

## MULTICOMPONENT REACTIONS: GREEN HOPE TOWARD SUSTAINABLE DEVELOPMENT

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### ABSTRACT

Practicing sustainable chemistry is one of the best ways to address 'man-made' environmental perils. The decorum set by the laws of green chemistry can lead us towards mitigating such menace. Multi-component reactions are one such weapon in the armoury of a chemist towards developing and inventing commodities ranging from life-saving drugs to lifestyle products through sustainable synthetic methodologies. Though much advancement is accomplished in developing such reactions, a correlation between 'environmentally benign operation' and 'mere synthesis' is yet to be realized. Herein, we have tried to highlight the gradual advancement of this procedure and what still needs to be achieved to entice the philosopher within ourselves towards greener thoughts and ideas.

**Keywords:** Multicomponent Reaction, Green Chemistry, Sustainable Development.

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### INTRODUCTION

To make Mother Earth a better place to thrive not for the human race alone but all other living creatures alike, every human has a role to play be it minuscule or mammoth. We, the researchers, in varied fields, are running at a stupendous pace towards achieving newer feats in designing sophisticated devices to make our life smooth, and free from diseases often forgetting the hazards and the strain we are gradually releasing into the space where we thrive. We, the chemists and chemical industries are often blamed for causing such peril. Thus, giving stress on practicing green chemistry is the only way out.<sup>1</sup> Initially it was thought that the concept of green chemistry only calls for managing the pollutant released during the reaction or production but with the mounting toxic excreta, managing them becomes a mammoth and sometimes impossible task. So, the most likely path towards a greener environment is to stop generating such toxins. It is easier said than done as a lot of thinking, logic, innovation, designing, engineering, and application are required for the same. One innovative way of achieving such a goal is Multi-Component Reactions (MCR). MCR or MCAP (see Glossary) is a process of combining two or more reactants under suitable conditions to get a single product without generating any waste. The concept of atom economy (see Glossary), one of the twelve principles of green chemistry, can thus be achieved. Most of us may think of this as a utopian way of explaining MCR but, one must accept the fact that if we want to achieve something in practice, we must stretch ourselves towards ideality.

### History

Nature has it all and we, humans, need an eye to identify and mimic her for our sustenance. Ugi and his co-workers have correctly defined MCR as 'older than life' while stating that the origin of adenine was presumably from five units of hydrogen cyanide where every hydrogen cyanide plays a distinct role.<sup>2</sup> The first documented MCR goes way back to the 1850s when Strecker prepared  $\alpha$ -cyano amines by condensing, ammonia and hydrogen cyanide with an aldehyde, which was easily hydrolyzable to  $\alpha$ -amino acids.<sup>3</sup> Utilizing the concept of MCR, researchers gradually started synthesizing various heterocyclic moieties like pyrrole (Hantzsch synthesis), dihydropyrimidine (Bignelli synthesis), and precursors to bioactive alkaloids.<sup>4,7</sup> In this regard, the work of Passerini towards the synthesis of various  $\alpha$ -acyloxy carboxylic