ejpmr, 2016,3(12), 556-558

SJIF Impact Factor 3.628

EUROPEAN JOURNAL OF PHARMACEUTICAL AND MEDICAL RESEARCH

www.ejpmr.com

Review Article

ISSN 2394-3211

EJPMR

ONE-POT SYNTHESIS OF BENZIMIDAZOLES THE PRESENCE OF LEMON JUICE AS A NEW AND EFFICIENT CATALYST

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Article Received on 20/10/2016 **Article Revised on 10/11/2016** **Article Accepted on 30/11/2016**

ABSTRACT

A series of substituted benzimidazoles were prepared through the one-pot reaction of phenylenediamine l with various aldehydes in the presence of lemon juice as catalyst without any solvent. The reactions proceed smoothly in excellent yield, high chemo selectivity and with an easy work-up.

KEYWORDS: Benzimidazole, Benzothiazole, Lemon juice Aldehyde.

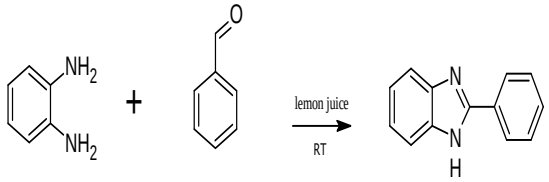
INTRODUCTION

Heteroaromatic ring system is the important part of any biologically active drug molecule. Heteroaromatic rings are essential because have similarity with respect to the biologically active compounds in animal Body which include acids, hormones, neurotransmitters, which constitutes one or the other Heteroaromatic ring. Many Heteroaromatic rings present, fused and pendent benzimidazoles are also different feature of many pharmaceutical products. Heterocyclic compounds possessing two hetero atoms in a ring are of massive biological importance in clinical research field. Heterocyclic compounds possess a cyclic structure with two or more different kinds of atoms in the ring. These type of compounds are very widely distributed in nature very important to life to life, playing a vital role in the metabolism of all living cells e.g. the pyrimidine and purine bases of the genetic material DNA, the essential amino acids alanine valine, isolucines proline, hisitidine, the vitamins and coenzymes etc. There are a large number of pharmacologically active heterocyclic compounds, many of which are in regular clinical use. A wide range of synthetic and naturally occurring heterocyclic compounds find their use in medicine and also as pesticides, agrochemicals, polymers plastic, drugs and dyes are the way for considerable amount of research leading to new heterocyclic molecules having better biological activity. are important as antitumor,[8] antimicrobial agents[9] and LTD4 receptor antagonist.[10] Despite their importance of these heterocyclic moieties from pharmacological, industrial and synthetic points of view, comparatively few methods for the preparation of benzimidazoles and benzothiazoles have been reported. The literature assay shows that the two general methods for the synthesis of benzimidazoles and benzothiazoles are the acidic cyclocondensation of o-phenylenediamine or oaminothiophenol with carboxylic acids or their derivatives and oxidative cyclo-dehydrogenation of o-phenylenediamin or o-aminothiophenol with aldehydes.[11] Various oxidative reagents such as DDQ,[12] NaHSO3(aq),[13] nitrobenzene,[14] MnO2,[15] 1,4-benzoquinone,[16] benzofuroxan,[17] tetracyanoethylene,[18] $Pb(OAc)_4$[19] and Oxone[20] have been employed for the synthesis of benzimidazoles and benzothiazoles. However, a number of these methods have some drawbacks such as low yields, long reaction times, drastic reaction conditions, tedious work-up procedures and co-occurrence of several side reactions. Promoted by the need for finding another new and efficient method for the synthesis of these heterocyclic compounds and in continuations of our previous work,21-25 we became interested in the synthesis of 2-substituted benzimidazoles and benzothiazoles by the condensation of ophenylenediamine and o-aminothiophenol with various aldehydes in the presence of lemon juice as an oxidative catalyst.

Experiment

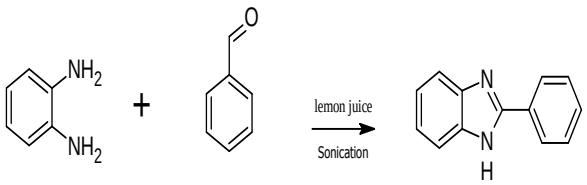
A mixture of o-phenylenediamine (1 mmol), arylaldehyde (1 mmol) and Lemon juice (1 -2ml) were stirred at grind in pristle and mortor. The progress of the reaction was followed by TLC. After the completion of the reaction, water (20 mL) was added. The resulting precipitate was filtered, washed with hot water. These products were pure enough but further purification can be obtained by recrystallization from ethanol. catalyst can be reused for reactions.

Reaction Benzimidazole



Experiment

A mixture of o-phenylenediamine (1 mmol), arylaldehyde (1 mmol) and Lemon juice (1-2 ml) were stirred at room temperature in sonicator. The progress of the reaction was followed by TLC. After the completion of the reaction, water (20 mL) was added. The resulting precipitate was filtered, washed with hot water. These products were pure enough but further purification can be obtained by recrystallization from ethanol. catalyst can be reused for reactions.



Observation Table 1: At Room Temperature in pristle and mortor

Entry I	Aldehyde	Time (min)	Yields	M.P. ^{o}C
1	Benzaldehyde	15	70	287
2	Anisaldehyde	20	67	232
3	4-methyl benzaldehyde	18	91	227
4	4-chlorobezaldehyde	13	93	295
5	4-flurobenzaldehyde	10	94	247
6	3-bromobenzaldehyde	11	98	266
7	Furan-2carbaldehyde	11	97	285
8	Cinnamaldehyde	23	80	199-201
9	3-nitrobanzaldehyde	12	90	309-312

Benzimidazol Phenyl-1H-benzimidazole: paleyellow solid. mp: 293–296ºC; IR (KBr) 3042, 1440, 1403, 1271, 971 cm–1. MS: *m/z* = 193(M+). 1H NMR (300 Hz, DMSO): δ 7.22 (m, 2H), 7.48 (m, 5H), 7.58 (s, IH), 8.04 (d,2H, J = 1.6 Hz).

Table 2: At Room Temperature in Sonicator

Entry I	Aldehyde	Time (min)	Yields	M.P. ^{o}C
1	Benzaldehyde	14	47	288
2	Anisaldehyde	16	48	238
3	4-methyl benzaldehyde	15	60	227
4	4-chlorobezaldehyde	12	80	295
5	4-flurobenzaldehyde	10	85	246
6	3-bromobenzaldehyde	10	86	265
7	Furan-2carbaldehyde	10	85	287
8	Cinnamaldehyde	16	67	199-201
9	3-nitrobanzaldehyde	10	82	309-312

CONCLUSION

lemon juice is a cheap and easily prepared acidic and oxidizing agent has been synthesized according to our previously published method, but its application as an oxidant in the synthesis of 2-arylbenzimidazoles and 2-arylbenzothiazoles has not been studied. In order to study the effect of solvent on the rate and yield of reaction, we performed a set of preliminary experiments on the reaction of o-phenylenediamine The observed results showed that ethanol is the best organic solvent for the reaction. This study shows that lemon juice an efficient oxidant in the synthesis of 2 arylbenzimidazoles and 2-arylbenzothiazoles. 2-Arylbenzimidazoles are obtained by the condensation reaction of 1,2 phenylenediamine with different aromatic aldehydes i at room temperature (Scheme 1). A variety of aromatic aldehydes bearing electron-donating and electron-withdrawing substituents are successfully used to prepare the corresponding benzimidazole derivatives in excellent yields Electron-withdrawing groups on benzaldehyde accelerate the reaction rate in comparison to electron-donating groups which decrease the rate. Substitution ortho position of aldehydes decreases the rate which their reactions were completed in longer times. On the other hand, electron-withdrawing group on o phenylenediamine ring extended the reaction times to 10-50 min. In order to explore an environmentally friendly green.

In summary, lemon juice has been employed as a novel, mild and efficient catalyst and oxidant for the convenient preparation of benzimidazoles in good to excellent yields from the treatment of o-phenylenediamine with various aldehydes, respectively. This method has several advantages like short reaction time, easy and quick work-up and excellent chemo selectivity. Also, by using lemon juiceas catalyst, the mentioned reactions do not need

toxic solvents and do not give environmentally harmful by-products.

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