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***Review Article***

# Use of different Fruit juices as a Catalyst in Various Organic Synthesis (A Sustainable Development of Chemistry)

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**ABSTRACT**
Due to materialistic approach of all the nations in this world pollution is increasing day by day. As a result of this air, water and soil are polluted which are the basic needs of living organisms. Therefore organic/medicinal chemists have to develop synthetic protocols which follow green chemistry approach (Sustainable Chemistry). Catalysts play dominating role in any organic synthesis and first choice is a bio catalyst in the form of various fruit juices. This article summarizes use of various fruit juices((lemon/ Pineapple /Tamarind/grape juice) as a catalyst in number of multicomponent reactions exploited for the syntheses of Dihydropyrimidones / Dihydrothio pyrimidone, Triazoles, bis, trisindolylmethanes, bis di (indolyl) methanes. These protocols are having simple workup procedure with good yield and more over environmentally benign.

**KEYWORDS**
Bio-catalyst, Organic Synthesis, Sustainable, Chemistry, Economical.

## 1. INTRODUCTION

Due to materialistic approach of all the nations and as a result of industrial revolution[1] (1760 to 1840) transition of hand power to machine took place and chemical reactions were accomplished on large scale by using steam power, the environment of this planet started to be polluted and as a result of this various ill effects were observed on human health. All the scientists in general and chemists in particular were worried about this pollution problem of this planet and new term was emerged i.e. Green Chemistry[2] defined as "an area of chemistry and chemical engineering focused on the designing of products and processes that minimize the use and generation of hazardous substances". In 1998, Paul Anastas (who then directed the Green Chemistry Program at the US EPA) and John C. Warner (then of Polaroid Corporation) published a set of principles to guide the practice of green chemistry which are as under.

1. **Prevention**. Preventing waste is better than treating or cleaning up waste after it is created.
2. **Atom economy.** Synthetic methods should try to maximize the incorporation of all materials used in the process into the final product.
3. **Less hazardous chemical syntheses**. Synthetic methods should avoid using or generating substances toxic to humans and/or the environment.
4. **Designing safer chemicals.** Chemical products should be designed to achieve their desired function while being as non-toxic as possible.
5. **Safer solvents and auxiliaries**. Auxiliary substances should be avoided wherever possible and as non-hazardous as possible when they must be used.
6. **Design for energy efficiency**. Energy requirements should be minimized, and processes should be conducted at ambient temperature and pressure whenever possible.
7. **Use of renewable feedstocks**. Whenever it is practical to do so, renewable feedstocks or raw materials are preferable to non-renewable ones.
8. **Reduce derivatives**. Unnecessary generation of derivatives; such as the use of protecting groups; should be minimized or avoided if possible; such steps require additional reagents and may generate additional waste.
9. **Catalysis**. Catalytic reagents that can be used in small quantities to repeat a reaction are superior to stoichiometric reagents (ones that are consumed in a reaction).
10. **Design for degradation**. Chemical products should be designed so that they do not pollute the environment; when their function is complete, they should break down into non-harmful products.
11. **Real-time analysis for pollution prevention**. Analytical methodologies need to be further developed to permit real-time, in-process monitoring and control before hazardous substances form.
12. **Inherently safer chemistry for accident prevention**. Whenever possible, the substances in a process, and the forms of those substances, should be chosen to minimize risks such as explosions, fires, and accidental releases.

As a result of this development, obviously an organic/medicinal chemists have to develop a synthetic protocol which should follow principles of green chemistry, particularly a chemist has to take care of atom economy, nature of the catalyst, solvent and energy consumption of the synthetic protocol.

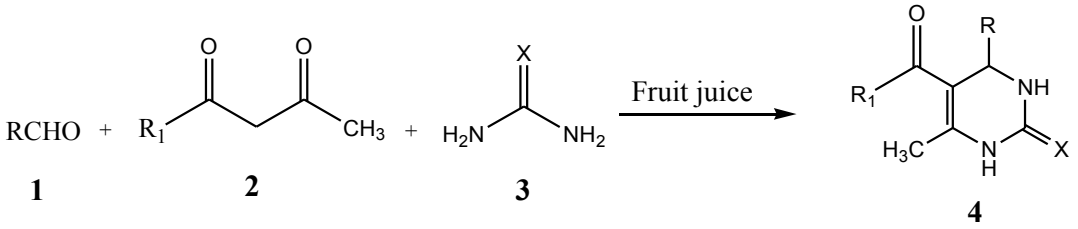
The atom economy of any synthetic strategy is nicely under controlled if instead of multi step reaction, multicomponent[3] reaction is selected. A bio-catalyst[4] is always preferred. Water[5] is always the best solvent in green approach. A reaction always should consume less energy i.e. supported by grinding technique[6], micro-wave[7] or ultrasound[8] irradiation with excellent yield of the product.

This article summarizes use of various fruit juices as a bio-catalyst in number of organic syntheses such as formation of Dihydropyrimidones/Dihydrothipyrimidone,Triazoles through multicomponent reactions (Pineapple/lemon/Tamarind juice),formation of bis, trisindolylmethanes ( grape and tamarind juice), bis di (indolyl) methane (tamarind juice).These protocols are having simple workup procedure with good yield and more over environmentally benign.

**2. Use of various fruit juices as a catalyst in number of organic syntheses**

*2.1: Synthesis of Dihydropyrimidone/Dihydrothiopyrimidone*

Different fruit juices catalyzed synthesis of dihydropyrimidinone and thione (DHPMs) derivatives were reported via Biginelli reaction between substituted aryl aldehydes, ethyl acetoacetate and thiourea/urea just by grinding technique or under ultrasound irradiation at ambient condition. The reaction is depicted in scheme-I

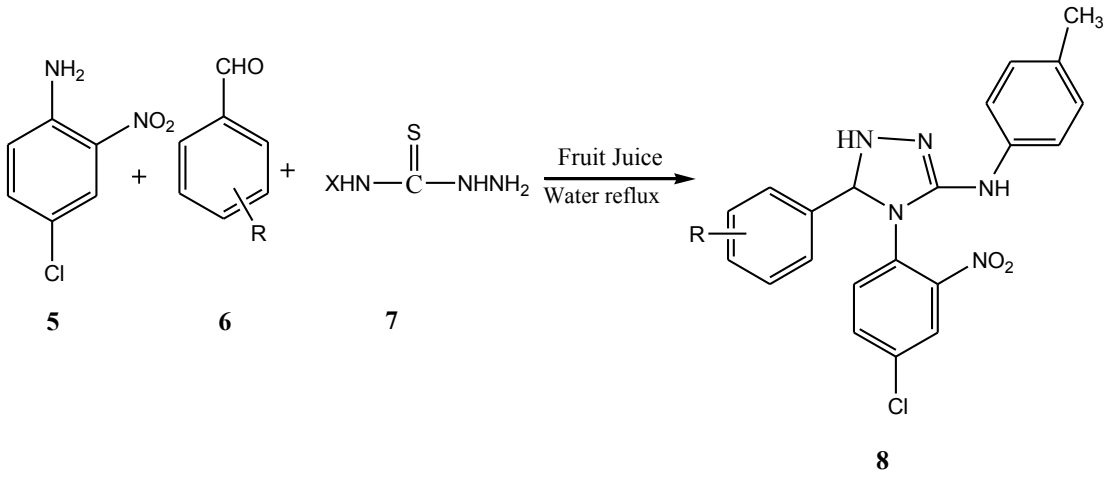



**Scheme I**: Synthesis of dihydropyrimidone/ thione Where, X= S, O.

3,4-Dihydropyrimidin-2(1H)-ones and thiones derivative have attracted increasing interest owing to their therapeutic and pharmaceutical properties[9,10,11] such as antiviral, antibacterial, anti-inflammatory and anti-tumor activities. Patil s et al[12,13] reported this synthesis using lemon juice and pineapple juice as a catalyst. Whereas Nazeruddin et al[14,15] reported the same reaction catalyzed by tamarind juice under ultra sound and Grape juice just by grinding at ambient conditions.

*2.2-Synthesis of Triazole Derivatives*

Sachdeva etal[16] reported synthesis of Triazole derivatives through lemon juice catalyzed reaction of 4-chloro-2-nitro aniline and aromatic aldehydes with thiosemicarbazide in ethanol under reflux (scheme-II)



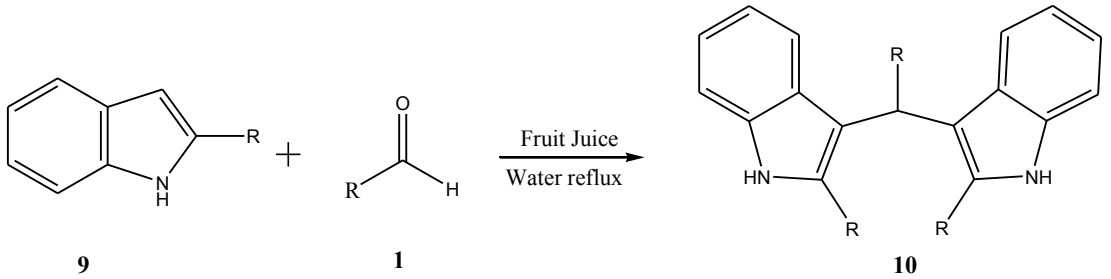

**5** **6** **7** **8**

**Scheme II**: Synthesis of triazole derivatives

The 1,2,4-triazoles and their derivatives are found to be associated with various biological activities such as anticonvulsant[17],antifungal[18], anticancer[19], anti-inflammatory[20], and antibacterial properties[21]

*2.3. Synthesis of bis, trisindolylmethanes (grape and tamarind juice), bis di (indolyl) methane (tamarind juice)*

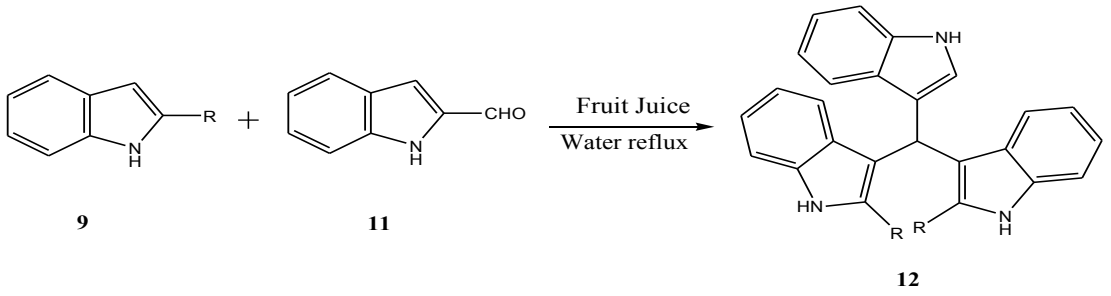
Shaikh, et al[22] reported bis-indolylmethane derivatves by condensing two moles of indole with Aryl aldehydes in presence of grape juice as a catalyst in aqueous medium under reflux.(Scheme-III).




**9** **1** **10**

**Scheme III**: Synthesis of bisindolylmethanes

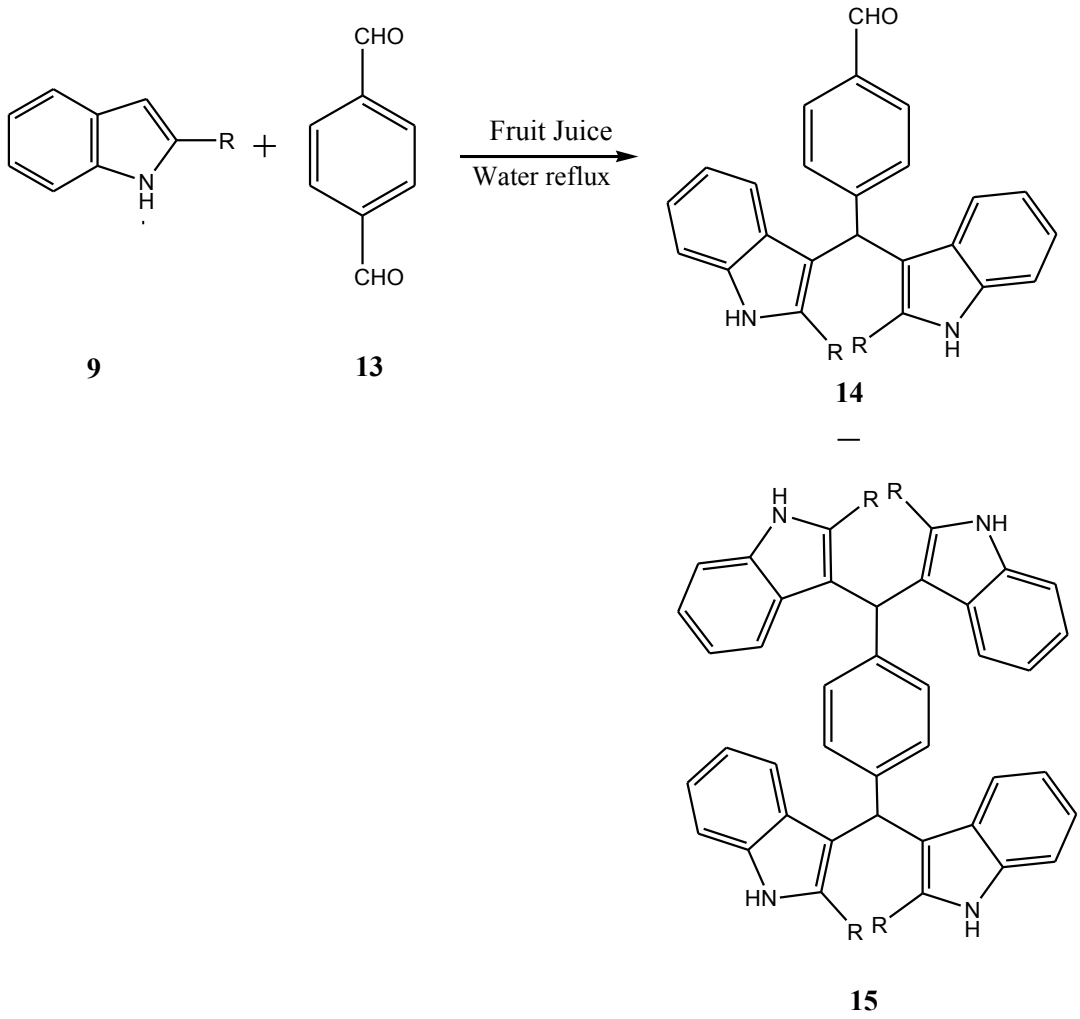
Whereas palco-worker[23,24] reported synthesis of bis, tris and tetra indolylmethanes using lemon and tamarind juice in aqueous medium under reflux(Scheme-IV and V)




**9** **11** **12**

**Scheme IV:** Synthesis of trisindolylmethanes

These derivatives are found to be associated with various biological activities such as anticancer[25], antibacterial properties[26] and anti-inflammatory activity[27].




**9** **13** **14** **15**

**Scheme V:** Synthesis of trisindolylmethanes

## 3. CONCLUSION

We hope that this review will serve to stimulate research in this fascinating and very useful area of organic synthesis and will encourage a research scholar to search application of various fruit juices to use them as a catalyst in aqueous medium for various multicomponent reactions to get the required product in high yield. The authors regret any omissions that may have occurred in this review.

## 4. ACKNOWLEDGMENT

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