SYNTHESIS OF \((E)-3-(3\text{-aryl-1-phenyl-1H-pyrazol-4-yl})-1-(1-((1\text{-benzyl-1H-1,2,3-triazol-4-yl})methoxy)naphtalen-2-yl)\) PROP-2-EN-1-ONES and \((E)-3-(3\text{-aryl-1-phenyl-1H-pyrazol-4-yl})-1-(2-((1\text{-benzyl-1H-1,2,3-triazol-4-yl})methoxy)naphtalen-1-yl)\) PROP-2-EN-1-ONES

Introduction:

The synthesis of heterocycles is of great importance in pharmaceutical and medicinal chemistry. The ever-increasing demand for novel biologically-active compounds and the laborious process of lead discovery and optimization have resulted in the continuous search for simple and efficient methods for generating libraries for biological screening. Isolation of natural 1,2,3-triazole derivatives does not seem to have been reported so far, however synthetic 1,2,3-triazoles derivatives were found to exhibit many industrial and pharmacological applications. The development of 1,2,3-triazoles for drug discovery and industrial use has been shown to be very versatile. The uses of triazoles have been found in various areas and are continuously growing. The applications of these triazoles are increasingly found in all aspects of drug discovery, ranging from cutting edge research through combinatorial chemistry and target-templated \textit{in situ} chemistry, to proteomics and DNA research using bioconjugation reactions\(^1\). These triazole products are more than just passive linkers; they readily associate with biological targets, through hydrogen bonding and dipole interactions\(^2\). Derivatives of 1,2,3-triazole have been found to have anti-HIV\(^3\), antiallergenic\(^4\), antimicrobial, cytostatic, virostatic, anti-inflammatory\(^4\) and anti-bacterial\(^5\) activities. Triazoles are also being studied for the treatment of obesity\(^6\) and osteoarthritis\(^7\). The increased interest in the 1,2,3-triazole is due to it being nontoxic, benign and stable. Triazoles are particularly interesting for medicinal use because they are more likely to be water soluble than normal aromatic compounds, and are stable in biological systems\(^8\). On the industrial side, 1,2,3-triazoles are found in hydraulic fluids, agrochemicals (fungicides), and photochemical products\(^9,10\). They have also been used as herbicides, light stabilizers, fluorescent whiteners, optical brightening agents, pigments and corrosion retardants\(^11-13\). This allows for the applications of 1,2,3-triazoles to grow exponentially due to their reliability, tolerance to a wide variety of functional groups, regiospecificity and the readily available starting materials. Through this, 1,2,3-triazoles are very attractive to use and apply in many fields.
Pyrazole derivatives have been reported in the literature to exhibit various pharmacological activities such as antimicrobial\textsuperscript{14}, anti-inflammatory\textsuperscript{15}, antitubercular\textsuperscript{16}, antitumor\textsuperscript{17}, antiangiogenesis\textsuperscript{18}, antiparasitic\textsuperscript{19}, antiviral\textsuperscript{20}, and also possess analgesic and anxiolytic activity\textsuperscript{21}. Chalcones are widely distributed in nature and are known to have multifold activity, they exhibit wide spectrum of biological activities, such as antibacterial\textsuperscript{22}, antifungal\textsuperscript{23}, anti-inflammatory\textsuperscript{24}, antioxidant and antitumor\textsuperscript{25} activities. A number of chalcone derivatives, have also been found to inhibit several important enzymes in cellular systems, including aldose reductase\textsuperscript{26}, protein tyrosine kinase\textsuperscript{27}, and quinone reductase\textsuperscript{28}. From the foregoing literature review it is evident that a number of naturally occurring and synthetic heterocyclic compounds having the chalcone moiety possess useful physiological properties. Therefore the aim of the present investigation is to synthesis of 1,2,3-triazole with pyrazolylchalcone backbone compounds.

**Synthesis of 1,4-Disubstituted-1,2,3-triazoles by click reaction:**

1,2,3-Triazoles are conveniently synthesized by click reaction. The term “CLICK” refers to a facile, efficient, selective and versatile chemical transformation, which leads to a single product\textsuperscript{48}. Although different chemical reactions e.g. cycloadditions, nucleophilic substitutions, addition on carbon-carbon double bonds can be considered to be of the click-type, the copper (I)-catalyzed azide-alkyne cycloaddition (CuAAC) is generally regarded as the quintessential example of the click chemistry\textsuperscript{29,30}. Hence, the term “click” has been almost exclusively used to denote this reaction in recent literature. The Huisgen 1,3-dipolar cycloaddition between a terminal alkyne and an azide has rapidly become the most popular click reaction to date\textsuperscript{31}.

The formation of triazoles via the cycloaddition of acetylene (2.1) and azide (2.2) was first reported by Dimroth in the early 1900’s but the generality, scope, and mechanism of these cycloadditions was not fully realized until the 1960’s\textsuperscript{32}. The reaction generates a mixture of 1,4-disubstituted triazoles (2.3) and 1,5-disubstituted triazoles (2.4). Various attempts to control the regioselectivity have been reported without much success until the discovery of the copper (I) catalyzed reaction in 2002, which exclusively yields the 1,4-disubstituted-1,2,3-triazole (2.3).

In the absence of Cu(I) catalyst, the original 1,3-dipolar Huisgen cycloaddition of terminal alkynes and azides are not regioselective and usually slow\textsuperscript{33,34}. Meldal and coworkers
reported that the use of catalytic amounts of copper (I), which can bind to terminal alkynes, leads to fast, highly efficient and regioselective azide-alkyne cycloadditions at room temperature in organic medium.

Later, Sharpless and Fokin reported that CuAAC can be performed in polar media such as tert-butylalcohol, ethanol or pure water. These two important reports led to a remarkable renaissance of Huisgen cycloadditions in synthetic chemistry.\(^{35-37}\)

**Some of the main advantages of the click reaction are:**

**i)** The reaction is highly regioselective leading to 1,4-disubstituted 1,2,3-triazoles (anti-isomer). It typically does not require temperature elevation but can be performed over a wide range of temperatures (0-160°C), in a variety of solvents (including water), and over a wide range of pH values (5-12). It proceeds as much as \(10^7\) times faster than the uncatalyzed version.

**ii)** This reaction can be performed in an aqueous media using readily accessible reagents and without exclusion of atmospheric oxygen.

**iii)** The reaction between alkyne and azide is orthogonal to any functional group and it can be performed without the protection of other functional groups within the reactants.

**iv)** The reaction products are pure and do not require chromatographic purification.

**v)** The 1,4-disubstituted triazole has high chemical and metabolic stability. The 1,4-disubstituted 1,2,3-triazole is relatively stable, posses a large dipole moment and the nitrogen atoms in
positions two and three serve as weak hydrogen bond acceptors improving the solubility of the product in water.

vi) It is unaffected by steric factors. “Various substituted primary, secondary, tertiary and aromatic azides readily participate in this transformation, Tolerance for variations in the acetylene component is also excellent”\(^{38}\). It tolerates most organic functional groups and shows a wide scope with respect to both alkyne and azide reactant. The reaction proceeds in a variety of solvents, tolerates a wide range of pH values, and performs well over a broad temperature range.

The use of copper(I) catalyst rejuvenated the Huisgen reaction. The standard catalytic system uses copper (II) salts (e.g., CuSO\(_4\) 5H\(_2\)O or copper acetate) in the presence of a reducing agent, such as sodium ascorbate or metallic copper, nano copper, hydrazine\(^{39}\) and tris(2-carboxyethyl)phosphine (TCEP)\(^{40}\), are also used for the Cu(II) to Cu(I) conversion. This reduces copper (II) to copper (I) in situ maintaining significantly high levels of the catalytic species. A mixture of tert-butanol and water is used as solvent, as under these conditions it is not necessary to use a base to generate the copper acetylide species. Aqueous alcohols (MeOH, EtOH, t-BuOH), TFA, CH\(_2\)Cl\(_2\)\(^{41}\), dioxane\(^{42}\) and DMSO can be used as solvent. When aqueous conditions cannot be used, organic solvents (e.g., tetrahydrofuran, toluene, dichloromethane, acetonitrile) in the presence of stoichiometric amount of copper (I) salts (e.g., CuI, CuBr(PPh\(_3\))\(_2\)) and an excess of a base, usually a tertiary amine (e.g., TEA, DIPEA) can be used. For example, copper-in-charcoal is an efficient heterogeneous catalyst for triazole formation. Copper (I) salts (CuI, CuBr) and coordination complexes (such as [Cu(CH\(_3\)CN)\(_4\)]PF\(_6\), (EtO)\(_3\)PCuI\(^{43}\), [Cu(PPh\(_3\))\(_3\)]Br\(^{44}\) can also be used directly. Copper nanoclusters, which are easily obtained and are air-stable\(^{45}\), and copper/cuprous oxide nanoparticles\(^{46}\) have also shown excellent catalytic activity. Catalytic amounts of Cu(I) can also be introduced in the reaction through comproportionation of Cu(II) and Cu(0), further simplifying the experimental procedure. A small piece of copper metal (wire or turning) is all that is added to the reaction mixture, followed by shaking or stirring for 12-48 hours\(^{47}\).
Previous approaches:

The methods adopted for the synthesis of 1,2,3-triazole, chalcones and chalcone with 1,2,3-triazole compounds are useful for the synthesis of title compounds. Therefore these methods are briefly reviewed in the following pages.

Methods for the synthesis of 1,2,3-triazole:

1) Sharpless et al.,\textsuperscript{48} have reported the synthesis of 1,4-Disubstituted-1,2,3-triazoles (2.7) by 1,3-dipolar cycloaddition of azides (2.5) with acetylene (2.6) in the presence of CuSO\textsubscript{4}. 5H\textsubscript{2}O and sodium ascorbate.

Scheme-2.1: Synthesis of 1,4-Disubstituted-1,2,3-triazoles (2.7).

\[
\text{R-N}_3 + \text{CuSO}_4.5\text{H}_2\text{O}, \text{sodium ascorbate} \xrightarrow{t-\text{BuOH:H}_2\text{O}} \text{rt, 6-12 hr} \rightarrow \text{R-N=N-R}_1
\]

2) Jiang et al.,\textsuperscript{49} have reported the synthesis of 1-Aryl-1,2,3-triazoles (2.10) by Copper (I) catalyzed 1,3-dipolar cycloaddition of arylazide (2.8) and calcium carbide (2.9).

Scheme-2.2: Synthesis of 1-aryl-1,2,3-triazoles (2.10).

\[
\text{Ar-N}_3 + \text{CaC}_2 \xrightarrow{\text{Cul, MeCN/H}_2\text{O}} \text{rt, 20 hr} \rightarrow \text{Ar-N=N}
\]

3) Saleh M. Al-Monsawi et al.,\textsuperscript{50} have reported the synthesis of 1-(5-Amino-2-phenyl-2\textsubscript{H}-1,2,3-triazol-4-yl)ethanone (2.12) by refluxing a mixture of \textit{N}-Hydroxo-3-oxo-2-(phenyl hydrazono) butyramidine (2.11) in DMF with few drops of piperidine.
4) Lann Tao et al.,\textsuperscript{51} have reported the synthesis of 1-Aryl-1,2,3-triazoles (2.14) by reacting arylazides (2.8) with $\alpha$-ketophosphorous ylides (2.13) on the silica gel support under microwave irradiation.

\textbf{Scheme-2.4: Synthesis of 1-Aryl-1, 2, 3-triazoles (2.14).}

Methods for the synthesis of chalcones:

5) Satyender Kumar et al.,\textsuperscript{52} have synthesized (E)-3-(1,3-Diphenyl-1H-pyrazol-4-yl)-1-phenylprop-2-en-1-one (2.17) by reacting a mixture of acetophenone (2.15), 1,3-diphenyl-1H-pyrazole-4-carbaldehyde (2.16) and activated barium hydroxide (C-200) using grinding.

\textbf{Scheme-2.5: Synthesis of (E)-3-(1,3-Diphenyl-1H-pyrazol-4-yl)-1-phenylprop-2-en-1-one (2.17).}

6) P. K. Sharma et al.,\textsuperscript{53} have reported the synthesis of (E)-3-(3-Aryl-1-phenyl-1H-pyrazol-4-yl)-1-arylprop-2-en-1-ones (2.20) by reacting to a cold, stirred mixture of methanol and sodium
hydroxide, substituted acetophenones (2.18) and substituted formyl pyrazoles (2.19) in tetrahydrofuran.

**Scheme-2.6:** Synthesis of (E)-3-(3-Aryl-1-phenyl-1H-pyrazol-4-yl)-1-arylprop-2-en-1-ones (2.20).

![Scheme-2.6](image)

**Methods for the synthesis of 1,2,3-triazole with chalcones derivatives:**

7) N. Anand et al., have reported the synthesis of 1-[2-Hydroxy-4-(1-aralkyl/alkyl-1H-1,2,3-triazol-4-yl)-methoxylphenyl]-3-phenylprop-2-en-1-ones (2.22) by reacting 1-(4-((1-aralkyl/alkyl-1H-1,2,3-triazole-4-yl)methoxy)-2-hydroxyphenyl)-ethanones (2.21) with aralkyl/alkyl azide in the presence of CuSO$_4$.5H$_2$O and sodium ascorbate in t-BuOH:H$_2$O (1:1).

**Scheme-2.7:** Synthesis of 1-[2-Hydroxy-4-(1-aralkyl/alkyl-1H-1,2,3-triazol-4-yl)-methoxyl phenyl]-3-phenylprop-2-en-1-ones (2.22).

![Scheme-2.7](image)

8) Vipan Kumar et al., have reported the synthesis of 1,2,3-Triazole tethered β-lactam-chalcone bifunctional hybrids (2.25) by reacting 3-azido-1-alkyl-4-styryl-azetidin-2-ones (2.23) with 3-phenyl-1-(4-prop-2-ynyloxy-phenyl)-propenones (2.24) in the presence of CuSO$_4$.5H$_2$O and sodium ascorbate in t-BuOH:H$_2$O (1:1).
Scheme-2.8: Synthesis of 1,2,3-Triazole tethered β-lactam-chalcone bifunctional hybrids (2.25).

9) José A. F. P. Villar et al.,\textsuperscript{56} have reported the synthesis of (2E)-1-(2-Hydroxy-4-(4-[4-(hydroxymethyl)-1H-1,2,3-triazol-1-yl]butoxy)phenyl)-3-substituted-phenylprop-2-en-1-ones (2.27) by reacting (2E)-1-[4-(4-azidobutoxy)-2-hydroxyphenyl]-3-substituted-phenylprop-2-en-1-ones (2.26) with alkyl acetylene in the presence of CuI in DMSO.

Scheme-2.9: Synthesis of (2E)-1-(2-Hydroxy-4-[4-(hydroxymethyl)-1H-1,2,3-triazol-1-yl]butoxy)phenyl)-3-substituted-phenylprop-2-en-1-ones (2.27).

10) Poovan Shanmugavelan et al.,\textsuperscript{57} have synthesized (E)-1-(1-Benzyl-5-methyl-1H-1,2,3-triazol-4-yl)-3-substituted-phenylprop-2-en-1-ones (2.30) by reacting 4-acetyl-1-benzyl-5-methyl-1,2,3-triazole (2.29) with substituted aromatic aldehydes (2.29) in the presence of 50% aq. NaOH.
**Present work:**

Recent literature survey revealed that the 1,2,3-triazole and pyrazole compounds are found to exhibit various biological activities. The synthesis and study of biological activity of 1,2,3-triazole with pyrazolyl chalcones is a relatively not much explored area. Therefore we have taken up the synthesis of (E)-3-(3-Aryl-1-phenyl-1H-pyrazol-4-yl)-1-(1-(1-benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-2-yl)prop-2-en-1-ones and (E)-3-(3-Aryl-1-phenyl-1H-pyrazol-4-yl)-1-(2-(1-benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-1-yl)prop-2-en-1-ones with a view to study their ease of formation and also to evaluate their antimicrobial activity. All these compounds were synthesized by using Click reaction and Claisen-Schimdt condensation under conventional heating and also under microwave irradiation methods. Moreover, the increasing importance of microwave irradiation as a source of thermal energy in organic reactions and the use of microwave oven in this regard is well established in Microwave induced Organic Reaction Enhancement (MORE). It could be named as e-chemistry in view of its simplicity, easy, effectiveness, economical and eco-friendly nature. It is viewed already as an important component of ‘Green Chemistry’. Therefore, in the present investigation, it was proposed to use both conventional and microwave methods, at different levels. Microwave Assisted Organic Synthesis (MAOS) offers new possibilities for the development of any chemical reaction that is thermally possible.
SECTION-A: SYNTHESIS OF \((E)-3-(3\text{-}Aryl\text{-}1\text{-}phenyl\text{-}1\text{H}-\text{pyrazol}\text{-}4\text{-}y l)-1-(1\text{-}((1\text{-}benzyl\text{-}1\text{H}\text{-}1,2,3\text{-}triazol}\text{-}4\text{-}y l)\text{methoxy})\text{naphthalen}\text{-}2\text{-}yl)\text{prop\text{-}2\text{-}en\text{-}1\text{-}ones}\) (2.31 a-g)

Synthesis of \((E)-3-(3\text{-}Aryl\text{-}1\text{-}phenyl\text{-}1\text{H}-\text{pyrazol}\text{-}4\text{-}yl)-1-(1\text{-}((1\text{-}benzyl\text{-}1\text{H}\text{-}1,2,3\text{-}triazol}\text{-}4\text{-}y l)\text{methoxy})\text{naphthalen}\text{-}2\text{-}yl)\text{prop\text{-}2\text{-}en\text{-}1\text{-}ones}\) (2.31 a-g) involves five steps.

1) Synthesis of Benzyl azide (2.34)
2) Synthesis of 1-(1-Prop-2-ynyloxy-naphthalen-2-yl)-ethanone (2.36)
3) Synthesis of 1-(1-((1-Benzyl-1H-1,2,3-triazol-4-yl)ethoxy)naphthalen-2-yl)ethanone (2.37)
4) Synthesis of 3-Aryl-1-phenyl-1H-pyrazole-4-carbaldehydes (2.41 a-g)
5) Synthesis of (E)-3-(3-Aryl-1-phenyl-1H-pyrazol-4-yl)-1-(1-((1-benzyl-1H-1,2,3-triazol-4-y l)ethoxy)naphthalen-2-yl)prop-2-en-1-ones (2.31 a-g)

1) Synthesis of Benzyl azide (2.34).

Benzyl bromide (2.33) on reaction with sodium azide in acetone:water at room temperature for 24 hr to afford benzyl azide (2.34).

Scheme-2.11: Synthesis of Benzyl azide (2.34)
2) Synthesis of 1-(1-Prop-2-ynyloxy-naphthalen-2-yl)-ethanone (2.36) under conventional heating and microwave irradiation methods

**Conventional heating method:**

A mixture of 1-(1-Hydroxy-naphthalen-2-yl)-ethanone (2.35) and propargylbromide in acetone was refluxed to afford 1-(1-Prop-2-ynyloxy-naphthalen-2-yl)-ethanone (2.36).

**Microwave irradiation method:**

A mixture of 1-(1-Hydroxy-naphthalen-2-yl)-ethanone (2.35) and propargyl bromide was adsorbed on potassium carbonate and subjected to microwave irradiation to give 1-(1-Prop-2-ynyloxy-naphthalen-2-yl)-ethanone (2.36).

**Scheme-2.12: Synthesis of 1-(1-Prop-2-ynyloxy-naphthalen-2-yl)-ethanone (2.36)**

Spectral analysis of 1-(1-Prop-2-ynyloxy-naphthalen-2-yl)-ethanone (2.36) is discussed below.

In IR spectrum (KBr, cm\(^{-1}\), Fig-2.1) of (2.36), the characteristic peaks observed at 2127 was assigned to C≡C and 1662 was assigned to C=O respectively. In the \(^1\)H-NMR spectrum (CDCl\(_3\), 400 MHz, Fig-2.2) of (2.36) showed a peak at \(\delta\) 2.58 integrating for one proton of acetylene group, another at \(\delta\) 4.75 integrating for two protons of methylene group and another singlet appeared at \(\delta\) 2.62 integrating for three protons of methyl group. All the remaining aromatic protons appeared in between \(\delta\) 7.35-8.26. In the mass (Fig-2.3) of (2.36) [M+H]\(^+\) peak observed at \(m/z\) 225 (100%).

3) Synthesis of 1-(1-((1-Benzyl-1\(H\)-1,2,3-triazol-4-yl)methoxy)naphthalen-2-yl)ethanone (2.37) under conventional and microwave irradiation methods.
Conventional method using Copper (II) sulphate:

A mixture of 1-(1-Prop-2-ynyloxy-naphthalen-2-yl)-ethanone (2.36), benzyl azide (2.34), sodium ascorbate and CuSO$_4$.5H$_2$O in $t$-butanol:water (2:1) was stirred at room temperature for 24 hr to afford 1-((1-benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-2-yl)ethanone (2.37).

Microwave irradiation method using Copper (II) sulphate:

A mixture of 1-(1-Prop-2-ynyloxy-naphthalen-2-yl)-ethanone (2.36), benzyl azide (2.34), sodium ascorbate and CuSO$_4$.5H$_2$O in DMF was subjected to microwave irradiation at 180 watts for 8 min to afford 1-((1-benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-2-yl)ethanone (2.37).

Conventional method using Copper (I) iodide:

A mixture of 1-(1-Prop-2-ynyloxy-naphthalen-2-yl)-ethanone (2.36) reacts with benzyl azide (2.34) in presence of diisopropylethylamine and CuI in DMF at room temperature to was stirred at room temperature for 18 hr to afford 1-((1-benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-2-yl)ethanone (2.37).

Microwave irradiation method using Copper (I) iodide:

A mixture of 1-(1-Prop-2-ynyloxy-naphthalen-2-yl)-ethanone (2.36), benzyl azide (2.34), diisopropylethylamine and CuI and DMF was subjected to microwave irradiation at 180 watts for 6 min to give 1-((1-benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-2-yl)ethanone (2.37) in good yields.
Scheme 2.13: Synthesis of 1-(1-((1-Benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-2-yl)ethanone (2.37)

Spectral analysis of 1-(1-((1-Benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-2-yl)ethanone (2.37) is discussed below.

In IR spectrum (KBr, cm⁻¹, Fig-2.4) of (2.37), the characteristic peaks observed at 1671, 1621 and 1596 were assigned to C=O, C=C and C=N respectively. In the ¹H-NMR spectrum (CDCl₃, 400 MHz, Fig-2.5) of (2.37) the newly formed triazole rings proton appeared at δ 7.46 as singlet. The two protons of -OCH₂- groups resonated at δ 5.54 as a singlet and another two protons of N-CH₂ group appeared at δ 5.22 as singlet. A singlet appeared at δ 2.68 integrating for three protons were assigned to methyl protons. All the remaining aromatic protons appeared in between δ 7.23-8.28. In the mass (Fig-2.6) of (2.37) [M+H]⁺ peak observed at m/z 358 (100%).

4) Synthesis of 3-Aryl-1-phenyl-1H-pyrazole-4-carbaldehydes (2.41 a-g)

3-Aryl-1-phenyl-1H-pyrazole-4-carbaldehydes (2.41 a-g) are the key starting materials for the synthesis of title compounds, were synthesized by the Vilsmeier-Haack reaction of N-phenyl-N¹-(1-arylethylidine)hydrazones (2.40 a-g).
Step-1: Synthesis of $N$-Phenyl-$N^l$-(1-arylethylidine)hydrazones (2.40 a-g)

A mixture of substituted acetophenone (2.38 a-g) and phenyl hydrazine (2.39) was heated for 10 min in the presence of acetic acid to yield $N$-phenyl-$N^l$-(1-arylethylidine)hydrazones (2.40 a-g).

Scheme-2.14: Synthesis of $N$-Phenyl-$N^l$-(1-arylethylidine)hydrazones (2.40 a-g)

\[
\begin{align*}
\text{Ar} & \quad \text{CH}_3 \quad \text{O} \quad \text{AcOH} \quad 10 \text{ min} \quad \text{Ar} \quad \text{CH}_3 \quad \text{N} \quad \text{N} \\
(2.38 \text{ a-g}) & \quad (2.39) \quad \xrightarrow{\text{AcOH} \ 10 \text{ min}} \quad (2.40 \text{ a-g})
\end{align*}
\]

Step-2: Synthesis of 3-Aryl-1-phenyl-1H-pyrazole-4-carbaldehydes

3-Aryl-1-phenyl-1H-pyrazole-4-carbaldehydes (2.41 a-g) were synthesized by reacting $N$-phenyl-$N^l$-(1-arylethylidine)hydrazones (2.40 a-g) with Vilsmeir-Haack reagent at room temperature for 12 hr.

Scheme-2.15: Synthesis of 3-Aryl-1-phenyl-1H-pyrazole-4-carbaldehydes (2.41 a-g).

\[
\begin{align*}
\text{Ar} & \quad \text{CH}_3 \quad \text{N} \quad \text{N} \quad \text{OHC} \\
(2.40 \text{ a-g}) & \quad \xrightarrow{\text{DMF} / \text{POCl}_3 \ rt, 12 \text{ hr}} \quad (2.41 \text{ a-g})
\end{align*}
\]

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5) Synthesis of (E)-3-(3-Aryl-1-phenyl-1H-pyrazol-4-yl)-1-[(1-benzyl-1H-1,2,3-triazol-4-yl)methoxy]naphthalen-2-yl)prop-2-en-1-ones (2.31 a-g) under conventional heating and microwave irradiation methods.
Conventional heating method:

1-(1-((1-Benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-2-yl)ethanone (2.37) on condensation with 3-aryl-1-phenyl-1H-pyrazole-4-carbaldehydes (2.40 a-g) in the presence of alcoholic KOH gave corresponding (E)-3-(3-aryl-1-phenyl-1H-pyrazol-4-yl)-1-(1-((1-benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-2-yl)prop-2-en-1-ones (2.31 a-g).

Microwave irradiation method:

1-(1-((1-Benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-2-yl)ethanone (2.37) on condensation with 3-aryl-1-phenyl-1H-pyrazole-4-carbaldehydes (2.40 a-g) in the presence of KOH under microwave irradiation yielded corresponding (E)-3-(3-Aryl-1-phenyl-1H-pyrazol-4-yl)-1-(1-((1-benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-2-yl)prop-2-en-1-ones (2.31 a-g).

Scheme-2.16: Synthesis of (E)-3-(3-Aryl-1-phenyl-1H-pyrazol-4-yl)-1-(1-((1-benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-2-yl)prop-2-en-1-ones (2.31 a-g).

\[
\begin{array}{ccccccc}
\text{Ar} & \text{a} & \text{b} & \text{c} & \text{d} & \text{e} & \text{f} & \text{g} \\
\text{O} & \text{ Phenyl} & \text{CH}_3 & \text{OCH}_3 & \text{Cl} & \text{Br} & \text{NO}_2 & \text{S}
\end{array}
\]
Table 1: Physical data of (E)-3-(3-Aryl-1-phenyl-1H-pyrazol-4-yl)-1-(1-(1-benzyl-1H-1,2,3-triazol-4-yl) methoxy)naphthalen-2-yl)prop-2-en-1-ones (2.31 a-g).

<table>
<thead>
<tr>
<th>S.N.</th>
<th>Compound</th>
<th>M. P. (°C)</th>
<th>M.F. (M.Wt.)</th>
<th>Reaction time</th>
<th>Yield (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>(E)-1-(1-((1-Benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-2-yl)-3-(1,3-diphenyl-1H-pyrazol-4-yl)prop-2-en-1-one (2.31 a)</td>
<td>90</td>
<td>C$<em>{38}$H$</em>{29}$N$<em>{5}$O$</em>{2}$ (587)</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>(E)-1-(1-((1-Benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-2-yl)-3-(1-phenyl-3-(p-tolyl)-1H-pyrazol-4-yl)prop-2-en-1-one (2.31 b)</td>
<td>98</td>
<td>C$<em>{39}$H$</em>{31}$N$<em>{5}$O$</em>{2}$ (601)</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>(E)-1-(1-((1-Benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-2-yl)-3-(3-(4-methoxyphenyl)-1-phenyl-1H-pyrazol-4-yl)prop-2-en-1-one (2.31 c)</td>
<td>84</td>
<td>C$<em>{39}$H$</em>{31}$N$<em>{5}$O$</em>{3}$ (617)</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>(E)-1-(1-((1-Benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-2-yl)-3-(3-(4-chlorophenyl)-1-phenyl-1H-pyrazol-4-yl)prop-2-en-1-one (2.31 d)</td>
<td>102</td>
<td>C$<em>{38}$H$</em>{28}$ClN$<em>{5}$O$</em>{2}$ (621)</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Molecular Structure</td>
<td>Mass</td>
<td>Formula</td>
<td>Calc.</td>
<td>Exp.</td>
</tr>
<tr>
<td>---</td>
<td>-------------------</td>
<td>------</td>
<td>---------</td>
<td>-------</td>
<td>------</td>
</tr>
<tr>
<td>5</td>
<td>(E)-1-((1-Benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-2-yl)-3-(3-(4-bromophenyl)-1-phenyl-1H-pyrazol-4-yl)prop-2-en-1-one (2.31 e)</td>
<td>122</td>
<td>C$<em>{36}$H$</em>{28}$BrN$_4$O$_2$ (665)</td>
<td>9</td>
<td>6</td>
</tr>
<tr>
<td>6</td>
<td>(E)-1-((1-Benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-2-yl)-3-(3-(4-nitrophenyl)-1-phenyl-1H-pyrazol-4-yl)prop-2-en-1-one (2.31 f)</td>
<td>118</td>
<td>C$<em>{32}$H$</em>{28}$N$_6$O$_4$ (632)</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>7</td>
<td>(E)-1-((1-Benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-2-yl)-3-(1-phenyl-3-(thiophen-2-yl)-1H-pyrazol-4-yl)prop-2-en-1-one (2.31 g)</td>
<td>72</td>
<td>C$<em>{36}$H$</em>{27}$N$_5$O$_2$S (593)</td>
<td>8</td>
<td>4</td>
</tr>
</tbody>
</table>
Structures of the products were established based on spectral analysis. As a representative case the spectral analysis of (E)-1-((1-Benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-2-yl)-3-(1-phenyl-3-(p-tolyl)-1H-pyrazol-4-yl)prop-2-en-1-one (2.31 b) has been discussed below in IR spectrum (KBr, cm$^{-1}$, Fig-2.7) of (2.31 b), the characteristic peaks observed at 1647, 1622 and 1585 were assigned to C=O, C=C and C=N respectively. In the $^1$H-NMR spectrum (CDCl$_3$, 400 MHz, Fig-2.8) of (2.31 b) the newly formed triazole rings proton appeared at $\delta$ 8.42 as singlet. The two protons of O-CH$_2$ groups resonated at $\delta$ 5.35 as a singlet and another two protons of N-CH$_2$ group appeared at $\delta$ 5.19 as singlet. A singlet appeared at $\delta$ 2.41 integrating for three protons were assigned to methyl protons. All the remaining aromatic protons appeared between $\delta$7.07-8.32. In the $^{13}$C-NMR spectrum (CDCl$_3$, 100 MHz, Fig-2.9) of (2.31 b) peaks appeared as follows: $\delta$ 21.3 (CH$_3$), 54.1 (N-CH$_2$), 69.4 (O-CH$_2$), 118.2, 119.3, 123.4, 124.7, 125.9, 126.0, 126.7, 126.9, 127.1, 127.9, 128.1, 128.3, 128.6, 128.7, 128.8, 129.0, 129.4, 129.5, 129.6, 134.2, 135.2, 136.5, 138.6, 139.5, 143.5, 154.1, 154.5, 192.2 (C=O). In the mass (Fig-2.10) of (2.31 b) [M+H]$^+$ peak observed at $m/z$ 602 (20%).
SECTION-B: SYNTHESIS OF \((E)-3-\text{(3-ARYL-1-PHENYL-1H-PYRAZOL-4-YL)}-1-(2-((1-BENZYL-1H-1,2,3-TRIAZOL-4-YL)METHOXY)NAPHTHALEN-1-YL)\) PROP-2-EN-1-ONES

![Chemical Structure](image)

Synthesis of \((E)-3-\text{(3-Aryl-1-phenyl-1H-pyrazol-4-yl)}-1-(2-((1-benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-1-yl)prop-2-en-1-ones (2.32 a-g) involves five steps.

1) Synthesis of Benzyl azide (2.34)  
2) Synthesis of 1-(2-Prop-2-ynyloxy-naphthalen-1-yl)-ethanone (2.43)  
3) Synthesis of 1-(2-((1-Benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-1-yl)ethanone (2.44)  
4) Synthesis of 3-Aryl-1-phenyl-1H-pyrazole-4-carbaldehydes (2.41 a-g)  
5) Synthesis of \((E)-3-\text{(3-Aryl-1-phenyl-1H-pyrazol-4-yl)}-1-(2-((1-benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-1-yl)prop-2-en-1-ones (2.32 a-g)

1) Synthesis of Benzyl azide (2.34) (already discussed in section-A of chapter-II)

2) Synthesis of 1-(2-Prop-2-ynyloxy-naphthalen-1-yl)-ethanone (2.43) under conventional heating and microwave irradiation methods

Conventional heating method:  
A mixture of 1-(2-Hydroxy-naphthalen-1-yl)-ethanone (2.42) and propargylbromide in acetone was refluxed to afford 1-(2-Prop-2-ynyloxy-naphthalen-1-yl)-ethanone (2.43).
Microwave irradiation method:

A mixture of 1-(2-Hydroxy-naphthalen-1-yl)-ethanone (2.42) and propargyl bromide was adsorbed on potassium carbonate and subjected to microwave irradiation to give 1-(2-Prop-2-ynyloxy-naphthalen-1-yl)-ethanone (2.43).

**Scheme-2.17: Synthesis of 1-(2-Prop-2-ynyloxy-naphthalen-1-yl)-ethanone (2.43)**

In IR spectrum (KBr, cm\(^{-1}\), Fig-2.11) of (2.43), the characteristic peaks observed at 2120 was assigned to C≡C and 1673 was assigned to C=O respectively. In the \(^1\)H-NMR spectrum (CDCl\(_3\), 400 MHz, Fig-2.12) of (2.43) showed a peak at \(\delta\) 2.53 integrating for one proton of acetylene group, another peak at \(\delta\) 4.86 integrating for two protons of methylene group and another singlet appeared at \(\delta\) 2.67 integrating for three protons of methyl group. All the remaining aromatic protons appeared between \(\delta\) 7.35-7.90. In the mass (Fig-2.13) of (2.43) [M+H]\(^+\) peak observed at \(m/z\) 225 (100%).

3) Synthesis of 1-[2-(1-Benzyl-1H-[1,2,3]triazol-4-ylmethoxy)-naphthalen-1-yl]-ethanone (2.44) under conventional and microwave irradiation methods.

Conventional method using Copper (II) sulphate:

A mixture of 1-(2-Prop-2-ynyloxy-naphthalen-1-yl)-ethanone (2.43), benzylazide (2.34), sodium ascorbate and CuSO\(_4\).5H\(_2\)O in \(t\)-butanol:water (2:1) medium to afford 1-(2-((1-benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-1-yl)ethanone (2.44).
Microwave irradiation method using Copper (II) sulphate:

A mixture of 1-(2-Prop-2-ynyloxy-naphthalen-1-yl)-ethanone (2.43), benzylazide (2.34), sodium ascorbate and CuSO$_4$.5H$_2$O in DMF was subjected to microwave irradiation to afford 1-(2-((1-benzyl-1$H$-1,2,3-triazol-4-yl)methoxy)naphthalen-1-yl)ethanone (2.44).

Conventional method using Copper (I) iodide:

1-(2-Prop-2-ynyloxy-naphthalen-1-yl)-ethanone (2.43) reacts with benzylazide (2.34) in presence of diisopropylethylamine and CuI in DMF at room temperature to afford 1-(2-((1-benzyl-1$H$-1,2,3-triazol-4-yl)methoxy)naphthalen-1-yl)ethanone (2.44).

Microwave irradiation method using Copper (I) iodide:

A mixture of 1-(2-Prop-2-ynyloxy-naphthalen-1-yl)-ethanone (2.43), benzylazide (2.34), diisopropylethylamine and CuI and DMF was subjected to microwave irradiation to give 1-(2-((1-benzyl-1$H$-1,2,3-triazol-4-yl)methoxy)naphthalen-1-yl)ethanone (2.44) in good yields.

Scheme-2.18: Synthesis of 1-(2-((1-Benzyl-1$H$-1,2,3-triazol-4-yl)methoxy)naphthalen-1-yl)ethanone (2.44)

Spectral analysis of 1-(2-((1-benzyl-1$H$-1,2,3-triazol-4-yl)methoxy)naphthalen-1-yl)ethanone (2.44) is discussed below.
In IR spectrum (KBr, cm\(^{-1}\), Fig-2.14) of (2.44), the characteristic peak observed at 1684, 1620 and 1591 were assigned to C=O, C=C and C=N respectively. In the \(^1\)H-NMR spectrum (CDCl\(_3\), 400 MHz, Fig-2.15) of (2.44) the newly formed triazole rings proton appeared at \(\delta\) 7.50 as singlet. The two protons of O-CH\(_2\) groups resonated at \(\delta\) 5.51 as singlet and another two protons of N-CH\(_2\) group appeared at \(\delta\) 5.36 as singlet. A singlet appeared at \(\delta\) 2.57 integrating for three protons were assigned to methyl protons. All the remaining aromatic protons appeared between \(\delta\) 7.22-7.86. In the mass (Fig-2.16) of (2.44) [M+H]\(^+\) peak observed at \(m/z\) 358 (35%).

4) Synthesis of 3-Aryl-1-phenyl-1\(H\)-pyrazole-4-carbaldehyde (2.41 a-g) (already discussed in section-A of chapter-II)

5) Synthesis of \((E)-3-(3-Aryl-1-phenyl-1\(H\)-pyrazol-4-yl)-1-(2-((1-benzyl-1\(H\)-1,2,3-triazol-4-yl)methoxy)naphthalen-1-yl)prop-2-en-1-ones (2.32 a-g) under conventional heating and microwave irradiation methods.

Conventional heating method:

1-(2-((1-Benzyl-1\(H\)-1,2,3-triazol-4-yl)methoxy)naphthalen-1-yl)ethanone (2.44) on condensation with 3-aryl-1-phenyl-1\(H\)-pyrazole-4-carbaldehydes (2.41 a-g) in the presence of alcoholic KOH gave corresponding \((E)-3-(3-aryl-1-phenyl-1\(H\)-pyrazol-4-yl)-1-(2-((1-benzyl-1\(H\)-1,2,3-triazol-4-yl)methoxy)naphthalen-1-yl)prop-2-en-1-ones (2.32 a-g).

Microwave Irradiation method:

1-(2-((1-Benzyl-1\(H\)-1,2,3-triazol-4-yl)methoxy)naphthalen-1-yl)ethanone (2.44) on condensation with 3-aryl-1-phenyl-1\(H\)-pyrazole-4-carbaldehydes (2.41 a-g) in the presence of KOH under microwave irradiation yielded corresponding \((E)-3-(3-aryl-1-phenyl-1\(H\)-pyrazol-4-yl)-1-(2-((1-benzyl-1\(H\)-1,2,3-triazol-4-yl)methoxy)naphthalen-1-yl)prop-2-en-1-ones (2.32 a-g).
Scheme-2.19: Synthesis of (E)-3-(3-Aryl-1-phenyl-1H-pyrazol-4-yl)-1-(2-((1-benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-1-yl)prop-2-en-1-ones (2.32 a-g)
**Table-2:** Physical data of \((E)-3-(3-Aryl-1-phenyl-1H-pyrazol-4-yl)-1-(2-((1-benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalene-1-yl)prop-2-en-1-ones (2.32 a-g).

<table>
<thead>
<tr>
<th>S.N o</th>
<th>Compound</th>
<th>M. P. (°C)</th>
<th>M. F. (M.Wt.)</th>
<th>Reaction time</th>
<th>Yield (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Conv. (hr)</td>
<td>MWI (min)</td>
</tr>
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<td>(E)-1-(2-((1-Benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-1-yl)-3-(1,3-diphenyl-1H-pyrazol-4-yl)prop-2-en-1-one (2.32 a)</td>
<td>80</td>
<td>C\textsubscript{38}H\textsubscript{29}N\textsubscript{5}O\textsubscript{2} (587)</td>
<td>9</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>(E)-1-(2-((1-Benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-1-yl)-3-(1-phenyl-3-(p-tolyl)-1H-pyrazol-4-yl)prop-2-en-1-one (2.32 b)</td>
<td>68</td>
<td>C\textsubscript{39}H\textsubscript{31}N\textsubscript{5}O\textsubscript{2} (601)</td>
<td>9</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>(E)-1-(2-((1-Benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-1-yl)-3-(3-(4-methoxyphenyl)-1-phenyl-1H-pyrazol-4-yl)prop-2-en-1-one (2.32 c)</td>
<td>86</td>
<td>C\textsubscript{39}H\textsubscript{31}N\textsubscript{5}O\textsubscript{3} (617)</td>
<td>9</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>(E)-1-(2-((1-Benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-1-yl)-3-(3-(4-chlorophenyl)-1-phenyl-1H-pyrazol-4-yl)prop-2-en-1-one (2.32 d)</td>
<td>89</td>
<td>C\textsubscript{38}H\textsubscript{28}ClN\textsubscript{5}O\textsubscript{2} (621)</td>
<td>10</td>
<td>6</td>
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<tr>
<td></td>
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<td>Formula</td>
<td>Yield</td>
<td>Rf</td>
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</tr>
<tr>
<td>5</td>
<td>((E))-1-((1-Benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-1-yl-3-(3-(4-bromophenyl)-1-phenyl-1H-pyrazol-4-yl)prop-2-en-1-one (2.32 e)</td>
<td>C$<em>{36}$H$</em>{28}$BrN$_4$O$_2$ (665)</td>
<td>10</td>
<td>6</td>
<td>60</td>
</tr>
<tr>
<td>6</td>
<td>((E))-1-((1-Benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-1-yl-3-(3-(4-nitrophenyl)-1-phenyl-1H-pyrazol-4-yl)prop-2-en-1-one (2.32 f)</td>
<td>C$<em>{32}$H$</em>{28}$N$_6$O$_4$ (632)</td>
<td>9</td>
<td>5</td>
<td>58</td>
</tr>
<tr>
<td>7</td>
<td>((E))-1-((1-Benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-1-yl-3-(1-phenyl-3-(thiophen-2-yl)-1H-pyrazol-4-yl)prop-2-en-1-one (2.32 g)</td>
<td>C$<em>{36}$H$</em>{27}$N$_5$O$_2$S (593)</td>
<td>8</td>
<td>4</td>
<td>75</td>
</tr>
</tbody>
</table>
Structures of the products were established based on elemental and spectral analysis. As a representative case the spectral analysis of (2.32 g) has been discussed below In IR spectrum (KBr, cm\(^{-1}\), Fig-2.17) of (2.32 g), the characteristic peaks observed at 1621 and 1589 cm\(^{-1}\) assigned for C=O and C=N respectively. In the \(^1\)H-NMR spectrum (CDCl\(_3\), 400 MHz, Fig-2.18) of (2.32 g) the newly formed triazole ring proton appeared at \(\delta\) 8.27 as singlet. Protons of aromatic region appeared in between \(\delta\) 6.95-7.92 were integrating for 22 protons, the N-CH\(_2\) group proton resonated at \(\delta\) 5.35 as singlet and O-CH\(_2\) appeared at \(\delta\) 5.38 as singlet. In the \(^{13}\)C-NMR spectrum (CDCl\(_3\), 100 MHz, Fig-2.19) peaks appeared as follows: \(\delta\) 54.1 (N-CH\(_2\)), 63.6 (O-CH\(_2\)), 114.6, 117.5, 119.2, 119.3, 122.9, 124.3, 124.5, 126.4, 126.7, 127.4, 127.6, 127.7, 127.9, 128.1, 128.6, 128.7, 129.0, 129.3, 129.6, 131.5, 131.6, 134.3, 135.6, 139.1, 144.3, 147.7, 152.8, 196.2 (C=O). In the mass spectrum (Fig-2.20) of (2.32 g) [M+H]\(^+\) peak observed at \(m/z\) 594 (88%).
Mechanism of Claisen-Schmidt condensation reaction:

\[
\begin{align*}
&\text{Ar} \text{CH}_3 \leftrightarrow \text{Ar} \text{CH}_2 \text{OH} + \text{CH}_2 \text{OEt} \quad \text{Ar} \text{CH}_2 \text{OEt} + \text{Ar}_1 \text{O} + \text{H}^+ \\
&\text{Ar} \text{CH}_2 \text{Ar}_1 \quad \text{Ar} \text{CH}_2 \text{Ar}_1
\end{align*}
\]

Mechanism of Click reaction:

\[
\begin{align*}
&\text{CuL}_n \text{R'} \text{H} + \text{N} \text{N} \text{R} \quad \text{CuL}_n \text{R'} \text{H} \\
&\text{R'} \text{CuL}_n \quad \text{R'} \text{CuL}_n \text{1} \\
&\text{N} \text{N} \text{R} \quad \text{N} \text{N} \text{R}
\end{align*}
\]

Conclusion:

In Conclusion, we have successfully synthesized new series of \((E)-3-(3\text{-Aryl}-1\text{-phenyl}-1\text{H}-\text{pyrazol}-4\text{-yl})-1-((1\text{-benzyl}-1\text{H}-1,2,3\text{-triazol}-4\text{-yl})\text{methoxy})\text{naphthalen-2-yl}\)prop-2-en-1-ones (\textbf{2.31 a-g}) and \((E)-3-(3\text{-Aryl}-1\text{-phenyl}-1\text{H}-\text{pyrazol}-4\text{-yl})-1-((2\text{-((1\text{-benzyl}-1\text{H}-1,2,3\text{-triazol}-4\text{-yl})\text{methoxy})naphthalene-1-yl})\text{prop-2-en-1-ones (\textbf{2.32 a-g}) under conventional and microwave irradiation methods. The microwave irradiation method provides an easier facile and environmentally benign synthesis in which the reaction time is reduced with better yields. Moreover we have examined the click reaction with two different catalysts such as CuSO}_4.5\text{H}_2\text{O and CuI in various solvents. In our investigation maximum yields were obtained the reaction condition CuI with diisopropylethylamine (DIPEA) in DMF under microwave irradiation.}
Experimental:

Section-A: Synthesis of \((E)-3\text-(3\text{-Aryl-1-phenyl-1}\text{H-pyrazol-4-yl})\text{-1-(1-(1-benzyl-1}\text{H-1,2,3-triazol-4-yl)methoxy)naphthalen-2-yl})\text{-prop-2-en-1-ones (2.31 a-g) involves five steps.}

1) Synthesis of Benzyl azide (2.34)
2) Synthesis of 1-(1-Prop-2-ynyloxy-naphthalen-2-yl)-ethanone (2.36)
3) Synthesis of 1-(1-(1-Benzyl-1\text{H-1,2,3-triazol-4-yl)methoxy)naphthalen-2-yl)ethanone (2.37)
4) Synthesis of 3-Aryl-1-phenyl-1\text{H-pyrazole-4-carbaldehydes (2.41 a-g)}
5) Synthesis of \((E)-3\text-(3\text{-Aryl-1-phenyl-1}\text{H-pyrazol-4-yl})\text{-1-(1-(1-benzyl-1}\text{H-1,2,3-triazol-4-yl)methoxy)naphthalen-2-yl})\text{-prop-2-en-1-ones (2.31 a-g)}

1) Synthesis of Benzyl azide (2.34)

A solution of Sodium azide (0.975 gm, 0.01 mol) and benzyl bromide (2.33) (1.70 gm, 0.01 mol) in 20 ml of acetone and 5 ml of water was stirred for 24 hr at room temperature. After completion of the reaction acetone was evaporated and extracted with chloroform, dried over Na\text{2}SO\text{4} and concentrated to yield benzyl azide (1.06 gm, 80%) as colorless liquid.
IR (KBr, cm\text{\textsuperscript{-1}}): 2122 (N≡N).

2) Synthesis of 1-(1-Prop-2-ynyloxy-naphthalen-2-yl)-ethanone (2.36) under conventional heating and microwave irradiation methods

Conventional heating method:

A mixture of 1-(1-Hydroxy-naphthalen-2-yl)-ethanone (2.35) (1.86 gm, 10 mmol), propargyl bromide (1.40 gm, 1.2 mmol), anhydrous K\text{2}CO\text{3} (2 gm, 14 mmol) in 15 ml of dry acetone was taken round bottomed flask and refluxed for 8 hr. After completion of the reaction acetone was distilled under vacuum and it was diluted with cold water and the precipitate formed was filtered, washed with water and crystallized from methanol to give 1-(1-prop-2-ynyloxy-naphthalen-2-yl)-ethanone (2.36).
M.P.: 136 °C
Yield: 88%
Microwave irradiation method:

A mixture of 1-(1-Hydroxy-naphthalen-2-yl)-ethanone (2.35) (1.86 gm, 10 mmol), propargylbromide (1.40 gm, 12 mmol), anhydrous K$_2$CO$_3$ (2 gm, 14 mmol) in 5 ml of DMF was taken into Quartz tube and inserted into a Teflon vial, then it was subjected to microwave irradiation at 160 watts for 6 min with an 30 sec intervals. Progress of the reaction was monitored by TLC. After completion of the reaction acetone was distilled under vacuum and it was diluted with cold water and the precipitate formed was filtered, washed with water and crystallized from methanol to give 1-(1-prop-2-ynyloxy-naphthalen-2-yl)-ethanone (2.36).

M.P.: 136 °C
Yield: 94%

IR (KBr): v 2127 (C≡C), 1662 (C=O) cm$^{-1}$; $^1$H-NMR (CDCl$_3$, 400 MHz): $\delta$ 8.24-8.26 (d, 1H, ArH), 7.84-7.86 (d, 1H, ArH), 7.54-7.58 (m, 2H, ArH), 7.35-7.38 (dd, 2H, ArH), 4.75 (d, 2H, O-CH$_2$), 2.62 (s, 3H, CH$_3$), 2.58 (t, 1H, acetylene proton); MS: m/z = 225 [M+H]$^+$.  

3) Synthesis of 1-(1-((1-Benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-2-yl)ethanone (2.37) under conventional and microwave irradiation methods.

Conventional method using CuSO$_4$.5H$_2$O & Sodium ascorbate:

A mixture of 1-(1-Prop-2-ynyloxy-naphthalen-2-yl)-ethanone (2.36) (1.68 gm, 7.5 mmol), benzyl azide (2.34) (0.84 gm, 7.5 mmol), CuSO$_4$.5H$_2$O (0.060 gm, 0.37 mmol), sodium ascorbate (0.237 gm, 1.2 mmol) in t-BuOH:H$_2$O (2:1, v/v) (10 ml) was taken in to round bottomed flask and it was stirred under room temperature for 24 hr. After completion of the reaction (monitored by TLC), the resulting mixture was poured into ice cold water (20 ml), extracted with EtOAc (30 ml), washed twice with saturated solution of NH$_4$Cl, twice with brine and dried over Na$_2$SO$_4$. The organic layer was concentrated in vacuo and the residue was purified by column chromatography on silica gel eluted with petroleum ether:EtOAc (2:1) to give 1-(1-((1-benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-2-yl)ethanone (2.37).

MP: 118°C.
Yield: 78%
Microwave irradiation method using CuSO$_4$.5H$_2$O & Sodium ascorbate:

A mixture of 1-(1-Prop-2-ynyloxy-naphthalen-2-yl)-ethanone (2.36) (1.68 gm, 7.5 mmol), benzyl azide (2.34) (0.84 gm, 7.5 mmol), CuSO$_4$.5H$_2$O (0.060 gm, 0.37 mmol) and sodium ascorbate (0.237 gm, 1.2 mmol) in DMF (5 ml) was taken into Quartz tube and inserted into a Teflon vial, then it was subjected to microwave irradiation at 180 watts for 8 min. After completion of the reaction (monitored by TLC), the resulting mixture was poured into ice cold water (20 ml), extracted with EtOAc (30 ml), washed twice with saturated solution of NH$_4$Cl, twice with brine and dried over Na$_2$SO$_4$. The organic layer was concentrated in vacuo and the residue was purified by column chromatography on silica gel eluted with petroleum ether:EtOAc (2:1) to give 1-(1-((1-benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-2-yl)ethanone (2.37). MP: 118°C. Yield: 84%

Conventional method using CuI:

A mixture of 1-(1-Prop-2-ynyloxy-naphthalen-2-yl)-ethanone (2.36) (1.68 gm, 7.5 mmol), benzyl azide (2.34) (0.84 gm, 7.5 mmol), diisopropylethylamine (1.2 ml, 9 mmol) and CuI (0.75 mmol) in DMF (10 ml) was taken into round bottomed flask and it was stirred under room temperature for 18 hr. After completion of the reaction (monitored by TLC), the resulting mixture was poured into ice cold water (20 ml), extracted with EtOAc (30 ml), washed twice with saturated solution of NH$_4$Cl, twice with brine and dried over Na$_2$SO$_4$. The organic layer was concentrated in vacuo and the residue was purified by column chromatography on silica gel eluted with petroleum ether:EtOAc (2:1) to give 1-(1-((1-benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-2-yl)ethanone (2.37). MP: 118°C. Yield: 82%

Microwave irradiation method using CuI:

A mixture of 1-(1-Prop-2-ynyloxy-naphthalen-2-yl)-ethanone (2.36) (1.68 gm, 7.5 mmol), benzyl azide (2.34) (0.84 gm, 7.5 mmol), diisopropylethylamine (1.2 ml, 9 mmol) and
CuI (0.142 gm, 0.75 mmol) in DMF (5 ml) was taken into Quartz tube and inserted into a Teflon vial, then it was subjected to microwave irradiation at 180 watts for 6 min. After completion of the reaction (monitored by TLC), the resulting mixture was poured into ice cold water (20 ml), extracted with EtOAc (30 ml), washed twice with saturated solution of NH₄Cl, twice with brine and dried over Na₂SO₄. The organic layer was concentrated in vacuo and the residue was purified by column chromatography on silica gel eluted with petroleum ether:EtOAc (2:1) to give 1-(1-((1-benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-2-yl)ethanone (2.37).

MP: 118°C.
Yield: 90%

IR (KBr): ν 1671 (C=O), 1621 (C=N), 1226 (O-CH₂) cm⁻¹; ¹H-NMR (CDCl₃, 400 MHz): δ 8.26-8.28 (d, 1H, ArH), 7.84-7.86 (d, 1H, ArH), 7.63-7.69 (dd, 2H, ArH), 7.54-7.58 (m, 2H, ArH), 7.46 (s, 1H, triazole proton), 7.35-7.38 (m, 3H, ArH), 7.23-7.26 (m, 2H, ArH), 5.54 (s, 2H, O-CH₂), 5.22 (s, 2H, N-CH₂), 2.68 (s, 3H, -CH₃); MS: m/z = 358 [M+H]⁺.

4) Synthesis of 3-Aryl-1-phenyl-1H-pyrazole-4-carbaldehydes (2.41 a-g)

Synthesis of 1-Phenyl-3-(p-tolyl)-1H-pyrazole-4-carbaldehyde (2.41 b) involve two steps

a) Synthesis of (E)-1-Phenyl-2-(1-(p-tolyl)ethylidene)hydrazine (2.40 a-g)

To a mixture of 1-(p-Tolyl)ethanone (2.38 a) (0.134 gm, 1 mmol) and phenylhydrazine (2.39) (0.108 gm, 1 mmol) 5 drops of glacial acetic acid was added and refluxed for 10 min. The progress of the reaction was monitored by TLC. At the end, the reaction mixture was cooled and filtered the solid. The colorless crystalline (E)-1-phenyl-2-(1-(p-tolyl)ethylidene)hydrazine was obtained in good yields.
Yield: 0.2 gm, 90%.

b) Synthesis of 1-Phenyl-3-(p-tolyl)-1H-pyrazole-4-carbaldehyde (2.41 b) under conventional heating and microwave irradiation methods
Conventional heating method:

To an ice cold DMF (0.584 gm, 8 mmol) and POCl₃ (0.604 gm, 4 mmol) was added drop wise to it, maintaining the temperature at 0 °C. *(E)*-1-phenyl-2-(1-(p-tolyl)ethylidene)hydrazine *(2.40 b)* (0.224 gm, 1 mmol) was added to DMF-POCl₃ mixture drop wise, maintaining the temperature at 0 °C for 15 min. The reaction mixture was kept at room temperature over night with continuous stirring. The progress of the reaction was checked with TLC. Then reaction mixture was poured into ice-cold water and neutralized with aqueous sodium hydroxide. The solid obtained was filtered and recrystallized from alcohol to yield *(2.41 b)*. Yield: 0.236 gm, 90 %.

Microwave irradiation method:

DMF (0.584 gm, 8 mmol) was cooled to 0 °C and POCl₃ (0.604 gm, 4 mmol) was added drop wise to it, maintaining the temperature at 0 °C. *N*-Phenyl-*N'*-(1-Arylethylidene)hydrazone *(2.40 b)* (0.224 gm, 1 mmol) was added to DMF-POCl₃ mixture drop wise, maintaining the temperature at 0 °C for 15 min. Then the reaction mixture was subjected to microwave irradiation for 3 min at 100 watts with one minute time interval. The progress of the reaction was checked with TLC. The reaction mixture was poured into ice-cold water and was neutralized with aqueous sodium hydroxide. The solid obtained was filtered and recrystallized from alcohol to yield *(2.41 b)*. Yield: 0.25 gm, 95 %.

By employing the same procedure remaining 2.41 a & c-g compounds were prepared and compared with literature melting points.

5) Synthesis of *(E)*-1-((1-Benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-2-yl)-3-(3-aryl-1-phenyl-1H-pyrazol-4-yl)prop-2-en-1-ones (2.31 a-g)

*(E)*-1-((1-Benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-2-yl)-3-(1-phenyl-3-(p-tolyl)-1H-pyrazol-4-yl)prop-2-en-1-one (2.31 b) under conventional heating and microwave irradiation methods.
Conventional heating method:

A mixture of 1-(1-((1-Benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-2-yl)ethanone (1.78 gm, 5 mmol), 1-phenyl-3-(p-tolyl)-1H-pyrazole-4-carbaldehyde (1.31 gm, 5 mmol) and potassium hydroxide (2.14 gm, 40 mmol) in EtOH (15 ml), was taken into round bottomed flask and it was refluxed for 8 hr. The progress of the reaction was monitored by TLC. After completion of reaction, it was poured into crushed ice, carefully neutralized with 3N HCl and extracted with EtOAc (15 ml). The organic layer was concentrated in vacuo and purified by column chromatography on silica gel eluted with petroleum ether:EtOAc (3:1) to give compound (2.31 b).

Microwave irradiation method:

A mixture of 1-(1-((1-Benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-2-yl)ethanone (1.78 gm, 5 mmol), 1-phenyl-3-(p-tolyl)-1H-pyrazole-4-carbaldehyde (1.31 gm, 5 mmol) and KOH (2.14 gm, 40 mmol) in EtOH (5 ml) was taken into Quartz tube and inserted into a Teflon vial, then it was subjected to microwave irradiation at 180 watts 4 min. The progress of the reaction was monitored by TLC. After completion of reaction, it was poured into crushed ice, carefully neutralized with 3N HCl and extracted with EtOAc (15 ml). The organic layer was concentrated in vacuo and purified by column chromatography on silica gel eluted with petroleum ether:EtOAc (3:1) to give compound (2.31 b).

By employing the same procedure remaining a & c-g compounds.

a) Synthesis of (E)-1-(1-((1-Benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-2-yl)-3-(1,3-diphenyl-1H-pyrazol-4-yl)prop-2-en-1-one (2.31 a)

Conventional heating method:

Yield: 67%
Microwave irradiation method:
Yield: 84%

IR (KBr): \( v \) 3060 (C-H), 1650 (C=O), 1586 (C=N) cm\(^{-1}\); \(^1\)H-NMR (CDCl\(_3\), 400 MHz): \( \delta \) 8.45 (s, 1H, pyrazole proton), 8.29-8.31 (d, 1H, ArH), 7.79-7.88 (m, 4H, ArH), 7.70-7.77 (m, 5H, ArH), 7.14-7.59 (m, 13H, ArH), 7.06-7.11 (d, 1H, \( \alpha \)-olefinic protons), 5.36 (s, 2H, O-CH\(_2\)), 5.20 (s, 2H, N-CH\(_2\)); \(^{13}\)C-NMR (CDCl\(_3\), 100 MHz): \( \delta \) 190.1 (C=O), 154.1, 143.49, 136.5, 135.0, 129.6, 129.5, 129.2, 129.1, 129.0, 128.9, 128.8, 128.7, 128.6, 128.5, 128.3, 128.2, 128.1, 127.9, 127.8, 127.2, 126.9, 126.8, 126.0, 125.9, 124.7, 123.4, 119.3, 69.4 (O-CH\(_2\)), 54.1 (N-CH\(_2\)); MS: \( m/z = 588 \) [M+H]\(^{+}\); Anal. Calcd for C\(_{38}\)H\(_{29}\)N\(_5\)O\(_2\): C, 77.66, H, 4.97, N, 11.92. Found: C, 77.61, H, 4.92, N, 11.95.

b) Synthesis of \((E)-1-(1-(1-Benzyl-1H-1,2,3-triazol-4-yl) methoxy)naphthalen-2-yl)-3-(1-phenyl-3-(p-tolyl)-1H-pyrazol-4-yl)prop-2-en-1-one (2.31 b)

Conventional heating method:
Yield: 70%

Microwave irradiation method:
Yield: 86%

IR (KBr): \( v \) 3057 (C-H), 1647 (C=O), 1585 (C=N) cm\(^{-1}\); \(^1\)H-NMR (CDCl\(_3\), 400 MHz): \( \delta \) 8.42 (s, 1H, pyrazole proton), 8.30-8.32 (d, 1H, ArH), 7.79-7.89 (m, 4H, ArH), 7.71-7.78 (m, 2H, ArH), 7.11-7.58 (m, 14H, ArH), 7.07-7.09 (d, 2H, ArH), 5.35 (s, 2H, O-CH\(_2\)), 5.19 (s, 2H, N-CH\(_2\)), 2.41 (s, 3H, CH\(_3\)); \(^{13}\)C-NMR (CDCl\(_3\), 100 MHz): \( \delta \) 192.2 (C=O), 154.5, 154.1, 143.5, 139.5, 138.6, 136.5, 135.2, 134.2, 129.6, 129.5, 129.4, 129.0, 128.8, 128.7, 128.6, 128.3, 128.1, 127.9, 127.1, 126.9, 126.7, 126.0, 125.9, 124.7, 123.4, 119.3, 118.2, 69.4 (O-CH\(_2\)), 54.1 (N-CH\(_2\)), 21.3 (CH\(_3\)); MS: \( m/z = 602 \) [M+H]\(^{+}\); Anal. Calcd. for C\(_{39}\)H\(_{31}\)N\(_5\)O\(_2\): C, 77.85, H, 5.19, N, 11.64. Found: C, 77.82, H, 5.25, N, 11.68.
c) Synthesis of (E)-1-(1-((1-Benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-2-yl)-3-(3-(4-methoxyphenyl)-1-phenyl-1H-pyrazol-4-yl)prop-2-en-1-one (2.31 c)

Conventional heating method:
Yield: 69%

Microwave irradiation method:
Yield: 85%

IR (KBr, cm\(^{-1}\)): 3062 (C-H), 1647 (C=O), 1581 (C=N) cm\(^{-1}\); \(^1\)H-NMR (CDCl\(_3\), 400 MHz): \(\delta\) 8.42 (s, 1H, pyrazole proton), 8.29-8.31 (d, 1H, ArH), 7.84-7.87 (m, 2H, ArH), 7.71-7.81 (d, 1H, \(\beta\)-olefinic proton), 7.23-7.72 (m, 15H, ArH), 7.07-7.08 (d, 2H, ArH), 6.97-6.99 (d, 2H, ArH), 5.35 (s, 2H, O-CH\(_2\)), 5.19 (s, 2H, N-CH\(_2\)), 3.85 (s, 3H, -OCH\(_3\)); \(^1^3\)C-NMR (CDCl\(_3\), 100 MHz): \(\delta\) 192.3 (C=O), 160.0, 154.5, 153.8, 143.5, 139.5, 136.5, 135.2, 134.2, 129.9, 129.6, 129.0, 128.8, 128.7, 128.1, 127.9, 127.1, 126.8, 126.7, 126.0, 125.8, 124.7, 124.6, 124.5, 123.4, 119.3, 118.0, 114.3, 69.4 (O-CH\(_2\)), 55.4 (OCH\(_3\)), 54.1 (N-CH\(_2\)); MS: \(m/z = 618\) [M+H]\(^+\); Anal. Calcd for C\(_{39}\)H\(_{31}\)N\(_5\)O\(_3\): C, 75.83, H, 5.06, N, 11.34. Found: C, 75.88, H, 5.12, N, 11.42.

d) Synthesis of (E)-1-(1-((1-Benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-2-yl)-3-(3-(4-chlorophenyl)-1-phenyl-1H-pyrazol-4-yl)prop-2-en-1-one (2.31 d)

Conventional heating method:
Yield: 72%

Microwave irradiation method:
Yield: 86%

IR (KBr): \(\nu\) 3062 (C-H), 1652 (C=O), 1585 (C=N) cm\(^{-1}\); \(^1\)H-NMR (CDCl\(_3\), 400 MHz): \(\delta\) 8.49 (s, 1H, pyrazole proton), 8.26-8.28 (d, 1H, ArH), 7.85-7.87 (m, 4H, ArH), 7.60-7.62 (m, 4H, \(\beta\)-olefinic proton & ArH), 7.47-7.49 (m, 4H, ArH), 7.28-7.29 (dd, 2H, ArH), 7.19-7.21 (m, 4H, ...
ArH), 7.11-7.13 (m, 4H, ArH), 5.39 (s, 2H, O-CH$_2$), 5.20 (s, 2H, N-CH$_2$); $^{13}$C-NMR (CDCl$_3$, 100 MHz): $^\delta$ 192.9 (C=O), 160.0, 154.6, 152.6, 143.4, 139.3, 136.6, 134.2, 131.9, 131.2, 130.2, 129.6, 129.1, 128.8, 128.7, 128.3, 128.1, 127.9, 127.4, 127.1, 126.9, 126.3, 125.9, 124.7, 123.4, 122.9, 119.3, 118.2, 69.0 (O-CH$_2$), 54.3 (N-CH$_2$); MS: m/z = 622 [M+H]$^+$; Anal. Calcd for C$_{38}$H$_{28}$ClN$_5$O$_2$: C, 73.36, H, 4.54, N, 11.26. Found: C, 73.32, H, 4.51, N, 11.22.

e) Synthesis of (E)-1-((1-Benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-2-yl)-3-(3-(4-bromophenyl)-1-phenyl-1H-pyrazol-4-yl)prop-2-en-1-one (2.31 e)

Conventional heating method:
Yield: 58%

Microwave irradiation method:
Yield: 80%

IR (KBr): $\nu$ 3059(C-H), 1646 (C=O), 1587 (C=N) cm$^{-1}$; $^1$H-NMR (CDCl$_3$, 400 MHz): $^\delta$ 8.48 (s, 1H, pyrazole proton), 8.27-8.29 (d, 1H, ArH), 7.86-7.88 (m, 2H, ArH), 7.65-7.76 (m, 4H, $\beta$-olefinic proton & ArH), 7.59 (s, 1H, triazole proton), 7.50-7.56 (m, 9H, ArH), 7.35-7.39 (dd, 2H, ArH), 7.27-7.30 (d, 2H, ArH), 7.09-7.10 (d, 2H, ArH), 5.39 (s, 2H, O-CH$_2$), 5.19 (s, 2H, N-CH$_2$); $^{13}$C-NMR (CDCl$_3$, 100 MHz): $^\delta$ 192.0 (C=O), 160.0, 154.6, 152.6, 143.4, 139.3, 136.6, 134.2, 131.9, 131.2, 130.2, 129.6, 129.1, 128.8, 128.7, 128.3, 128.1, 127.9, 127.4, 127.1, 126.9, 126.3, 125.9, 124.7, 123.4, 122.9, 119.3, 118.2, 69.3 (O-CH$_2$), 54.1 (N-CH$_2$); MS: m/z = 666 [M+H]$^+$; Anal. Calcd for C$_{38}$H$_{28}$BrN$_5$O$_2$: C, 68.47, H, 4.23, N, 10.51. Found: C, 68.42, H, 4.25, N, 10.44.

f) Synthesis of (E)-1-(1-((1-Benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-2-yl)-3-(3-(4-nitrophenyl)-1-phenyl-1H-pyrazol-4-yl)prop-2-en-1-one (2.31 f)

Conventional heating method:
Yield: 64%
Microwave irradiation method:
Yield: 82%

IR (KBr): ν 3059 (C-H), 1671 (C=O), 1596 (C=N) cm$^{-1}$; $^1$H-NMR (CDCl$_3$, 400 MHz): δ 8.53 (s, 1H, pyrazole proton), 8.28-8.32 (d, 1H, ArH), 7.88-7.93 (m, 2H, ArH), 7.65-7.67 (m, 3H, β-olefinic proton & ArH), 7.54-7.58 (m, 8H, ArH), 7.45 (s, 1H, triazole proton), 7.31-7.36 (m, 2H, ArH), 7.27-7.30 (d, 2H, ArH), 7.11-7.13 (d, 2H, ArH), 6.84-6.94 (d, 2H, ArH), 5.40 (s, 2H, O-CH$_2$), 5.20 (s, 2H, N-CH$_2$); $^{13}$C-NMR (CDCl$_3$, 100 MHz): δ 192.2 (C=O), 153.9, 152.1, 142.8, 138.5, 132.7, 128.6, 128.4, 128.1, 127.6, 127.4, 126.5, 125.4, 124.2, 124.1, 123.8, 119.7, 69.1 (O-CH$_2$), 54.3 (N-CH$_2$); MS: $m/z$ = 633 [M+H]$^+$; Anal. Calcd for C$_{38}$H$_{28}$N$_6$O$_4$: C, 72.14, H, 4.46, N, 13.28. Found: C, 72.10, H, 4.51, N, 13.23.

g) Synthesis of (E)-1-(1-(1-Benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-2-yl)-3-(1-phenyl-3-(thiophen-2-yl)-1H-pyrazol-4-yl)prop-2-en-1-one (2.31 g)

Conventional heating method:
Yield: 74%

Microwave irradiation method:
Yield: 88%

IR (KBr): ν 3061 (C-H), 1647 (C=O), 1584 (C=N) cm$^{-1}$; $^1$H-NMR (CDCl$_3$, 400 MHz): δ 8.44 (s, 1H, pyrazole proton), 8.29-8.31 (d, 1H,ArH), 7.84-7.86 (dd, 3H, ArH), 7.76-7.78 (d, 1H, ArH), 7.68-7.70 (d, 1H, ArH), 7.59 (s, 1H, triazole proton), 7.31-7.58 (m, 9H, ArH), 7.24-7.26 (m, 3H, ArH), 7.10-7.13 (dd, 1H, ArH), 7.08-7.09 (dd, 2H, ArH), 5.39 (s, 2H, O-CH$_2$), 5.19 (s, 2H, N-CH$_2$); $^{13}$C-NMR (CDCl$_3$, 100 MHz): δ 191.9(C=O), 154.8, 148.0, 143.4, 139.2, 136.6, 134.2, 134.0, 129.6, 129.5, 129.0, 128.7, 128.3, 128.2, 128.0, 127.9, 127.8, 127.3, 127.0, 126.9, 126.5, 126.0, 124.5, 123.4, 119.3, 118.1, 69.4 (O-CH$_2$), 54.1 (N-CH$_2$); MS: $m/z$ = 594 [M+H]$^+$; Anal. Calcd for C$_{38}$H$_{27}$N$_5$O$_2$S: C, 72.83, H, 4.58, N, 11.80, S, 5.40. Found: C, 72.78, H, 4.62, N, 11.82, S, 5.37. 
Section-B: Synthesis of \((E)-3-(3\text{-Aryl}\text{-1-phenyl-1H-pyrazol-4-yl})\text{-1-(2-((1-benzyl-1H-1,2,3-triazol-4-yl)methoxy)napthalen-1-yl)}\text{-prop-2-en-1-ones} (2.32\ a-g)\) involves five steps.

1) Synthesis of Benzyl azide (2.34)
2) Synthesis of 1-(2-Prop-2-ynyloxy-naphthalen-1-yl)-ethanone (2.43) under conventional heating and microwave irradiation methods

Conventional heating method:

A mixture of 1-(2-Hydroxy-naphthalen-1-yl)-ethanone (2.42) (1.86 gm, 10 mmol), propargylbromide (1.40 gm, 1.2 mmol), anhydrous K\(_2\)CO\(_3\) (2 gm) in 15 ml dry acetone was taken round bottomed flask and refluxed for 8 hr. After completion of the reaction acetone was distilled under vacuum and it was diluted with cold water and the precipitate formed was filtered, washed with water and crystallized from methanol to give 1-(2-prop-2-ynyloxy-naphthalen-1-yl)-ethanone (2.42).

MP: 122°C

Yield: 88%

Microwave irradiation method:

A mixture of 1-(2-Hydroxy-naphthalen-1-yl)-ethanone (2.42) (1.86 gm, 10 mmol), propargylbromide (1.40 gm, 12 mmol), anhydrous K\(_2\)CO\(_3\) (2 gm) in 5ml DMF was taken into Quartz tube and inserted into a Teflon vial, then it was subjected to microwave irradiation at 160 watts for 6 min with an 30 sec intervals. Progress of the reaction was monitored by TLC.
completion of the reaction, the reaction mixture poured into ice cold water and the precipitate formed was filtered, washed with water and crystallized from methanol to give 1-(2-prop-2-ynyloxy-naphthalen-1-yl)-ethanone (2.43).

MP: 122°C
Yield: 96%

IR (KBr): \(\nu\) 2120 (C≡C), 1673 (C=O) cm\(^{-1}\); \(^1\)H-NMR (CDCl\(_3\), 400 MHz): \(\delta\) 7.87-7.90 (d, 1H, ArH), 7.75-7.81 (d, 1H, ArH), 7.48-7.51 (m, 2H, ArH), 7.35-7.47 (dd, 2H, ArH), 4.86 (d, 2H, O-CH\(_2\)\(_2\)), 2.67 (s, 3H, CH\(_3\)), 2.53 (t, 1H, acetylene proton); MS: \(m/z = 225\) [M+H]\(^+\).

3) Synthesis of \(\text{1}-(\text{2-}((\text{1-Benzyl-1H-1,2,3-triazol-4-yl})\text{methoxy})\text{naphthalen-1-yl})\text{ethanone (2.44)}\) under conventional heating and microwave irradiation methods

**Conventional method using CuSO\(_4\).5H\(_2\)O & Sodium ascorbate:**

A mixture of 1-(2-Prop-2-ynyloxy-naphthalen-1-yl)-ethanone (2.43) (1.68 gm, 7.5 mmol), benzylazide (2.34) (0.84 gm, 7.5 mmol), CuSO\(_4\).5H\(_2\)O (0.060 gm, 0.37 mmol), sodium ascorbate (0.237 gm, 1.2 mmol) was in t-BuOH:H\(_2\)O (2:1, v/v) (10 ml) was taken into round bottomed flask and it was stirred under room temperature for 24 hr. After completion of the reaction (monitored by TLC), the resulting mixture was poured into ice cold water (20 ml), extracted with EtOAc (30 ml), washed twice with saturated solution of NH\(_4\)Cl, twice with brine and dried over Na\(_2\)SO\(_4\). The organic layer was concentrated in vacuo and the residue was purified by column chromatography on silica gel eluted with petroleum ether:EtOAc (2:1) to give 1-(2-((1-benzyl-1H-1,2,3-triazol-4-yl) methoxy)naphthalen-1-yl)ethanone (2.44).

MP: 108°C.
Yield: 76%

**Microwave irradiation method using CuSO\(_4\).5H\(_2\)O & Sodium ascorbate:**

A mixture of 1-(2-Prop-2-ynyloxy-naphthalen-1-yl)-ethanone (2.43) (1.68 gm, 7.5 mmol), benzylazide (2.34) (0.84 gm, 7.5 mmol), CuSO\(_4\).5H\(_2\)O (0.060 gm, 0.37 mmol) and sodium ascorbate (0.237 gm, 1.2 mmol) in DMF (5 ml) was taken into Quartz tube and inserted into a Teflon vial, then it was subjected to microwave irradiation at 180 watts for 8 min. After
completion of the reaction (monitored by TLC), the resulting mixture was poured into ice cold water (20 ml), extracted with EtOAc (30 ml), washed twice with saturated solution of NH₄Cl, twice with brine and dried over Na₂SO₄. The organic layer was concentrated in vacuo and the residue was purified by column chromatography on silica gel eluted with petroleum ether:EtOAc (2:1) to give 1-(2-((1-benzyl-1\textit{H}-1,2,3-triazol-4-yl)methoxy)naphthalen-1-yl)ethanone \((2.44)\).

**Convention method using CuI:**

A mixture of 1-(2-Prop-2-ynyloxy-naphthalen-1-yl)-ethanone \((2.43)\) (1.68 gm, 7.5 mmol), benzylazide \((2.34)\) (0.84 gm, 7.5 mmol), diisopropylethylamine (1.2 ml, 9 mmol) and CuI (0.75 mmol) in DMF (5 ml) was taken into round bottomed flask and it was stirred under room temperature for 18 hr. After completion of the reaction (monitored by TLC), the resulting mixture was poured in to ice cold water (20 ml), extracted with EtOAc (30 ml), washed twice with saturated solution of NH₄Cl, twice with brine and dried over Na₂SO₄. The organic layer was concentrated in vacuo and the residue was purified by column chromatography on silica gel eluted with petroleum ether:EtOAc (2:1) to give 1-(2-((1-benzyl-1\textit{H}-1,2,3-triazol-4-yl)methoxy)naphthalen-1-yl)ethanone \((2.44)\).

**Microwave irradiation method using CuI:**

A mixture of 1-(2-Prop-2-ynyloxy-naphthalen-1-yl)-ethanone \((2.43)\) (1.68 gm, 7.5 mmol), benzylazide \((2.34)\) (0.84 gm, 7.5 mmol), diisopropylethylamine (1.2 ml, 9 mmol) and CuI (0.142 gm, 0.75 mmol) in DMF (5 ml) was taken into Quartz tube and inserted into a Teflon vial, then it was subjected to microwave irradiation at 180 watts for 6 min. After completion of the reaction (monitored by TLC), the resulting mixture was poured into ice cold water (20 ml), extracted with EtOAc (30 ml), washed twice with saturated solution of NH₄Cl, twice with brine and dried over Na₂SO₄. The organic layer was concentrated in vacuo and the residue was purified by column
chromatography on silica gel eluted with petroleum ether:EtOAc (2:1) to give 1-(2-((1-benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-1-yl)ethanone (2.44).

MP: 108°C.
Yield: 92%

IR (KBr): ν 1684 (C=O), 1620 (C=N), 1242 (O-CH$_2$) cm$^{-1}$; $^1$H-NMR (CDCl$_3$, 400 MHz): δ 7.84-7.86 (d, 1H, ArH), 7.77-7.79 (d, 1H, ArH), 7.69-7.71 (d, 1H, ArH), 7.44-7.49 (m, 2H, ArH), 7.32-7.39 (m, 5H, ArH), 7.21-7.24 (m, 2H, ArH), 5.51 (s, 2H, O-CH$_2$), 5.36 (s, 2H, N-CH$_2$), 2.57 (s, 3H, -CH$_3$); MS: $m/z = 358$ [M+H]$^+$. 

4) Synthesis of 3-Aryl-1-phenyl-1H-pyrazole-4-carbaldehydes (2.40 a-g) (already discussed in section-A of chapter-II)

5) Synthesis of (E)-1-(2-((1-Benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-1-yl)-3-(3-aryl-1-phenyl-1H-pyrazol-4-yl)prop-2-en-1-ones (2.32 a-g)

(E)-1-(2-((1-Benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-1-yl)-3-(1-phenyl-3-(thiophen-2-yl)-1H-pyrazol-4-yl)prop-2-en-1-one (2.32 g) under conventional heating and microwave irradiation methods.

Conventional heating method:

A mixture of 1-(2-((1-Benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-1-yl)ethanone (2.44) (0.178 gm, 0.5 mmol), 1-phenyl-3-(thiophen-2-yl)-1H-pyrazole-4-carbaldehyde (2.41 g) (0.127 gm, 0.5 mmol) and potassium hydroxide (0.214 gm, 1.2 eq) in EtOH (15 ml), was taken into round bottomed flask and it was refluxed for 8 hr. The progress of the reaction was monitored by TLC. After completion of reaction, it was poured into crushed ice, carefully neutralized with 3N HCl and extracted with EtOAc (15 ml). The organic layer was concentrated in vacuo and purified by column chromatography on silica gel eluted with petroleum ether:EtOAc (3:1) to give compound (2.32 g).
Microwave irradiation method:

A mixture of 1-(2-((1-Benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-1-yl)ethanone (2.44) (0.178 gm, 0.5 mmol), 1-phenyl-3-(thiophen-2-yl)-1H-pyrazole-4-carbaldehyde (2.41 g) (0.127 gm, 0.5 mmol) and KOH (0.214 gm, 1.2 eq) in EtOH (5 ml) was taken into Quartz tube and inserted into a Teflon vial, then it was subjected to microwave irradiation at 180 watts 4 min. The progress of the reaction was monitored by TLC. After completion of reaction, it was poured into crushed ice, carefully neutralized with 3N HCl and extracted with EtOAc (15 ml). The organic layer was concentrated in vacuo and purified by column chromatography on silica gel eluted with petroleum ether:EtOAc (3:1) to give compound (2.32 g).

By employing the same procedure remaining compounds (2.32 a-f).

a) Synthesis of (E)-1-(2-((1-Benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-1-yl)-3-(1,3-diphenyl-1H-pyrazol-4-yl)prop-2-en-1-one (2.32 a)

Conventional heating method:

Yield: 66%

Microwave irradiation method:

Yield: 84%

IR (KBr): ν 3058 (C-H), 1619 (C=O), 1591 (C=N) cm⁻¹; ¹H-NMR (CDCl₃, 400 MHz): δ 8.28 (s, 1H, pyrazole proton), 7.86-7.88 (d, 1H, ArH), 7.75-7.82 (m, 4H, ArH), 7.29-7.50 (m, 12H, ArH), 7.20-7.22 (dd, 4H, ArH), 7.09-7.11 (dd, 2H, ArH), 6.92-6.96 (d, 1H, α-olefinic protons), 5.34 (s, 4H, N-CH₂ & O-CH₂); ¹³C-NMR (CDCl₃, 100 MHz): δ 196.4 (C=O), 153.5, 152.7, 144.3, 139.4, 136.7, 134.3, 131.9, 131.5, 131.4, 129.6, 129.3, 129.1, 129.0, 128.9, 128.7, 128.6, 128.5, 128.3, 128.2, 128.1, 127.9, 127.8, 127.5, 127.3, 126.9, 126.8, 124.6, 124.5, 124.3, 122.9, 119.3, 117.8, 114.3, 63.7 (O-CH₂), 54.1 (N-CH₂); MS: m/z = 588 [M+H]⁺; Anal. Calcd for C₃₈H₂₉N₅O₂: C, 77.66, H, 4.97, N, 11.92. Found: C, 77.62, H, 4.92, N, 11.96.
b) Synthesis of (E)-1-(2-((1-Benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-1-yl)-3-(1-phenyl-3-(p-tolyl)-1H-pyrazol-4-yl)prop-2-en-1-one (2.32 b)

Conventional heating method:
Yield: 64%

Microwave irradiation method:
Yield: 85%

IR (KBr): ν 3060 (C-H), 1623 (C=O), 1593 (C=N) cm⁻¹; ¹H-NMR (CDCl₃, 400 MHz): δ 8.26 (s, 1H, pyrazole proton), 7.87-7.89 (d, 1H, ArH), 7.74-7.82 (m, 4H, ArH), 7.35-7.50 (m, 10H, ArH), 7.21-7.23 (dd, 3H, ArH), 7.10-7.12 (dd, 4H, ArH), 6.91-6.95 (d, 1H, α-olefinic protons), 5.38 (s, 2H, O-CH₂), 5.37 (s, 2H, N-CH₂), 2.36 (s, 3H, CH₃); ¹³C-NMR (CDCl₃, 100 MHz): δ 196.4 (C=O), 152.7, 144.3, 139.4, 136.9, 131.5, 131.4, 129.6, 129.4, 129.0, 128.7, 128.3, 128.2, 128.1, 127.9, 127.8, 127.5, 127.2, 127.0, 126.7, 124.6, 124.5, 124.4, 122.9, 119.3, 118.2, 114.7, 63.8 (O-CH₂), 54.1 (N-CH₂), 21.3 (CH₃); MS: m/z = 602 [M+H]+; Anal. Calcd for C₉₉H₇₁N₅O₂: C, 77.85, H, 5.19, N, 11.64. Found: C, 77.82; H, 5.23, N, 11.68.

c) Synthesis of (E)-1-(2-((1-Benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-1-yl)-3-(3-(4-methoxyphenyl)-1-phenyl-1H-pyrazol-4-yl)prop-2-en-1-one (2.32 c)

Conventional heating method:
Yield: 68%

Microwave irradiation method:
Yield: 85%

IR (KBr): ν 3062 (C-H), 1622 (C=O), 1583 (C=N) cm⁻¹; ¹H-NMR (CDCl₃, 400 MHz): δ 8.25 (s, 1H, pyrazole proton), 7.86-7.88 (d, 1H, ArH), 7.75-7.82 (m, 4H, ArH), 7.46-7.50 (m, 4H, ArH), 7.42 (s, 1H, triazol proton), 7.31-7.40 (m, 4H, ArH), 7.20-7.23 (dd, 4H, ArH), 7.09-
7.11 (dd, 2H, ArH), 6.90-6.94 (d, 1H, α-olefinic proton), 6.80-6.82 (d, 2H, ArH), 5.35 (s, 4H, N-CH₂ & O-CH₂), 3.82 (s, 3H, -OCH₃); \[^{13}\text{C}\]-NMR (CDCl₃, 100 MHz): δ 196.4 (C=O), 159.9, 54.1 (N-CH₂), 153.4, 152.7, 144.3, 139.4, 137.0, 135.2, 134.2, 131.5, 131.4, 129.7, 129.6, 129.3, 129.0, 128.9, 128.7, 128.1, 128.0, 127.9, 127.5, 127.1, 126.6, 124.6, 124.5, 124.4, 124.3, 122.9, 119.3, 117.5, 114.8, 114.1, 63.7 (O-CH₂), 55.3 (O-CH₃); MS: m/z = 618 [M+H]⁺; Anal. Calcd for C₃₉H₃₁N₅O₃: C, 75.83, H, 5.06, N, 11.34. Found: C, 75.87, H, 5.13, N, 11.40.

d) Synthesis of (E)-1-(2-((1-Benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-1-yl)-3-(3-(4-chlorophenyl)-1-phenyl-1H-pyrazol-4-yl)prop-2-en-1-one (2.32 d)

Conventional heating method:
Yield: 63%

Microwave irradiation method:
Yield: 80%

IR (KBr): ν 3061 (C-H), 1622 (C=O), 1593 (C=N) cm⁻¹; \[^{1}\text{H}\]-NMR (CDCl₃, 400 MHz): δ 8.29 (s, 1H, pyrazole proton), 7.88-7.90 (d, 1H, ArH), 7.75-7.84 (m, 4H, ArH), 7.46-7.48 (m, 3H, ArH), 7.34-7.42 (m, 6H, ArH), 7.25-7.28 (m, 3H, ArH), 7.22-7.23 (dd, 3H, ArH), 7.11-7.12 (dd, 2H, ArH), 6.92-6.96 (d, 1H, α-olefinic proton), 5.38 (s, 2H, O-CH₂), 5.36 (s, 2H, N-CH₂); \[^{13}\text{C}\]-NMR (CDCl₃, 100 MHz): δ 196.2 (C=O), 152.9, 152.3, 144.2, 139.3, 136.1, 134.7, 134.3, 131.5, 131.3, 130.5, 129.7, 129.6, 129.3, 129.0, 128.9, 128.7, 128.5, 128.3, 127.9, 127.6, 127.4, 126.9, 124.3, 123.0, 119.3, 117.7, 114.8, 63.7 (O-CH₂), 54.1 (N-CH₂); MS: m/z = 622 [M+H]⁺; Anal. Calcd for C₃₈H₂₈ClN₅O₂: C, 73.36, H, 4.54, N, 11.26. Found: C, 73.33, H, 4.51, N, 11.22.

e) Synthesis of (E)-1-(2-((1-Benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-1-yl)-3-(3-(4-bromophenyl)-1-phenyl-1H-pyrazol-4-yl)prop-2-en-1-one (2.32 e)

Conventional heating method:
Yield: 60%
Microwave irradiation method:
Yield: 82%

IR (KBr): ν 3063 (C-H), 1617 (C=O), 1596 (C=N) cm⁻¹; ¹H-NMR (CDCl₃, 400 MHz): δ 8.28 (s, 1H, pyrazole proton), 7.82-7.84 (d, 1H, ArH), 7.78-7.80 (m, 4H, ArH), 7.48-7.51 (m, 4H, ArH), 7.28-7.30 (m, 6H, ArH), 7.18-7.21 (dd, 3H, ArH), 7.13-7.15 (dd, 2H, ArH), 6.89-6.93 (d, 1H, α-olefinic proton), 6.85-6.87 (d, 2H, ArH), 5.35 (s, 4H, N-CH₂ & O-CH₂); ¹³C-NMR (CDCl₃, 100 MHz): δ 196.0 (C=O), 159.6, 152.4, 144.3, 139.4, 137.0, 135.2, 133.2, 131.9, 131.3, 130.3, 129.7, 129.6, 127.4, 128.1, 128.0, 127.5, 126.8, 125.3, 124.5, 124.4, 124.3, 122.9, 119.4, 118.1, 114.8, 114.1, 63.7 (O-CH₂), 54.1 (N-CH₂), 55.3 (OCH₃); MS: m/z = 666 [M+H]^⁺; Anal. Calcd for C₃₈H₂₈BrN₅O₂: C, 68.47, H, 4.23, N, 10.51. Found: C, 68.42, H, 4.27, N, 10.45.

f) Synthesis of (E)-1-(2-((1-Benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-1-yl)-3-(3-(4-nitrophenyl)-1-phenyl-1H-pyrazol-4-yl)prop-2-en-1-one (2.32 f)

Conventional heating method:
Yield: 58%

Microwave irradiation method:
Yield: 80%

IR (KBr): ν 3052 (C-H), 1622 (C=O), 1597 (C=N) cm⁻¹; ¹H-NMR (CDCl₃, 400 MHz): δ 8.37 (s, 1H, pyrazole proton), 8.13-8.15 (d, 2H, ArH), 7.88-7.90 (d, 1H, ArH), 7.77-7.84 (m, 4H, ArH), 7.67-7.68 (d, 2H, ArH), 7.50 (s, 1H, triazole proton), 7.35-7.48 (m, 6H, ArH), 7.22-7.24 (dd, 4H, ArH), 7.12-7.13 (dd, 2H, ArH), 6.96-7.00 (d, 1H, α-olefinic proton), 5.39 (s, 2H, O-CH₂), 5.36 (s, 2H, N-CH₂); ¹³C-NMR (CDCl₃, 100 MHz): δ 195.9 (C=O), 152.9, 150.8, 147.6, 139.2, 138.5, 135.0, 134.3, 131.7, 131.4, 129.7, 129.3, 129.0, 128.8, 128.7, 128.3, 127.9, 127.7, 127.6, 127.3, 124.6, 124.5, 124.3, 123.8, 123.3, 123.1, 122.7, 119.4, 118.3, 114.8, 54.2 (N-CH₂), 63.8 (O-CH₂); MS: m/z = 633 [M+H]^⁺; Anal. Calcd for C₃₈H₂₈N₆O₄: C, 72.14, H, 4.46, N, 13.28. Found: C, 72.10, H, 4.52, N, 13.24.
g) Synthesis of (E)-1-(2-((1-Benzyl-1H-1,2,3-triazol-4-yl)methoxy)naphthalen-1-yl)-3-(1-phenyl-3-(thiophen-2-yl)-1H-pyrazol-4-yl)prop-2-en-1-one (2.32 g)

Conventional heating method:
Yield: 75%

Microwave irradiation method:
Yield: 90%

IR (KBr): ν 3062 (C-H), 1621 (C=O), 1589 (C=N) cm⁻¹; ¹H-NMR (CDCl₃, 400 MHz): δ 8.27 (s, 1H, pyrazole proton), 7.90-7.92 (d, 1H, ArH), 7.82-7.84 (d, 1H, ArH), 7.78-7.80 (d, 4H, ArH), 7.56-7.60 (d, 1H, β-olefinic proton), 7.31-7.52 (m, 5H, ArH), 7.21-7.23 (dd, 4H, ArH), 7.08-7.11 (dd, 1H, ArH), 7.06-7.07 (dd, 1H, ArH), 6.95-6.99 (m, 4H, α-olefinic proton & ArH), 5.38 (s, 2H, O-CH₂), 5.35 (s, 2H, N-CH₂); ¹³C-NMR (CDCl₃, 100 MHz): δ 196.2 (C=O), 152.8, 147.7, 144.3, 139.1, 135.6, 134.3, 131.6, 131.5, 129.6, 129.3, 129.0, 128.7, 128.6, 128.1, 127.9, 127.7, 127.6, 127.4, 126.7, 126.4, 124.5, 124.3, 122.9, 119.3, 119.2, 117.5, 114.6, 63.6 (O-CH₂), 54.1 (N-CH₂); MS: m/z = 594 [M+H]+; Anal. Calcd for C₃₆H₂₇N₅O₂S: C, 72.83, H, 4.58, N, 11.80, S, 5.40. Found: C, 72.78, H, 4.60, N, 11.81, S, 5.37.

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