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History and Therapeutic Benefits of Honey: From Ancient Traditions to Modern Medicine

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The history of honey spans millennia, with humans and honeybees intertwined in a remarkable journey dating back to ancient times. From the primitive collection of wild honey by early ancestors to the sophisticated practices of beekeeping and honey production today, honey has played diverse roles in various cultures and civilizations. Its significance transcends mere sustenance, extending into religious rituals, traditional medicine, and culinary delights. Across civilizations, honey has been revered for its delectable taste and myriad health benefits, including its therapeutic properties in wound care, its role in traditional medicinal practices such as Ayurveda, and its potential as an anti-bacterial, antiviral, anti-fungal, anti-inflammatory, and anti-cancer agent. Moreover, honey's

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versatility extends to oral health, stomach disorders, and wound and burn treatment, making it a valuable natural resource with immense cultural, medicinal, and culinary significance.

Keywords: Honey; history; beekeeping; medicinal properties; traditional medicine; antibacterial; antiviral; antifungal; anti-inflammatory; anti-cancer; oral health; wound treatment; burn treatment; ayurveda.

1. INTRODUCTION

Taking on a remarkable excursion across time, the alliance between humanity and honey reveals a tale that surpasses decades, from ancient ancestors wielding sticks to modern beekeeping practices. Honey's evolution from a culinary delight to a symbol of cultural and spiritual significance transcends epochs and continents, revered by civilizations worldwide. Delving into its medicinal marvels, honey emerges as a potent therapeutic agent, endorsed by luminaries like Hippocrates and cherished within Ayurvedic traditions. With its antibacterial efficacy rooted in unique composition and non-peroxide properties, honey stands as a formidable ally against microbial adversaries, offering promise in combating evolving pathogens (Simon et al*.,* 2009). From anti-allergic prowess to anti-fungal fortitude, honey's holistic healing potential captivates researchers and practitioners alike, promising new horizons in wellness. As science unravels the mysteries of honey's anti-cancer properties and its potential as an anti-diabetic agent, humanity continues to marvel at nature's bounty and the enduring quest for wellness it represents. Across history's tapestry, honey's golden threads weave tales of resilience, spirituality, and sustenance, enriching cultures and traditions through the ages. From the ancient Egyptians' pioneering use of honey in wound care to the Greeks' ambrosial indulgences, honey's allure transcends mere sustenance, becoming a symbol of abundance and vitality. Its rich tapestry extends to religious practices, with every major belief system endorsing its consumption as a nutrient-rich elixir. In Islam, the Prophet Muhammad (PBUH) (Aslam et al*.,* 2022) lauded honey's medicinal attributes, while Hinduism's "Jatakarma" tradition includes administering honey drops to newborns. Christianity, though cautious in certain dietary contexts, narrates instances like John the Baptist's desert sustenance by honey. As we traverse the annals of history and delve into honey's medicinal uses, from its role as an antibacterial agent to its potential as an anti-fungal and anti-cancer remedy, the timeless elixir continues to inspire wonder and reverence, bridging ancient wisdom with modern science (Chirsanova, 2021).

2. HISTORY OF HONEY

Humans and honey have shared an incredible journey spanning thousands of years, dating back to around 50,000 BC when our ancestors, akin to modern monkeys, utilized sticks to collect honey. Evidence from a painting in Spain illustrates how honey from wild beehives was consumed during the Neolithic era, where honey and water were mixed. The utilization of beeswax in religious ceremonies emerged during the Bronze Age. The practice of beekeeping began around 3000–4000 BC. By 2700 BC, honey gained recognition not only for its delectable taste but also for its medicinal properties, particularly in wound care. Ancient Egypt, from 2600 to 2200 BC, extensively employed honey to treat infections in wounds. Hippocrates endorsed honey-based remedies, and the ancient Greeks (circa 2000–1000 BC) celebrated Oenomel, a beverage crafted from honey and grape juice (Eteraf-Oskouei and Najafi, 2013). Beeswax held significant value during the Middle Ages, finding applications in art and commerce. The introduction of movable frames in L. L. Langstroth's hive design in 1852 revolutionized honey production (Nayik et al., 2014; Bhatta, 2022).

The religious significance of honey transcends cultural and ethnic boundaries, with every major belief system endorsing its consumption. Considered a nutrient-rich elixir, honey has been embraced across ages, customs, and civilizations, both ancient and modern (Nayik et al., 2014). In Islam, the medicinal attributes of honey were acknowledged by the Prophet Muhammad (PBUH), who prescribed it for various ailments, including gastrointestinal issues. A hadith narrates an incident where the Prophet advised honey for a man seeking treatment for his brother's stomach ailment, affirming its efficacy (Nayik et al., 2014). In Hinduism, the tradition of "Jatakarma" involves administering honey drops to newborns along with reciting God's name (Nayik et al., 2014).

Christianity, while cautioning against mixing yeast or honey with grain offerings, presents instances where honey, like that consumed by John the Baptist during his desert journeys, sustains individuals adhering to religious dietary laws (Nayik et al., 2014). The composition of honey reveals its richness in carbohydrates, predominantly fructose, glucose, and sucrose, irrespective of floral or geographical origin. Organic acids such as aspartic, butyric, citric, and acetic contribute to its flavour and potential health benefits. Enriched with trace amounts of protein and enzymes sourced from honeybees, honey serves as a versatile natural substance (Bhatta, 2022). In Ayurvedic medicine, honey is highly regarded for its multifaceted properties, aiding in balancing bodily substances known as Vata, Pitta, and Kapha. Its therapeutic applications include treating coughs, asthma, wounds, and even hiccups. Studies affirm its efficacy in addressing various ailments, reinforcing its significance in traditional and contemporary folk medicine (Arawwawala & Hewageegana, 2017; Molan, 1999; Ajibola et al., 2012; Eteraf-Oskouei et al., 2013).

3. MEDICINAL USES OF HONEY

3.1 Anti-bacterial Agent

Honey possesses antibacterial properties owing to several characteristics. Its high viscosity, low water content, acidic nature, and hydrogen peroxide content make it a remarkable therapeutic agent. In addition to hydrogen peroxide, methylglyoxal, a non-peroxide ingredient, plays a crucial role in limiting bacterial growth (Weston, 2000). Glycopeptides and non-peroxidase glycoproteins further enhance honey's antibacterial efficacy (Mavric et al., 2008). Water activity, representing the relationship between bacterial growth and unbound water molecules, falls within a typical range of 0.562 to 0.62 (Olaitan et al., 2007). Bacteria require a water activity range of 0.94 to 0.99 for growth (Blickstad, 1984), which honey inhibits by reducing water content (White and Doner, 1980). Honey's sugar content, ranging from 70% to 80%, also contributes to its antibacterial properties (Singh and Singh, 2018).

The antibacterial activity of honey has been associated with several non-peroxide properties. Unlike conventional honeys, which rely on hydrogen peroxide for antibacterial effects, some honeys retain antibacterial properties even in the presence of catalase. These honeys are often referred to as "non-peroxide honeys." Some studies suggest that the simple phenolic and flavonoid compounds present in honey (Khoo et al., 2017).

3.2 Honey as an Antiviral Agent

Honey's properties, extensively studied alongside antibiotics and antifungal drugs, highlight a significant research gap in its antiviral potential, crucial for both therapy and prevention of viral diseases. A 1996 in vitro study using monkey kidney cells infected with Rubella virus demonstrated honey's ability to neutralize the virus without causing cytotoxicity, with concentrations ranging from 1:1 to 1:1000. Notably, honey exhibited significant antiviral efficacy against Herpes Simplex Virus at 500µg/mL, reducing viral load by up to 100 µg/mL. Additionally, honey effectively treats recurrent HSV skin lesions (Al-Waili, 2004). Furthermore, a study showed honey, garlic, and ginger are clinically effective against viral division while promoting cell proliferation in human peripheral blood mononuclear cells (Vahed et al., 2016). Below are descriptions of the two main mechanisms by which honey kills the virus.

3.3 Anti Allergic Agent

Honey, a natural sweetener produced by bees from the nectar of flowers, has garnered attention for its potential role as an anti-allergic agent. Studies suggest that honey possesses anti-inflammatory properties due to its rich content of flavonoids and phenolic acids, which may help alleviate symptoms associated with allergic reactions (Zhang et al., 2014). Furthermore, the presence of bee pollen in honey is believed to desensitize the immune system to allergens, potentially reducing allergic responses over time (Sajjadi et al., 2012). Research has also highlighted the antimicrobial activity of honey, which could contribute to its ability to combat allergic reactions triggered by microbial agents (Kwakman et al., 2010). Additionally, the high osmolarity of honey creates an environment unsuitable for microbial growth, further enhancing its therapeutic potential in managing allergic conditions (Al-Waili, 2009). Moreover, the diverse range of antioxidants present in honey may protect against oxidative stress, a common feature of allergic responses (Erejuwa et al., 2012). Additionally, the unique composition of honey, including its enzymes and organic acids, may modulate immune function, offering protection against allergic reactions

(Samarghandian et al., 2015). The application of honey in traditional medicine for centuries underscores its perceived efficacy in managing allergic symptoms (Simon et al., 2009). However, more rigorous clinical trials are warranted to elucidate the specific mechanisms underlying honey's anti-allergic effects and to determine its optimal dosage and application in clinical practice (Gethin et al., 2007).

3.4 Honey as an Anti-Fungal Agent

Honey, a natural substance produced by bees from the nectar of flowers, has gained attention for its potential as an anti-fungal agent. Numerous studies have demonstrated honey's efficacy against a variety of fungal species, including Candida albicans, a common pathogen responsible for fungal infections in humans (Sherlock et al., 2010). The multifactorial nature of honey's anti-fungal activity involves its high sugar content, low pH, and production of hydrogen peroxide, which collectively create an inhospitable environment for fungal growth (Al-Waili et al., 2006). Additionally, honey exhibits broad-spectrum antimicrobial properties attributed to its diverse array of bioactive compounds, including flavonoids, phenolic acids, and enzymes (Erejuwa et al., 2012). Furthermore, the osmotic effect of honey draws moisture from fungal cells, leading to their dehydration and eventual death (Molan, 2006). Studies have also highlighted the synergistic effects of honey when used in combination with conventional antifungal agents, suggesting its potential as an adjunctive therapy for fungal infections (Gethin et al., 2007). Despite these promising findings, further research is needed to elucidate the mechanisms underlying honey's anti-fungal activity and to determine its optimal formulation and application in clinical settings (Alvarez-Suarez et al., 2013).

3.5 Honey as an Anti-cancer Agent

Honey, derived from floral nectar by bees, has garnered attention for its potential as an anti-cancer agent. Its diverse bioactive compounds, including phenolic acids and flavonoids, exhibit antioxidant and anti-inflammatory properties that may contribute to anti-cancer effects. In vitro studies suggest cytotoxic effects on cancer cells, particularly in certain floral varieties. Honey's modulation of immune responses and tissue repair mechanisms could aid in combating cancer progression (Khoo et al., 2017). Moreover, it shows promise in enhancing conventional cancer therapies and reducing their side effects. However, further clinical trials are needed to elucidate mechanisms and establish therapeutic utility in cancer management (Jaganathan et al., 2016).

3.6 Honey as an Anti-Diabetic Agent

The natural sweetener honey, which is made by bees from blossom nectar, has gained interest due to its possible anti-diabetic properties. Research indicates that some varieties of honey, especially those with elevated antioxidant levels, may provide advantages in the management of diabetes by enhancing insulin sensitivity and glycemic control (Erejuwa et al., 2012). Additionally, honey contains bioactive compounds such as flavonoids and phenolic acids, which have been shown to exert anti-diabetic effects through various mechanisms, including inhibition of carbohydrate digestion and absorption, as well as enhancement of pancreatic β-cell function (Abdulrhman et al., 2011). Furthermore, the low glycemic index of honey compared to other sweeteners may help regulate blood sugar levels and reduce the risk of hyperglycemia. Moreover, honey possesses anti-inflammatory properties that could mitigate insulin resistance, a key feature of type 2 diabetes (Majtan, 2014). While promising, further clinical trials are needed to elucidate the specific mechanisms of action and optimal dosage of honey in diabetes management, considering factors such as honey variety and individual metabolic profiles.

4. REMEDY FOR STOMACH DISORDERS

Honey offers a range of potential remedies for various stomach disorders, making it a versatile option for natural gastrointestinal relief. Its enzymes and oligosaccharides aid in digestion, alleviating issues such as indigestion and bloating (Mandal & Mandal, 2011). For those suffering from acid reflux, honey's natural acidity can help balance stomach acid levels, providing relief from heartburn and forming a protective barrier in the esophagus (Al-Waili et al., 2006). Moreover, honey's antimicrobial and anti-inflammatory properties may aid in treating gastric ulcers, combating *Helicobacter pylori* bacteria, and promoting tissue regeneration (Majtan, 2014). In cases of diarrhea, honey's antibacterial properties inhibit pathogen growth, while its high sugar content helps draw water into the intestines, easing symptoms (Erejuwa et al., 2012). Additionally, honey's soothing properties

can alleviate nausea and upset stomach, offering relief when consumed directly or added to herbal teas (Bogdanov et al., 2008). Regular consumption of honey may also support gut health by promoting the growth of beneficial bacteria, helping to maintain a healthy balance of gut microbiota and reducing the risk of gastrointestinal disorders (Al-Waili et al., 2004). However, individuals with existing medical conditions should consult healthcare professionals before using honey as a remedy.

5. ORAL HEALTH

Honey has several qualities that could be beneficial to dental health. Because of its antibacterial qualities, it may be possible to lower the risk of gum disease and dental caries by preventing the formation of oral bacteria (Molan, 2006). Additionally, several studies have shown that honey can lessen the development of plaque and gingivitis (Al-Waili et al., 2006). Some varieties of honey, especially those high in hydrogen peroxide, have potent antibacterial properties against oral infections (Erejuwa et al., 2012). Furthermore, the anti-inflammatory qualities of honey may aid in reducing the pain and irritation in the mouth brought on by diseases including periodontitis and gingivitis (Samet et al., 2009). It's crucial to remember that even while honey has potential as an additional oral health aid, basic oral hygiene routines like brushing, flossing, and routine dental checkups should still be prioritized.

6. WOUND AND BURN TREATMENT

Because of its antibacterial and wound-healing qualities, honey has been used for ages as a natural wound and burn therapy. Because of its high sugar content, it draws moisture from wounds and provides an environment that is not conducive to the growth of bacteria. Furthermore, honey has several compounds that are known to promote tissue regeneration and healing, including antioxidants and antimicrobial agents (Jull et al., 2008). Honey's low pH also aids in the prevention of bacterial growth. Furthermore, honey has anti-inflammatory effects, which can aid in the reduction of swelling and discomfort (Al-Waili et al., 2011). Because of its natural adhesive properties, honey can create a protective barrier over wounds, preventing contamination and promoting healing. However, it's important to use medical-grade honey for wound care and to consult with a healthcare professional before using honey on serious burns or wounds (Lusby et al., 2002).

7. CONCLUSION

In conclusion, honey's extensive historical journey, from ancient honey collection methods to modern beekeeping practices, highlights its enduring significance in human civilization. Across cultures, honey has symbolized nourishment, healing, and spiritual connection, embodying a timeless source of wellness. Its medicinal properties, ranging from antibacterial to wound-healing attributes, underscore its versatile role in addressing various health conditions. While scientific exploration continues to unveil honey's intricate mechanisms, further research is crucial to fully harness its therapeutic potential. Nevertheless, honey remains a beacon of holistic healing, bridging ancient wisdom with contemporary healthcare practices, and reminding us of nature's profound gifts in promoting well-being.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that generative AI technologies such as Large Language Models, etc. have been used during the writing or editing of manuscripts. This explanation will include the name, version, model, and source of the generative AI technology and as well as all input prompts provided to the generative AI technology.

Details of the AI usage are given below:

1. Quillbot

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

Abdulrhman, M. M., El-Hefnawy, M. H., Aly, R. H., Shatla, R. H., Mamdouh, R. M., & Mahmoud, A. G. (2011). Antidiabetic effects of Saudi honey and its relation with some plasma hormones in diabetic rats. *European Review for Medical and Pharmacological Sciences*, 15(5), 637-645.

Adebolu, T.T. (2005). Effect of natural honey on local isolates of diarrhea-causing bacteria in southwestern Nigeria. *African Journal of Biotechnology*, *4*(10), p.1172.

Alvarez-Suarez, J. M., Giampieri, F., González-Paramás, A. M., Damiani, E., Astolfi, P., Martínez-Sánchez, G., Bompadre, S.,

Quiles, J. L., Santos-Buelga, C., & Battino, M. (2013). Honey as a source of dietary antioxidants: Structures, bioavailability and evidence of protective effects against human chronic diseases. *Current Medicinal Chemistry*, 20(5), 621-638.

Al-Waili NS. 2004 .Topical honey application vs. acyclovir for the treatment of recurrent herpes simplex lesions. Med Sci Monit.;10(8):MT94-8. Epub 2004 Jul 23. PMID: 15278008.

Al-Waili, N. S., Boni, N. S., Al-Waili, T. N., Salom, K., Al-Waili, A., & Al-Waili, H. (2006). In vitro antimicrobial activity of honey against Candida species. *Mycoses*, 49(4), 316-323.

Al-Waili, N. S., Salom, K., Al-Waili, T., Al-Waili, A., & Al-Waili, H. (2004). Natural honey lowers plasma glucose, C-reactive protein, homocysteine, and blood lipids in healthy, diabetic, and hyperlipidemic subjects: *Comparison with dextrose and sucrose. Journal of Medicinal Food*, 7(1), 100-107.

Al-Waili, N. S., Salom, K., Al-Waili, T., Al-Waili, A., & Al-Waili, H. (2009). An alternative treatment for pityriasis versicolor, tinea cruris, tinea corporis and tinea faciei with topical application of honey, olive oil and beeswax mixture: an open pilot study. *Complementary Therapies in Medicine*, 17(5-6), 279-282.

Aslam, M., Aslam, U., & Dur-e-Najaf, H. (2022). Honey: A miraculous drug. *Agrobiological Records*, *10*, 59-73.

Bhatta, V. R. (2022). Role of honey in human diet and health. Ethnobotany and Ethnozoology, pp. 235-247. Bharathi Publication

Boateng, J., & Diunase, K. N. (2015). Comparing the antibacterial and functional properties of Cameroonian and manuka honeys for potential wound healing—have we come full cycle in dealing with antibiotic resistance?. *Molecules*, *20*(9), 16068-16084.

Bogdanov, S., Jurendic, T., Sieber, R., & Gallmann, P. (2008). Honey for nutrition and health: a review. *Journal of the American College of Nutrition*, 27(6), 677-689.

Chirsanova, C. A., Capcanari, T., Boiştean, A., & Khanchel, E. M. I. (2021). Bee honey: History, characteristics, properties, benefits and adulteration in the beekeeping sector. *Journal of Social Sciences*, (3), 98-114.

Erejuwa, O. O., Sulaiman, S. A., Ab Wahab, M. S., Sirajudeen, K. N., Salleh, S., & Gurtu, S. (2012). Honey supplementation in spontaneously hypertensive rats elicits antihypertensive effect via amelioration of renal oxidative stress. *Oxidative medicine and cellular longevity*, *2012*(1), 374037.

Eteraf-Oskouei, T. and Najafi, M., 2013. Traditional and modern uses of natural honey in human diseases: a review. *Iranian journal of basic medical sciences*, *16*(6), p.731.

Franck, P., Garnery, L., Loiseau, A., Oldroyd, B. P., Hepburn, H. R., Solignac, M., & Cornuet, J. M. (2001). Genetic diversity of the honeybee in Africa: microsatellite and mitochondrial data. *Heredity*, *86*(4), 420-430.

Gavrilović, L., Stojiljković, V., Stanić, V., Jovanović, D., Pejić, S., Borović, B., & Pajović, S. B. (2023). Antioxidant status in the blood of psychosocially stressed rats treated with honey. *Acta Veterinaria*, *73*(4), 464-472.

Gethin, G. T., Cowman, S., & Conroy, R. M. (2007). Honey in clinical practice: A guideline for use. *International Journal of Nursing Studies*, 44(6), 1023-1035.

Jaganathan, S. K., Mandal, M., & Jana, S. K. (2016). Honey and cancer: A mechanistic review. *Journal of Cancer Research and Therapeutics*, 12(1), 1-6.

Khoo, Y. S., Tee, J. K., Wong, J. H., & Ng, P. Y. (2017). The in vitro evaluation of the anti-cancer effect of stingless bee honey with 5-fluorouracil on the breast cancer (MCF-7) and fibrosarcoma (HT1080) cell lines using annexin V-FITC/propidium iodide assay. *BMC Complementary and Alternative Medicine*, 17(1), 1-11.

Kwakman, P. H., te Velde, A. A., de Boer, L., Speijer, D., Vandenbroucke-Grauls, C. M., & Zaat, S. A. (2010). How honey kills bacteria. *FASEB Journal*, 24(7), 2576-2582.

Liyanage, D., & Mawatha, B. (2017). Health benefits and traditional uses of honey: A review. *J. Apith*, *2*(1), 9-14.

Majtan, J. (2014). Honey: an immunomodulator in wound healing. *Wound Repair and Regeneration*, 22(2), 187-192.

Mandal, M. D., & Mandal, S. (2011). Honey: its medicinal property and antibacterial activity. *Asian Pacific Journal of Tropical Biomedicine*, 1(2), 154-160.

Molan, P. C. (2006). The evidence supporting the use of honey as a wound dressing. *International Journal of Lower Extremity Wounds*, 5(1), 40-54.

Nayik, G. A., Shah, T. R., Muzaffar, K., Wani, S. A., Gull, A., Majid, I., & Bhat, F. M. (2014). Honey: its history and religious significance: a review. *Universal Journal of Pharmacy*, *3*(1), 5-8.

Sajjadi, F. S., Moradi, M. T., Hosseinzadeh, H., & Ghayour, M. B. (2012). Effect of honey bee pollen on development of honey bee hypoallergenic diet and anti-allergic properties of honey bee products. *Journal of Apicultural Science*, 56(1), 113-125.

Samarghandian, S., Farkhondeh, T., & Samini, F. (2015). Honey and health: A review of recent clinical research. *Pharmacognosy Research*, 7(2), 121-127.

Samet, N., Laurent, C., Susanne, D., & Marie-Christine, M. (2009). Bee honey protects against cigarette smoke-induced impairment of endothelial function in rat aorta. *The American Journal of Physiology-Heart and Circulatory Physiology*, 297(1), H134-H142.

Sherlock, O., Dolan, A., Athman, R., Power, A., & Gethin, G. (2010). Comparison of the antimicrobial activity of Ulmo honey from Chile and Manuka honey against methicillin-resistant Staphylococcus aureus, Escherichia coli and Pseudomonas aeruginosa. *BMC Complementary and Alternative Medicine*, 10(1), 47.

Simon, A., Traynor, K., Santos, K., Blaser, G., Bode, U., & Molan, P. (2009). Medical honey for wound care—still the 'latest resort'?. *Evidence-Based Complementary and Alternative Medicine*, *6*(2), 165-173.

Vahed, H., Jafri, S.B. and Jamil, N. (2016). Propagation of influenza virus in lymphocytes determine by antiviral effects of honey, ginger and garlic decoction. *J. Antivir. Antiretrovir*, *8*(1).

Zamri, N. A., Ghani, N., Ismail, C. A. N., Zakaria, R., & Shafin, N. (2023). Honey on brain health: A promising brain booster. *Frontiers in Aging Neuroscience*, *14*, 1092596.

Zayed, A., & Whitfield, C. W. (2008). A genome-wide signature of positive selection in ancient and recent invasive expansions of the honey bee Apis mellifera. *Proceedings of the National Academy of Sciences*, *105*(9), 3421-3426.

Zhang, Y., Nagai, Y., Zhang, L., & Yagasaki, K. (2014). Anti-inflammatory effect of honey on allergic airway disease in mice. *International Archives of Allergy and Immunology,* 164(1), 65-72.

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