IJBPAS, November, 2024, 13(11): 5391-5408

ISSN: 2277–4998

International Journal of Biology, Pharmacy and Allied Sciences (IJBPAS)

'A Bridge Between Laboratory and Reader'

www.ijbpas.com

IN-SILICO PREDICTION APPROACH ON ANTIASTHMATIC ACTIVITY OF VOLATILE OIL ISOLATED FROM *MILLINGTONIA HORTENSIS* LINN. FLOWERS

V.E.IDA CHRISTI*, ARUNKUMAR V, DIVYA K, GAYATHRI S AND MANISELVI S

Department of Pharmacognosy, PSG College of Pharmacy, Coimbatore, India

***Corresponding Author: Dr. V. E. Ida Christi: E Mail: 1969idacsha@gmail.com**

Received 24th July 2023; Revised 25th Sept. 2023; Accepted 22nd Dec. 2023; Available online 1st Nov. 2024

https://doi.org/10.31032/IJBPAS/2024/13.11.8381

ABSTRACT

Millingtonia hortensis belongs to the family Bignoniaceae is a native of Asian continent. It is widely utilized in traditional medicine and their extracts contain a high concentration of flavonoids. The aim of the present study was to isolate and characterize the volatile oil from *Millingtonia hortensis* Linn. flower and study its various biological activities by *in-silico* model. The isolation of volatile oil was performed by hydro distillation and solvent extraction methods. The various phytoconstituents present in the volatile oil were identified by preliminary phytochemical analysis and then by Gas chromatography–mass spectrometry (GC-MS) method. Identification of pharmacological activity of the photochemical present in the volatile oil was performed by *in-silico* methods. In the initial phytochemical analysis, the presence of steroids and terpenoids was confirmed. The compounds present in the volatile oil was isolated by GC-MS and analyzed. There are about 37 compounds were characterized. Based on the peak of the phytomolecules in the GC-MS analysis was selected for an *in-silico* study to identify their pharmacological activity. The *in-silico* study was based on the affinity of molecules towards the protein and with this method eight compounds were identified with significant pharmacological activity. Our findings confirmed that the volatile oil isolated from *Millingtonia hortensis* Linn. flower contains phytomolecules have pharmacologically active like anti tubercular and antiasthmatic activity which may have therapeutic applications in the near future.

Keywords: *Millingtonia hortensis*, Volatile oil, GC-MS, *In silico,* Antiasthmatic

INTRODUCTION

Medicinal plants have an important place in health care since ancient times and traditional medicine which involves the predominant usage of medicinal plants is used by about 80% of the population worldwide. In ancient times, people were fully aware of the rich potential of herbs for curing different types of ailments and used them accordingly. Herbs include botanicals of various types like aromatic plants which are used in medicine or as seasoning. Herbs may be used directly as tea or extracts as well as in the production of drugs. The study or use of such medicinal herbs to prevent and treat diseases and aliments is commonly known as 'Phytotherapy', while the drugs or preparations made from plants and used for such purposes are classified as 'herbal drugs' **[1]**.

All plants produce chemical compounds as a part of their normal metabolic activity. They can be split into two broad categories, as either primary metabolites or secondary metabolites which are much more specialized substances with a wide variety of functions in the organisms that produce them. Primary metabolites are commonly, but secondary metabolites are found only in a narrow range of plants. Many of the pharmaceuticals drugs currently available have a long history of use secondary metabolites as herbal medicines **[2]**.

Higher plants and medications manufactured from them have long been used to treat infections. Numerous programs have aimed at discovering novel antibacterial chemicals from natural sources **[3]**. The *Millingtonia hortensis* flower is a larger version of jasmine, hence the reason of naming it 'Tree jasmine'or'Indian cork tree'. The present study gives the detailed literature search on pharmacognosy, phytochemistry and pharmacological activities of this plant. The name *Millingtonia hortensis* comes from the name of an English botanist, Thomas Millington, while *hortensis* means grown in gardens **[4]**.

The *Millingtonia hortensis* leaf extracts have the effects on a variety of Gram-positive and Gram-negative bacteria and fungi. It was reported earlier that the bark of *M. hortensis* contains a bitter substance and some tannins, and is used in Indonesia as an antipyretic. Hispidin and hortensin were extracted from the flowers, whereas carotene and 7-rutinoside were isolated from the leaves. The hispidulin is having bronchodilating properties. Almost all the parts of Indian cork tree (e.g., root, stem, bark, leaf, and flower) have been used in traditional and folk

medicine. Root of the plant has been used as anti-asthmatic and antimicrobial. Leaf of the plant can be used as antipyretic, useful against sinusitis, acts as a cholagogue (a substance that promotes production of bile in the gall bladder) and tonic, stem of the plant is used as cough suppressant and lung tonic. Flower buds are also used in asthma, to treat sinusitis, acts as a cholagogue and tonic **[5]**. Flowers are added to tobacco for smoking as treatment for throat ailments and whole part of the plant is used as an antipyretic, antitubercular, antimicrobial, larvicidal, antimutagenic and antifungal **[6]**.

In this present study volatile oil from the flowers was isolated and subjected to Gas chromatography–mass spectrometry (GC-MS) and molecular docking was performed on the compound obtained from GC-MS **[7]**. Molecular docking is a commonly used computer simulation approach for predicting the shape of a receptor-ligand complex, in which the receptor is typically a protein or a nucleic acid molecule, and the ligand is usually a small molecule or another protein.

MATERIALS AND METHODS

The *Millingtonia hortensis* Linn tree was identified and the flowers were collected in and around the college campus. The botanical identity was authenticated by the Director, Botanical Survey of India, Coimbatore with authentication no:BSI/SRC/5/23/2021/Tech-315.The voucher specimen was submitted and preserved in herbarium for future reference.

Isolation of volatile oil

The conventional methods of extraction include hydro distillation (water distillation, water and steam distillation, direct steam distillation), solvent extraction and enfleurage methods. Non-traditional methods of extraction include supercritical fluid extraction, microwave assisted hydro distillation, ultrasound assisted extraction, solvent free microwave extraction and microwave hydro diffusion and gravity**.** The present study employed the hydro distillation and solvent extraction methods **[8]**.

Hydrodistillation

Cohobation is a procedure that can only be used during water distillation or water and steam distillation. It employs the practice of returning the distillate water back into the still after the oil has been separated to facilitate re-boiling. The main principal behind the method is to reduce the loss of oxygenated components, mainly phenols which dissolve to a certain limit in the distillate water. For majority oils, this level of oil loss through solution in water is less than 0.2%, whereas for phenol-rich oils the amount of oil dissolved in the distillate water is 0.2%-0.7%. As this material is being constantly re-

vaporized, condensed and re-vaporized again, any dissolved oxygenated constituents will promote hydrolysis and degrade themselves or other oil constituents. Similarly, if an oxygenated component is constantly brought in contact with a direct heat source which is significantly higher than 100°C, it increases the chances of degradation **[9, 10]**.

In water and steam distillation, the fire source beneath the still cannot be in direct contact with the plant material. A major drawback of the steam and water distillation process is that the resultant plant material is quite wet. This results in a slowed down distillation process as the water must be vaporized by the steam allowing it to condense further up the still. To avoid this drawback and prevent water logging of the lower plant material resting on the grid, a baffle can be used to prevent the water from vigorously boiling and coming in direct contact with the plant material **[11, 12]**.

Solvent extraction

Solvent extraction, also known as Liquid–liquid extraction or partitioning, is a method to separate a compound based on the solubility of its parts. This is done using two liquids that do not mix; for example, water and an organic solvent **[13, 14]**. In the solvent-extraction method of essential oils recovery, an extracting unit is loaded with perforated trays of essential oil plant material and repeatedly washed with the solvent. Solvent extraction is utilized in the refinement of biodiesel, vegetable oils or perfumes. It is applied on delicate plants to provide higher yields of essential oils in a more cost-effective manner. It can also be utilized for sample preparation in the analysis of plant material. The limitation of the method lies in the compound solubility in the specific solvent used **[15]**. In this study the isolation of volatile oil from the flowers of *Millingtonia hortensis* Linn. was done by hydro distillation process and solvent extraction method.

Phytochemical study

The isolated volatile oil of *Millingtonia hortensis* Linn flowers was subjected to chemical identification of its phytoconstituents. The qualitative phytochemical test was performed to identify the main groups of chemical constituents like terpenoids, phytosterols, flavonoids and phenols present in the volatile oil of *Millingtonia hortensis* Linn flower **[16]**. Chemical tests were carried out using standard procedures.

Chemical tests for terpenoid

Liberman-Burchard test: Oil was mixed with acetic anhydride, to this mixture, concentrated sulfuric acid was added. This forms two layers with browning at the junction; the upper layer with green color

represents steroids, while the lower red colored layer represents terpenoid **[17]**.

Salkowski test: Oil was mixed with concentrated sulfuric acid and 2mL chloroform. The red colored upper layer represent steroids and the lower yellow colored layer represents tri terpenoid. The reddish brown color seen at the interface shows the presence of terpenoid **[18]**.

3.3 GC-MS analysis

The volatile oil isolated from the was subjected for GC-MS analysis to isolate and identify the phytoconstituents present in it. Gas chromatography/mass spectroscopy (GC/MS) is used in analytical chemistry for separating and analyzing compounds that can be vaporized without decomposition. GC-MS has considered a high-level benchmark for identification of forensic substances because it can provide 100% specific result, thereby positively identifying the availability of a distinct substance. By this method, a gaseous mobile phase transfers the analytic molecules through the gas chromatographer and elutes into the mass spectrometer, most commonly via electron impact ionization **[19]**. GC/MS analytical methods have practical applications in pharmaceutical development, as they can be utilized to detect unknown molecules and impurities in the drug product. The gas chromatograph uses a capillary column, the properties of which depend on the column dimensions (length, diameter, film thickness) as well as the phase properties (e.g. 5% phenyl polysiloxane) when it comes to molecule separation **[20]**. Difference in chemical properties between various molecules in combination and their individual relative affinity towards the columns' stationary phase will foster detachment of the molecules as the sample travels the entire length of the column. The molecules are maintained by the column and later elute from the column at different time periods (retention time). This allows the mass spectrometer downstream to facilitate capture, ionize, accelerate, deflect, and detection of separate ionized molecules. This is achieved by breaking of each molecule into ionized fragments and detection of these fragments utilizing their mass-to-charge ratio **[21]**.

***In-silico* studies of compounds**

The isolated compounds were applied for *in-silico* studies (molecular Docking) for the identification of pharmacological activity of the photochemical present in the volatile oil.

Computational details

In-silico simulations like protein preparation, ligand preparation, grid generation and molecular docking were performed using AutoDockTools version 1.5.7©Molecular graphics laboratory, The Scripps Research

Institute 1999-2011 and Discovery studio installed on a Dell Inspiron 15 with an intel core i3 processor.

Data collection-Creating a library of ligands: The library of ligands was collected from the GC-MS analysis of *Millingtonia hortensis* Linn flower extract.

Protein characterization

The protein structures were downloaded from Protein Data Bank (PDB). The PDB ID has been characterized based on the sub-cellular location and sequence using PROTPARAM and Self-Optimized Prediction Method with Alignment (SOPMA). This constitutes theoretical Pl, estimated half-life, aliphatic index, instability index, gravy value, alpha-helix, beta-turn and random coil. The PDB ID that showed favorable results were selected for further studies and is included in **Figure 1**.

Ligand preparation

The components showing highest peak in chromatogram (GC-MS) were selected for docking. There were about 39 components in the essential oil from which eight components showed highest peak. The structure was drawn using SWISS ADME (http://www.swissadme.ch/), and was saved in the PDB format.

Ligand modeling: Ligand molecules were generated using www.swissadme.ch/index.php. The molecules were geometrically optimized within the QM level till the PE values are converged, and the same is depicted in **Figure 2**.

Ligand characterization

Drug likeness (LIPINSKI'S Rule of Five)

All the developed ligand molecules satisfied Lipinski's rule of five; hence it was concluded that the above designed molecules showed drug like properties and these are tabulated in **Table 1**.

Protein preparation: The crystal structures of proteins (5MGV, 5JZS,1O8A and 4P38) **Figure 1**, were downloaded from Research Collaboratory for Structural Bioinformatics (RCSB) Protein Data Bank. The protein refinement was performed using Discovery studio., In the first step, the structures were analyzed and unwanted hetero groups were removed. In the second step, bond orders were assigned, hydrogen was added to the structure that lacked hydrogen atom and Kollmann charges were also added. All the docking calculations were performed using Auto dock vina.

Grid formation: The graphical user interface program was used to set the grid box for docking simulations. The grid was set so that it surrounds the region of interest in the macromolecule. Grid was generated by selecting the centre of the bound ligand in the centroid of the grid box (30Å x 30Å x 30Å).

Docking was performed using Command prompt.

RESULTS AND DISCUSSION

The volatile oil was isolated by Solvent extraction and Steam distillation methods. The yield of oil in solvent extraction method was 2%. The oil yield in steam distillation method was 1%. Therefore, the yield was more with solvent extraction method when compared to steam distillation method.

Preliminary phytochemical test

The isolated volatile oil was subjected to the qualitative phytochemical screening to identify the main groups of chemical constituents like terpenoids, phytosterols, flavonoids and phenols. It showed the presence of terpenoids and steroids.

GC-MS analysis

The volatile oil was analyzed by GC-MS and 37 compounds were isolated and the compound retention time, component area, formula, match factor and CAS# are tabulated in **Table 2**. The chromatogram has been attached as **Figure 3**.

***In-silico* study**

Molecular docking is used to predict the bound-conformation of a given small molecule at the active site of a target protein. Proteins selected for docking studies shown in **Figure 1**. In general, a ligand pose is finally selected in terms of a docking score that represents the binding affinity. Hence, high-affinity ligand binding results from greater attractive forces between the ligand and its enzyme or receptor, while low-affinity ligand binding involves less attractive forces. Binding affinity is reported using the equilibrium dissociation constant (K_D) values. The smaller the K_D, greater is the affinity of the ligand with the protein and larger the K_D value, weaker the binding affinity of the protein with molecule.

Antitubercular activity

On evaluating the affinity of the molecules towards the anti-tubercular protien(5JZS), anti-tubercular activity was shown by only two compounds among the eight compounds.Thesetwo compounds were Ethanone, 2-chloro, 1-2diphenyl and Pyridine-2-butyl- as depicted in table.3 and 2D interaction of the ligand and protein is depicted in **Table 4**.

Anti-asthmatic activity

The compounds which showed highest peak in the extract isolated from the essential oil of *Millingtonia hortensis* Linn exhibited anti asthmatic activity. Affinity of the ligands towards the Asthmatic activity Protein 4P38 shown in the **Table 5**. Cyclotridecanamine showed a docking score of -7.1,Dimethylphosphinicazide had a docking score of -4.1, Ethanone,2-chloro,1-2diphenyl

showed a docking score of -7.3, 2-{(1-[3-Methoxypropyl]-1H-1,2,3-triazol-4-yl)methyl}-4- [methyl(propyl)amino]isothiazolidine1,1-dioxide had a docking score of -7.3, P-toluic acid,2-phenylethyl estershowed a docking score of -6.3, Pyridine-2-butyl- had a docking score of -4.7, Pyridine-3-butyl- showed a docking score of -4.6, Cyclopentanecarbonitrile,3-(1-methylethylidene) had a docking score of -4.9 and this is depicted in table 9,2D interaction of the ligand and protein is depicted in **Table 6**. Higher the affinity of the ligand, higher the activity towards the protein.

The previous studies reported the antifungal, larvicidal, antioxidant and antiproliferative activities of this plant **[22]**. The phytoconstituents previously isolated from root were lapachol, and beta sitosterol from the leaf constituents such as hispidulin, rutinoside, beto carotene were isolated **[23, 24]**, while from the stem beta sitosterol, from the bark constituents like beta sitosterol, tannin, tocopherol, vitamin E, and from the flower a new glycoside scutatellarein- 5-galactoside were isolated **[25]**.

Table 1: Molecular properties of designed molecules

S. No.	Ligand	iLOGP	Molecular weight(g/mol)	Hydrogen bond donor	Hydrogen bond acceptor	Molar refractivity
1	Cyclotridecanamine	3.81	197	2	0	74.018
2	Dimethylphosphinic azide	2.98	333.4	0	7	98.45
3	Ethanone,2-chloro,1-2-diphenyl	2.27	230.69	0	1	65.92
4	2-{(1-[3-Methoxypropyl]-1H-1,2,3-triazol-4-yl)methyl}-4-[methyl(propyl)amino]isothiazolidine1,1-dioxide	0.053	312	5	6	77.145
5	P-toluic acid,2-phenylethyl ester	3.18	240	0	2	66.59
6	Pyridine-2-butyl	2.17	135	0	1	43.82
7	Pyridine-3-butyl	2.17	135	0	1	73.62
8	Cyclopentanecarbonitrile,3-(1-methylethylidene)	2	135	0	1	47.72

Table 2: GC-MS Library of *Millingtonia hortensis* Linn flower oil

COMPOUND RT	COMPOUND NAME	CAS#	FORMULA	COMPONENT AREA	MATCH FACTOR
4.0804	Nitric acid, 1-methylethyl ester	1712-64-7	$C_3H_7N0_3$	4392761308.7	91.1
4.0967	Mercaptoacetone	24653-75-6	C_3H_6OS	22199946862.8	70.4
4.0971	Acetic acid, mercapto-	68-11-1	$C_2H_40_25$	740747817.9	80.2
4.1005	Acetamide, 2-amino-	598-41-4	$C_2H_6N_20$	119636885.8	57.4
4.1454	Urethane	51-79-6	$C_3H_7N0_2$	245354253.7	71.3
4.3093	Carbonochloridic acid, ethyl ester	541-41-3	$C_3H_5CI0_2$	166191493.8	54.3
5.0917	Glutaric acid, di(3,4-difluorobenzyl) ester	1000377-64-4	$C_{19}H_{16}F_40_4$	385297901.8	53.9
5.0938	Urethane	51-79-6	$C_3H_7N0_2$	449395613.8	53.8
5.0938	Ethane, 1,1-difluoro-	75-37-6	$C_2H_4F_2$	870779656.5	67.8
5.2169	Heptanonitrile	629-08-3	$C_7H_{13}N$	293769935.8	72.5
5.2426	Ethanone,1-(1H-pyrrol-2-yl)-	1072-83-9	C_6H_7NO	143214762.0	62.2
5.2426	2-Pentenenitrile, 4,4-dimethyl-	39168-14-4	$C_7H_{11}N$	147396551.9	61.0
5.2651	cis-3-Hexenyl crotonate	1000-429-17-4	$C_{10}H_{16}0_2$	123824186.6	77.5
5.2651	2-Propen-1-amine, N-2-propenyl-	124-02-7	$C_6H_{11}N$	122687567.7	62.7
5.2841	Dehydromevalonic lactone	2381-87-5	$C_6H_80_2$	203649398.2	68.0
5.2841	Histamine	51-45-6	$C_5H_9N_3$	213736260.4	76.6
5.5218	1H-isoindole-1,3(2H)-dione,2-(benzoyloxy)-	1000401-67-0	$C_{15}H_9NO_4$	246601815.1	58.0
5.5218	Ethanone,2-chloro-1,2-diphenyl-	447-31-4	$C_{14}H_{11}CIO$	246776491.1	57.1
5.6169	Ethanone,2-chloro-1,2-diphenyl-	447-31-4	$C_{14}H_{11}CIO$	489757012.4	60.1
5.6169	1H-isoindole-1,3(2H)-dione,2-(benzoyloxy)-	1000401-67-0	$C_{15}H_9NO_4$	491125289.5	59.3
7.1427	Benzoyl isothiocyanate	532-55-8	C_8HSNOS	105683962.6	84.5
7.1757	p-Toluic acid, 2-phenylethyl ester	203587-50-2	$C_{16}H_{16}0_2$	290968062.3	57.4
7.3164	Dimethylphosphinic azide	58347-13-0	$C_2H_6N_30P$	126434228.3	61.7
7.3164	p-Toluic acid, 2-phenylethyl ester	203587-50-2	$C_{16}H_{16}0_2$	127400731.0	55.0
7.8929	Dimethylphosphinic azide	58347-13-0	$C_2H_6N_30P$	392757602.5	60.5
7.8930	p-Toluic acid, 2-phenylethyl ester	203587-50-2	$C_{16}H_{16}0_2$	389738861.3	53.9
10.6846	Cyclopentanecarbonitrile,3-(1-methylethylidene)-	89683-72-7	$C_9H_{13}N$	1061620135.5	54.3
20.9008	Pyridine, 2-butyl	5058-19-5	$C_9H_{13}N$	303726007.8	59.9
21.8158	Pyridine, 3-butyl	539-32-2	$C_9H_{13}N$	487177186.8	57.4
24.0206	Cyclopentanecarbonitrile,3-(1-methylethylidene)-	89683-72-7	$C_9H_{13}N$	213488398.4	52.8
32.6423	Cyclododecylamine	1502-03-0	$C_{12}H_{25}N$	119201261.5	63.1
32.6425	2-{(1-[3-Methoxypropyl]-1H-1,2,3-triazol-4-yl)methyl}-4-[methyl(propyl)amino]isothiazolidine1,1-dioxide	1333142-62-3	$C_{14}H_{27}N_50_3S$	120108716.7	59.0
33.5267	Cyclotridecanamine	5266-81-9	$C_{13}H_{27}N$	108372962.6	63.5
34.5001	Iron pentacarbonyl	13463-40-6	C_5Fe0_5	164070927.1	63.1
34.5002	2-{(1-[3-Methoxypropyl]-1H-1,2,3-triazol-4-yl)methyl}-4-[methyl(propyl)amino]isothiazolidine1,1-dioxide	1333142-62-3	$C_{14}H_{27}N_50_3S$	167052257.3	57.0
35.6062	N-Ethylidene-t-butylamine	7020-80-6	$C_6H_{13}N$	115563170.5	52.6
36.8999	2-{(1-[3-Methoxypropyl]-1H-1,2,3-triazol-4-yl)methyl}-4-[methyl(propyl)amino]isothiazolidine1,1-dioxide	1333142-62-3	$C_{14}H_{27}N_50_3S$	159520408.3	59.6

Table 3: Affinity of the ligand towards the Anti tubercular protein (5JZS)

S. No.	COMPOUNDS	AFFINITY (Kcal/mol)
1	Ethanone,2-chloro,1-2diphenyl	-6.2
2	Pyridine-2-butyl-	-4.5

Table 4: 2D interactions of the ligans and the Anti tubercular protein (5JZS)

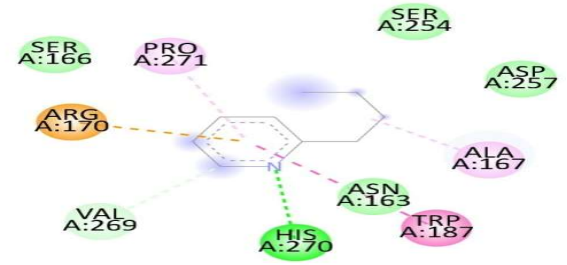
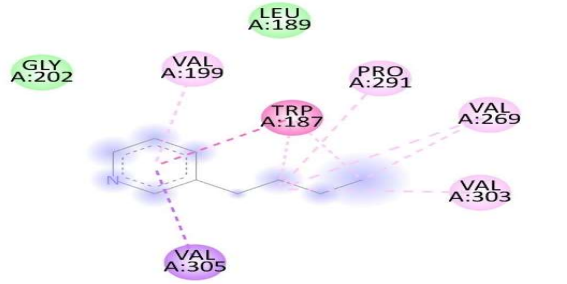
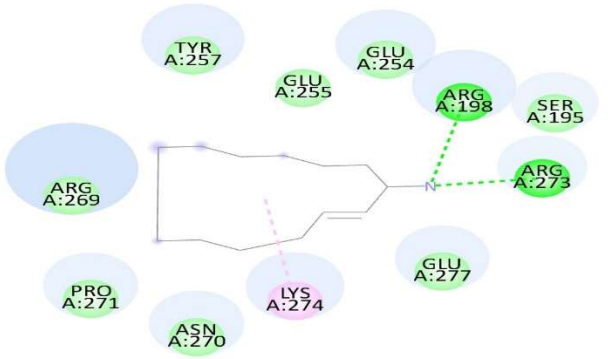
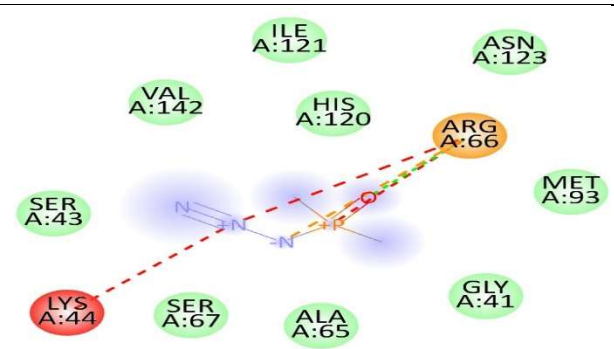
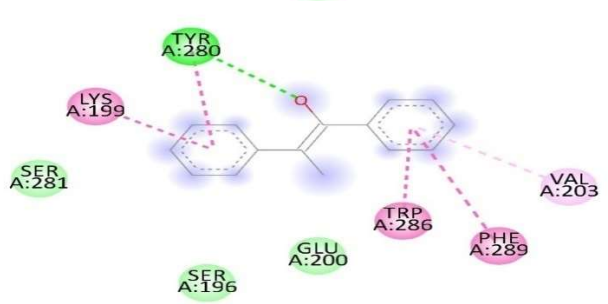
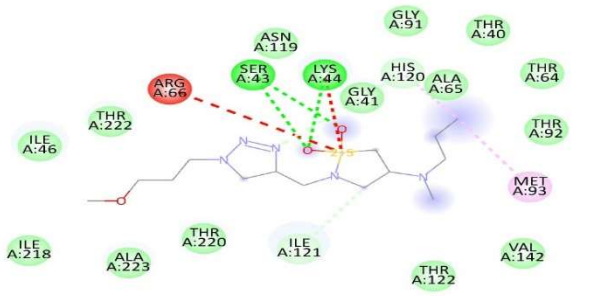
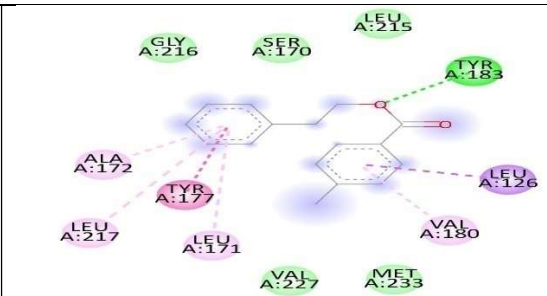
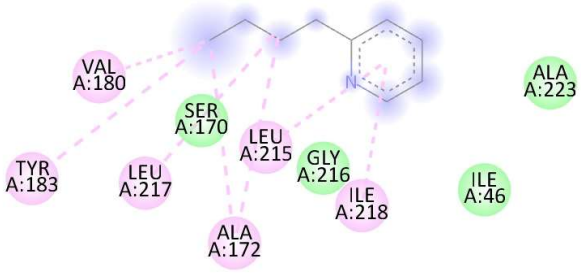
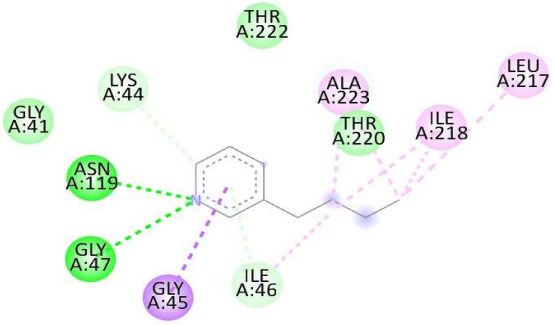
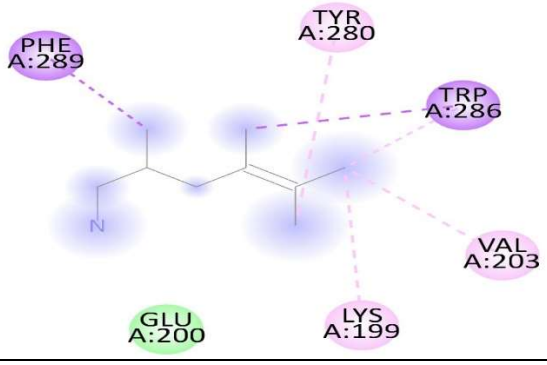
S. No.	Compound Name	2D Interaction
1	Ethanone,2-chloro,1-2diphenyl	
2	Pyridine-2-butyl-	

Table 5: Affinity of the ligands towards the Asthmatic activity Protein 4P38

S. No.	COMPOUNDS	AFFINITY (Kcal/mol)
1	Cyclotridecanamine	-7.1
2	Dimethylphosphinic azide	-4.1
3	Ethanone,2-chloro,1-2diphenyl	-7.3
4	2-{(1-[3-Methoxypropyl]-1H-1,2,3-triazol-4-yl)methyl}-4-[methyl(propyl)amino]isothiazolidine1,1-dioxide	-7.3
5	P-toluic acid,2-phenylethyl ester	-6.3
6	Pyridine-2-butyl-	-4.7
7	Pyridine-3-butyl-	-4.6
8	Cyclopentanecarbonitrile,3-(1-methylethylidene)	-4.9

Table 6: 2D interactions of the ligands and the asthmatic activity protein 4P38

S. No.	Compound name	2D Interaction
1	Cyclotridecanamine	
2	Dimethylphosphinic azide	
3	Ethanone,2-chloro,1-2diphenyl	
4	2-{(1-[3-Methoxypropyl]-1H-1,2,3-triazol-4-yl)methyl}-4-[methyl(propyl)amino]isothiazolidine1,1-dioxide	

5	P-toluic acid,2-phenylethyl ester	
6	Pyridine-2-butyl-	
7	Pyridine-3-butyl-	
8	Cyclopentanecarbonitrile,3-(1-methylethylidene)	

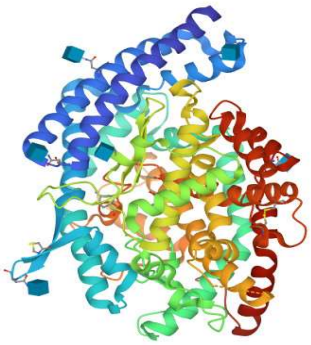
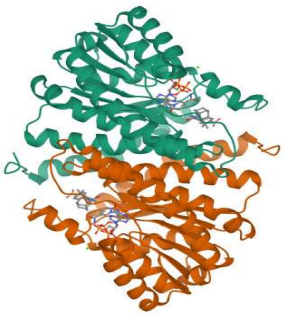
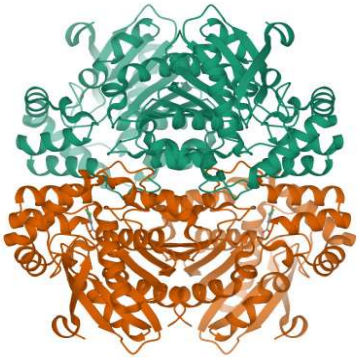
	
O8A	**4P38**
	
5JZS	**5MJV**

Figure 1: Proteins selected for docking studies

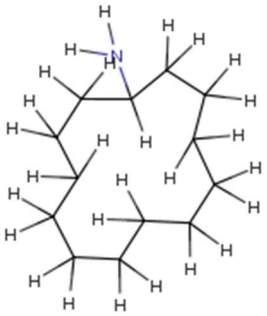
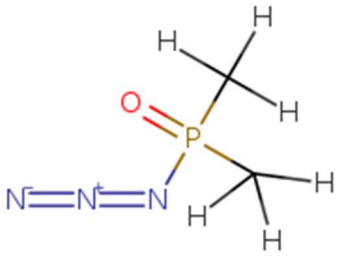
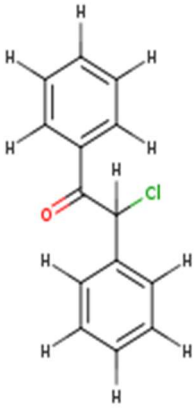
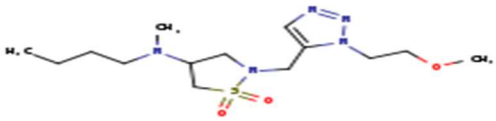
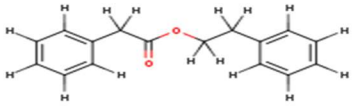
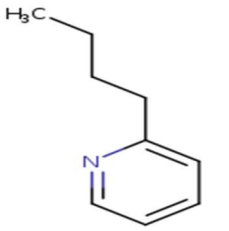
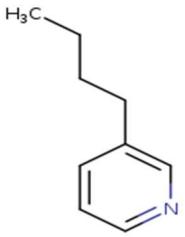
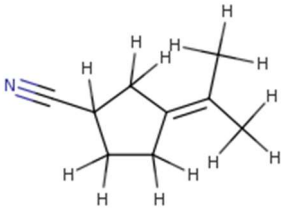
	
Cyclotridecanamine	**Dimethylphosphinic azide**
	
Ethanone,2-chloro,1-2diphenyl	**2-{(1-[3-Methoxypropyl]-1H-1,2,3-triazol-4-yl)methyl}-4 -[methyl(propyl)amino]isothiazolidine1,1-dioxide**
	
P-toluic acid,2-phenylethyl ester	**Pyridine-2-butyl-**
	
Pyridine-3-butyl-	**Cyclopentanecarbonitrile,3-(1-methylethylidene)**

Figure 2: Structure of ligand molecules generated for docking.

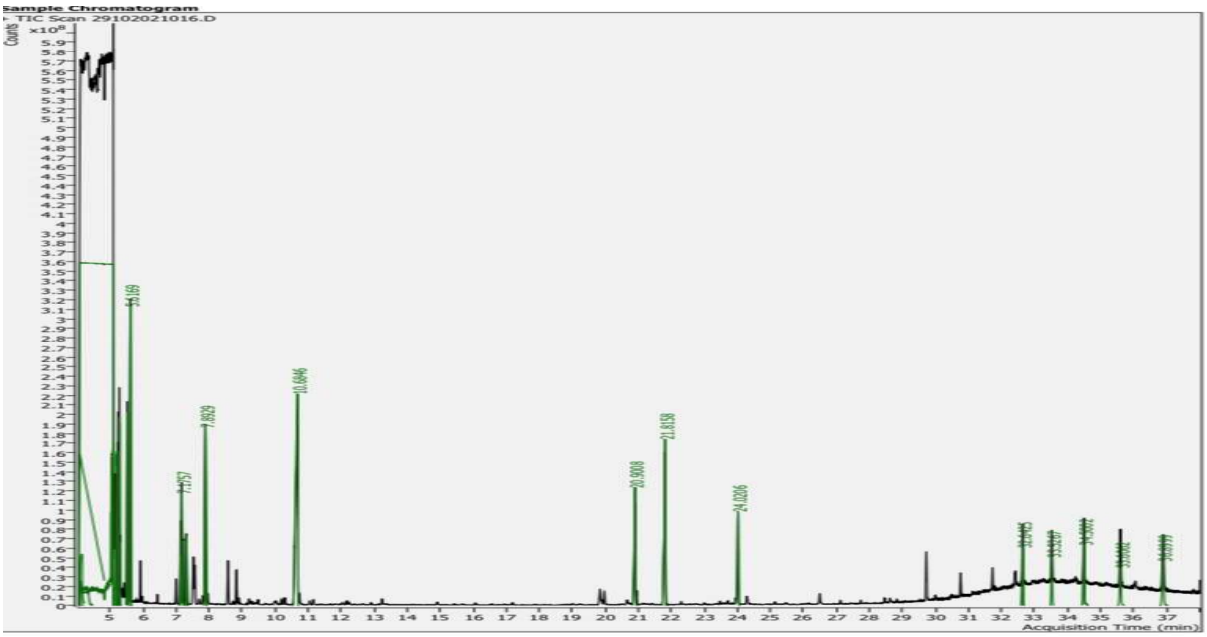


Figure 3: GC-MS chromatogram of *Millingtonia hortensis* Linn flower oil

CONCLUSION

The volatile oil present in the plant *Millingtonia hortensis* Linn. flower was separated by hydro distillation and solvent extraction methods. The isolated volatile oil was applied for the phytochemical analysis and GC-MS studies. The preliminary phytochemical analysis showed the presence of terpenoids and phytosterols in the volatile oil. From the GC-MS analysis, 37 phytoconstituents were isolated and identified. The selected 8 phytochemical compounds were used to performan *in-silico* study to identify their pharmacological activity. The *in-silico* study was based on the affinity of molecules towards the protein. By this method, we identified eight compounds showed significant anti-asthmatic activity while two phytochemicals showed anti-tubercular activity. This study is the new approach towards the antiasthmatic effect, so further detailed studies are required to elaborate the therapeutic applications of the volatile oil from *Millingtonia hortensis* Linn flower.

Acknowledgement

The authors are thankful to the management of PSG College of Pharmacy for providing the facilities to complete the study**.**

REFERENCES

[1] Obeidat M, Shatnawi M, Al-alawi M, Al-Zubi E, Al-Dmoor H, Al-Qudah M, *et al*. Antimicrobial activity of crude extracts of some plant leaves. Res J Microbiol. 2012; 7(1): 59–67.

[2] Gadir SA. Assessment of bioactivity of

some Sudanese medicinal plants using brine shrimp (*Artemia salina*) lethality assay. J Chem Pharm Res., 2012; 4(12): 5145–5148.

[3] Chanda S, Rakholiya K. Combination therapy: Synergism between natural plant extracts and antibiotics against infectious diseases. In: Mendez-Vilas A (Ed), Science against microbial pathogens: communicating current research and technological advances. Badajos/ Spain: Formatex;2011. p. 520-529.

[4] Kumari A, Sharma RA. A review on *Millingtonia hortensis* Linn.Int J Pharm Sci Rev Res, 2013; 19(2): 85–92.

[5] Tansuwanwong S, Yamamoto H, Imai K, Vinitketkumnuen U. Antiproliferation and apoptosis on RKO colon cancer by *Millingtonia hortensis*.Plant Foods Hum Nutr 2009; 64(1): 11–17.

[6] Jetty A, Iyengar DS. Antimicrobial activity of *Millingtonia hortensis* leaf extract. Pharm Biol 2000; 38(2): 157–160.

[7] Sasidharan BR, Balaji P, Ashok KR, Soundarya G. A study on biochemical constituents and anti-bacterial activity in the bark extract of *Millingtonia hortensis*.Int J Curr Microbiol Appl Sci. 2020; 9(5): 2436–2442.

[8] Paibon W, Yimnoi CA, Tembab N, Boonlue W, Jampachaisri K, Nuengchamnong, *et al*. Comparison and evaluation of volatile oils from three different extraction methods for some Thai fragrant flowers. Int J Cosmet Sci 2011; 33(2): 150–156.

[9] M. A. Suryawanshi, V. B. Mane, G. B. Kumbhar, (2016), Methodology To Extract Essential Oils From Lemongrass Leaves: Solvent Extraction Approach, International Research Journal of Engineering and Technology (IRJET) eISSN: 2395 -0056 Volume: 03 Issue: 08, 1775-1780.

[10] Chen Zhi-linga, Chao Jian-pinga, Cao Hui-linb, Bi Wei-taoa, Cui Hai-yana, Li Mo-lina, (2011), Research on the Extraction of Plant Volatile Oils. Procedia Environmental Sciences, 8, 426 – 432.

[11] El Kharraf S, El-Guendouz S, Abdellah F, Bahia B, Maria M, El Mestafa H, *et al*. Hydrodistillation and simultaneous hydrodistillation-steam distillation of Rosmarinus officinalis and Origanum compactum: Antioxidant, anti-inflammatory, and antibacterial effect of the essential oils. Ind Crops Prod 2021; 168: 113591.

[12] El Kharraf S,El-Guendouz S, Abdellah F, Bahia B, Maria M, El Mestafa H, *et al*. Hydrodistillation and simultaneous hydrodistillation-steam distillation of

Rosmarinus officinalis and *Origanum compactum*: Antioxidant, anti-inflammatory, and antibacterial effect of the essential oils.Ind Crops Prod 2021; 168: 113591.

[13] Cassel E and R. Vargas R, "Experiments and Modeling of the *Cymbopogon winterianus* Essential Oil Extraction by Steam Distillation", J. Mex. Chem. Soc., 2006, Vol. 50(3), PP.126-129.

[14] M. A. Suryawanshi, V. B. Mane, G. B. Kumbhar, (2016), Methodology to Extract Essential Oils from Lemongrass Leaves: Solvent Extraction Approach, International Research Journal of Engineering and Technology (IRJET) eISSN: 2395 -0056 Volume: 03 Issue: 08. 1775-1780.

[15] Onyebuchi C, Kavaz D. Effect of extraction temperature and solvent type on the bioactive potential of *Ocimum gratissimum* L. extracts. Sci Rep2020;10:1–11.

[16] Anulakanapakorn K, Nuntavan P, Jutamaad S, Phytochemical and Pharmacological studies of the flowers of *Millingtonia hortensis* Linn., Journal of Sciences Soc., 13(2), 1987, 71-83

[17] Kokate CK, Purohit AP, Gokhale SB. Practical Pharmacognosy. 5th ed. India: Vallabh Prakashan; 2014. p. 593-7.

[18] Khadabadi SS, Deore SL, Baviskar BA, Experimental Phytopharmacognosy. India: Nirali Publishers; 2013. p. 1-4, 12.

[19] Mlozi SH, Mmongoyo JA, Chacha M. GC-MS analysis of bioactive phytochemicals from methanolic leaf and root extracts of *Tephrosia vogelii*. Sci African, 2022; 16: e01255.

[20] Junxing LI, Aiquing M, Gangjun Z, Xiaoxi L, Haibin W, Jianning L,*et al*. Assessment of the 'taro-like' aroma of pumpkin fruit (*Cucurbita moschata* D.) via E-nose, GC–MS and GC-O analysis. Food Chem. 2022;15:100435.

[21] Abo-Gaida AAH, Shendy AH, Taha S M, Mahmoud HA, Attallah ER, Fernandez-Alba AR. Fennelseeds extract as an analyte protectant for the GCMS/MS residue analysis of 182 pesticide in strawberries: Comparing the manual mixing and sandwich injection. J Chromatogr Open. 2022; 2: 100056.

[22] Sharma RC, Zaman A, Kidwai AR, Chemical examination of *Millingtonia hortensis*, Phytochemistry, 7, 1968, 1891-1892.

[23] Kumar SM, Ravichandran N, Antioxidant activity of *Millingtonia hortensis* Linn. Stem bark Aqueous Extract, Journal of Pharmacy Research, 4(8), 2011, 2760-2763.

[24] Szkop M, Sikora P, Orzechowski S. A novel, simple, and sensitive colorimetric method to determine aromatic amino acid aminotransferase activity using the Salkowski reagent. Folia Microbiol (Praha)2012;57:1–4.

[25] Mangayarkarasi A, Nagarajan S, Chemical examination of the leaves of *Millingtonia hortensis* Linn., Indian Drugs, 21, 1984, 420- 422.