Konjac Glucomannan: A Functional Dietary Fiber for Gut Health, Metabolic Regulation, and Clinical Applications – A Comprehensive Review

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ABSTRACT

This article provides a comprehensive review of the potential of konjac glucomannan (KGM) as a functional dietary fiber that supports digestive health, metabolic regulation, and clinical applications. The main focus includes the role of KGM in weight management, glycemic control, and modulation of gut microbiota. Based on recent scientific findings, this review highlights the physiological mechanisms, extraction methods, chemical structure, as well as the regulatory status and safety of KGM. The findings indicate that KGM forms a gel matrix in the gastrointestinal tract, enhancing satiety, reducing glucose absorption, and promoting the growth of gut microbiota through short-chain fatty acid (SCFA) production. These results underscore the potential of KGM as a promising candidate for the development of functional foods and clinical therapies. This review also emphasizes the importance of further research to understand its long-term effects and personalized applications.

Keywords: Konjac glucomannan; glycemic control; gut health; prebiotic

ABSTRAK

Artikel ini mengulas secara komprehensif potensi *konjac glucomannan* (KGM) sebagai serat pangan fungsional yang mendukung kesehatan pencernaan, pengaturan metabolisme, dan aplikasi klinis. Fokus utama mencakup peran KGM dalam manajemen berat badan, kontrol glikemik, serta modulasi mikrobiota usus. Berdasarkan analisis berbagai temuan ilmiah terbaru, artikel ini menyoroti mekanisme fisiologis, metode ekstraksi, struktur kimia, serta status regulasi dan keamanan KGM. Hasil menunjukkan bahwa KGM membentuk matriks gel di saluran cerna yang meningkatkan rasa kenyang, menurunkan penyerapan glukosa, dan mendukung pertumbuhan mikroba usus melalui produksi *short-chain fatty acid* (SCFA). Temuan ini menegaskan potensi KGM sebagai kandidat kuat dalam pengembangan pangan fungsional dan terapi klinis. Kajian ini juga menekankan pentingnya riset lanjutan untuk memahami efek jangka panjang dan personalisasi penggunaannya.

Kata kunci: Konjak glukomanan; kontrol glikemik; kesehatan usus; prebiotik

INTRODUCTION

Dietary fiber is a critical component of the human diet, contributing to gastrointestinal health, metabolic regulation, and gut microbiota balance (Fu, Zheng, Gao, & Xu, 2022; Myhrstad, Tunsjø, Charnock, & Telle-Hansen, 2020). Among various dietary fibers, Konjac Glucomannan (KGM) has gained significant scientific interest due to its unique physicochemical properties and extensive health benefits (Hao, Zhu, Ji, & Shi, 2024; Luo, Liu, Qi, & Dong, 2022). Derived from the tuber of *Amorphophallus konjac*, KGM is a highly viscous, water-soluble polysaccharide known for its effects on satiety, glycemic control, and gut microbiota modulation. KGM's ability to form a gel-like matrix within the gastrointestinal tract enhances its functional role in weight management, lipid profile improvement, and overall digestive health (Alonso-Sande, Teijeiro-Osorio, Remuñán-López, & Alonso, 2009; Du, Liu, & Ding, 2021).

The extraction of KGM involves sophisticated purification techniques, including water extraction, alcohol precipitation, enzymatic hydrolysis, and ultrasonic methods to ensure high purity and efficacy (Nurlela, Ariesta, Santosa, & Muhandri, 2022; Wardhani, Rahayu, Cahyono, & Ulya, 2020). Initially, *A. konjac* tubers are harvested, followed by rigorous cleaning, peeling, and segmentation into smaller pieces (Nurlela, Ariesta, Laksono, Santosa, & Muhandri, 2021). The segments are dried and ground into konjac flour, which serves as the primary raw material for KGM. Advanced purification techniques, including water extraction, alcohol precipitation, filtration, enzymatic processes, and ultrasonic methods, are employed to selectively isolate glucomannan from other plant components. The purified KGM extract is subsequently dried and further refined, yielding a high-quality powder or gel suitable for use in dietary supplements, functional foods, and pharmaceutical applications (Anissa, Rahayoe, Harmayani, & Ulya, 2023; Iskandar, Cahyono, Harmayani, & Witasari, 2024; Nurlela et al., 2021; Yunita, Rizky, Rahajeng, & Fredy, 2019).

A key physiological effect of KGM is its capacity to form a highly viscous gel upon hydration, which delays gastric emptying and enhances satiety (Guo et al., 2021a). Consequently, KGM has been extensively studied for its potential role in appetite modulation and weight management (W. Chen et al., 2025). Furthermore, KGM contributes to improved glycemic control by slowing the digestion and absorption of carbohydrates, making it a promising dietary intervention for individuals with diabetes or metabolic syndrome (X. Jian, Jian, & Deng, 2024). Its ability to sequester bile acids also supports cholesterol regulation and cardiovascular health (Gallaher, Munion, Hesslink, Wise, & Gallaher, 2000; X. Jian et al., 2024; Joyce, Kamil, Fleige, & Gahan, 2019; Musazadeh, Rostami, Moridpour, & Hosseini, 2024).

Beyond digestive benefits, KGM actively modulates gut microbiota by promoting the growth of beneficial bacteria such as *Bifidobacterium* and *Lactobacillus*. This fermentation process produces SCFAs like butyrate, acetate, and propionate, which regulate intestinal pH, enhance gut barrier integrity, and reduce inflammation (Apalowo, Adegoye, & Obuotor, 2024; Deng et al., 2024; Tan et al., 2024). Additionally, the prebiotic properties of KGM thus contribute to microbial diversity, which is essential for maintaining a resilient gut ecosystem (Oliver et al., 2024; Portincasa et al., 2022).

KGM is widely recognized as a functional fiber with applications in clinical and nutritional settings (Alonso-Sande et al., 2009; Du et al., 2021; X. Jian et al., 2024). Future research should continue to investigate its effects on digestion, metabolism, and microbiota composition, with particular emphasis on elucidating its mechanisms of action and long-term implications. This review aims to comprehensively assess KGM's structural characteristics, physiological mechanisms, clinical applications, and future research directions.

Although several previous reviews have addressed specific aspects of KGM, such as its metabolic effects or its applications in food systems, to date, there is no up-to-date integrative review that systematically encompasses the physiological mechanisms, clinical relevance, molecular structure, and regulatory aspects of KGM in the scientific literature. The objective of this review is to consolidate and critically evaluate current knowledge on KGM by integrating these various dimensions, thereby providing a cohesive and comprehensive framework to support future research directions and its application in nutritional science and clinical practice.

Composition and Structure of KGM

KGM is a high-molecular-weight polysaccharide primarily composed of β-D-glucose and β-D-mannose in a ratio of approximately 1:1.6 to 1:1.8, linked by β-(1,4)-glycosidic bonds (**Fig.1**) (Behera & Ray, 2016; Widjanarko, Affandi, & Wahyuli, 2022). This structural configuration differentiates KGM from other dietary fibers and contributes to its unique physicochemical properties (Blackwood, Salter,

Dettmar, & Chaplin, 2000). The polymer's high degree of polymerization and molecular weight influence its viscosity, solubility, and gel-forming ability, making it highly effective in water absorption and thickening applications (Davoodi, Al-Shargabi, Wood, Rukavishnikov, & Minaev, 2024; McBride, Miller, Blanazs, Hähnle, & Armes, 2022; Rather, Bhat, & Shalla, 2022; Setiati, Malinda, & Sabrina, 2021).

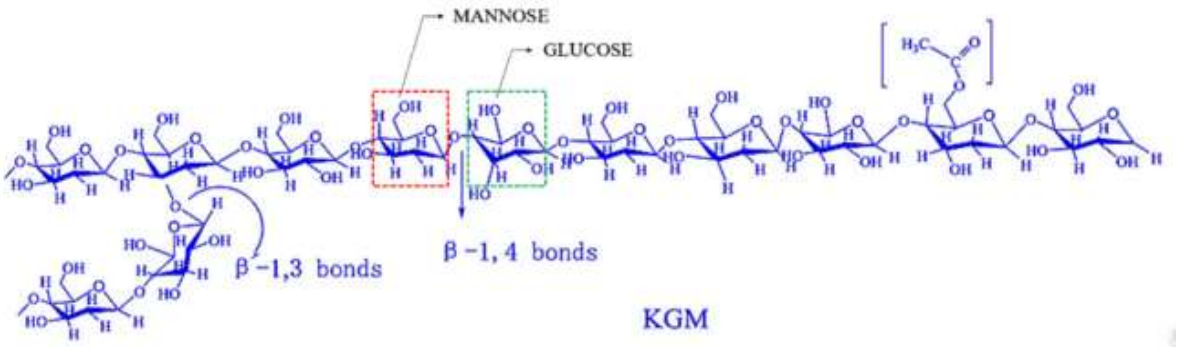

Fig. 1. Structural representation of konjac glucomannan (KGM), showing β-(1,4)-linked D-glucose and D-mannose monomers with occasional acetyl groups

The backbone of KGM consists of β-(1,4)-linked mannose and glucose units, with acetyl groups present at irregular intervals along the chain (Ratcliffe, Williams, Viebke, & Meadows, 2005; Yasar Yildiz & Toksoy Oner, 2014). These acetyl groups enhance water solubility and gel formation. In alkaline conditions, deacetylation occurs, strengthening the gel structure, which is beneficial for food and pharmaceutical applications (Davoodi et al., 2024; S. Wang, Zhou, Wang, & Li, 2015).

KGM exhibits a high-water retention capacity, forming highly viscous solutions even at low concentrations (Guo et al., 2021b; Martínez-Padilla, Sosa-Herrera, & Osnaya-Becerril, 2021). This viscosity is influenced by molecular weight, temperature, and pH. Additionally, KGM's interaction with other polysaccharides, such as xanthan gum, enhances its stability in food and industrial applications (W. Jian, Siu, & Wu, 2015; Saha & Bhattacharya, 2010). The structural characteristics of KGM determine its behavior in solution, its interaction with other polysaccharides, and its stability under different processing conditions. These structural attributes contribute to KGM's high water retention capacity, enabling it to form highly viscous solutions with extensive applications in food, pharmaceuticals, and nutraceuticals. A thorough understanding of KGM's physicochemical properties is essential for optimizing its use in various formulations (Dai, Jiang, Shah, & Corke, 2017; Jain, Sarsaiya, Gong, Wu, & Shi, 2025; R. Zhang, He, Xiong, & Sun, 2025).

Extraction and Production of KGM

The extraction and purification of Konjac Glucomannan (KGM) require carefully controlled methods to ensure optimal yield, purity, and functional integrity. Common extraction methods include water extraction, alcohol precipitation, enzymatic hydrolysis, and ultrasonic assisted extraction (UAE) (Anissa et al., 2023; Iskandar et al., 2024; Nurlela et al., 2021; W. Xu et al., 2014; Yunita et al., 2019). These techniques vary in complexity, efficiency, and impact on KGM quality.

Water extraction is widely used due to its simplicity and low cost, although it typically results in lower purity (70 to 80 percent) as it co extracts other polysaccharides and proteins (Xu et al., 2014). Alcohol precipitation, particularly using ethanol or isopropanol, helps to selectively recover KGM with higher purity (80 to 90 percent), but may reduce yield (Wardhani et al., 2020).

Enzymatic hydrolysis improves specificity by degrading unwanted carbohydrates using cellulase or amylase enzymes, yielding purity up to 95 percent (Albrecht et al., 2011; Yanting Zhang et al., 2024). Ultrasonic assisted extraction (UAE) enhances extraction efficiency by breaking cell walls with sound waves, increasing both yield and purity, and significantly reducing extraction time (Vo et al., 2023; Yanlin Zhang et al., 2023).

Recent studies indicate that combining UAE with enzymatic hydrolysis results in superior outcomes. For instance, Iskandar et al., (2024)reported a KGM purity of 93.42 percent with reduced processing time and energy input. These advanced techniques also help preserve KGM's native molecular structure, which is crucial for its viscosity, gel forming ability, and functional behavior in food and pharmaceutical applications.

The extraction and production workflow of KGM from raw tuber processing to purification and drying is summarized and illustrated in **Fig. 2**, which visually presents the major steps and

methods used in the production of high purity KGM for industrial applications. Standardization of extraction protocols remains essential to ensure consistent quality across production batches. Selection of the method should be tailored to the target application, whether for dietary supplements, functional foods, or clinical formulations.

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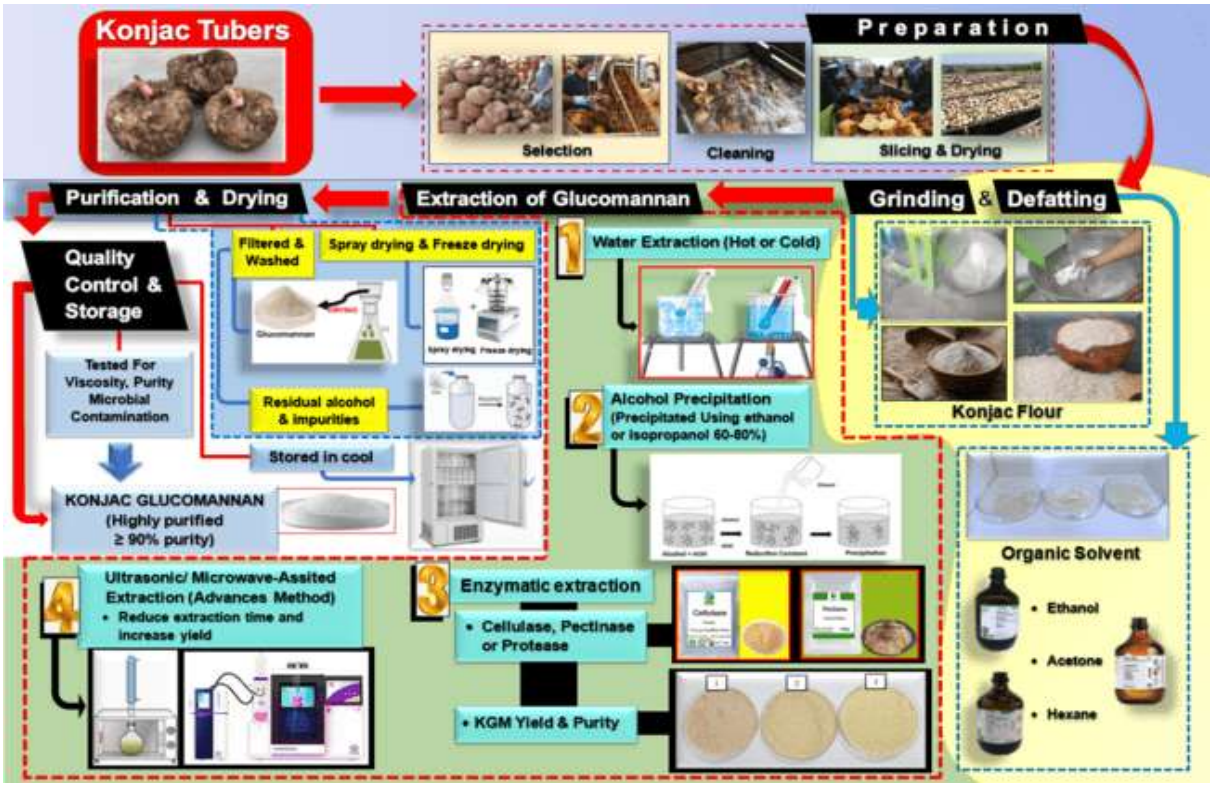

Fig. 2. Overview of the konjac glucomannan (KGM) production process from konjac tubers, including cleaning, grinding, extraction, purification, and drying steps. This process affects KGM's final purity, solubility, and viscosity.

Physiological Effect of KGM

Konjac glucomannan (KGM) exhibits multifunctional physiological effects along the human gastrointestinal tract, beginning with its ability to hydrate and swell upon oral ingestion due to its high hydrophilicity. As a non-digestible polysaccharide composed of glucose and mannose, KGM remains largely resistant to enzymatic degradation in the upper gastrointestinal tract. Upon entering the stomach, its significant water absorption capacity allows it to form a viscous gel, delaying gastric emptying and promoting satiety through gastric distension and slower nutrient transit (Kapoor et al., 2024a; L. Zhang et al., 2023; Z. Zhang et al., 2023).

In the small intestine, this gel matrix slows the digestion and absorption of carbohydrates, contributing to improved glycemic control. Additionally, KGM can bind bile acids, promoting their excretion and enhancing cholesterol metabolism, which benefits cardiovascular health (Luo et al., 2022; L. Zhang et al., 2023). The bulk-forming nature of KGM also facilitates bowel regularity, helping to alleviate constipation (H. L. Chen, Cheng, Wu, Liu, & Liu, 2008).

A crucial physiological function of KGM occurs in the colon, where it undergoes microbial fermentation by gut microbiota, resulting in the production of short-chain fatty acids (SCFAs) such as acetate, propionate, and butyrate. These SCFAs exert wide-ranging effects on host metabolism, including maintaining intestinal barrier integrity, modulating lipid metabolism, and suppressing inflammation (Alonso-Sande et al., 2009; Fu et al., 2022; X. Jian et al., 2024; Myhrstad et al., 2020; Oliver et al., 2024; Tan et al., 2024). The physiological effect of KGM in the human body is depicted in **Fig. 3.**

Importantly, comparative studies show that while KGM is effective in SCFA production, its fermentability is generally lower than that of other prebiotics such as inulin or fructooligosaccharides (FOS). However, KGM tends to produce higher butyrate proportions relative to acetate, which may have enhanced anti-inflammatory and gut-barrier-protective effects (Connolly, Lovegrove, & Tuohy, 2010). This suggests that although the total SCFA yield may be lower than inulin or FOS, KGM still offers

distinct functional advantages due to its SCFA profile.

Regarding long-term consumption, studies suggest that KGM does not significantly disrupt gut microbial balance when consumed in moderation. However, some evidence indicates that excessive and prolonged intake may reduce microbial diversity, particularly if not paired with a varied diet, potentially leading to unfavorable shifts in the gut ecosystem (Deng et al., 2024; Tan et al., 2024). Hence, dosage and dietary context should be considered when using KGM as a prebiotic intervention.

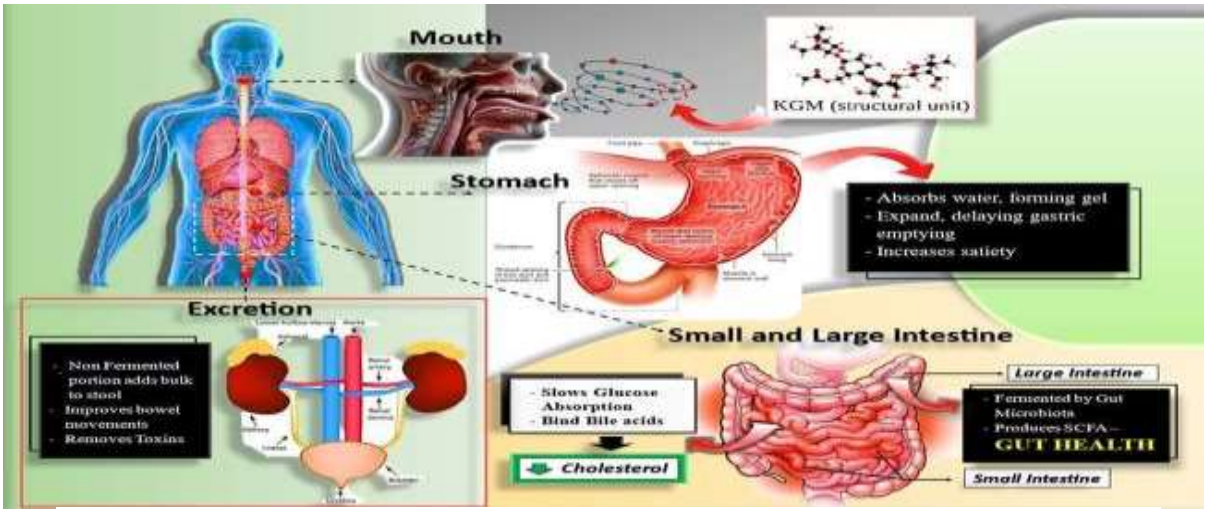

Fig. 3. Illustration the physiological effects of KGM in the human gastrointestinal tract, including satiety enhancement, delayed gastric emptying, glycemic control, and gut microbiota modulation through SCFA production.

Role in Weight Management and Glycemic Control

KGM plays a key role in weight management and blood sugar regulation, as shown in **Fig.4**. One of the primary mechanisms involves its ability to delay gastric emptying, which prolongs satiety. This delayed emptying is crucial for reducing caloric intake by promoting a lasting feeling of fullness, thereby supporting weight management efforts. By slowing the passage of food through the stomach and intestines, it helps individuals experience reduced hunger and more controlled eating habits (X. Jian et al., 2024).

Fig.4 illustrates that KGM consumption stimulates the release of hormones like GLP-1 (glucagon-like peptide-1) and Peptide YY (PYY) from L-cells in the small intestine. GLP-1 is a potent incretin hormone that enhances insulin secretion in response to glucose intake, thereby aiding in the regulation of blood sugar levels. It also helps reduce hepatic glucose production, further improving glycemic control. These hormonal effects of KGM are particularly beneficial for individuals with diabetes, as they promote both insulin sensitivity and glucose

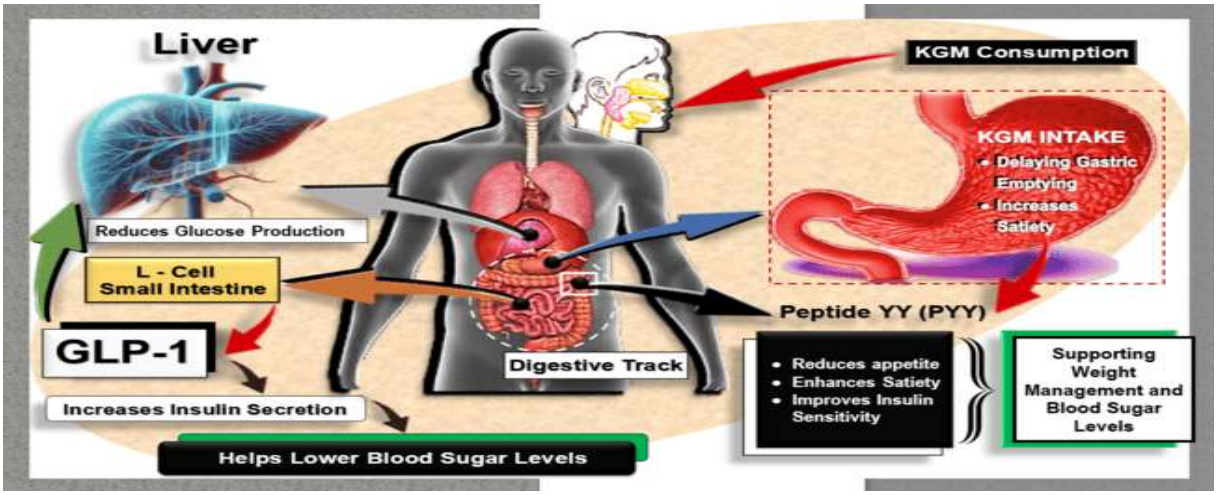

Fig. 4. Mechanism by which KGM aids in weight management and glycemic control, including stimulation of satiety hormones (GLP-1, PYY), reduction of glucose absorption, and improvement of insulin sensitivity.

metabolism (Connolly et al., 2010; Sukkar et al., 2013; L. Wang et al., 2024).

Peptide YY, another hormone activated by KGM intake, plays an additional role in appetite regulation. As seen in the **Fig.4**, PYY reduces appetite, enhances satiety, and improves insulin sensitivity. This contributes not only to reduced food intake but also to better blood sugar management. PYY's role in supporting insulin sensitivity further highlights the fiber's potential benefits for metabolic health, which extends beyond weight loss and addresses underlying issues like insulin resistance (Batterham & Bloom, 2003; Guida & Ramracheya, 2020; C. Xu et al., 2023).

Overall, the intake of KGM enhances satiety, reduces glucose production in the liver, and promotes insulin secretion, all of which contribute to improved weight management and blood sugar regulation. Its dual action on appetite and blood sugar control makes it an effective supplement for supporting individuals with metabolic syndrome, obesity, or diabetes.

Effect on Gut Health

The prebiotic effect of KGM on gut health is demonstrated through its promotion of the growth of beneficial bacterial strains, including *Bifidobacterium* and *Lactobacillus*, as illustrated in **Fig. 5**. Fermentation primarily occurs in the colon, a specific region of the large intestine, where KGM is metabolized SCFAs such as butyrate, propionate, and acetate, which play a crucial role in maintaining gut health. These SCFAs are essential metabolic by-products that regulate various physiological processes within the digestive system, thereby positioning KGM as a promising agent for enhancing gut microbial balance and integrity (Connolly et al., 2010; X. Jian et al., 2024; Kapoor et al., 2024b; Myhrstad et al., 2020).

Butyrate is one of the most extensively studied SCFAs due to its crucial role in maintaining intestinal health (Fusco et al., 2023; Shin et al., 2023). It serves as the primary energy source for colonocytes, the epithelial cells lining the colon, and is necessary for the repair and regeneration of the intestinal epithelium. Butyrate enhances the function of the epithelial barrier by promoting the expression of tight junction proteins like occludin and claudin, which prevent unwanted permeability in the gut lining (commonly known as "leaky gut"). This improved epithelial integrity helps to prevent the translocation of pathogens and toxins into the bloodstream (ago, 2016; Farré, Fiorani, Rahiman, & Matteoli, 2020; Silva, Bernardi, & Frozza, 2020). Moreover, butyrate has been shown to possess strong anti-inflammatory properties, which are particularly important in the context of inflammatory bowel diseases (IBD) (Hodgkinson et al., 2023; Recharla, Geesala, & Shi, 2023; Tedelind, Westberg, Kjerrulf, & Vidal, 2007). Butyrate alleviates inflammation in the intestinal mucosa by inhibiting the activation of pro-inflammatory signaling pathways and reducing cytokine production. (Canani et al., 2011; W. Chen et al., 2025).

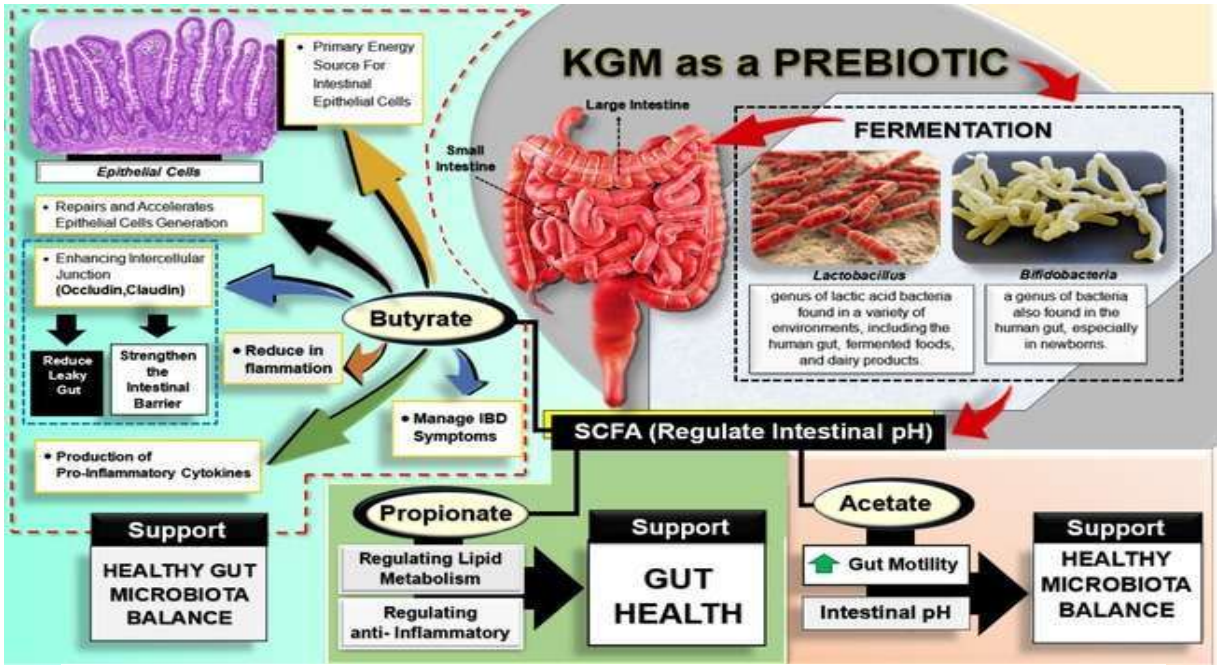

Fig. 5. Mechanism of konjac glucomannan in promoting gut health through fermentation in the colon, production of SCFAs (butyrate, propionate, acetate), and enhancement of intestinal barrier integrity.

Propionate is another SCFA produced by the fermentation of dietary fibers like KGM, and it plays a significant role in regulating lipid metabolism and inflammation. It is known to suppress cholesterol synthesis in the liver, thereby contributing to lipid homeostasis and cardiovascular health (Chambers et al., 2015; Joyce et al., 2019; Portincasa et al., 2022). In addition to its metabolic effects, propionate has been demonstrated to modulate the immune system by dampening inflammatory responses. Propionate can inhibit the production of pro-inflammatory cytokines and enhance the production of regulatory T-cells, which are essential for maintaining immune tolerance and preventing chronic inflammation. This anti-inflammatory effect of propionate is critical for preventing disorders such as metabolic syndrome and certain gastrointestinal inflammatory conditions (Ciarlo et al., 2016; Fakharian et al., 2023).

Acetate, the most abundant SCFA produced during microbial fermentation, has a broad range of functions in the gut and beyond. It acts as a regulator of intestinal pH, creating an acidic environment that is conducive to the growth of beneficial bacteria like *Bifidobacterium* and *Lactobacillus*, while simultaneously inhibiting the growth of pathogenic bacteria (X. Han, Ma, Ding, Fang, & Liu, 2023; Victoria Obayomi, Folakemi Olaniran, & Olugbemiga Owa, 2024; M. Zhou et al., 2024). Acetate also plays a role in regulating gut motility, ensuring that the contents of the intestine are propelled forward at an appropriate rate, thereby preventing conditions such as constipation (Zheng, Tang, Hu, & Zhang, 2022). Furthermore, acetate serves as a substrate for the synthesis of cholesterol and other lipids in peripheral tissues, which highlights its importance in maintaining overall metabolic health (Du et al., 2021; Hernández, Canfora, Jocken, & Blaak, 2019; Tang & Li, 2021; Zheng et al., 2022).

The synergistic action of SCFAs like butyrate, propionate, and acetate is essential for supporting a balanced gut microbiota, which is the foundation of gut health. A balanced microbiota contributes to the prevention of dysbiosis (a state characterized by an imbalance between beneficial and harmful gut microbes) which is associated with a range of diseases, including obesity, diabetes, and gastrointestinal disorders like irritable bowel syndrome (IBS). The presence of SCFAs also helps to maintain a low inflammatory state in the gut, promoting mucosal immunity and protecting against pathogen invasion. By strengthening the gut's epithelial barrier, SCFAs reduce the likelihood of chronic inflammation, a condition that underlies many systemic diseases (Fusco et al., 2023; Ma, Piao, Mahfuz, Long, & Wang, 2022).

When compared to other well-known prebiotic fibers such as inulin and fructooligosaccharides (FOS), KGM has demonstrated comparable or higher efficacy in stimulating butyrate production depending on fermentation conditions and individual microbiome profiles (Deehan et al., 2020). Butyrate is particularly important as it serves as the main energy source for colonocytes and supports intestinal epithelial repair. In contrast, inulin and FOS typically lead to a higher proportion of acetate and propionate, which exert more systemic metabolic effects (Sheng, Ji, & Zhang, 2023).

Clinical and Nutritional Applications

Numerous clinical trials have demonstrated KGM's efficacy in weight management, lipid metabolism, and glycemic control. Table 1 presents a comprehensive summary of clinical trials investigating the administration of KGM across various populations, including individuals who are overweight or obese, as well as patients with diabetes and hyperuricemia. It includes data from 12 independent studies, comprising randomized controlled trials, meta-analyses, and systematic reviews. The study designs differ, with some focusing on the effects of KGM on weight reduction (Kaats, Bagchi, & Preuss, 2015; Keithley et al., 2013; Mohammadpour et al., 2020; Sood, Baker, & Coleman, 2008; Zalewski & Szajewska, 2019), lipid profiles (Ho et al., 2017; Kaats et al., 2015; Sood et al., 2008; Vuksan et al., 1999; Zalewski & Szajewska, 2019), blood glucose regulation (Mirzababaei et al., 2022; Sood et al., 2008; Vuksan et al., 1999), constipation (Y. Han, Zhang, Liu, Zhao, & Lv, 2017), inflammatory bowel disease (IBD) (Suwannaporn et al., 2013), and gut microbiota composition (Deng et al., 2024; Tan et al., 2024). The duration of these trials ranges from several weeks to several months, with KGM dosages typically administered in varying quantities, reported in grams per day.

Clinical studies indicate that KGM aids in weight management by enhancing satiety and reducing calorie intake. However, its effects on weight loss are inconsistent, with some trials reporting significant reductions in body fat while others indicate minimal impact, particularly in pediatric populations. In lipid metabolism, KGM consistently demonstrates the ability to lower LDL cholesterol and triglycerides, suggesting its potential role in cardiovascular health improvement. Furthermore, KGM exhibits strong benefits in glycemic control, with several studies confirming reductions in fasting blood glucose

Table 1. Clinical trials reporting KGM administration in humans

No.	Title of Research	Study Design	Subjects	KGM Dose	Results	References
1	Safety and Efficacy of Glucomannan for Weight Loss in Overweight and Moderately Obese Adults	Randomized, double-blind, placebo-controlled trial, 8-12 weeks	50 overweight and moderately obese adults (BMI 25-35 kg/m^2)	3 g/day (1g, three times daily before meals)	- Glucomannan supplementation was safe, no significant weight loss	(Keithley et al., 2013)
2	Effect of glucomannan on plasma lipid and glucose concentrations, body weight, and blood pressure: systematic review and meta-analysis	Meta-analysis, 14 trials, 3-16 weeks	Adults with varying health statuses (healthy, overweight, obese, hyperlipidemic, or diabetic)	1.2 – 15.1 g/day	- Significantly reduce total cholesterol and triglycerides - Lowered LDL cholesterol - Reduced triglycerides - Significant reduction in fasting blood glucose	(Sood et al., 2008)
3	Konjac-Mannan (Glucomannan) Improves Glycemia and Other Associated Risk Factors for Coronary Heart Disease in Type 2 Diabetes	Randomized, double-blind, placebo-controlled clinical trial, 4 weeks	Patients with Type 2 Diabetes	3.6 g/day (administered in divided doses before meals)	- Significant improvements in glycemic control (reduced fasting blood glucose and HbA1c) - Reduced total cholesterol, LDL cholesterol, and triglycerides, along with improved insulin sensitivity	(Vuksan et al., 1999)
4	Effect of konjac glucomannan on gut microbiota from hyperuricemia subjects in vitro: fermentation characteristics and inhibitory xanthine oxidase activity	Clinical trial	Three healthy male volunteers and three hyperuricemia male patients, aged between 20-30 years	10 g/L	- Modulated the gut microbiota composition in hyperuricemia subjects - Increase production of SCFAs, particularly butyric acid and valeric acid. - Significantly inhibited XOD activity, which is linked to its uric acid-lowering effect	(Deng et al., 2024)
5	*Konjac Glucomannan Dietary Supplementation Causes Significant Fat Loss in Compliant Overweight Adults*	*Randomized, double-blind, placebo-controlled trial,* 60 days	*83 overweight adults* (66 women and 17 men)	3 g/day with 300 mg calcium carbonate	Significant reductions in body weight, body fat percentage, fat mass, total cholesterol, and LDL cholesterol	(Kaats et al., 2015)
6	Effect of glucomannan on functional constipation in children: a systematic review and meta-analysis of randomised controlled trials	Systematic review and meta-analysis of randomised controlled trials (RCTs)	122 children from 3 RCTs (3-16 years suffering from functional constipation)	100 mg/kg/day	Increased the frequency of defecation	(Y. Han et al., 2017)

7	No Effect of Glucomannan on Body Weight Reduction in Children and Adolescents with Overweight and Obesity: A Randomized Controlled Trial	Randomized, double-blind, placebo-controlled trial, 12 weeks	96 children (6-17 years with overweight or obesity)	3 g/day	- No effect on BMI - Lower total and LDL cholesterol levels	(Zalewski & Szajewska, 2019)
8	A systematic review and meta-analysis of randomized controlled trials of the effect of konjac glucomannan, a viscous soluble fiber, on LDL cholesterol and the new lipid targets non-HDL cholesterol and apolipoprotein B	Systematic review and meta-analysis of randomized controlled trials (RCTs)	370 participants (adults and children)	4 g/day	Significantly lowered LDL cholesterol and non-HDL cholesterol	(Ho et al., 2017)
9	Tolerance and nutritional therapy of dietary fibre from konjac glucomannan hydrolysates for patients with inflammatory bowel disease (IBD)	Clinical trial	- Group 1: 14 participants (aged 20 to 78) suffering from diarrhea. - Group 2: 20 patients diagnosed with IBD-related symptoms	3.3 g/day	- For patients with diarrhea, significant improvements were observed in bowel movement, stool consistency, abdominal pain, and flatulence after 10 days. No significant effect was seen on vomiting. - For IBD patients, after 14 days, significant improvements were noted in bowel movement, stool consistency, diarrhea, presence/absence of blood in stool, abdominal pain, flatulence, and vomiting.	(Suwannaporn et al., 2013)
10	The effect of Glucomannan on fasting and postprandial blood glucose in adults: a systematic review and meta-analysis of randomized controlled trial	**Systematic review and meta-analysis** of randomized controlled trials (RCTs), 4-12 weeks	124 participants (19 to 77 years), including those who were overweight, obese, and diagnosed with T2DM.	3-15 g/day	Significantly reduced Fasting Blood Glucose (FBG)	(Mirzababaei et al., 2022)
11	Effects of glucomannan supplementation on weight loss in overweight and obese adults: A systematic review and meta-analysis of randomized controlled trials	A **systematic review and meta-analysis** of randomized controlled trials (RCTs)	**225 overweight and obese adult subjects**	1.2-3.9 g/day	Significant reduction in body weight	(Mohammadpour et al., 2020)

12	Fecal fermentation behaviors of Konjac glucomannan and its impacts on human gut microbiota	Metabolomic analysis	Four healthy volunteers (two males and two females)	10 mg/kg/day	- Significantly altered the gut microbiota composition by increasing beneficial bacteria like *Desulfovibrio* and *Faecalibacterium* - Produced SCFAs such as acetic and propionic acids - Increased key metabolites like panose and N-(1-carboxy-3-carboxanilidopropyl) alanylproline	(Tan et al., 2024)

Abbreviations: **BMI**, Body Mass Index; **FBG**, Fasting Blood Glucose; **HbA1c**, Hemoglobin A1c; **HDL**, High-Density Lipoprotein; **IBD**: Inflammatory Bowel Disease; **LDL**, Low-Density Lipoprotein; **SCFA**, Short-Chain Fatty Acids; **T2DM**, Type 2 Diabetes Mellitus; **XOD**: Xanthine Oxidase.

and improved insulin sensitivity, making it a promising dietary intervention for individuals with type 2 diabetes. The prebiotic effects of KGM have also been validated, with evidence showing its ability to modulate gut microbiota composition and increase SCFA production, contributing to better bowel regularity and reduced inflammation in gastrointestinal conditions such as irritable bowel syndrome and inflammatory bowel disease. Despite these promising outcomes, further research is needed to establish optimal dosages and assess long-term efficacy in diverse populations.

Future Perspectives and Research Directions for KGM

Future research on KGM should focus on optimizing its health benefits, improving bioavailability, and exploring its therapeutic potential for various diseases, given the increasing scientific interest in dietary fibers. While KGM has been extensively studied for its role in weight management, gut health, and metabolic regulation, further investigation is needed to understand its long-term effects and synergistic interactions with other dietary components (Du et al., 2021; Feng, 2024). Novel formulations, such as KGM-based prebiotic blends or encapsulated fiber supplements, could improve stability and efficacy in clinical and nutritional applications (Kapoor et al., 2024b; Shah, Li, Al, Xu, & Mráz, 2020).

One promising area of future research involves the personalized application of KGM based on an individual's gut microbiota composition. Recent advances in microbiome science suggest that different individuals respond uniquely to dietary fibers depending on their existing gut microbial communities (Bianchetti et al., 2023; Deehan et al., 2020). By utilizing microbiome sequencing and metabolomics, researchers could develop tailored dietary recommendations that maximize the prebiotic effects of KGM for specific populations, such as individuals with irritable bowel syndrome (IBS), metabolic syndrome, or autoimmune disorders (Bootz-Maoz et al., 2022; Chey & Menees, 2018; Shaikh, Sun, Canakis, Park, & Weber, 2023). Such precision nutrition approaches would help optimize gut health and metabolic function through targeted dietary interventions (Jardon, Canfora, Goossens, & Blaak, 2022).

Another critical research direction is the investigation of KGM's role in the gut-brain axis and cognitive health. Emerging studies indicate that SCFAs produced from KGM fermentation may influence neurotransmitter activity, inflammation, and mood regulation (Dicks, 2022; Silva et al., 2020). Given the rising prevalence of neurological disorders such as depression, anxiety, and neurodegenerative diseases, exploring the potential neuroprotective effects of KGM could provide novel dietary strategies for mental health support (Pagonabarraga, Álamo, Castellanos, Díaz, & Manzano, 2023; van Zonneveld et al., 2024). Future clinical trials should assess how KGM consumption affects cognitive function, mood disorders, and stress resilience in diverse populations.

Additionally, further studies should explore the molecular mechanisms through which KGM interacts with metabolic pathways. Although its benefits in glycemic control and lipid metabolism are well-documented, the specific signaling pathways and gene expressions influenced by KGM require deeper investigation (Fang et al., 2023; X. Jian et al., 2024). Advanced techniques such as transcriptomics and proteomics

could shed light on how KGM influences cellular processes related to insulin sensitivity, lipid metabolism, and inflammatory responses. Such research would provide a mechanistic foundation for its therapeutic applications in chronic diseases such as diabetes and cardiovascular disorders (Czajkowska et al., 2024; Yang, Vijayakumar, & B. Kahn, 2019).

The potential of KGM as a functional ingredient in food technology and product development is another area that warrants further exploration. As consumers seek natural and health-promoting food options, KGM could be incorporated into various functional food products, including gluten-free baked goods, plant-based meat alternatives, and low-calorie beverages (Abotsi, Panagodage, & English, 2024; Karabulut, Goksen, & Mousavi Khaneghah, 2024; Mahmud, Valizadeh, Oyom, & Tahergorabi, 2024). However, challenges related to its texture, solubility, and sensory attributes must be addressed to enhance consumer acceptance. Advanced processing techniques, such as nanoencapsulation, could improve KGM's stability and efficacy in functional food applications (Chang et al., 2023; Meng et al., 2020; Yanting Zhang et al., 2024).

Regulatory Considerations and Safety of KGM

The safety and regulatory status of KGM have been extensively evaluated due to its widespread use in functional foods, dietary supplements, and pharmaceuticals. Regulatory agencies, including the U.S. Food and Drug Administration (FDA), European Food Safety Authority (EFSA), and China Food and Drug Administration (CFDA), classify KGM as a safe dietary fiber when consumed within recommended limits (Behera & Ray, 2016; Panel & Nda, 2010). KGM has GRAS (Generally Recognized as Safe) status in many countries and is approved for use in beverages, low-calorie meals, and gluten-free products (Y. Zhou et al., 2013). However, concerns remain regarding excessive consumption, particularly in vulnerable populations such as children, the elderly, and individuals with gastrointestinal disorders.

A key safety concern is KGM's high water-absorbing capacity, which can cause gastrointestinal discomfort, bloating, or obstruction if not consumed with adequate fluids (Keithley et al., 2013). Its ability to expand in the stomach and intestines may lead to esophageal or intestinal blockages, especially in individuals with swallowing difficulties or pre-existing digestive conditions. Regulatory agencies emphasize consuming KGM with sufficient water to minimize these risks. Reports of choking incidents, especially related to konjac jelly products in Japan, have prompted regulatory authorities to revise labeling requirements and product design. For example, Japan has issued mandatory warnings and banned certain product formats like mini-cup jelly to reduce choking risks (Sidell, Kim, Coker, Moreno, & Shapiro, 2013).

In addition, long-term or excessive intake of highly viscous fibers like KGM may affect the absorption of micronutrients. Studies suggest that KGM may reduce the bioavailability of fat-soluble vitamins (A, D, E, and K) and essential minerals such as calcium, iron, and magnesium due to its gel-forming nature (Z. Zhang et al., 2023). While moderate consumption is generally safe, prolonged high-dose usage may necessitate dietary monitoring or supplementation, especially in individuals with pre-existing nutritional deficiencies.

Toxicological studies confirm KGM's safety, showing no evidence of carcinogenic, mutagenic, or teratogenic effects in animals or humans (Mortensen et al., 2017). Clinical trials report good tolerability, with no significant adverse effects at moderate intake levels, supporting its regulatory approval and widespread use (Keithley et al., 2013).

Beyond safety, regulatory agencies oversee KGM quality standards and labeling requirements. Standardization of purity, viscosity, and molecular composition ensures product consistency and efficacy (Wilianto et al., 2024). Food-grade KGM must meet specific purity thresholds, with regulations governing allowable contaminants, such as heavy metals and residual solvents (Mortensen et al., 2017). Proper labeling is essential for informing consumers about serving sizes, potential allergens, and recommended consumption guidelines. Continuous monitoring and compliance with regulatory frameworks are crucial for maintaining consumer trust and product integrity (FAO, 2016).

Conclution

Konjac glucomannan (KGM) is a functional dietary fiber with wide-ranging health benefits, particularly in weight management, glycemic control, and gut microbiota modulation. Its prebiotic properties and influence on metabolic pathways underscore its therapeutic potential in both nutritional and clinical contexts. For practical applications, attention must be given to establishing standardized clinical dosages to maximize efficacy while minimizing potential side effects, such as gastrointestinal discomfort or nutrient malabsorption. Additionally, challenges related to formulation such as its high viscosity, water absorption capacity, and sensory impact in food products must be

addressed to enhance consumer acceptability and product stability. Continued research on advanced delivery systems and personalized nutrition strategies will further support the safe and effective integration of KGM into functional foods and medical nutrition therapies.

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