RESEARCH ARTICLE

Study of Antimicrobial Activity of *ZiziphusJujuba* Leaf, Fruit and Seed Extracts

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ABSTRACT: Nearly 60% of the world's population and pharmaceuticals depends on natural plants as a source for treating human ailments. In this context, *Ziziphus jujube* has been called a multipurpose tree from time immemorial as it has immense medicinal and Phytopharmacological properties. The present study was involved in establishing the antimicrobial effect of the leaves, seeds, and fruits of *Ziziphusjujuba.* Hence, the crude extracts of different parts of the above-mentioned multipurpose tree had been tested to determine their antimicrobial nature against two gram-positive and five gram-negative bacterial species in which all the extracts showed more potent antibacterial activity against gram-negative bacterial species than gram-positive bacteria. The crude extracts obtained from the leaf, seeds and fruits of *Ziziphus jujube* were also tested to determine its antifungal activity against *Candida albicans*, *Aspergillusniger,* and *Trichopytontonsurans*. The results stated that all three crude extracts were effective against *Candida albicans* and *Aspergillusniger* when compared with *Trichopytontonsurans*.

KEYWORDS: *Ziziphusjujuba,* Antibacterial activity, Antifungal activity, Minimum inhibitory concentration.

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INTRODUCTION

Plants plays vital role in treating many life-threatening disordersin the human community. Though technology has developed the usage of traditional medicines became common among people right from ancient times. To be a pool proof of the above statement a researcher stated that worldwide nearly 60% of humans depend on herbal extracts for their major health issues [1]. The pharmacological properties of plants mainly depend on the biologically active substances scattered in their various parts. As an aim to analyze it elaborately an effort has been taken to prove the antimicrobial activity of *Ziziphusjujuba.*

Ziziphusjujuba commonly called Chinese dates or Red dates belongs to the family called Rhamnaceae which had been called a multipurpose tree in the past in which each and every part of the plant had been established with abundant medicinal properties [2]. The plant was mainly distributed in tropical and subtropical places in Asia [3,4]. The fruits and seeds of *Ziziphus* species had various medical applications and it is also involved in treating diverse disorders like insomnia and anxiety [5]. The fruit extract of *Ziziphus jujube* was involved in the treatment of throat infectionsand the extracts prepared from its leaves had been used to treat several complications in humans like headache, dysentery, and abdominal pain caused during pregnancy [6].

The fruits of the multipurpose plant also help to treat burning sensations, tuberculosis, blood and bone disorders from the recent past [7-9]. Due to the presence of many therapeutically bioactive substances, it was considered the most valuable plant species among the Pharmaceutical industries and researchers to elaborate its extensive antibacterial and antifungal properties against infectious agents.

METHODOLOGY

Sample preparation

The healthy plant parts like leaves, seeds and fruits of *Ziziphusjujuba* were collected and washed thoroughly in tap water and distilled

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water after that shade dried at room temperature for 21 days. The dried parts (Leaves, seeds and fruits) were powdered in a blender and extracts were prepared from different solvents like chloroform, methanol, ethanol, petroleum ether, acetone and water with the soxhlet apparatus for 18 hrs. The prepared crude extracts were used for further process.

Antibacterial Activity for the leaf, fruit and seed extract

The diameter of the zone of inhibition by different microorganisms such as *Escherichia coli, Vibriocholera, Staphylococcus aureus, Salmonella typhi, Staphylococcus epidermidis, Klebsiellapneumoniae, Pseudomonas aeruginosa, Aspergillusniger, Trichophytontonsurans, Candida albicans* against the antibiotics Gentamycin Streptomycin, Erythromycin, Tetracycline, Kanamycin, Nalidixic Acid, Ciprofloxacin, Neomycin and Rifampicin and their zone of inhibition will be observed in diameter (mm).The screening of antibacterial activity for the leaf, fruit and seed extracts was performed using Muller Hinton Agar against the above used microorganisms and their zone of diameter (mm) was measured. Statistical Analysis of Mean and Standard Deviation are performed in all experimental results in triplicate values.

RESULTS

Minimum inhibitory (5 to 40µg per ml) concentration for different microorganisms of *Ziziphusjujuba* leaf extract was determined against ten different pathogenic organisms, in which the leaf extract showed higher inhibitory concentration against *Candida albicans* followed by *Pseudomonas aeruginosa, Aspergillusniger* and *Trichophytontonsurans.* The same leaf extract showed moderate inhibitory concentration against *Vibrocholera* followed by *Escherichia coli, Salmonella typhi, Staphylococcus aureus* and *Klebsiellapneumonia.* It showed a very lower inhibitory concentration against a species called *Staphylococcus epidermidis* (Figure 1).

Minimum inhibitory concentration for different microorganisms of *Ziziphusjujuba* fruit extract was determined against ten different pathogenic organisms, in which the fruit extract showed higher inhibitory concentration against *Candida albicans* followed by *Aspergillusniger*, *Pseudomonas aeruginosa,* and *Trichophytontonsurans.* The same leaf extract showed moderate inhibitory concentration against *Vibryocholerea* followed with *Escherichia coli, Salmonella typhi* and *Staphylococcus aureus.* It showed very a lower inhibitory concentration against two species called *Staphylococcus epidermidis* and *Klebsiella pneumonia*(Figure.2).

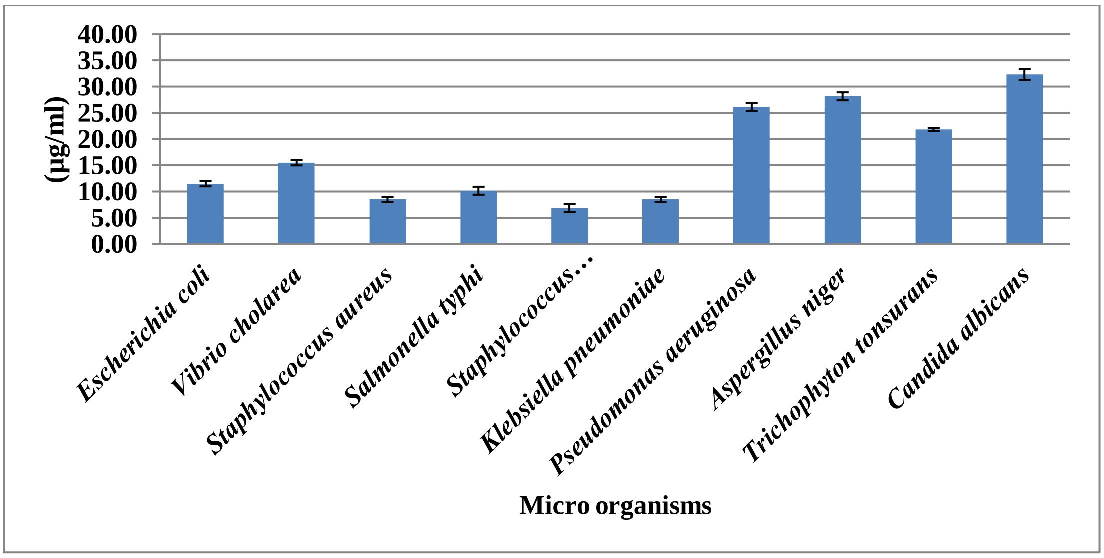

Figure 1: Minimum inhibition concentration for different micro organisms of *Ziziphus jujuba* leaf extract

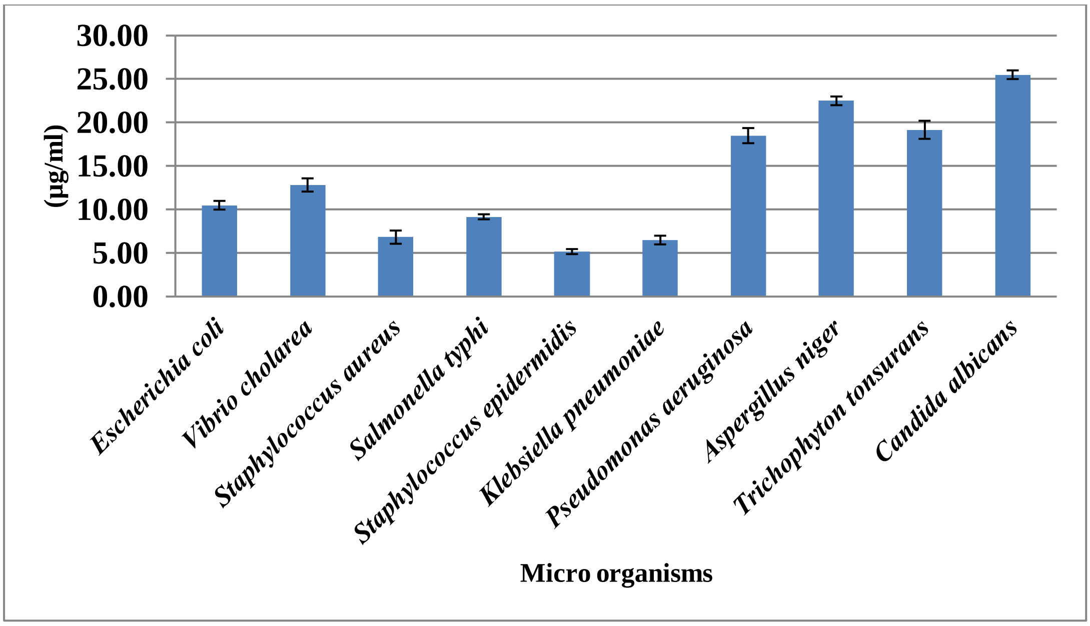

Figure 2: Minimum inhibition concentration for different micro organisms of *Ziziphus jujuba* fruit extract

Minimum inhibitory concentration for different microorganisms of *Ziziphusjujuba* seed extract was determined against ten different pathogenic organisms, in which the seed extract showed higher inhibitory concentration against *Candida albicans* followed by *Aspergillusniger*, *Pseudomonas aeruginosa,* and *Trichophytontonsurans.* The same leaf extract showed moderate inhibitory concentration against *Vibro cholera* followed by *Escherichia coli, Salmonella typhi* and *Staphylococcus aureus.* The seed extract also showed a very lower inhibitory concentration against two species called *Staphylococcus epidermidis* and *Klebsiellapneumonia* (Figure 3).

The diameter of the zone of inhibition of different microorganisms with different antibiotics was determined and tabulated in Table 1. The species *Escherichia coli* showed a higher zone of inhibition against the antibiotic Neomycin followed by Nalidixic acid, Gentamycin, Rifampicin, Teracyclin, Ciproflaxin, Erythromycin and Streptomycin with the diameter (mm) of about 18.00±0.50, 15.50±0.87, 13.67±0.76, 11.50±0.50, 11.17±0.76, 8.50±0.50, 8.17±0.29 and 7.00±0.50 respectively whereas it showed lower zone of inhibition against only Kanamycin with the diameter (mm) of about 5.83±0.29. The microbe *Vibrio cholara* showed a higher zone of inhibition against Ciproflaxin followed by Erythromycin, Gentamycin, Neomycin, Kanamycin, Teracyclin and Sterptomycin with a diameter (mm) of about 22.00±0.50, 19.33±0.29, 18.50±0.50, 18.50±0.50, 15.67±0.76, 15.17±1.26 and 13.67±0.76 respectively. The same species showed a lower zone of inhibition against two antibiotics like Rifampicin and Nalidixic acid with a range of about 10.33±0.76 and 8.50±0.87. The microorganism *Staphylococcus aureus* showed a higher zone of inhibition against Rifampicin followed by Neomycin, Ciproflaxin, Nalidixicacid, Sterptomycin and Gentamycin with the range of about 18.00±0.50, 13.83±0.29, 11.67±0.58, 11.33±0.29, 11.33±0.29 and 10.83±0.76 respectively. It also has a lower zone of inhibition against Kanamycin, Tetracyclin and Erythromycin with a diameter (mm) of about 9.33±0.29, 8.33±0.29 and 8.17±0.29. *Salmonella typhi* showed higher zone of inhibition against Gentamycin and Ciproflaxin with same diameter of inhibition followedby Erythromycin, Kanamycin and Neomycin with zone diameters of about 22.17±0.29, 19.17±0.29, 17.33±0.29 and 17.67±0.76 respectively whereas it showed lower zone of inhibition against Rifampicin with the range of about 10.50±0.50.Another organism named *Staphylococcus epidermidis* showed a higher zone of inhibition against Streptomycin followed by Rifampicin, Neomycin and Gentamycin by the diameter(mm) of zone of inhibition like 11.50±0.50, 10.83±0.29, 10.67±0.29 respectively. It a showed lower zone of inhibition against Tetracyclin and Nalidixic acid with diameters of about 8.00±0.87 and 7.67±0.29.

Klebsiella pneumonia showed higher zone of inhibition against three antibiotics like Gentamycin, Tetracyclin and Ciproflaxin with the same diameter (mm) of about 21.00±1.00 followed with Kanamycin, Erythrocyclin, Sterptomycin and Neomycin with the range of about 17.50±0.50, 16.33±0.29, 15.17±0.29 and 13.33±1.15 respectively. The same species showed lower zone of inhibition against Nalidixic acid with the range of about 8.17±0.29.*Pseudomonas aeruginosa* showed a higher zone of inhibition against Ciproflaxin followed with Gentamycin and Streptomycin with a the diameter(mm) of about 27.50±0.50, 26.00±0.50 and 24.00±0.50. It also showed a lower zone of inhibition against Kanamycin and Nalidixic acid with the same diameter (mm) of about 9.50±0.50 followed with Rifampicin with a range of about 8.83±0.29. Another species *Aspergillusniger* showed a higher zone of inhibition against Gentamycin followed with Erythromycin, Streptomycin, Tetracyclin and Kanamycin with the diameter (mm) of about 20.67±0.76, 17.67±0.58, 16.33±0.29 and 15.17±0.58. It also showed a lower zone of inhibition against Ciproflaxin and Rifampicin with the range of about 9.33±0.76 and 8.50±0.50.*Trichophytontonsurans* showed a higher zone of inhibition against Nalidixic acid followed with Kanamycin and Erythromycin with the range of about 7.67±0.29 and 7.17±0.29 whereas it showed a lower zone of inhibition against Rifampicin and Neomycin with the diameter (mm) of about 3.83±0.29 and 4.83±0.76. *Candida albicans* showed higher zone of inhibition against two antibiotics like Tetracyclin and Neomycin with the same diameter(mm) of about 12.00±1.00 and a lower zone of inhibition against Kanamycin with the range of about 8.33±0.58.

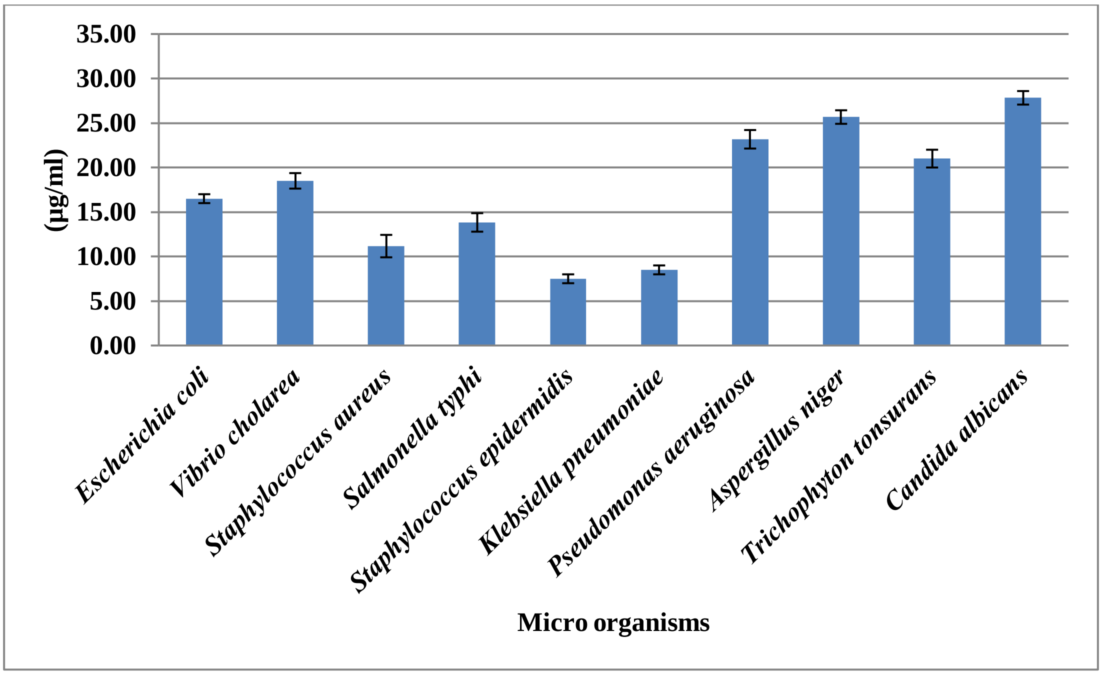

Figure 3: Minimum inhibition concentration for different micro organisms of *Ziziphus jujuba* seed extract

The minimal inhibitory concentration of leaf, fruit and seed extracts for different microorganisms were determined and tabulated in Table 2. *Escherichia coli* and *Vibrio cholera* showed higher inhibitory concentration with seed extract followed by leaf and fruit extracts with the p and f value of about < 0.0001, 0.000 and 124.000, 45.703 respectively. The other two microorganisms like *Staphylococcus aureus* and *Salmonella typhi*also showed higher inhibition concentration with seed extract followed by leaf extracts and seed extracts with the p of 0.003, 0.001 and f values of about 17.858 and 31.071. *Staphylococcus epidermidis* also showed higher inhibition concentration with seed extract followed with leaf and fruit extract with the p value of 0.005 and q value of about 14.204 respectively.

Table 1: Diameter of zone of inhibition (mm) by different micro organisms with different antibiotics

Microbial species	Gentamycin	Streptomycin	Erythromycin	Tetracyclin	Kanamycin	Nalidixic acid	Ciproflaxacin	Neomycin	Rifampicin
Escherichia coli	13.67±0.76	7.00±0.50	8.17±0.29	11.17±0.76	5.83±0.29	15.50±0.87	8.50±0.50	18.00±0.50	11.50±0.50
Vibrio cholarea	18.50±0.50	13.67±0.76	19.33±0.29	15.17±1.26	15.67±0.76	8.50±0.87	22.00±0.50	18.50±0.50	10.33±0.76
Staphylococcus aureus	10.83±0.76	11.33±0.29	8.17±0.29	8.33±0.29	9.33±0.29	11.33±0.29	11.67±0.58	13.83±0.29	18.00±0.50
Salmonella typhi	22.17±0.29	15.50±0.50	19.17±0.29	13.33±1.53	17.33±0.29	13.83±0.76	22.17±0.29	17.67±0.76	10.50±0.50
Staphylococcus epidermidis	10.67±0.29	11.50±0.50	8.00±0.87	7.67±0.29	10.17±0.76	8.00±0.87	9.33±0.58	10.67±0.29	10.83±0.29
Klebsiellapneumoniae	21.00±1.00	15.17±0.29	16.33±0.29	21.00±1.00	17.50±0.50	8.17±0.29	21.00±1.00	13.33±1.15	12.17±0.76
Pseudomonas aeruginosa	26.00±0.50	24.00±0.50	10.83±0.29	17.83±0.76	9.50±0.50	9.50±0.50	27.50±0.50	10.67±0.29	8.83±0.29
Aspergillusniger	20.67±0.76	16.33±0.29	17.67±0.58	15.17±0.58	15.67±0.58	13.50±0.50	8.50±0.50	11.83±0.76	9.33±0.76
Trichophytontonsurans	6.00±0.50	5.00±0.50	7.17±0.29	5.50±0.50	7.17±0.29	7.67±0.29	6.50±0.50	4.83±0.76	3.83±0.29
Candida albicans	9.83±0.76	11.17±0.29	11.67±0.29	12.00±1.00	8.33±0.58	9.50±0.50	10.50±0.50	12.00±1.00	9.00±0.50

Table 2: Minimum inhibition concentration of leaf, fruit and seed extracts for different micro organisms along with statistical analysis

Micro organisms	Leaf	Mean	SE	Fruit	Mean	SE	Seed	Mean	SE	*P*	*F*
Escherichia coli	11.500	0.500	0.289	10.500	0.500	0.289	16.500	0.500	0.289	< 0.0001	124.000
Vibrio cholera	15.500	0.500	0.289	12.830	0.760	0.439	18.500	0.870	0.502	0.000	45.703
Staphylococcus aureus	8.500	0.500	0.289	6.830	0.760	0.439	11.170	1.260	0.728	0.003	17.858
Salmonella typhi	10.170	0.760	0.439	9.170	0.290	0.167	13.830	1.040	0.600	0.001	31.071
Staphylococcus epidermidis	6.830	0.760	0.439	5.170	0.290	0.167	7.500	0.500	0.289	0.005	14.204
Klebsiellapneumoniae	8.500	0.500	0.289	6.500	0.500	0.289	8.500	0.500	0.289	0.004	16.000
Pseudomonas aeruginosa	26.170	0.760	0.439	18.500	0.870	0.502	23.170	1.040	0.600	0.000	55.650
Aspergillusniger	28.170	0.760	0.439	22.500		0.289	25.670	0.760	0.439	0.000	51.716
Trichophytontonsurans	21.830	0.290	0.167	19.170	1.040	0.600	21.000	1.000	0.577	0.022	7.697
Candida albicans	32.330	1.040	0.600	25.500	0.500	0.289	27.830	0.760	0.439	0.000	56.826

Table 3: Comparative statistical analysis of *Ziziphusjujuba* leaf, fruit and seed extracts minimum inhibition concentration for different micro organisms

Comparison	Difference	q	P value
Escherichia coli			
Leaves vs Fruits	1.000	3.464	ns P>0.05
Leaves vs Seeds	-5.000	17.321	*** P<0.001
Fruits vs Seeds	-6.000	20.785	*** P<0.001
Vibrio cholera			
Leaves vs Fruits	2.670	6.363	** P<0.01
Leaves vs Seeds	-3.000	7.150	** P<0.01
Fruits vs Seeds	-5.670	13.513	*** P<0.001
Staphylococcus aureus			
Leaves vs Fruits	1.670	3.224	ns P>0.05
Leaves vs Seeds	-2.670	5.154	* P<0.05
Fruits vs Seeds	-4.340	8.378	** P<0.01
Salmonella typhi			
Leaves vs Fruits	1.000	2.272	ns P>0.05
Leaves vs Seeds	-3.660	8.316	** P<0.01
Fruits vs Seeds	-4.660	10.588	*** P<0.001
Staphylococcus epidermidis			
Leaves vs Fruits	1.660	5.216	* P<0.05
Leaves vs Seeds	-0.6700	2.105	ns P>0.05
Fruits vs Seeds	-2.330	7.321	** P<0.01
Klebsiellapneumoniae			
Leaves vs Fruits	2.000	6.928	** P<0.01
Leaves vs Seeds	0.000	0.000	ns P>0.05
Fruits vs Seeds	-2.000	6.928	** P<0.01
Pseudomonas aeruginosa			
Leaves vs Fruits	7.670	14.803	*** P<0.001
Leaves vs Seeds	3.000	5.790	* P<0.05
Fruits vs Seeds	-4.670	9.013	** P<0.01
Aspergillusniger			
Leaves vs Fruits	5.670	14.349	*** P<0.001
Leaves vs Seeds	2.500	6.327	* P<0.05
Fruits vs Seeds	-3.170	8.023	** P<0.01
Trichophytontonsurans			
Leaves vs Fruits	2.660	5.423	* P<0.05
Leaves vs Seeds	0.8300	1.692	ns P>0.05
Fruits vs Seeds	-1.830	3.731	ns P>0.05
Leaves vs Fruits	6.830	14.829	*** P<0.001
Leaves vs Seeds	4.500	9.770	** P<0.01
Fruits vs Seeds	-2.330	5.059	* P<0.05

*Klebsiellapneumonia*e showed same inhibition concentration with leaf and seed extract with p and f value of about 0.500 and 0.289. *Pseudomonas aeruginosa* and *Aspergillusniger* showed higher inhibition concentration against leaf extract when compared with other two extracts with same p value of about 0.000 but different f value of about55.650 and 51.716. The microbial species *Trichophytontonsurans* also showed higher inhibition against leaf extract followed with seed and fruit extract with the values of about 0.022 and 7.697 respectively.

Candida albicans showed higher inhibitory concentration with leaf extract when compared with other two extracts with different p and f value of about 0.000 and 56.826.

Comparative statistical analysis of *Ziziphusjujuba* leaf, fruit and seed extracts minimum inhibition concentration for different microorganisms were tabulated in Table 3. *Escherichia coli* has less activity with Leaves vs Fruits with p and f values of about 3.464 and >0.05 whereas it was highly significant with Leaves vs Seeds and Fruits vs Seeds with the same p-value of about <0.001 but different f value of about 17.321 and 20.785 respectively. *Vibrio cholera* was less significant with Leaves vs Fruits and Leaves vs Seeds with the same p-value and different q value of about 7.150 and 6.363 respectively whereas it was highly significant with Fruits vs Seeds a the p-value of about <0.001 and q-value of about 13.513. *Staphylococcus aureus* was non-significant with Leaves vs Fruits whereas less significant with Leaves vs Seeds and Fruits vs Seeds with different p and q value of about >0.05, <0.05, <0.01 and 3.224, 5.154, 8.378. *Salmonella typhi* was alone significant with Leaves vs Fruits with the q value of about 2.272 and p value of about >0.05. The same was less significant with Leaves vs Seeds and highly significant with Fruits vs Seeds. *Staphylococcus epidermidis*non significant with Leavesvs Seeds and less significant with Fruits vs Seeds and Leaves vs Fruits with different p-and q-values. *Klebsiella pneumonia*e was also non-significant with Leaves vs Seeds and less significant with Fruits vs Seeds and Leaves vs Fruits with different p values like <0.01, >0.05, <0.01 and q values of about 0.000, 6.928 and 6.928 respectively. *Pseudomonas aeruginosa* and*Aspergillus niger* was highly significant with Leaves vs Fruits whereas less significant with Leaves vs Seeds and Fruits vs Seeds with the same p value of about <0.001, <0.05, <0.01 but different q values of about 14.803, 5.790, 9.013, 14.349,6.327 and 8.023 respectively. The other microbial species *Trichophytontonsurans* was non-significant with Leaves vs Seeds and Fruits vs Seeds with the same p-values of about >0.05 but q values of about 1.692 and 3.731 and it was less significant with Leaves vs Fruits with p and q value of about <0.05 and 5.423.

DISCUSSION

An antibiotic plays a major role in reducing the severity of infections caused by bacteria and fungus by destroying the activity of it in the living system. In such a way, an antibiotic sensitivity test was done in the present research against seven bacterial species and three fungal species to determine the sensitive nature of antibiotics like Gentamycin, Steptomycin, Erythromycin, Tetracyclin, Kanamycin, Nalidixic acid, Ciproflaxin, Neomycin and Rifampicin respectively. A recent study states that, the bacterial species named *Staphylococcus epidermidis* was highly sensitive to rifampicin followed with ciproflaxin, erythromycin and gentamycin [10,11]. Thus in the present study it was proved that the same bacterial species was highly sensitive streptomycin followed with rifampicin, gentamycin and ciproflaxin. It was clearly stated that the species named *Pseudomonas aeruginosa* was highly sensitive to an antibiotic called ciproflaxin [9]. Thus the above research work also proved that *Pseudomonas aeruginosa* was highly sensitive to ciproflaxin when compared to all other antibiotics.

The present research clearly states that *Escherichia coli* was highly sensitive to Neomycin followed with nalidixic acid, gentamycin and tetracyclin whereas less effect against ciproflaxin. Thus the same was reported by Kaufman that *E. coli* was highly sensitive to levofloxacin whereas it showed only minimal sensitivity against ciproflaxin. Thus the above work leads a way to know about the sensitive nature of different bacterial and fungal species against different antibiotics and this will become easier to find out the antibiotics easily against different infections in future in sustained manner.

The present study was also aimed at performing the antibacterial and antifungal activity was done to determine the antibacterial and antifungal nature of *Ziziphusjujuba* leaf, fruit and seed extracts against different bacterial and fungal species. *Ziziphusjujuba*a tree which contains different medicinal properties in each and every part was tested to find out the antibacterial and antifungal activity. A recent research states that the crude extract of roots of *Ziziphus* species and fresh leaf juice had the capability of treating jaundice and also involved in the prevention of liver inflammation [12]. It was also reported by another researcher that crude extract of *Rhamnus*fruit was used as an excellent source of antiseptic in curing deep wounds [13]. Hence from the above research work, it was clear that the infusions of different parts like leaves, fruits and seeds of *Ziziphus jujube* were found to be active against some of the bacterial and fungal species.

A finding states that the Hexane and aqueous extracts of leaves of *Ziziphus* have potent antimicrobial activity against *B. pumalis, S. typhi, S.epidermidis* and *P. aeruginosa* [7]. Hence the above research work also states that *Ziziphus jujube* leaf extract showed higher inhibition against *Pseudomonas aeruginosa*and *Klebsiellapneumonia*e. It was also stated by a researcher that the seed extracts of *Ziziphus jujube* were found to inhibit the growth of *Staphylococcus aureus, Escherichia coli, Pseudomonas aeruginosa, Klebsiella pneumonia* [14]. Thus, in accordance with the above finding it was also clear that the seed extract of *Ziziphus jujube* were very sensitive against *Pseudomonas aeruginosa, Escherichia coli* and *Salmonella typhi*. Some of the research findings proved that the crude extracts of seeds and fruits of *Ziziphus* species were possessed to have antifungal, anti-allergic, antibacterial, anti-inflammatory properties [2]. Hence, the present work also clearly states that leaf, seed and fruit extracts of *Ziziphusjujuba*were found to have different antibacterial and antifungal activities against different fungal and bacterial species.

An elaborate research finding of Elmahi, proved that the Ethanolic extract prepared from the root bark and fruits of *Ziziphus* had found to show potent antibacterial activity against twenty different bacterial species [15]. The leaf extract of *Ziziphus jujube* was found to possess abundant anti allergic activity and also involved in preventing the WBC infections that predominantly occurs in humans [8]. A recent research states that the silver nanoparticles retrieved from the crude leaf extract of *Ziziphusmauritiana* showed higher antibacterial activity against the bacterial species Staphylococcus aureus [15]. Thus, the present work also clearly states that different parts like leaves, fruits and seeds of *Ziziphusjujuba*were found to have antibacterial activity against gram positive and gram negative bacteria.

Antifungal activity was performed to determine the antifungal nature of different parts of *Ziziphus jujube* against three fungal species like *Candida albicans*, *Aspergillusniger* and *Trychophytontonsurans*. Many research had detailly discussed about antifungal nature of *Ziziphus*species with various fungal pathogens. A recent finding reported that the ethanol extract of roots and leaves of *Ziziphus* was found to establish antifungal activity against the fungal pathogens like *Aspergillusniger, Candida albicans, Aspergillusflavus* and *Candida tropicalis* [16]. Mirza stated that the crude extracts of leaves, fruits and roots of *Ziziphus jujube* were found to establish potent antibacterial and anticancer property [17]. Hence,the present finding also results the same in that the leaf, fruit and seed extracts of *Ziziphus jujube* were found to show potent antibacterial activity against *Candida albicans* and *Aspergillusniger* when compared with *Trychophytontonsurans*.

CONCLUSION

Thus the present study mainly focused on establishing the antibacterial and antifungal activity of different parts like fruits, leaves and seeds of *Ziziphus jujube* against bacterial and fungal pathogens. The research work also clearly establishes the antimicrobial properties against gram-positive and gram-negative bacterial pathogens and fungal pathogens. Hence the above findings work will provide informationfor future research on these plants that possessed the bioactive compounds which will be used for pharmaceutical applications.

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