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PHYTOCHEMICAL CHARACTERIZATION AND EVALUATION OF THE ANTIMICROBIAL ACTIVITY OF MEDICINAL PLANTS EXTRACT AGAINST ISOLATED *MDR SALMONELLA TYPHIMURIUM*

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Abstract

It is still necessary to assess the antibacterial potential of medicinal plants in order to produce broad-spectrum antimicrobial compounds. Traditional medicine is one of the most widely available types of treatment in impoverished areas. The current study's goal was Phytochemical Characterization and to assess the antibacterial activity of *Allium sativum bulbs, Bridelia micrantha bark, Citrus Lemon peels, Glycyrrhiza glabra roots, Punica granatum peels* extract against MDR *salmonella typhimurium.* Extract is prepared by using methanol and characterizations were done by Biochemical, UV-Visible, and FTIR studies. The antibacterial studies were carried out by disk diffusion method. The phytochemical analysis of the extracts of *Allium sativum bulbs, Bridelia micrantha bark, Citrus Lemon peels, Glycyrrhiza glabra roots, Punica granatum peels* showed presence of amino acids, alkaloids, glycosides, saponins, flavonoids, steroids and terpenoids. It was discovered that these extracts worked well against *MDR salmonella typhimurium.* Mean diameter of zones of inhibition (mm) of *Allium sativum bulbs, Bridelia micrantha bark, Citrus Lemon peels, Glycyrrhiza glabra roots, Punica granatum peels* extracts were found as 10.12±1.71 mm, 23.50 ±0.00 mm, 26.60±0.64 mm, 29.20±0.11 mm , and 19.50 ± 0.00 mm respectively which were considerable to different standard antibiotics used as positive control. When compared

to the standards, the methanolic extract of the plants was found to have promising antimicrobial activity, providing early evidence that the plant may be used to treat MDR infections.

Keywords: *Salmonella Typhimurium*, Multidrug resistance, *Allium sativum bulbs, Bridelia micrantha bark, Citrus Lemon peels, Glycyrrhiza glabra roots, Punica granatum peels*, Zones of inhibition.

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1.Introduction

The most common food-borne infections that are isolated are those caused by salmonella. As a result of this significant public health problem, there are 93.8 million cases of foodborne illness each year, as well as 155,000 fatalities. The majority of human Salmonella infections are caused by the subspecies Salmonella Enterica, which is home to more than half of the more than 2500 Salmonella serotypes that have been documented to date [1]. As fluoroquinolones, ampicillin, and chloramphenicol are antimicrobials and have been shown to be the most effective treatments, they are some of the drugs used to treat enteric fever [2]. Case fatality rates are predicted to be between 20% and 30% without antibiotics, but with the right course of treatment, they drop to between 2% and 4% [3].

One of the major public health problems has been the global expansion of Salmonella typhimurium, which is commonly resistant to five or more antimicrobial medicines [4,5]. As a result of the rise in antibiotic-resistant infections, new therapeutic chemicals for these bacteria have been created. The use of plant materials as an alternative method to manage pathogenic germs has recently garnered a lot of attention [6], and various compounds contained in plant products have been proved to be precisely targeted against pathogenic bacteria with a high level of resistance [7].

Plants have been utilized as folk medicines since the dawn of human civilization. Due to its higher compatibility with the human body and lower danger of adverse effects, herbal medicine remains the primary source of primary healthcare for 70-80% of the world's population, particularly in underdeveloped nations [8]. Many intricate chemical components found in plants support the body's natural healing processes. A variety of illnesses, including cancer and infectious disorders like malaria and tuberculosis, have been demonstrated to be

helped by plants. Nonetheless, the rise in multidrug-resistant infections and the well-known negative effects of some popular drugs have highlighted the need to look for medical alternatives.

As an anti-infective, garlic (Allium sativum) has been used traditionally in food preparation and medicine [9]. In all regions of the world, garlic is a common dietary spice that is used both as a spice and a herbal remedy for the treatment and prevention of a wide range of illnesses, from infections to heart conditions [10]. There are a number of pharmacologic and therapeutic uses for garlic. It is primarily used as a condiment in many types of cooked meals [11]. According to Ankri and Mirelman (1999) [3]; According to Reuter et al. (1996) [12], garlic is a powerful antibacterial agent that inhibits the growth of both Gram-positive and Gram-negative bacteria, including E. coli, Salmonella, Streptococcus, Staphylococcus, Klebsiella, Proteus, and Helicobacter pylori. Allicin, a volatile molecule with sulphur, is a bioactive component in garlic that possesses antibacterial activity [13,14]. Dialil disulphide and dialil trisulphide are two more bioactive chemicals that have antibacterial action [15].

The *Bridelia micrantha* stem bark's methanol extract was examined for antibacterial properties and the plant has a long history of use in ethnomedicine. The synergistic activities or the discrete actions of the phytochemicals found in the stem bark may be related to the antibacterial capabilities demonstrated by the *Bridelia micrantha* extract. The concentration of *Bridelia micrantha* extract affected its antibacterial action. *Bridelia micrantha* has ability to modulate drug resistance [16,17].

A significant member of the Rutaceae family of medicinal plants is citrus fruit. It is mostly employed for its alkaloids, which have anticancer properties and the potential to be antibacterial in crude extracts of several lemon components (leaves, stem, root, juice, peel, and flower). Due to the presence of alkaloids, citrus fruits exhibit a wide range of biological activity, including antibacterial, antifungal, antidiabetic, anticancer, and antiviral effects [18]. Different solvents, including ethanol, methanol, and acetone, are used to extract the lemon peel, and the extracts are then tested for antibacterial properties. Higher antibacterial activity is demonstrated by methanolic extract against the studied microorganisms. [19]. Citrus peels are full of nutrients and contain a variety of phytochemicals, including volatile oils, glycosides, and beta-sitosterol. Ascorbic acid, flavones, and other poly ethoxylated phenolic compounds have a number of significant functions that are quite uncommon in other plants. Citrus peels have also historically been used to treat scurvy, digestive problems, respiratory

issues, peptic ulcers, eye infections, gum infections, gout, piles, skin problems, and weight loss. Additionally, it serves as a disinfectant and sterilizing agent.

A well-known medicinal plant known as Glycyrrhiza glabra grows all over the world. One of the oldest and most popular herbs from the early practise of Ayurveda medicine, it is used both as a medicine and as a flavouring to mask the bad taste of other drugs [20]. The roots and rhizomes of Glycyrrhiza glabra have been used clinically for millennia in the traditional system of medicine due to their anti-inflammatory, antiulcer, expectorant, antibacterial, and anxiolytic properties [21]. The dried rhizome and root were utilized by the Egyptian, Chinese, Greek, Indian, and Roman civilizations as an expectorant and a carminative. Chinese medicine has used licorice since 2800 B.C. It was regarded as traditional medicine in Tibet. The therapeutic properties of licorice roots were mentioned in the tomb of the Egyptian pharaoh Tutanchamon (1350 B.C.). For more than 2000 years, licorice formulations have been used to treat throat and bronchial infections [22].

It has been found that *Punica granatum* has anti-inflammatory, anti-atherosclerotic, antibacterial and antiviral characteristics. Gallocatechins, delphinidin, cyanidin, gallic acid, ellagic acid, pelargonidin, and sitosterol are among the components of P. granatum, and they are well known for their medicinal qualities. Furthermore, it has been noted that *Punica granatum* extracts have antibacterial action against Salmonella [23].

Traditional qualitative and quantitative estimations as well as spectroscopic methods can be used to perform phytochemical analysis of the extract in particular organic solvents. UV-Vis spectrophotometer and chromatography can be used to estimate the bioactive ingredients individually. [24] The peak of the functional group of phytochemicals, denoted by lambda-max in UV-VIS Spectroscopy, can be seen and compared to standards. [25] In the present studies, G. glabra extracts were obtained using methanol, and the study was completed using UV-Vis, FTIR and high performance liquid chromatography (HPLC).

The use of antibiotics affects bacterial resistance in addition to issues with antibiotic residues. Results of Salmonella isolates from chicken carcass samples taken from a Jakartan market revealed that 14.28% of S. enteritidis isolates were resistant to chloramphenicol, while 28.57% were resistant to tetracycline and amoxicillin. One isolate of S. enteritidis and one isolate of S. hadar were found to be resistant to the three antibiotics tested, with resistance levels of 12.5% to chloramphenicol, 50% to amoxicillin, and 75% to tetracycline [26].

2.Material and methods

2.1 Materials and bacterial sample:

The *Allium sativum bulbs, Bridelia micrantha bark, Citrus Lemon peels, Glycyrrhiza glabra roots, Punica granatum peels* samples were collected from vendors. The Department of Pharmacognosy, PWCOP in Yavatmal, confirmed the taxonomic identity of plant components. Test bacteria were isolated from samples of chicken, roadside soil, and roadside water, from five different areas of the state of Maharashtra. Salmonella typhimurium biochemical, microbiological, multidrug resistance pattern, and molecular identification investigations were performed at PWCOP Yavatmal.

The samples of Glycyrrhiza glabra roots, Punica granatum peels, Citrus Lemon peels, Bridelia micrantha bark, and Allium sativum bulbs were first separated, dried by air, and then ground into a fine powder. The dehydrated media of Hi-Media Laboratories Limited, India, were employed as the plating medium in this experiment and included Nutrient Agar, Nutrient Broth, and Muller Hinton Agar. Moreover, analytical-grade chemicals and reagents were employed.

2.2 Preparation of extracts:

In a soxhlet extractor, dried fine powder of Allium sativum bulbs, Bridelia micrantha bark, Citrus lemon peels, Glycyrrhiza glabra roots, and Punica granatum peels were fed, and methanol solvent was extracted with (60-80°C) until all of the solvent was used up. This was extracted using the Soxhlet technique, as directed by Eidi et al. (2006) [27], for 72 hours. The solvent was then filtered following extraction. To get rid of the solvent, the extract was concentrated. The concentrated extract was then placed in a container that was properly sealed and refrigerated at 4°C for later use.

2.3 Antibacterial Activity:

The Clinical and Laboratory Standards Institute claims that (CLSI), the antibacterial activity of the *Allium sativum bulbs, Bridelia micrantha bark, Citrus Lemon peels, Glycyrrhiza glabra roots, Punica granatum peels* extracts were examined using the disc diffusion method against the test Salmonella typhimurium on Mueller Hinton agar [27]. To ensure a uniform distribution of the inoculums, the medium plates (MHA) were streaked with bacteria 2-3

times by rotating the plate at 60 degrees for each streak. After inoculation, a disc containing test samples was placed on the bacteria-seeded plates in five different concentrations. The plates were then incubated for a day at 37°C. The inhibition zone surrounding the disc was measured and noted. Tetracycline was the positive internal control (Hi-Media).

2.4 Phytochemical Characterization:

Phytochemical Screening of *Allium sativum bulbs, Bridelia micrantha bark, Citrus Lemon peels, Glycyrrhiza glabra roots, Punica granatum peels* extracts the subsequent techniques were used to find the presence of phytochemicals: quinones (Borntrager's test) [28], alkaloids (Dragendorff's test) [29], glycosides (Benedict's test) [30], phenols (FeCl3) [31], tannins (Folin-Ciocalteu method) [32], flavonoids (Ammonia test) [33], saponins (Frothing test) [34], steroids (Chloroform and concentrated H2SO4 meth) [35], terpenoids (Chloroform and concentrated H2SO4) [36] and thiosulphates ethyl (p-hydroxybenzoate) [37], amino acids (ninhydrin test) [38].

The measurements in the UV-Visible range were made for *Allium sativum bulbs, Bridelia micrantha bark, Citrus Lemon peels, Glycyrrhiza glabra roots, Punica granatum peels* extracts were studied in the range between at various nm ranges by spectrometer.

2.5 Quantitative analysis:

a) Total phenolic content:

Using the Folin- Ciocalteu technique, the total phenolic content of the methanolic extract of lemon peel was ascertained [39]. Sample and Folin and Ciocalteu's phenol reagent were combined. After three minutes, saturated Na2CO3 was added to the mixture, and the desired volume was then achieved by adding distilled water. The reaction was monitored with a UV-Vis spectrophotometer for 90 minutes while it was maintained in the dark. As a benchmark, varying concentrations of gallic acid were utilised. With various Gallic acid concentrations as the standard, a calibration curve was created. In terms of mg of GAE/g of extract, the results were presented.

b) Total flavonoid content:

The total flavonoid content of the extracts was assessed using the aluminium chloride complex-forming assay [40]. The flavonoid concentration was determined to be the quercetin

equivalent using quercetin as the benchmark. A clean test tube was taken and the sample (100µl Extract) is added, containing 400µl of methanol. Following the addition of 100 l of 10% aluminium chloride, 100 l of 1.0 M sodium acetate were added after 6 min, and the liquid was further diluted with 0.275 ml of distilled water. On the spot, a UV spectrophotometer was used to measure the mixture's absorbance. The amount of flavonoids was specified as mg of querecitin equivalents per gramme of sample.

c) Total Alkaloids content:

5 ml of pH 4.7 phosphate buffer, 5 ml of BCG solution, and 4 ml of chloroform were added to 1 ml of test extract. The mixture was then shaken. The extracts were gathered in a 10-ml volumetric flask and diluted with chloroform to adjust volume. The complex's chloroform absorbance was evaluated in comparison to a blank made in the same manner but without extract. Atropine is used as a reference substance to compare the results of the assay to Atropine equivalents.

d) Total Tannin content:

Using catechin as a reference ingredient, the tannin contents were assessed using a slightly modified version of the Broadhurst et al., 1978 technique. 400 litres of extract are combined with 1.5 mL of strong hydrochloric acid, 3 mL of vanillin solution (4% in methanol), and 400 litres of extract. The absorbance was measured following a 15-minute incubation period.

e) Total saponin content:

Diosgenin (1 mg) and methanol (0.8 ml) were dissolved to create the standard saponin solution. Distilled water was then added (0.2 ml). Vanillin reagent (8%, 0.25 ml) and sulphuric acid (72% v/v), each added gently on the inner side of the wall, were added to the aliquots for each tube. After thoroughly combining the solutions, the tubes were placed in a 60 °C water bath. The tubes were chilled in an ice water bath for 3 to 4 minutes after being incubated for 10 minutes. In comparison to the reagent blank, the absorbance was measured. In methanol, 1 g of the freeze-dried material was dissolved (10 ml). For the spectrophotometric determination of total saponins, 0.25 ml of an aliquot was collected.

2.6 FTIR analysis:

Allium sativum bulbs, Bridelia micrantha bark, Citrus Lemon peels, Glycyrrhiza glabra roots, Punica granatum peels extracts different components were detected using an infrared spectroscopy, the biomolecules' functional groups that are present in the sample extract. Using a mortar and pestle, the methanol extracts were combined with potassium bromide salt, crushed into a thin pellet, and then placed in an IR spectrometer. Between the chosen ranges, the results were recorded on an FTIR spectrometer. As observed in the annotated spectrum, the chemical bonds can be identified by the wavelength of light that is absorbed.

3.Results and Discussion

The extract's phytochemical analysis *Allium sativum bulbs, Bridelia micrantha bark, Citrus Lemon peels, Glycyrrhiza glabra roots, Punica granatum peels* showed presence of phytochemicals as mentioned in table no.-1.

Table 1: Qualitative Phytochemical Screening:

Sr. No.	Phytochemicals	Citrus Lemon	Punica Granatum	Allium Sativum	Glycyrrhiza Glabra	Bridella micrantha
1	Test for Carbohydrates	-	+	+	-	-
2	Test for Tannins	-	+	-	+	+
3	Test for Saponins	+	+	+	+	+
4	Test for Alkaloids	+	+	+	+	+
5	Test for Flavonoids	+	+	+	+	+
6	Test for Glycosides	-	-	+	+	+
7	Test for Quinones	-	+	+	+	-
8	Test for Phenols	+	+	+	+	+
9	Test for Terpenoids	-	+	+	+	+
10	Test for Cardiac Glycosides	+	+	-	+	-
11	Test for Anthraquinones	+	-	-	-	+
12	Test for Steroids	+	+	+	+	+
13	Test for Phlobatannins	-	-	+	-	+

Quantitative Determination of Secondary Metabolites:

The results of the quantitative analysis of the methanolic extracts of each of the chosen medicinal plants revealed the presence of the phytochemicals listed in table no. 2. Figures (1 to 5) depict the typical graphs for total phenolic content (TPC), total flavonoid content (TFC), total alkaloid content (TAC), total tannin content (TTC), and total saponin content (TSC).

Table 2: Quantitative Determination of Secondary Metabolites:

Sr. No.	Sample	TPC mgGAE/g	TFC mgQE/g	TAC mgAE/g	TTC mgCE/g	TSC mgDE/g
1	Allium sativum	78.16	12.81	29.46	Ab	96.76
2	Bridelia micrantha	0.86	0.84	86.14	0.81	9.63
3	Citrus Lemon	106.2	9.38	15.14	Ab	2.41
4	Glycyrrhiza glabra	7.52	13.41	7.73	0.129	2.14
5	Punica granatum	86.35	26.59	38.14	0.656	19.17

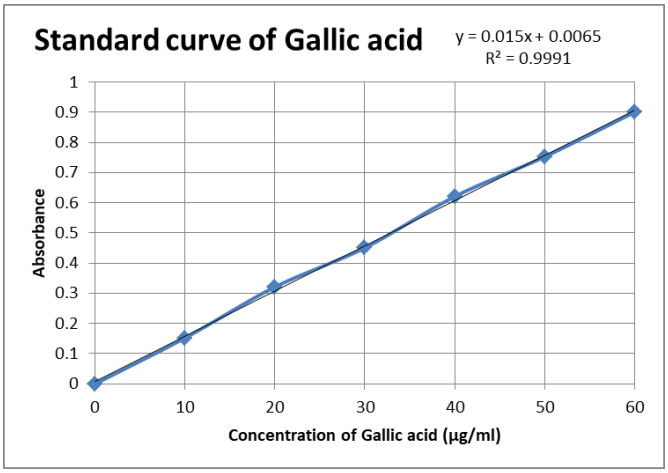

Figure 1: Standard graph of Gallic acid

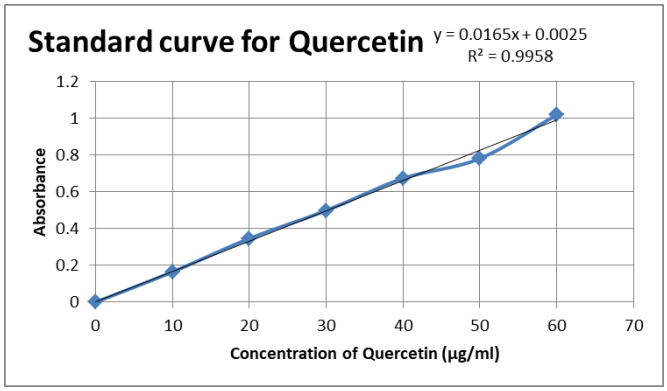

Figure 2: Standard graph of Quercetin

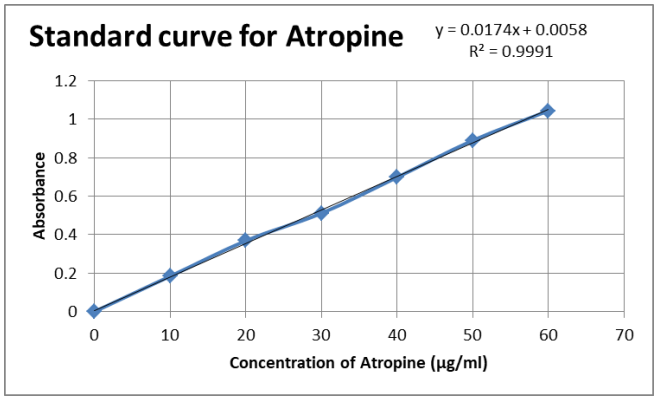

Figure 3: Standard graph of Atropine

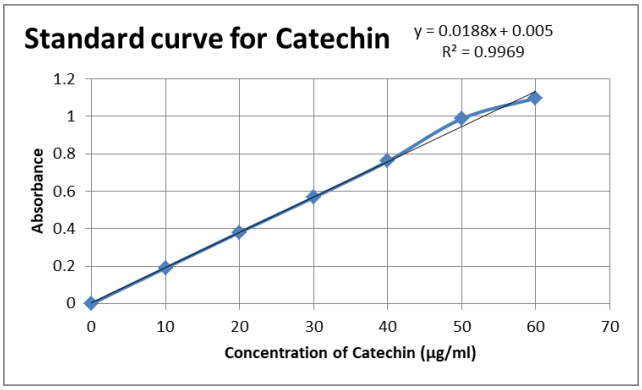

Figure 4: Standard graph of Catechin

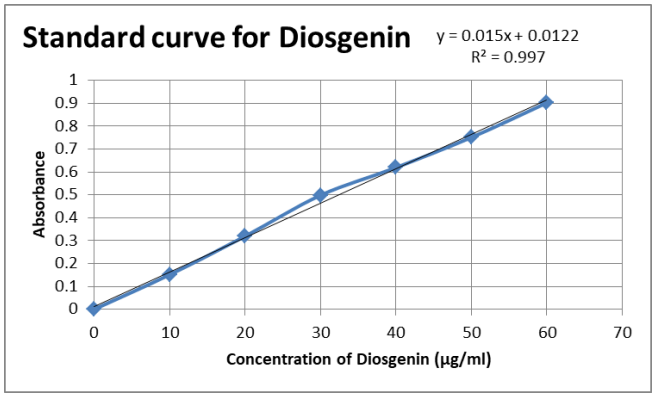

Figure 5: Standard graph of Diosgenin

According to a recent study, organosulfur compounds, flavonoids, and fructans primarily inulin are the phytochemical components of garlic that are responsible for its antibacterial activity [43]. Similar to a study by Njue, et al. (2014) (Njue, Kanja), phytochemical screening in this study revealed amino acids, alkaloids, glycosides, saponins, flavonoids, steroids, and terpenoids may be the cause of the Allium sativum Bulbs extract's antibacterial effectiveness against Staphylococcus aureus, Escherichia coli, and Salmonella typhimurium. [44].

We found that all of the Bridelia micrantha samples included significant phytochemicals like tannins, steroids, flavonoids, and phenolic compounds, which is consistent with earlier research (leaves, barks and roots). All three samples leaves, barks, and roots were discovered to include tannins, alkaloids, and glycosides, albeit the amounts varied depending on the solvents used. Only the bark extracts made from methanol and ethyl acetate contained flavonoids; leaf extracts lacked phytosterols. [45]

This study is in agreement with others have conclude the presence of bioactive Phytoconstituents such carbohydrates, oils, flavonoids, alkaloids, glycosides, phenolics, tannins, saponins, etc. was detected during phytochemical screening of several peel extracts. The polar nature of these Phytoconstituents is shown by the presence of tannins, phenolic compounds, and flavonoids in the pomegranates peel extracts of ethyl acetate and methanol. [47,46].

The methanolic extract of Glycyrrhiza glabra was discovered to include saponin, flavonoids, alkaloids, steroids, terpenoids, tannins, and glycosides, but not proteins, carbohydrates, phlobatannins, phenolic compounds, or anthraquinones. [48].

The results of this study are well correlated with those of other studies that examined the presence and absence of secondary metabolites in the methanolic peel extract of Punica granatum using a variety of techniques. The secondary metabolites were examined, including saponins, tannins, flavonoids, terpenoids, phenols, glycosides, steroids, and alkaloids. For tannins, saponins, flavonoids, alkaloids, terpenoids, phenols, steroids, and cardiac glycosides, pomegranate peel methanolic extract exhibits positive results. There were no proteins, glycosides, or lipids [49].

The presence of functional groups including hydroxyl, carbonyl, carboxylic, and organosulfur compounds was detected in the methanolic extract by FTIR. According to the data in, a hydroxyl group's O-H stretching is what causes the large peak at 3265 cm-1. (figure 6).

The acquired spectra demonstrated the existence of several functional groups that are unique to phytochemicals. Strong C=O absorption band at 1720, O-H broad peaks at around 3300, and C-H stretch at about 2850 indicate the presence of saponins. The presence of flavonoids is indicated by the C=C aromatic bonds at 1600 and 1400, the presence of glycosides is indicated by the C-O-C glycosidic linkage between 1100-1000, and the presence of saponins is indicated by a prominent absorption peak at approximately 2900 (figure 7).

Due to bound OH groups, intense absorption peaks at roughly 3387–3366 cm-1. The existence of free hydroxyl groups and bound OH bands of carboxylic acids is indicated by the OH stretching vibrations, which occur across a wide frequency range. The characteristic O-H stretching vibration and hydrogen bond of the hydroxyl groups are reflected in the broad absorption band in the area of 3600-3100 cm-1 in all of the peel powder samples. Stretching asymmetric vibration of the CH group can be attributed to absorption peaks between 2933 and 2928 cm-1. The extremely strong peak around 1729.83-1724.05 cm-1 is attributed to the stretching vibrations of -COOH and -COOCH3; 1636-1617 cm-1 are credited to carboxylic acid and alkyl carbonate C-OH of carboxyl; and 1415-1406 cm-1 are attributed to carbonate ion vibrations of lemon peel. In the studied peel samples, the wave number between 800 and 1200 corresponds to the finger print region of the fibre for CH3 deformation, C-O-C stretching, and O-H bending (figure 8).

The (2832, 1449, 1020) peak on the FTIR spectrum of the various phytochemical groups found in G. glabra extracts represents the absorption of IR radiation by various functional groups. The results of the FTIR analysis revealed phenolic and carbonyl groups, C-H stretch,

and C-H bends, which suggest that the extracts included only a little amount of flavanoids and other phytochemicals (figure 9).

The resulting graph illustrates the stretching range at 1613 cm-1 associated with the presence of, -unsaturated ketone. Alkanes' C-H stretching is visible in the bands at 2935.69 cm-1 and 1445.68 cm-1. Aldehydes are stretched to C=O at a length of 1728.84 cm-1. Alcohols, primary and secondary alcohols, and C-O stretching are represented by the bands between 875.17 cm and 3280.77 cm. Alkanes, aldehydes, alcohols, and other substances are present, according to the FTIR results (figure 10).

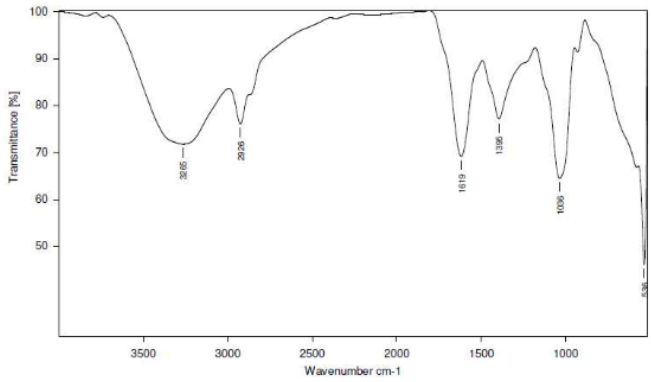

Figure 6: FTIR analysis for the methanolic extract of Allium sativum Bulbs

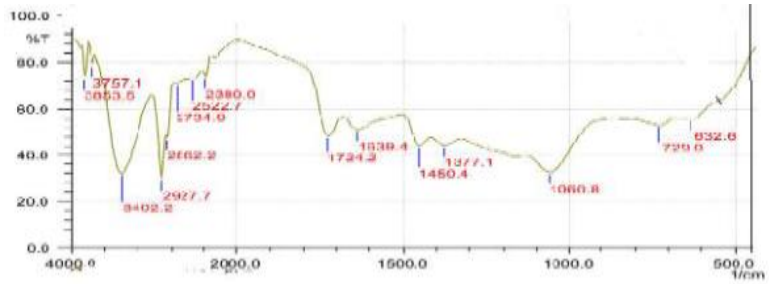

Figure 7: FTIR analysis for the methanolic extract of Bridella micrantha barks

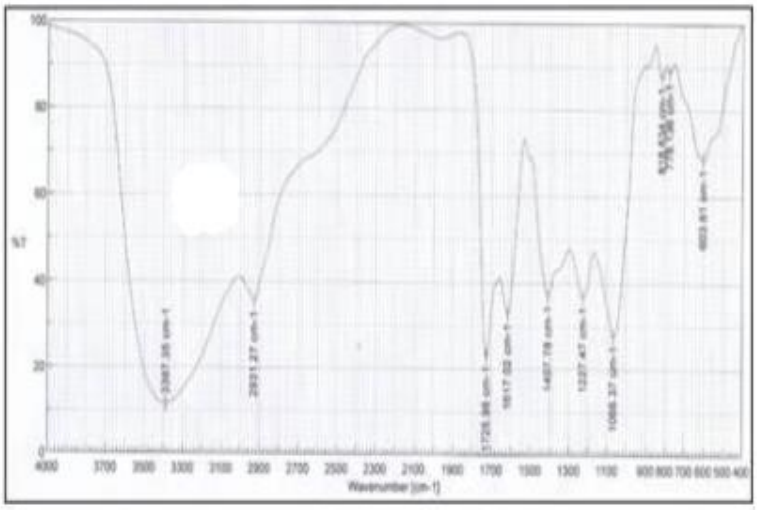

Figure 8: FTIR analysis for the methanolic extract of Citrus Lemon peels

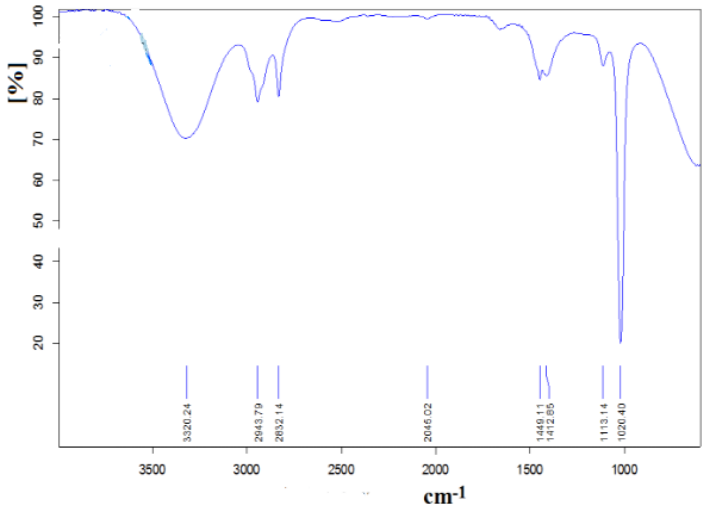

Figure 9: FTIR analysis for the methanolic extract of Glycyrrhiza Glabra roots

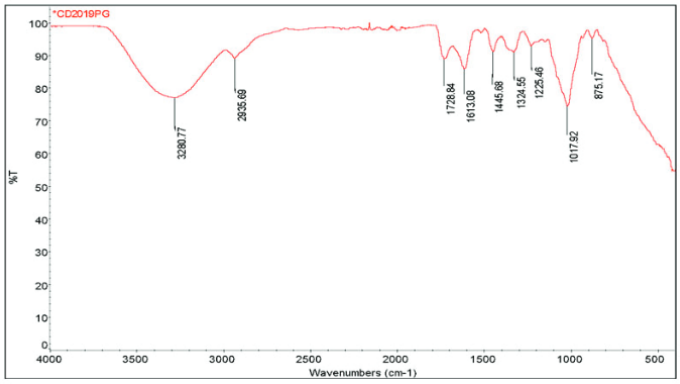

Figure 10: FTIR analysis for the methanolic extract of Punica Granatum peels

Our work is similar to this one, in which an FTIR analysis indicated the presence of particular functional groups in garlic methanolic extract, including hydroxyl, carbonyl, carboxylic, and organo-sulfur compounds [50].

The various components of the herbal medication exhibit OH, CH, C=C, C=O, and C-O-C infrared absorptions, which are indicative of oleanane triterpenoid saponins and are distinguished by the C=O infrared absorbance caused by oleanolic acid/ester. Due to the presence of a C=O functional group, these triterpenoid saponins because they have two glycon attachments, they are also likely to be bidesmosides (i.e., glycosidic and ester groups) to the sapogenin. Peaks between 1069.66 and 1058.73 cm-1 are seen in all of the samples that were examined because the sugar component's CC, CO, and CCO are stretched [51,52].

For different extracts, the peak values in FTIR varied, and these values can be referred to for the OH group, methylene -CH bend, -CH bend, -C=O group, and -CH stretch functional groups [53].

Antibacterial activity of *Allium sativum bulbs, Bridelia micrantha bark, Citrus Lemon peels, Glycyrrhiza glabra roots, Punica granatum peels* extracts were investigated against Salmonella typhimurium isolates are studied by disc diffusion method as shown in Figure 7. Mean diameter zones of inhibition (mm) of *Allium sativum bulbs, Bridelia micrantha bark, Citrus Lemon peels, Glycyrrhiza glabra roots, Punica granatum peels* extracts were found as 10.12±1.71 mm, 23.50 ±0.00 mm, 26.60±0.64 mm, 29.20±0.11 mm , and 19.50 ± 0.00 mm respectively which were considerable to different standard antibiotics used as positive control.

This study discovered and validated garlic extract's high inhibitory action against Salmonella isolates, which has also been shown against other bacteria. Feldberg et al. (1988) and O' Gara et al. (1989) both described the same outcome (2000) [54] Inhibition is characterised by an inhibitory phase detected during the lag phase that appears to be longer than that observed in cell growth control.

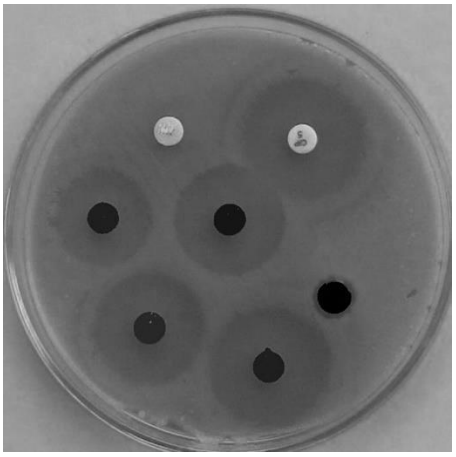

Figure 7: Antibacterial activity of *Allium sativum bulbs, Bridelia micrantha bark, Citrus Lemon peels, Glycyrrhiza glabra roots, Punica granatum peels extract, negative control and positive control*

Researchers Uchida et al. (1975) [55] also looked into garlic's capacity to inhibit microorganisms with antibiotic resistance. According to Feldberg et al. (1988) [57], allicin inhibited Salmonella typhimurium growth in vitro by delaying and partially inhibiting DNA and protein synthesis while instantly inhibiting RNA synthesis at bacteriostatic concentrations (0.2 to 0.5 mM), indicating that this is the principal target of allicin activity.

Our study is coinsides with Douglas et. al. (2016), they demonstrated that the active components responsible for the antibacterial activity may be extracted most effectively using methanol and ethyl acetate. G. plagiophylla and B. micrantha have a broad zone of inhibition against S. aureus and S. typhi, indicating that they have tremendous potential as a treatment for infectious disorders caused by S. aureus and S. typhi.

In this work, *MDR Salmonella typhimurium* was used as a test subject for antibacterial activity, and inhibition zones of 26 mm were discovered. According to Okmen et al. [58] *citrus lemon* ethanolic extract was 10mm. and according to Otang and Afolayan [59] during the investigation, a 20 mm inhibition zone for S. typhimurium and a 15 mm inhibition zone for E. coli were discovered. Hindi and Chabuck [60] examined the peel, juice, and dried form of *Citrus lemon* and discovered various outcomes. Despite the fact that S. aureus (30 mm) and S. typhimurium can be killed by the peeled sections (30 mm). Although our investigations' findings are in agreement with the literature, there are some variances.

The results show that methanolic extracts of these plants have a significant zone of inhibition against Salmonella typhi. The zone of inhibition is closest to ampicillin, a referenced drug. The typhoid fever-causing agent is Salmonella typhi. Typhoid fever is currently a serious health issue in developing nations, with antimicrobial treatment having only patchy success. This is in line with the findings of other researchers who examined the pomegranate peel ethanolic extract's in vitro antibacterial efficacy against sixteen strains of Salmonella [61,62].

These outcomes are consistent with earlier studies that examined the antibacterial activity of Glycyrrhiza Glabra extracts against B. cereus ATTC 7064. E. coli ATCC 11293 E. faecalis ATCC 51299 K. pneumoniae ESBL (C) MRSA M. luteus C. krusei ATCC 6258 C. parapsilosis ATCC 22019 Most of the microorganisms utilised in the investigation were able to be inhibited by P. aeruginosa S. aureus ATCC 6538 [63].

It becomes sense to look into novel sources of naturally occurring substances having antibacterial action in light of the advent of antibiotic-resistant microorganisms. It has been established that edible plants are safe and cost-effective.

4.Conclusion

The research for effective substitutes for antimicrobial chemical additions has steadily increased with the goal of replacing them completely or in part. The results of the current investigation showed that a high concentration of phytochemicals may be found in methanolic extracts of the following plants: *Allium sativum bulbs, Bridelia micrantha bark, Citrus lemon peels, Glycyrrhiza glabra roots, and Punica granatum peels.* Early indications suggest that the plant may be used to treat MDR infections come from the discovery that the methanolic extract of the plants has promising antibacterial activity when compared to the standards.

Recommendations for Future Research

More research should be done on a variety of subjects, including toxicology against human or animal cells, mechanisms of action, in vivo effects, positive and negative interactions with typical antibiotics, and others.

Data study statement

This article contains all of the data generated or analyzed during this investigation.

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There is no research funds included for this proposal.

Conflicts of interest

There are no competing interests in this study, according to the authors.

Ethical approval

Because in present study animals were not used as result of this, ethical approval was not required.

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