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Original Article

# Phytochemical and Molecular Docking Studies on Indigenous Herbs *Glycyrrhiza glabra, Terminalia chebula* and *Hamdard joshanda*

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## ABSTRACT

**Background:** *Glycyrrhiza glabra, Terminalia chebula* and *Hamdard joshanda* is used as a traditional home medicine in developing countries that is easily available for a lesser cost with no side effects. These medicine decoctions made record in pandemic that have found efficacious in Covid-19 patients with RTI in addition to Dengue and Malarial fever. Our study aimed to explore the qualitative as well as quantitative in potential traditional medicines such as *Glycyrrhiza glabra, Terminalia chebula* and *Hamdard joshanda* through phytochemical and GC-MS analytical technique were conducted for finding all the potential chemical constituents in these herbal medicines. Docking studies were carried out between *Glycyrrhiza glabra*, *Terminalia chebula* and *Hamdard joshanda* and receptors of the crystal structure of SARS coronavirus, Lung Cancer and *Mycobacterium tuberculosis* proteins. **Materials and Methods:** The presence of various phytochemicals, total phenolic and flavonoid content were determined in *Glycyrrhiza glabra, Terminalia chebula* and *Hamdard joshanda* by standard procedure. Docking study was investigated using the crystal structure of *SARS* coronavirus protease for the modeling (PDB ID: 3SN8), Lung Cancer Protein for the modeling (PDB ID: 6JZ0) and *Mycobacterium tuberculosis protein* for the modeling (PDB ID: 4FDO). **Results:** GC-MS chromatogram showed 26, 18 and 23 peaks that revealed 26, 18 and 23 phytoconstituents present in *Glycyrrhiza glabra, Terminalia chebula,* and *Hamdard joshanda* respectively. Total phenolic and flavonoid contents found in *Glycyrrhiza glabra, Terminalia chebula,* and *Hamdard joshanda* were 1.95, 1.88, 1.55, and 0.66, 0.56, 0.49 mg/ml, respectively. Docking studies were exhibited that moderate to higher efficacy against Covid-19, Tuberculosis and Lung cancer. However, several more *in vivo* and *in vitro* research needs to investigate their molecular system or any other significance of unused bioactive substance in these traditional medicines used for human relapse. **Conclusion:** These potential traditional medicines have been confirmed to be safe for human consumption and the present study would also suggest its direct consumption as well as for attaining the proven benefits.

**Key words:** Herbal plants, Phytochemical analysis, Docking, Tuberculosis, Lung cancer, Covid-19.

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## INTRODUCTION

Medicinal herbs seemed to play a vital role for folks to treat various diseases since the fourth century BC. During the recent decades, they have been considered a valuable and cost-effective source for drug formulations and development against various diseases in developing countries attributed to their unique phytoconstituents. Ancient civilizations of Sri Lanka, Nepal, Malaysia, China, India, the Mayans of Central America, the Mediterranean, the Red Indians of North America and Greeks had used therapeutic plants and minerals for their antimalarial alkaloid potent, chewed coca leaves containing cocaine, consumed mushrooms containing methylated tryptamine, ipecacuanha root containing emetine, opium, squill and Hyoscyamus, viper toxin, morphine, and metallic drugs. Globally, around 3000 plants have been identified and reported for their high pharmacological properties. Europe and Israel have focused on indigenous traditional medicines and spent $5 billion per year for research on their pharmacological applications, which have largely replaced synthetic chemotherapeutic agents. According to World Health Organization (WHO), traditional medicines have been trusted by the people of developing countries for major health care practices and as well as an important basis for the development of novel modern drugs.[1] This is due to their exponential biological and medicinal properties, holistic approach to a healthy lifestyle, natural origins with higher safety margins, fewer side effects, eco-friendly, hazardless, less toxic and cost effective budget in drug development. Traditional medicines derived from *Glycyrrhiza glabra*, *Terminalia chebula*, and *Hamdard joshanda* were used extensively in Asia, Africa, Europe and the Middle Eastern countries for the treatment of bounteous diseases. These traditional medicines have been reported to have pharmaceutical and therapeutic activities, encompassing germicide, antibacterial, antiviral, antifungal, non-steroidal anti-inflammatory, antioxidant, anticancer, antiulcer, anti-mutagen, antidiabetic, hepatoprotective, antiproliferative, protection against harmful effects on radiation, serving to protect the heart, acts against arthritis and tending to prevent tooth decay. They are well known for using digestive movement and laceration activities besides being in use for the treatment of paralysis, cardiovascular diseases, gout, fever, and arthritis.[2-4] Besides this, it is to annotate that these traditional medicines serve as a source for the extension to make herbal procreation, as therapy of transmissible diseases like sore throat, asthma, leprosy, wheezing, dysentery, stomach flu, scabs, thrush, cystitis, and fracture. It also treats intestinal flu, leukorrhea, periodontal disease, mycosis, heartburn, vomiting, diarrhea, dysentery, piles and bladder diseases. These plants also owe a history of being in utilization for preventing the process of aging, to

impart longevity and immunity as well.[5,6] Though *Glycyrrhiza glabra, Terminalia chebula and Hamdard joshanda* have been well known for their pharmacological potent and in treating the aforementioned diseases, there exist no research studies for proving their applications in drug designing for Lung Cancer, Tuberculosis and preventing COVID – 19.[7,8] Hence the present study is an initiative to investigate these medicinal plants for the same. It aims to reveal the chemical constituents of these traditional medicines by carrying out preliminary phytochemical tests, GC-MS and assessing the efficacy of these plants against lung cancer, tuberculosis and COVID–19 through docking studies. Results of the study shall provide novel and deep insights into the application of these plants in the aforementioned clinical aspects and as well as in paving a way for drug designing in the future.

## MATERIALS AND METHODS

### Collection and Processing of Plant Material

The herbs *Glycyrrhiza glabra root* (*Leguminosae), Terminalia chebula seeds* (*Combretaceae)* and *Hamdard joshanda (Fructus Foeniculi seeds (Apiaceae) and Mentha balsamea Wild leaf* (*Lamiaceae))* were collected from the forest area of Kanyakumari and Kollimalai Hills, Namakkal district, Tamil Nadu, India and were authenticated by The Rapinat Herbarium, P.B. 315, St. Josephs College, Tiruchirapalli, 620 002, Tamil Nadu, India. The herbarium specimens were kept in The Rapinat Herbarium, P.B. 315, St. Josephs College, Tiruchirapalli, 620 002, Tamil Nadu, India. They were washed with soap solution to remove the debris and other extraneous matters. They were rinsed thrice with distilled water and shade dried for a period of 2 weeks. They were then crushed to a substance by grinding and boutique in the air-tight packet.[9]

### Maceration Method

The crushed dried substance of the herbs, each (250 g) was maceration with hexane (3 X 500 ml), dichloromethane (3 X 500 ml), ethyl acetate (3 X 500 ml) and methanol (3 X 500 ml) by an orbital circular shaking motion with a slow speed 25-500 rpm and at 24°C for 72 hr using an orbital shaker. Maceration substance solvent was filtered using Whatman No 1 filter paper and Cotton plug. Finally, extracts were concentrated by rotary evaporator- BUCHI Rotavapor RII, Switzerland. This powder from the extract was undergone for phytochemical screening and GC-MS analysis.[9]

### Phytochemical Analysis

Preliminary phytochemical analysis was carried out to unravel different forms of chemical constituents present in the plant compounds. Qualitative assessment of alkaloids, carbohydrate, glycoside, triterpenoids, phenolic compounds, steroids, and tannins in the studied species was performed following the standard method. The total flavonoid content was determined using a modified calorimetric aluminium chloride method. Saponin contents were determined using the previously reported methods.[7,10,11,14]

### GC-MS Operating Procedure and Analytical Techniques

GC-MS analysis was done using Agilent 8890 -Version: 2021-0709-2206-17619 (GC- model) equipped with HP 5 MS column. The initial temperature was fixed from 50 to 75°C and the Maximum temperature was at 350°C with a hold time of 0.5 min. The temperature was programmed to rise by 5°C /min with a final temperature of 280°C. In the process, 1µl of the sample was injected into the port and immediately vaporized and moved down the column with helium as the carrier gas with a flow rate of 1 ml/min. Electron energy was fixed at 70 eV. After the separation in the column, the components were identified and further analysed by FID. Compounds were identified by comparing the spectrum of unknown compounds with the spectrum of known compounds in the NIST MS 2.0 structural library to find out the names, molecular weight, and structure. Total GC running time was around 34 min for each sample. Methanol extracts of *Glycyrrhiza glabra* (1a – 26a), *Terminalia chebula* (27b – 44b) and *Hamdard joshanda* (45c – 67c) powder were carried out by GC-MS Acquisition Method in IIT – Madras.[13-19]

### Docking Assessment Method

Docking studies were carried out by AutoDock Version 4.2.6. Software that is a powerful tool in understanding different protein functions, calculating the strongest binders based on various scoring functions. It is a powerful approach that is used to find glide score, hydrogen bond, interactions, glide energy, molecule, protein, and enzymes. The molecules might tie up with the receptor and change their role. This is a powerful approach for chemical structure-based novel drug discovery that interaction of the new compound with target crystal was identified via docking and their corresponding firmness was evaluated using computer simulation method. Evaluation of their chemical attractions was performed by AutoDock Version 4.2.6.[18-21] The docking studies were conducted between the chemical constituents of traditional medicines *Glycyrrhiza glabra, Terminalia chebula* and *Hamdard joshanda* and receptors of COVID-19 (Protein ID: 3SN8; Crystal structure of SARS coronavirus main protease complexed with Cm-FF-H (soaking); Resolution: 1.99 Å), Lung Cancer (Protein ID: 6JZ0; Crystal structure of EGFR kinase domain in complex with compound 78; Resolution: 2.86 Å) and *Mycobacterium Tuberculosis* (Protein ID: 4FDO; Mycobacterium tuberculosis DprE1 in complex with CT319; Resolution: 2.40 Å). The receptor structures which were taken from protein data bank developed using protein preparation wizard Schrodinger. Since hydrogen, protein minimizations were determined using computer software with the removal of torsional potential. Molecular docking was performed by ensuring the rigidness and flexibility of enzyme molecule and Phytoconstituents respectively. In that method, we came out with various conformations while executing the program and the greatest conformer that matched with the least binding energy (kcal/mol) was recorded. Glide energies are indicated to find favourable binding between chemical compounds and the receptors. The glide scoring function is calculated by the following equation:

$$\text{Gscore} = 0.05 * \text{vdW} + 0.15 * \text{Coul} + \text{Lipo} + \text{Hbond} + \text{Reward} + \text{RorB} + \text{Site} + \text{hydrophobicity}$$

## RESULTS

### Preliminary Qualitative and Quantitative Phytochemical Analysis

Table 1 showed the results of preliminary qualitative phytochemical analysis of (a) *Glycyrrhiza Glabra*, (b) *Terminalia chebula*, and (c) *Hamdard joshanda* using various solvents such as ethanolic, methanolic, hexane, and aqueous extract. A preliminary phytochemical study showed the presence of alkaloids, carbohydrates, glycoside, saponins, triterpenoids, flavonoids, phenolic compounds, steroids, and tannins in the studied plant species. *Glycyrrhiza glabra* and *Hamdard joshanda* both contained catechin and volatile oil. *Glycyrrhiza glabra* contained quinones and coumarins. *Glycyrrhiza glabra, Terminalia chebula,* and *Hamdard joshanda* extracts had total phenolic and flavonoid contents of 1.95, 1.88, 1.55, and 0.66, 0.56, 0.49 mg/ml, respectively.[7,10,11,13,14,15]

### GC-MS Analysis

GC-MS chromatogram of methanol extracts of *Glycyrrhiza glabra* (1a – 26a), *Terminalia chebula* (27b – 44b) and *Hamdard joshanda* (45c – 67c) were presented in Figure 1. R*t* Value, Peak area, % Peak

**Table 1: Phytochemical analysis of (a) *Glycyrrhiza glabra,* (b)*Terminalia chebula* and (c) *Hamdard joshanda* in ethanolic, methanolic, hexane and water solvent.**

| Sl. No | Metabolites | | Ethanolic extract | Methanolic extract | Hot aqueous extract | Cold aqueous extract | Hexane Extract |
|---|---|---|---|---|---|---|---|
| 1. | Alkaloids Dragendorff, Wagner and Mayer | a | + | + | + | + | + |
| | | b | + | + | + | + | + |
| | | c | + | + | + | + | + |
| 2. | Protein by Lowry's | a | - | - | - | - | - |
| | | b | - | - | - | - | - |
| | | c | - | - | - | - | - |
| 3. | Carbohydrate by Anthrone | a | + | + | + | + | + |
| | | b | + | + | + | + | + |
| | | c | + | + | + | + | + |
| 4. | Reducing Sugars | a | - | - | - | - | - |
| | | b | - | - | - | - | - |
| | | c | - | - | - | - | - |
| 5. | Glycoside | a | + | + | + | + | + |
| | | b | + | + | + | + | + |
| | | c | + | + | + | + | + |
| 6. | Starch | a | - | - | - | - | - |
| | | b | - | - | - | - | - |
| | | c | - | - | - | - | - |
| 7. | Quinones | a | + | + | + | + | + |
| | | b | - | - | - | - | - |
| | | c | - | - | - | - | - |
| 8. | Saponins | a | + | + | + | + | + |
| | | b | + | + | + | + | + |
| | | c | + | + | + | + | + |
| 9. | Mucilages | a | - | - | - | - | - |
| | | b | - | - | - | - | - |
| | | c | - | - | - | - | - |
| 10. | Coumarins | a | + | + | + | + | + |
| | | b | - | - | - | - | - |
| | | c | - | - | - | - | - |
| 11. | Steroids/Triterpenoids | a | + | + | + | + | + |
| | | b | + | + | - | - | - |
| | | c | + | + | + | + | + |
| 12. | Resins | a | - | - | - | - | - |
| | | b | - | - | - | - | - |
| | | c | - | - | - | - | - |
| 13. | Flavonoids byShindo's /Bohm-KocipayAbhayzan | a | + | + | + | + | + |
| | | b | + | + | + | + | + |
| | | c | + | + | + | + | + |
| 14. | Anthraquinone | a | - | - | - | - | - |
| | | b | - | - | - | - | - |
| | | c | - | - | - | - | - |
| 15. | Catechin | a | + | + | + | + | + |
| | | b | - | - | - | - | - |
| | | c | + | + | + | + | + |
| 16. | Phenolic compounds | a | + | + | + | + | + |
| | | b | + | + | + | + | + |
| | | c | + | + | + | + | + |
| 17. | Volatile oil | a | + | + | + | + | + |
| | | b | - | - | - | - | - |
| | | c | + | + | + | + | + |
| 18. | Tannins by folin-denis | a | + | + | + | + | + |
| | | b | + | + | + | + | + |
| | | c | + | + | + | + | + |

+ = presence; – = absent.

**Table 2: Report of Mass-spectrum of gas chromatography - mass spectrometry (GC-MS) of *Glycyrrhiza glabra* (1a – 26a), *Terminalia chebula* (27b – 44b) and *Hamdard joshanda* (45c – 67c).**

| Sl.NO | Name of the compound and Molecular formula | Rt Value (min) | Peak area | Peak area % | Peak @ | Score | m/z |
|---|---|---|---|---|---|---|---|
| 1a | Undecane [$C_{11}H_{24}$] | 4.937 | 2075311.290 | 7.85 | 4.937 | 949 | 156.0 |
| 2a | Resorcinol[$C_6H_6O_2$] | 7.304 | 247131.110 | 0.93 | 7.300 | 904 | 110.0 |
| 3a | Benzene,1-(1,5-dimethyl-4-hexenyl)-4-methyl [$C_{15}H_{22}$] | 10.031 | 136480.673 | 0.52 | 10.033 | 896 | 202.1 |
| 4a | 1,4-BenzeneDicarboxylicacid, dimethylester [$C_{10}H_{10}O_4$] | 10.231 | 314319.836 | 1.19 | 10.231 | 934 | 194.0 |
| 5a | Oxadiargyl [$C_{10}H_{10}N_2O_3$] | 10.328 | 746710.442 | 2.82 | 10.329 | 819 | 206.1 |
| 6a | Benzene, ethylpenta methyl [$C_{13}H_{20}$] | 10.449 | 86710.066 | 0.33 | 10.449 | 830 | 176.0 |
| 7a | Comarin, 3,4,4a,5,6,8a-hexahydro-6,8a-epidioxy-4a,6-dimethyl[$C_{11}H_{14}O_4$] | 11.935 | 585021.297 | 2.21 | 11.934 | 663 | 195.0 |
| 8a | 3-O-Methyl-d-glucose [$C_7H_{14}O_6$] | 12.038 | 1462816.457 | 5.53 | 12.040 | 734 | 194.0 |
| 9a | Apiol [$C_{12}H_{14}O_4$] | 12.387 | 99543.695 | 0.38 | 12.384 | 888 | 222.0 |
| 10a | Dihydroflavopereirine [$C_{17}H_{15}N_2$] | 13.210 | 85271.852 | 0.32 | 13.206 | 793 | 234.0 |
| 11a | Dasatinib [$C_{20}H_{22}ClN_7O_2S$] | 15.189 | 104021.135 | 0.39 | 15.192 | 642 | 232.0 |
| 12a | Hexadecanoicacid, methyl ester[$C_{17}H_{34}O_2$] | 15.343 | 300106.893 | 1.13 | 15.345 | 896 | 270.2 |
| 13a | 5-Methoxy psoralen [$C_{12}H_8O_4$] | 15.463 | 1347534.405 | 5.10 | 15.464 | 663 | 217.0 |
| 14a | n-Hexadecanoic acid [$C_{16}H_{32}O_2$] | 15.766 | 263328.260 | 1.00 | 15.770 | 857 | 256.0 |
| 15a | 9,12-Octadecadienoic acid (Z,Z)- [$C_{18}H_{32}O_2$] | 18.276 | 291386.434 | 1.10 | 18.274 | 900 | 280.2 |
| 16a | cis-Vaccenic acid [$C_{18}H_{34}O_2$] | 18.351 | 168170.668 | 0.64 | 18.351 | 865 | 264.0 |
| 17a | Octadecanoic acid [$C_{18}H_{36}O_2$] | 18.682 | 97942.233 | 0.37 | 18.680 | 824 | 284.0 |
| 18a | Cyclocurcumin[$C_{19}H_{14}O_6$] | 19.191 | 87118.908 | 0.33 | 19.191 | 764 | 280.0 |
| 19a | Hexadecanoic acid, 2-hydroxy-1-(hydroxymethyl)ethyl ester[$C_{19}H_{38}O_4$] | 23.897 | 316630.855 | 1.20 | 23.896 | 866 | 299.0 |
| 20a | Octadecanoic acid,2,3-dihydroxypropylester[$C_{21}H_{42}O_4$] | 26.881 | 208032.791 | 0.79 | 26.881 | 754 | 327.0 |
| 21a | Berberine cation[$C_{20}H_{18}NO_4$] | 28.477 | 363701.225 | 1.38 | 28.474 | 660 | 336.0 |
| 22a | Di(pentamethylphenyl)ketone[$C_{23}H_{30}O$] | 29.289 | 339603.944 | 1.28 | 29.285 | 713 | 322.0 |
| 23a | 17-Methoxy-4-methyl-d-homo-18-norandrosta-4,8,13,15,17-pentaen-3-one [$C_{21}H_{24}O_2$] | 29.563 | 254107.602 | 0.96 | 29.563 | 723 | 326.9 |
| 24a | 5,5'-Diallyl-2,2'-biphenyldiol, mono(trimethylsilyl) ether [$C_{21}H_{26}O_2Si$] | 30.083 | 161738.441 | 0.61 | 30.082 | 662 | 338.0 |
| 25a | 4'-O-MethylGlabridin [$C_{20}H_{20}O_4$] | 31.113 | 2391753.413 | 9.04 | 31.115 | 869 | 323.0 |
| 26a | Glabridin [$C_{20}H_{20}O_4$] | 32.290 | 13913456.790 | 52.61 | 32.291 | 929 | 324.0 |
| 27b | Undecane [$C_{11}H_{24}$] | 4.937 | 637112.539 | 1.08 | 4.934 | 836 | 156.0 |
| 28b | Levoglucosenone [$C_6H_6O_3$] | 5.245 | 566414.165 | 0.96 | 5.243 | 693 | 126.0 |
| 29b | 4H-Pyran-4-one, 2,3-dihydro-3,5-dihydroxy-6-methyl [$C_6H_8O_4$] | 5.617 | 1001654.568 | 1.70 | 5.613 | 786 | 144.0 |
| 30b | 5-Hydroxy methylfurfural [$C_6H_6O_3$] | 6.658 | 5138802.440 | 8.73 | 6.657 | 947 | 126.0 |
| 31b | 5-(Hydroxymethyl)-2-(dimethoxymethyl)furan [$C_8H_{12}O_4$] | 7.578 | 2411123.051 | 4.10 | 7.580 | 785 | 172.0 |
| 32b | Resorcinol, TMS derivative [$C_6H_6O_2$] | 7.818 | 3142975.427 | 5.34 | 7.820 | 751 | 182.0 |
| 33b | 1,2,3-Benzenetriol [$C_6H_6O_3$] | 8.562 | 18129074.048 | 30.80 | 8.563 | 956 | 126.0 |
| 34b | Benzaldehyde, 3-hydroxy-4-methoxy [$C_8H_8O_3$] | 8.985 | 753811.171 | 1.28 | 8.986 | 824 | 152.0 |
| 35b | 2-Propenoic acid,3-phenyl [$C_9H_8O_2$] | 9.202 | 1258153.379 | 2.14 | 9.205 | 780 | 147.0 |
| 36b | Benzoic acid, 3-hydroxy [$C_7H_6O_3$] | 9.825 | 589434.830 | 1.00 | 9.825 | 741 | 138.0 |
| 37b | β-D-Gluco pyranose, 1,6-anhydro [$C_{12}H_{22}O_{11}$] | 9.980 | 2064692.596 | 3.51 | 9.979 | 741 | 162.0 |
| 38b | 3-Pyridine carboxylic acid,6-amino [$C_6H_6N_2O_2$] | 10.117 | 685438.451 | 1.16 | 10.120 | 659 | 138.0 |
| 39b | Melezitose [$C_{18}H_{32}O_{16}$] | 11.421 | 1478675.787 | 2.51 | 11.422 | 715 | 207.1 |
| 40b | Hexadecanoic acid, methyl ester [$C_{17}H_{34}O_2$] | 15.343 | 252382.330 | 0.43 | 15.347 | 784 | 270.2 |
| 41b | Benzoic acid, 3,4,5-trihydroxy [$C_7H_6O_5$] | 16.023 | 18753410.950 | 31.86 | 16.025 | 878 | 170.0 |
| 42b | 9,12-Octadecadienoic acid (Z, Z) [$C_{18}H_{32}O_2$] | 18.282 | 710265.081 | 1.21 | 18.281 | 812 | 280.0 |
| 43b | Oleic Acid [$C_{18}H_{34}O_2$] | 18.356 | 1147635.651 | 1.95 | 18.358 | 837 | 264.0 |

Continued...

**Table 2: Cont'd.**

| Sl.NO | Name of the compound and Molecular formula | Rt Value (min) | Peak area | Peak area % | Peak @ | Score | m/z |
|---|---|---|---|---|---|---|---|
| 44b | Octadecanoic acid [$C_{18}H_{36}O_2$] | 18.688 | 132216.510 | 0.22 | 18.686 | 685 | 284.0 |
| 45c | Thiazole [$C_3H_7NS$] | 3.999 | 568909.840 | 0.68 | 3.999 | 656 | 89.0 |
| 46c | Lincomycin [$C_{18}H_{34}N_2O_6S$] | 4.736 | 9573231.475 | 11.42 | 4.736 | 793 | 126.0 |
| 47c | Thiomorpholine-3-carboxylic acid amide [$C_5H_{10}N_2OS$] | 5.554 | 1077820.868 | 1.29 | 5.554 | 654 | 146.0 |
| 48c | 4H-Pyran-4-one, 2,3-dihydro-3,5-dihydroxy-6-methyl [$C_6H_8O_4$] | 5.686 | 6931806.547 | 8.27 | 5.686 | 852 | 144.0 |
| 49c | Benzoic acid [$C_7H_6O_2$] | 5.863 | 9760444.079 | 11.64 | 5.860 | 860 | 122.0 |
| 50c | α,β-Gluco-octonic acid lactone [$C_8H_{14}O_8$] | 6.166 | 1275518.177 | 1.52 | 6.164 | 651 | 238.1 |
| 51c | Isosorbide Dinitrate [$C_6H_8N_2O_8$] | 6.275 | 579342.104 | 0.69 | 6.270 | 670 | 236.0 |
| 52c | Maltose [$C_{12}H_{22}O_{11}$] | 6.663 | 3637139.338 | 4.34 | 6.661 | 660 | 342.1 |
| 53c | 5-Hydroxy methyl furfural [$C_6H_6O_3$] | 6.738 | 20596735.457 | 24.57 | 6.734 | 883 | 126.0 |
| 54c | (6-Hydroxymethyl-2,3-dimethylPhenyl)methanol [$C_{10}H_{14}O_2$] | 7.498 | 305207.020 | 0.36 | 7.500 | 653 | 166.0 |
| 55c | Melibiose [$C_{12}H_{22}O_{11}$] | 7.630 | 152246.255 | 0.18 | 7.634 | 685 | 342.1 |
| 56c | 1,2,4-Benzenetriol [$C_6H_6O_3$] | 8.893 | 787977.061 | 0.94 | 8.893 | 690 | 126.0 |
| 57c | Melezitose [$C_{18}H_{32}O_{16}$] | 10.500 | 16657413.692 | 19.87 | 10.498 | 789 | 207.1 |
| 58c | Benzenepropanoic acid,4-hydroxy [$C_9H_{10}O_3$] | 11.786 | 6378591.129 | 7.61 | 11.787 | 846 | 166.0 |
| 59c | Desulphosinigrin [$C_{10}H_{17}NO_6S$] | 12.656 | 485100.412 | 0.58 | 12.654 | 714 | 281.0 |
| 60c | 2-Hydroxy-3-isopropyl-6-methylbenzoicacid [$C_{11}H_{14}O_3$] | 15.017 | 1004661.013 | 1.20 | 15.017 | 749 | 193.0 |
| 61c | Cyclopropanebutanoicacid,2-[[2-[[2-[(2-pentyl cyclopropyl) methyl] cyclopropyl]m [$C_{24}H_{40}O_2$] | 15.343 | 334804.358 | 0.40 | 15.343 | 715 | 270.0 |
| 62c | n-Hexadecanoic acid [$C_{16}H_{32}O_2$] | 15.772 | 636420.657 | 0.76 | 15.777 | 781 | 256.0 |
| 63c | [1,1'-Bicyclopropyl]-2-octanoic acid, 2'-hexyl-, methyl ester [$C_{21}H_{38}O_2$] | 18.270 | 351515.777 | 0.42 | 18.271 | 794 | 291.0 |
| 64c | Oleic Acid [$C_{18}H_{34}O_2$] | 18.345 | 195402.671 | 0.23 | 18.345 | 784 | 264.0 |
| 65c | 1-Phenanthrene methanol, 1,2,3,4,4a,9,10,10a-octahydro-6-methoxy-1,4a-dime [$C_{17}H_{22}O_3$] | 19.357 | 1110196.495 | 1.32 | 19.355 | 671 | 274.0 |
| 66c | (Hexadecanoic acid, 2-hydroxy-1-(hydroxymethyl) ethyl ester [$C_{19}H_{38}O_4$] | 23.897 | 988862.068 | 1.18 | 23.896 | 875 | 299.0 |
| 67c | Octadecanoic acid, 2-hydroxy-1-(hydroxymethyl) ethyl ester [$C_{19}H_{38}O_4$] | 26.870 | 454042.214 | 0.54 | 26.867 | 820 | 327.0 |

Phytochemical compounds found in Glycyrrhiza glabra (1a – 26a), Terminalia chebula (27b – 44b) and Hamdard joshanda (45c – 67c) by GC-MS Only. *NICFD – Not Individual Compound Full Details.

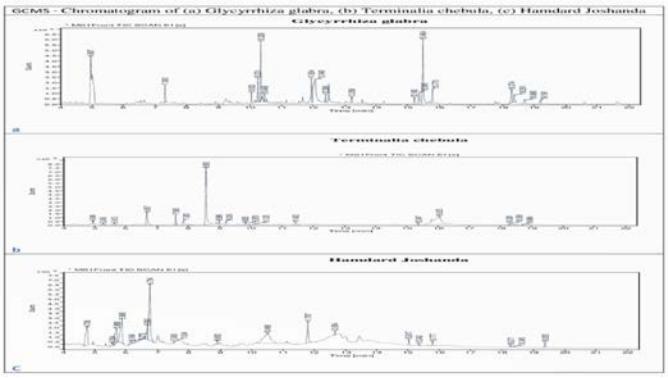


**Figure 1:** GC-MS chromatogram of methanol extracts of *Glycyrrhiza glabra, Terminalia chebula and Hamdard joshanda*.

area, Score, Molecular formula and name, Molecular weight (m/z), were shown in Table 2. GC-MS chromatogram of methanol extracts (Figure 1) showed 26, 18 and 23 peaks that indicated 26, 18 and 23 phytoconstituents were present in *Glycyrrhiza glabra, Terminalia chebula,* and *Hamdard joshanda* respectively. GC-MS results showed that the following biological active substance like undecane, resorcinol, benzene,1-(1,5-dimethyl-4-hexenyl)-4-methyl, 1,4-benzene, dicarboxylic acid, dimethyl ester, oxadiargyl, benzene, ethyl penta methyl, coumarin, 3,4,4a,5,6,8a-hexahydro-6,8a-epidioxy-4a,6-dimethyl,3-O-Methyl-d-glucose, apiol, dihydro flavopereirine, dasatinib, hexadecanoic acid, methyl ester,5-methoxy psoralen, n-hexadecanoic acid, 9,12-Octadecadienoic acid (Z, Z)-, cis-Vaccenic acid, Octadecanoic acid, Cyclocurcumin, hexadecanoic acid, 2-hydroxy-1-(hydroxymethyl)ethyl ester, Octadecanoic acid, 2,3-dihydroxy propyl ester, Berberine cation, Di(pentamethylphenyl) ketone, 17-Methoxy-4-methyl-d-homo-18-norandrosta-4,8,13,15,17-pentane-3-one, 5,5'-Diallyl-2,2'-biphenyldiol, mono(trimethylsilyl) ether, 4'-O-Methyl glabridin and Glabridin found in *Glycyrrhiza glabra*. *Terminalia chebula herbs* consisted of therapeutic potential compounds such as undecane, levoglucosenone, 4H-pyran-4-one, 2,3-dihydro-3,5-dihydroxy-6-methyl, 5-hydroxy methyl furfural, 5-(hydroxymethyl)-2-(dimethoxy methyl)furan, resorcinol, TMS derivative, 1,2,3-benzenetriol, benzaldehyde, 3-hydroxy-4-methoxy, 2-propenoic acid, 3-phenyl, benzoic acid, 3-hydroxy, β-D-Gluco pyranose, 1,6-anhydro-3-pyridine carboxylic acid, 6-amino, melezitose, hexadecanoic acid, methyl ester, Benzoic acid, 3,4,5-trihydroxy, 9,12-octadecadienoic acid (Z, Z),

oleic acid, and octadecanoic acid. *Hamdard joshanda* unani medicine consisted of therapeutic potential compounds viz thiazole, lincomycin, thiomorpholine-3-carboxylic acid amide, 4H-pyran-4-one, 2,3-dihydro-3,5-dihydroxy-6-methyl, benzoic acid, α,β-gluco-octonic acid lactone, isosorbide dinitrate, maltose, 5-hydroxy methyl furfural, (6-hydroxy methyl-2,3-dimethyl phenyl) methanol, melibiose, 1,2,4-benzenetriol, melezitose, benzenepropanoic acid-4-hydroxy, desulphosinigrin, 2-hydroxy-3-isopropyl-6-methyl benzoic acid, cyclopropanebutanoic acid, n-hexadecanoic acid,[1,1'-bicyclopropyl]-2-octanoic acid, 2'-hexyl-, methyl ester, oleic acid, 1-phenanthrene methanol, 1,2,3,4,4a,9,10,10a-octahydro-6-methoxy-1,4a-dime, (hexadecanoic acid, 2-hydroxy-1-(hydroxymethyl)ethyl ester and octadecanoic acid, 2-hydroxy-1-(hydroxymethyl)ethyl ester.[13-16]

## Chemical Constituents

Herbs *Glycyrrhiza glabra*, *Terminalia chebula*, and *Hamdard joshanda* had important potent ingredients that might brings mixed reactive chemical compounds together to form a new compound like flavanone, aromatic cyclic compound, disaccharide, trisaccharide, polymer, an unsaturated six-membered ring containing oxygen atom and a ketone functional group, heterocyclic compounds, polycyclic aromatic hydrocarbon, Pentagalloyl glucose, glycosides …. etc. Phytoconstituents of *Glycyrrhiza glabra*, *Terminalia chebula*, and *Hamdard joshanda* were rich in polygalloyl glucose mixtures (32-50%) that were responsible for a limited number of pharmacological activities. The vital constituents of herbal medicines such as furfural, pyranone, furan, melezitose, oxadiargyl, coumarin, dihydroflavopereirine, dasatinib, cyclocurcumin, berberine cation, glabridin, thiazole, lincomycin, thiomorpholine-3-carboxylic acid amide, melibiose, desulphosinigrin, phenanthrenemethanol, volatile oil, apiol as well as acids such as amino, 9,12-octadecadienoic, octadecanoic, benzoic, vaccenic, oleic, linoleic, octadecanoic and hexadecenoic were present in the investigated medicinal plants. Fourteen hydrolyzable tannin components were found, including gallic acid, chebulagic acid, punicalagin, chebulanin, corilagin, neochebulinic acid, ellagic acid, chebulinic acid, anthraquinones, 1,2,3,4,6-penta-O-galloyl-D-glucose, casuarinin, 3,4,6-tri-o-Chebulinas, flavonol glycosides, triterpenoids, and coumarin compounds containing gallic also phenolic compounds. Polyphenols such as corilagin, galloyl glucose, punicalagin, terflavin A, and maslinic acid were also found as minor constituents. Fructose, amino acids, succinic, beta-sitosterol, and resin were among the other compounds detected. Palmitic, linoleic, and oleic acid are among the 10 fatty acids that were found in *Glycyrrhiza glabra, Terminalia chebula*, and *Hamdard joshanda*. Triterpenoid glycosides, vanillic acids, polyphenols and pyrogallol have also been reported.[8,9,12,14]

## Molecular Docking Studies in *COVID – 19, Lung Cancer and Mycobacterium Tuberculosis*

The docking studies were conducted between chemical constituents of traditional medicines such as *Glycyrrhiza glabra, Terminalia chebula* and *Hamdard joshanda* and *COVID-19 SARS-CoV-2 S* protein for the modeling (PDB ID:3SN8), Lung Cancer protein for the modeling (PDB ID:6JZ0) and *Mycobacterium Tuberculosis* protein for the modeling (PDB ID:4FDO) respectively. The results of docking and crucial interaction between the ligand and the receptor, greatest binding pose, and prime binding site were shown in (Figure 2). These binding results showed that important constituents of *Glycyrrhiza glabra, Terminalia chebula* and *Hamdard joshanda* bounds very well with COVID-19, *Mycobacterium Tuberculosis* and Lung Cancer main protease and receptors.[20,21]

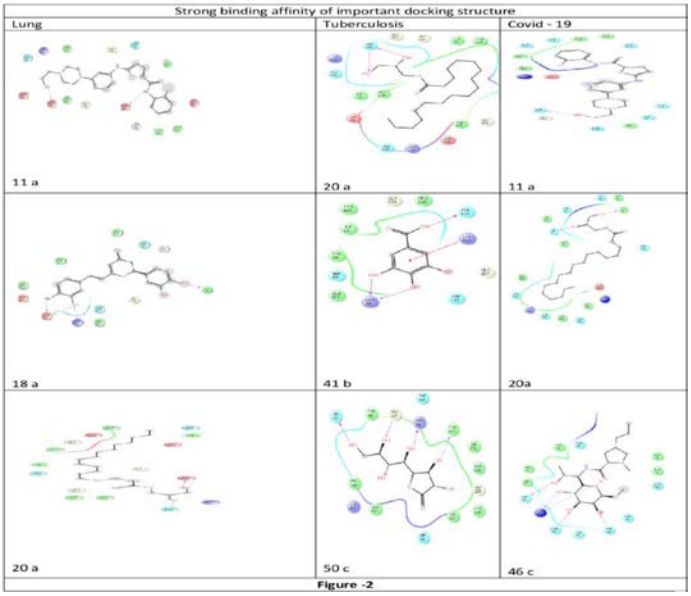


**Figure 2:** Molecular docking studies in COVID – 19, Lung Cancer and Mycobacterium Tuberculosis.

# DISCUSSION

GC-MS results displayed that the major compound present in *G. glabra* was Glabridin (52.61%), related with medicinal valuables such as antioxidant, anti-inflammatory, preventing atherogenesis, metabolic control, immunomodulatory, neuroprotective, anti-osteoporotic and skin-whitening due to the presence of two hydroxyl group in dihydrofuran ring. The second major percentage compound was 4'-O-methylglabridin (9.04%), Undecane (7.85%), 3-O-methyl-d-glucose (5.53%), 5-methoxy psoralen (5.10%) which exhibited anti-inflammatory, immunodeficiency, cytotoxic, antimutagenic, antiplasmodial, antiviral activities, antimicrobial, antioxidant, hypocholesterolemic, hemolytic, nematicide, potent mosquito larvicide, and pesticide activity because of the presence of two methyl group. From the literature survey, glabridin is an important flavonoid though has not been studied its numerous bioactivities. 3-O-methyl-d-glucose acts as a CEST contrast agent for brain-tumor detection.[18-20] Similarly, the most dominating compounds present in *Terminalia chebula* were (Gallic acid) 3, 4, 5 trihydroxy benzoic acid (31.86%) and (Pyrogallic acid) 1,2,3 benzene triol (30.80), which were reported to possess multiple biological, pharmacological and chemical properties. 3, 4, 5 trihydroxy benzoic acid is a powerful chelating agent with metal ions through hydroxyl groups because of less toxicity, antioxidant activity and secure natural antiviral compounds. Gallic acid is able to alter virus replication and functional protein synthesis. Volatile oils exploit effective solvents and detergents, applicable to solubilize and smash the lipid layer of the wrapped viruses which relate with antiviral activity due to the presence of phenyl ring, vinyl and carboxyl, ester, hydroxyl and methoxy groups. Gallic acids contain free hydroxyl groups that high level polar phenolics produce a protective coating on the cell's surface, cell penetration, prevent viral adsorption, antiviral efficacy. According to literature surveys and clinical studies show that gallic acid possesses the best bioavailability in humans.[8,5,13,17]

Predominating compounds present in *Hamdard joshanda* is 5-hydroxy methyl furfural (24.51%), considered as the major medicative potential that concede as a fundamental intermediate in the making of carbohydrates and insulin. This is acid-catalyzed dehydration of sugars, hexoses which is highly non-selective when taking place in aqueous

media. Hydroxy methyl furfural is excessively found in coffee, dried fruits and HMF is found in less numbers in honey, fruit juices and milk. Hence HMF is used as an indicator in vinegar, jams, biscuits, and alcoholic products for baking. A major metabolite in humans is 5-hydroxy methyl furfural which gets excreted in urine and cures abnormal haemoglobin. The second major percentage compound was melezitose (19.87) which is an important portion of the honeydew that attracts ants also has a symbiotic relationship with ants moreover a food source for bees. Turanose and sucrose are present in melezitose that hydrolyzed to glucose and turanose which were an isomer of sucrose. However, melezitose-containing honey is known to cure malnutrition, controls diet, increase food intake, elevated mortality, swollen abdomen, abdomen tipping and improve blood circulation.[8,5,6,7] The third major percentage compound was linomycin (11.42) which is used to treat certain kinds of bacterial infections. Octadecanoic acid, 2-hydroxy-1-(hydroxymethyl)ethyl ester manifests skin disease, hay fever, an abnormal deficiency of cholesterol in the blood, nematicide, hepatoprotective, antioxidant and antimicrobial activity. Some of the minor percentage compounds have been reported to treat antimicrobial activity, antioxidant, an abnormal deficiency of cholesterol in the blood, anti-inflammatory, immunodeficiency, cytotoxic, cancer, antimutagenic, antiplasmodial, antiviral activities, antimicrobial, antioxidant, hemolytic, nematicide, potent mosquito larvicide, pesticide and androgenic activity.[18,19]

We carried out to evaluate the interactions of *Glycyrrhiza glabra*, *Terminalia chebula* and *Hamdard joshanda* chemical constituents with *SARS coronavirus* main protease complex FF-H (Hydrolase inhibitor) which had very good interaction with the following phytochemical constituents such as undecane, dihydroflavopereirine, dasatinib, hexadecanoic acid - methyl ester, 5-methoxy psoralen, n-hexadecanoic acid, 9,12-Octadecadienoic acid (Z, Z), cis-Vaccenic acid, Octadecanoic acid, cyclocurcumin, hexadecanoic acid, 2-hydroxy-1-(hydroxymethyl) ethyl ester, octadecanoic acid- 2, 3-dihydroxy propyl ester, berberine cation and di (pentamethylphenyl). Energy binding was nearly -5.761 (Kcal/mol), inhibition constant value was -46.596, hydrogen bond glide rewards was around -2.823, glide evdw was about -35.467, glide energy was closely -47.532, glide posenum was absolutely 390, maximum glide score value was at -5.976, glide ligand was -1.869 and total intermolecular energy was -46.596 (Kcal/mol). Dasatinib (11a) present in *Glycyrrhiza glabra* interacted with fifteen active site residues like THR24, THR25, LEU27, ASN142, GLY143, THR26, GLU166, S89307, MET165, LEU167, GLN192, THR190, PRO168, ALA191 and GLN189. Octadecanoic acid-2,3-dihydroxy propyl ester (20a) found in *Glycyrrhiza glabra* interacted with seventeen active site residues like ASN142, GLU166, S89307, MET165, THR190, LEU167, GLN189, ARG188, GLN192, PRO168, LEU27, HIE41, VAL42, THR25, THR45, MET49 and CYS44. Lincomycin (46c) found in *Hamdard joshanda* interacted with thirteen active site residues in thirteen different modes ASN142, S89307, THR45, GLN189, LEU27, HIE41, VAL42, THR24, THR25, THR26, MET49, ALA46 and CYS44. Docking analysis of the *COVID-19 SARS-CoV-2 S* protein with these three phytochemical constituents Dasatinib (11a), Octadecanoic acid-2,3-dihydroxy propyl ester (20a) and Lincomycin (46c) showed that they all strongly bounds with the S proteins with ΔG values of -5.761, -5.13 and -3.617 kcal/mol respectively.[18,19]

We advanced to examine the interactions of *Glycyrrhiza glabra, Terminalia chebula* and *Hamdard joshanda* chemical constituents with *Mycobacterium tuberculosis* DPRE1 in complex with CT319 which possessed well interaction with the following phytochemical constituents like oxadiargyl, benzene-ethylpentamethyl, dihydroflavopereirine, 5-methoxy psoralen, 4H-pyran-4-one, 2,3-dihydro-3,5-dihydroxy-6-methyl, 2,3-dihydro-3,5-dihydroxy-6-methyl, benzaldehyde, 3-hydroxy-4-methoxy, β-D-glucopyranose, 1,6-anhydro, benzoic acid, 3,4,5-trihydroxy and 4H-pyran-4-one. Energy binding was nearly -7.426 (Kcal/mol), inhibition constant value was -66.098, hydrogen bond glide rewards was around -2.706, glide evdw was about -36.329, glide energy was closely -38.849, glide posenum was absolutely 383, maximum glide score value was -7.426, glide ligand was -1.883 and total intermolecular energy was -47.532 (Kcal/mol). The docking study showed that octadecanoic acid-2,3-dihydroxy propyl ester (20a) present in *Glycyrrhiza glabra* interacted significantly with the amino acids present in the active sites GLY117, GLY133, TYR60, TYR415, ALA417, ARG58, TRP16, THR118, SER59, VAL121, GLY321, GLU322, ASP318, ARG119, GLN120, ASP99, PRO116, ILE131, GLN336, LYS418 and HIE132. Benzoic acid, 3,4,5-trihydroxy (41b) presenced in *Terminalia Chebula* coordinated with different types of active site residues like TYR415, ILE131, TYR60, SER59, ALA417, ARG58, THR118, GLY117, LYS418, HIE132, PRO116 and GLY 133. α, β-gluco-octonic acid lactone (50 c) presenced in *Hamdard joshanda* fits appropriately in the active site viz HIE132, TYR60, GLY117, ARG58, TYR415, ILE131, ALA126, GLY125, CYS129, VAL121, SER59, ALA417, LYS418 and PRO116.[20]

Docking analysis of *Mycobacterium tuberculosis* DPRE1 in complex with CT319 protein and the three phytochemical constituents octadecanoic acid-2,3-dihydroxy propyl ester (20a), benzoic acid, 3,4,5-trihydroxy (41b) and α, β-gluco-octonic acid lactone (50 c) showed that they all strongly bound with CT319 protein with ΔG values are -4.426, -6.023 and -5.19 kcal/mol. The docking results were obtained between phytochemical constituents of the selected medicinal plants and Lung cancer crystal structure of EGFR kinase domain in complex with comp (Transferase/Inhibitor) that had associated with the following chemical constituents viz Thiomorpholine-3-carboxylic acid amide, benzoic acid-3,4,5-trihydroxy, glabridin, resorcinol, melibiose, cyclocurcumin, 1,2,3-benzenetriol, benzoic acid, 3-hydroxy benzoic acid, α,β-gluco-octonic acid lactone, 2-hydroxy-3-isopropyl-6-methyl benzoic acid, 4H-pyran-4-one, 2,3-dihydro-3,5-dihydroxy-6-methyl, 1,2,4-benzenetriol, 4H-pyran-4-one, 2,3-dihydro-3,5-dihydroxy-6-methyl, 3-hydroxy-4-methoxy benzaldehyde, 4-hydroxy benzenepropanoic acid, maltose, 3-phenyl 2-propenoic acid and (6-hydroxymethyl-2,3-dimethyl phenyl) methanol. Energy binding was nearly -5.725 (Kcal/mol), inhibition constant value was -50.803, hydrogen bond glide rewards was around -2.25, glide evdw was about -36.329, glide energy was closely -41.297, glide posenum was absolutely 399, maximum glide score value was -5.725, glide ligand was -1.352 and total intermolecular energy was -51.119 (Kcal/mol). dasatinib (11a) present in *Glycyrrhiza glabra* was found to bind with different types of amino acids ASN842, ARG841, PHE723, GLY719, SER720, LEU718, GLU804, CYS797, PHE 795, GLY796, ASP800, GLY 721, LEU858, ASP837 and ASP855. Cyclocurcumin (18a) present in *Glycyrrhiza glabra* bound with amino acid residues like ALA722, SER720, GLY721, LEU 718, GLY719, ASN842, PRO877, ARG841, ASP837, ASP855, LEU858, PHE723. Octadecanoic acid-2,3-dihydroxy propyl ester (20a) present in *Glycyrrhiza glabra* interacted with sixteen active site residues like TYR801, ASP800, GLY796, CYS797, LEU718, SER720, GLY721, PHE723, ALA722, ASN842, ARG841, ASP 855, GLY719, GLU804, PHE795 and HIS805. The phytochemical constituents inside protein were outlined by different amino acids through halogen bond, polar, hydrophobic, pi-pi, metal-ligand and hydrogen bond interactions. Docking analysis between Lung cancer crystal structure of EGFR kinase and three phytochemical constituents dasatinib (11a), Octadecanoic acid-2,3-dihydroxy propyl ester (20a) and cyclocurcumin (18a) showed that they all strongly bounds to Lung cancer crystal structure of EGFR kinase with ΔG values as -3.262, -2.02 and -5.064 kcal/mol.[18-21]

Results of molecular docking studies revealed that dasatinib (11a), octadecanoic acid-2,3-dihydroxy propyl ester (20a) and lincomycin (46c) exhibited high activity against *COVID-19 SARS-CoV-2* protein.

Octadecanoic acid-2,3-dihydroxy propyl ester (20a), benzoic acid, 3,4,5-trihydroxy (41b) and α, β-gluco-octonic acid lactone (50 c) possessed moderate antituberculosis activity. Dasatinib (11a), octadecanoic acid-2,3-dihydroxy propyl ester (20a) and cyclocurcumin (18a) had very good effect against lung cancer. Overall studies reveal that the chemical constituents of *Glycyrrhiza glabra* (from 10 a to 22 a), *Terminalia chebula* (29b, 37b and 41b) and *Hamdard joshanda* (47c, 48c, 49c, 50c, 52c, 54c, 55c, 56c and 60c) exhibited moderate to higher efficacy against Covid-19, Tuberculosis and Lung cancer.

## CONCLUSION

This article may help researchers to validate traditional claims and develop safe and efficient botanical treatments by providing a framework for the appropriate evaluation of herbal medicines against diverse human diseases. This study confirms that presence of phytochemicals such as polyphenols, terpenes, anthocyanins, flavonoids, alkaloids, aromatic cyclic compound, disaccharide, trisaccharide, polymer, an unsaturated six-membered ring containing oxygen atom and a ketone functional group, heterocyclic compounds, polycyclic aromatic hydrocarbon, pentagalloyl glucose, glycosides …. etc in *Glycyrrhiza glabra*, *Terminalia chebula,* and *Hamdard joshanda* herbal medicines shall help in reaping the maximum benefits and advantages in health sector. Docking studies proved the potent of bioactive chemical compounds in these herbs to bind efficiently with receptors of Covid-19, Tuberculosis and Lung cancer. However, several more *in vivo* and *in vitro* probe are mandatory to investigate their molecular interactions between therapeutic treatment and the biological target or any other significance of unused bioactive substance in these herbal medicines used for human relapse.

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## CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

## REFERENCES

1. Seth SD, Sharma B. Medicinal plants in India. Indian J Med Res. 2004;120(1):9-11. PMID 15299226.
2. Rajeh MA, Zuraini Z, Sasidharan S, Latha LY, Amutha S. Assessment of *Euphorbia hirta* L. Leaf, flower, stem and root extracts for their antibacterial and antifungal activity and brine shrimp lethality. Molecules. 2010;15(9):6008-18. doi: 10.3390/molecules15096008, PMID 20877206.
3. Sonyot W, Lamlertthon S, Luangsa-Ard JJ, Mongkolsamrit S, Usuwanthim K, Ingkaninan K, *et al. In vitro* antibacterial and anti-inflammatory effects of novel insect fungus Polycephalomyces phaothaiensis extract and its constituents against Propionibacterium acnes. Antibiotics (Basel). 2020;9(5):274. doi: 10.3390/antibiotics9050274, PMID 32466146.
4. Mizushima Y, Kobayashi M. Interaction of anti-inflammatory drugs with serum proteins, especially with some biologically active proteins. J Pharm Pharmacol. 1968;20(3):169-73. doi: 10.1111/j.2042-7158.1968.tb09718.x, PMID 4385045.
5. Mandegary A, Arab-Nozari M, Ramiar H, Sharififar F. Anticonvulsant activity of the essential oil and methanolic extract of *Bunium persicum* (Boiss). B. Fedtsch. J Ethnopharmacol. 2012;140(2):447-51. doi: 10.1016/j.jep.2012.01.024, PMID 22301447.
6. Thappa RK, Ghosh S, Agarwal SG, Raina AK, Jamwal PS. Comparative studies on the major volatiles of Kalazira (*Bunium persicum* seed) of wild and cultivated sources. Food Chem. 1991;41(2):129-34. doi: 10.1016/0308-8146(91)90040-U.
7. Avinash DK, Waman SN. Phytochemical constituents of leaves of *Paniculatus wild*: endangered medicinal plant. Int J Pharmacogn Phytochem Res. 2014;6(4):792-4.
8. Munro B, Vuong QV, Chalmers AC, Goldsmith CD, Bowyer MC, Scarlett CJ. Phytochemical, Antioxidant and Anti-Cancer Properties of *Euphorbia tirucalli* Methanolic and Aqueous Extracts. Antioxidants (Basel). 2015;4(4):647-61. doi: 10.3390/antiox4040647, PMID 26783950.
9. Bashir S, Gilani AH. Antiurolithic effect of Bergenia ligulata rhizome: An explanation of the underlying mechanisms. J Ethnopharmacol. 2009;122(1):106-16. doi: 10.1016/j.jep.2008.12.004, PMID 19118615.
10. Chauhan A, Mittu B. Phyto-chemical Screening and antilisterial activity of *Annona muricata* (L.) leaf extract. J Chromatogr Sep Tech. 2015;6(3):1-4.
11. 14, Banu KS, Catherine L. General techniques involved in phytochemical analysis. International. J Advan Res Chem Sci. 2015;2(4):25-32.
12. Krisgnaveni G, Sailaja O, Mounika K. Identification and estimation of phytochemicals from the plant *Pedicularis bicornuta* leaf extract by UV-spectrophotometry. Res Desk. 2014;3(1):410-8.
13. Bhaigyabati T, Devi PG, Bag GC. Total flavonoid content and antioxidant activity of aqueous rhizome extract of three Hedychium species of Manipur valley. Res J Pharm Biol Chem Sci. 2014;5(5):970.
14. Malla MY, Sharma M, Saxena RC, Mir MI, Mir AH, Bhat SH. Phytochemical screening and spectroscopic determination of total phenolic and flavonoid contents of *Eclipta* A. Linn. J Nat Prod Plant Resour. 2013;3(2):86-91.
15. Tupe RS, Kemse NG, Khaire AA. Evaluation of antioxidant potentials and total phenolic contents of selected Indian herbs powder extracts. Int Food Res J. 2013;20(3):1053-63.
16. Vogel HG, Vogel WH, Schölkens BA, Sandow J, Müller G, Vogel WF. Drug discovery and evaluation: Pharmacological assays. 3rd ed. Berlin, Germany: Springer-Verlag; 2007.
17. Zeb A, Ahmad S, Ullah F, Ayaz M, Sadiq A. Anti-nociceptive activity of ethnomedicinally important analgesic plant *Isodon rugosus* Wall. ex Benth: Mechanistic study and identifications of bioactive compounds. Front Pharmacol. 2016;7:200. doi: 10.3389/fphar.2016.00200, PMID 27458379.
18. Rezaee-Asl M, Sabour M, Nikoui V, Ostadhadi S, Bakhtiarian A. The Study of Analgesic Effects of *Leonurus cardiaca* L. in Mice by Formalin, Tail Flick and Hot Plate Tests. Int Sch Res Notices. 2014;2014:687697. doi: 10.1155/2014/687697. PMID 27433501.
19. Praveena A, Arthi S, Sudarmathi B. *In vitro* and *in silico* analysis to identify novel lead compound from *Morinda tinctoria* fruit against breast cancer. IJPS. 2019;81(5):970-5. doi: 10.36468/pharmaceutical-sciences.593.
20. Aertgeerts K, Skene R, Yano J, Sang BC, Zou H, Snell G, *et al.* Structural analysis of the mechanism of inhibition and allosteric activation of the kinase domain of HER2 protein. J Biol Chem. 2011;286(21):18756-65. doi: 10.1074/jbc.M110.206193, PMID 21454582.
21. Bareschino MA, Schettino C, Troiani T, Martinelli E, Morgillo F, Ciardiello F. Erlotinib in cancer treatment. Ann Oncol. 2007;18(6);Suppl 6:vi35-41. doi: 10.1093/annonc/mdm222, PMID 17591829.

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