AI-ASSISTED COMPARATIVE STUDY ON THE ANTIMICROBIAL ACTIVITIES OF HONEY AVAILABLE IN URBAN AND RURAL MARKETS AGAINST *S. AUREUS* AND *E. COLI*

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Crossref DOI - https://doi.org/10.63665/rh.v7i2.53

Abstract :

Honey is a natural product with remarkable antimicrobial, antioxidant, and therapeutic properties. Its composition—including sugars, enzymes, phenolic compounds, flavonoids, organic acids, and bioactive peptides—contributes to broad-spectrum antimicrobial activity. Mechanisms responsible for its antibacterial effects include high osmolarity, low pH, hydrogen peroxide generation, and non-peroxide compounds such as methylglyoxal, especially in Manuka honey. These components inhibit the growth of clinically relevant pathogens, including Staphylococcus aureus and Escherichia coli. The study compares the antibacterial activity of honey collected from urban (branded) and rural (unprocessed) markets using agar well diffusion. Results demonstrate that rural honey exhibits significantly higher antimicrobial potency than branded honey, with S. aureus more susceptible than E. coli. The findings support the potential use of honey as a natural antimicrobial agent for therapeutic applications.

Keywords : Honey; Antimicrobial activity; Hydrogen peroxide; Methylglyoxal; Phenolic compounds; Bioactive compounds; Antibiotic resistance; Wound healing

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Introduction :

Honey is a natural product long recognized for its medicinal and antimicrobial properties. Its antibacterial activity is attributed to high sugar content, low pH, hydrogen peroxide, methylglyoxal (especially in Manuka honey), phenolic compounds, and bioactive peptides. These factors inhibit pathogenic bacteria such as *Staphylococcus aureus* and *Escherichia coli*, which are responsible for skin infections, gastrointestinal illnesses, and hospital-acquired diseases. With increasing antibiotic resistance, natural alternatives like honey are gaining attention. This study compares the antimicrobial activity of honey from urban (branded) and rural (unprocessed) markets to evaluate the influence of processing and source on antibacterial potency.

Literature Review :

Honey has long been recognized for its medicinal and antimicrobial properties. Its antibacterial activity is attributed to high sugar content, low pH, hydrogen peroxide, methylglyoxal, phenolic compounds, flavonoids, and bee-derived peptides. Molan (1992) demonstrated honey inhibits a wide range of Gram-positive and Gram-negative bacteria, including *S. aureus* and *E. coli,* mainly due to hydrogen peroxide and other bioactive compounds. Mandal and Mandal (2011) reported that the antimicrobial activity varies with floral source, geographical origin, and processing, with raw honey retaining higher bioactive compounds. Kwakman and Zaat (2012) identified key antibacterial components, including defensin-1, methylglyoxal, and phenolic acids, acting synergistically to inhibit bacterial growth. Alvarez-Suarez et al. (2014) emphasized Manuka honey's therapeutic potential in inhibiting pathogens and promoting wound healing. Israili (2014) confirmed honey's ability to disrupt biofilms and combat antibiotic-resistant strains. Few studies directly compare urban vs rural honey, highlighting the importance of this study.

Materials and Methods :

Sample Collection : Ten honey samples were collected from urban (branded) and rural (unprocessed) markets. All samples were stored in sterile containers at room temperature.

Test Organisms : Two bacterial strains were used: *Staphylococcus aureus* (Gram-positive) and *Escherichia coli* (Gram-negative). Cultures were maintained on nutrient agar slants and sub-cultured before use.

Inoculum Preparation : A loopful of each bacterium was inoculated into nutrient broth and incubated at 37°C for 18–24 hours.

Agar Well Diffusion Assay : Mueller–Hinton agar plates were inoculated with bacterial suspensions using sterile swabs. Wells (6 mm) were prepared, and 100 µL of each honey sample was added. Plates were incubated at 37°C for 24 hours. Zones of inhibition were measured in millimeters.

Results and Observation :

Honey sample	**ZOI *S.aureus***	**ZOI E.*coli***
Dabur	15 mm	12 mm
Saffola	13mm	11 mm
Apis	12mm	9 mm
Baidyanath	16 mm	13 mm
Patanjali	13 mm	12 mm
Sample 1	25 mm	21 mm
Sample 2	30 mm	26 mm
Sample 3	25 mm	20 mm
Sample 4	35 mm	30 mm
Sample 5	30 mm	20 mm
Sample 6	30 mm	25 mm
Sample 7	38 mm	35 mm

Sample 8	20 mm	15 mm
Sample 9	32 mm	28 mm
Sample 10	35 mm	30 mm

Table 1: zone of inhibition of honey against *S aureus* and *E .coli*

Rural honey samples showed larger zones of inhibition compared to branded honey for both bacteria.

S. aureus: Rural honey : 30–38 mm; Urban honey: 13–16 mm

E. coli: Rural honey : 25–35 mm; Urban honey: 9–13 mm

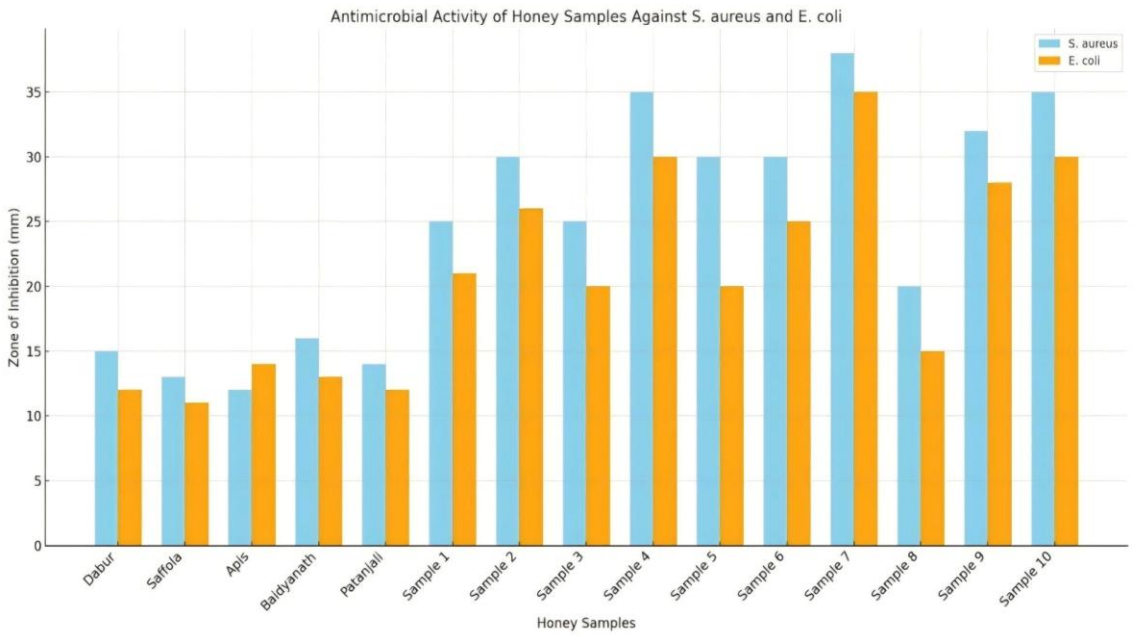

Fig 1 : ZOI of honey against *S aureus* and *E coli*

Observation :

- Rural honey displayed stronger antibacterial activity.
- *S. aureus* was more sensitive than *E. coli.*
- Branded honey showed comparatively lower activity.
- Inhibition zones were clear and circular, confirming measurable antibacterial effects.

Discussion :

Honey's antibacterial activity is attributed to hydrogen peroxide, methylglyoxal, phenolics, flavonoids, and osmotic effects. Rural honey's higher activity may be due to minimal processing and retention of bioactive compounds. Gram-positive *S. aureus* was more susceptible than Gram-negative *E. coli*, consistent with prior studies. The findings confirm honey's potential as a natural antimicrobial agent and suggest unprocessed honey can serve as an alternative or adjunct to conventional antibiotics, especially against resistant strains. Differences between urban and rural honey highlight the influence of processing and floral

source on antimicrobial potency.

Conclusion :

Honey exhibits significant antimicrobial activity against *S. aureus* and *E. coli*, with rural honey showing higher potency than branded honey. *S. aureus* was more susceptible than *E. coli,* and Sample 7 exhibited the strongest antibacterial effect. Findings support the use of unprocessed honey as a natural antimicrobial agent in therapeutic applications, including wound care and infection management. Honey source and processing significantly affect its antibacterial effectiveness.

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