



## Comparison of antimicrobial activity of honey and ginger essential oil on streptococcus and lactobacillus species-an invitro study

## KEYWORDS

honey,ginger,Streptococcus ,Lactobacillus

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**ABSTRACT** This study aimed to evaluate the antibacterial activity of raw honey, processed honey and ginger on *Streptococcus* and *Lactobacillus* species. The honey and ginger essential oil at 100, 50, 25, and 12.5% (v/v) concentrations were screened for their antibacterial activity using agar well-diffusion method against *Streptococcus* spp and *Lactobacillus* spp in nutrient agar. Antibacterial activity was assessed by measuring the diameter of the inhibition zones surrounding the wells. All assays were repeated thrice for each of the group. Raw honey has antibacterial activity against streptococcus species at 100% concentration. Ginger essential oil showed antibacterial activity against *Lactobacillus* species at all concentrations while antibacterial activity against *Streptococcus* species was seen at 50% and 100% concentration. It is concluded from the study that Ginger has good antimicrobial activity against streptococcus and lactobacillus species while Raw honey has antibacterial activity at 100% concentration against *Streptococcus* species.

**INTRODUCTION**

Antibiotics provide an invaluable tool for control of infection in modern dentistry<sup>1</sup>. A rekindled interest in the pharmaceutical importance of plants has led to the discovery and adaptation of plant extract which were commonly used in traditional medicine as alternative source of remedy<sup>2</sup>. Moreover, most antimicrobial agents that are currently in use have been rendered ineffective by a wide occurrence of multiple drug resistant strains of microbes<sup>3</sup>. Herbal preparation of honey and ginger are used as an essential ingredient in the preparation of most herbal concoctions.

Honey has been used as an eco-friendly medicine throughout the ages and recently regarded for its potential in treatment of burns and peptic ulcer, infected wounds, bacterial gastro-enteritis and eye infection<sup>4</sup>.

Ginger (*Zingiber officinale*) is a medicinal plant that has been widely used in Chinese, Ayurvedic and Tibb-Unani herbal medicines all over the world<sup>5</sup>.

The need to identify a common and cheap herbal remedy for the prevention and treatment of sore-throat, mouth sore and dental caries, especially in a developing nation, prompted to investigate the therapeutic potentials of ginger and honey.

**Materials**

Processed honey (Dabur India limited, BM0067, India), raw (unprocessed and unpasteurized honey obtained from a local market in Moodbidri, Mangaluru, India) and ginger (*Zingiber officinale*) essential oil (Swastik Eucalyptus oil, lot: 4 Ooty, India)

were used in the study. Di-methyl sulfoxide (DMSO), nutrient broth, and nutrient agar were obtained from HiMedia, India.

**Methods****Preparation of bacterial inocula**

Antibacterial activity of honey and ginger essential oil was tested against *Streptococcus* spp. and *Lactobacillus* spp. Inocula of these bacteria were prepared in nutrient broth (18 h incubation at 37°C).

**Antibacterial activity assay by well diffusion method**

The inocula were spread over nutrient agar using a sterile glass spreader. Wells of 8 mm diameter were cut in the inoculated nutrient agar using a sterile cork borer. The wells were loaded with 100µL of honey (dissolved in sterile distilled water) or ginger essential oil (suspended in 10% DMSO), at 100, 50, 25, and 12.5% (v/v) concentrations. A control was maintained wherein the well was loaded with sterile distilled water or 10% DMSO. The loaded plates were incubated at 37°C for 24 h. After incubation, any inhibition zone surrounding the wells was measured using a ruler. These experiments were conducted in triplicates and the results presented as mean ± S.D.

**RESULTS**

The result showed that raw honey has antibacterial activity against streptococcus species at 100% concentration. Ginger essential oil showed antibacterial activity against *Lactobacillus* species at all concentrations while antibacterial activity against *Streptococcus* species was seen only at 50% and 100% concentration. The control did not show any antimicrobial activity (Table 1)

**TABLE 1- Mean ± SD zones of inhibition of extracts on isolates**

Test bacteria	Inhibition zone (mm)											
	Processed honey				Raw honey				Ginger essential oil			
	12.5%	25%	50%	10%	12.5%	25%	50%	100%	12.5%	25%	50%	100%
<i>Streptococcus</i> spp.	0	0	0	0	0	0	0	3.3 ± 0.6	0	0	4.0 ± 1.0	6.0 ± 1.0
<i>Lactobacillus</i> spp.	0	0	0	0	0	0	0	0	4.3 ± 0.6	4.7 ± 0.6	7.0 ± 1.0	9.3 ± 0.6

## DISCUSSION-

The beneficial role of honey is attributed to its antibacterial property with regards to its high osmolarity, acidity (low pH) and content of hydrogen peroxide ( $H_2O_2$ ) and non-peroxide components, i.e., the presence of phytochemical components like methylglyoxal (MGO)<sup>6,7</sup>. The antimicrobial agents in honey are predominantly hydrogen peroxide, of which the concentration is determined by relative levels of glucose oxidase, synthesized by the bee and catalase originating from flower pollen<sup>6</sup>. Most types of honey generate  $H_2O_2$  when diluted, because of the activation of the enzyme glucose oxidase that oxidizes glucose to gluconic acid and  $H_2O_2$ , which thus attributes the antimicrobial activity<sup>8</sup>.

But, in some cases, the peroxide activity in honey can be destroyed easily by heat or the presence of catalase. Honey is characteristically acidic with pH between 3.2 and 4.5, which is low enough to be inhibitory to several bacterial pathogens<sup>9</sup>. A recent study examining the antimicrobial properties of honey in vitro found that  $H_2O_2$ , methylglyoxal and an antimicrobial peptide, bee defensin-1, are distinct mechanisms involved in the bactericidal activity of honey<sup>10</sup>. In the present study, only raw honey showed antibacterial activity. The commercial available honey did not show any activity against any of the bacteria at any of the concentrations. The commercial available honey undergoes standard heat and filtration processing which is detrimental to level of hydrogen peroxide thus affecting the antibacterial action. All commercial table honey is filtered to remove particulate debris, and heating up to 45°C is regularly used to increase the rate of filtration, but it is important to recognize that even relatively mild heat processing can reduce antimicrobial activity. The level of glucose oxidase in honey can vary depending on the health of the bees and the quality of their diet<sup>11</sup>. However, the amount of  $H_2O_2$  produced in a given honey sample is not determined by glucose oxidase alone, as honey can also contain catalase, peroxidases, and antioxidants such as gallic acid and caffeic acid that can degrade  $H_2O_2$  or interfere with its ability to damage microbial cells<sup>12</sup>. It was also reported that Methyl glyoxal directly modifies some proteinacious compounds in honey and if present this may also affect glucose oxidase activity<sup>13</sup>. The final level of  $H_2O_2$  in a given honey sample therefore depends on various components, which can be present and active to varying degrees. Since any of these may be affected by honey processing, it is not unexpected that the different honey samples responded quite differently to heat treatment. Researchers evaluated honey from different regions in Egypt for antimicrobial effects. While all samples had antibacterial activity on negative and positive gram bacteria, they were ineffective against *Candida albicans* and *Aspergillus niger*<sup>14</sup>. Research showed that *Helicobacter pylori* is sensitive to honey<sup>15</sup>. One study indicated growth inhibition and acid production of *Streptococcus mitis*, *Streptococcus sorbinus* and *Lactobacillus casei* with 7%, 7.5-8.5% and 8-12% of honey<sup>16</sup>.

In the present study antimicrobial activity of ginger was present at all concentrations against *Lactobacilli* species compared with *Streptococcus* species. A similar study by Duboni et al (2013) showed that *Lactobacilli* was more sensitive to ginger than *Streptococcus*<sup>17</sup>. The antimicrobial activity in ginger essential oil is probably due to oxygenated compound like Geraniol, Cineole, Neral. Sesquiterpene hydrocarbons like Zingiberene,  $\alpha$ -curcumene,  $\beta$ -bisabolene are also other compound for its antimicrobial activity. Hydrocarbon compounds are reported to have less activity compared to oxygenated compounds<sup>18</sup>. Variations in chemical composition of distilled oils is known to differ consider-

ably not only due to the existence of different subspecies, but also might be attributed to the varied agro climatic condition (climatic, seasonal, geographic) of the regions, stage of maturity, adaptive metabolism of plants, distillation conditions, the plant part analyzed and some other factors<sup>19</sup>.

Generally speaking, the exact antimicrobial mechanism of essential oils has not been completely elucidated. However, it has been proposed that lipophilicity or hydrophobicity and chemical structure of essential oils or their main compounds such as the presence of functional polar groups and aromaticity could play an important role for the antimicrobial activity<sup>20,21</sup>. which enable them to partition between lipids of the bacterial or fungal cell membrane and mitochondria, disturbing the cell structures and rendering them more permeable, which will lead to cell death<sup>22</sup>. The bioactivity of essential oils is dependent not only on the major compounds but also on the chemical structures of these compounds<sup>20</sup>. Previous researchers have described the antibacterial activity of ginger against multi drug resistant (MDR) *S. mutans* as well as methicillin resistant *S. aureus* and MDR *P. aeruginosa*.<sup>23,24</sup> Patel et al (2011) described there is a synergistic effect of antimicrobial activity from the combination of honey and ginger against isolates of carious teeth.

## CONCLUSION-

Considering the invitro data obtained from the present study, Ginger has good antimicrobial activity against *Streptococcus* and *Lactobacillus* species while raw honey has antibacterial activity at 100% concentration against *Streptococcus* species. However, further studies are recommended at clinical and field setting to assess its practical and economic feasibility and to recommend its use in the clinical setting.

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