ACTA SCIENTIFIC MICROBIOLOGY (ISSN: 2581-3226)

Volume 3 Issue 12 December 2020

Research Article

Study of Herbal Antibiotics Derived from Turmeric and Ginger Applied on *Enterobacteriaceae*

Mehwish Saleem[1]*, Mashal Manzoor[2], Sana Amjad[2] and Aqsa Malik[2]

[1]*PCSIR-Lab, Lahore, Pakistan*

[2]*Microbiology Lab Islamia College, Lahore, Pakistan*

***Corresponding Author:** Mehwish Saleem, PCSIR-Lab, Lahore, Pakistan.

Received: August 13, 2020

Published: November 11, 2020

Abstract

Humans have been using natural products for medicinal use for ages. Natural products of therapeutic importance are compounds derived from plants, animals, or any microorganism. Ginger and Turmeric are also used as most commonly used condiments and natural drugs in vogue. These are traditional medicine, having some active ingredients used for the treatment of many diseases and killing of gram negative bacteria as well as gram positive i.e. *E. coli*, *Klebsiella sp. Pseudomonas aeruginosa*. Turmeric (*Curcuma longa*) and ginger (*Zingiber officinale*) has been used in cooking, and in herbal remedies. It's possible mechanism of action was examined in terms of antioxidant availability during actual cooking conditions and in therapeutic applications using standardized extracts. The assays involve different levels of serial dilutions of ginger and turmeric and their activity on different stages of killing of bacteria. The aim of this study is to determine whether herbal antibiotics are efficient in their result of mortality in enterobacteriaceae. Aqueous, Methanolic and Ethanolic test extracts of *Zingiber officinale* and *Curcuma longa* were prepared. Microbiological tests were employed to determine the zone of inhibition. Standardization of isolates were obtained after incubating for 24 hours. Serial dilutions of Ginger and Turmeric were prepared to measure the OD value and growth of bacteria in the dilutions measured by spectrophotometer. The aqueous extracts of two major preparations of turmeric and ginger, corresponding to its use in cooking and medicine, shows significant antioxidant abilities. The studies reveal that the ability of ginger and turmeric having anti-inflammatory potential that shows susceptibility to gram negative bacteria in ethanol and methanol extract. The OD values of serial dilutions of Turmeric and Ginger determine the ratio of killing of bacteria in different concentrations. Thus it is concluded that Herbal antibiotics have a significant role in killing of bacteria. According to the research it is concluded that due to the excessive usage of medicines it is to be noted that the bacteria are shifting towards more resistancy. However usage of Herbal antibiotics can minimize this effect. Therefore scientists are shifting more towards Herbal medicines as compared to synthetic antibiotics.

Keywords: Turmeric; Ginger; *Enterobacteriaceae*

Introduction

Historically, plants have provided a source of inspiration for novel drugs compounds, as plants derived medicines have made large contributions to human health and well being [1]. Natural products are a major source of new natural drugs and their use as an alternative medicine for treatment of various diseases has been increased in the last few decades [2]. In comparison to the formulated drugs the herbs and spices have fewer side effects. They are also inexpensive, show better patient tolerance and are readily available for low socioeconomic population [3]. In recent years, in view of their beneficial effects, use of spices or herbs is gradually increasing not only in developing countries but also in developed countries. Although approximately, 20% of the world plants have been submitted to pharmacological or biological test, it could be concluded that natural products from plant origin are an important source to discover new leads with economical and pharmaceutical importance and great possibilities to be developed as drugs, dyes, fragrances and pesticides, among others [4]. To obtain novel and

promissory substances many plant extracts have to be assayed [5]. Furthermore, the screening of plant extracts as antimicrobial agents is necessary to go insight into medicinal flora and get the molecules responsible for this activity and add value to natural resources from tropical areas [6]. The plant based recent antibiotics are antimicrobial compounds that are effective against resistant organism. Ginger is increasingly used in the diets of worldwide population and is commonly used in teas having antibiotics effects together. Ginger is one of the most important plants that have been seriously investigated because of its enormous antibiotic ability against *Staphylococus aureus* and *Streptococcus pyogene* are major causative agents against infections and diseases [7]. In South India ginger is used in the production of a candy called Injimurappa meaning ginger candy in Tamil [8]. Powdered ginger rhizome contains 3.6% fatty oil, 9% protein, 60-70% carbohydrates, 3.8% crude fiber, 8% ash, 9-12% water and other terpenes and terpenoids. Fresh ginger contains 80.9% moisture, 23% protein, 0.9% fat, 1.2% minerals, 2.4% fibre, and 12.3% carbohydrates. Ginger has been shown to be effective against the growth of both gram-positive and gram-negative bacteria including *Escherichia coli, Proteus vulgaris, Salmonella typhi, Staphylococcus aureus and Streptococcus viridians* [9].

Gingerol, properly as [6]-gingerol is a chemical compound found in fresh ginger. Chemically, gingerol is a relative of capsaicin and piperine, the compounds which give chili peppers and black peppers their relative spiciness [10]. Ginger also contains [8]-gingerol, [10]-gingerol and [12]-gingerol collectively deemed gingerols. In particular its gingerol-related components have been reported to possess antimicrobial and antifungal properties as well as several pharmaceutical properties. However, the effective ginger constituents that inhibit the growth of oral bacteria associated with peridontitis in the human oral cavity have not been elucidated. This study revealed that the ethanol and n-hexane extracts of ginger exhibited antibacterial activities against three anaerobic Gram negative bacteria, *Porphyromonas gingivalis* ATCC 53978, *Porphyromonas endodontalis* ATCC 35406 and *Prevotella intermedia* ATCC 25611, causing peridontal diseases. Thereafter five ginger constituents were isolated by a preparative high performance liquid chromatographic method from active silica-gel column chromatography fractions, elucidated their structures by nuclear magnetic resonance spectroscopy and electrospray ionization mass spectrometry and their antibacterial activity evaluated. In conclusion, two highly alkylated gingerols [10]-gingerol and [12]-gingerol effectively inhibited the growth of these oral pathogens at a minimum inhibitory concentration (MIC) range of 6-30 microg/mL. These ginger compounds also killed the oral pathogens at a minimum bactericidal concentration (MBC) range of 4-20 microg/mL, but not the other ginger compounds 5-acetoxy-[6]-gingerol, 3,5-diacetoxy-[6]-gingerdiol and galanolactone [11]. Medicinal plants extracts have been used and studied extensively for their antimicrobial activity and have been demonstrated as good plant disease control agents [12]. Plant extracts shown antibacterial activity because of phtyochemicals like alkaloids, tannins, flavonoids phenolic compounds and steroids [13]. Plant extracts are used as traditional medicine for the treatment of many diseases. Plant extracts are used as traditional medicine for the treatment of many diseases. Ethanol and methanol extracts of ginger had significant antimicrobial effect on *Escherichia coli* isolates but the ginger aqueous extract was only mildly effective. The antibacterial activity of crude ethanol extracts and essential oils of Ginger (*Zingiber officinale*) against five strains of diarrhea causing *Escherichia coli* (They showed the *E. coli* strains were susceptible to the essential oils but not to the crude extracts) [14]. In the present study, we examined the antimicrobial activities of 31 herbal teas alone and in combination with antibiotics or antifungals against both standard and clinical isolates of *Pseudomonas aeruginosa*, *A. baumannii*, *E. coli*, *Klebsiella pneumoniae*, *Enterococcus faecalis*, methicillin-susceptible *S. aureus* (MSSA), MRSA, and *Candida albicans*, which can cause serious nosocomial or community-acquired infection [15]. In the present day, the detailed antibacterial activity of curcumin against two Gram-positive bacteria, namely, *S. aureus* and *Enterococcus faecalis,* and two Gram-negative bacteria, namely, *Escherichia coli* and *P. aeruginosa* has been investigated [16].

Material and Methods

Antimicrobial susceptibility of isolates was tested for all bacteria by the agar diffusion according to Clinical Laboratory Standards Institute (CLSI) guide lines. In antimicrobial susceptibility test Muller Hinton agar was used. The bacterial colonies were suspended with McFarland standard. Using sterile inoculating loop picked the bacterial colony and dispensed into saline solution. By comparing the McFarland standard adjusted the turbidity of the suspension. Sterile swab were dipped into the inoculums tubes and inoculated onto Muller Hinton agar plates. Herbal Antibiotics were placed on the surface of inoculated agar plate. Herbal antibiotics are evenly distributed on the plates. Plates were incubated at 37^0C for 24 hours. Examined the plates after 24 hours and noted the re-

sults. Using the ruler measured the diameter of zone of inhibition. Identify the sensitivity or resistance of the bacteria against all tested drug by using the available CLSI guide lines. For each antibiotic hole, measured the zone size either it is sensitive, intermediate or resistance and compared the zone size with CLSI guide lines chart. The freshly found roots of ginger and turmeric was sun dried for many days and then crushed to fine powder and then mixed with boiled water to avoid any contamination. This pure solution then undergo filtration and then serial dilution was performed. Before starting the procedure the materials should be autoclaved for 20 mins like Petri plates, test tubes, inoculating pins etc. The Muller Hilton agar was weighted on weight balance and then mixed with 250 ml of distilled water in a flask and provide it heat to homogenize it. The agar was poured in petri plates and places it for 24 hrs until it solidifies. Various concentrations of Extracts of *Zingiber Officinale* and *Curcuma longa,* was applied on *E. coli*, *Pseudomonas aeruginosa* and *Klebsiella sp*. To measure the bacterial count or concentration of the solution the Optical Density is measured. A standard stock of the bacterial isolates was prepared by suspending a loop full of each microbial growth in about 10 ml of nutrient broth. After incubation at 37 °C for 24 hours it gives a standard load of bacteria. Then the serial dilution of ginger and turmeric was placed in cuvette that are added into this broth that undergo spectrophotometry. After serial dilutions the ethanolic, methanolic and aqueous extract of ginger and turmeric were prepared. 50 gms of each spice (Fresh Ginger and Turmeric dry powder was taken in a conical flask containing 250 ml of distilled water and 250 ml of absolute ethanol and methanol. It was kept in mechanical shaker water bath for 6-7 hrs at room temperature. The supernatant was filtered through the whatman filter paper no 1 under vacuum. The residue was again resuspended in 100 mL of ethanol and water and shaken for 6-7 hrs and the procedure was repeated again. The total filtrate was concentrated under vacuum in Rota evaporator at 60-70°C. The concentrated extract was then lyophilized at -100 to -110°C with methanol and ethanol bath temperature between -100 °C under vacuum. The final powder extract was stored in a container and kept in the refrigerator for further analysis.

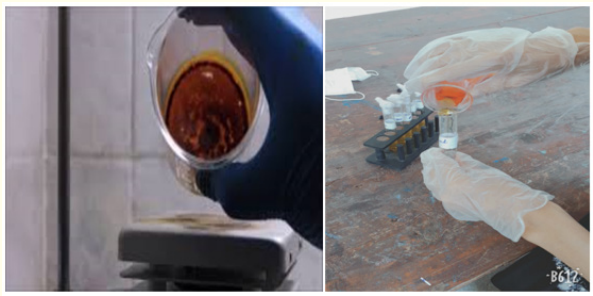
Result

The rhizomes of the plants were cut, sundried, ground and sieved. The percentage yield of each extract in each of the solvent was calculated. To determine the growth and killing effect on bacteria these extracts were poured on different gram negative bacterial isolates on petri plates. *Klebsiella sp.* make Large Yellowish/ white and colony elevation while *Pseudomonas aeruginosa* make Pale blue green with irregular edges and *E.coli* form Large yellow colonies The Effect of Ginger and Turmeric's serial dilutions on the killing of *E. coli, Klebsiella sp. and Pseudomonas aeruginosa* is very efficient. The zone of inhibitions determine by the agar well diffusion test.. *E. coli* showed the lowest zone of inhibition in ginger and turmeric extracts 8mm and 16 mm respectively while *Klebsiella aeruginosa* showed the antimicrobial activity of 25mm diameter in turmeric and 18mm in ginger. The zone of inhibition in *P. aeruginosa* was greater among all by applying turmeric herbal crude antibiotic and the showed the highest zone of inhibition of 33mm in 20 µg of turmeric solution. The *Pseudomonas aeruginosa* is a gram positive bacteria while *E. coli* and *Klebsiella spp*. are gram negative bacteria. *E. coli* showed more resistance to herbal antibiotics while *Pseudomonas aeruginosa* and *Klebsiella spp*. showed susceptibility to these antibiotics. The greater the zone of inhibition the greater the antibiotic and bacteria diffusion. The Methanol and Ethanol extracts of ginger are more efficient than simple ginger crude solution. Therefore the antibacterial properties are more present in turmeric as well as ginger in case of gram positive bacteria. Due to the formation of Ethanol methanol and aqueous extracts of ginger and turmeric the results are more efficient as compared to crude herbal antibiotics. According to research the methanol extracts of ginger showed low potency towards *E. coli* while aqueous extracts of ginger showed more susceptibility towards gram negative bacteria i.e. *E. coli*, *Klebsiella spp.* The ethanol extracts of ginger showed resistancy towards *Pseudomonas aeruginosa*. ginger aqueous extracts are more effective against all tested bacterial strains than ginger methanol and ethanol extracts. *E. coli* and *P. aeruginosa* were also more susceptible to the ginger extracts. *P. aeruginosa* showed maximum susceptibility to the ginger methanolic extracts while *E. coli* showed maximum susceptibility to ginger aqueous extract. The Turmeric also shows more susceptibility to bacteria in ethanol extracts as compared to aqueous and methanol extracts. Gram positive bacteria showed more susceptibility towards Turmeric antibiotic.

Figure a

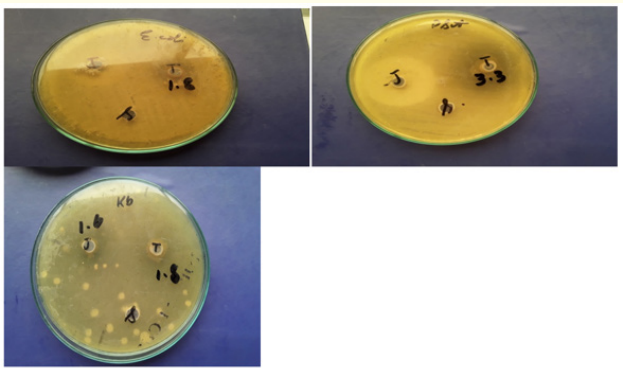
Serial dilutions of Ginger | Methanol extract of Ginger

Figure b



Methanol extract of Turmeric | Pouring of Nutrient broth in test tubes.

Figure c



Measure of zone of inhibition by applying ginger and turmeric juice against *Klebsiella sp.*, *E. coli* and *Pseudomonas aeruginosa*.

Figure d

By the application of pure concentration of ginger and turmeric in its freshly squashed juice form to measure the zone of inhibition, the results are very good. The Gram negative bacteria shows good results and are effectively susceptible to the fresh juice of ginger and turmeric. The *P. aeruginosa* is more effective against turmeric while *E. coli* is susceptible to ginger. The Zone of inhibition is a circular area around the spot of the antibiotic in which the bacterial colonies do not grow. It shows the area of killing of bacteria by applying the solution of Turmeric and ginger. The size of the zone of inhibition is directly proportional to the sensitivity of the organism to the Herbal antibiotic.

Spectrophotometer for detecting OD of serial dilutions.

Figure e

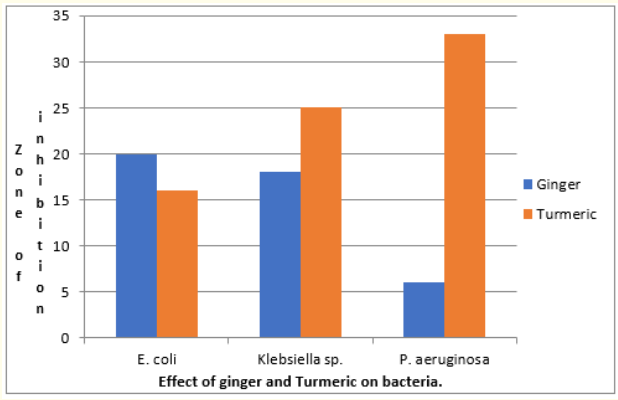


Figure f: Effect of ginger and turmeric against *E. coli*, *Klebsiella* sp. and *P. aeruginosa* by applying ginger and

The graph represent the range where the bacteria lies in their zones of inhibition. It shows that *P. aeruginosa* form the maximum zone of inhibition.

Clinical isolates	Zone of inhibition in pure Concentration of Ginger (20µg/mL).	Zone of inhibition in pure Concentration of Turmeric (20µg/mL).
E. coli	08mm	16mm
Klebsiella sp.	18mm	25mm
P. aeruginosa	20mm	33mm

Table a: Effects of Ginger and Turmeric on Gram negative bacteria to measure the zone of inhibition.

According to table. *E. coli* showed the lowest zone of inhibition in ginger and turmeric extracts 8mm and 16 mm respectively while *Klebsiella aeruginosa* showed the antimicrobial activity of 25mm diameter in turmeric and 18mm in ginger. The zone of inhibition in *P. aeruginosa* was greater among all by applying turmeric herbal crude antibiotic and the showed the highest zone of inhibition of 33mm in 20 µg of turmeric solution. The *Pseudomonas aeruginosa* is a gram positive bacteria while *E. coli* and *Klebsiella spp*. are gram negative bacteria. *E. coli* showed more resistance to herbal antibiotics while *Pseudomonas aeruginosa* and *Klebsiella spp*. showed susceptibility to these antibiotics. The greater the zone of inhibition the greater the antibiotic and bacteria diffusion. Therefore the antibacterial properties are more present in turmeric as well as ginger in case of gram positive bacteria.

According to the table; As the dilution increases in the simple ginger and turmeric solution the concentration of particles decreases so optical density values were also decreasing. In the case of *E.coli* bacterial count it tends to decreasing while performing further dilutions because the amount of light absorbed is directly proportional to the concentration of absorbing compounds in that sample, so a spectrophotometer can also be used to determine concentrations of compounds in solution. Similarly in case of *Klebsiella sp* and *P. aeruginosa* the bacterial count tends to be decreasing because of the optical density is decreased. The spectrophotometry showed that the bacterial concentrations are decreasing as the dilution is increasing.

	OD values of Ginger serial dilutions in spectrophotometer.					OD values of Turmeric serial dilutions in spectrophotometer.				
Dilution Factor	0.1mL	0.01mL	0.001mL	0.0001mL	0.00001mL	0.1mL	0.01mL	0.001mL	0.0001mL	0.00001mL
Simple	1.9	0.6	0.4	0.3	0.3	0.9	0.8	0.4	0.3	0.3
E. coli	2.5	2.4	2.3	2.2	2.1	1.7	1.2	0.7	0.3	0.2
Klebsiella sp.	1.6	1.7	1.5	1.4	1.3	0.9	0.8	0.7	0.5	0.9
P. aeruginosa	0.5	0.4	0.3	0.2	0.1	0.9	0.8	0.7	0.6	1.9

Table b: OD values of Ginger and Turmeric serial dilutions to determine the growth of bacteria in different concentrations.

	Turmeric			Ginger		
	Aqueous Extract	Ethanol Extract	Methanol Extract	Aqueous Extract	Ethanol Extract	Methanol Extract
Concentration (g/mL)	50/250	50/250	50/250	50/250	50/250	50/250
E.coli (Zone of inhibition)	11.3 ± 0.54	13.3 ± 0.27	13 ± 0	15.2 ± 0.27	14.4 ± 0.47	13.5 ± 0.27
P. aeruginosa (Zone of inhibition)	12.3 ± 0.72	13.3 ± 0.27	13 ± 0	12 ± 0.47	13.3 ± 0.94	13 ± 0.54

Table c: Antibacterial activity of spices extracts measured as diameter (mm) of zone of inhibition.

Table shows the diameter of zone of inhibition by the application of ethanol, methanol and aqueous extracts of ginger and turmeric that are more effective against all tested bacterial strains. *E. coli* and *P. aeruginosa* were also more susceptible to the ginger extracts. *P. aeruginosa* showed maximum susceptibility to the ginger methanolic extracts while *E. coli* showed maximum susceptibility to ginger aqueous extract. The Turmeric also shows more susceptibility to bacteria in ethanol extracts as compared to aqueous and methanol extracts. Gram positive bacteria showed more susceptibility towards Turmeric antibiotic. The turmeric showed more sus-

ceptibility to bacteria when they are combined with ethanol and methanol extract while ginger shows more susceptibility to bacteria in aqueous extract than ethanol and methanol extracts and shows greater zone of inhibition on Petri plates.

Discussion

Chemical variation leads to difference within the antimicrobial activity. While the other point is that because of the difference in concentration of this material i.e., α-curcumene with methanol extract may also leads to differences in the antimicrobial potency, this difference in concentration could be due to the nature of solvent used for extraction [17]. Also the results for Methanol extracts were more effective against the Gram-positive bacteria compared to the results for the Gram-negative ones. The higher resistance of the Gram-negative bacteria could be due to the complexity of the cell wall of this group of microorganisms. Indeed, the external membrane of Gram-negative bacteria renders highly hydrophilic surfaces whereas the negative charge of the surface of the Gram-positive wall may reduce their resistance to antibacterial compounds [18]. In ginger, the gingerol related components have been found to have antimicrobial activities [19]. There are several reports of the inhibitory effect of ginger in the form of extract against several bacteria [20]. Moderate to good antimicrobial properties of ginger were shown in previous studies [21]. The ginger extract had lower zone of inhibition which ranged from 6.67 ± 0.57 to no inhibition. *E. coli* and *Salmonella Typhi* were completely resistant to all the ginger extract samples tested. The antimicrobial activity of ginger may be due to the considerable amounts of phenolic compounds present in ginger [17]. Similarly, Gull showed that ethanolic and methanolic extracts of ginger had significant antimicrobial effect on Escherichia coli isolates but the ginger aqueous extract was only mildly effective [22]. Ginger methanol and ethanol extracts are more effective against all tested bacterial strains than ginger aqueous extracts. *E. coli* and *Shigella* were also more susceptible to the ginger extracts. *E. coli* showed maximum susceptibility to the ginger ethanol extracts while *Shigella* showed maximum susceptibility to both ginger methanol and ethanol extract. The results of antimicrobial effect of ginger in the study are in accordance with most of the reports published regarding ginger antimicrobial activity [23]. The inhibitory effects of *Zingiber officinale* extract on eight drug resistant pathogenic bacteria using the agar diffusion method. The type of understudy bacteria (*Escherichia coli, Pseudomonas aeruginosa, Bacillus subtilis, Staphylococcus aureus, Klebsiella pneumoniae, Shigella sonnei, Staphylococcus epidermidis, and Salmonella typhi* in their study) and the methodology of their study were different from those in our investigation. They reported that all the tested bacterial strains in their study were susceptible to both ginger and garlic extracts, which confirms our results [22]. The result showed that the extractive value of ginger using water, ethylacetate, ethanol, acetone and chloroform were 16.62 ± 0.05%, 11.98 ± 0.02%, 13.88 ± 0.04%, 10.14 ± 0.05% and 10.18 ± 0.01% respectively while the extractive value of turmeric using water, ethylacetate, ethanol, acetone and chloroform were 3.30 ± 0.02%, 13.34 ± 0.08%, 15.24 ± 0.10%, 12.50 ± 0.07% and 7.48 ± 0.03% respectively [23]. The results from Arawande also support the concept that aqueous extract of ginger has antimicrobial activity against gram negative bacteria. The ethanol extracts of ginger and its family also has anti-inflammatory effect against gram negative bacteria and is susceptible to *E. coli and Klebsiella sp.* The antimicrobial potency of plants is believed to be due to tannins, saponins, phenolic compounds, essential oils and flavonoids. The ethanolic extracts of ginger are most effective and susceptible to *Pseudomonas aeruginosa* as it forms greater zone of inhibition as compared to ethanolic and methanolic extracts. While the ethanolic extract of turmeric is more susceptible to *E. coli.* The antimicrobial effects of ethanolic extract of *Zingiber zerumbet* and its chloroform and petroleum ether soluble fractions against 13 pathogenic bacteria and three fungi using the disc diffusion method. Of the tested solvents of the extract, the ethanol extract had the highest activity against bacteria and fungi [24]. Factors responsible for the high bacterial susceptibility of understudy bacteria to ginger extract have yet to be clearly understood; however, the antibacterial activity of this plant is mainly attributed to its secondary metabolites [25]. The presence of Gingerol 6 is the bioactive compound in ginger that is effective against *Enterobacteriaceae*. These compounds are always active in their role of performing antimicrobial activity against pathogens. Previous studies on the rhizomes of *Zingiber officinale* have revealed that gingerols and shogaols are among the active components of ginger. The characteristic odor and flavor of ginger are caused by a mixture of zingerone, shogaols, and gingerols that are volatile oils which compose 1–3% of the weight of fresh ginger. In animal models, gingerols increased peristalsis and showed analgesic, tranquilizing, antipyretic, and antibacterial properties [26]. The dilutions of turmeric and ginger when applied on bacterial cultures of *E. coli, P. aeruginosa* and *Klebsiella sp*. the *P. aeruginosa* shows more susceptibility to *Curcuma longa* as compared to *E. coli* and *Klebsiella sp*. The findings also support the use of *C. azedoria* tubers in traditional medicine for the treatment of

bacterial and fungal infections. While observations they evaluated of the antibacterial activity of *C. longa* rhizome extracts showed that only the clinical isolate of *S. aureus* showed more sensitivity towards essential oil fraction than the standard strain. This was similar to sensitivity pattern of clinical and standard isolates in our study [27]. Turmeric extract was effective against *Escherichia coli, Bacillus subtilis* and *Staphylococcus aureus* which may be due to the presence of curcuminoid, a phenolic compound [28]. Negi reported that turmerone and curlone components of turmeric possessed better antibacterial activity against a wide range of microbes including *Bacillus cereus, Bacillus coagulans, Bacillus subtilis, Staphylococcus aureus. Escherichia coli and Pseudomonas aeruginosa* [29]. Also the results for both extracts were more effective against the Gram-positive bacteria compared to the results for the Gram-negative ones. The higher resistance of the Gram-negative bacteria could be due to the complexity of the cell wall of this group of microorganisms. Indeed, the external membrane of Gram-negative bacteria renders highly hydrophilic surfaces whereas the negative charge of the surface of the Gram-positive wall may reduce their resistance to antibacterial [31]. The results show that the extraction of ginger by using either methanol or n-hexane has an antimicrobial activity against both bacteria and fungi. This may be caused as a result of the presence of gingerol and shogaol as active ingredient within ginger. Since many studies indicated that the antimicrobial potency of ginger mainly caused by the presence of oxygenated mono- and sesquiterpenes, phenolic compounds (shogaol, gingerol) compounds [18]. which are lipid-soluble phenol compounds primarily isolated from the root of ginger [31]. Bajpai and his colleague also support our explanation that as a result of the presence of mono- and sesquiterpenoids within plant extract, which consider main cause for their antimicrobial mode of action. Since these compounds have different ways of effect since these compounds not only attack cell walls and cell membranes i.e., affecting their permeability and release of intracellular constituents (e.g. ribose, Na glutamate) but they also interfere with membrane functions (electron transport, nutrient uptake, protein, nucleic acid synthesis and enzyme activity). Thus, these compounds might have several invasive targets which could lead to the inhibition of bacterial pathogens [32-35].

Conclusion

Due to changing lifestyle, the trend of using natural products for treating diseases is increasing. People all around the world are giving preference to natural products over the synthetic, due to their fewer side effects. People have become more health and nutrition conscious and use the natural drugs for pharmaceutical purposes. Within the limitations of this study it may be concluded that *Zingiber officinale* and *Curcuma longa* which are used as edible roots in Pakistan agricultural industry can be used as antibiotic against *E.coli*, *Pseudomonas aeruginosa, Klebsiella sp.* and many other gram positive as well as gram negative bacteria for Herbal medication purposes. It is therefore recommended that instead of using high doses of medicines that have many side effects and harmful for body as well, that causes resistance in bacteria and it becomes stronger than previous time. So it is concluded that Herbal medication treatments should be included in our lifestyle as it

Bibliography

1. Igbinosa OO., *et al*. "Antimicrobial activity and phytochemical screening of stem bark extracts from Jatropha curcas (Linn)". *African Journal of Pharmacy and Pharmacology* 3.2 (2009): 058-062.

2. Vuorelaa P., *et al*. "Natural products in the process of finding new drug candidates". *Current Medicinal Chemistry*11 (2004): 1375-1389.

3. Adeshina GO., *et al*. "Antibacterial activity of fresh juices of Allium cepaand Zingiber officinale against multidrug resistant bacteria". *International Journal of Pharma and Bio Sciences* 2 (2011): 289-295.

4. Hamburger M and Hostettman K. "Bioactive an plants: The link between phytochemistry and medicine". *Phytochemistry* 30 (1991): 3864-3874.

5. Suffredini IB., *et al*. "Screening of antibacterial extracts from plants native to the Brazilian Amazon Rain Forest and Atlantic Forest". *Brazilian Journal of Medical and Biological Research* 37 (2009): 379-384.

6. Ríos JL and Recio MC. "Medicinal plants and antimicrobial activity". *Journal of Ethnopharmacology* 100 (2005): 80-84.

7. Amita S., *et al*. "Class1 integron and SXT Element in EI-Tor-strains. Calcuta, India". *Emerging Infectious Diseases* 9.4 (2011): 500-507.

8. Sebiomo A., *et al*. "Comparative studies of antibacterial effect of some antibiotics and ginger (Zingiber officinale) on two pathogenic bacteria". *Journal of Microbiology and Antimicrobial Agents* 3 (2011): 18-22.

9. Nirmala K., *et al*. "Dose-dependent effect in the inhibition of oxidative stress and anticlastogenic potential of ginger in STZ induced diabetic rats". *Food Chemistry* 135 (2012): 2954-2959.

10. McGee Harold. "A survey of tropical spices". McGee on Food and Cooking. Hodder and Stoughton (2004): 426.

11. Park M., *et al*. "Antibacterial activity of [10]-gingerol and [12]-gingerol isolated from ginger rhizome against periodontal bacteria". 22.11 (2008): 1446-1449.

12. Singh P., *et al*. *Mycobiology* 28.4 (2000): 185-189.

13. Sofowora EA. "Medicinal Plants and Traditional Medicine in Africa". John Wiley and Sons Ltd., Hoboken (1982): 64-79.

14. Porkhel S., *et al*. "Comparison of antimicrobial activity of crude ethanolic extracts and essential oils of spices against five strains of diarrhea causing Escherichia coli". *International Journal of Pharmacy and Life Sciences* 3.4 (2012): 1624-1627.

15. Kunz and Brook. "Emerging resistant Gram-negative aerobic bacilli in hospital-acquired infections". *Chemotherapy* 56.6 (2010): 492-500.

16. Aggarwal BB., *et al*. "Curcumin: an orally bioavailable blocker of TNF and other pro-inflam-matory biomarkers". *British Journal of Pharmacology* 169.8 (2013): 1672-1692.

17. SINGH G., *et al*. "Chemistry, antioxidant and antimicrobial investigations on essential oil and oleoresins of Zingiber officinale". In Food and Chemical Toxicology 46 (2008): 3295-3302.

18. Michielin EM., *et al*. "Chemical composition and antibacterial activity of Cordia verbenacea extracts obtained by different methods". *Bioresource Tech* 100 (2009): 6615-6623.

19. RAHIMAN A., *et al*. "Antibacterial activity of natural spices on multiple drug resistant Eschericha coli isolated from drinking water, Bangladesh". In Annals of Clinical Microbiology 10 (2011): 1-4.

20. NANA SOMABAT S and LOHASUPTHAWEE P. "Antibacterial activity of crude ethanolic extracts and essential oils of spices against salmonellae and other enterobacteria". In KMITL Science and Technology Journal 5 (2010): 527-538.

21. IBRAHIM SA., *et al*. "Antimicrobial activity of Bifidobacterium Longum (CNCFB2259) as influenced by spices". In Internet Journal of Food Safety 2 (2003): 6-8.

22. Gull I., *et al*. "Inhibitory effect of Allium sativum and Zingiber officinale extracts on clinically important drug resistant pathogenic bacteria". *Annals of Clinical Microbiology and Antimicrobials* 11 (2012): 8.

23. Arawande., *et al*. "Extractive Value and Phytochemical Screening of Ginger (zingiber officinale) and Turmeric (curcuma longa) Using Different Solvents". 8 (2018): 13-22.

24. Kader G., *et al*. "Antimicrobial activities of the rhizome extract of Zingiber zerumbet Linn". *Asian Pacific Journal of Tropical Biomedicine* 1.5 (2011): 409-412.

25. Nweze E I., *et al*. "Antimicrobial activities of methanolic extracts of Trema guineensis (Schumm and Thorn) and Morinda lucida Benth used in Nigerian". *Journal of Biological Research and Biotechnology* 2.1 (2004): 39-46.

26. O'Hara M., *et al*. "A review of 12 commonly used medicinal herbs". *Archives of Family Medicine* 7.6 (1998): 523-536.

27. Singh R., *et al*. "Antibacterial activity of Curcuma longa rhizome extract on pathogenic bacteria research communications". *Current Science* 83.6 (2002): 738.

28. Kim KJ., *et al*. "Antibacterial activity of Curcuma longa L. against methicillin-resistant Staphylococcus aureus". *Phytotherapy Research* 19 (2005): 599-604.

29. Negi PS., *et al*. "Antibacterial activity of turmeric oil: a by product from curcumin". *Journal of Agricultural and Food Chemistry* 47 (1999): 4297-4300.

30. Singh G., *et al*. "Chemistry, antioxidant and antimicrobial investigations on essential oil and oleoresins of Zingiber officinale". *Food and Chemical Toxicology* 46 (2008): 3295-3302.

31. Wang W., *et al*. "Simultaneous determination of 6-gingerol , 8-gingerol, 10-gingerol, 6-shaogol in rat plasma by liquid chromatography-mass spectrometry: Application to pharmacokinetics". *Journal of Chromatography B: Analytical Technologies in the Biomedical and Life Science B* 877 (2009): 671-679.

32. Bajpai VK., *et al*. "Chemical composition, antibacterial and antioxidant activities of leaf essential oil and extracts of Metasequioa glyptostroboides Miki ex Hu". *Food Chemistry and Toxicology* 47 (2009): 1876-1883.

33. "Application to pharmacokinetics". *Journal of Chromatography B: Analytical Technologies in the Biomedical and Life Science B* 877: 671-679.

34. Borges M Saavedra and M Simoes. "Insights on antimicrobial resistance, biofilms and the use of phytochemicals as new antimicrobial agents" (2015).

35. Parveen Gul and Jehan Bakht. "Antimicrobial activity of turmeric extract and its potential use in food industry". *Journal of Food Science and Technology* 52.4 (2015): 2272–2279.