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Article

Expression of an Up-to-date Model for the Analysis of Amidoalkyl Naphthol Synthesis Methods

Samaneh Mohammad Ebrahimzadeh Sepasgozar[a], Sharareh Mohseni[a*], Babak Feizyzadeh[a], Ali Morsali[b]

[a]*Department of Chemistry, Quchan Branch, Islamic Azad University, Quchan, Iran*
[b]*Department of Chemistry, Mashhad Branch, Islamic Azad University, Mashhad, Iran*

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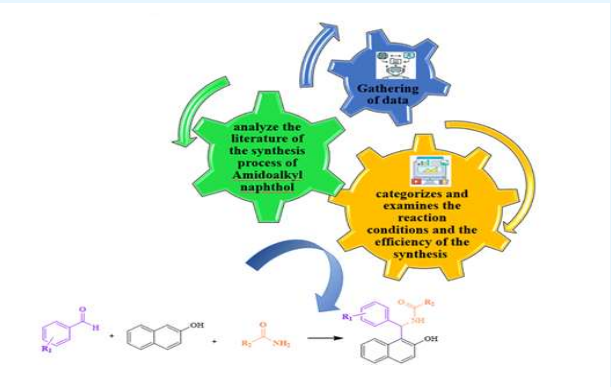
Abstract: This paper tends to present a thorough critical systematic review of the relevant literature on the Synthesis of Amidoalkyl naphthols, including a bibliographic analysis. The paper addresses key questions of what has been learned from a decade of research into the optimal reaction conditions and catalysts used in the Synthesis of Amidoalkyl naphthol literature as well as variables that have been ignored. The systematic search was conducted to develop a valuable specialized dataset of publications focusing on Amidoalkyl naphthol synthesis, including 128 selected studies covering various aspects of the synthesis and identifying various scholars' utilized methods. This paper categorizes and examines the reaction conditions, the catalysts used, and the efficiency of the synthesis in various articles. Then Scopus data is analyzed. In this study, the most critical factors affecting the reaction to the fishbone pattern were identified.



Keywords: Amidoalkyl naphthol, Synthesis, Multicomponent reactions, Microsoft projects, Fishbone pattern

1. INTRODUCTION

Multicomponent reactions (MCRs) are a cost-effective technique to manufacture highly functionalized and complex compounds in one step from simple materials that are easily available in one-pot systems. As a result of synthesizing carbon-carbon or carbon-heteroatom bonds in a single action, a great selectivity, yield, and synthetic simplicity can be observed in MCRs[1]. Multicomponent helps to the demands of an ecologically friendly process by reducing the number of synthetic steps, energy consumption, the number of solvents used (or the use of no solvents), and waste material. The Synthesis of Amidoalkyl naphthols is one such example[2]. For example, synthesis of amidoalkyl naphthols has been developed by using an effective PbS nanocatalyst under solvent-free conditions[2]. In another research eco-friendly reaction via 2-naphthol, aromatic aldehyde, amide, and P_2O_5 as a catalyst has been done for the synthesis of amidoalkyl naphthols[3]. Also, citric acid as a catalyst has been used for the three-component reaction of 2-naphthol, aldehydes, and amides or urea[4].

Because of their pharmacological and agricultural applications, naphthalene derivatives have sparked a lot of attention. The cardiovascular effects of Naphazoline and Pronethalol, for example, have been observed. Plant growth regulators have been identified as 1-naphthaleneacetic acid and 2-naphthaloxyacetic acid. Meanwhile, bactericides and antioxidants have been found for 2-naphthol and its derivatives. Many chiral Amidoalkyl phenols have also been shown to be good chelating agents for metal-catalyzed asymmetric synthesis[5]. Amidoalkyl naphthol derivatives have been the focus of strong interest, because of their promising biological and pharmacological properties such as adrenoceptor blocking, antihypertensive, cardiovascular and Ca^{2+} channel blocking activities, such as antitumor, antibiotics, antianginals, antimalarial, and HIV protease inhibitors. Various reports have been published regarding the preparation of 1-amidoalkyl-2-naphthol derivatives .1-Amidoalkyl-2-naphthols can be converted to aminoalkyl naphthols by an amide hydrolysis reactiona[6-7].

1-Amidoalkyl-2-naphthols are essential chemicals in synthetic organic chemistry because they are used to make a variety of useful compounds. Through amide hydrolysis, several interesting intermediates can be easily transformed into physiologically active 1-aminoalkyl-2-naphthalene derivatives. These substances' hypotensive and bradycardic effects have been studied. Through the Vilsmeier cyclization reaction, Amidoalkyl naphthols can also be used to make highly functionalized oxazine derivatives[8]. Recently, due to rigorous environmental and economic requirements, organic synthesis involving green

techniques and solvent-free circumstances has been intensively researched around the world. Traditional acid methods, on the other hand, are naturally connected with issues such as high toxicity, caustic and polluting chemicals, catalyst waste, and difficulty in product separation and recovery[9]. The synthesis of organic compounds with great efficiency is one of the most important goals in drug development. Furthermore, the processes used in the synthesis of organic compounds should be quick and simple, and the resulting chemicals should be easy to separate and purify. As a result, new procedures and tactics must be implemented for these reasons[10]. Although various catalytic procedures for the preparation of Amidoalkyl naphthol derivatives have been published, the majority of them have encountered difficulties in synthetic chemistry, such as severe reaction conditions, high operating reaction temperatures, and long reaction times with low yields[11]. In the presence of different catalysts, a three-component condensation process of aromatic aldehydes, 2-naphthol, and acetonitrile or amides/carbamates or urea may be utilized to synthesize 1-Amidoalkyl-2-naphthols Synthes[12-13]. As part of our ongoing investigation and analysis of effective synthetic methods, we report a variety of efficient and practical methods for synthesizing 1-Amidoalkyl-2-naphthol derivatives.

2. REVIEW METHOD

Based on an initial review of existing processes in the literature, a set of strings was created to pick the final search criteria. The search term “Amidoalkyl naphthol” was entered into the Scopus database. The search string was selected as “Amidoalkyl naphthol” and was applied to the Scopus database criteria using TITLE-ABS-KEY (“Amidoalkyl naphthol”). We found 128 records. The search was limited to studies published in the last 13 years that investigated catalyst and reaction conditions from 2009 to 2022. The terms “catalyst” and “conditions reaction” was added to the search criteria. Putting the criteria into practice, as a result, a database of Amidoalkyle naphthol conditions of synthesis is being built, comprising records. The search criteria were for using items such as the VOS Viewer and other tools and techniques.

Bibliography and systematic analysis

This section presents the process of a systematic search and analysis using a quantitative approach, including network visualizations and bibliographic features of co-citations. This analysis was used to detect interconnections of the synthesis of Amidoalkyl naphthol literature within a dataset of publications and the citations collected from Scopus. During the search, article selection, and bibliography analysis, the systematic analysis eliminates bias. The outcome of co-authorship analysis utilizing the full counting approach is shown in Figure 1. The co-authorship analysis was also conducted to visualize active groups of authors in the field. Figure 2 depicts the network of co-authors working on the synthesis of the Amidoalkyl naphthol based on the created dataset. The total strength values of co-authorship linkages were determined for all authors, and the strongest link strength was used to visualize Figure 1. Furthermore, different numbers of papers by the same author were chosen for further research. Among the few authors who consistently or regularly contribute to the literature on Amidoalkyl naphthol synthesis are Shaterian, H.R.[9,14-20], Narayanan, D.P.[21-22], Singh, R.[23-27], Nguyen, V. T.[7,28], Moghanian, H.[29-30], and Ghorbani-Choghamarani, A.[31-32], Safari, J.[33-35]. Only a small number of writers frequently co-author in the Synthesis of Amidoalkyl naphthol, though a significant number of scholars are exploring alternative conditions of Synthesis for Amidoalkyl naphthol. This is also limited where the criteria are employed, and the literature focuses on catalysts and reaction conditions that are observed for the Amidoalkyl naphthol synthesis based on the selected database. In this section (Figure 1), we have identified the co-authors. Figure 6 shows the various topics in the authors’ composition, indicating the importance of the themes related to the synthesis of Amidoalkyl Naphthols and the synthesis challenges under optimal conditions. In the areas that are a combination of modern catalysts, challenges in the field of Synthesis of Amidoalkyl naphthol have emerged, which has led to interdisciplinary studies by researchers and elites in the field, leading to collaboration in articles from 2009 to 2022. Figure 2 shows the color coverage of authors who contributed to the field by year, which shows that joint studies between authors have started since 2010 and the need for collaboration has increased, and this shows the various challenges that exist in this area.

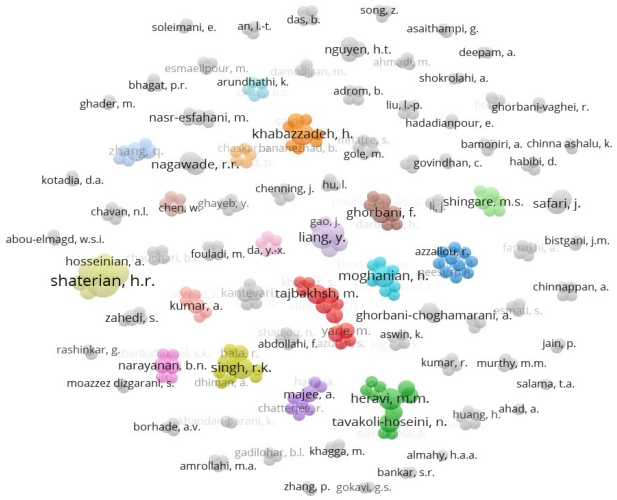


Figure 1. Visualization of the network of co-authors based on a bibliographic dataset including 128 papers.

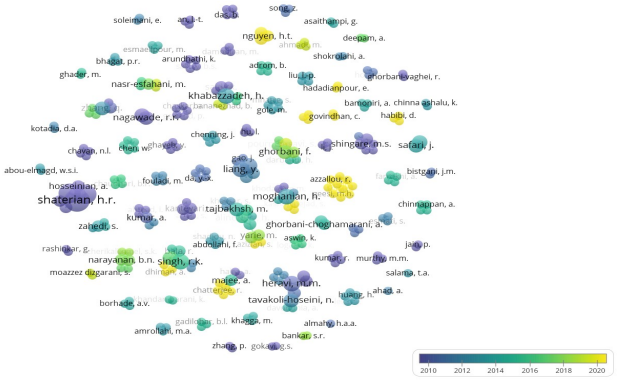


Figure 2. Authors' collaboration on research at different times of the year 2009-2022.

In particular, the set of bibliography shown in Figure 3, shows an overview of the relationship between words and examines the relationship between the Synthesis of Amidoalkyl naphthol and important topics such as catalysts, reaction conditions, and Amidoalkyl naphthol derivatives over different periods. Figure 4 shows the words or concepts used in articles published in the Synthesis of Amidoalkyl naphthol based on their number of repetitions and their occurrence in different years. This diagram shows that Amidoalkyl naphthol is a central concept to which all other concepts in the literature are related. Brighter colors indicate that brightly worded words or concepts have been added to the subject literature in recent years. Although these words are not new, they have been the focus of recent articles. That is, recent articles have moved from general to more detailed and specialized topics. For example, the very bright words (yellow or light green) that have been the subject of articles in recent years regarding: optimal reaction conditions, catalysts used, and green chemistry, which have been discussed in connection with the Synthesis of Amidoalkyl naphthol. These can go further and become more researched areas. These recent words indicate directions for research shortly.

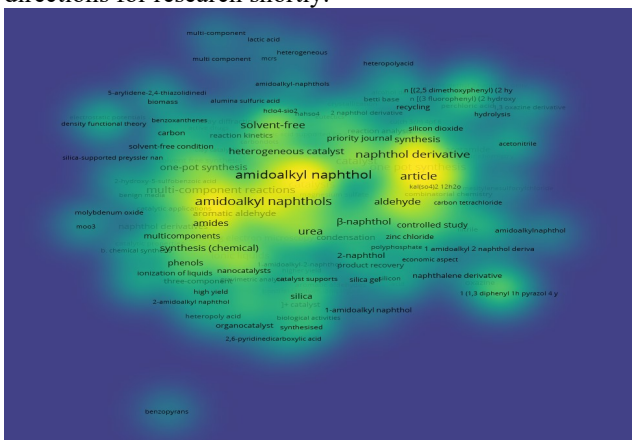


Figure 3. An overview of the relationship between words and a study of the relationship between the Synthesis of Amidoalkyl naphthol with important topics in different periods.

The co-occurrence network of key themes and words based on the selected dataset of publications is shown in Figure 5. The Amidoalkyl naphthol synthesis dataset consisted of 128 publications. According to Figure 5, Amidoalkyl naphthol has the most relationships in the synthesis section with aromatic aldehydes, β-naphthol, acetonitrile or amides or urea, catalysts, and the conditions and reaction of the solvent used. The analysis shows that these links with the field of green chemistry and catalysts have recently increased as the colors are lighter than other keywords.

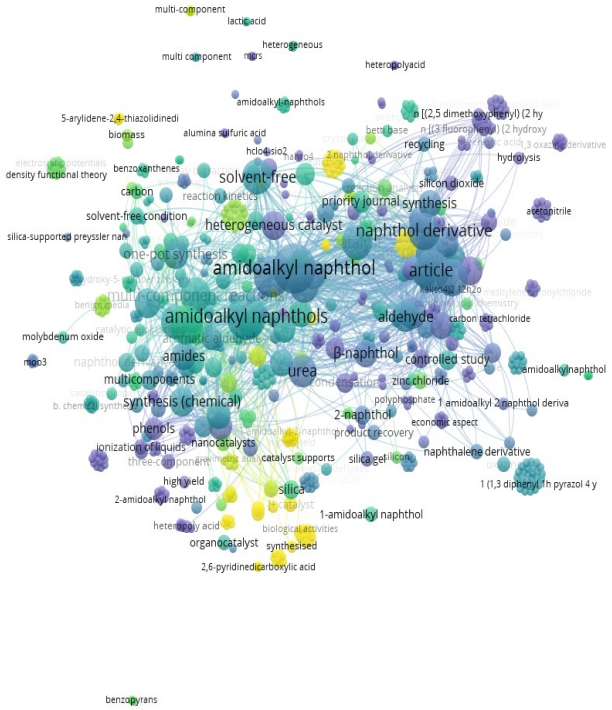


Figure 4. Investigating the time interval of words and the relationship between Synthesis of Amidoalkyl naphthol topics in articles extracted from the Scopus scientific database 2009 to 2022.

Content analysis and reporting of various conditions of amidoalkyl naphthol synthesis

The challenging issue in organic chemistry and the chemical industry is the creation and enhancement of environmentally friendly technology. Reduced waste, as well as renewable feedstock usage, environmentally friendly solvents, reagents, and easily recoverable catalysts, can all be significantly considered for achieving more sustainable approaches based on green chemistry principles[4,36-37].

Researchers are particularly interested in organic reactions that do not require the use of solvents, as well as the employment of chemical and green catalysts. Therefore, we reported some of these multicomponent reaction solvent-free conditions, which are given in Tables 1 and 2. To determine various conditions in this

field, we looked at publications over the previous ten years. The content of the synthesis conditions dataset is examined in this part, which looks at catalyst, temperature, time, and yield. Table 1 shows the conditions for manufacturing amidoalkyl naphthol from β-naphthol, benzaldehyde, and benzamide. The conditions for producing amidoalkyl naphthol from β-naphthol, benzaldehyde, and acetamide are listed in Table 2. The schematic of 1-amidoalkyl-2-naphthols synthesis is given in Scheme 1.

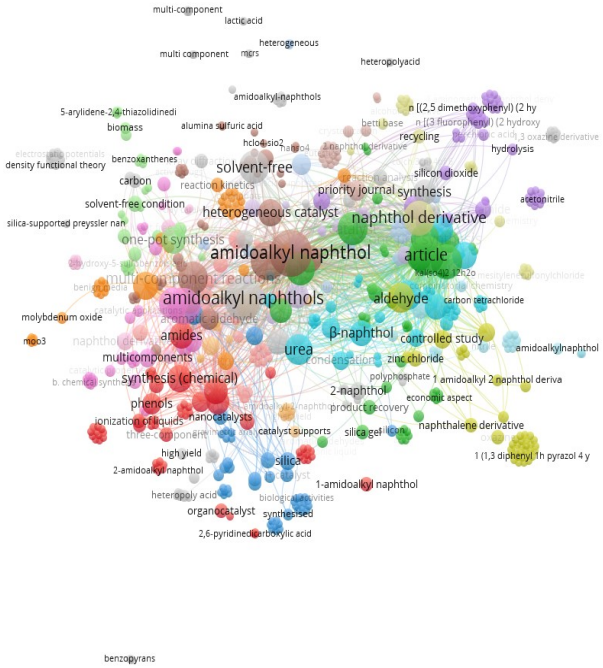
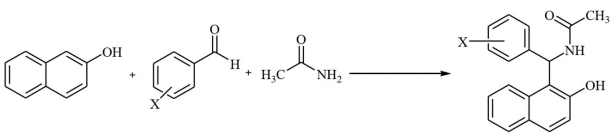


Figure 5. Visualisation of co-occurrence network analysis of themes and relevant keywords created based on the dataset.



Scheme 1. Three-component synthesis of amidoalkyl naphthol derivatives

Factors affecting the synthesis of derivatives Amidoalkyl Naphthol with the fishbone pattern

In the synthesis of organic molecules, multicomponent reactions have gotten a lot of attention. Various factors affect the optimal synthesis of hybrids. But economic and environmental considerations have also been considered by researchers. These factors include energy considerations, green warnings, the reduction of polluting and corrosive wastes, the reduction of toxicity and complications related to product separation and recovery, achieving effective catalyst control, product purification, and waste generation[9]. It has been presented with the fishbone pattern (Figure 6).

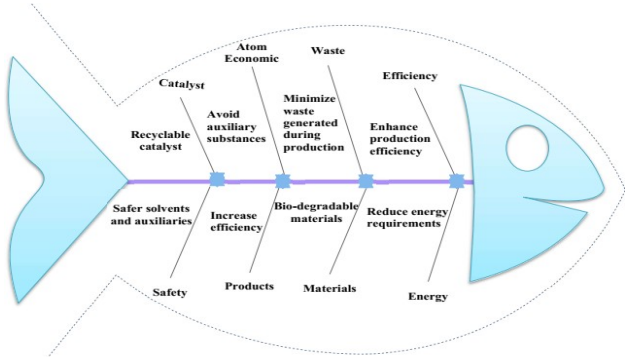


Figure 6. Factors affecting the synthesis of derivatives Amidoalkyl Naphthol with the fishbone pattern.

Table 1. Different catalysts and conditions for the reaction of β-naphthol, benzaldehyde, and benzamide

Entry	Catalyst	Condition solvent/T C	Time	Yield%	Ref.
1	37% nano-$BF_3.SiO_2$	S.F./80	50 min	95	38
2	PTA, $H_3PW_{12}O_{40}.XH_2O$ 10%	S.F./120	6 min	96	21
3	$ZrOCl_2.8H_2O$ (2 mol%)	S.F./80	30 min	94	39
4	Cobalt(II) chloride (30 mol%)	S.F./120	1 min	99	12
5	Sulfamic acid-functionalized magnetic nanoparticles	S.F./80	3 min	88	40
6	$Cu(NO_3)_2.3H_2O$	CH_3CN/90	4 h	92	41
7	MWCNTs@SiO_2/SO_3H	S.F./100	15 min	90	42
8	magnetic nanoparticle-immobilized ionic liquid (IL@MNP) (1.5 mol%)	--/30	18 min	92	43
9	Nano-S-Catalyzed	S.F./50	30 min	95	44
10	Silica chloride	ultrasound	9 min	98	45
11	Chloroacetic acid (20 mol%)	S.F./Oil bath	18 min	80	46
12	Graphene oxide (35 wt%)	S.F./120	20 min	88	47
13	Reduced graphene oxide/$CoFe_2O_4$@Cu(II) (0.03 g)	S.F./100	30 min	90	48
14	Silica gel supported –SO_3H functionalized benzimidazolium	-/100	7 min	82	49
15	Graphite-Supported Perchloric acid	S.F./125	2 h	87	50
16	β-Cyclodextrin-monosulphonic acid	S.F./80	10 min	94	51
17	$NiFe_2O_4$@SiO_2– polyphosphoric acid	S.F./120	5 min	92	52
18	Sulfanilic acid-functionalized silica-coated nano-Fe_3O_4 particles	S.F./120	25 min	90	29
19	Sulphonated coconut shell char	S.F./125	3 min	98	21
20	Mesoporous silica nanoparticles (MSNs-HPZ-SO_3H)	S.F./120	95 min	84	53
21	Oxalic acid (10 mol%)	S.F./125	8 min	96	54
22	Citric acid (10 mol%)	S.F./120	10 min	90	3
23	Activated Fuller's earth	S.F./110	10 min	93	55
24	Fe_3O_4 nanoparticles (MNPs-SO_3H)	S.F./100	10 min	82	33
25	Tannic acid (0.03 mmol)	oil-bath	11 min	82	46
26	$Ba_3(PO_4)_2$ (0.083 mmol)	S.F./100	75 min	86	56

Table 2. Different catalysts and conditions for the reaction of β-naphthol, benzaldehyde, and acetamide

Entry	Catalyst	Condition solvent/T C	Time	Yield%	Ref.
1	37% nano-$BF_3.SiO_2$	S.F./80	55 min	98	38
2	PTA, $H_3PW_{12}O_{40}.XH_2O$ 10%	S.F./120	8 min	91	21
3	$ZrOCl_2.8H_2O$ (2 mol%)	S.F./80	30 min	96	39
4	magnetic phosphonium ionic liquid	S.F./45	10 min	93	11
5	Cobalt (II) chloride (30 mol%)	S.F./120	3 min	85	12
6	$KHSO_4$	S.F./100	1 h	90	57
7	Sulfamic acid-functionalized magnetic nanoparticles	S.F./80	5 min	90	40
8	$Cu(NO_3)_2.3H_2O$	CH_3CN/90	4 h	92	41
9	MWCNTs@SiO_2/SO_3H	S.F./100	15 min	93	42
10	Magnetic nanoparticle-supported acidic ionic liquid	S.F./90	10 min	91	58
11	Magnetic nanoparticle-immobilized ionic liquid (IL@MNP) (1.5 mol%)	-/30	17 min	93	43
12	Nano-S-Catalyzed	S.F./50	30 min	95	44
13	Silica chloride	ultrasound	9 min	95	45
14	Graphene oxide-SiC_3-NH_3-$H_3PW_{12}O_{40}$ (0.03 g)	EtOH/Reflux	20 min	88	59
15	Chloroacetic acid (20 mol%)	S.F./Oil bath	15 min	92	46
16	Melamine-Br_3	S.F./130	150 min	95	31
17	Graphene oxide (35 wt%)	S.F./120	20 min	90	47
18	Nano-Al_2O_3 (68.7 mol%)	S.F./110	15 min	94	60
19	Reduced graphene oxide/$CoFe_2O_4$@Cu(II) (0.03 g)	S.F./100	35 min	90	48
20	Silica gel supported –SO_3H functionalized benzimidazolium	-/100	7 min	90	49
21	Graphite-supported perchloric acid	S.F./125	2 h	81	50
22	β-Cyclodextrin-monosulphonic acid	S.F./80	20 min	76	51
23	$NiFe_2O_4$@SiO_2– polyphosphoric acid	S.F./120	7 min	86	52
24	Zeolite H-BEA	S.F./120	5-7 min	85	61
25	Sulfanilic acid-functionalized silica-coated nano-Fe_3O_4 particles	S.F./120	40 min	94	29
26	Nano-Fe_3O_4 (0.1 g)	ultrasound acetic acid /80	70 min	95	62
27	Sulphonated coconut shell char	S.F./125	18 min	93	21
28	Mesoporous silica nanoparticles (MSNs-HPZ-SO_3H)	S.F./120	60 min	94	53
29	Oxalic acid (10 mol%)	S.F./125	8 min	96	54
30	Citric acid (10 mol%)	S.F./120	40 min	87	3
31	Activated Fuller's earth	S.F./110	10 min	95	55
32	Fe_3O_4 nanoparticles (MNPs-SO_3H)	S.F./100	10 min	93	33
33	Tannic acid (0.03 mmol)	oil-bath	11 min	83	46
34	$Ba_3(PO_4)_2$ (0.083 mmol)	S.F./100	45 min	87	56

4. CONCLUSION

This paper aimed to examine the condition of synthesis of Amidoalkyl Naphthol via a critical systematic review of the literature. The content of the synthesis Amidoalkyl naphthol dataset was critically reviewed. The paper also analyzed the relevant literature using a bibliographic and network analysis, and key factors are presented by a fishbone pattern. This study, which was meticulously carried out, had systematic content. The findings reveal several key aspects and deficient areas that should be addressed in future research. The factors include biodegradability minimizing waste generated during production, and special attention to green chemistry principles. This paper is the first in the field which review all the relevant papers in the field. This paper contributes to the body of knowledge by reviewing and comparing various catalysts and conditions for the reaction of β-naphthol, benzaldehyde, acetamide, and benzamide. The paper discussed that various catalytic procedures for preparing Amidoalkyl naphthol derivatives have been previously published, where the majority of them have encountered difficulties in synthetic processes such as severe reaction conditions, high operating reaction temperatures, and long reaction times with low yields. The outcome of the analysis is useful to the scholars and experts in the file.

LIST OF ABBREVIATIONS

S.F Solvent free

PTA Phosphotungstic acid

MWCNTs Multiwalled carbon nanotubes

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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AUTHOR INFORMATION

Corresponding Author

Sharareh Mohseni: Email: sh.mohseni@iauq.ac.ir, *ORCID: 0000-0001-6348-1313*

Author(s)

Samaneh Mohammad Ebrahimzadeh Sepasgozar, Babak Feizyzadeh, Ali Morsali

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