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Review Paper

A Review on Synthesis of some New Heterocyclic Compounds and Study of their Microbial Activities

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Abstract

Chalcones, a group of compounds having interesting biological activities. Many of aromatic ketones are used as bactericides, disinfectant etc. It has wide range of bioactivity like antimycotic, anti-oxidant, anti-malaria, anti-tubercular, anti-gout, anti-bacterial, anti-ulcer, anti-cancer, insecticidal, anti-protozoal, anti-steroidal etc. Chalcones and their derivatives are used as a man-made sweetener, scintillator, polymerization catalyst, fluorescence brightening agent, organic brightening agent, visible light, ultraviolet light (UV) and aging. They are all reactive to many of the reagents such as hydrazine's, aminophenol's etc. containing the keto-ethylenic group in their structure. The Chalcones are used in clarifying structures of natural products.

Keywords: Synthesis, Chalcones, Heterocyclic Compounds, Microbial Activities.

Introduction

The chemistry Chalcones has a great importance in scientific studies in whole world. Preparation and biological activities of these are the most interested topics. It was Kostanecki and Tambor[1] who gave it its name 'Chalcones'. The other names by which they are known is Benzalacetophenone or phenyl styryl ketones. Chalcone has two aromatic rings connected by three aliphatic carbon chain. It has many synthetic applications as it contains synthons. Hence, they have great importance in pharmacology.

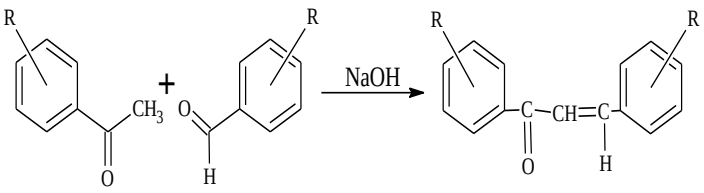
The Chalcones are α-β-unsaturated ketones. The presence of chromophore –CO-CH=CH- imparts them as coloured compounds. Chalcones are biologically active because of their presence of Reactive α-β- Ketonic group. Pyrazoles and their variously substituted derivatives are crucial biological agents and the significant research activity has been directed towards this category of Pyrazoles and Pyrazolines. The heterocyclic compounds like Pyrazoles Pyrazolines, Oxazoles, Isoxazoles etc. can be synthesized using Chalcones and flavonoids.

Chalcones have contributed significantly to the understanding and development of heterocyclic chemistry and have also found wide applications in organic synthesis. They are important precursors in the biosynthesis of flavonoids and isoflavonoids, which are naturally occurring compounds widely found in many edible and medicinal plants.

Methodology

Chalcones can be synthesized through several established methods, but the Claisen–Schmidt[2] condensation is one of the most commonly employed approaches. In this method, equimolar amounts of a substituted acetophenone and a substituted aldehyde are reacted in an aqueous alcoholic medium in the presence of an alkaline catalyst.

Typically, a concentrated alkali solution, sometimes reaching about 60%, is used, and reaction is proceeded at around 50°C for approximately 12–15 days. This method is widely preferred because of its straightforward procedure and its suitability for preparing a variety of substituted chalcone derivatives.



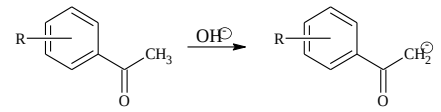
A variety of condensing agents can be employed for the preparation of chalcones. Commonly used reagents include alkaline catalysts such as NaOH and KOH, as well as hydrochloric acid, aqueous borax, piperidine, amino acids, and alkali-metal alkoxides.

Other Lewis and strong acid catalysts, such as BF_3 and perchloric acid, have also been reported for promoting chalcone formation under suitable reaction conditions.

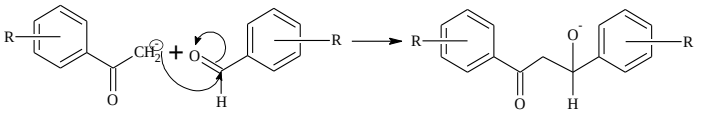
Mechanism: The base-catalyzed mechanism involved in the formation of chalcones and their derivatives can be described

through the following sequence of reaction steps:

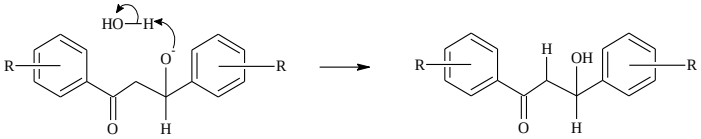
1. Formation of enolate ion



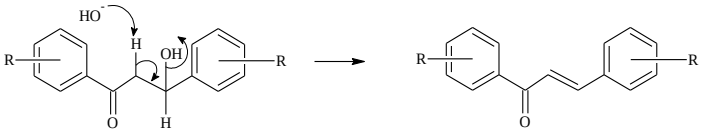
2. Alkoxide formation (Nucleophilic addition)



3. Protonation of alkoxide

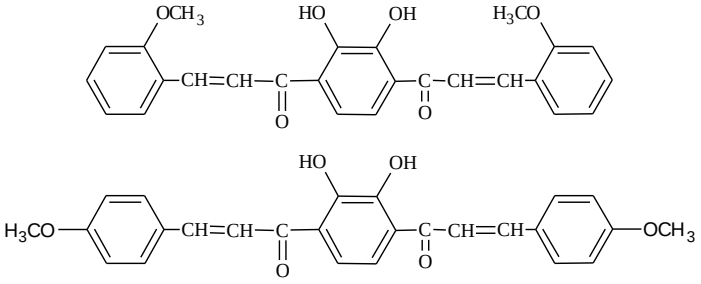


4. Dehydration

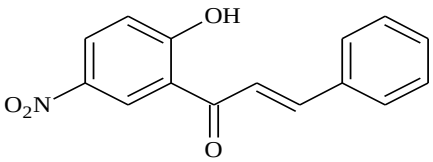


Literature review of Chalcone Synthesis

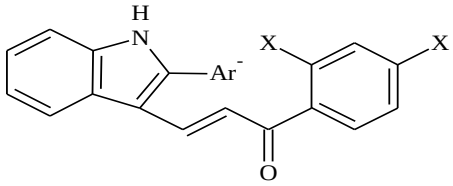
Venkatraman and Nagrajan[3] also reported the synthesis of substituted chalcones from dihydroxy-diacetylbenzene and anisaldehyde under alkaline reaction conditions.



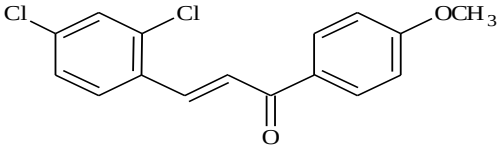
Onoda and Sasaki[4] reported the synthesis of hydroxy-nitrochalcone by reacting 2-hydroxy-5-nitroacetophenone with *p*-anisaldehyde in the presence of hydrochloric acid as the catalyst.



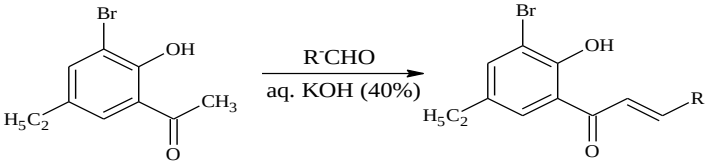
Dandia, Sehgal and Singh[5] were synthesized some chalcones containing indole moiety-



Mistry and Desai[6] reported a convenient method for synthesizing chalcones using microwave irradiation, which helped make the reaction faster and more efficient.



Naik and Naik[7] successfully prepared derivative of chalcones by using 2-hydroxy-3-bromo-5-ethylacetophenone.



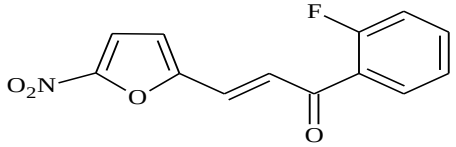
Biological Activities

The α,β-unsaturated carbonyl moiety present in chalcones plays an important role in their biological activity. Several studies have shown that chalcones possess antibacterial and antifungal properties against microorganisms such as *S. aureus*, *E. coli*, *C. albicans*, *T. utilis*, *S. sake*, and *W. anomala*. Moreover, chalcones and their derivatives have been investigated for a variety of biological activities, including insecticidal, anticancer, anti-inflammatory, bactericidal, fungicidal, antiviral, antitumor, antimalarial, and antiulcer effects. Because of this diverse range of biological properties, chalcones and their derivatives have received considerable attention in pharmaceutical and medicinal chemistry research.

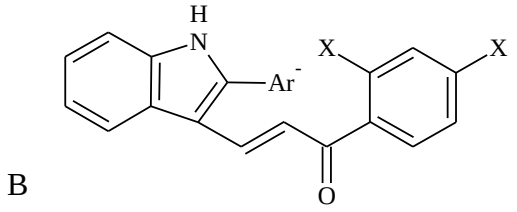
De Vincenzo et al.[8] explored the antibacterial activity of a number of substituted chalcones and also indicated anti-inflammatory activity. Okuyama and Toru[9] studied the anticancer properties of chalcone compounds with the potential of being useful in cancer-related research. Bhatt et al.[10] studied the chalcones and pyrazole derivatives and found them to be cytotoxic.

Z. Mohammed Abd Al-Khaliq[11] synthesized a series of nitrofuryl chalcone derivatives and did a study of their antibacterial activity. Derivative (A) resulted in the highest inhibition efficacies against Staphylococcus with 1 µg/mL, suggesting its potential antibacterial activity.

A

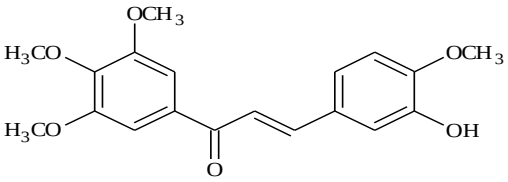


The Dandia, Sehgal and Singh[12] studied the antibacterial and antifungal activity of a series of synthesized chalcone derivatives with indole moiety (B). Their study showed that these compounds were biologically active chalcone derivatives.



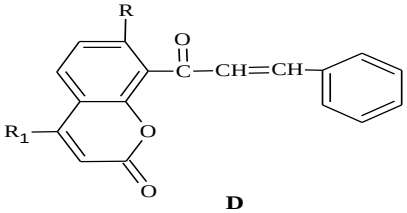
B

A highly active chalcone derivative (C) was studied by S. Farber and colleagues[13] for use in chemotherapy of leukemia, and it was concluded that it should be considered as a biologically active compound for cancer treatment



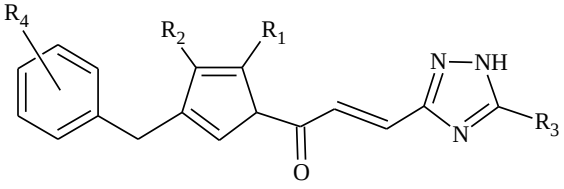
C

The heterocyclic substituted chalcones (D) were synthesized by V. Kumar, S. Dhawan and P. S. Girase[14] and evaluated for their biological applications. A few of the synthesized compounds were reported having potential in the management of breast cancer as well as menopausal disorders and osteoporosis in humans.



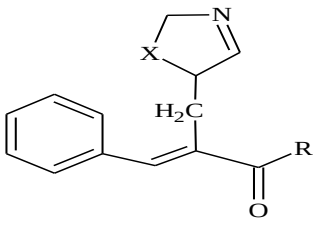
D

Uenaka, Kawata, Nagai, and Endoh[15] synthesized a series of β-hydroxy chalcone derivatives (E) and evaluated their biological activity. Among the compounds studied, the fluoro-substituted derivatives exhibited considerable activity against human immunodeficiency virus (HIV), suggesting their potential for further antiviral investigation.



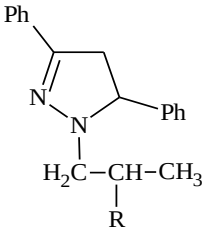
E

A. M. Ali, H. Salah, M. A. Gad, Y. M. A. M., and N. A. A. Elkanzi[16] reported the synthesis of derivatives chalcone containing heterocyclic moieties (F) and investigated their insecticidal properties. Some of these compounds demonstrated promising insecticidal activity, indicating their potential for further study as biologically active chalcone derivatives.

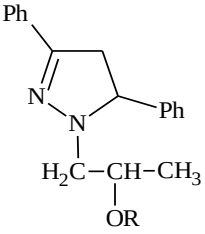


F

Jamode et al.[17] investigated the antimicrobial properties of 3,5-diaryl pyrazole derivatives. Similarly, Sonare[18] explore the antimicrobial activity of 1-H-3-(2′-acetyl-4′-methoxyphenyl)-5-substituted phenyl-2-pyrazolines. Barot et al.[19] also evaluated 1-H-3-(2′-hydroxy-3′-ethoxy-5′-bromophenyl)-5-substituted phenyl-2-pyrazolines and reported their antimicrobial activity against for *E. coli* and *S. aureus*. In addition to their antimicrobial properties, certain 3,5-diphenyl-1-H-pyrazole derivatives (G) and (H) have been reported to exhibit a range of biological effects, including sedative, platelet anti-aggregating, anesthetic, analgesic, and anti-inflammatory activities.

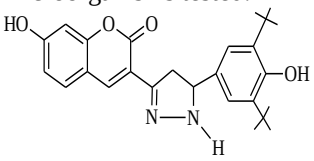


G

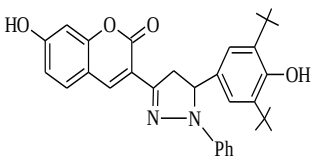


H

Desai et al.[20] studied several pyrazoline (I) and phenylpyrazoline (J) derivatives and found that these compounds showed promising antimicrobial activity against the microorganisms tested.

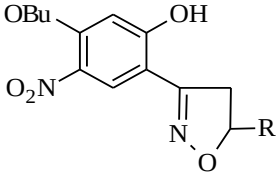


I



J

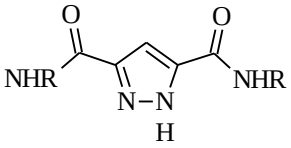
An antimicrobial activity of facile synthesis of isoxazolines (K) was studied by Ankhiwala[21] in 1989.



K

Kadu and Jamode[22] synthesized a series 3,5-diaryl-4-benzoyl-1-pyridoyl pyrazole derivatives and evaluated their antibacterial properties. Their findings indicated that these compounds exhibited notable antibacterial activity.

Baures Paul W.[23] reported a sequence of pyrazole derivatives (L) and investigated their potential as inhibitors of HIV-1 protease, suggesting their possible application in antiviral drug research.



L

Conclusion

A careful review of the available literature indicates that the compounds selected for the present study have not yet been extensively investigated for their antibacterial and antifungal properties. Chalcones are valuable compounds in organic as well as medicinal chemistry because they serve as important building blocks for the synthesis or preparation of a wide range of heterocyclic derivatives and possess diverse biological activities. Considering their significant therapeutic potential, this study is focused on the synthesis of new heterocyclic derivatives of chalcones and the evaluation of their antibacterial and antifungal activities. The study also aims to gain a better understanding of the relationship between their chemical structures and biological activity, which may help in identifying promising compounds for future antimicrobial research.

Acknowledgement

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