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Forecasting the Protocol for Microwave Radiation Availed Forced Degradation of the Drug Molecules

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ABSTRACT

The Forced degradation and stability testing involve the foremost time portion in researching the chemistry of the molecules. To obtain a green and fast technique for forced degradation study of the drug molecules, microwave radiation is adopted for the studies in the recent scenario. The drug development life cycle may be a long process that additionally involves ample efforts within the testing of the chemical stability of the drug molecules and potential impurity and degradation product of the drug before it comes within the sort of stable formulation. This shows the vital development within the forced degradation methodology by this innovative approach. As the approach is new it requires a methodical protocol, the paper presents suitable factorial setups for the described application.

Keywords- Drug Stability, Forced Degradation, Protocol, Factors.

I. INTRODUCTION

Forced degradation studies are indispensable for revealing the drug stability, elucidate the key degradation pathways, and examine the degradation of drug substance in qualitative/quantitative stipulations. The forced degradation method is an example of a development/control quality test that's executed routinely in pharma to gauge a drug's chemical stability. Using it also reduces the degradation products, provides an insight into the degradation pathway and therefore the specificity of stability indicating methods, employing a degradation process under conditions (acid, basic, oxidative, and temperature) that are more severe than accelerated conditions. Considering that, most of the regulatory guidance documents have defined the awareness of forced degradation, but they do not provide meticulous information about forced degradation strategies. Over the years, the pharmaceutical industry has been using a conventional method for heating in degradation study; this requires a drawn-out process, high energy, and time. Recently, a new-fangled forced degradation method using modern microwave reactors has been reported as a greener, more inexpensive, and resourceful alternative[1].

Current practice for forced degradation

Literature published in recent studies describes, the colossal interest and experimentations to optimize the time for degradation, stressor strength, and temperature set required for invoking the preliminary degradation of drugs and medicines and to develop green techniques for forced degradation methodologies.[4 -12] The conventional method involves the heating by the traditional source like a hot plate or temperature-controlled water bath, in this process thermal conductivity of the various materials is the key factor that initially heats the reaction vessel and then heats the drug solution to be degraded. The degradation is performed in the volumes up to 100 ml and heating ranging from room temperature to 100 ° C. The time required for the reaction, sample handling, and analysis in the traditional approach is reduced greatly by the microwave-assisted reaction. It has been highlighted in various approaches published in the literature that the microwave radiation can be employed in the forced degradation study, stability-indicating method development. It can also be broadened to the isolation of the impurity, due to greater control over reaction and reasonable reproducibility.

II. ADVANTAGES OF THE NEWER MICROWAVE AIDED METHOD

Microwave energy produces efficient internal heating by the direct blending of microwave energy with polar molecules. Accordingly, microwave-assisted reactions are predominantly based on the proficient heating of materials by microwave dielectric heating effects. A significant reduction of time has been achieved without the degradation losing the profile and efficiency that have already been observed in exposing the drugs to degrading agents for long periods of time, either at room temperature or in heating through stoves or reflux. Also besides, the use of microwave irradiation heating can also considerably reduce the amounts of solvents used as stressing agents, without affecting the efficiency of the study or decreasing the energy; overall, the great advantage is by following the green chemistry principles.[1-3]

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Figure 1: Graphical abstract of the paper demonstrating the overall concept of forced degradation through microwave

Considering the three major factors microwave power, time and concentration of the stressor for the degradation study an experimental design either full-factorial or with diminished runs can be utilized for the setup of the targeted degradation amount required for study purpose. One more aspect of response surface prediction can be availed to optimize the experimental setup for the microwave aided approach. The following are the three levels of set up to conduct the drug degradation study, which preludes the drug susceptibility for the degradation.

Forced degradation conditions majorly employed by conventional methods:[13-15]

1 Hydrolytic Degradation
2 Oxidation
3 Photo Degradation
4 Thermal Degradation

Forced degradation studies are administered to realize subsequent pur-poses:

- To get insight into the degradation pathway of the drug substance.
- Degradation product from the excipients matrix can be evaluated
- Structure elucidation of the degradation products.
- To predict the stability of the drug substance into the formulation.
- A detailed assessment of the drug substance in a variety of stressed conditions like hydrolysis, oxidation, Photo decomposition, etc.
- To set up the stability-indicating nature of the drug substance estimation method.
- To disentangle stability related issues of the drug and develop the long-standing formulation.

Factorial combination setups to conduct the drug degradation study

Combination 1: Mild set up for the drugs, which are highly susceptible to degradation.

Microwave radiation	Strength of the Chemical stressor	Time of exposure
80 – 200/240 Watt	0.1 -0.5 N HCl /NaOH	120 - 180 seconds
	0.1 – 1 % H_2O_2	

Combination 2: Moderate set up for the drugs, which are moderately susceptible to degradation.

Microwave radiation	Strength of the Chemical stressor	Time of exposure
300 – 500 Watt	1 – 2 N HCl /NaOH	60 -120 seconds
	3 % H_2O_2	

Combination 3: Extreme set up for the drugs, which are very less susceptible to the degradation.

Microwave radiation	Strength of the Chemical stressor	Time of exposure
500 - 800 Watt	Up to 5 N HCl /NaOH	30 -60 seconds
	6 % H_2O_2	

III. CONCLUSION

The factors set up on the three different levels can be used for the degradation of target achievement. Taking into account the susceptibility of the drug to degradation from basic drug chemistry, this green approach should be embraced in the field of the forced degradation study.

REFERENCES

[1] N Patel P. & J Mehta P. (2017). Impact of Microwave Assisted Heating on Hydrolytic Forced Degradation Study of Pharmaceuticals. *Current Microwave Chemistry*, *4*(2), 152-157.

[2] Nüchter, M., Ondruschka, B., Bonrath, W., & Gum, A. (2004). Microwave assisted synthesis – a critical technology overview. *Green Chem.*, *6*(3), 128–141. https://doi.org/10.1039/B310502D

[3] Razzaq, T., & Kappe, C. O. (2007). Rapid preparation of pyranoquinolines using microwave dielectric heating in combination with fractional product distillation. *Tetrahedron Letters*, *48*(14), 2513–2517. https://doi.org/10.1016/j.tetlet.2007.02.052

[4] Abdelwahab, N. S., Hassan, H. M., & Magd, A. M. A. (2020). Rapid microwave-assisted hydrolytic degradation of colchicine: In silico ADME/Tox profile, molecular docking, and development of innovative RP-Chromatographic methods. *Microchemical Journal*, *152*, 104419. https://doi.org/10.1016/j.microc.2019.104419

[5] Bende, G., Kollipara, S., Kolachina, V., & Saha, R. (2007). Development and Validation of an Stability Indicating RP-LC Method for Determination of Imatinib Mesylate. *Chromatographia*, *66*(11–12), 859–866. https://doi.org/10.1365/s10337-007-0415-3

[6] Madhavi, A., Reddy, G. S., Suryanarayana, M. V., & Naidu, A. (2008). Development and Validation of a New Analytical Method for the Determination of Related Components in Tolterodine Tartarate Using LC. *Chromatographia*, *68*(5–6), 399–407. https://doi.org/10.1365/s10337-008-0735-y

[7] Prekodravac, B., Damm, M., & Kappe, C. O. (2011). Microwave-assisted forced degradation using high-throughput microtiter platforms. *Journal of Pharmaceutical and Biomedical Analysis*, *56*(5), 867–873. https://doi.org/10.1016/j.jpba.2011.07.042

[8] Da Silva FE, Kaefer CL, Becker N, Barbosa S, Picolotto RS, Barin JS, Flores ÉM. (2013). Innovative use of microwave radiation in forced degradation of azol pharmaceutical. *Rev Bras Farm.*, *94*, 265-272.

[9] Sonawane, S. (2011). Optimization of Forced Degradation Using Experimental Design and Development of a Stability-Indicating Liquid Chromatographic Assay Method for Rebamipide in Bulk and Tablet Dosage Form. *Scientia Pharmaceutica*, *79*(1), 85–96. https://doi.org/10.3797/scipharm.1011-06

[10] Sonawane, S., & Gide, P. (2013). Study on approaches to expedite and simplify forced degradation of eplerenone. *Journal of Liquid Chromatography & Related Technologies*, *36*(15), 2156–2165. https://doi.org/10.1080/10826076.2012.717054

[11] Prajapati DK, Dave JB, Patel CN. (2015). Microwave assisted comparative forced degradation study of oral Cephalosporin drugs using quality by design (QbD) approach and stability indicating RP-HPLC analysis. *World J Pharm Pharmaceut Sci.*, *4*, 1714-1727.

[12] Patel, P., & Mehta, P. (2017). Microwave-assisted heating: Innovative use in hydrolytic forced degradation of selected drugs. *Journal of Microwave Power and Electromagnetic Energy*, *51*(3), 205–220. https://doi.org/10.1080/08327823.2017.1354746

[13] Blessy, M., Patel, R. D., Prajapati, P. N., & Agrawal, Y. K. (2014). Development of forced degradation and stability indicating studies of drugs—A review. *Journal of Pharmaceutical Analysis*, *4*(3), 159–165. https://doi.org/10.1016/j.jpha.2013.09.003

[14] Reynolds DW, Facchine KL, Mullaney JF, Alsante KM, Hatajik TD, Motto MG. (2002). Conducting forced degradation studies. *Pharmaceutical Technology*, 48-56.

[15] Ngwa G. (2010). Forced degradation as an integral part of HPLC stability-indicating method development. *Drug Delivery Technology*, *10*(5), 56-59.