Introduction

Actin is the favorable macromolecule of microfilaments that mainly possess essential roles in central processes within the cell system, as well as transport, cellular division, and motility. The first biological activity of simple protein is its chemical process to create filaments that may generate force at cell membranes or act as staging structures or tracks for motor proteins.\(^1,2\) These filaments area unit on a timer based on the reaction of tightly certain nucleotide molecules; however, some microfilaments that constrain structural factors are unknown. The situation of this supermolecule contains metallic ions throughout the reaction by exploiting the phosphate cluster that correlates with three-letter amino acids like essential amino acid, lysine, and amino alkanoic acid and essential amino acid.\(^3\) The loops of the ternary supermolecule square measure mainly connected with the simple protein protomer that links the inner and outer domain. Sarcomeres square measure divided into units that square measure derived by I bands and also the unit of measurement bisected by Z discs and A bands with a dark M in the middle. I bands accommodate skinny protein filaments, tropomyosin, and troponin. Thick filaments unit of measurement created from simple protein.\(^6\) The A band consists of overlapping skinny with thick filaments and various proteins. Acacia catechu (Wild or noncanonical link between nucleotide molecules; however, the bioactive compounds of Acacia catechu using gas chromatography-mass spectroscopy and the inhibitory activity against contractile protein Plasmodium falciparum against the protozoan disease were studied. This research mainly focuses on finding novel drug screening against the malarial enzyme. The compounds of Acacia catechu are screened using Lipinski rule of five with absorption distribution metabolism excretion (ADMET) properties in which the character, as well as behavior of the drug compound, is known. The compounds were checked for its dosage level in human and rat as well as distribution properties in the blood-brain barrier and central nervous system. The compounds 9,12,15-Octadecatrienoic acid has a higher affinity with −7.95 Kcal/mol followed by Phthalic acid, butyl 2-pentyl ester −7.35 Kcal/mol and Furo[2,3-d] Pyrimidine-4,6 [5H,7H]-dion −6.24 Kcal/mol were docked using Autodock software. The compound 9,12,15-Octadecatrienoic acid, Phthalic acid butyl 2-pentyl ester, Furo[2,3-d] Pyrimidine-4,6 [5H,7H]-dion has higher affinity such as −7.95 Kcal/mol, −7.35 Kcal/mol and −6.24 Kcal/mol, respectively. Thus this research proves that the drug compounds of Acacia catechu have novel therapeutic drug activity against virulent enzymes.

ABSTRACT

The bioactive compounds of Acacia catechu using gas chromatography-mass spectroscopy and the inhibitory activity against contractile protein Plasmodium falciparum against the protozoan disease were studied. This research mainly focuses on finding novel drug screening against the malarial enzyme. The compounds of Acacia catechu are screened using Lipinski rule of five with absorption distribution metabolism excretion (ADMET) properties in which the character, as well as behavior of the drug compound, is known. The compounds were checked for its dosage level in human and rat as well as distribution properties in the blood-brain barrier and central nervous system. The compounds 9,12,15-Octadecatrienoic acid has a higher affinity with −7.95 Kcal/mol followed by Phthalic acid, butyl 2-pentyl ester −7.35 Kcal/mol and Furo[2,3-d] Pyrimidine-4,6 [5H,7H]-dion −6.24 Kcal/mol were docked using Autodock software. The compound 9,12,15-Octadecatrienoic acid, Phthalic acid butyl 2-pentyl ester, Furo[2,3-d] Pyrimidine-4,6 [5H,7H]-dion has higher affinity such as −7.95 Kcal/mol, −7.35 Kcal/mol and −6.24 Kcal/mol, respectively. Thus this research proves that the drug compounds of Acacia catechu have novel therapeutic drug activity against virulent enzymes.
Khair) belongs to a family Mimosaceae, this plant contains herbal remedies and is used as ayurvedic medicine. The medicinal character in plant helps to cure stomach and gastrointestinal diseases. Antioxidant properties are also reported from both extract (Wild and Khair) rather than an anti-cognitive disorder, anti-acetylcholinesterase, and anti-schizophrenic reports were not available.\textsuperscript{7}

**Phytochemical screening**

The biochemical studies show the presence of phytochemicals like resins, saponins, flavonoids, alkaloids, steroids, glycosides, protein, and carbohydrate.\textsuperscript{[6,9]} The physiochemical parameters like ash content, soluble acid ash, water-soluble ash, water-soluble extractives, volatile oil, fiber content, and total sugar were analyzed in which various factors like CO\textsubscript{3}\textsuperscript{2-}, PO\textsubscript{4}\textsuperscript{3-}, SO\textsubscript{4}\textsuperscript{2-}, AL\textsuperscript{3+}, Ca\textsuperscript{2+}, Mg\textsuperscript{2+}, and K\textsuperscript{+} were found to be positive.\textsuperscript{[10]} The flavonoids and the tannins present in the plant plays a major role as an inhibitory factor against virulent enzymes. This plant has fluorescence behavior of different extracts of *Acacia catechu* with extractives like petroleum ether, benzene, acetone, etc.\textsuperscript{[11]}

**Materials and Methods**

**Biologically Active Compounds of *Acacia Catechu* by Using Gas Chromatography–Mass Spectrometry (GCMS)**

The biologically active compounds of the *Acacia catechu* were analyzed using GCMS, and the peaks were compared using WILEY and NIST libraries. The major components found in the hydroethanolic leaf extract were Benzenamine, 3 ethoxy, 2Methyl-1,2,3,4-tetrahydro betacarboline, 1-Methoxy-4-(4-Methoxy benzene), 2-napthalenamine, phthalic acid, 6-ethyl-3-octyl butyl ester, phthalic acid, butyl 2-pentyl ester, hexadecanoic acid, ethyl ester, 12-methoxy19-norpo docarpa, furo[2,3-d] pyrimidine-4,6 [5H,7H]-dion, Phytol 9,12,15-octadecatrienoic acid, butylphosphoric acid, di(4-methoxy benzene) and 2-pyridine carbonitrile, 1,2,5,6.\textsuperscript{[12]} The phytocompounds have better antioxidant activities against several diseases due to the presence of various phytochemicals. The compounds were analyzed using the Lipinski rule of five in which various parameters were checked like hydrogen bond acceptor and donor, molecular weight, lipophilicity and molar refractivity.

**Preparation of Contractile Protein**

The three-dimensional (3-D) structure of the contractile protein were taken from the protein data bank ID is 6I4L as shown in Fig. 1 with active site presentation. The protein, along with actin, is responsible for causing disease like *Plasmodium falciparum* that consists of virulent malarial strain. This disease plays an important role in suppressing the immunity system by interfering with phagocytic functions of macrophage. The contractile protein gets precipitated at pH 5 in which the malaria strain gets activated in smooth muscles. The protein stored in the database is at a resolution of 1.83 Å at X-ray diffraction method. The protein mainly consists of A chain comprises of 378 amino acids. The three-letter coding active sites of amino acids in *Plasmodium falciparum* are shown in Fig. 1. The sequence of amino acid in protein is mainly responsible for stabilizing the macromolecules of the mutant protein to induce the protozoan enzyme.\textsuperscript{[13,14]}

**Absorption Distribution Metabolism Excretion ADMET Properties**

The physiochemical properties like ADMRT were screened with the bioactive compounds of *Acacia catechu* determined from GCMS. These property plays a major role to analyze the behavior and characteristic of drug materials like water absorption level, gastrointestinal...
absorption, the penetration level of drug molecules in the central nervous system, and blood-brain barrier. The hepatoprotective and skin permeability measures were also analyzed for both humans and rats. The ADME/T properties were analyzed using the software http://www.sib.swiss for calculating the behavior of drug compounds that directly based on the principle of the vector-based algorithm.[15,16]

**Molecular Docking Using Autodock 4.2.6**

The software Autodock 4.2.6 is mainly used for protein-ligand docking in which compounds will be rigid like structure. The parameters utilized for the process of docking will be a genetic algorithm in which the output file format will be of the Lamarckian genetic algorithm. The software can able to perform protein-protein interactions and ligand-protein interactions for showing better potential activity against virulent enzymes. The grid points for the total map were 64,000, with grid spacing 0.375 Å (default). The grid size set as default was 20 Å. The center grid box sizes in the protein sequence were centered as x center: −16.302, y center: −23.34, and −16.245, respectively.

**RESULTS AND DISCUSSION**

The biologically active compounds of *Acacia catechu* were confirmed using Lipinski rule of five to determine the drug properties. The bioactive compound that satisfies the lipinski rule of five are benzenamine, 3-ethoxy, 12-methoxy19-norpo dorca, furo[2,3-d] pyrimidine-4,6 [5h,7h]-dion, 2methyl-1,2,3,4-tetrahydro beta-carboline, 1-methoxy-4-(4-methoxy benzene), phthalic acid, butyl 2-pentyl ester, 9,12,15-octadecatrienoic acid, butylphosphoric acid, di(4-methoxy benzene) and 2-pyridine carbonitrile, 1,2,5,6 are listed in Table 1.

**Absorption Distribution Metabolism Excretion (ADMET) Properties**

The compounds that mainly satisfy the Lipinski rule of five were screened for ADMET for better identification of potential activity. The absorption properties of the drug were analyzed in which the water solubility of the drug molecule, glycoprotein inhibitor and substrate, gastrointestinal absorption, and skin permeability was shown in Table 2. The distribution properties that include the permeability level of the blood-brain barrier (BBB) and central nervous system (CNS) were shown in Table 3. The metabolism properties of the drug compounds have better-promising parameters under cytochrome p450 which, as shown in Table 4. The excretion and toxicity level was analyzed in which the dosage level of the drug compound was tabulated in Tables 5 and 6 along with hepatotoxicity test and skin sensation.[15–17]

**Molecular Docking Studies**

The docking analysis was done against virulent enzyme *Plasmodium falciparum*, which was compared with the

### Table 1: Compounds analyzed in lipinski rule of five

| Compound                                             | Mass of compounds | Hydrogen bond donor | Hydrogen bond acceptor | LOGp   | Molar refractivity |
|------------------------------------------------------|-------------------|---------------------|------------------------|--------|-------------------|
| Benzenamine, 3 ethoxy                                | 193               | 0                   | 2                      | 2.93   | 61.17             |
| 12-Methoxy19-norpo docarpa                           | 244               | 1                   | 1                      | 5.18   | 73.96             |
| Furo[2,3-d] pyrimidine-4,6 [5h,7h]-dion               | 196               | 0                   | 5                      | 0.50   | 43.55             |
| 2Methyl-1,2,3,4-tetrahydro betacarboline              | 186               | 1                   | 1                      | 2.15   | 58.33             |
| 2-Naphthalenamine                                    | 297               | 2                   | 3                      | 5.99   | 94.48             |
| Phthalic acid, 6-ethyl-3-octyl butyl ester           | 362               | 0                   | 4                      | 5.79   | 104.4             |
| 1-Methoxy-4-(4-methoxy benzene)                      | 212               | 0                   | 4                      | 1.74   | 55.69             |
| Pthalic acid, butyl 2-pentyl ester                   | 292               | 0                   | 4                      | 3.99   | 81.43             |
| Hexadecanoic acid, ethyl ester                      | 284               | 0                   | 2                      | 6.03   | 86.94             |
| Phytol                                               | 296               | 1                   | 1                      | 6.3    | 95.56             |
| 9,12,15-Octadecatrienoic acid                       | 278               | 1                   | 2                      | 5      | 86.89             |
| Butylphosphoric acid, di(4-methoxy benzene)         | 172               | 4                   | 5                      | −0.149 | 36.25             |
| 2-Pyridine carbonitrile, 1,2,5,6                     | 104               | 0                   | 2                      | 0.95   | 28.95             |

### Table 2: Absorption properties of compounds

| Compound                                             | Water solubility (log mol/L) | CoC0 permeability (Log Pabb in 10⁻⁶ cm/Sec) | GI absorption (%) | Skin permeability (Log Kp) | P-glycoprotein substrate | P-glycoprotein inhibitor |
|------------------------------------------------------|-------------------------------|---------------------------------------------|-------------------|---------------------------|-------------------------|--------------------------|
| Benzenamine, 3-ethoxy                                | −1.643                        | 1.453                                       | 93.28             | −2.969                    | No                      | No                       |
| Furo[2,3-d] pyrimidine-4,6 [5h,7h]-dion              | −1.429                        | 0.797                                       | 98.14             | −2.683                    | No                      | No                       |
| 2Methyl-1,2,3,4-tetrahydro betacarboline             | −2.64                         | 1.276                                       | 93.76             | −2.617                    | Yes                     | No                       |
| 1-Methoxy-4-(4-methoxy benzene)                      | −1.766                        | 1.633                                       | 95.91             | −1.397                    | No                      | No                       |
| Pthalic acid, butyl 2-pentyl ester                   | −4.594                        | 1.639                                       | 94.19             | −2.649                    | No                      | No                       |
| 9,12,15-Octadecatrienoic acid                       | −5.787                        | 1.577                                       | 92.83             | −2.722                    | No                      | No                       |
| Butylphosphoric acid, di(4-methoxy benzene)         | −0.11                         | −0.61                                       | 54.01             | −3.504                    | No                      | No                       |
| 2-Pyridine carbonitrile, 1,2,5,6                     | −2.208                        | 1.635                                       | 97.06             | −2.817                    | No                      | No                       |
standard drug as control. When compared with standard drug the bioactive compounds have a high affinity towards the virulent enzymes. The binding energy of each ligand molecule is listed along with the types of interactions like hydrogen and vander Waals interaction. The active site of the enzymes was docked in which the compound 9, 12, 15-octadecatrienoic acid has greater inhibitory activity against malaria disease by interfering with a normal habitat of the human body. These compounds do not have any toxic factors which has been evaluated using Lipinski rule of five and ADMET properties. The Table 6 and Figs. 2 to 4 shows detailed information about the active amino acids involved in properties. The Table 6 and Figs. 2 to 4 shows detailed information about the active amino acids involved in properties. The Table 6 and Figs. 2 to 4 shows detailed information about the active amino acids involved in properties. The Table 6 and Figs. 2 to 4 shows detailed information about the active amino acids involved in properties. The Table 6 and Figs. 2 to 4 shows detailed information about the active amino acids involved in properties. The Table 6 and Figs. 2 to 4 shows detailed information about the active amino acids involved in properties.
Fig. 2: 2D and 3D interactions of 9,12,15-octadecatrienoic acid

Fig. 3: 2D and 3D interactions of phthalic acid, butyl 2-pentyl ester

Fig. 4: Surface image of 9,12,15-octadecatrienoic acid
CONCLUSION

This research work concludes that the structure-based drug designing of molecules against virulent enzymes shows better inhibitory activity. The ligand compounds of Acacia catechu were docked against malarial enzyme Plasmodium falciparum. They were screened using the Lipinski rule of five and ADMET properties in which the compounds show various properties. The drugs were checked for activities, whether it breaches the blood-brain barrier as well as the central nervous system. Then the satisfied compounds were docked using Autodock software, in which the compounds show high affinities. The discovery of novel drugs can be used as a therapeutic agent after several trials. The comprehensive docking provides high accuracy studies. Hence, this research concludes that Acacia catechu has better inhibitory potential activity against malarial disease, and the bioactive compounds from Acacia catechu have better drug-like properties.

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