressing kidney diseases, cognitive issues, and skin inflammation, based on the gut-brain axis association, is an emerging area of research. The diverse health benefits profile of psyllium husk provides an opportunity to explore its innovative applications in functional foods and nutraceuticals, offering a promising solution to modern dietary and health issues.

Keywords: Cardiovascular, Diabetes, Diet, Dietary fibers, Gut health, Psyllium husk

INTRODUCTION

Dietary fibre is essential to a balanced diet, which helps with anticipated metabolism, efficient digestion, and weight regulation to maintain the body's health (Aleshkov *et al*., 2020). Soluble dietary fibres are recognized for their abilities to improve gut health, regulate blood sugar levels, and reduce cholesterol (Guan *et al*., 2021; Smith *et al*., 2023). Psyllium husk is a remarkable source of dietary fibre and is widely used in conventional and modern drug therapies due to its excellent therapeutic properties. A balanced diet incorporating psyllium husk is centered on gut health, promoting regular bowel movements and weight management (Sharma *et al*., 2023; Smith *et al*., 2023). Psyllium exhibits significant pharmaceutical benefits in mitigating the risks of obesity, diabetes, and cardiovascular diseases, extending beyond its digestive properties (Kumar *et al*., 2022; Nguyen & Singh, 2021; Pal *et al*., 2021). Psyllium is thus signified as a very crucial element of modern dietary practice. This review aims to outline the potential health benefits of psyllium husk, including its clinical studies, safety, and therapeutic applications. The appraisal of existing literature will help to illustrate the importance of psyllium in diet today for improved health.

Psyllium husk is obtained from the seeds of *Plantago ovata*, an herbaceous plant from the family of Plantaginaceae (Katke *et al*., 2020; Patel and Kumar, 2020; Przybyszewska *et al*, 2024). Although it originates from the Indian subcontinent, it is cultivated throughout Asia, the Mediterranean region, and parts of North America (Sarfraz *et al*., 2017; Singh *et al*., 2023). Being a hardy

and productive crop, it grows well in arid and semi-arid regions without extra irrigation, thus thriving in challenging agricultural conditions (Asgharipour and Rafiei, 2010; Patel *et al*., 2022). Psyllium is derived from the husk of Plantago ovata, an excellent source of soluble fibre and bioactive compounds (Khan *et al*., 2021; Miller and Zhang, 2021). Compounds associated with such health benefits include the maintenance of good digestive health, which was traditionally considered a major characteristic of the crop. The main product rich in dietary fiber is extracted from the outer husk of the plant seeds. Psyllium is one of the treatments from folk medicine that was utilised long ago to resolve digestive disorders (Kumar *et al*., 2019; Kousar *et al*., 2023). Nowadays, it is one of the most common natural remedies for illnesses like constipation (Patel *et al*., 2020). The main active component of the husk is soluble fibre, represented as a complex mixture of polysaccharides and mucilage, which provides a remarkable therapeutic effect (Kumar *et al*., 2022).

The content in psyllium mucilage makes it highly effective in relieving constipation and serves as a good bulking agent for stools when exposed to water. The chemical composition comprises hemicellulose, lignin, and arabinoxylans, all of which collectively contribute to its high fibre concentration (Qaisrani *et al*., 2016; Chen *et al*., 2022). Nutrition-wise, psyllium husk is high in carbohydrates, primarily as fibre, low in calories and fat, and contains small quantities of protein and essential minerals, including calcium, magnesium, and potassium (Khan *et al*., 2021). It is nearly sugar-free and has little to no impact on blood glucose levels, making it ideal for diabetics and athletes who wish to manage their sugar intake (Abutair *et al*., 2016). Psyllium husk is renowned for its high soluble fibre content, significantly contributing to healthy bowel movements. Other bioactive constituents include phenolics and antioxidants (Patel *et al*., 2016; Patel *et al*., 2022). Psyllium has significantly lower phenolic levels than most other plant-based food sources, but this does not mean it cannot have bioactive health benefits beyond its gastrointestinal tract functions. The relative studies are still at the primary level in suggesting that antioxidant functionality may be beneficial for immune and cardiovascular health; however, far more research is needed to fully understand the benefits of psyllium.

MECHANISM OF PSYLLIUM HUSK

Psyllium through its unique ability to absorb water and form a gel-like substance in the digestive tract, underlines its multiple health benefits (Jayakody *et al*., 2023). This gel increases stool bulk with moisture, improves bowel movement and maintains digestive health by relieving constipation (Patil *et al*., 2023). The viscous gel formation also results in increased satiety, which reduces appetite and calorie intake, leading to improvements in fat and cholesterol inflexion. This is a beneficial factor in weight management and metabolic diseases (Geremew Kassa *et al*., 2024). Moreover, psyllium improves insulin sensitivity by lowering glucose absorption, which helps regulate blood sugar levels in diabetes management (Gholami *et al*., 2024). It binds bile acids in the gut, reducing LDL (bad) cholesterol levels and supporting heart function to maintain cardiovascular health (Chen *et al*., 2022). It also provides protection against colon cancer by facilitating the faster expulsion of carcinogenic compounds from the intestine and reducing their contact with the colon lining (Jalanka *et al*., 2019; Martellet *et al*., 2022). The schematic (Fig. 1) supports the declaration that psyllium husk is a dynamic contributor in digestive and cardiovascular health improvement, blood sugar and weight management, and colon cancer risk decrement, justifying its pivotal role in metabolic disease management.

HEALTH BENEFITS OF PSYLLIUM HUSK

The health benefits of psyllium husk include improvements in metabolism, as well as protection against cardiovascular disease and cancer. This wide range of therapeutic applications is associated with the high soluble fibre content of psyllium. The comprehensive exploration of the health advantages of psyllium husk in managing digestive health, metabolic syndrome, obesity, cardiovascular conditions, and cancer is supported by evidence from scientific studies.

Digestive health

Psyllium is one of the most popular herbal medicines for preventing constipation. Because of its hydrocolloid nature, it absorbs water, turns into a gel, and contributes to bulking up stools for easier excretion (McRorie and Fahey, 2013). Results from studies have shown that psyllium is generally more potent than insoluble fibre sources, such as bran, because it produces milder stools and fewer incidents of side effects (Eswaran *et al*., 2017). Specifically, firmer stools are one of the outcomes of fiber supplementation when it is consumed in the form of psyllium (McRorie and Fahey, 2013). Its effectiveness in decreasing common symptoms (bloating, inconsistent stools, and abdominal pain) of irritable bowel syndrome is well reported (Moayyedi *et al*., 2014), along with its positive effect on stool quality and frequency, which is superior to other types of fibre in patients with IBS (Garg, 2021). Psyllium acts as a prebiotic, favouring beneficial flora such as Lactobacillus and Bifidobacteria, which helps maintain a proper balance in the gut microbiome (Slavin, 2013; Yang *et al*., 2021). Other types of fiber are fully fermented in the gut, while psyllium is only partially fermentable. Therefore, psyllium can sustain the effects on gut mi-

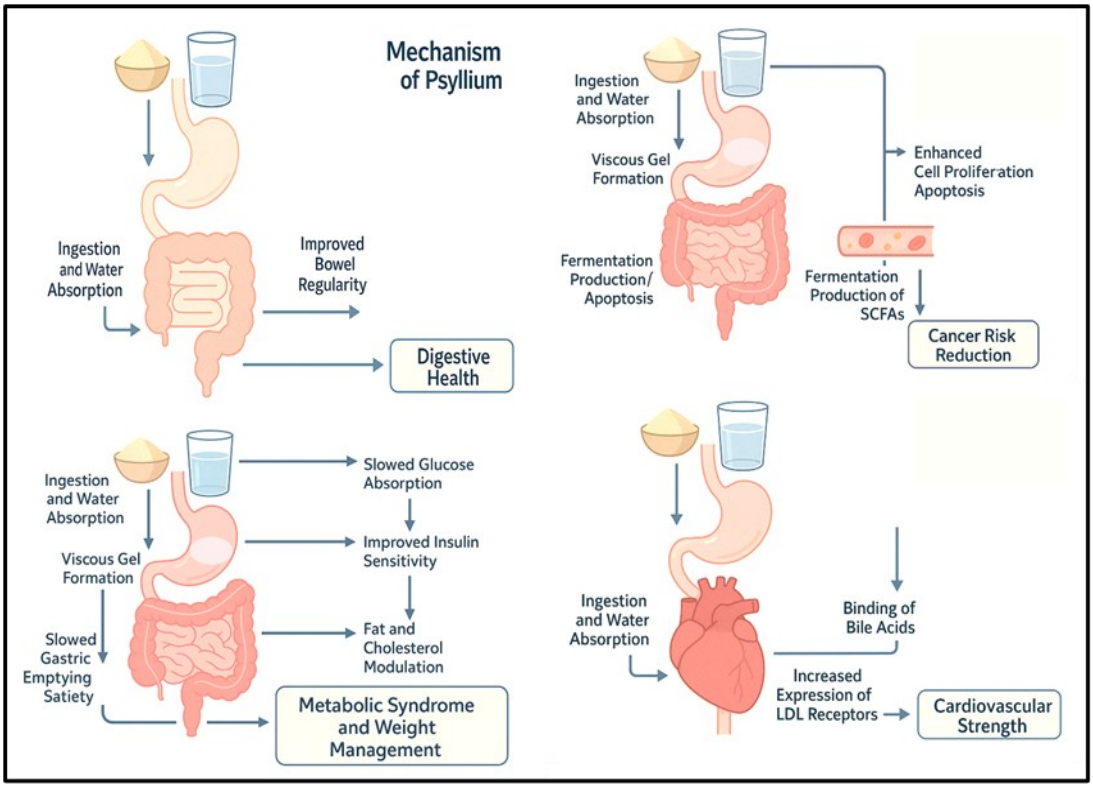

Fig.1. *Mechanism of psyllium fiber in disease management (Patil et al., 2023; Geremew Kassa et al., 2024; Martellet et al., 2022; Chen et al., 2022)*

crobiota without causing a gas overflow (Slavin *et al*., 2013; Jalanka *et al*., 2019). Psyllium enhances gut flora and microbial diversity, which is beneficial for both digestive and immune health, leading to improved digestion, reduced inflammation, and a decrease in gastrointestinal disorders (Ouwehand *et al*., 2002; Eswaran *et al*., 2017).

Metabolic syndrome and weight management

The metabolic syndrome, a group of conditions characterized by high blood pressure, high blood glucose, and abnormal lipid profiles, are known to direct the people towards heart disease and diabetes (Grundy *et al*., 2004). Psyllium helps address many of these risk factors by increasing satiety, improving blood lipid profiles, and enhancing glycemic control (Vuksan *et al*., 2000). A meta-analysis demonstrated the significance of psyllium consumption reducing fasting blood glucose, triglycerides, and waist circumference in patients with metabolic syndrome (Pal *et al*., 2011). Psyllium promotes feelings of fullness, subsequently lowering calorie intake and thereby controlling weight, which is a crucial factor in the expression of metabolic syndrome (Geremew Kassa *et al*., 2024). Psyllium supplementation reduces levels of CRP (C- Reactive Protien), an inflammation marker in overweight and obese people (Vuksan *et al*., 2000). Lower levels of CRP can indicate reduced inflammation, thereby enhancing metabolic health and reducing the risk of specific chronic diseases (Luan and Yao, 2018).

Diabetes management

The effects of psyllium on regulating blood glucose levels, especially in diabetes patients, are well reported. The soluble fibres in psyllium slow down the digestion and absorption of carbohydrates by producing a viscous gel in the digestive tract, which helps prevent an abrupt rise in blood glucose levels (Abutair *et al*., 2016). Psyllium's gel-forming properties reduce the glycemic load and lower insulin demand, which is beneficial for maintaining steady glucose levels in the blood (Gibb *et al*., 2015; Gholami *et al*., 2024).

Cardiovascular strength

In collaboration with dietary intervention, Psyllium supplementation is potent in the cardiovascular wellness programme. Its efficacy in managing cardiovascular risk factors is explored through several meta-analyses based on its cholesterol-lowering effects. Psyllium is useful in reducing LDL cholesterol levels in the bloodstream, a critical factor in atherosclerosis and heart disease (Anderson *et al*., 2009; Chen *et al*., 2022). It also reduces systolic blood pressure, another important aspect of cardiovascular wellbeing (Clark *et al*., 2020). Clinical studies have addressed the impact of psyllium on blood pressure in hypertensive patients (Pal *et al*., 2011). The dietary fiber intake in the form of psyllium husk has been shown to positively impact blood pressure levels (Gholami and Paknahad, 2023). The gel-forming soluble fiber in psyllium aids cholesterol reduc-

tion and blood pressure regulation by improving arterial elasticity and reducing vascular resistance (Vuksan *et al*., 2000). This results in a reduced risk of cardiovascular diseases and hypertension (Khan *et al*., 2017). Thus, psyllium supplementation may be recommended for people with mild to moderate hypertension as an adjunctive therapy to medication and lifestyle changes.

Role in colon cancer prevention

Increased faecal bulk, accompanied by a decrease in the time it takes to move waste through the colon, can reduce the colon's exposure to carcinogenic compounds by decreasing the amount of time spent in the colon, potentially lowering the risk of DNA damage in the colon's lining (O'Keefe *et al*., 2015). High fibre intake, achieved through high levels of psyllium, increases faecal bulk, thereby reducing the risk of colorectal cancer (Cummings *et al*., 1992). Many studies have shown that high fibre intake, including soluble fibre such as psyllium, reduces the risk of several cancers (Deschasaux *et al*., 2013; Wang *et al*., 2017; Xu *et al*., 2018; Li *et al*., 2020; Nucci *et al*., 2021; Hu *et al*., 2023). Furthermore, psyllium's prebiotic nature helps prevent colon cancer, as it encourages a beneficial microbiome associated with low inflammation and a stronger immune system in the gut (Slavin, 2013).

Emerging health applications

Emerging research suggests that psyllium may support skin health, particularly in reducing inflammation-related skin conditions. Psyllium's prebiotic effects may positively impact skin by improving gut health, which is closely linked to skin conditions such as acne, eczema, and psoriasis (Fradinho *et al*., 2015; Widhiati *et al*., 2021; India Psyllium, 2025; Jha *et al*., 2025). Gut health and skin health are interconnected through the gut-skin axis; therefore, improving gut microbiota through prebiotics, such as psyllium, may reduce skin inflammation (Bowe and Logan, 2011; Fitnesshealth, 2024). Psyllium is being studied for its potential benefits in supporting kidney function, especially in patients with chronic kidney disease (CKD) (Pal *et al*., 2011; Hu *et al*., 2023). The enhanced blood glucose level and controlled blood pressure that occurs with psyllium use may improve kidney health by reducing risk factors for advancement of CKD (Howarth *et al*., 2001; Cigarrán Guldris). Some research studies have proposed the efficacy of psyllium in reducing uremic toxins, the products of kidney dysfunction accumulation in the blood (Anderson *et al*., 2009; Vuksan *et al*., 2000; Hu *et al*., 2023); however, more scientific studies are required to confirm these effects.

Psyllium has anti-inflammatory properties, which help in managing autoimmune diseases and other inflammation-driven conditions (Chen *et al*., 2022). Psyllium promotes gut health and reduces inflammation, which benefits individuals with autoimmune disorders, such as rheumatoid arthritis and inflammatory bowel disease (McRorie *et al*., 2015). A daily intake of psyllium helps reduce C-reactive protein (CRP), a key marker of inflammation (Vuksan *et al*., 2000). More systematic research is required to justify the potential of psyllium in developing immune responses and reducing inflammation, which is a promising area for future research. Primary research on psyllium has been conducted to assess its effects on mental health, based on the concept of the gut-brain axis, which links gut health to mood and cognitive function (Clapp *et al*., 2017). By refining the composition of gut microbiota, psyllium may have incidental effects on mental health linked with reduced symptoms of anxiety and depression (Merlo *et al*., 2024). Although direct evidence is limited, preliminary studies suggest that consuming fibre through psyllium is crucial in sustaining mental well-being (Ioniță-Mîndrican, 2022). This area of research is still in the early stages but may hold potential for those seeking holistic approaches to mental health.

CLINICAL STUDIES TARGETING DISEASE-SPECIFIC ROLE OF PSYLLIUM HUSK

The psyllium husk has gained popularity in recent times due to its therapeutic potential in managing chronic conditions such as diabetes, hypertension, and obesity, among others. As it contains a high concentration of soluble fibre, it offers benefits by enhancing the human body's ability to deal with a number of health problems. The role of psyllium husk in managing digestive disorders, diabetes, cardiovascular health, and obesity is clinically explored by nutritionists and medical researchers, along with its emerging applications (Table 1).

SAFETY OF PSYLLIUM AS A DIETARY SUPPLEMENT

Psyllium husk, a derivative of the seeds of Plantago ovata, is a commonly used dietary fibre recognised for its numerous health benefits, including gastrointestinal regulation and cardiovascular support. However, its safety profile, particularly with long-term consumption, is a key consideration for its use as a dietetic supplement. Extensive research on psyllium's safety has generally confirmed its tolerability when consumed within recommended doses (permitted dose: 5–10 g per day) (Anderson *et al*., 2009; Gupta *et al*.,2019; Rubio-Tomas *et al*., 2022).

Digestive safety and gastrointestinal tolerability

Multiple studies have demonstrated the safety of psyllium as a treatment for regulating bowel movements and improving gastrointestinal health (McRorie *et al*., 2015). Psyllium is useful in both diarrhoea and constipation, as it forms a gel when hydrated, resulting in an enlarged

Table.1. Effect of psyllium in disease management

Disease	Mechanism and outcome	Reference
Digestive disorders / IBS	Psyllium decreased common indications in irritable bowel syndrome (IBS) with, including bloating, inconsistent stools, and abdominal pain.	Moayyedi *et al*. (2014)
	Stool water increment with a substantial effect on microbiota is demonstrated in individuals with constipation following psyllium supplementation.	Jalanka etal. (2019)
	Psyllium improved stool quality and frequency than other types of fiber in patients with IBS.	Garg (2021)
	Participants who consumed 10 g/day of psyllium experienced reduced symptoms of IBS without significant adverse effects.	Voderholzer *et al*. (2021)
	The alteration in gut microbiota composition and signs of constipation were alleviated in older individuals and women through psyllium husk intervention.	Yang *et al*. (2021)
	Psyllium improves the entire gut system by allowing good bacteria to flourish and enhance nutrient absorption while reducing the gastric disorders.	Menon *et al*. (2023)
	The independent actions of psyllium, resulting in improved gut microbiota, regulated bowel movement, and anti-inflammatory effects in the gut, provide relief in irritable bowel syndrome (IBS).	Garg *et al*. (2024)
	Soluble fibres in psyllium support the formation of a gel-like substance in the gut, leading to the formation of softer stools and easier passage.	Keller *et al*. (2024)
	Psyllium husk, rich in soluble dietary fibre, is effective in stimulating gut health through regular excretion and alleviating chronic constipation.	Kassa *et al*. (2024)
Diabetes	HbA1c levels in type 2 diabetic patients were estimated to decline by 0.5% during three months from two servings of psyllium per day.	Jenkins *et al*. (2002)
	Supplementing psyllium during meals significantly improved insulin sensitivity in diabetic patients by lowering fasting blood glucose levels by 8–12%	Sierra *et al*. (2002)
	Psyllium lowered (12-15%) postprandial glucose levels in diabetics, which is comparable with specific medications used in the management of diabetes.	Ziai *et al*. (2005)
	Diabetic patients in controlled clinical trials treated with psyllium daily (10.5 g/day) showed decreased levels of fasting blood glucose and postprandial glucose.	Anderson *et al*. (2009)
	Psyllium while being safe has enabled some patients to reduce their need for medication by providing an alternative approach to the management of blood sugar levels.	Slavin (2013)
	Psyllium supplementation before meals decreased blood glucose peaks by 15% among the individuals with reduced glucose tolerance.	Zhu *et al*. (2014)
	Regular psyllium supplementation enhanced HbA1c levels and improved long-term control of blood sugar level	Khan *et al*. (2017)
	A substantial reduction in blood sugar levels and HOMA-IR value, resulting from the collaborative effect of psyllium fibre intake and lifestyle alterations, has been shown to improve cardiovascular wellbeing in healthy individuals.	Bacha *et al*. (2022)
	Psyllium interrupts the digestion and absorption of sugar, preventing a post glycemic control.	Sharma *et al*. (2023); Kassa *et al*. (2024)
Hypertension and Cardiovascular diseases	Incorporation of psyllium in daily diet reported 7-9% drop in LDL cholesterol of hyperlipidemic patients	Davidson *et al*. (1998); Keenan *et al*. (1999)
	Daily administration of 2 doses of psyllium (5.1g) resulted in reduced serum total and LDL-cholesterol levels (4.7% and 6.7%) in male and female patients with primary hypercholesterolemia after 24-26 weeks.	Anderson *et al*. (2000)
	Regular consumption of psyllium husk has been reported to reduce systolic blood pressure by approximately 2-5 mmHg, which is beneficial for cardiovascular health.	Howarth *et al*. (2001)
	Hypertensive patients who were daily supplemented with psyllium had lower blood pressure (systolic and diastolic) than those who were not.	Solah *et al*. (2010)
	Up to 7% reduction in LDL cholesterol was reported in patients affected with mild hypercholesterolemia.	Pal *et al*. (2011)
	Augmented low-calorie meal with 10.2 g psyllium stimulated cholesterol modulation (7% decrease in LDL and 4% decrease in total cholesterol).	Chen *et al*. (2022)
	5g psyllium per day reduced total cholesterol in post-menopausal women	Ionita-Mindrican *et al*. (2022)
	Psyllium has been shown to reduce blood pressure in hypertensive patients.	Gibb *et al*. (2023)
	The binding of bile acids in the presence of soluble psyllium fibres in the intestine causes the liver to use additional cholesterol to generate bile acids, while lowering cholesterol in the bloodstream.	Kassa *et al*. (2024)

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Obesity/ overweight	Psyllium supplementation reduced the levels of CRP (C-Reactive Protein), an inflammation marker, in overweight and obese individuals.	Vuksan *et al*. (2000)
	Increased BMI by 1.5 points in overweight adults is observed on psyllium supplementation.	Howarth *et al*. (2001)
	Psyllium supplementation before meals resulted in significant decreases in food intake and weight loss during a 12-week period.	Solah *et al*. (2010)
	An average 3% weight loss of body weight was reported after six months of intervention when psyllium supplementation was combined with calorie restriction.	Pal *et al*. (2011)
	The expansion of psyllium fibres in the stomach, which exhibits satiety, results in reduced overall diet and calorie intake as a direct effect. Additionally, its ability to regulate bowel movements promotes gut health, contributing indirectly to weight loss and managing obesity.	McRorie *et al*. (2021)
	Administration of gel-forming non-fermented psyllium fibre prior to meals has been reported to be effective in facilitating weight loss in individuals who are overweight or obese.	Gibb *et al*. (2023)
	The gelling property of psyllium, responsible for increased viscosity and a feeling of fullness for a longer span, is helpful for appetite control and weight management.	Geremew Kassa *et al*. (2024)

bulk of stool (Gupta *et al*., 2019). Although rare, the overconsumption of psyllium is reported to have mild adverse effects, such as bloating, gas, or discomfort, in individuals who are not accustomed to high intakes of dietary fibre (Marlett and Slavin, 2020). However, the gradual introduction of psyllium into the diet reduces side effects, indicating an adaptation of the gut microbiome to high soluble fibre content over time (Vuksan *et al*., 2000; McRorie *et al*., 2015). A randomised controlled trial reported that participants who consumed 10 g/day of psyllium experienced reduced symptoms of irritable bowel syndrome (IBS) with no significant adverse effects (Voderholzer *et al*., 2021). Psyllium, being a natural plant-based fibre, is mostly considered safe in appropriate quantities (1-2 tablespoons per day), as higher doses may raise allergic or gastrointestinal issues. Moreover, it is recommended to consume adequate water or fluids to avoid choking or intestinal blockage (Jha *et al*., 2025). Psyllium intake prior to meals was reported to have better tolerance, reduced hunger, increased fullness, and decreased craving between meals (Geremew Kassa *et al*., 2024). The tolerable psyllium dosages (20–25 g per day) along with sufficient water and exercises could efficiently provide ease (20–25 g per day), along with sufficient water and exercise, can provide efficient relief from IBS (Garg *et al*., 2024). Long-term consumption and cardiovascular safety

Long-term psyllium supplementation has been proven safe and effective for treating hypercholesterolemia. A meta-analysis of 28 trials suggests that psyllium reduces LDL cholesterol with minimal effects on HDL cholesterol and triglycerides (Anderson *et al*., 2009). The serious adverse effects were absent in any of these trials, even at the higher doses (up to 20 g/day) used, which did not threaten cardiovascular safety. The functionality of psyllium has been confirmed through clinical studies conducted on healthy individuals who received 10.5 g of supplementation for 52 weeks, indicating its tolerance without any major adverse effects (Chen *et al*., 2022). Psyllium's efficacy as a medicinal component in lowering plasma LDL cholesterol is already reported. However, further investigation is anticipated to validate the efficacy of psyllium in enhancing cardiovascular health and reducing the risk of heart disease (Ahmad *et al*., 2025).

Metabolic safety in chronic diseases

For individuals with chronic diseases such as diabetes and metabolic syndrome, psyllium has proven to be a safe dietary adjunct. A long-term intervention study on diabetic patients consuming 5–15 g/day of psyllium for one year observed improved glycemic control without significant side effects (Rubio-Tomás *et al*., 2022). The intake of psyllium husk fibre over 16 weeks, along with lifestyle alterations, has shown a remarkable effect on blood sugar levels and insulin resistance in healthy individuals (Bacha *et al*., 2022). Psyllium has a slow gelation process in the intestines, which retards glucose absorption to ensure safety while achieving glycemic regulation (Sierra *et al*., 2002). Advanced statistical analysis of adverse events in this cohort showed that psyllium was better tolerated than synthetic fiber supplements. Additionally, psyllium, being hypoallergenic, it can be used by a wide range of people with food sensitivities (Geremew Kassa *et al*., 2024).

Safety in special populations

Psyllium's safety has also been assessed for children and elderly people. In a study conducted on elderly individuals with chronic constipation, a daily dose of 6 g of psyllium was well tolerated, with no significant

Table 2. Recommended dosages for safe consumption of psyllium

Category	Recommended Dosage	References
Adults	5–10 g per day, splitting it into 2- 3 doses with proper water	Anderson *et al*. (2009); Gupta *et al*. (2019)
Children (6–12 years)	3–5 g per day, splitting it into 2 doses with proper water	Marlett and Slavin (2020)
Pregnant Women	5–10 g per day, with proper consultation of doctor	EFSA Panel (2019)
Elderly people	5–10 g per day, if increased prevents discomfort	Rubio-Tomas *et al*. (2022)
Individuals with diabetes	5–15 g per day, it controls glycemic but under medical advice	Voderholzer *et al*. (2021); Rubio-Tomas *et al*. (2022)
Individuals with iBS	25 g per day with 500 ml water to make soft and bulky stool	Garg *et al*. (2024)
Diebetic individuals	10 g per day, prior to meal	Gholami *et al*. (2024)
Healthy individuals	6.8 g per day following breakfast to reduce hunger	Ahmad *et al*. (2025)

Table 3. Advantages and limitations of dietary and supplement forms of psyllium

Form	Advantages	Limitations	References
Dietary (e.g. Enriched psyllium Foods)	Increases nutritional value; Easy to incorporate into daily meals.	Per serving fiber concentration is lowered; It requires large portions.	Anderson et al., 2018; Martinez et al., 2019
Supplement (e.g. Capsules, Powders)	Precise dosage: Easier to use.	It may cause dependence on supplements; No good taste.	Cummings et al., 2020; Gupta et al., 2019

changes in nutritional profile or micronutrient absorption (Kumar *et al*., 2017). Similarly, psyllium supplementation has been reported to yield positive results in children with functional gastrointestinal disorders, with minimal adverse effects (Liu *et al*., 2017). Psyllium is generally safe for most people when taken at the recommended dosage, which varies according to age, health status, and medical conditions (Table 2).

DIETARY AND SUPPLEMENT FORMS

Psyllium is consumed as a dietary source, such as psyllium-enriched foods, and as a supplement that comes in forms like capsules and powders (Table 3). Dietary products are easily incorporated into daily meals but often consume larger portions with a less desirable fibre dose for adequate intake (Martinez *et al*., 2019). The supplements are easy to use and accurate for therapy but may promote overdependence and have a less favorable taste (Gupta *et al*., 2019; Cummings *et al*., 2020). Hence, it can be consumed as a dietary fiber source in the variety of fortified foods like cookies (Qaisrani *et al*.,2014), bread (Wojciechowicz-Budzisz *et al*., 2023), breakfast cereals (Fogacci *et al*., 2024), nutrition bars (Singh *et al*., 2023), yoghurt (Sakr, 2019), ice cream (Elwahsh *et al*., 2023), plant-based milk alternatives (Leahu *et al*., 2022), meat patties (Balestra *et al*., 2019), chicken meat rolls (Mehta *et al*., 2016) and meat alternatives like plant-based sausages (Noguerol *et al*., 2022; Marczak & Mendes, 2024).

FUTURE PERSPECTIVES

Psyllium husk has potential in emerging nutraceutical and functional foods. Studies have demonstrated the anticipated physicochemical properties of psyllium husk, such as its gel-forming ability and high water-binding capacity, which make it a reflective ingredient for current and emerging health challenges. As food systems focus on sustainability and personalisation, psyllium can play a significant role in developing innovative solutions. Psyllium in nutraceuticals is gaining popularity due to its benefits in treating chronic conditions such as diabetes, hypercholesterolemia, and irritable bowel syndrome (McRorie *et al*., 2015). Recent studies have reported the use of encapsulated psyllium for enhanced bioavailability and efficacy (Albuquerque *et al*., 2021). The ability to function synergistically with bioactive compounds, such as polyphenols and probiotics, further expands psyllium's utility for the development of multifunctional health supplements (Mishra *et al*., 2021).

Interactions between psyllium and the gut microbiome are an exciting area of research. Although psyllium is not heavily fermented in the gut, it can indirectly influence microbiota composition by modifying the colonic environment (McRorie *et al*., 2015). This is associated with increased short-chain fatty acids, particularly butyrate, which is recognised to possess anti-inflammatory effects and is involved in maintaining the integrity of the intestinal epithelium (Anderson *et al*., 2009). Such out-

comes support the basis for developing psyllium as a prebiotic and as a potential delivery platform for therapies targeting the microbiome. Existing studies aim to determine how the effects of psyllium can be personalised for each individual based on their gut microbiota profile, thereby advancing the role of psyllium in precision nutrition (Verma *et al*., 2023).

Conclusion

Psyllium husk, a plant-derived product (Plantago ovata), is an exceptionally versatile dietary fibre source with potential health benefits. It profoundly affects gastrointestinal health, cardiovascular support, glycemic regulation, and weight management, thereby becoming an essential functional ingredient in addressing modern health issues. Psyllium improves digestion, reduces LDL cholesterol, maintains blood glucose levels, and enhances satiety. It possesses prebiotic properties that enhance the gut microbiota composition, conferring systemic benefits through reduced inflammation and improved immune function. Emerging potential applications include managing metabolic syndrome, supporting skin and kidney health, and developing sustainable and innovative products such as biodegradable films. Although it is quite safe in its overall profile, proper hydration and adherence to the recommended dose are critical factors in preventing rare adverse effects.

Conflict of interest

The authors declare that they have no conflict of interest.

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