PROJECT REPORT

On

"SYNTHESIS,CHARACTERISATION,DFT CALCULATIONS AND DOCKING STUDIES ON CHALCONE DERIVATIVES CONTAINING HETEROATOM"

Submitted by
IRIS REGI
(AM21CHE008)

In partial fulfillment for the award of the Post graduate Degree in Chemistry

DEPARTMENT OF CHEMISTRY
AND
CENTRE FOR RESEARCH

ST. TERESA'S COLLEGE (AUTONOMOUS)
ERNAKULAM

2022-2023

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Year of Work **: 2022-2023**

This is to certify that the project "**SYNTHESIS ,CHARACTERISATION,DFT CALCULATIONS AND DOCKING STUDIES ON CHALCONE DERIVATIVES CONTAINING HETEROATOM**" is the work done by **IRIS REGI.**

Dr. Jaya T.Varkey **Dr.Maria Linsha P.L**
Head of the Department **Staff-member in charge**

Submitted to the Examination of Master's degree in Chemistry

Date: ……..…

Examiners :……..

: ……

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ERNAKULAM

CERTIFICATE

This is to certify that the project work entitled "**SYNTHESIS,CHARACTERISATION,DFT CALCULATIONS AND DOCKING STUDIES ON CHALCONE DERIVATIVES CONTAINING HETEROATOM**" is the work done by **Iris Regi** under the guidance of **Dr.Maria Linsha P.L, Assistant professor,** Department of Chemistry and Centre for Research, St. Teresa's College, Ernakulam in partial fulfilment of the award of the Degree of Master of Science in Chemistry at St. Teresa's College, Ernakulam affiliated to Mahatma Gandhi University, Kottayam.

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Dr.Maria Linsha P.L
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DECLARATION

I hereby declare that the project work entitled "**SYNTHESIS,CHARACTERISATION,DFT CALCULATIONS AND DOCKING STUDIES ON CHALCONE DERIVATIVES CONTAINING HETEROATOM**" submitted to Department of Chemistry and Centre for Research, St. Teresa's College (Autonomous) affiliated to Mahatma Gandhi University, Kottayam, Kerala is a record of an original work done by me under the guidance of Dr.MARIA LINSHA P.L, ASSISTANT PROFESSOR, Department of Chemistry and Centre for Research, St. Teresa's College (Autonomous), Ernakulam (Internal Guide) This project work is submitted in the partial fulfillment of the requirements for the award of the Degree of Master of Science in Chemistry.

IRIS REGI

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Iris Regi

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TAA	((E)-phenyl-3-(thiophen-2-yl) prop-2-en-1-one))
TAMA	((E)-1-(4-methoxyphenyl)-3-(thiophen-2-yl) prop-2-en-1-one))
TANA	((E)-1-(4-nitrophenyl)-3-(thiophen-2-yl) prop-2-en-1-one))
PAA	((E)-1-phenyl-3-(1H-pyrrol-2-yl) prop-2-en-1-one)
PAMA	((E)-1-(4-methoxyphenyl)-3-(1H-pyrrol-2-yl) prop-2-en-1-one)
PANA	6 ((E)-1-(4-nitrophenyl)-3-(1H-pyrrol-2-yl) prop-2-en-1-one)

Chapter 1

Introduction

The chemical formula for chalcone is $C_6H_5C(O)CH=CHC_6H_5$. It's a α,β—unsaturated ketone. The term "chalcones" or "chalconoids" refers to a variety of important biological compounds . They are well-known as bioactive compounds, fluorescent materials, and chemical intermediaries. Chalcones have been employed in medicinal chemistry as antioxidants, anticancer agents, diabetes medication, antiviral agents, antimalarial agents, and more. They can be used as liquid crystals, fluorescent scaffolds, metal sensors, corrosion inhibitors, and plant growth promoters in addition to being used as medicines[4].

Around the world, there have been extensive scientific investigations on the chemistry of chalcones. The synthesis of chalcones and their biodynamic activities have drawn a lot of attention. These substances are also referred to as benzylidene acetophenone or benzalacetophenone. In chalcones, an aliphatic three-carbon chain connects two aromatic rings. Chalcone has a very good synthon, making it possible to construct a wide range of novel heterocycles with good pharmaeutical profile. These compounds are coloured because of the presence of chromophore -CO-CH=CH-, which depends on the presence of other auxochromes. The majority of natural chalcones aromatic rings are discovered to be hydroxylated[31].

These substances are present in many different plant tissues in addition to flowers. Plants (Cannabaceae) also contain a large number of prenylchalcones. Numerous plant families, including Solanaceae, Anacardiaceae, Caesalpiniaceae, and Piperaceae, have been discovered to contain them.Chalcones have two benzene rings with conjugated double bonds and a completely delocalized Π -electron system. Such systems allow molecules to have relatively low redox potentials and a higher possibility of undergoing electron transfer processes.chalcones which are byproducts of an edible or medicinal plant. Most Chalcones are mailnly composed of polyphenolic substances with colours ranging from yellow to orange, and they play a key role in the coloration of some plants corollas[30].

Natural and synthetic chalcones have been the subject of extensive research in medicinal chemistry in the 21st century due to their wide range of pharmacological potential, including activities and characteristics like antibacterial, anti-inflammatory, analgesic, antioxidative, antimalarial, antiviral, antihelmintic, antidiabetic.According to biological findings, the chalcone compounds' antiviral activity is enhanced by the insertion of purine (sulphur) ether and the addition of diethyl malonate or nitromethane in the double bond.They often exist in cis- and trans-forms and are easily cyclized to produce flavanones through Michael addition.Chalcones, whether they are derived from natural or synthetic sources, have been shown to have an impact on many carbohydrate pathways, most notably glucose metabolism[26].

1.1 General synthesis and characteristics

Chacones considered to be the precursor of flavonoids and isoflavonoids are abundant in plants. They consist of open chain flavonoids in which the two aromatic rings are joined by a three-carbon α, β - unsaturated carbonyl system. Chalcones have two absorption maxima at 280nm and 340nm. Studies revealed that compounds with a chalcone-based structure have varieties of activities like anti-inflammatory, anti-bacterial, anti-malarial, anti-fungal, anti-tumor. These activities are largely influenced due to the α, β - unsaturated ketone moiety. Various substituents into the two aryl rings is also a subject of interest because it leads to useful structure-activity relationship[5].

The general structure of chalcone is shown in Fig 1:

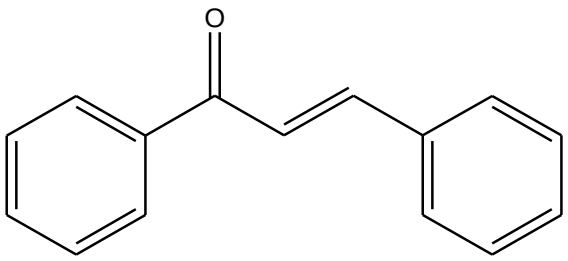


Fig 1:Structure of chalcone

Different methods are available for preparation of chalcones:

Best method is Clasien-Schmidt condensation of equimolar quantities of a substituted acetophenone with substituted aldehydes in the presence of aqueous alcoholic alkali.

The condensation reaction between two different molecules of an aldehyde or ketone in a protic solvent such as water or alcohol constitute the crossed aldol reaction. When both aldehydes have alpha hydrogens, both can form carbanions and can also act as carbanion acceptors. In this reaction, the electron rich CH2- group get attached to the electron deficient. In this reaction, aldehyde and ketone reacts with base to form a carbanion. Then it reacts with an acid H+ and dehydration takes places, the chalcone is formed[5].

The mechanism is shown in Fig 2:

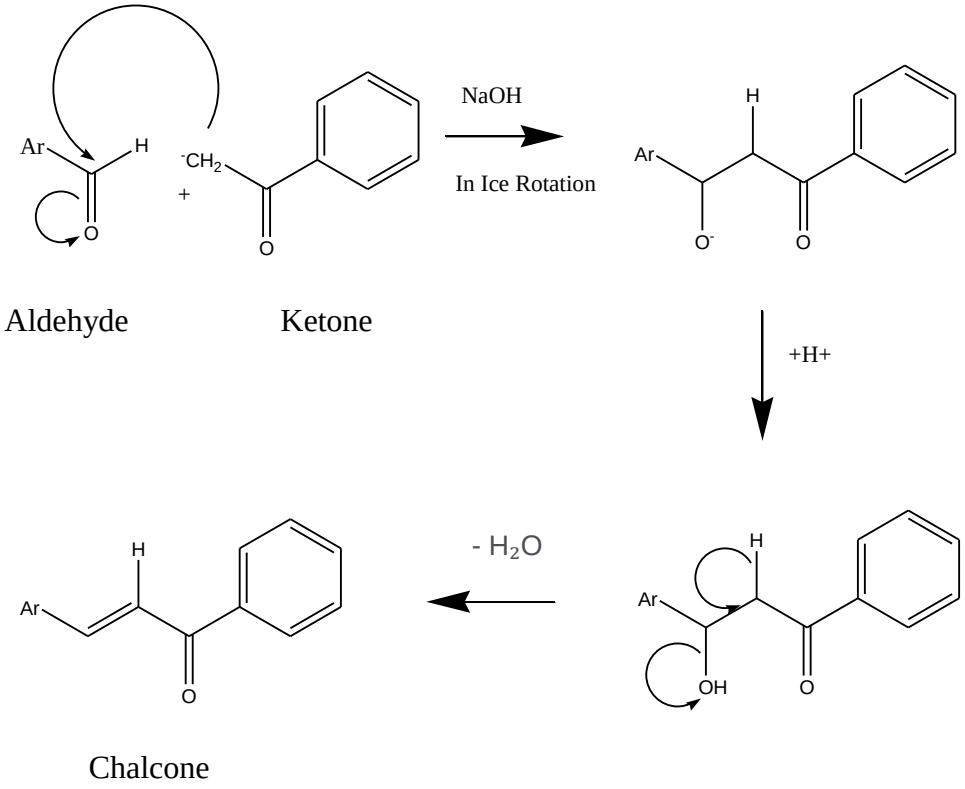


Fig 2: Mechanism of chalcone formation

1.2 Properties of chalcones

Chalcones can be found in many sections of plants, including leaves, fruits, stems, roots, and flowers. The chalcones that occur naturally are typically crystalline solids and posses variety of colors, including yellow, orange, and brown. Comparatively speaking, chalcones are more stable than isoflavonoids and flavonoids[2]. Chalcones readily dissolve in organic solvents including acetone, chloroform, and dichloromethane as well as in

alcohols, aqueous acidic and alkaline solutions.They display orange red or deep red colours in alkaline solutions.The Wilson test results for all chalcones are positive, i.e., they turn pink when treated with concentrated H2SO4. A violet colorization of chalcones are seen after treatment with an alcoholic ferric chloride solution denotes the presence of free phenolic hydroxyl groups. To produce flavonoids, chalcones go through isomerization processes. When chalcones are heated for two hours with a trace of iodine in dimethylsulfoxide, the corresponding flavones are produced.Through cyclization of chalcones treated with hydrobromic acid in glacial acetic acid ,flavanones can be easily achieved. Partial demethylation and debenzylation may take place in this isomerization reaction.Chalcones were oxidised with hydrogen peroxide in a methanolic sodium hydroxide solution, resulting in flavonols[20].

1.3 Application of Chalcones

Anti-bacterial activity:

Chalcone has a reactive -unsaturated system, which gives it a moderate to high level of antibacterial activity. The derivative of chalcone showed potential antibacterial activities against different pathogenic strains including antibiotic-resistant bacteria. Increasing alkyl chain length causes decreasing antibacterial activity of chalcones. Compared to the common antibiotic streptomycin, chalcone had outstanding antibacterial activity against Gram-positive B. cereus[23]. Chalcones are open chain flavonoids that have the strongest anti-MRSA activity. Its basic structure consists of two aromatic rings connected by an unsaturated carbonyl group. These compounds antibacterial effects are frequently caused by the presence of -

OH groups in different positions of the B ring. Methoxy and hydroxyl compounds show stronger antibacterial activity than those lacking these groups[16].

Antimicrobial Activity:

Antimicrobial agent resistance has grown to be a serious and urgent global issue. The antimicrobial action of chalcones is discovered to be caused by the presence of a reactive unsaturated keto function in it. By employing the cup-plate method, antimicrobial activity was demonstrated against gram- positive bacteria and gram-negative bacteria. The derivatives of chalcones have excellent scope for further development as commercial antimicrobial agents[29].

Anti-fungal Activity:

Derivative of Chalcones were tested for their antifungal activity using potato-dextrose-agar (PDA) medium by cup plate method. The antifungal activity of compounds with pharmacophores like chloro, dichloro, and fluoro groups on all three fungi has been found to be greater than that of other compounds[11].

Anticancer potential:

One of the most significant clinical issues in the world is cancer. By using the MTT assay, synthetic benzofuran chalcone compounds were evaluated in vitro for their anticancer activities. The benzofuran substituted chalcone compounds had significant anticancer activity. Chalcone compounds with a benzofuran ring could be used to create new anti-cancer medications in the future[7].

Anti-diabetic Activity:

The usage of anti-diabetic medications has grown significantly over the world. Chalcones are able to produce these effects by acting on a variety of therapeutic targets. The hydroxyl, prenyl, and geranyl groups in their skeleton enhance their activity for the assessed anti-diabetic targets.precursors of the flavonoids have been used for a long time in traditional medicine, from which the anti-diabetic activity stands out[22].

1.4 UVSPECTROSCOPY

Electronic transitions between energy levels are related to the UV and visible spectra of substances. The transitions typically occur between bonding or lone pair orbitals and non-bonding or antibonding orbitals. The relationship between the absorption intensity and the light's absorbed UV/VIS spectrum.

UV-visible spectrophotometer

A UV/Vis spectrophotometer is the tool used in ultraviolet-visible spectroscopy.
It calculates the intensity of one light beam that passes through a sample (I) and compares it to the intensity of another beam of the same wavelength that does not pass through the sample (Io).The transmittance is defined as the ratio I/Io[28].

1.5 IR spectroscopy

The infrared section of the electromagnetic spectrum, or light with a longer wavelength and a lower frequency than visible light, is an aspect of infrared spectroscopy. The study of a molecule's interaction with infrared light is known as infrared spectroscopy.

Three methods can typically be used to analyse the idea of IR spectroscopy: reflection, emission, and absorption measurements. Finding the functional groups of molecules—relevant to both organic and inorganic chemistry—is the main use of infrared spectroscopy.

An equipment known as an infrared spectrometer (or spectrophotometer), which generates an infrared spectrum, is used to perform the infrared spectroscopy method or procedure[13].

1.6 Density Functional Theory method

Similar to ab initio and SE calculations, density functional calculations are founded on the Schrodinger equation and are frequently referred to as

density functional theory (DFT) computations. However, unlike the other two methods, DFT directly derives the electron distribution (electron density function) rather than computing a wavefunction. The Hohenberg-Kohn theorems provide the foundation of density functional theory, which states that "a trial electron density must give an energy greater than or equal to the true energy" and that "the ground-state properties of an atom or molecule are determined by its electron density function."DFT is not variational; it can provide an energy that is less than the actual energy[14].

1.6.1 Basis Set

MOs, which are themselves approximated by atomic orbitals (LCAO), can be used to construct an approximate wavefunction (for example, a Slater determinant).The AOs themselves are built from combinations of basic functions.

Basic operationAO'S⟶MO'S⟶wave function.Basis set refers to the collection of all basis functions employed in a calculation. A basis set is a collection of mathematical operations (basis functions), the linear combinations of which produce molecular orbitals. Atomic nuclei are typically, but not always, at the centre of the functions. There are various ways to see how electrons are distributed around an atom. Slater functions, Gaussian functions, polynomial functions with changeable parameters, and hydrogen-like functions based on solutions of the Schrodinger equation for the hydrogen atom have all been employed. Slater performs among these.(STOs) and Gaussian functions (GTOs) are mathematically the simplest, and it is these that are currently used as the basis functions in molecular calculations. Slater functions are used in semi-empirical

calculations.Modern molecular ab initio programs employ Gaussian functions[15].

1.6.2 Gaussian software

The Gaussian computer programme for computational chemistry was created by John Pople and his research team at Carnegie-Mellon University. It was first released as Gaussian 70 in 1970. Since then, it has been updated frequently.

The term comes from Poples' decision to employ Gaussian orbitals rather than slater type orbitals to speed up calculations in order to increase performance on the frequently constrained computational capabilities of existing computer hardware for Hartree-Fock calculations. Different packages of Gaussian are Gaussian 70,Gaussian76, Gaussian80, Gaussian 82, Gaussian 86, 88 Gaussian 90, Gaussian 92, Gaussian 92/DFT, Gaussian 94, Gaussian 98,Gaussian 03, Gaussian 09 and Gaussian 16[10] .

1.7 Molecular Docking

Putting molecules in the right arrangements so they can interact with a receptor is a process known as molecular docking. A cell's natural process of molecular docking takes place in a matter of seconds. The study of how two or more molecular structures fit together is known as "molecular docking" in molecular modelling.

For the creation of new drugs and the research of protein-ligand interactions, computational docking is frequently utilised. Usually, the procedure begins with a target whose structure is known, like the crystal

structure of an enzyme of potential medical value.The bonded conformation is then predicted using docking. tiny molecule targets are bound by their binding free energy[8].

1.8 Auto Dock Vina Software

Auto Dock is a collection of open-source, free tools for virtual receptor screening and computational docking of small compounds.There are now a number of supplementary tools in the suite.The molecular docking software Auto Dock Vina is open-source. In the Molecular Graphics Lab at The Scripps Research Institute, it was initially created and put into use by Dr. Oleg Trott[12].

1.9 Scope and Possibilities

Due of the recognised consequences on a variety of common and general diseases like cancer, allergic reactions, cardiovascular disease, infectious diseases, parasitic diseases, type 2 diabetes mellitus, and others, interest in and attraction to natural substances are steadily growing. The most significant in vitro and in vivo biological actions, such as antibacterial, antimalarial, antidiabetic, anti-cancer, and antifungal, were highlighted in this study.Derivatives of chalcones have demonstrated antibacterial action against both Gram-negative and Gram-positive germs, as well as anticancer activity against a number of cancer cell lines[23].Clinical trials with chalcones have demonstrated good plasma concentrations, a lack of side effects in individuals with chronic venous insufficiency, and a reduction in clinical signs and symptoms although conducted in small

number. However, further clinical research is required to completely comprehend the cellular mechanisms of action and establish links between their structure and pharmacological actions, particularly anticancer activity[9].

Although they demonstrated a variety of intriguing biological effects and allowed for a wide range of preclinical testing, their exact mode of action is unknown. Future research must focus on creating new synthesis techniques that enable the investigation of novel biological properties, a deeper understanding of molecular mechanisms of action, and in particular the identification of the action's target. In order to discover new drugs and pharmaceutical forms using modern methods, particularly new nano-formulations, in order to increase their bioavailability, prolonged effect, or transport to the target of action, this successful story of the promising therapeutic effects of chalcones is applicable[23].

1.10 Objectives of current work

- To synthesize and characterize the new chalcone derivatives containing hetero atoms like S and N.

- To compare the UV, IR and HOMO LUMO gaps by experimental and DFT Calculations.

- To optimize the structures of chalcones by DFT method using Gaussian 09 software.

- To find out the binding energy of Triclosan-5bnm interactions (standard) by docking .

- To find out the binding energy of 5bnm–chalcones interactions by docking.

- To compare the binding energies of above interactions with standard and predict the antibacterial activity of chalcones.

- To find out the binding energy of Chloroquine -6mo3 interactions (standard) by docking .

- To find out the binding energy of 6mo3–chalcones interactions by docking.

- To compare the binding energies of above interactions with standard and predict the antiviral activity of chalcones.

Chapter 2

Literature review

Yi-Hui Wang and co-workers studied the synthesis and antibacterial activity of novel chalcone derivatives bearing a coumarin moiety, and their structures were confirmed using 1H NMR, 13C NMR, and H RMS.According to the bioassay results, the majority of the title compounds displayed impressive antibacterial effects.The compounds synthesiszed were,3a($C_{23}H_{15}NO_4$),3b ($C_{24}H_{15}ClO_4$) ,3c ($C_{22}H_{14}O_4S$),3d ($C_{24}H_{16}O_4$) , 3e ($C_{25}H_{18}O_5$) ,3f ($C_{22}H_{14}O_5$) 3g ($C_{25}H_{18}O_5$) ,3h ($C_{26}H_{20}O_6$) , 3i($C_{23}H_{15}O_4N$), 3j($C_{24}H_{15}O_4F$) ,3k ($C_{26}H_{20}O_6$), 3l ($C_{22}H_{15}O_4NS$) ,3m ($C_{25}H_{18}O_4$),3n($C_{24}H_{15}O_6N$),3o($C_{24}H_{15}O_4Br$),3p($C_{24}H_{15}O_4Cl$),3q($C_{25}H_{15}O_5F_3$),3r($C_{25}H_{15}O_4F_3$),3s($C_{24}H_{14}O_4BrCl$) 3t($C_{24}H_{15}O_4Cl$) ,3u ($C_{24}H_{15}O_4Br$), 3v($C_{25}H_{15}O_5F$) .Compound 3a, in particular, demonstrated the most effective antibacterial action[27].

Y. RAJENDRA PRASAD described the synthesis and Antimicrobial Activity of Some Chalcone Derivatives. The structures of the synthesized compounds were assigned on the basis of elemental analysis and IR, 1H-NMR spectral data. By using cup plate method,the newly synthesized compounds were screened for their antibacterial activity and anti fungal activity. Among the 12 synthesized compounds the antifungal activity of compounds with pharmacophores like chloro, dichloro and fluoro groups

on all three fungi has been found to be greater than that of other compounds. Indicative antibacterial activity was found in the 12 compounds synthesized according to the screening results[19].

ALKA N CHOUDHARYA and co-workers conducted the synthesis of chalcone and their derivatives as antimicrobial agents. It is found that the antibacterial action of chalcones is caused by the presence of a reactive, unsaturated keto function in it. IR, 1HNMR, and mass spectral analyses were used to confirm the synthesised compounds structural details. Antimicrobial activity of all synthetic compounds were assessed using the disc diffusion method.

At both concentrations, 500 g/ml and 1000 g/ml, the 3-(4-methoxy phenyl)-1-(4-iodophenyl)-2-propen-1-one (1b) had excellent activity against S. aureus. At both concentrations, i.e. 500 g/ml and 1000 g/ml, the compounds 1b, 1i, 1d, 1h, & 1g had good to moderate activity against S aureus[6].

Ahmed Mutanabbi Abdula and co-workers studied the synthesis, characterization and antibacterial activity of (E) - chalcone derivatives.The (E) chalcone derivatives were tested antibacterial activity against Escherichia coli, Klebsiela SPP as well as Staphylococcus aureus and Enterococcus faecalis using diffusion method.

The antibacterial result gives (2E)-3-[5-(substituted phenyl)-furan-2-yl]-1-(aryl) prop-2-en-1-ones exhibited potent to moderate activity as antimicrobial species against some gram positive and negative bacterial species[1].

Deepa Gupta and coworkers conducted study on Chalcone derivatives as potential antifungal agents.For antifungal activity ten derivatives were synthesized and were biologically screened. *C. albicans* ATCC 10231, *A. niger* ATCC 1015, and *M.gypseum* C 115 2000, dermatophyte fungal species are the fungal species evaluated for antifungal activity by cup plate method. The standard used for antifungal activity was Ketoconazole .They synthesized 9 compounds amd the synthesized compounds showed significant antifungal activity against *M. gypseum*, a dermatophyte. Strong antifungal activity was shown by compounds 2-benzylidene-3,4-dihydronaphthalen-1(2H)-one (3a) and 2-(4-chlorobenzylidene)-3,4-dihydronaphthalen-1 (2H)-one (3d) were superior to ketoconazole[11].

Kalpana Sharma and coworkers studied the synthesis, spectroscopic characterization, electronic and docking studies on novel chalcone derivatives (3DPP and 5PPD) by experimental and DFT methods. In this study, 3-(2,4-Dichloro-phenyl)-1-pyridin-3-yl-propenone (3DPP) and 5-Phenyl-1-pyridin-3-yl-penta-2,4-dien-1-one (5PPD) were synthesised and then characterised using spectroscopic techniques such as NMR, UV-Vis, FT-Raman, and FT-IR. The outcomes of computational analyses carried out with Gaussian software were associated with these spectroscopic findings. The molecule's optimisation process confirms the structure with the least amount of energy. The optimised structure is produced using the basis set B3LYP/6-311++G (d, p). Experimental data are used to compare computed geometrical parameters. We acquire experimental results for 3DPP and 5PPD FT-IR spectra in the 4000-400 cm-1 and 4000-50 cm-1 FT-Raman wavelength ranges. PED, or potential energy distribution, is used to facilitate the detailed determination of the molecules' vibrational assignments. Theoretical NMR (1H and 13C) analysis is carried out using

the GIAO method for structural characterization, and is compared with experimental chemical shift values. With the aid of the Time-Dependent DFT method, an experimental UV-Vis spectrum is obtained in DMSO solvent and compared with the theoretically computed spectrum. The periplasmic proteins used in the molecular docking experiments (PDB IDs: 2IPM, 2IPL, and 5Y2O) for both molecules. In addition to these investigations, analyses like MEP, FMO, NBO, and NLO have also been carried out to comprehend the nature of molecules[24].

Helvina Saputri and coworkers conducted study on synthesis and molecular docking studies of chalcones derivatives as potential antimalarial agent .According to reports, chalcone compounds exhibit a wide range of biological actions, including antiviral, antibacterial, antimalarial, antitumor, antifungal, and anticancer properties. Here, we report the synthesis of the compounds (E) -1- (4-fluorophenyl) -3- (3-hydroxyphenyl) prop-2-en-1-one (1) and (E) -1- (4-chlorophenyl) -3- (4-hydroxyphenyl) prop-2-en-1-one (2), which are synthesised from chalcones. The antimalarial protein with the code 5JWA.pdb is used in the In Silico approach along with chloroquine as a positive control using Discovery studio software. The docking data for compound (1) revealed that Ser48, Ser70, Thr435, Asp354, and Lys168 had strong hydrogen bond interactions, with an interaction energy of cDOCKER -32,5006 kcal/mol. Likewise molecule (2) exhibits Ala436, Lys168, and Ala150 hydrogen bond interactions, with interaction energy of cDOCKER -30.0162 kcal/mol. Chloroquine has a hydrogen bond ,Val148 for positive control with an interaction energy of cDOCKER -37,408 kcal/mol. While the original FAD ligand displayed interactions of hydrogen bond Cys117, Ala150, Trp50, Asp354, Ser70, and Ser48 with an interaction energy of

cDOCKER -123,444 kcal/mol. The docking results demonstrate the possibility of compounds (1) and (2) for usage as antimalarial medications. By using 1HNMR and 13C-NMR spectroscopic analyses, it was possible to comprehend the interactions that resulted in the structure of molecules[17].

Mohammed Rayees Ahmad and cpworkers conducted study on synthesis of novel chalcone derivatives by conventional and microwave irradiation methods and their pharmacological activities. The cell cycle disruption, angiogenesis inhibition, disruption of the p53-MDM2 relationship, mitochondrial uncoupling, or induction of apoptosis are possible causes of the cytotoxicity against cancer cell lines. Both traditional and microwave assisted synthesis techniques are used to create chalcones. A significant increase in reaction rate and greater yields have been seen with microwave assisted synthesis. The compounds have undergone testing for antioxidant and cytotoxic activity. The BSLT bioassay method was used to evaluate the cytotoxic activity of each of the five chalcones. All of the substances were discovered to have cytotoxic action. Using several reactive species assays with radical scavenging activity, the5 chalcones' in vitro antioxidant activity and scavenging effects were assessed. The IC50 values were used to determine the potency of the chalcone derivatives.All of the chalcones had their DPPH (1,1-diphenyl-2-picrylhydrazyl) radical scavenging activity evaluated[21].

Makarand Attarde and cowkers studies the synthesis and evaluation of chalcone derivatives for its alpha amylase inhibitory activity. The Claisen-Schmidt reaction between a benzaldehyde and an acetophenone in the presence of NaOH as a catalyst and ethanol as a solvent results in a class

of chemicals called chalcones, which have intriguing biological properties. Using different substituted aldehydes such 4-nitrobenzaldehyde, 4-hydroxybenzaldehyde, 4-chlorobenzaldehyde, and 2-furfuraldehyde, four distinct chalcones were created. Using literature methods, the intended compounds were successfully synthesised in the lab, and NMR and IR spectroscopy validated their structural integrity. A test called the alpha amylase inhibitory assay was used to identify anti-diabetic activity.The synthesised substance 3-(4-hydroxyphenyl)-1-phenylprop-2-en-1-one possesses an alpha amylase inhibitory activity, according to the data obtained[3].

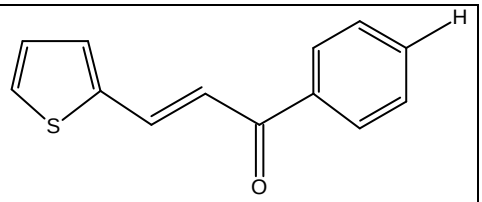
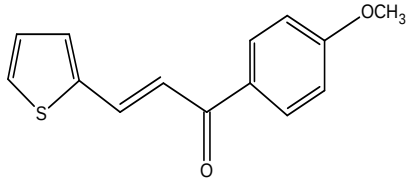
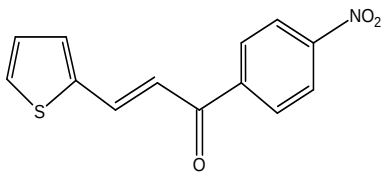
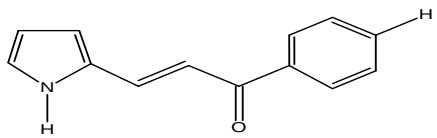
Emelda N. Okolo and co-workers conducted study on new chalcone derivatives as potential antimicrobial and antioxidant agent.The Claisen-Schmidt condensation was used to create seven chalcone derivatives. Spectral information from the ultraviolet/visible, infrared, nuclear magnetic resonance, and mass spectroscopy validated the compounds' structural details. The compounds' in vitro and in silico antibacterial and antioxidant properties were examined. All of the drugs shown strong binding affinity with the target microorganism proteins, according to the molecular docking evaluations. The results of the antimicrobial test showed that every substance that was screened was effective against Bacillus subtilis and Staphylococcus aureus[18].

Chapter 3

Materials and Methods

3.1 Experimental Section

The molecule chosen for the present study are

Chalcone TAA	 (*E*)-1-phenyl-3-(thiophen-2-yl)prop-2-en-1-one
Chalcone TAMA	 (*E*)-1-(4-methoxyphenyl)-3-(thiophen-2-yl)prop-2-en-1-one
Chalcone TANA	 (*E*)-1-(4-nitrophenyl)-3-(thiophen-2-yl)prop-2-en-1-one
Chalcone PAA	 (*E*)-1-phenyl-3-(1*H*-pyrrol-2-yl)prop-2-en-1-one

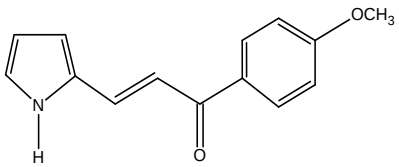
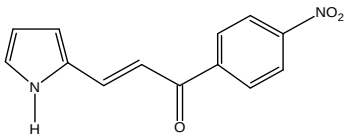
Chalcone PAMA	 (*E*)-1-(4-methoxyphenyl)-3-(1*H*-pyrrol-2-yl)prop-2-en-1-one
Chalcone PANA	 (*E*)-1-(4-nitrophenyl)-3-(1*H*-pyrrol-2-yl)prop-2-en-1-one

Table 1:Synthesized chalcones

3.1.1 Chemicals

- Acetophenone
- 4-Methoxyacetophenone
- 4-Nitroacetophenone
- Sodium Hydroxide
- Ethanol
- Thiophene-2-carboxaldehyde
- Pyrrole-2-carboxaldehyde

3.1.2.Experimental setup

The experimental setup consists of:

- Reactor: The experiments were carried out in small scale so 250ml Borosil beaker was used as the reactor.
- Ice cold water bath where the beaker with solution kept and stirred properly for cooling.

- Refrigerator-The made up solution of chalcone was kept in the refrigerator for 72 hours.
- Desiccator used for proper drying of the product.
- Glass rod used as stirrer.
- Filter paper for filtration of solution.

3.1.3 Synthesis of Chalcone-1 ((E)-phenyl-3-(thiophen-2-yl) prop-2-en-1-one)

Thiophene-2-carboxaldehyde and acetophenone undergoes claisen Schmidt condensation reaction and forms (E)-phenyl-3-(thiophen-2-yl) prop-2-en-1-one by the removal of a molecule of H_2O.

Take 0.025 M 1.5 ml of thiophene-2-carboxaldehyde in a beaker and is dissolved in required amount of methanol/ethanol. It is dissolved and stirred well using a glass rod. Then add 0.025 M 1.5 ml of acetophenone and equal amount of NaOH simultaneously to it. Stir well for few minutes. Place the beaker in a cold bath and stir continuously for 10-20 minutes or place the beaker in the magnetic stirrer. After stirring, cover the beaker using a filter paper or normal paper and put some holes in it for proper cooling and it is kept in the refrigerator for 24-48 hours. After proper cooling take the beaker from the refrigerator and place the beaker in the room temperature for getting evaporated, if not the residue is filtered using a filter paper and it is kept in the desiccator for drying up. After putting in the desiccator leave it for 24 hours. After 24 hours take it back and is stored in a container[25].

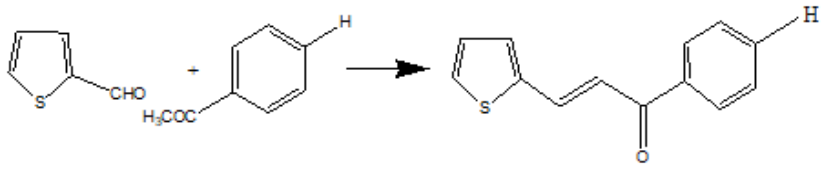


Fig 3-Synthesis of Chalcone 1 ((E)-1-phenyl-3-(thiophen-2-yl) prop-2-en-1-one)

Synthesized chalcone 1 ((E)-1-phenyl-3-(thiophen-2- yl) prop-2-en-1-one)

3.1.4 Synthesis of Chalcone-2 ((E)-1-(4-methoxyphenyl)-3-(thiophen-2-yl) prop-2-en-1-one)

Thiophene-2-carboxaldehyde and 4-methoxyacetophenone undergoes claisen Schmidt condensation reaction and forms ((E)-1-(4-methoxyphenyl)-3-(thiophen-2-yl) prop-2-en-1-one) by the removal of a molecule of H_2O.

Take 0.025 M 1.5 ml of thiophene-2-carboxaldehyde in a beaker and is dissolved in required amount of methanol/ethanol. It is dissolved and stirred well using a glass rod. Then add 0.025 M 1.5 ml of 4-methoxyacetophenone and equal amount of NaOH simultaneously to it. Stir well for few minutes. Place the beaker in a cold bath and stir continuously for 10-20 minutes or place the beaker in the magnetic stirrer. After stirring, cover the beaker using a filter paper or normal paper and put some holes in it for proper cooling and it is kept in the refrigerator for 24-48 hours. After proper cooling take the beaker from the refrigerator and place the beaker in the room temperature for getting evaporated, if not the residue is filtered using a filter paper and it is kept in the desiccator for drying up. After putting in the desiccator leave it for 24 hours. After 24 hours take it back and is stored in a container[25] .

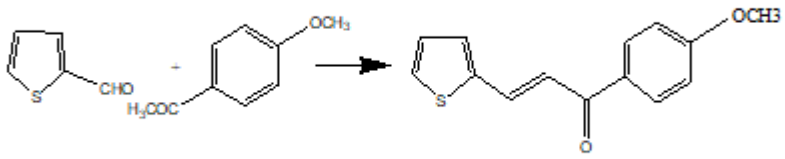


Fig 4-Synthesis of Chalcone 2 ((E)-1-(4-methoxyphenyl)-3-(thiophen-2-yl) prop-2-en-1-one)

Synthesized chalcone 2 ((E)-1-(4-methoxyphenyl)-3-(thiophen-2-yl) prop-2-en-1-one)

3.1.5 Synthesis of Chalcone-3 ((E)-1-(4-nitrophenyl)-3-(thiophen-2-yl) prop-2-en-1-one)

Thiophene-2-carboxaldehyde and 4-nitroacetophenone undergoes claisen Schmidt condensation reaction and forms (E)-1-(4-nitrophenyl)-3-(thiophen-2-yl) prop-2-en-1-one)by the removal of a molecule of H_2O.

Take 0.025 M 1.5 ml of thiophene-2-carboxaldehyde in a beaker and is dissolved in required amount of methanol/ethanol. It is dissolved and stirred well using a glass rod. Then add 0.025 M 1.5 ml of 4-nitroacetophenone and equal amount of NaOH simultaneously to it. Stir well for few minutes. Place the beaker in a cold bath and stir continuously for 10-20 minutes or place the beaker in the magnetic stirrer. After stirring, cover the beaker using a filter paper or normal paper and put some holes in it for proper cooling and it is kept in the refrigerator for 24-48 hours. After proper cooling take the beaker from the refrigerator and place the beaker in the room temperature for getting evaporated, if not the residue is filtered using a filter paper and it is kept in the desiccator for

drying up. After putting in the desiccator leave it for 24 hours. After 24 hours take it back and is stored in a container[25].

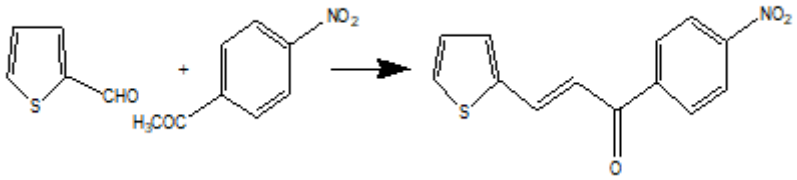


Fig 5:-Synthesis of Chalcone 3 ((E)-1-(4-nitrophenyl)-3-(thiophen-2-yl) prop-2-en-1-one)

Synthesized chalcone 3 ((E)-1-(4-nitrophenyl)-3-(thiophen-2-yl)prop-2-en-1-one)

3.1.6 Synthesis of Chalcone-4 ((E)-1-phenyl-3-(1H-pyrrol-2-yl) prop-2-en-1-one)

Pyrrole-2-carboxaldehyde and acetophenone undergoes claisen Schmidt condensation reaction and form((E)-1-phenyl-3-(1h-pyrrol-2-yl) prop-2-en-1-one) by the removal of a molecule of H_2O.

Take 0.025 M 1.5 ml of pyrrole-2-carboxaldehyde in a beaker and is dissolved in required amount of methanol/ethanol. It is dissolved and stirred well using a glass rod. Then add 0.025 M 1.5 ml of acetophenone and equal amount of NaOH simultaneously to it. Stir well for few minutes. Place the beaker in a cold bath and stir continuously for 10-20 minutes or place the beaker in the magnetic stirrer. After stirring, cover the beaker using a filter paper or normal paper and put some holes in it for proper cooling and it is kept in the refrigerator for 24-48 hours. After proper cooling take the beaker from the refrigerator and place the beaker in the room temperature for getting evaporated, if not the residue is filtered using a filter paper and it is kept in the desiccator for drying up. After putting in the desiccator leave it for 24 hours. After 24 hours take it back and is stored in a container[25].

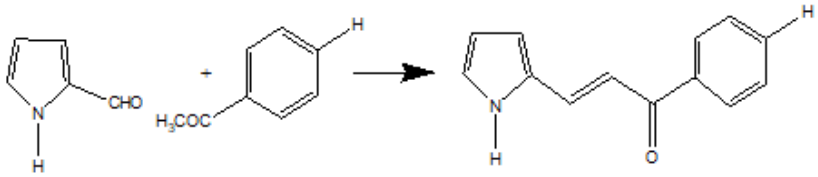
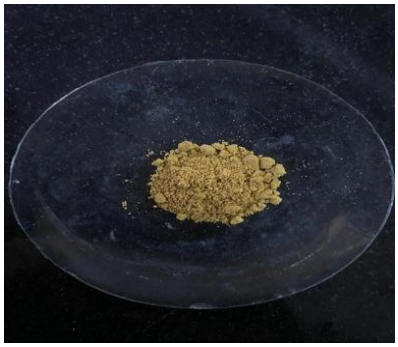


Fig 6-Synthesis of Chalcone 4 ((E)-1-phenyl)-3-(1H-pyrrol-2-yl)prop-2-en-1-one



Synthesized chalcone 4 ((E)-1-phenyl)-3-(1H-pyrrol-2-yl) prop-2-en-1-one)

3.1.7 Synthesis of Chalcone-5 ((E)-1-(4-methoxyphenyl)-3-(1H-pyrrol-2-yl) prop-2-en-1-one)

Pyrrole-2-carboxaldehyde and 4-methoxyacetophenone undergoes claisen Schmidt condensation reaction and forms ((E)-1-(4-methoxyphenyl)-3-(1H-pyrrol-2-yl) prop-2-en-1-one) by the removal of a molecule of H_2O.

Take 0.025 M 1.5 ml of pyrrole-2-carboxaldehyde in a beaker and is dissolved in required amount of methanol/ethanol. It is dissolved and stirred well using a glass rod. Then add 0.025 M 1.5 ml of 4-methoxyacetophenone and equal amount of NaOH simultaneously to it. Stir well for few minutes. Place the beaker in a cold bath and stir continuously for 10-20 minutes or place the beaker in the magnetic stirrer. After stirring, cover the beaker using a filter paper or normal paper and put some holes in it for proper cooling and it is kept in the refrigerator for 24-48 hours. After proper cooling take the beaker from the refrigerator and place the beaker in the room temperature for getting evaporated, if not the residue is filtered using a filter paper and it is kept in the desiccator for drying up. After putting in the desiccator leave it for 24 hours. After 24 hours take it back and is stored in a container [25].

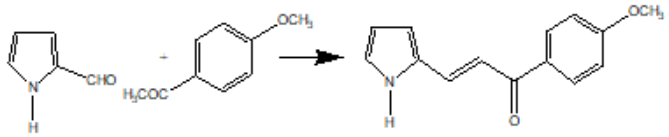
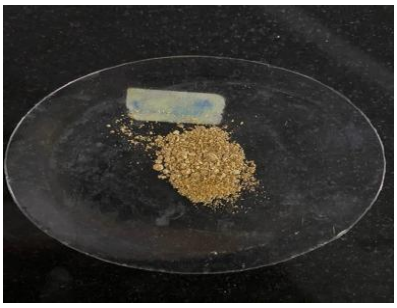


Fig 13-Synthesis of Chalcone 5 ((E)-1-(4-methoxyphenyl)-3-(1H-pyrrol-2-yl) prop-2-en-1-one)



Synthesized chalcone 5 ((E)-1-(4-methoxyphenyl)-3-(1H-pyrrol-2-yl) prop-2-en-1-one)

3.1.8 Synthesis of Chalcone-6 ((E)-1-(4-nitrophenyl)-3-(1H-pyrrol-2-yl) prop-2-en-1-one)

Pyrrole-2-carboxaldehyde and 4-ntroacetophenone undergoes claisen Schmidt condensation reaction and forms((E)-1-(4-nitrophenyl)-3-(1H-pyrrol-2-yl) prop-2-en-1-one)by the removal of a molecule of H_2O.

Take 0.025 M 1.5 ml of pyrrole-2-carboxaldehyde in a beaker and is dissolved in required amount of methanol/ethanol. It is dissolved and stirred well using a glass rod. Then add 0.025 M 1.5 ml of 4-nitroacetophenone and equal amount of NaOH simultaneously to it. Stir well for few minutes. Place the beaker in a cold bath and stir continuously for 10-20 minutes or place the beaker in the magnetic stirrer. After stirring, cover the beaker using a filter paper or normal paper and put some holes in it for proper cooling and it is kept in the refrigerator for 24-48 hours. After proper cooling take the beaker from the refrigerator and place the beaker in the room temperature for getting evaporated, if not the residue is filtered using a filter paper and it is kept in the desiccator for drying up. After putting in the desiccator leave it for 24 hours. After 24 hours take it back and is stored in a container[25].

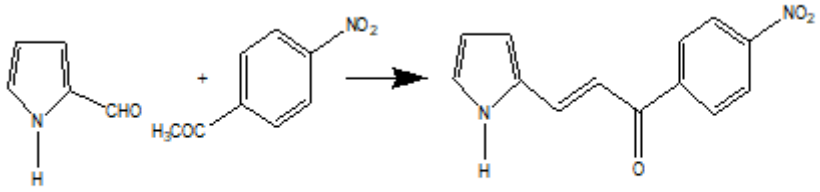


Fig14-Synthesis of Chalcone 6 ((E)-1-(4-nitrophenyl)-3-(1H-pyrrol-2-yl) prop-2-en-1-one)

Synthesized chalcone 6 ((E)-1-(4-nitrophenyl)-3-(1H- pyrrol-2-yl) prop-2-en-1-one)

3.2 CHARACTERIZATION

3.2.1 Ultraviolet-Visible spectroscopy

In ultraviolet-visible spectroscopy, light from the UV area is absorbed by the molecule, which causes the electrons to be excited from their ground state to a higher energy state[28].The chemical compounds' apparent colour is directly influenced by the absorption or reflectance within the visible range.Acetone was used to record UV visible absorption spectra. 3.0 ml of the prepared 10-5M solutions of the samples in solvent were used to record the spectra.Shimadzu UV 1800 double beam spectrophotometer was used to record the spectra

3.2.2 FT-IR Spectroscopy

A type of vibrational spectroscopy is Fourier transform infrared spectroscopy. IR spectrophotometer was used to record IR spectra.The IR portion of the electromagnetic spectrum is the subject of infrared

spectroscopy.The types of functional groups that are present in the ligands can be determined from their IR spectra[13].

3.2.3 Molecular docking study

The three dimensional structure of the chalcones were obtained by DFT calculations at B3LYP/6-31-G (d,p) level. The protein molecules were downloaded from RCSB protein data bank. Know drug molecule were downloaded from Pub chem. Docking of known drug molecule (Triclosan and chloroquine) and optimized chalcones, with protein (5bnm and 6mo3) were performed using Autodock Vina. Gaussian 09 software package became used for DFT calculation and TD-DFT calculations .DFT calculations gives geometry optimization and IR spectrum calculation.TD-DFT calculations gives UV-visible spectrum. The calculations were done at B3LYP/6-31G(d,p) level. The calculations in the solution phase was carried out using CPCM model which is part of the Gaussian software package. HOMO and LUMO for all the molecules are identified. Gauss View 5 cewere finished the use of HPv185e workstation computer equipped with Intel 7 core processor and 24 GB RAM, Microsoft Windows as the operating system[24].

Chapter 4

Result and Discussion

4.1Result and Discussion

The synthesized chalcones are characterised by UV Visible,IR and HOMO-LUMO gap and are compared by experimental and DFT calculations

4.1.1 UV- Vis SPECTRAL STUDY

The UV-Vis spectrum obtained was carried out in the range of 200 to 500 nm.Thiophene substituted chalcones shows UV absorption maxima in a range of 335-345nm.pyrrole substituted chalcones show UV absorption maxima in a range 345-375.

Chalcone TAA

Measured UV spectrum of chalcone TAA shows a peak at a wavelength of 338 nm due to n--> π* transition of the compound. A similar range peak of 335.46nm is seen in the calculated UV Visible spectrum.The maximum wavelength of both measured and calculated UV Visible spectrum is shown in the figure 15.

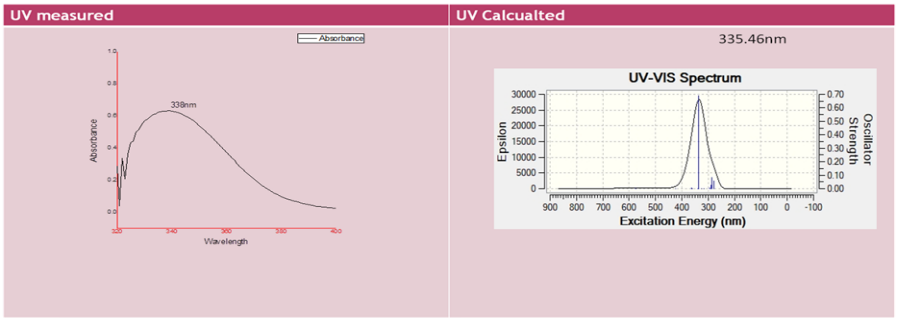


Fig 15 UV absorption maxima of chalcone TAA

Chalcone TAMA

Measured UV spectrum of chalcone TAA shows a peak at a wavelength of 336 nm due to n--> π* transition of the compound. A similar range peak of 345nm is seen in the calculated UV Visible spectrum.The maximum wavelength of both measured and calculated UV Visible spectrum is shown in the figure 16

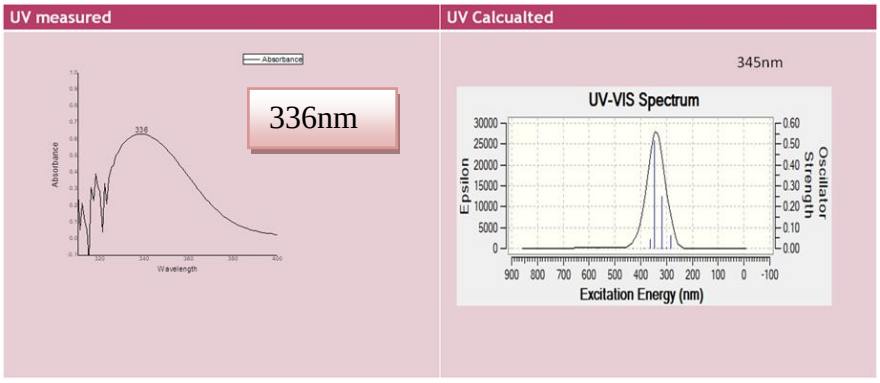


Fig 16 UV absorption maxima of chalcone TAMA

Chalcone TANA

Measured UV spectrum of chalcone TAA shows a peak at a wavelength of 343 nm due to n--> π* transition of the compound. A similar range peak of 342nm is seen in the calculated UV Visible spectrum.The maximum wavelength of both measured and calculated UV Visible spectrum is shown in the figure 17

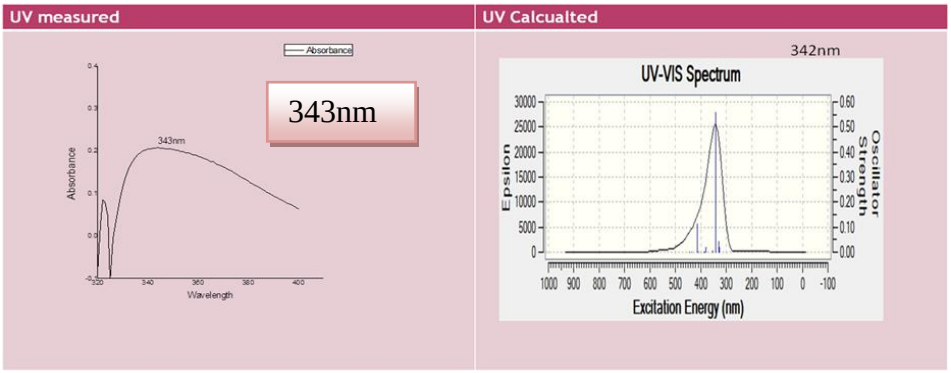


Fig 17 UV absorption maxima of chalcone TANA

Chalcone PAA

Measured UV spectrum of chalcone TAA shows a peak at a wavelength of 372 nm due to n--> π* transition of the compound. A similar range peak of 345nm is seen in the calculated UV Visible spectrum.The maximum

wavelength of both measured and calculated UV Visible spectrum is shown in the figure 18

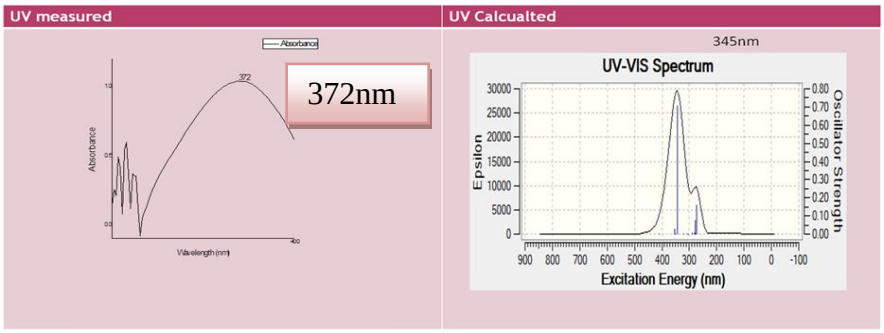


Fig 18 UV absorption maxima of chalcone PAA

Chalcone PAMA

Measured UV spectrum of chalcone TAA shows a peak at a wavelength of 370 nm due to n--> π* transition of the compound. A similar range peak of 348nm is seen in the calculated UV Visible spectrum.The maximum wavelength of both measured and calculated UV Visible spectrum is shown in the figure 19

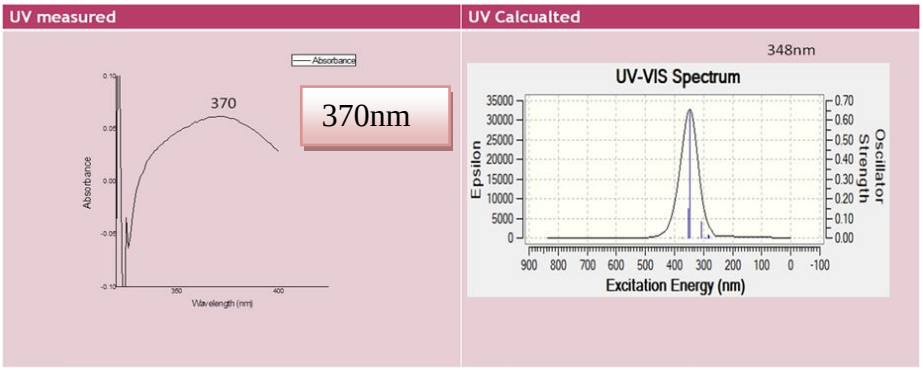


Fig 19 UV absorption maxima of chalcone PAMA

Chalcone PANA

Measured UV spectrum of chalcone TAA shows a peak at a wavelength of 370 nm due to n--> π* transition of the compound. A similar range peak of 352nm is seen in the calculated UV Visible spectrum.The maximum wavelength of both measured and calculated UV Visible spectrum is shown in the figure 20

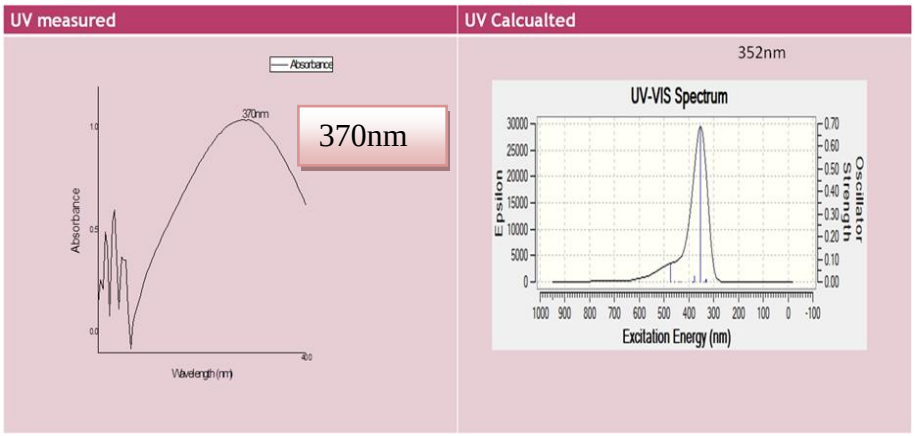


Fig 20 UV absorption maxima of chalcone PANA

λmax Values of Chalcones (Measured and calculated)

Name	λmax (Measured)	λmax (Calculated)
TAA	338nm	335.4nm
TAMA	336nm	345nm
TANA	343nm	342nm
PAA	372nm	345nm
PAMA	370nm	348nm
PANA	374nm	352nm

TABLE 1 UV Absorption maxima values of chalcones

4.1.2 IR SPECTRAL STUDY

The vibrational IR spectrum of all chalcone show similar range in both experimental and theoretical spectrum.

Chalcone TAA

The IR spectrum of chalcone TAA is shown in figure 21. The four characteristics bands observed are 3069.1 $cm^{-1,}$1649.07 $cm^{-1,}$1583.4 cm^{-1},971.32 cm^{-1}. They were assigned as the vibrational modes of C-H thiophene,C=O,Aromatic C=C,aliphatic CH=CH .The frequencies of all peaks are summarized in table 2

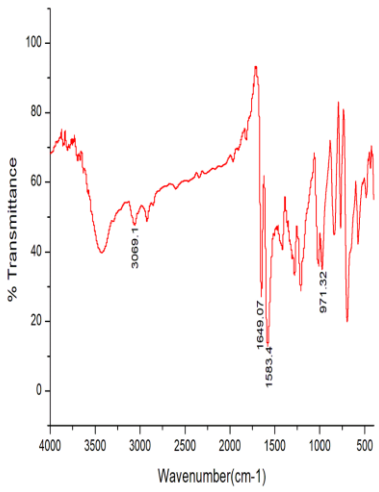
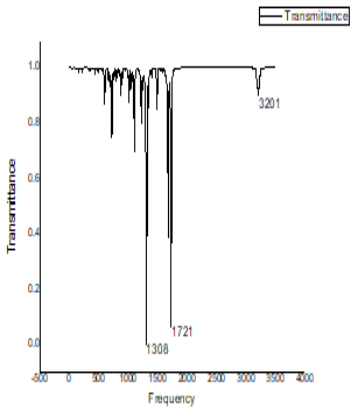
Experimental	Theoretical
	

Figure 21 IR SPECTRUM OF CHALCONE TAA

Frequency cm^{-1}	Vibration
3069.1 cm^{-1}	C-H thiophene
1649.07 cm^{-1}	C=O
1583.4 cm^{-1}	Aromatic C=C
971.32 cm	aliphatic CH=CH

TABLE 2 Vibrational peaks of CHALCONE TAA

Chalcone TAMA

The IR spectrum of chalcone TAMA is shown in figure 22. The five characteristics bands observed are 3110.8$cm^{-1,}$1650.58 $cm^{-1,}$1587.57 cm^{-1},1261.61 $cm^{-1,}$,968.3 cm^{-1}. They were assigned as the vibrational modes of C-H thiophene,C=O,Aromatic C=C,asymmetric C-O-C,aliphatic CH=CH .The frequencies of all peaks are summarized in table 3

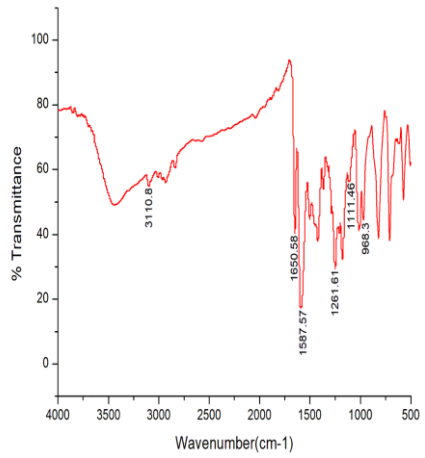
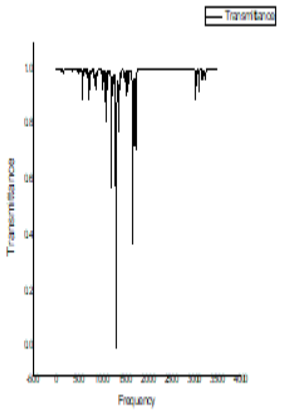
Experimental	Theoretical
	

Figure 22 IR SPECTRUM OF CHALCONE TAMA

Frequency cm^{-1}	Vibration
3110.8 cm^{-1}	C-H thiophene
1650.58 cm^{-1}	C=O
1587.57cm^{-1}	Aromatic C=C
1261.61 cm^{-1}	asymmetric C-O-C
968.3 cm^{-1}	aliphatic CH=CH

TABLE 3Vibrational peaks of CHALCONE TAMA

Chalcone TANA

The IR spectrum of chalcone TANA is shown in figure 23. The four characteristics bands observed are 3085.39cm$^{-1,}$1583.46 cm^{-1},1338.40 cm$^{-1,}$,856.69cm^{-1}. They were assigned as the vibrational modes of C-H Aromatic,,Aromatic C=C,symmetric Ar-NO2,C-N Ar-NO2 .The frequencies of all peaks are summarized in table 4.

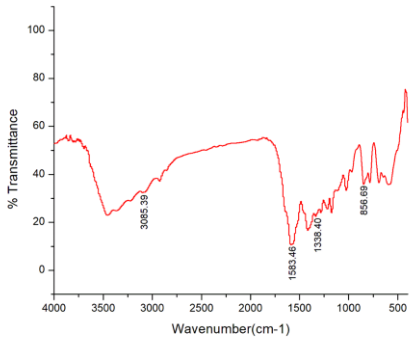
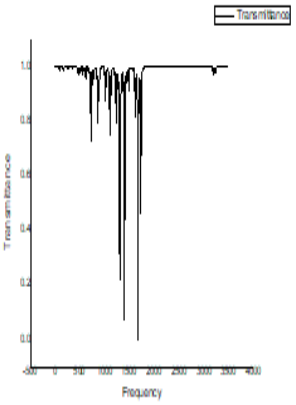
Experimental	Theoretical
	

Figure 23 IR SPECTRUM OF CHALCONE TANA

Frequency cm^{-1}	Vibration
3085.39 cm^{-1}	Aromatic C-H
1583.46cm^{-1}	Aromatic C=C
1338.40 cm^{-1}	symmetric Ar-NO2
856.69 cm^{-1}	C-N Ar-NO2

TABLE 4 Vibrational peaks of CHALCONE TANA

Chalcone PAA

The IR spectrum of chalcone PAA is shown in figure 24. The four characteristics bands observed are 3436.67$cm^{-1,}$1649.07 cm^{-1},1583.46 ,cm^{-1},971.32cm^{-1}. They were assigned as the vibrational modes ofN-H,C=O,Aromatic C=C,.Aliphatic CH=CHThe frequencies of all peaks are summarized in table 5

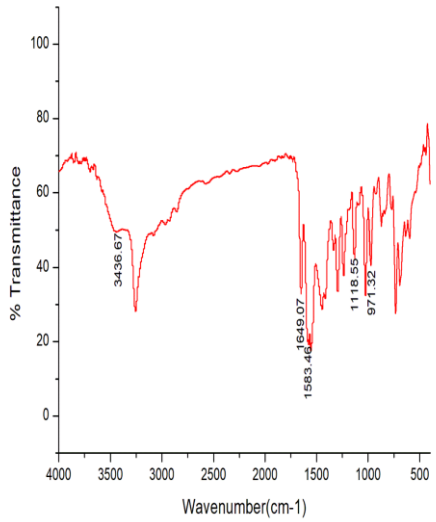
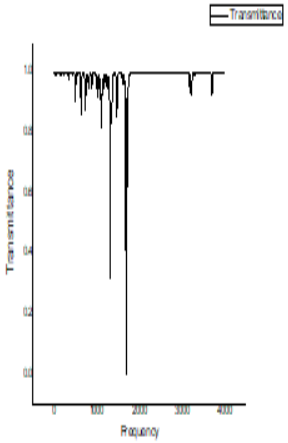
Experimental	Theoretical
	

Figure 24 IR SPECTRUM OF CHALCONE PAA

Frequency cm^{-1}	Vibration
3436.67cm^{-1}	N-H
1649.07 cm^{-1}	C=O
1583.46 ,cm^{-1}	Aromatic C=C
971.32cm^{-1}	Aliphatic CH=CH

TABLE 5 Vibrational peaks of CHALCONE PAA

Chalcone PAMA

The IR spectrum of chalcone PAMAis shown in figure 25. The four characteristics bands observed are 3300.29cm$^{-1,}$1650.58 cm^{-1},1587.57 ,cm^{-1},1015.78cm^{-1}. They were assigned as the vibrational modes of N-H,C=O,Aromatic C=C,.Aliphatic CH=CH,Symmetric C-O-C.The frequencies of all peaks are summarized in table 6

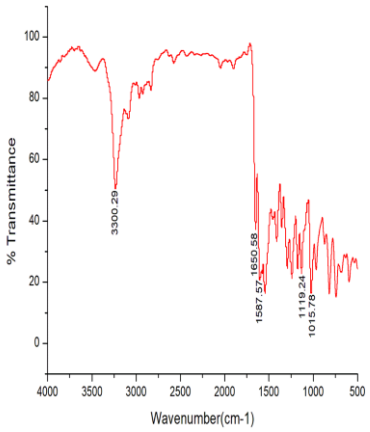
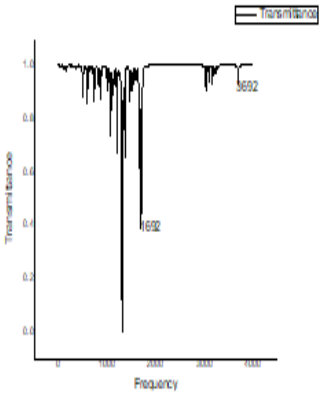
Experimental	Theoretical
	

Figure 25 IR SPECTRUM OF CHALCONE PAMA

Frequency cm^{-1}	Vibration
3300.29cm^{-1}	N-H

1650.58 cm^{-1}	C=O
1587.57 ,cm^{-1}	Aliphatic CH=CH
1015.78cm^{-1}	Symmetric C-O-C

TABLE 6Vibrational peaks of CHALCONE PAMA

Chalcone PANA

The IR spectrum of chalcone PANA is shown in figure 26. The four characteristics bands observed are 3452.3$cm^{-1,}$,1595.39 cm^{-1},1396.97$cm^{-1,}$1166.7cm^{-1} They were assigned as the vibrational modes of N-H,Aromatic C=C,Symmetric Ar-NO2,C-N. The frequencies of all peaks are summarized in table 7

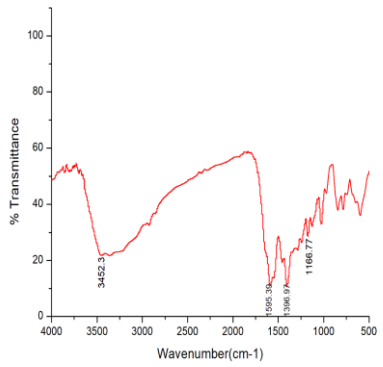
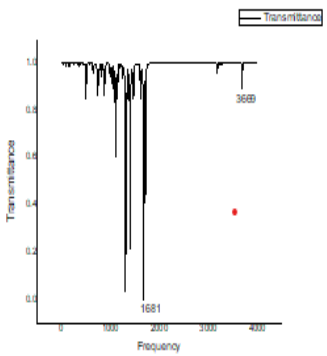
Experimental	Theoretical
	

Figure 26 IR SPECTRUM OF CHALCONE PANA

Frequency cm^{-1}	Vibration
$3452.3cm^{-1}$	N-H
$1595.39\ cm^{-1}$	Aliphatic CH=CH
$1396.97cm^{-1}$	Symmetric Ar-NO2
$1166.7cm^{-1}$	C-N

TABLE 7 Vibrational peaks of CHALCONE PANA

4.1.3 HOMO-LUMO Gap

The idealised optimised molecular geometry depicts a isolated molecule with a stationary point on the potential energy surface. The absence of imaginary vibrational frequencies served as confirmation of the convergence. At the B3LYP/6-31G (d, p) level, several conformational isomeric cisoid and transoid structures of molecules were optimised.The optimised structure is shown in table 8 and 9.

Calculated HOMO-LUMO Gap is measured by taking the difference between LUMO and HOMO energy levels.The calculated values of the synthesized chalcones are shown in table 8 and 9.Methoxy substituted chalcone shows the highest calculated HOMO-LUMO gap.

Measured HOMO-LUMO gap is calculated by the equation $1240/\lambda$ in Ev where the λ is the wavelength measured.The measured HOMO-LUMO

values is shown in table 8 and 9 Methoxy substituted chalcone shows the highest measured HOMO-LUMO gap.

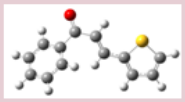
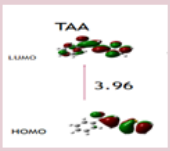
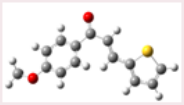
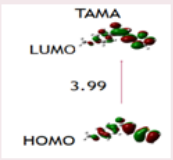
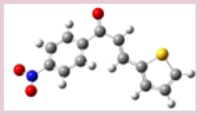
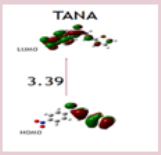
Compound	HOMO-LUMO Gap	HLG (measured)= 1240/λ In eV	HLG (Calculated)= E(LUMO) - E (HOMO)
TAA 		3.66	3.96
TAMA 		3.69	3.99
TANA 		3.61	3.39

TABLE 8 HOMO-LUMO GAP OF CHALCONES

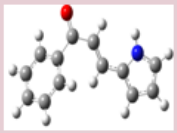
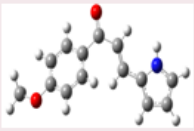
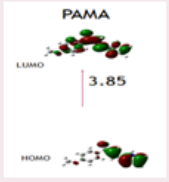
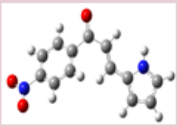
Compound	HOMO-LUMO Gap	HLG (measured)= 1240/λ	HLG (Calculated)= E(LUMO) - E (HOMO)
PAA 		3.33	3.80
PAMA 		3.35	3.85
PANA 		3.31	2.99

TABLE 9 HOMO-LUMO GAP OF CHALCONES

4.1.4Molecular Docking

Antibacterial activity

Binding energy of Triclosan-5bnm interaction (standard)is found by molecular docking.Then the binding energy of 5bnm–chalcones interactions by docking is calculated.

The binding energies of above interactions with standard is compared and predicted the antibacterial activity of chalcones.

Chalcones which show higher numerical binding energy than triclosan has a better antibacterial activity than triclosan.

Methoxy substituted pyrrole shows the best antibacterial activity since it has higher binding energy than triclosan which is -6.6 K Cal/mol.

Docking of TRICLOSAN with 5bnm is shown in figure 27

Binding Energy = -6.0K Cal/mol

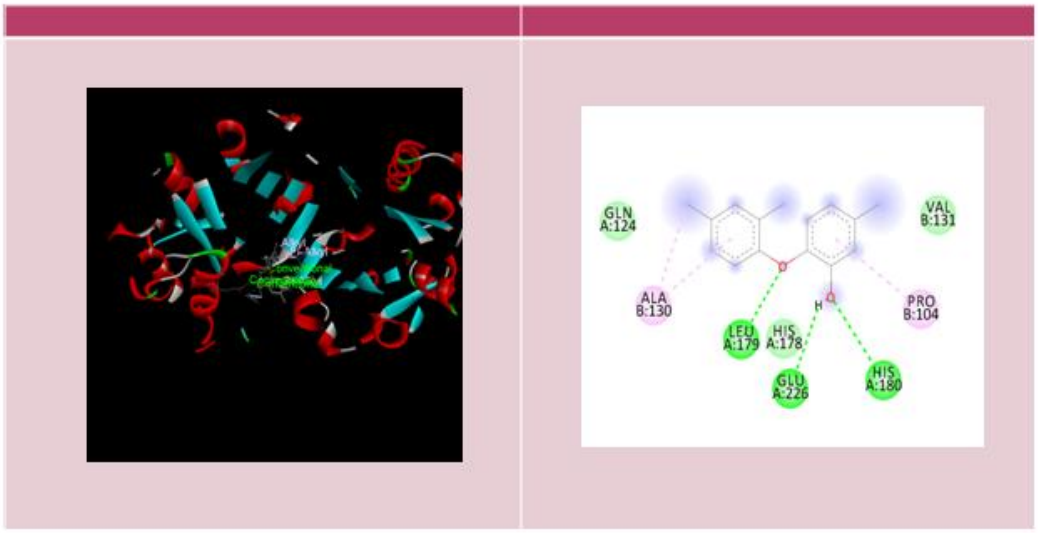


Figure 27 Triclosan-5bnm interaction

Docking of chalcone TAA with 5bnm is shown in figure 28

BINDING ENERGY=-5.7Kcal/mol

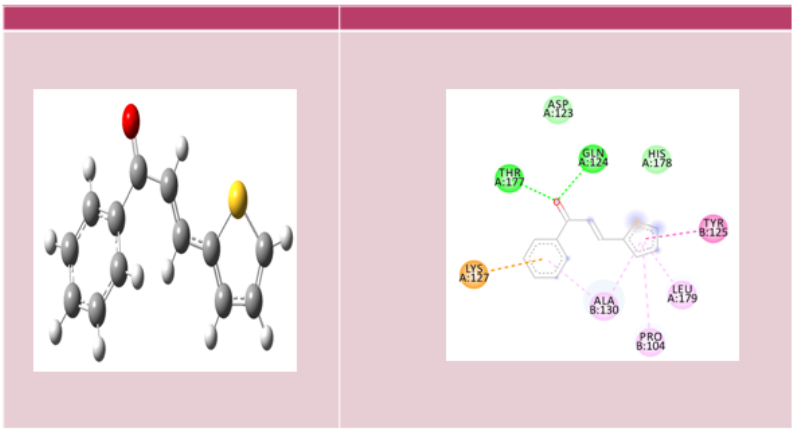


Figure 28 chalcone TAA -5bnm interaction

Docking of chalcone TAMA with 5bnm is shown in figure 29

BINDING ENERGY=-6.1Kcal/mol

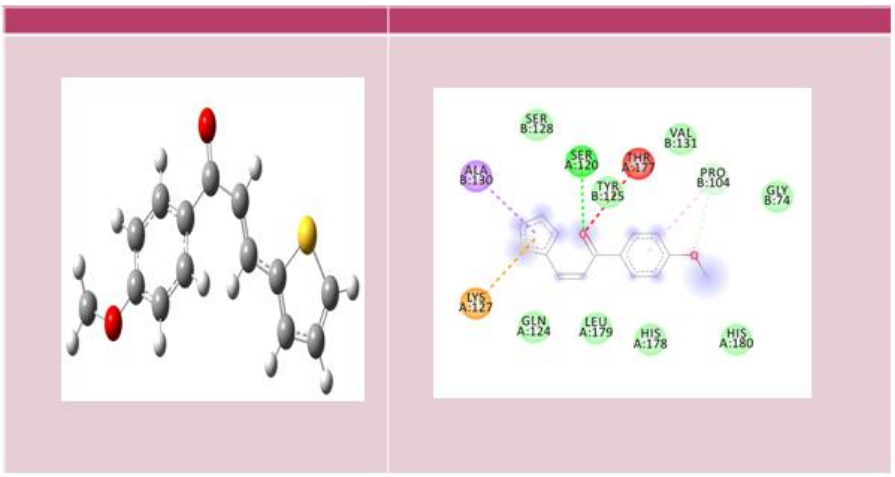


Figure 29 chalcone TAMA -5bnm interaction

Docking of chalcone TAMA with 5bnm is shown in figure 30

BINDING ENERGY=-6.4Kcal/mol

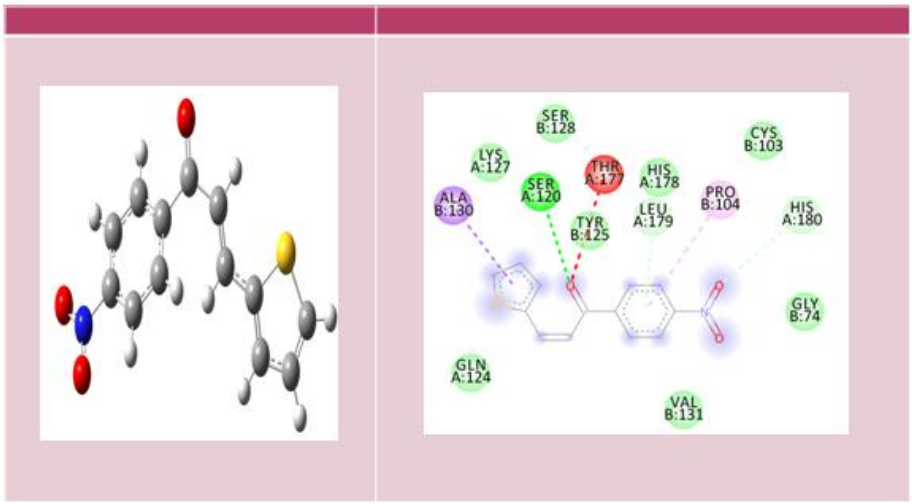


Figure 30 chalcone TANA -5bnm interaction

Docking of chalcone PAA with 5bnm is shown in figure 31

BINDING ENERGY=-6.3K cal/mol

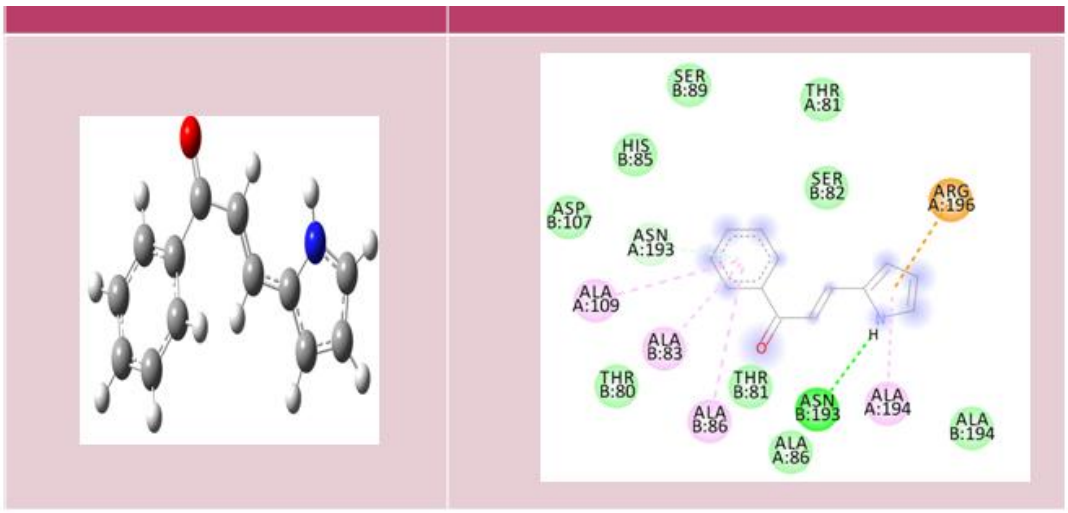


Figure 31 chalcone PAA -5bnm interaction

Docking of chalcone PAMA with 5bnm is shown in figure 32

BINDING ENERGY=-6.6K cal/mol

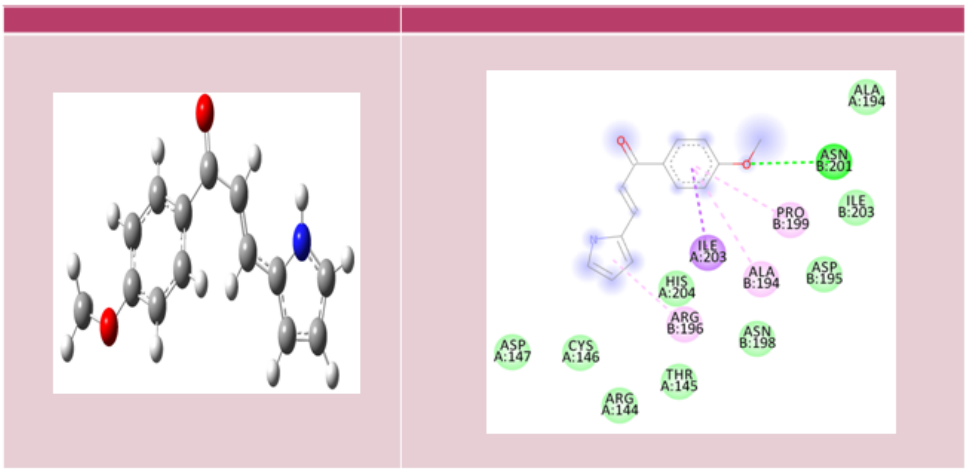


Figure 32 chalcone PAMA -5bnm interaction

Docking of chalcone PANA with 5bnm is shown in figure 33

BINDING ENERGY=-6.3K cal/mol

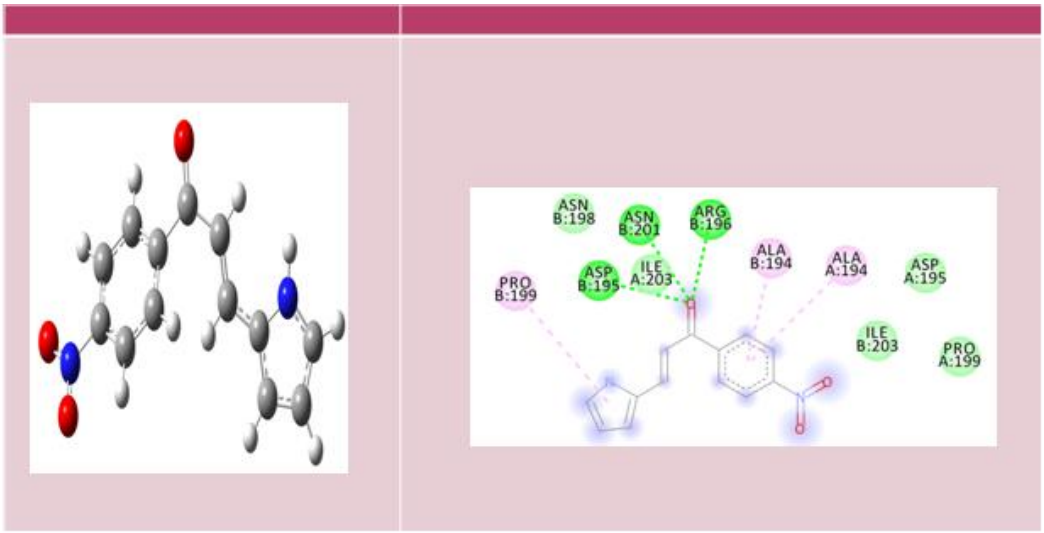


Figure 33 chalcone PANA -5bnm interaction

Antiviral activity

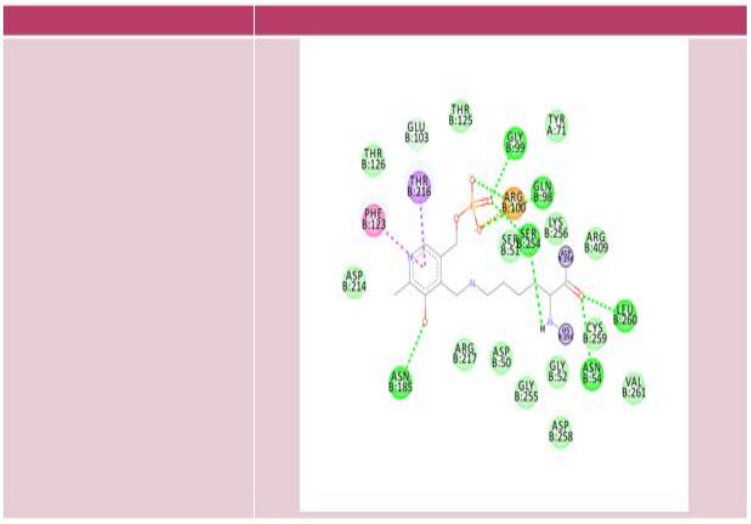
Binding energy of cloroquine-6mo3 interaction (standard)is found by molecular docking.Then the binding energy of6mo3–chalcones interactions by docking is calculated.

The binding energies of above interactions with standard is compared and predicted the antiviralactivity of chalcones.

Chalcones which show higher numerical binding energy than chloroquine has a better antiviral activity than chloroquine.

Methoxy substituted pyrrole shows the best antiviral activity since it has higher numerical binding energy than chloroquine which is -9.4 Kcal/mol.

Docking of cloroquine-6mo3 is shown in figure 34



BINDING ENERGY=-8.4K cal/mol

Anti viral activity of chalcones is shown in table 10

Compound	Binding energy (K Cal/mol)
TAA	-8.4
TAMA	-8.7
TANA	-9.0
PAA	-8.7
PAMA	-9.4
PANA	-8.8

Table 10 Binding energy of chalcones

Chapter 5

Conclusions

The purpose of this study was to synthesize chalcone derivatives containing heteroatom and six chalcones were synthesized by claisen schmidt condensation between equimolar quantities of a substituted acetophenone with substituted aldehydes in the presence of aqueous alcoholic alkali.The synthesized chalcones were characterized by ultraviolet spectroscopy,infra red spectroscopy.UV spectra, IR spectra and HOMO LUMO gaps were compared by experimental and DFT Calculations.Calculated and measured values of IR spectra and UV sprectra comes in similar range. The UV values of synthesized chalcones comes with in the range 335-375nm.HLG follows the same pattern as the previous comparatative study .Methoxy substituted chalcone shows the highest calculated and measured HOMO-LUMO gap.In this project as a pharmaceutical application we studied the antibacterial and antiviral properties of chalcones using molecular docking.Anti bacterial and anti viral activity of synthesized chalcones was studied by Docking method using triclosan and chloroquine as the standard drug and 5bnm and 6mo3 as the protein respectively. From the docking study it is clear that methoxy substituted pyrrole aldehyde shows the best antibacterial and antiviral activity.

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