REVIEW OF RESEARCH
ISSN: 2249-894X
IMPACT FACTOR : 5.7631(UIF)

MICROWAVE ASSISTED SYNTHESIS: REVOLUTION IN SYNTHETIC CHEMISTRY

Vikas V. Borgaonkar[1], Sanjay R. Pawar[2],
[1]Department of Chemistry, Shri. Siddheshwar Mahavidyalaya, Majalgaon, MS, India.
[2]Department of Chemistry, Smt. C. H. M. College, Ulhasnagar, Thane, MS, India.

ABSTRACT:-

The green chemical synthesis segment is emerging as one of the highest priorities in research community. The microwave (MW) induced techniques have proven to be good alternative over traditional methods which make use of hazardous chemical and tedious work up procedures. The reactions carried out by microwave (MW) induced techniques have various advantages compared to that of using conventional heating methods. In last two decades there is a dramatic surge in the methodologies using microwave (MW) induced techniques as an energy source to promote chemical conversions. Many organic transformations which require several hours or even days to complete are successfully completed in few minutes by using microwave (MW) induced techniques. Microwave assisted synthesis have advantages of providing ecofriendly conditions such as quick reaction time, operational simplicity, enhanced yields of products.

In the light of mentioned observations and other literature evidences an attempt has been made to summarize the significance of microwave technique and its use in various chemical transformations.

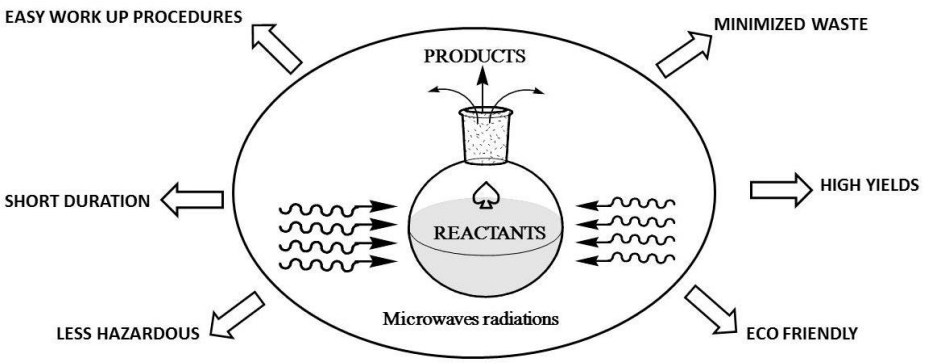

Figure 1: Microwave Assisted Reactions

KEY WORDS: *Microwave synthesis, synthetic chemistry.*

INTRODUCTION:

The microwave irradiation assisted reactions have become increasingly in organic synthesis in organic synthesis. Due to simple operational procedures it has become popular within the pharmaceutical and academic domens, enabling new ways for drug discovery and development.[1] Microwave synthesis have various advantageous over conventional heating methods to bring out chemical changes, which evolved as the preferred tool for performing chemical synthesis relating to key factor in pharmaceutical and biotechnology companies. The reactions at various scales ranging from few grams to kilogram can be successfully performed using microwave chemistry, since research has already been started. Classical methods are not potential tools for transferring energy into the reacting system. In microwave technique, the molecules of the entire reaction mixture are exposed directly to microwaves, which give rise to a rapid increase in temperature. A dipole or are ionic molecules are directly activated by microwave irradiation, as energy is transferred in less than a nanosecond.

The term “Enhanced Microwave Synthesis” (EMS), has been studied as an alternative method for carrying out microwave assisted organic reactions.[2] More energy can be transferred to the reaction vessel with external cooling by compressed air, and at the same time irradiating microwave irradiation to the reaction mixture. The literature survey provides evidence for the use of simultaneous cooling of reactions being heated by microwave energy.[3-4]

APPLICATIONS OF MICROWAVE TECHNIQUE:-

1) Chemical Synthesis

Methods in organic synthesis have been developed by the choice of available material and other tools. Microwave-assisted organic synthesis has been the popular and one of the most investigated applications in chemical reactions. Since then, scientists have successfully performed a large number of organic reactions like Diels-Alder reaction, Suzuki reaction, Mannich, Wittig reaction and many more using microwave techniques.

The Wittig reaction is achieved by reacting aromatic aldehydes and phosphonium ylides to produce alkenes. In this reaction rate-determining step is the generation of phosphonium ylides. By the conventional method process is very slow but using microwave radiations the reactions occur in minutes[5].

In case of organometallic compounds, in the synthesis of organo-B-metal compounds, the rate of reaction has been found to increase in by a 40-fold using microwave technique. This advantage is obtained under similar reaction conditions identical to high-pressure organic synthesis[6].

2) Solvent-free Reactions

The modern organic chemistry emphasis on use of various organic solvent for the synthesis of organic compounds, but this view has serious concerns to environmental issues. So, worldwide chemists are focusing on the solvent free reactions that reduce solvent hazards and pollution.

Synthesis of ketimines is obtained by reacting substituted hydroxypropiophenones with ethylene diamine under solvent free microwave irradiation method as an eco-friendly synthetic route over classical method[7]. Traditional methods have limitation of strictly using solvent for heating solid compounds whereas microwave technique for conducting reactions on solids by direct heating has opened new window for such reactions. Various reactions have been studied in ‘dry media’ by using catalytic system such as, solid supported alumina, silica, montmorillonite clay and zeolites by microwave irradiation.

3) Biochemical Applications

Microwave irradiation tool is established to be a potential source of energy for biochemical transformations. In early stages of development of microwave heating techniques high temperature was one of the limitations compared to organic synthesis, as properties and structures of many of the biochemical molecules are greatly affected by change in temperature. Today, with developing technologies in microwave

irradiations, temperatures as low as 35-40 °C is possible by accurate power input which allows a much wider range of chemistries to be discovered. Literature shows that, there have been significant discoveries published using such advance techniques on carbohydrates[8-10], nucleosides[11-13], peptides[14], proteins[15].

CONCLUSION:-

With increasing new disease threats, drug discovery is utmost prime and ever challenging task for scientists and chemists. The development of drug discoveries requires accumulation of various methods and tools as no one technique is always helpful. Although all techniques have its own benefits and drawbacks the microwave chemistry has been continually shared with other useful tools and approaches such as multi-component reactions, solid-phase organic synthesis, or combinatorial chemistry. The explorations of multidisciplinary methodologies with microwave heating boost scientists to discover new and unidentified areas of multifaceted pharmaceutical systems.

REFERENCES:-

1. a. P. Lidstrom, J. Tierney, B. Wathey, J. Westman, *Tetrahedron,* 57, **2001**, 9225.
   b. M. Larhed, A. Hallberg, *Drug Discovery Today,* 6*,* **2001**, 406.
2. B. L. Hayes, M. J. Collins, World Patent WO 04002617, January 8, **2004.**
3. J. J. Chen, S. V. Deshpande, *Tetrahedron Lett.,* 44*,* **2003**, 8873.
4. C. E. Humphrey, M. A. M. Easson, J. P. Tierney, N. J. Turner, *J. Org. Lett.,* 5*,* **2003**, 849.
5. S. Frattini, M. Quai, E. Cereda, *Tetrahedron Lett.*, Sep **2001**.
6. M. Ali, S. P. Bond, S. A. Mbogo, W. R. McWhinnie & P. M. Watts, *J. Organometallic Chem.,* 11, **1989**, 371.
7. V. V. Borgaonkar and B. R. Patil, *Der Pharma Chemica*, 6(1), **2014**, 120-124.
8. V. Singh, A. Tiwari, D. N. Tripathi, T. Malviya, *Tetrahedron Lett.,* 44*,* **2003**, 7295.
9. V. Bailliez, R. M. de Figueiredo, A. Olesker, J. Cleophax, *Synthesis,* **2003**, 1015.
10. S. K. Das, K. A. Reddy, J. Roy, *Synlett,* **2003**, 1607.
11. E. Petricci, M. Radi, F. Corelli, M. Botta, *Tetrahedron Lett.,* 44, **2003**, 9181.
12. A. A. H. Abdel-Rahman, E. S. H. El Ashry, *Synlett,* **2002**, 2043.
13. N. S. Rao, P. Kumar, V. K. Chauhan, B. S. Garg, K. C. Gupta, *Nucleosides, Nucleotides Nucleic Acids,* 21, **2002**, 393.
14. I. Roy, M. N. Gupta, *Tetrahedron,* 59, **2003**, 5431.
15. B. N. Pramanik, Y. H. Ing, A. K. Bose, L. K. Zhang, Y. H. Liu, S. N. Ganguly, P. Bartner, *Tetrahedron Lett.,* 44, **2003**, 2565.