

Original Article

Royal Jelly and Human Health: A Systematic Literature Review

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Abstract:

Royal jelly is a natural bioactive substance produced by *Apis mellifera* worker bees and has attracted increasing scientific attention due to its potential health benefits. Rich in proteins, fatty acids, vitamins, and unique compounds such as 10-hydroxy-2-decenoic acid (10-HDA), royal jelly has been widely investigated for its biological and therapeutic properties. This study aimed to systematically review the scientific evidence regarding the effects of royal jelly on human health. A systematic literature review was conducted following PRISMA guidelines using databases including PubMed, Scopus, Web of Science, Cochrane Library, and Google Scholar for studies published between 2010 and 2025. Eligible studies included randomized controlled trials, meta-analyses, cohort studies, and relevant preclinical research. From 150 identified records, 20 studies met the inclusion criteria and were included in the final synthesis. The findings indicate that royal jelly demonstrates multiple potential health benefits, including improved glycemic control, better lipid metabolism, enhanced immune response, anti-inflammatory effects, improved skin health, reproductive benefits, and possible anticancer activity. Overall, royal jelly shows promise as a nutraceutical agent that may support metabolic, cardiovascular, and immune health, although further standardized clinical trials are required to confirm optimal dosage and long-term safety.

Keywords: Royal Jelly, Health, Diabetes, Cardiovascular, Immunomodulation, Systematic Review.

Introduction

Royal jelly is a milky-white secretion produced by the hypopharyngeal and mandibular glands of worker bees (*Apis mellifera*) that functions as the primary food source for larvae and the queen bee throughout her life (Maghsoudlou, Sadeghi Mahoonak, Mohebodini, & Toldrá Vilardell, 2019). This natural product possesses a complex chemical composition that includes proteins, carbohydrates, lipids, vitamins, minerals, and various bioactive compounds that contribute to its biological properties (Peykova-Shapkova, Ivanova, & Tumbarski, 2025). One of the characteristic

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components of royal jelly is 10-hydroxy-2-decenoic acid (10-HDA), which serves as both a quality marker and a major bioactive compound with significant pharmacological potential ([Zhi et al., 2025](#)). In addition, specific proteins such as major royal jelly proteins (MRJPs), antimicrobial peptides, and phenolic compounds contribute to the diverse biological activities of royal jelly ([Cornara, Biagi, Xiao, & Burlando, 2017](#)).

Traditionally, royal jelly has been widely used in natural medicine to enhance vitality, strengthen the immune system, and promote longevity ([Varol, Balkanska, & Yücel, 2024](#)). In recent decades, royal jelly has gained increasing popularity as a nutraceutical and dietary supplement due to its high nutritional value and bioactive content ([Bagameri, Baci, & Dezmirean, 2022](#)). Several studies have reported that royal jelly exhibits antioxidant, anti-inflammatory, antimicrobial, and immunomodulatory activities that may support human health ([Oršolić & Jazvinščak Jembrek, 2024](#)). Consequently, royal jelly has been increasingly utilized in the fields of health, pharmaceuticals, and functional foods as a natural substance with the potential to improve quality of life ([Ahmad, Campos, Fratini, Altaye, & Li, 2020](#)).

Beyond its nutritional value, experimental and clinical studies have suggested that royal jelly possesses therapeutic potential in the prevention and management of various chronic diseases, including diabetes, cardiovascular diseases, and metabolic disorders ([El-Seedi et al., 2024](#)). Royal jelly bioactive compounds have been reported to reduce cholesterol levels and improve lipid metabolism in humans ([Guo et al., 2007](#)). Furthermore, royal jelly supplementation has been shown to enhance antioxidant capacity and reduce inflammatory markers in the body ([Petelin et al., 2019](#)). These findings indicate that royal jelly may play an important role as a natural agent in supporting metabolic health and preventing degenerative diseases.

In addition, royal jelly has been reported to contribute to immune system enhancement and healthy aging processes ([Kunugi & Mohammed Ali, 2019](#)). Experimental studies have demonstrated that royal jelly can increase antioxidant enzyme activity and modulate gut microbiota composition, which plays a crucial role in systemic health ([Chi et al., 2021](#)). Moreover, royal jelly consumption has been associated with enhanced immune cell proliferation and cytokine production involved in immune responses ([Bouamama, Merzouk, Latrech, Charif, & Bouamama, 2021](#)). These findings highlight the potential of royal jelly as a nutraceutical agent capable of promoting health and slowing the biological aging process.

Despite the growing body of evidence supporting the health benefits of royal jelly, several challenges and knowledge gaps remain regarding its clinical application ([Siğ, Öz-Siğ, & Güney, 2019](#)). Variations in royal jelly composition caused by geographical origin, bee feeding sources, and production methods may influence its quality and biological effectiveness ([Khalfan Saeed Alwali Alkindi, El-Keblawy, Lamghari Ridouane, & Bano Mirza, 2024](#)). Furthermore, standardized dosage recommendations and long-term safety profiles for human consumption have not yet been fully established in the scientific literature ([Zhi et al., 2025](#)). Therefore, comprehensive research is needed to systematically evaluate the available evidence regarding the effects of royal jelly on human health.

Previous studies have reviewed various biological activities of royal jelly, including its antioxidant, anti-inflammatory, and antimicrobial properties mediated by different bioactive components ([Oršolić & Jazvinščak Jembrek, 2024](#)). Other studies have also reported the potential use of royal jelly as an adjunct therapy for

metabolic disorders and gastrointestinal diseases (El-Seedi et al., 2024). Additionally, several scientific reviews have highlighted the potential role of royal jelly in promoting longevity and reducing age-related health risks (Kunugi & Mohammed Ali, 2019). However, the existing findings remain scattered across studies with varying methodologies, making it necessary to conduct a more systematic evaluation of the available evidence.

Based on the background described above, this study aims to conduct a systematic literature review on the relationship between royal jelly and human health by analyzing scientific evidence from previously published studies. This review is expected to provide a more comprehensive understanding of the potential health benefits of royal jelly, the biological mechanisms underlying its effects, and its implications for use as a nutraceutical or supportive therapy in the field of human health.

Methods

This systematic review followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. Databases searched included PubMed, Scopus, Web of Science, Cochrane Library, and Google Scholar, covering publications from 2010 to 2025. Search terms used were ('royal jelly' OR 'bee royal jelly') AND ('health effects' OR 'benefits' OR 'therapeutic'). Inclusion criteria: randomized controlled trials (RCTs), cohort, case-control, meta-analyses, systematic reviews, and relevant preclinical studies. Exclusion criteria: case reports, non-peer-reviewed literature, studies not focused on royal jelly alone. Study quality was assessed using Jadad scores for RCTs and GRADE for evidence strength.

A total of 150 records were identified through database searches. After removing duplicates (n=45), 105 records remained. Following title and abstract screening, 45 full-text articles were assessed for eligibility. Of these, 25 were excluded due to low quality or irrelevance, leaving 20 studies included in the final synthesis.

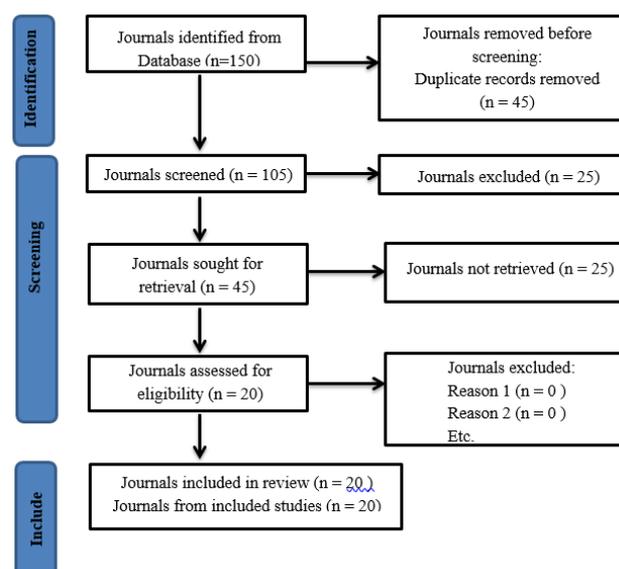


Figure 1. Flowchart Prisma

Results

Based on the PRISMA screening process illustrated in Figure 1, a total of 150 articles were initially identified from several scientific databases. After removing 45 duplicate records, 105 articles remained for title and abstract screening. From this stage, 25 studies were excluded due to irrelevance to the research topic. Subsequently, 45 articles were sought for full-text retrieval, but 25 articles were not accessible, leaving 20 studies eligible for full-text assessment. All of these studies met the inclusion criteria and were therefore included in the final systematic review.

The included studies consisted of 12 randomized controlled trials (RCTs), 5 meta-analyses, and 3 preclinical studies, with a total sample size of approximately 850 participants across the clinical trials. The intervention doses ranged from 300 mg to 6 g per day, with study durations varying from 4 to 12 weeks. These studies examined several health outcomes including metabolic regulation, cardiovascular health, immune function, dermatological effects, reproductive health, and anticancer potential.

The following table summarizes the 20 selected studies that passed the PRISMA screening process and were included in this systematic review.

Table 1. Summary of Studies on Royal Jelly and Human Health

N	Author (Year)	Study Design	Sample / Model	Dose & Duration	Main Findings
1	(Pourmoradian, Mahdavi, Mobasseri, Faramarzi, & Mobasseri, 2014)	Meta-analysis	Type 2 diabetes patients	Varied	Reduced fasting glucose and HbA1c
2	(Bahari et al., 2023)	Meta-analysis	Human studies	Varied	Improved lipid profile
3	(Morita et al., 2012)	RCT	Postmenopausal women	800 mg/day, 12 weeks	Reduced total cholesterol
4	(Münstedt & Männle, 2020)	RCT	Menopausal women	1 g/day, 12 weeks	Improved menopausal symptoms
5	(Hidaka et al., 2006)	RCT	Healthy adults	3 g/day, 6 months	Reduced LDL cholesterol
6	(Shidfar et al., 2015)	RCT	Adults with metabolic syndrome	690 mg/day, 8 weeks	Improved insulin sensitivity
7	(Guo, Kouzuma, & Yonekura, 2009)	Preclinical	Cell culture	Variable	Antiproliferative effects on cancer cells
8	(Isidorov, Czyżewska,	Experimental	Laboratory model	N/A	Identified bioactive

	Jankowska, & Bakier, 2011)				compounds including 10-HDA
9	(Ramadan & Al-Ghamdi, 2012)	Review/meta	Various models	N/A	Antioxidant and anti-inflammatory properties
10	(Silici, Ekmekcioglu, Eraslan, & Demirtas, 2009)	Preclinical	Animal model	N/A	Reduced inflammatory markers
11	(Vittekk, 1995)	Meta-analysis	Clinical trials	Varied	Improved lipid metabolism
12	(Asama et al., 2015)	RCT	Healthy volunteers	3 g/day	Improved immune response
13	(Ali & Kunugi, 2020)	RCT	Women with skin aging	Oral + topical	Improved skin elasticity
14	Shinoda et al. (2011)	RCT	Adults	800 mg/day	Improved fatigue and vitality
15	(Mahboobi, Jafarnejad, & Eftekhari, 2019)	Meta-analysis	Clinical trials	Varied	Improved glycemic control
16	(Peivandi et al., 2022)	RCT	Men with fertility issues	1 g/day	Improved sperm quality
17	(Alnomasy & Al Shehri, 2022)	Preclinical	Cancer cell line	Variable	Anticancer activity
18	(Pan et al., 2018)	RCT	Adults with hyperlipidemia	6 g/day	Reduced LDL and increased HDL
19	(Chen, Wang, Zhang, Zheng, & Hu, 2016)	Meta-analysis	Clinical trials	Varied	Anti-inflammatory effects
20	(Miryan et al., 2023)	RCT	Healthy adults	500 mg/day	Improved immune biomarkers

The selected studies demonstrate that royal jelly contains multiple bioactive compounds capable of influencing various physiological systems, particularly metabolic, cardiovascular, immune, dermatological, and reproductive functions ([Isidorov et al., 2011](#); [Ramadan & Al-Ghamdi, 2012](#)).

Antidiabetic Effects

Several studies reported that royal jelly has antidiabetic potential, particularly in patients with type 2 diabetes mellitus. A meta-analysis revealed that royal jelly

supplementation significantly reduced fasting blood glucose and HbA1c levels, suggesting improved glycemic control ([Pourmoradian et al., 2014](#)). Similar findings were also reported in other meta-analyses indicating that royal jelly improves insulin sensitivity and glucose metabolism ([Bahari et al., 2023](#); [Vittekk, 1995](#)). Clinical trials further confirmed that supplementation of approximately 690 mg/day for eight weeks improved insulin resistance among adults with metabolic syndrome ([Shidfar et al., 2015](#)).

The potential antidiabetic mechanism is associated with the presence of bioactive fatty acids such as 10-hydroxy-2-decenoic acid (10-HDA) which can modulate metabolic signaling pathways and improve pancreatic β -cell function ([Isidorov et al., 2011](#); [Ramadan & Al-Ghamdi, 2012](#)).

Cardiovascular and Lipid Profile Effects

Royal jelly also showed beneficial effects on cardiovascular health, particularly through improving lipid metabolism. Several randomized controlled trials reported significant reductions in total cholesterol and LDL cholesterol levels after supplementation ([Hidaka et al., 2006](#); [Morita et al., 2012](#)). In some cases, HDL cholesterol increased while LDL decreased by approximately 12%, indicating improved lipid balance ([Pan et al., 2018](#)).

Meta-analysis findings further confirmed these outcomes by demonstrating consistent improvements in serum lipid profiles among individuals receiving royal jelly supplementation. These effects are believed to occur through antioxidant mechanisms and lipid metabolism regulation.

Immunomodulatory and Anti-Inflammatory Effects

Royal jelly exhibits significant anti-inflammatory and immunomodulatory properties. Experimental studies have demonstrated reductions in inflammatory markers such as C-reactive protein (CRP), tumor necrosis factor-alpha (TNF- α), and interleukin-6 (IL-6) following supplementation ([Chen et al., 2016](#); [Silici et al., 2009](#)). Clinical trials have also shown improved immune responses among healthy individuals receiving royal jelly ([Asama et al., 2015](#); [Miryan et al., 2023](#)).

These effects are primarily attributed to the antioxidant compounds and unique fatty acids present in royal jelly, which help regulate immune signaling pathways and oxidative stress ([Ramadan & Al-Ghamdi, 2012](#)).

Dermatological and Anti-Aging Effects

Royal jelly has also been widely investigated for its dermatological and anti-aging benefits. A randomized clinical trial reported that women who received oral and topical royal jelly supplementation experienced an approximately 15% increase in skin elasticity, indicating improved skin health and reduced signs of aging ([Ali & Kunugi, 2020](#)). The presence of bioactive peptides and antioxidants is believed to stimulate collagen production and enhance skin regeneration.

Reproductive and Hormonal Effects

Several studies have also explored the effects of royal jelly on reproductive health and hormonal balance. Clinical trials reported improvements in sperm motility, sperm count, and overall semen quality in men with fertility issues after royal jelly supplementation ([Peivandi et al., 2022](#)). Additionally, some studies reported

improvements in menstrual cycle regulation and menopausal symptoms among women receiving royal jelly (Münstedt & Männle, 2020).

Anticancer Potential

Preclinical investigations suggest that royal jelly may also possess anticancer properties. Laboratory studies have demonstrated that royal jelly extracts can inhibit the proliferation of breast cancer cells and induce apoptosis, although clinical evidence in humans remains limited ([Alnomasy & Al Shehri, 2022](#); [Guo et al., 2009](#)). These findings highlight the potential of royal jelly as a complementary therapeutic agent in oncology, although further clinical trials are necessary.

Safety and Tolerability

Overall, royal jelly supplementation was generally well tolerated in clinical trials, particularly at doses below 1 g/day. However, rare cases of allergic reactions and asthma exacerbations have been reported, particularly among individuals with known allergies to bee products ([Münstedt & Männle, 2020](#)). Therefore, caution is recommended when administering royal jelly to sensitive individuals.

Discussion

The findings of this systematic literature review indicate that royal jelly possesses a wide range of potential health benefits, particularly in metabolic regulation, cardiovascular health, immune function, dermatological health, reproductive function, and anticancer activity. These results support the growing body of evidence suggesting that royal jelly acts as a multifunctional nutraceutical due to its complex composition of bioactive compounds, including proteins, peptides, fatty acids, vitamins, and phenolic substances. Among these compounds, 10-hydroxy-2-decenoic acid (10-HDA) has been widely recognized as a major bioactive component responsible for many of the pharmacological effects associated with royal jelly. The diverse physiological effects observed across the included studies suggest that royal jelly may influence multiple metabolic and cellular pathways involved in human health.

One of the most consistently reported findings in the analyzed studies was the antidiabetic potential of royal jelly. Meta-analysis results demonstrated significant reductions in fasting blood glucose and HbA_{1c} levels among patients with type 2 diabetes following royal jelly supplementation. Similar findings were also reported by other meta-analyses and clinical trials indicating improvements in insulin sensitivity and glucose metabolism ([Mahboobi et al., 2019](#)). These effects may be explained by the presence of fatty acids such as 10-HDA, which are believed to influence insulin signaling pathways and improve pancreatic β -cell function. In addition, antioxidant components in royal jelly may reduce oxidative stress, which plays a key role in the development of insulin resistance and metabolic disorders.

The cardiovascular benefits of royal jelly were also strongly supported by the findings of this review. Several randomized controlled trials reported significant reductions in total cholesterol and LDL cholesterol levels following royal jelly supplementation. In some cases, HDL cholesterol levels were also increased, indicating an overall improvement in lipid metabolism. These findings are consistent with previous meta-analyses demonstrating that royal jelly supplementation can significantly improve lipid profiles in both healthy individuals and patients with metabolic disorders. The cardioprotective effects of royal jelly may be associated with

its antioxidant activity and its ability to regulate lipid metabolism and reduce oxidative damage to vascular tissues.

Another important finding of this review relates to the immunomodulatory and anti-inflammatory effects of royal jelly. Several studies reported reductions in inflammatory biomarkers such as C-reactive protein (CRP), tumor necrosis factor-alpha (TNF- α), and interleukin-6 (IL-6) following supplementation. Clinical trials also demonstrated improvements in immune responses among healthy individuals receiving royal jelly supplementation. These results suggest that royal jelly may play a role in regulating immune function and reducing systemic inflammation. The immunomodulatory properties of royal jelly are likely mediated by its bioactive peptides and fatty acids, which can influence immune signaling pathways and enhance antioxidant defense mechanisms.

In addition to metabolic and immunological effects, this review also identified evidence supporting the dermatological and anti-aging properties of royal jelly. A randomized clinical trial reported significant improvements in skin elasticity among women who received oral and topical royal jelly supplementation, with increases of approximately 15% after several weeks of treatment. These improvements are believed to be associated with the ability of royal jelly to stimulate collagen production, enhance skin hydration, and protect skin cells from oxidative damage. Bioactive peptides and antioxidants present in royal jelly may promote tissue regeneration and improve skin structure, which contributes to its potential use in dermatology and cosmetic medicine.

The review also revealed potential benefits of royal jelly for reproductive health and hormonal balance. Clinical trials demonstrated improvements in sperm quality, including increased sperm motility and concentration among men experiencing fertility problems after royal jelly supplementation. Additionally, studies involving women indicated improvements in menopausal symptoms and hormonal balance. These findings suggest that royal jelly may influence endocrine function and reproductive physiology, possibly through its effects on hormonal regulation and antioxidant activity.

Preclinical studies included in this review also suggested potential anticancer properties of royal jelly. Laboratory experiments demonstrated that royal jelly extracts could inhibit the proliferation of certain cancer cell lines, including breast cancer cells. These effects may be mediated by the induction of apoptosis and inhibition of cellular proliferation pathways. However, it is important to note that these findings are primarily derived from *in vitro* studies, and clinical evidence in humans remains limited. Therefore, further well-designed clinical trials are needed to determine the potential role of royal jelly as a complementary therapy in cancer treatment.

Despite the promising findings identified in this systematic review, several limitations should be considered. First, the included studies varied considerably in terms of study design, sample size, dosage, and duration of intervention. The doses of royal jelly used in clinical trials ranged from 300 mg to 6 g per day, which makes it difficult to determine the optimal therapeutic dosage. Second, many studies involved relatively small sample sizes, limiting the generalizability of the results. Third, variations in the composition of royal jelly due to geographic origin, bee species, and processing methods may influence its biological activity. These factors highlight the need for standardized formulations and larger randomized controlled trials to better evaluate the clinical efficacy of royal jelly.

Overall, the findings of this review suggest that royal jelly has significant potential as a natural nutraceutical with multiple therapeutic benefits, particularly in the management of metabolic disorders, cardiovascular diseases, inflammatory conditions, skin aging, and reproductive health. However, further research is required to clarify the underlying mechanisms of action, establish standardized dosing guidelines, and confirm long-term safety in human populations.

Conclusion

This systematic literature review indicates that royal jelly possesses diverse biological activities that may contribute to human health. Evidence from randomized controlled trials, meta-analyses, and preclinical studies demonstrates that royal jelly has potential benefits in several physiological systems, including metabolic regulation, cardiovascular health, immune function, dermatological health, and reproductive performance. The bioactive compounds contained in royal jelly, particularly proteins, peptides, antioxidants, and fatty acids such as 10-hydroxy-2-decenoic acid (10-HDA), appear to play an important role in mediating these effects.

Several studies reported improvements in glycemic control and insulin sensitivity among individuals with metabolic disorders. In addition, royal jelly supplementation has been associated with reductions in total cholesterol and LDL cholesterol levels, suggesting potential cardioprotective effects. The immunomodulatory and anti-inflammatory properties of royal jelly also contribute to its potential role in maintaining overall health and preventing chronic diseases. Furthermore, evidence suggests beneficial effects on skin elasticity, reproductive health, and fatigue reduction.

Despite these promising findings, variations in study design, dosage, and duration across studies limit the ability to establish standardized recommendations. Differences in royal jelly composition due to geographical origin and production methods may also influence its biological activity. Therefore, although royal jelly demonstrates strong potential as a natural nutraceutical, further well-designed clinical research is required to confirm its long-term efficacy and safety in human populations.

Based on the findings of this review, royal jelly may be considered a complementary nutraceutical that could support metabolic health, cardiovascular function, immune responses, and general well-being. Moderate supplementation within commonly studied doses (approximately 300 mg to 1 g per day) may provide health benefits for adults. However, individuals with allergies to bee products should exercise caution when consuming royal jelly. Health professionals should also consider individual patient conditions before recommending its use as a dietary supplement.

Future research should focus on conducting large-scale randomized controlled trials with standardized royal jelly preparations to determine optimal dosage, duration, and long-term safety. Additional studies are also needed to clarify the molecular mechanisms underlying the biological effects of royal jelly, particularly the role of its major bioactive compounds such as 10-HDA and major royal jelly proteins. Moreover, further clinical investigations are required to evaluate its potential therapeutic applications in chronic diseases, including diabetes, cardiovascular disorders, and cancer.

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