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Antimicrobial profiling of Green Tea and Arabica Green Coffee Beans Extract against some Pathogens

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Abstract

Clinical pharmacologists are becoming more interested in natural items and herbal medicines that have antimicrobial properties. It has been demonstrated that *C. sinensis* has therapeutic and health-promoting qualities, including the capacity to stop the growth of several harmful bacteria. The current study's findings demonstrated that green tea extract is effective against both Gram-positive and Gram-negative bacteria. This study found that strains of *P.aeruginosa* were sensitive to extract from green coffee beans. The extract from green coffee beans exhibited the strongest antibacterial action. This shows that the material was significantly impacted by the extract. A statistical study revealed a substantial difference between the concentrations used. According to the study's findings, tea extracts have the potential to be a rich source of antimicrobial agents against a variety of bacteria, and their phytochemical components and mineral concentrations are responsible for their bioactivity. Significant antimicrobial properties were demonstrated by all tea extracts, including green and herbal teas, in addition to other positive aspects.

Keywords: *C. Sinensis*, Antimicrobial properties, Green Tea Extract, Green coffee bean extract)

Introduction

One of the main problems in preventing infectious diseases is the emergence of antibiotic resistance in bacteria. Multidrug-resistant bacteria are currently spreading throughout the community in addition to nosocomial illnesses. The most prevalent multidrug-resistant bacteria are *Pseudomonas aeruginosa (P. aeruginosa), Escherichia coli (E. coli), and Staphylococcus aureus (S. aureus),* particularly through nosocomial infections. The focus has shifted from chemotherapeutic drugs to green pharmaceuticals in recent years, possibly because of their quick action and metabolism. About 80% of the world's population is served by traditional medical systems, according to a World Health Organization (WHO) report.

Since the bacteria causing the infection proved resistant to first-line antibiotics, a second or third choice of antibiotics—which are typically far more costly—is typically used in place of the first line of treatment. Therefore, in order to control germs that are resistant to several drugs, other antimicrobial agents must be discovered and used.

People from all over the world have been employing plants and their juices for the prevention and treatment of numerous infectious diseases since ancient times, and medicinal plants may provide an alternative that is an essential component of traditional human medicine. Even before they were aware that bacteria existed, they employed local plants or their extracts. Approximately 80% of the world's 4,000 million people rely on herbal remedies for their medical needs(Katoch et.al., 2013).The leaves and leaf buds of the evergreen shrub or small tree Camellia sinensis are used to make tea. It belongs to the family of flowering plants in the genus Camellia (Chinese: Chahua; literally: "tea flower"). "Tea plant," "tea shrub," and "tea tree" are examples of common names. Camellia sinensis leaves and buds that have not experienced the same oxidation and withering process as oolong and black teas are used to manufacture green tea.

There are several types of green tea, and they vary greatly depending on the type of *C. sinensis* utilized, growth circumstances, horticulture techniques, production processes, and harvest timing. The first step in processing green tea leaves is soaking them in an alcohol solution, which can then be concentrated to different degrees. The process's byproducts are also packed and utilized. Over-the-counter extracts come in liquid, powder, capsule, and tablet forms. They may contain up to 17.4% caffeine by weight, while decaffeinated versions are also offered. Produced from young leaves of *Camellia sinensis (C.sinensis)*. Which is one of the most widely consumed most popular beverages after water worldwide. Besides the attractive flavors of teas, their popularity comes from their primary and secondary antioxidant properties, therefore tea is designated as a “Health drinks” (A. B. Sharangi, 2009).

Green and black teas are made from leaves, whereas white tea is made from the buds. Oolong tea is in between green and black teas because it is slightly fired before being steamed. Every sample of tea has its own distinct flavor, character, and chemical makeup (Sharangi, 2009; Owuor and Kwach, Wu et al., 2012).The amazing spectrum of pharmacological activity of the aqueous extract of dried tea leaves (Camellia sinensis) has led to its widespread usage in traditional medicine. Numerous harmful microorganisms, including methicillin-resistant Staphylococcus aureus (S. aureus), have been demonstrated to be inhibited by C. sinensis aqueous extract. Additionally, tea extract proved bactericidal to *Yersinia enterocolitica and staphylococci.*

The ingredients of *C. sinensis* tea manufactured using various manufacturing techniques vary depending on the technique used. Steaming or panning green tea stops polyphenol oxidation from oxidizing catechins. Green tea leaves retain their green hue and nearly all of their original polyphenolic chemicals when this approach is applied. Both gram-positive and gram-negative bacteria are susceptible to the antibacterial properties of green tea chatechins, especially EGCG and EGC (Hamilton-Miller, 1995). By suppressing oral microorganisms, green tea can stop tooth decay (Wang et al., 2000). Additionally, by blocking chromosomal penicillinase, EGCG prevents S. aureus from growing.

Tea leaves and buds contain compounds that are extremely susceptible to oxidation. As stated by Toda et al. (1989). Pathogenic microorganisms such as Staphylococcus aureus, *Vibrio parahemolyticus, Clostridium perfringens, Bacillus cereus, and Pleisomes shigelloides* were eliminated by daily use of green tea. Black tea only has 3–7% polyphenols, whereas green tea has about 30–40% polyphenols and related substances including Epigallocatechin gallate (EGCG), Epicatechin gallate (EGC), Epicatechin gallate (ECG), and Epicatechin (EC).

According to Archana and Abraham (2011), EGCG is the most potent chemical tested for biological action in terms of preventing the growth of pathogenic germs, and it is also the most luxuriant component of tea extract. According to Bunkova et al. (2005), tea polyphenols have been shown to be effective against a range of food-borne pathogenic microorganisms that can be devastating to human health. One of the most popular drinks in the world, coffee is praised for its pleasant flavor and scent, pharmacological properties, and—most importantly—its ability to stimulate both mental and physical activity. According to clinical and epidemiological studies, *P. aeruginosa* is the primary cause of nosocomial infections and accounts for 10% of all hospital-acquired infections globally. This has led to a recent increase in scientific and public interest in its significance for health. One of the main causes of hospital-acquired pneumonia and persistent lung infections in people with cystic fibrosis is *P. aeruginosa.*

Growth requires iron, and *P. aeruginosa* expresses several iron absorption systems that contribute to lung infections. *P. aeruginosa* and *Staphylococcus aureus* are the most common bacteria that cause corneal ulcers. Using the well diffusion method, coffee extract's antibacterial potential against various pathogenic organisms was examined (Noha, MEL Sayed, and others, 2018).

Review of Literature

In order to determine the antibacterial activity of the methanolic extract of green tea leaves, Chakraborty and Chakraborty (2010) measured ZDI and MIC at four different concentrations (10, 25, 25, and 100 mg/mL). The antibacterial activity of a 50% methanolic leaf extract was higher against B. cereus and P. aeruginosa. For B. cereus, the MIC was 10 mg/ml, and for E. coli, it was 100 mg/ml. EGCG's antibacterial action against gram-negative rods, such as E. coli, salmonella, and K. pneumonia, as well as several strains of staphylococcus (gram positive cocci).

It was found that inhibiting the growth of *S. aureus* required a concentration of 50–100 µg/ml, while gram-negative rods required a concentration of more than 800 µg/ml (Yoda et al., 2004).

Tahir and Moeen (2011) used the paper diffusion test and MIC to evaluate the antibacterial activity of green tea's ethanolic and aqueous extracts. Zones of inhibition of 6–18 mm and 8–27 mm are produced by *C. sinensis* water extract against *L. acidophilus and S. mutans*, respectively. Archana and Abraham (2011) discovered that fresh green tea extract (methanol and aqueous) has stronger antibacterial activity against *Enterococcus faecalis*, *Staphylococcus aureus*, *Pseudomonas aeruginosa, and E. coli.* Dust tea had the least antibacterial action, while commercial green tea leaves and fresh green tea extract with methanol had the highest activity.

When compared to fresh green tea leaves, black tea's minimum inhibitory concentration (MIC) for *Staphylococcus aureus, Salmonella typhi, and E. coli* was found to be greater. When Iranian green and black tea were tested against Streptococcus mutans, Naderi et al. (2011) found that green tea showed an antibacterial effect at doses of 100 to 400 mg/ml. The green tea methanolic extract had a mean ZDI of 9.5 mm and a minimum inhibitory concentration (MIC) of 150 mg/ml.

The antibacterial activity of green tea methanolic extract against *Listeria monocytogenes* was reported by Mbata et al. (2008), who demonstrated that the methanolic extract had stronger antibacterial qualities (ZDI = 20.1 mm) than the hydrophilic extract (ZDI = 10 mm). Their investigation revealed that the methanolic extract had a ZDI of 15 mm, but the water extract had no inhibitory effect. Methanol and aqueous leaf extracts had respective MICs of 0.26 and 0.68 mg/ml.

Green tea extract (GTE) and different solvent fractions (methylene chloride (MC), water, and ethyl acetate (EtOAc)) were assessed for their antibacterial and antifungal properties by Kim et al. (2013). They claimed that the caffeine moved to the MC layer while the majority of the

catechins were in the EtOAc layer of the green tea leaf aqueous extract. The water fraction still contained some caffeine and catechins. Green tea has four different kinds of catechin. With 30.43 mg/ml of GTE, 114.73 mg/g of the EtOAc fraction, and 11.32 mg/g of the water fraction, EGCG has the strongest physiological activity among these four catechins. The MC fraction had 936.72 mg/g of caffeine. The information Only one strain of a clinically isolated S. aureus showed the synergistic effects. These results lend credence to the hypothesis that caffeine may be more effective against Gram-positive bacteria than Gram-negative ones. These findings are consistent with earlier research that demonstrated the antibacterial properties of some methylxanthine derivatives, which are particularly effective against Gram-positive bacteria. When coupled with gentamycin, green tea extract exhibits strong antibacterial properties.

In the methanolic extract, the phytochemical analysis showed the presence of flavonoids, alkaloids, tannins, and the absence of glycosides, terpenes, and saponins; however, in the aqueous extracts, the results were consistent with the findings of Lee et al. (2004) (19). They demonstrated that the components of green tea extracts, such as tannins, reducing sugar, and protein, might be in charge of the antioxidant activity. According to Gupta and colleagues (2011), Murraya koenigii's ethanolic extract has comparatively greater inhibitory efficacy. However, they discovered that Murraya koenigii leaf extract in water did not exhibit any inhibitory action.

Chan et al. (2012), found that fresh guava leaves had a total antioxidant activity of 71.16% RSA. Combinations of steam-blanched and hot water-blanched herbal tea yield 89.39 and 91.28 (% RSA), respectively. The findings are consistent with their investigation, which found that steam-blanched guava leaf herbal tea had greater antioxidant activity than unblanched guava leaf herbal tea.

The antimicrobial activities of *Psidium guajava* against Gram positive and negative bacteria were assessed by Sanches et al. (2005). They found that the ethanol: water extract of *P. gaujava* leaves, stem, bark, and root and the aqueous extract were more active against Staphylococcus aureus than the aqueous extract alone.

The antibacterial activity of Bay leaves was demonstrated by the zone of inhibition (in millimeters) of n-hexane, dichloromethane, and methanolic extracts at doses of 0.5 mg/ml against the investigated microorganisms (Algabri et al., 2018). According to their findings, the methanolic extract of Bay leaves exhibits antibacterial activity against Staphylococcus aureus with a zone of inhibition of 18±0.8 mm, which is significantly greater than the inhibition zone of the positive control (phenol) (10±1.0 mm). However, no antibacterial inhibition was observed against the other tested bacteria.

The results of their investigation demonstrated the antibacterial and antioxidant properties of bay leaf extracts. However, more research on a variety of diseases is advised to evaluate the spectrum of bay leaf extracts, and quantitative DPPH assay is required to validate the results.

Materials and Methods

The leaves of Camellia sinensis were gathered from the local market in the vicinity of Katol City, dried in the shade, and then processed into a powder. The powdered Arabica green coffee beans were gathered from the neighborhood store. Uniformity in the ways that all herbal tea leaves are processed. Two distinct processing methods were applied to the leaves in order to maximize the retention of bioactive components. After carefully examining the fresh leaves and removing any foreign objects, they were gently rinsed with tap water. Ordinary preparation involved spreading the cleaned leaves thinly on trays and drying them for six to seven days at room temperature (35 ^{0}C). To obtain a consistent particle size for herbal tea powder, the aforementioned dried and processed leaves were ground up in a blender and then put through 100g polyethylene bags. Air-tight plastic bags were used to keep the plant powder.

Preparation of plant extracts: -

Preparation of Green Coffee Bean Extract: Aqueous extracts of coffee were obtained by a coffee brewing procedure based on a previous study by Antonio et al.; Preparation of 10% extract was done by percolating 100 ml of pre-boiling (95ºC) sterile water through 10 g of ground coffee. A filter paper was used to filter the extracts. After preparation of 10% aqueous, Ethanol and n-butanol extract of coffee, further dilution was done using sterile water, Ethanol and n-butanol to obtain the concentrations of 30%, 20% and 10%.

Green Coffee Bean Extract Preparation: A coffee brewing method based on an earlier work by Antonio et al. was used to create aqueous extracts of coffee; 10% extract was prepared by percolating 100 ml of sterile water that had been pre-boiled at 95ºC through 10 g of powdered coffee. The extracts were filtered with filter paper. Following the synthesis of a 10% aqueous, ethanol, and n-butanol extract of coffee, concentrations of 30%, 20%, and 10% were obtained by further dilution using sterile water, ethanol, and n-butanol.

By lowering the order of solvent polarity, various extracts of all combinations of teas, including green tea, green coffee, and herbal teas, were made. Distilled water, a highly polar solvent, was used to begin the extraction process in this approach. Ethanol and n-butanol came next.

A 10g sample was weighed using a weighing machine as part of the extraction procedure for each tea sample. And use a measuring cylinder to add 100 milliliters of distilled water, ethanol, and n-butanol. The sample was put into a thimble. Aqueous, ethanol, and n-butanol were created as solvents. The soxlet apparatus was filled with the thimble. Solvents were allowed to be siphoned just once. After that, the solvent was injected just enough to cover the thimble. The temperature was set between 55 and 60 degrees Celsius, which is close to the mixture's boiling point, which is 75 degrees Celsius for ethanol and 70.2 degrees Celsius for n-butanol. The siphoning process is then initiated. The extraction was siphoned until it became transparent.

After passing through a Whatman filter paper with a 0.2 µm membrane, the extract was transferred to a beaker and dried using a rotary evaporator. When a different plant extract was needed, this procedure was repeated. After immersing the solution for the entire night, the residues were frozen at -60 degrees Celsius. The extracts were prepared for phytochemical and antibacterial activity testing.

Test microorganism isolation

Three clinical isolates of bacterial pathogens, including *Pseudomonas aeruginosa* (pyogenic infection and urinary tract infection), *Escherichia coli,* and *Staphylococcus aureus* (opportunistic pathogen of human skin), were employed using conventional microbiological methodology.

Inoculum preparation

Five to six colonies of each organism from the new culture were suspended in 20 milliliters of nutrient broth in a tiny conical flask to create inoculums. The turbidity of each suspension was then measured the next day after the inoculums were incubated for 24 hours at 35 degrees Celsius.

Antibacterial activity test

Antibacterial activity was determined using the well diffusion method, according to the departmental guidelines. The bacteria used in this study is *Staphylococcus aureus, E. coli,* and *Pseudomonas aeruginosa.* Procedure were start with to prepared specified bacterial isolates Mueller Hinton Agar plates, the medium was autoclaving at 121 ^{o} C for 15-20 min.Allow to cool, poured in Petri plates , then plates are allow to solidified at room temperature, and performed the procedure, spread the bacterial inoculums on the surface of MHA medium with sterile L-shaped spreader, after drying 5-minutes,6mmdiameter wellsare punched into the Muller Hinton agar plates with the help of sterile well puncture.

In accordance with departmental rules, the well diffusion method was used to test antibacterial activity. *Pseudomonas aeruginosa, E. coli*, and *Staphylococcus aureus* were the microbes used in this investigation. Mueller Hinton Agar plates were used to prepare specific bacterial isolates, and the medium was autoclaved for 15 to 20 minutes at 121 degrees Celsius. After allowing the plates to cool and solidify at room temperature, the bacterial inoculums are spread on the MHA medium's surface using a sterile L-shaped spreader. After five minutes of drying, six-millimeter-diameter wells are punched into the Muller Hinton agar plates using a sterile well puncture.0.2 ml of the produced plant extracts were added to the wells on the infected medium's surface, and the extract was allowed to settle for five minutes. The zone of inhibition was noted when the plates were incubated at 37 °C for a full day. The diameter of the zone of inhibition of bacterial growth surrounding the wells was measured using a millimeter scale to evaluate the antibacterial activity.

Screening for Phytochemicals

The standard procedure was followed to screen the plant extracts for various phytochemicals. The plant extracts were examined for the presence of diverse chemicals such as alkaloids, flavonoids, protein, terpenoid, steroids, glycoside, tannins, saponins, quinones, carbohydrates, sugars etc.

Results and Discussion

Antimicrobial activity of green tea extract

Green tea extract's antimicrobial properties (Table 1)show the results of the inhibitory activity of *Camellia sinensis* (green tea) extracts on the development of *Pseudomonas aeruginosa, Escherichia coli,* and *Staphylococcus aureus,* which were shown to be extremely sensitive. A zone of inhibition was seen when water, ethanol, and n-butanol extracts were diluted against each of the chosen bacterial strains. It is important to note that the aqueous, ethanol, and n-butanol extracts of *Camellia sinensis* significantly inhibited the strains of *Staphylococcus aureus, Pseudomonas aeruginosa,* and *Escherichia coli* employed in this investigation.

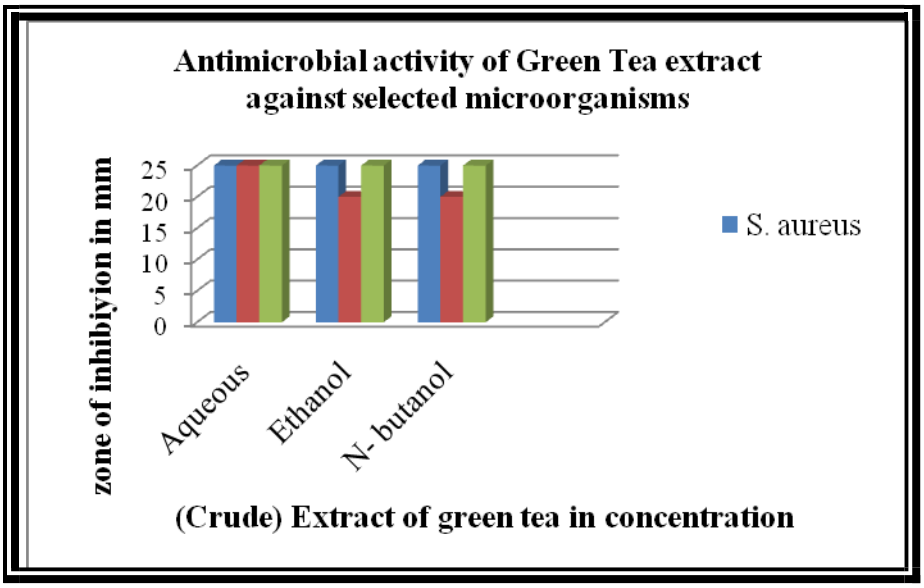
Table No 1: -Antimicrobial activity of green tea extract

Sr No	Material	Test organism	Zone of inhibition(mm)											
01	Green Tea Extract		Aqueous/Dilutions Zone of Inhibition (mm)				Ethanol/Dilutions				N-butanol/Dilutions			
			Crude	10^{-1}	10^{-2}	10^{-3}	Crude	10^{-1}	10^{-2}	10^{-3}	Crude	10^{-1}	10^{-2}	10^{-3}
		S.aureus	25	15	12	10	25	12	11	10	25	15	10	10
		P. aeruginosa	25	20	10	10	20	13	11	10	20	10	10	12
		E.coli	25	20	15	10	25	15	12	13	25	20	15	10

Once more, an intriguing finding in this case is that the crude extract of *Camellia sinensis* in water, ethanol, and n-butanol exhibits almost comparable zones against both Gram-positive and Gram-negative organisms (25 mm, 25 mm, and 20 mm in diameter in crude extract). Compared to *S. aureus and E. coli,* green tea ethanol and n-butanol extract exhibit less zone inhibition against *P. aeruginosa.*

According to the findings, the dilutions decline to 101, 102, and 103 (20 mm, 17 mm, 16 mm, 15 mm, 13 mm, 12 mm, 11 mm, and 10 mm in diameter depending on the extract concentration). Table 1 lists similar outcomes with water, ethanol, and n-butanol extract against *S. aureus, P. aeruginosa,* and *E. coli.*

Fig No 1: - Graphical representation green tea extract (zone of inhibition mm)



The strongest antibacterial action was demonstrated by green tea extract. This shows that the material was significantly impacted by the extract. A statistical study revealed a substantial difference in the concentrations that were used. The graph against Escherichia coli (A-25, E-25, N-25mm), *Pseudomonas aeruginosa* (A-25, E-20, N-20mm), and *Staphylococcus aureus* (A-25, E-25, N-25mm) illustrates this. It revealed that the S. aureus and E. coli shown comparable and stronger antibacterial activity than *P. aeruginosa* in (Fig. 1), demonstrating the inhibitory effect of green tea's ethanolic and n-butanolic extract on *E. "coli"* (Fig. 2) demonstrated the green tea aqueous extract's inhibitory efficacy against *P. aeruginosa,* and (Fig. 3) demonstrated the same effect against *S. "aureus"*

Tahir and Moeen (2011) used the paper diffusion test and MIC to evaluate the antibacterial activity of green tea ethanolic and aqueous extract. Zones of inhibition of 6–18 mm and 8–27 mm, respectively, are produced by *C. sinensis* water extract against L. acidophilus and *S. mutans.* Larger zones of inhibition were generated by *C. sinensis* ethanolic extracts against *L. acidophilus* and *S. mutans,* respectively, measuring 15–33 mm and 19–35 mm. The minimum inhibitory concentration (MIC) of aqueous extract against *S. mutans* and *L. acidophilus* was 0.8 and 0.9 mg/ml, respectively.

In contrast, it was 0.7 and 0.7 mg/ml for ethanolic extract against *S. mutans* and *L. acidoplilus,* respectively. (Archana and Abraham 2011) discovered that fresh green tea extract (methanolic and aqueous) has stronger antibacterial activity against *Enterococcus faecalis, Pseudomonas aeruginosa, Staphylococcus aureus,* and *E. coli.* Dust tea had the least antibacterial action, while fresh green tea extract with methanol had the highest, followed by commercial green tea leaves. When compared to fresh green tea leaves, the MIC of black tea is efficient against *Staphylococcus aureus, Salmonella typhi,* and *E. coli,* which were found to be at higher concentrations.

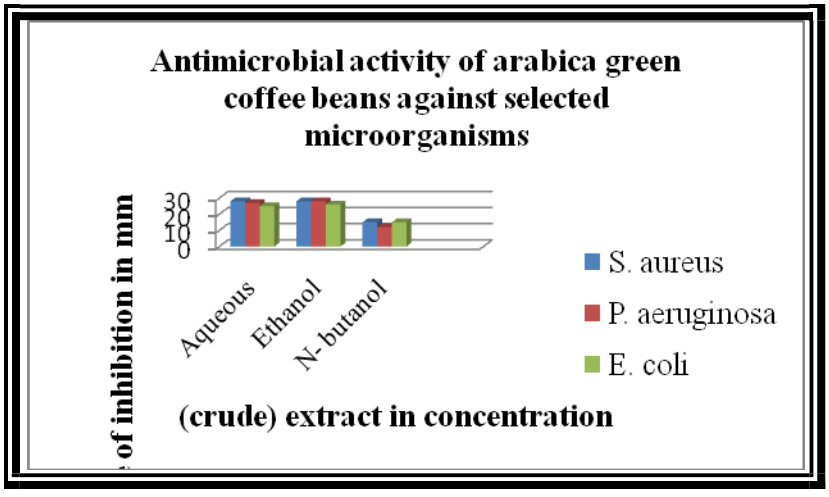
Green coffee bean extract's antimicrobial properties:

The second table. demonstrated that the concentration of green coffee extract in aqueous, ethanol, and n-butanol increased the inhibitory zones. The diameter of the inhibitory zones was 28 mm, 27 mm, 26 mm, 25 mm, 15 mm, and 12 mm, respectively. This outcome unequivocally demonstrated the antibacterial efficacy of Arabia green coffee bean extract against *S. aureus, P. aeruginosa,* and *E. coli* microorganisms used in this investigation. Sensitive to the green coffee extract is indicated by an induced large zone of inhibitions.

Table No 2:Antimicrobial activity of Arabica Green coffee beans extract

Sr No	Material used	Test organisms	Zone of inhibition(mm)											
1	Arabica green coffee beans extract		Aqueous				ethanol				n-butanol			
			crude	10^{-1}	10^{-2}	10^{-3}	crude	10^{-1}	10^{-2}	10^{-3}	crude	10^{-1}	10^{-2}	10^{-3}
		S.aureus	28	25	15	10	28	20	10	_	15	10	_	_
		P.aeruginosa	27	21	12	9	28	20	10	_	12	9	_	_
		E.coli	25	20	10	_	26	20	11	_	15	10	_	_

Graph No 2 :- Graphical representation of Arabica green coffee beans extract



The extract from green coffee beans exhibited the strongest antibacterial action. This shows that the material was significantly impacted by the extract. A statistical study revealed a substantial difference between the concentrations used. The graph illustrates this against *Pseudomonas aeruginosa* (A-27, E-28, N-12mm), *Escherichia coli* (A-25, E-26, N-15mm), and *Staphylococcus aureus* (A-28, E-28, and N-15mm). (Figure 4) demonstrated the green coffee bean ethanolic extract's ability to inhibit E. coli. Figure 2 demonstrated the green coffee bean aqueous

extract's ability to inhibit *S. aureus.* (Fig.3) demonstrated the green coffee bean aqueous extract's ability to inhibit *P. aeruginosa*. The antibacterial activity of green coffee Arabic bean extract against multidrug *P. aeruginosa* strains was examined in this study. The outcomes unequivocally demonstrated the green coffee Arabica bean extract's antibacterial efficacy against every strain employed in this investigation. Bacteria are categorized as resistant if the antimicrobial drug-induced zone of inhibition is less than 8 mm, intermediate if it is between 8 and 11 mm, and sensitive if the inhibition zone width is 12 mm or above.

Analyzing extracts phytochemically

Table No. 6 presented the phytochemical analysis of green tea and green coffee bean extracts. The table shows that tannins, saponins, alkaloids, flavonoids, glycosides, steroids, terpens, etc. were present in the aqueous, ethanol, and n-butanol. These findings vary from those reported by (Dogra et al., 2011), which showed that both extracts contained sugar. Terpenoids were absent from all of the extracts in the table 3.

Table 3:- Phytochemical analysis of green tea extract and green coffee extract:

Sr No	Phytochemical Tests	Green tea extract			Green coffee extract		
		Aqueous	Ethanol	N-butanol	Aqueous	Ethanol	N-butanol
01	Flavonoids	+	+	-	+	+	+
02	Alkaloids	+	+	+	+	+	+
03	Saponins	+	+	+	+	+	+
04	Tannins	+	+	+	+	+	+
05	Terpenoids	-	-	-	-	-	-
06	Proteins	+	-	-	+	-	-
07	Steroids	+	+	+	+	+	+
08	Glycosides	+	+	+	+	+	+
09	carbohydrates	+	+	+	+	+	+

One test served as the basis for our analysis. However, a more accurate analysis might be obtained by combining several assays for the identification of a certain phytochemical. Phytochemical examination showed that the methanolic extract included flavonoids, alkaloids, and tannins but lacked glycosides, terpenes, and saponins.

However, aqueous extracts revealed the presence of flavonoids, saponins, tannins, alkaloids, and the absence of terpenes and glycosides. This finding was consistent with a study by Lee et al. (2004) (19), which suggested that the components of green tea extracts, such as protein, reducing sugar, and tannins, may be responsible for antioxidant activity. However, a more accurate analysis might be obtained by combining several assays for the identification of a certain phytochemical. In order to avoid missing any chemicals, a combination of testing is ideally advised. The study's findings are in line with recent research showing that green tea has antibacterial properties against strains of resistant bacteria like *P aeruginosa*, among others. Green tea extract demonstrated action in a number of earlier investigations. Additionally, green tea has been shown to work in concert with B-lactum antibiotics. Additionally, it was observed that epigallocatechin gallate, one of the primary components of tea polyphenols, might reverse the bacteria.

Conclusion

According to the study's findings, tea extracts have the potential to be a rich source of antimicrobial agents against a variety of bacteria, with their phytochemical ingredients and mineral contents contributing to their bioactivity. Along with additional beneficial effects like anti-atherogenic properties, all tea extracts (including green and herbal teas) had strong antibacterial activities. Their ethnic-pharmacological use as a treatment for infections and disorders brought on by microorganisms is supported by the current review. The results of this study demonstrate the benefits of combining herbal teas, green tea, and green coffee extract against both Gram-positive and Gram-negative bacteria, as well as investigations and supplemental studies.

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