



## Antibacterial activity of commercial green tea and honey

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### Abstract

Green tea is one of the most popular drinks all over the world. It is supposed to have a broad spectrum of biological activities. On the other hand, honey is widely used traditional medicine throughout the world. It is regarded as one of the best versatile natural remedy in the treatment of various health problems. The intention of the proposed work was to investigate antibacterial activity of three commercial green tea (Himalaya, Lipton and Te-A-Me) and honey (Baidyanath, Dabur and Dhanwantari) samples against some pathogenic bacteria using agar well diffusion method. Green tea extracts and honey showed significant antibacterial activity against all tested pathogens. The results of this study justify the use of honey and green tea as an alternative to or a supplement for antibiotics in treatment of various bacterial diseases.

**Keywords:** antibacterial activity, green tea, honey, agar well diffusion method

### 1. Introduction

Antimicrobial agents play important role in prevention, control and management of infectious diseases. In recent years, the susceptibility of pathogens against major antibiotic groups is decreasing significantly [21]. Antibiotics may also cause adverse effects on the host. Therefore, it becomes inevitable to find new alternatives for antimicrobial agents. The natural substances can be used as possible alternatives to antimicrobial drugs. Over the years, antimicrobial substances from natural resources have been identified and used as antimicrobial agents [20].

Green tea is one of the most popular drinks all over the world. It is obtained from the leaves of *Camellia sinensis*, a plant from thecae family. Green tea is a non-fermented tea. It contains higher amount of polyphenols as it is not exposed to oxidation. It has a large medicinal value. It has also received more attention with regards to health benefits [22].

Green tea serves as a stimulating drink which play important role in weight loss. It hydrates the body, provides pain relief, boosts immunity, reduces stress and prevents cancer. It also reduces risk of heart disease, high blood pressure and unhealthy blood sugar [5, 12].

Honey is widely used traditional medicine throughout the world. It is regarded as one of the best versatile natural remedy in the treatment of various health problems. Historically, honey is known for its broad spectrum of antimicrobial action. Honey also helps in relieving of the night cough and allows proper sleep. External use of honey is helpful in healing of wounds [17].

Honey is a natural product of supersaturated sugars produced by honey bees from nectars of flowers. Natural honey consists of sugars, mainly glucose, fructose, sucrose and maltose, water and other minor components. The minor ingredients include proteins, minerals, phytochemicals and antioxidants [1, 2]. The well known antimicrobial factors in honey are high sugar concentration, low pH, hydrogen peroxide, enzymes and

phytochemicals [8, 15].

The health benefits of green tea and honey cannot be neglected. Hence, the present study was carried out to evaluate antibacterial potential of three commercial green tea and honey samples against seven pathogenic bacteria.

### 2. Materials and Methods

#### Test pathogens

Seven pathogenic bacteria (*Bacillus subtilis*, *Escherichia coli*, *Klebsiella pneumoniae*, *Proteus vulgaris*, *Pseudomonas aeruginosa*, *Salmonella typhi* and *Staphylococcus aureus*) were used in the present study. Identity of the organisms was confirmed by morphological characteristics and conventional biochemical tests. Pure cultures were preserved at 4°C on nutrient agar and MacConkey's agar slant.

#### Collection of green tea samples

Three different commercial green tea samples (Himalaya, Lipton and Te-A-Me) were used in the present study. They were purchased from the local markets of Shirala.

#### Preparation of aqueous extract of green tea

5 gm green tea powder was added to 50 ml sterile distilled water and heated for 15 minutes with intermittent stirring. It was then filtered twice through Whatmann No. 1 filter paper. The filtrate was collected and stored at 4°C until further use.

#### Collection and dilution of honey samples

Three different commercial honey samples (Baidyanath, Dabur and Dhanwantari) were used in the present study. They were purchased from the local markets of Shirala. Honey samples were then diluted with sterile distilled water to 4 different concentrations- 20%, 40%, 60% and 80%.

#### Determination of antibacterial activity

Antibacterial activities of commercial green tea and honey

samples were evaluated by agar well diffusion method. 0.1 ml of freshly grown culture of test organisms ( $10^6$ cfu/ml) was aseptically introduced and spread on the surface of sterile nutrient agar plates. Wells of 6 mm diameter were made in agar plate with the help of sterile cork-borer. Fifty micro-liters of different concentrations of honey and aqueous extracts of green teas were filled in the wells aseptically. Streptomycin (100 $\mu$ g/ml) was used as a standard reference antibiotic. Plates were left for some time at 4 $^{\circ}$ C till the extract diffuses in the medium with the lid closed and incubated at 37 $^{\circ}$ C for 24 hr. The plates were observed for zone of inhibition. Antibacterial activity was evaluated by measuring the diameter of the zone of inhibition against the tested pathogens. Each assay in this experiment was replicated three times and average values were represented [19, 20].

### 3. Results and Discussion

In present study, seven bacteria which are known to cause diseases in human beings such as *Bacillus subtilis*, *Escherichia coli*, *Klebsiella pneumoniae*, *Proteus vulgaris*, *Pseudomonas aeruginosa*, *Salmonella typhi* and *Staphylococcus aureus* were selected and antibacterial activities of three different commercial green tea and honey samples were evaluated against them by agar well diffusion method. For comparison, streptomycin (100 $\mu$ g/ml) was used as a standard reference antibiotic.

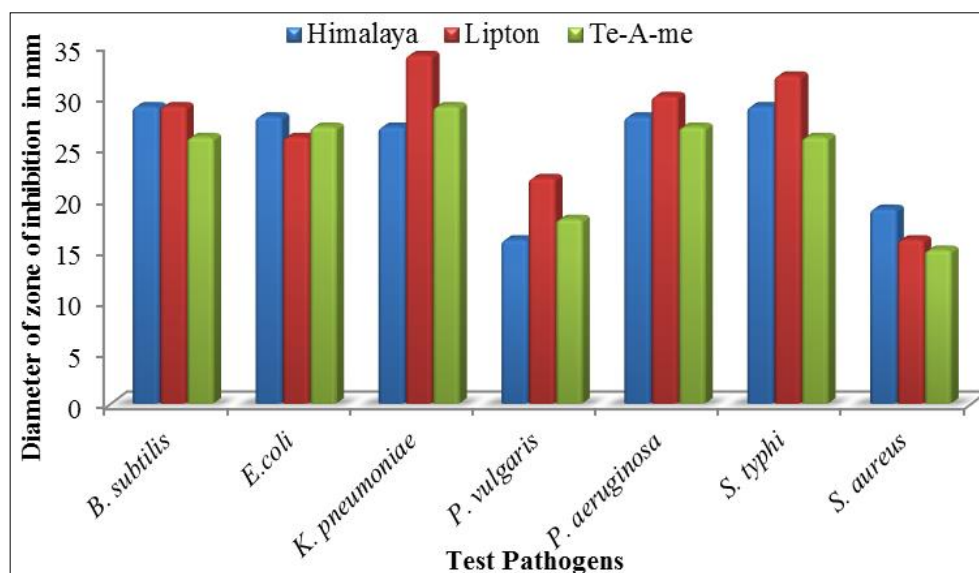
The results indicated that both green tea and honey had broad spectrum antibacterial activities comparable to that of streptomycin. The test pathogens showed high degree of sensitivity towards both samples.

Antibacterial activity of aqueous extracts of commercial green tea samples is shown in table 1.

**Table 1:** Antibacterial activity of aqueous extracts of commercial green tea samples

Name of commercial green tea samples	Diameter of zone of inhibition (mm)						
	<i>B. subtilis</i>	<i>E. coli</i>	<i>K. pneumoniae</i>	<i>P. vulgaris</i>	<i>P. aeruginosa</i>	<i>S. typhi</i>	<i>S. aureus</i>
Himalaya	29	28	27	16	28	29	19
Lipton	29	26	34	22	30	32	16
Te-A-Me	26	27	29	18	27	26	15
Streptomycin (Control)	29	18	25	20	16	18	20

(Note: Figures indicate average values of diameter of inhibition zone in mm)



**Fig 1:** Antibacterial activity of aqueous extracts of commercial green tea samples

Aqueous extracts of all three samples of green tea showed good antibacterial activity against all test pathogens.

Aqueous extract of Lipton green tea showed maximum zone of inhibition (34 mm) against *K. pneumoniae*, while minimum zone of inhibition (15 mm) was shown by aqueous extract of Te-A-Me green tea against *S. aureus*.

*K. pneumoniae*, *S. typhi*, *B. subtilis*, *P. aeruginosa* and *E. coli* were found to be highly sensitive to green tea extracts, while *P. vulgaris* and *S. aureus* were found to be least sensitive to

green tea extracts.

The clinical important components of green tea is catechins group of flavonoids which has four major forms- Epicatechins (EC), epigallocatechin (EGC), epicatechingallate (ECG) and epigallocatechingallate (EGCG). The catechins group of flavonoids play vital role in inhibiting growth of bacteria [3].

Antibacterial activity of different dilutions of commercial honey samples is shown in table 2.

**Table 2:** Antibacterial activity of commercial honey samples

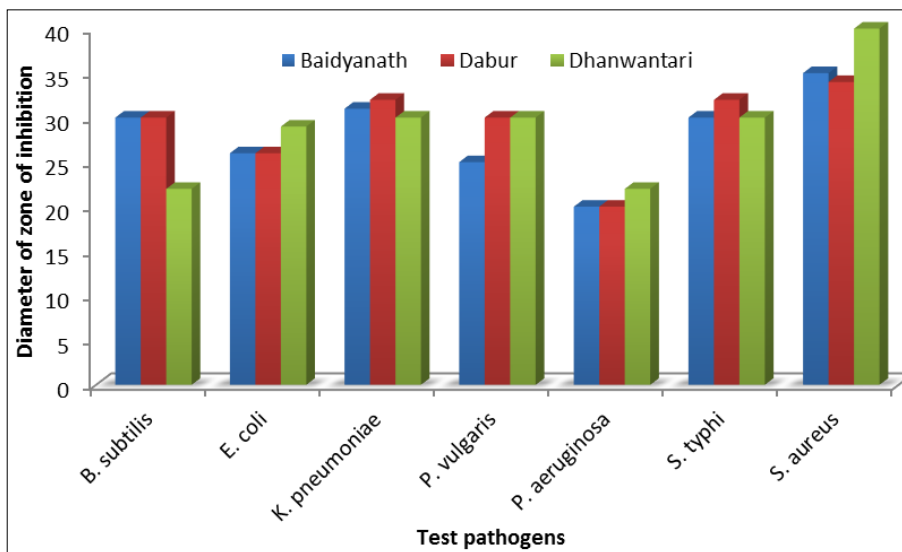
Name of the honey sample	% Concentration (v/v)	Diameter of zone of inhibition (mm)						
		<i>B. subtilis</i>	<i>E. coli</i>	<i>K. pneumoniae</i>	<i>P. vulgaris</i>	<i>P. aeruginosa</i>	<i>S. typhi</i>	<i>S. aureus</i>
Baidyanath	20	23	21	25	22	10	23	28
	40	25	23	27	23	13	27	30
	60	28	25	29	24	18	28	34
	80	30	26	31	25	20	30	35
Dabur	20	22	16	23	24	10	25	25
	40	26	22	24	26	11	31	30
	60	28	24	25	29	16	32	32
	80	30	26	32	30	20	32	34
Dhanwantari	20	11	20	21	24	10	23	28
	40	15	25	23	25	12	27	36
	60	20	27	25	29	17	29	38
	80	22	29	30	30	22	30	40

(Note: Figures indicate average values of diameter of inhibition zone in mm)

All three samples of honey showed good antibacterial activity against test pathogens. Antibacterial activity increases with increase in concentration of honey. Highest antibacterial activity was obtained at 80 % concentration while lowest antibacterial activity was obtained at 20 % concentration of honey.

Dhanwantari honey showed maximum zone of inhibition (40 mm) against *S. aureus* at 80 % concentration, while all three honey samples showed minimum zone of inhibition (10 mm) against *P. aeruginosa* at 20 % concentration.

*P. aeruginosa* was found to be least sensitive, while *S. aureus* was found to be highly sensitive to honey samples.

**Fig 2:** Antibacterial activity of commercial honey samples (at 80% concentration)

Honey has long been recognized for its antimicrobial activity against bacteria, moulds and yeasts. The high osmotic pressure, low water activity, low pH, low redox potential, hydrogen peroxide and other phytochemical factors might contribute to the antimicrobial nature of honey. The antibacterial activity of honey is highly complex due to the involvement of multiple compounds and due to the large variation in the concentrations of these compounds among honeys [7, 10, 14].

Up till now, there has been no report of bacterial resistance to honey. This is likely due to the complex composition of honey, which causes the components to act either individually or in synergy to prevent resistance [11].

In present study, the growth of both Gram positive bacteria and Gram negative bacteria was inhibited by commercial green tea and honey samples. Green tea and honey consist of a mixture of active components that is responsible for an

inhibitory effect on growth of bacteria. The positive results provide a scientific indication for the ethno medical uses of green tea and honey in the treatment of various diseases.

#### 4. Conclusions

The green tea and honey exhibited significant antibacterial activity against all test pathogens. Most of the commercial antibiotics may have side effects. Drug resistance in pathogen is also increasing day by day. The present study revealed the antibacterial activity of green tea and honey and they are safe as well. Therefore, they can be used as an alternative to or a supplement for antibiotics in the treatment of different bacterial diseases. Further study is required for identification and characterization of new active principles that may provide valuable information on the quality and possible therapeutic potential of green tea and honey.

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## 6. References

1. Aiken A, Karuri D, Wanyoro A, Macleod J. Interventional studies for preventing surgical site infections in sub-Saharan Africa-a systematic review. *Int. J. Surg.* 2012; 10:242-249.
2. Almasaudi SB, Al-Nahari AAM, El-Ghany ESMA, Barbour E, Al Muhayawi SM, Al-Jaouni S. Antimicrobial effects of different types of honey on *Staphylococcus aureus*. *Saudi Journal of biological Sciences.* 2017; 24:1225-1261.
3. Amit Kumar, Ajay Kumar, Payal Thakur, Sandip Patil, Chandani Payal, Anit Kumar and Pooja Sharma. Antibacterial activity of green tea (*Camellia sinensis*) extracts against various bacteria isolated from environmental sources. *Recent Res. Sci. Technol.* 2012; 4:19-23.
4. Amy E, Jeffrey, Carlos M, Echazarreta, Medical uses of honey. *Review of Biomedicine.* 1996; 7:43-49.
5. Archana S, Jayanthi A. Comparative analysis of antimicrobial activity of leaf extracts from fresh green tea, commercial green tea and black tea on pathogens. *Journal of Applied Pharmaceutical Science.* 2011; 01(08):149-152.
6. Bagyalakshmi B, Balamurugan A. Inhibitory activity of fresh green tea and black tea extracts (*Camellia sinensis*) on intestinal pathogens isolated from diarrheal samples. *Int. Res. J. Pharm.* 2017; 8(10):93-98.
7. Bogdanov S. Characterization of antibacterial substance in honey. *Lebensm Wiss Technol.* 1984; 17(2):74-76.
8. Chauhan A, Pandey V, Chacko KM, Khandal RK. Antibacterial activity of raw and processed honey. *Electronic Journal of Biology.* 2010; 5(3):58-66.
9. Chowdaiah M, Dhamodhar P. Antibacterial properties of honey and green tea extracts against multidrug resistant *Streptococcus mutans* isolated from dental plaque samples. *Int. J. Pharm. Bio. Sci.* 2017; 8(2):(B)547-552.
10. Cooper RA, Molan PC, Harding KG. The Sensitivity to Honey of Gram Positive cocci of Clinical Significance Isolated from Wounds. *Journal of Appl Microbiol.* 2002; 93:857-863.
11. Cooper RA, Jenkins L, Henriques AF, Duggan RS, Burton NF. Absence of bacterial resistance to medical-grade manuka honey. *Eur. J. Clin. Microbiol. Infect. Dis.* 2010; 29(10):1237-1241.
12. Halis B, Cengiz C, Akif E, Ilker Zeki K, Şevki K. Evaluation of Antibacterial Activity of Green Tea (*Camellia sinensis* L.) Seeds against Some Fish Pathogens in Rainbow Trout (*Oncorhynchus mykiss*, Walbaum). *Turkish Journal of Fisheries and Aquatic Sciences.* 2015; 15:49-57.
13. Haramain SE, Almagboul AZ, Ahmed AO. Antimicrobial activity and phytochemical screening of Chinese Green Tea (*Camellia sinensis* L.). *ARPN Journal of Science and Technology.* 2015; 5(5):246-252.
14. Mandal MD, Mandal S, Honey: its medicinal property and antimicrobial activity. *Asian Pac J Trof Biomed.* 2011; 1(2):154-160.
15. Molan PC. The antibacterial activity of honey. *Bee world.* 1992; 73(1):5-28.
16. Murugesan K, Vijayan H, Ezhilarasi MR, Maheshwaran P, Radha RS. Antibacterial activity of honey against selected pyogenic bacteria. *Int. J. Pharm. Sci. Rev. Res.* 2017; 45(2):142-145.
17. Samanta A, Patra A, Mandal S, Pradhan M, Saha A, Bhattacharjee D *et al.* Combined Antimicrobial Activity of Honey and Commercial Green Tea Extract against Some Pathogenic Bacterial Species. *Int. J. Pharm. Sci. Rev. Res.* 2017; 45(1):192-198
18. Senthil Kumar SR, Sivakumar T, Arulmozhi KT, Mythili N. Antimicrobial Activity of Indian Commercial Green Teas (*Camellia Sinensis*). *International Journal of Biosciences and Nanosciences.* 2016; 3(7):108-112.
19. Shinde AB, Mulay YR. Phytochemical Analysis and Antibacterial Properties of Some Selected Indian Medicinal Plants. *Int. J. Curr. Microbiol. App. Sci.* 2015; 4(3):228-235.
20. Shinde AB. Phytochemical analysis and Preliminary screening of antimicrobial activity of *Jatropha curcas* L. *International Journal of Applied Research.* 2017; 3(3):782-785.
21. Shinde AB. Screening and evaluation of antimicrobial activity of some common indian spices against certain human pathogens. *Review of Research.* 2013, 2(6):1-8.
22. Sinija VR and Mishra, HN. Green tea: Health benefits. *J. Nutrit. Environ. Med.* 2008; 17:232-242.