

THE ROLE OF HONEY IN HUMAN HEALTH AND NUTRITION

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REVIEW ARTICLE

Abstract

Honey, one of the most complex apicultural products, has long surpassed the status of a simple natural sweetener, being regarded as a functional food with significant therapeutic benefits. Due to its rich composition in flavonoids, phenolic acids, enzymes, and bioactive compounds, honey exerts multiple biological effects, among which antioxidant, anti-inflammatory, antibacterial, antifungal, cardioprotective, gastroprotective, and antidiabetic activities stand out. The aim of this study was to synthesize recent scientific data regarding the role of honey in human health and nutrition, highlighting its main mechanisms of action and potential clinical applications. The analysis was based on a systematic search of the PubMed, Elsevier, Google Scholar, and Wiley databases, selecting approximately 250 relevant articles published in English. The results confirm that the biological activity of honey largely depends on its botanical and geographical origin, which determine the variation in polyphenol content and other bioactive substances. Its antioxidant and anti-inflammatory properties contribute to reducing oxidative stress and protecting the cardiovascular system, while topical application promotes wound healing and tissue regeneration. Moreover, honey shows beneficial effects in regulating carbohydrate metabolism and maintaining the balance of intestinal microbiota. In conclusion, honey emerges as a functional food of high biological value, positioned at the interface between nutrition and therapy, supporting the need for further clinical studies to validate its use as a safe and effective therapeutic adjuvant.

Keywords: Honey, human health, nutrition, functional foods, therapeutic properties.

INTRODUCTION

Beekeeping represents both knowledge and art, aiming to support human health through the use of hive products such as honey, royal jelly, propolis, bee venom, and bee bread (Pasupuleti et al., 2017). In recent years, these natural products have gained increasing attention due to their applicability in both traditional and modern medicine. Numerous studies have highlighted their pharmacological properties and health benefits, paving the way for the development of functional foods and nutraceuticals (Pasupuleti et al., 2017).

Among bee products, honey holds a central position. For centuries, it has been valued not only as a natural sweetener but also as a therapeutic substance with nutritional, antioxidant, antimicrobial, anti-inflammatory, and cardioprotective effects (Badolato et al., 2017; Khan et al., 2017). The composition and properties of honey vary depending on its floral origin, which gives it a wide diversity of flavors, colors, and bioactive compounds (Chen et al., 2019; Jaganathan & Mandal, 2009). Beyond its nutritional value, scientific studies confirm honey's role in regulating the glycemic response, promoting wound healing, and supporting overall health through oral administration or topical application (Khan et al., 2017; Fakhlaei et al., 2020).

Through its wide range of biological effects, honey remains one of the most important natural functional foods, with therapeutic applications spanning metabolic, cardiovascular, digestive, and dermatological health (Miguel et al., 2017; Fakhlaei et al., 2020).

The aim of this presentation is to synthesize and update current information regarding the role of honey in human health and nutrition, emphasizing its scientifically proven benefits.

MATERIAL AND METHOD

This paper represents a synthesis of recent scientific data from the specialized literature, aiming to highlight the efficacy of honey in maintaining health and in the treatment of various medical conditions. Information was obtained through a systematic search of online databases including PubMed, Elsevier, Google Scholar, and Wiley, restricted to articles published in English.

The search strategy included keywords such as honey, human health, nutrition, functional foods, therapeutic properties. The initial search identified 1,074 articles, of which approximately 250 were selected for evaluation. Their abstracts were critically analyzed, classified, and compared, focusing on scientific relevance and potential therapeutic applications.

RESULTS AND DISCUSSIONS

The reviewed research highlights that honey exhibits numerous biological activities, mainly determined by its complex composition and the botanical origin of the flowers from which nectar is collected (Anguebes-Franceschi et al., 2019). According to the scientific literature, honey exerts a wide range of pharmacological effects, including antioxidant, cardioprotective, wound-healing, anti-inflammatory, gastroprotective, anticancer, antibacterial, antidiabetic, and antifungal activities (Fakhlai et al., 2020).

The antioxidant properties of honey are primarily attributed to the presence of flavonoids and phenolic acids, which act by chelating metal ions, neutralizing free radicals, and reducing oxidative stress involved in degenerative, cardiovascular, and neoplastic diseases (Kamaruzzaman et al., 2019; Moniruzzaman et al., 2012). High levels of polyphenols in raw honey contribute to the prevention of inflammation, thrombosis, diabetes, and other chronic disorders (Ahmed et al., 2018; Mandal & Mandal, 2011).

The anti-inflammatory activity of honey is well-documented, showing effects in reducing edema, exudates, and tissue inflammation through the inhibition of reactive oxygen species formation, leukocyte infiltration, and the expression of pro-inflammatory enzymes such as COX-2 and inducible nitric oxide synthase (Majtan, 2014; Holt et al., 2012). Moreover, honey demonstrates remarkable antibacterial activity due to the combined effects of its low pH, osmotic pressure, hydrogen peroxide, and non-peroxide compounds such as phenolic acids and flavonoids (Mandal & Mandal, 2011; Seraglio et al., 2019). Methylglyoxal (MGO) and its precursor dihydroxyacetone (DHA) inhibit bacterial growth by blocking urease activity, while bacterial species such as *Salmonella* spp., *Escherichia coli*, and *Shigella* spp. are sensitive to honey's bactericidal effect (Mandal & Mandal, 2011; Gobin et al., 2018; Almasaudi, 2021). Honey also exhibits antifungal activity against *Candida albicans*, *Aspergillus flavus*, *Microsporum gypseum*, and *Penicillium chrysogenum*, due to its glucose oxidase, methylglyoxal, and high sugar content (Mandal & Mandal, 2011; Anyanwu, 2012).

Several studies have confirmed the cardioprotective effects of honey, mainly related to its phenolic and flavonoid content, which improve endothelial function, inhibit platelet aggregation, reduce oxidative stress and inflammatory responses, thus providing

protection against vascular dysfunction and cardiovascular diseases (Ab Wahab et al., 2018). Flavonoids such as quercetin, kaempferol, and caffeic acid contribute to lipid profile regulation and reduction of thrombotic risk (Khalil et al., 2010; Olas, 2020).

Honey's wound-healing properties result from its synergistic antibacterial, anti-inflammatory, and antioxidant actions, which stimulate angiogenesis, collagen synthesis, epithelialization, and edema reduction (Al-Waili et al., 2011; Takzaree et al., 2016). It promotes tissue regeneration, granulation tissue formation, and moist wound healing, being widely used in dressings, gels, and medical creams (Al-Waili et al., 2011; Gupta & Stangaciu, 2014).

The gastroprotective effects of honey are explained by the presence of enzymes that facilitate the digestion of sugars and starches, as well as by its bactericidal action against enteropathogenic microorganisms (Pasupuleti et al., 2017; Ma et al., 2019). Moreover, honey exhibits important anticancer properties attributed to phenolic acids (gallic and caffeic) and flavonoids (catechin, kaempferol, quercetin), which act through antioxidant, anti-inflammatory, antiproliferative, and apoptotic mechanisms (Waheed et al., 2019).

Regarding its antidiabetic effect, honey helps regulate the insulin response through its fructose and antioxidant content, which protect pancreatic cells from oxidative stress and reduce hyperglycemia (Mandal & Mandal, 2011; Bobiş et al., 2018). Experimental studies support the role of honey as a beneficial dietary supplement for diabetes control and for reducing associated metabolic complications (Bobiş et al., 2018).

Overall, the literature confirms that honey is a natural product with significant therapeutic potential, whose biological effects are closely linked to its chemical composition and botanical origin, justifying its use as a functional food and adjuvant in the prevention and management of various human diseases.

The synthesized data confirm the biochemical complexity of honey and its relevance in maintaining human health. Beyond its traditional role as an energy source, honey emerges as a true functional agent with direct implications for metabolic homeostasis and cellular protection. The presence of flavonoids, phenolic acids, and antioxidant enzymes largely explains its anti-inflammatory and cardioprotective effects, demonstrating the

strong relationship between its phytochemical composition and observed biological activity.

An essential aspect emerging from the analyzed studies is the dependence of therapeutic effects on the botanical and geographical origin of honey. The variable content of polyphenols, vitamins, and minerals results in significant differences in antioxidant and antibacterial capacity. This supports the need for strict standardization of honey intended for therapeutic use to ensure reproducibility of clinical outcomes and safety of administration.

The antibacterial and antifungal activity of honey, attributed to the synergy between hydrogen peroxide, high acidity, and phenolic compounds, opens promising perspectives for the development of natural topical and medical formulations for treating skin infections and chronic wounds. Furthermore, honey's ability to stimulate tissue regeneration and angiogenesis justifies its inclusion in advanced medical products such as gels, bioactive dressings, and ointments.

From a metabolic perspective, current data suggest that honey, when consumed in moderate amounts, can help regulate blood glucose and protect pancreatic function; however, these effects depend on the type of honey and patient profile. Despite the experimentally demonstrated benefits, further clinical studies are needed to establish optimal doses and elucidate the molecular mechanisms underlying its antidiabetic effects.

Moreover, the growing interest in using honey as a functional food and nutraceutical calls for an integrated approach involving nutrition science, pharmacology, and apicultural biotechnology. In a world where chronic inflammation and oxidative stress underlie most non-communicable diseases, honey stands out as a natural health modulator capable of supporting physiological processes and reducing the risk of degenerative pathologies.

Nevertheless, the literature also reveals certain methodological limitations, including sample heterogeneity, lack of honey source standardization, and variability in clinical study design. These factors may affect data interpretation and highlight the need for well-controlled, multicenter research to strengthen the evidence regarding honey's therapeutic efficacy.

In conclusion, the critical analysis of available data confirms that honey is a natural product with complex pharmacological potential, positioned at the interface between

food and medicine. The valorization of this potential depends on a deeper understanding of its biochemical mechanisms, the establishment of quality parameters, and the integration of scientific findings into evidence-based medical and nutritional practice.

CONCLUSIONS

The analysis of the scientific literature demonstrates that honey is an apicultural product with complex therapeutic and nutritional value, far beyond that of a simple natural sweetener. Due to its rich content of flavonoids, phenolic acids, enzymes, and bioactive compounds, honey exerts a wide range of beneficial effects on human health, including antioxidant, anti-inflammatory, antibacterial, antifungal, cardioprotective, gastroprotective, and antidiabetic activities.

The biological efficacy of honey is closely correlated with its botanical and geographical origin, emphasizing the need to standardize its chemical composition for therapeutic use and to ensure the quality of apicultural products intended for human consumption.

Through its ability to modulate oxidative and inflammatory responses, honey contributes to maintaining metabolic balance and preventing chronic non-communicable diseases such as cardiovascular disorders, diabetes, and degenerative conditions. Furthermore, its topical use has proven effective in wound healing, tissue regeneration, and the reduction of skin infections, confirming its role in regenerative and dermatological medicine.

However, in order to transform honey into a scientifically validated therapeutic adjuvant, additional controlled and multicenter clinical studies are required to establish optimal doses, underlying molecular mechanisms, and possible drug interactions.

In conclusion, honey emerges as a functional food of high biological value, positioned at the intersection of nutrition and pharmacotherapy. The integration of current scientific findings into evidence-based medical and nutritional practice could strengthen the position of honey as a strategic natural resource for promoting health and preventing disease within the framework of modern personalized medicine.

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