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Amorphophallus Konjac as a Natural Modulator of Inflammation and Immunity in Cancer Therapy

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ABSTRACT

Amorphophallus konjac is a perennial plant whose bioactive component, konjac glucomannan (KGM), has garnered increasing attention due to its broad therapeutic potential. While KGM has been traditionally utilised in East Asian medicine for detoxification and metabolic regulation, recent studies have highlighted its significant anti-inflammatory and immunomodulatory properties. This review aims to provide a focused synthesis of current evidence on the role of A. konjac and KGM in modulating immune responses and alleviating inflammation-related disorders. KGM has demonstrated efficacy in reducing pro-inflammatory cytokines such as TNF-α, IL-1β, IL-4, and IL-13, particularly in experimental models of colitis, atopic dermatitis, and skin inflammation. Additionally, KGM contributes to gut immune homeostasis by enhancing the growth of beneficial gut microbiota and promoting the production of short-chain fatty acids (SCFAs), which are key mediators in immune tolerance and mucosal defence. The polysaccharide also supports the activity of T-cells and macrophages, regulating the balance between pro-inflammatory and regulatory immune pathways. Beyond its localised effects, KGM exhibits systemic immunomodulatory benefits, suggesting a role in the prevention or adjunctive treatment of autoimmune and allergic conditions. Moreover, its application in wound healing further demonstrates its anti-inflammatory profile and biocompatibility. Despite its promising benefits, factors such as individual variability in immune responses and potential interactions with pharmacological agents necessitate further investigation. Future research should emphasise clinical trials to validate its therapeutic efficacy, dosage optimisation, and potential as a functional food or nutraceutical. In conclusion, A. konjac and its active compound, KGM, represent a compelling plant-based strategy for managing inflammation and supporting immune health through multifaceted mechanisms rooted in gut-immune interactions.

Keywords: *Amorphophallus Konjac, Anti-Inflammatory, Immune Regulation, Cancer, Konjac glucomannan*

1. INTRODUCTION

The global burden of chronic inflammatory and immune-related disorders has surged significantly, driven by lifestyle changes, environmental factors, and genetic predispositions (Dou et al., 2024; Piovani et al., 2020). These diseases are often characterised by dysregulated immune responses and persistent low-grade inflammation, which contribute to tissue damage, impaired organ function, and a diminished quality of life. As the demand for safe, effective, and sustainable therapeutic strategies increases, attention has shifted increasingly toward bioactive compounds derived from natural sources. Among them, *Amorphophallus konjac*—a perennial plant native to Southeast Asia—has gained prominence due to its traditional medicinal applications and diverse health-promoting properties (Kapoor et al., 2024). The primary bioactive constituent of this plant, konjac glucomannan (KGM), is a soluble dietary fibre with notable functional, nutritional, and pharmacological potential (Danalakoti et al., 2023).

The historical use of A. konjac in TCM spans over 2000 years, with applications ranging from detoxification and tumour suppression to treating respiratory and dermatological ailments. Modern research continues to validate its therapeutic benefits, particularly in the management of metabolic health and disease (Khan & Marya, 2019). Its root tubers, rich in glucomannan, have also been consumed as food and therapeutic agents, especially in Japan and China. Recent advances in phytochemistry, molecular biology, and omics-based research have brought KGM to the forefront of functional food and nutraceutical development, with a particular emphasis on its metabolic, gastrointestinal, and immune-modulatory effects (Beteri et al., 2024; Jain et al., 2025).

KGM is composed primarily of D-glucose and D-mannose units in a molar ratio of approximately 1:1.6, forming a high-molecular-weight polysaccharide with β-1,4-glycosidic linkages (Devaraj et al., 2019). This molecular configuration gives KGM its unique physicochemical properties, including high water solubility, gel-forming capacity, and prebiotic potential. When consumed, KGM absorbs water in the digestive tract to form a viscous gel, which not only contributes to satiety and weight control but also modulates gastrointestinal function and nutrient absorption (Chen et al., 2025). In addition to its mechanical effects, KGM serves as a fermentable substrate for beneficial gut microbiota, particularly *Bifidobacteria* and *Lactobacilli* ("Effect of Selenium-Rich Konjac Glucomannan on Intestinal Microbial Diversity in Mice," 2023). This fermentation process leads to the production of short-chain fatty acids (SCFAs), such as acetate, propionate, and butyrate, which exert diverse physiological effects, including anti-inflammatory activity, reinforcement of intestinal barrier integrity, and modulation of immune cell function (Abdelhalim, 2024).

The interplay between gut microbiota and host immunity has emerged as a central axis in regulating inflammation and systemic immune homeostasis (Brown et al., 2019). Dysbiosis, or microbial imbalance in the gut, is closely associated with chronic inflammation, autoimmunity, and metabolic disturbances. Prebiotic dietary fibers, such as KGM, play a crucial role in restoring microbial balance and enhancing gut-associated lymphoid tissue (GALT) responses (Shen et al., 2025). Experimental studies have demonstrated that KGM can downregulate pro-inflammatory cytokines such as tumour necrosis factor-alpha (TNF-α), interleukin-1 beta (IL-1β), and interleukin-6 (IL-6), while promoting anti-inflammatory mediators. Moreover, animal models of colitis and allergic dermatitis have shown that KGM reduces histopathological damage, improves mucosal immunity, and alleviates clinical symptoms (Shen et al., 2025).

In the context of immune regulation, KGM has been found to influence both innate and adaptive immune responses. It supports the activation and function of key immune cells, including macrophages, dendritic cells, and T-lymphocytes (Ahmadi et al., 2022). Through these interactions, KGM enhances immune surveillance while maintaining tolerance and reducing hyperreactivity (Thylur Puttalingaiah et al., 2024). This immunomodulatory profile makes it particularly valuable not only for inflammatory diseases but also for conditions marked by immune dysfunction, such as allergic rhinitis, eczema, and even hyperthyroidism-related gastrointestinal disturbances.

KGM's impact on skin inflammation is another area of growing interest (H. Li et al., 2023a). Topical and dietary administration of KGM has been shown to relieve symptoms of atopic dermatitis by modulating the interleukin-4 (IL-4)/interferon-gamma (IFN-γ) ratio and suppressing IgE-mediated hypersensitivity reactions (Wang et al., 2025). Additionally, its incorporation into wound dressings has yielded promising outcomes, promoting tissue regeneration, controlling local inflammation, and preventing secondary infections. These benefits, which is attributed to the polysaccharide's ability to maintain moisture at the wound site, absorb exudates, and facilitate the recruitment of immune cells involved in tissue repair.

Despite the mounting evidence supporting the anti-inflammatory and immune-regulating effects of KGM, several challenges remain in translating these findings into clinical applications. The variability in KGM's molecular structure, influenced by species, cultivation conditions, and extraction techniques, can lead to inconsistent bioactivity and therapeutic outcomes (Xia et al., 2023a). Moreover, gastrointestinal discomfort and potential allergenicity reported in some individuals highlight the need for standardised formulations and dosage optimisation (Drewes et al., 2020). Future research should therefore focus on advanced formulation techniques, such as microencapsulation and targeted delivery systems, to enhance KGM's bioavailability and minimise adverse effects.

Cutting-edge research methodologies, such as multi-omics analyses and high-throughput screening (HTS), have played a crucial role in elucidating the molecular pathways through which KGM exerts its effects (Ogris et al., 2021). These tools facilitate the identification of key biomarkers, signalling cascades, and gene expression profiles modulated by KGM intake, offering new insights into its role in immunonutrition and inflammation resolution. Furthermore, the integration of systems biology and bioinformatics can help uncover synergistic interactions between KGM and other bioactive compounds, potentially leading to the development of novel combination therapies.

Given the increasing prevalence of non-communicable diseases linked to immune dysregulation and inflammation, the role of functional food components such as KGM in preventive and adjunctive health strategies is more relevant than ever (Q. Hu et al., 2025). As populations worldwide seek safer, natural alternatives to conventional pharmacotherapy, *A. konjac* and its derivatives present a compelling case for inclusion in dietary interventions, clinical nutrition programs, and holistic healthcare models.

Therefore, this review article aims to consolidate the current scientific understanding of the anti-inflammatory and immune-regulating properties of *Amorphophallus konjac*, with a particular focus on konjac glucomannan as the key functional molecule. We explore its mechanisms of action, clinical relevance, and therapeutic applications across various domains of human health. By synthesising findings from preclinical and clinical studies, this review underscores the potential of *A. konjac* as a valuable component in integrative medicine, highlighting its promise in contributing to the prevention and management of inflammation-driven diseases.

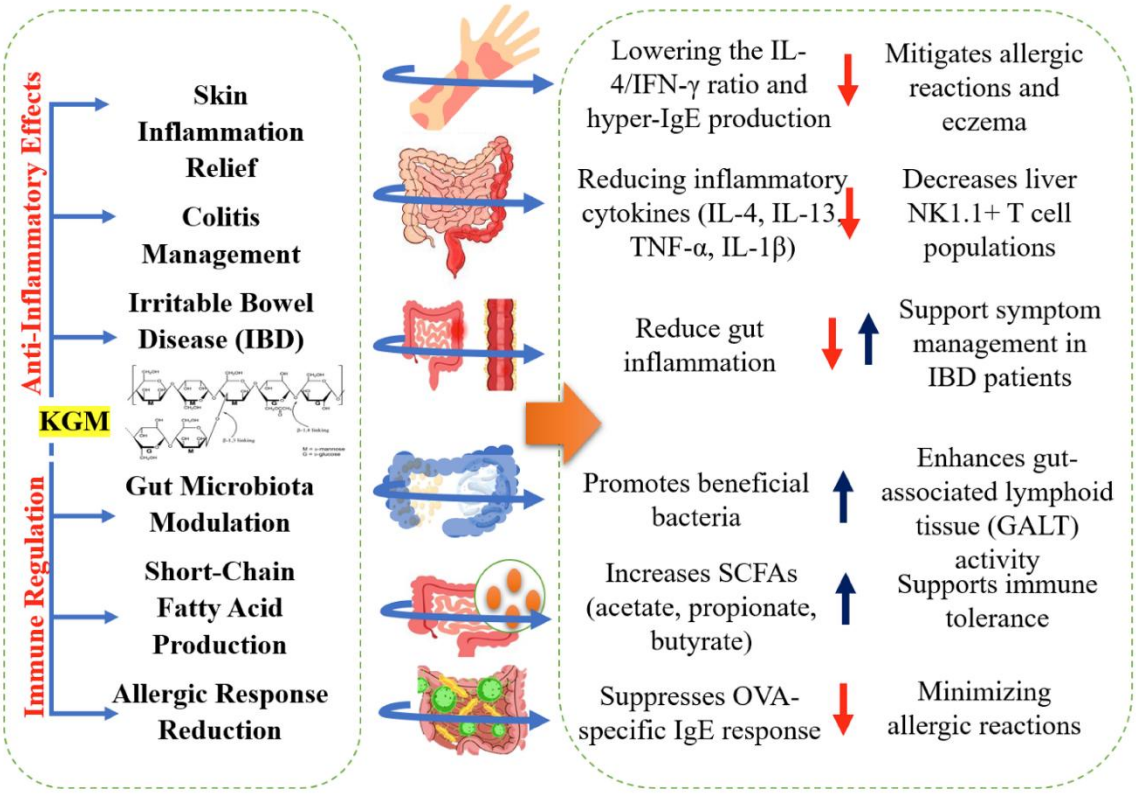
Anti-Inflammatory and Immune Regulation

The anti-inflammatory and immunomodulatory properties of *Amorphophallus konjac*, primarily through its bioactive constituent konjac glucomannan (KGM), have become a focal point in recent nutritional and pharmaceutical research (Robert Antony et al., 2024). With the increasing global prevalence of chronic inflammation-related diseases, such as inflammatory bowel disease (IBD), eczema, allergic rhinitis, and metabolic syndrome, the need for safe and effective dietary interventions is critical (Wagenaar et al., 2021). This section discusses the mechanistic basis, experimental evidence, and therapeutic implications of KGM's role in controlling inflammation and modulating the immune system.

1. Modulation of Pro-Inflammatory Cytokines

KGM exerts its anti-inflammatory effects by directly modulating pro-inflammatory cytokines. Several studies have demonstrated that KGM significantly downregulates the expression of tumour necrosis factor-alpha (TNF-α), interleukin-1 beta (IL-1β), IL-4, and IL-13. These cytokines are crucial mediators in the pathogenesis of chronic inflammation and allergic responses. For instance, in an oxazolone (OXA)-induced colitis model, mice receiving pulverized konjac glucomannan (PKGM) exhibited marked reductions in IL-4 and IL-13 levels in the colonic lamina propria, resulting in the amelioration of colitis symptoms (Y. Li et al., 2022).

Moreover, the anti-inflammatory impact is not limited to the gut. In murine models of atopic dermatitis, PKGM administration resulted in a decrease in serum IgE levels and downregulation of Th2-related cytokines, indicating its systemic immune regulatory capacity. These findings suggest that KGM plays a dual role by inhibiting both local and systemic inflammatory pathways.



Sources: Jain et al.(2025)

Figure 1. Anti-inflammatory and immune-regulating properties of konjac glucomannan (KGM).

2. Regulation of Gut Microbiota and SCFA Production

The gut microbiome plays a crucial role in maintaining immune homeostasis and regulating inflammation (Cui & Cong, 2025). KGM functions as a prebiotic fibre, promoting the proliferation of beneficial gut bacteria such as *Bifidobacteria* and *Lactobacilli (Hayeeawaema et al., 2020)*. These bacteria ferment KGM into short-chain fatty acids (SCFAs), such as acetate, propionate, and butyrate, which serve as signalling molecules in the immune system (Du et al., 2024a).

SCFAs regulate inflammation through multiple pathways: enhancing regulatory T cell (Treg) differentiation, suppressing nuclear factor kappa B (NF-κB) activation, and modulating histone deacetylase (HDAC) activity (M. Hu et al., 2022). These mechanisms culminate in reduced production of pro-inflammatory cytokines and improved mucosal barrier integrity. Studies have confirmed that increased SCFA levels are associated with lowered intestinal inflammation and improved gut permeability, further establishing KGM's prebiotic value (Du et al., 2024b).

3. Enhancement of Gut-Associated Lymphoid Tissue (GALT)

The intestinal immune system, particularly the gut-associated lymphoid tissue (GALT), serves as a primary interface for antigen recognition and immune activation. KGM supplementation has been shown to enhance GALT activity by increasing Peyer's patch cellularity and promoting interactions between dendritic cells and T cells (Iweala & Nagler, 2019). This effect is crucial in maintaining immune tolerance while allowing for efficient pathogen defence.

By fostering the proliferation of anti-inflammatory immune cell subtypes (e.g., Tregs, tolerogenic dendritic cells), KGM supports the shift from pro-inflammatory responses to immune regulation (Xia et al., 2023b). Furthermore, its ability to reinforce tight junction proteins such as occludin and claudin-1 in epithelial cells indicates its role in maintaining mucosal integrity, thereby preventing microbial translocation and systemic inflammation.

4. Systemic Immune Modulation and Allergy Control

In the context of allergic diseases, KGM's immune-modulating properties are of significant interest. Allergic disorders often involve hyperreactivity of the immune system, primarily through the Th2-mediated immune axis. KGM has demonstrated a capacity to shift the Th2/Th1 balance toward a more regulated immune response by lowering IL-4 and increasing interferon-gamma (IFN-γ) production (Jin et al., 2022).

A notable example is its effect on ovalbumin (OVA)-induced hypersensitivity models, where KGM supplementation reduced specific IgE titers and suppressed mast cell degranulation (Higashio et al., 2024). These findings underline its potential utility in managing conditions like asthma, allergic rhinitis, and atopic dermatitis. Moreover, by reducing eosinophilic infiltration and inhibiting mast cell activation, KGM contributes to the attenuation of tissue damage and allergic inflammation.

5. Colitis and Inflammatory Bowel Disease (IBD)

The therapeutic application of KGM in IBD has gained traction in experimental medicine (Pan et al., 2024). In chemically induced colitis models, KGM administration ameliorated colonic inflammation, reduced histopathological damage, and modulated gut cytokine expression profiles (Changchien et al., 2021). The beneficial effects were particularly pronounced in reducing IL-1β, TNF-α, and IL-6 levels.

Furthermore, the fermentation of KGM leads to the expansion of beneficial microbial taxa that produce SCFAs, which, in turn, inhibit Th17 responses—often implicated in IBD pathogenesis. The restoration of gut microbial balance and increased SCFA levels also correlate with enhanced expression of mucin-2 and antimicrobial peptides, essential for mucosal defense (Ma et al., 2022). Therefore, KGM serves as both a microbiota regulator and a mucosal protector in intestinal inflammation.

6. Wound Healing and Inflammatory Skin Disorders

Beyond the gastrointestinal tract, KGM's anti-inflammatory properties have been explored in dermatology (H. Li et al., 2023b). In topical formulations and biopolymer-based wound dressings, KGM has demonstrated superior performance in terms of moisture retention, exudate absorption, and tissue regeneration. Its gel-forming nature provides a protective barrier that reduces local inflammation and promotes fibroblast migration.

Additionally, in wound healing models, KGM-based dressings reduced neutrophil infiltration, lowered local levels of TNF-α and IL-6, and increased collagen deposition (H. Li et al., 2023c). These effects underscore the potential of KGM as a component in bioactive wound care systems, particularly for patients with diabetes or chronic inflammatory skin conditions.

7. Hyperthyroidism and Gastrointestinal Inflammation

Although limited, emerging studies suggest that KGM may alleviate gastrointestinal symptoms associated with hyperthyroidism, such as diarrhea and nutrient malabsorption. Its high viscosity and gel-forming properties help regulate stool consistency and delay gastric emptying, allowing improved nutrient uptake (Setyo Adiguna et al., 2024).

Additionally, the modulation of gut microbiota by KGM may reduce hyperthyroidism-induced inflammation and oxidative stress in the gastrointestinal tract. These preliminary findings suggest its potential utility as a dietary adjunct in endocrine-inflammatory conditions, warranting further clinical investigation.

8. Mechanistic Insights from Multi-Omics and HTS Approaches

Recent advances in multi-omics technologies, including transcriptomics, proteomics, and metabolomics, have deepened our understanding of KGM's biological effects (X. Li et al., 2022). High-throughput screening (HTS) techniques have identified specific gene expression changes and signalling pathways modulated by KGM, including the PI3K/Akt, NF-κB, and MAPK pathways (Evangelisti & Martelli, 2023).

Moreover, studies using gene knockout models have helped identify the involvement of pattern recognition receptors (PRRs), such as TLR4 and NOD2, in sensing KGM-derived metabolites, leading to downstream anti-inflammatory responses. These cutting-edge insights provide molecular validation for KGM's immunonutritional potential, supporting its development as a precision nutraceutical.

9. Clinical Relevance and Translational Perspectives

Despite the robust preclinical evidence, clinical studies on KGM's anti-inflammatory and immunoregulatory effects remain limited. However, existing trials have indicated that KGM supplementation improves glycemic control, lipid profiles, and markers of inflammation in patients with metabolic syndrome. Given the interconnectedness between metabolic inflammation and immune dysregulation, these findings provide indirect support for its clinical utility (Charles-Messance et al., 2020).

The challenge lies in standardising KGM formulations and defining optimal dosage and treatment duration. Individual variations in gut microbiota composition, genetic background, and baseline immune status can significantly affect therapeutic outcomes. Personalised approaches, potentially guided by microbiome profiling, may enhance efficacy and safety.

Conclusion of the Discussion

Collectively, the available data support the hypothesis that *Amorphophallus konjac*, through its primary bioactive compound KGM, exerts multifaceted anti-inflammatory and immunomodulatory effects. These actions are mediated through suppression of pro-inflammatory cytokines, enhancement of beneficial gut microbiota and SCFA production, modulation of immune cell activity, and support of mucosal integrity. Applications span gastrointestinal, dermatological, metabolic, and allergic conditions.

Future research should focus on well-designed human trials, integration with other immunonutrients, and exploration of its synergistic effects in complex disease models. In the era of systems medicine and integrative health, KGM holds significant promise as a natural therapeutic agent for managing inflammation and regulating immune function.

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