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Solanum Xanthocarpum Assisted Benign Synthesis of Benzimidazole

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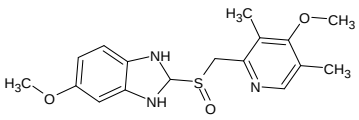
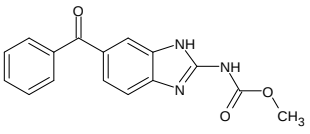
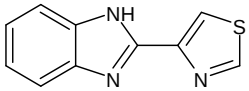
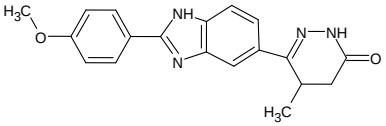
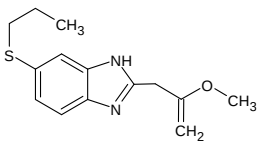
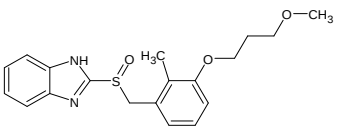
ABSTRACT: Heterocyclic chemistry is major and fascinating branch of chemistry where you have scope to synthesize molecules which will show variety of pharmacological activities. Numerous compounds of heterocyclic molecules were synthesized by researchers and tested for activities and utilised in health care industry to serve the peoples. Among these heterocyclic molecules we in this paper reporting synthesis of benzimidazole using novel catalyst. Catalyst employed here is *Solanum Xanthocarpum* which show exciting results for benzimidazole synthesis. Synthesis show good yield of product without utilising harmful catalyst. Products obtained were established on the basis of standard methods. Method used is benign for environment which applies green chemistry for heterocyclic synthesis.

KEYWORDS: Heterocyclic chemistry, One-pot synthesis, Benzimidazole, Solanum Xanthocarpum, Benign.

INTRODUCTION

Benzimidazole molecule is bicyclic heterocyclic molecule which show various pharmaceutical activities antimicrobial agents [1], antitumor [2], anti-inflammatory [3], antiprotozoal agents [4]. Derivatization of benzimidazole also shows enhanced pharmaceutical activities like 1H benzyl derivative of benzimidazole reported to show anticancer activity [5], anti-diabetic [6], anti-viral and anti-microbial [7], cytotoxic [8], anti-oxidant [9] many more activities like those are reported for benzimidazole and its derivatives.

Most popular derivatives of benzimidazole known and utilized in daily life for medical uses are summarized below with their structure

 Omeprazole (Proton pump inhibitor)	 Mebendazole (Anti-protozoal)
 Thiabendazole (Anti-worm)	 Pimobendan (Calcium sensitizer)
 Albendzole(anthelmintic)	 Rabeprazole (proton pump inhibitor

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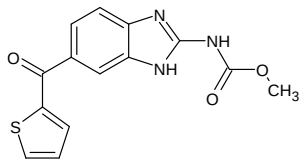
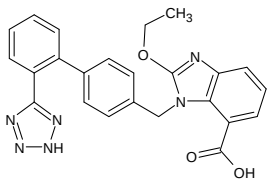
 Nocodazole (anticancer)	 Candesartan(antihypertensive

Above mentioned material evidence that benzimidazole is having large potential to show pharmacological activities which developed interest of researcher to synthesized new derivatives of benzimidazole or to develop the new methodology for its synthesis. To synthesis benzimidazole numerous catalyst where also reported such as silica sulphuric acid [10], CAN [11], $FePO_4$[12], palladium [13], copper catalysts [14], Dowex-50-W [15], $FePO_4$ [16], $FeCl_3.6H_2O$ [17], $In(OTf)_3$ [18], NH_4OAc [19], (bromodimethyl) sulfonium bromide [20], manganese(III) acetate [21], mono and bifunctional solid Catalysts [22], scolecite [23] etc.

Due to demanding nature of heterocyclic particular from benzimidazole containing heterocyclic compounds, researchers focus towards novel method for synthesis of benzimidazole and its derivatives which can gives use good yield and reduce the time costing etc. To achieve the some they deployed various above mentioned catalyst which are most of the times harmful to the environment.

To overcome this problem we herein reporting synthesis of benzimidazole using a plant material which is found in nearby area of Dahanu (Maharashtra) and most of the times waste material considered by the farmers. If we look into the previous references of organic synthesis many of the plant material were utilized as biocatalyst for chemical synthesis and successfully produced material with good yield, short reaction time and impurity free and recyclable also.

Enzymes [24] were utilized for metal organic material synthesis, parsley and dill seed [25] extracts were used for 1,2,4-oxadiazoles synthesis, plant biomass [26] were also used for organic material synthesis many other references also indicates that utilization of plant material and its product can good alternatives for catalyst instead of using regular chemical based organic or inorganic molecules.

EXPERIMENTAL

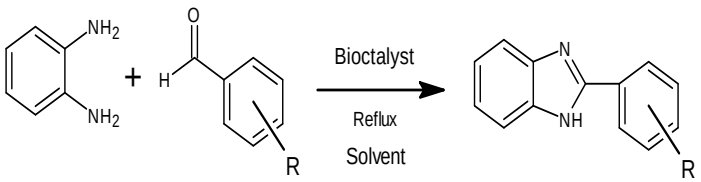


Figure 1. Reaction scheme

MATERIALS AND METHODS

Chemicals o-phenylenediamine, Aldehyde, alcohols are of loba chemie. All the commercially available reagent grade chemicals were used as received. All solvents were reagent grade. The melting point ranges of newly synthesized compounds were determined by open glass capillary tubes.

Synthesis of catalyst

Solanum Xanthocarpum plant material were obtained from local are of Dahanu, Maharashtra. To remove any dust or impurities that might present on the *Solanum Xanthocarpum* leaf material, it was thoroughly cleaned with tap water. Material was then left in the sun to dry for more than 10 hours. Using a mixer dry material was crushed into small pieces and into a powder. The fine-particle powder of *Solanum Xanthocarpum* was prepared through sieving.

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Solanum Xanthocarpum

Powder of *Solanum Xanthocarpum*

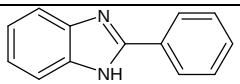
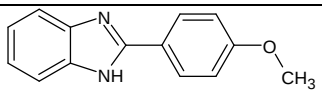
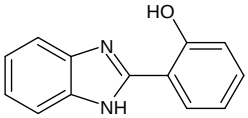
Fig.2 Plant and powder images

Synthesis of benzimidazole

For synthesis of Benzimidazole from aldehydes a solution of o-phenylenediamine (0.01 mol), Aldehyde (0.01 mol) and methanol (5 cm^3) has been mixed with powder catalyst of *Solanum Xanthocarpum* (0.01 g). Reaction mixture was refluxed on water bath for reaction completion to obtain the product. Completion of reaction were monitored using thin layer chromatography technique. After completion of reaction, material from round flask was filtered to separate the catalyst powder from reaction mass in hot condition. Reaction mass then cooled and poured on ice peace to obtain the product. Product washed by water, dried and recrystallized to obtain pure product.

RESULT AND DISCUSSION

Table No. 1 Solvent study and different derivatives of benzimidazole

Sr. No.	Aldehyde	Product	Solvent	Time (min)	Yield (%)
1	R = H		CH_3CN	75	77
			Methanol	82	71
			Ethanol	90	73
2	R = OCH_3		CH_3CN	81	68
			Methanol	92	71
			Ethanol	97	62
3	R = OH		CH_3CN	85	72
			Methanol	89	69
			Ethanol	95	62

m.p.:294-295^{0}c
IR: 3531 (NH), 1438 (C=C), 1560 (C=N).
^{1}HNMR: 5.06 (s, 1H, NH), 7.32 (d, 2H, Ar-H), 7.58-7.51 (m, 3H, Ar-H), 7.62 (d, 2H, Ar-H), 7.78-7.72 (m, 2H, Ar-H).

CONCLUSION

We herein able to synthesize benzimidazole and its derivatives successfully with moderate reaction time and good yields. Use of novel biocatalyst *Solanum Xanthocarpum* optimized reaction conditions and also provided a new greener substitute for traditional organic synthesis of benzimidazole and its derivatives. Benefits of the reported process is the use of gentle reaction conditions, decreased use of harmful chemicals, optimum reaction time and good yield of the products. This reported catalyst has a great potential for further application in synthetic or catalytic reactions.

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