International Journal of Research in Engineering and Innovation (IJREI)
journal home page: http://www.ijrei.com
ISSN (Online): 2456-6934

ORIGINAL ARTICLE

Local chemical compounds: synthesis and characterization with antibiotic application

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Article Information

Received: 08 December 2023
Revised: 27 January 2024
Accepted: 08 February 2024
Available online: 18 February 2024

Keywords:

α-amino nitrile
Strecker reaction
Pleurotus

Abstract

In this work, the main idea was to introduce toxic cyanide compounds, convert them through a chemical reaction into non-toxic compounds, and apply them as growing media in farms to grow mushrooms. Pathogen resistance to traditional antibiotics is becoming a public health issue, necessitating the search for new, effective remedies. α-amino-nitrile ligands are a paramount medium in chemical reactions. The reaction of aromatic aldehydes substituted with various groups and secondary amines (diphenylamine) in the presence of potassium cyanide salt has produced novel organic compounds. Biological contamination went down when three different concentrations (0.015, 0.02, and 0.03) g/L were added to potato dextrose agar (PDA) medium. This didn't hurt the prepared farm and cut the time it took to sterilize from 30 minutes to 10 minutes. IR, 1H-NMR, and melting points characterized the structures of synthesized ligands.

1. Introduction

α-amino nitriles are useful intermediate compounds for the synthesis of different chemical reactions. Adolph Strecker first discovered. The α-amino nitrile reaction in the mid-eighteenth century (1850). They have been prepared by three-component coupling (amine, aldehyde, or ketone in the presence of cyanide). This classic synthesis was known as the Strecker reaction [1]. The Strecker reaction is a highly straightforward and effective method for generating a-amino nitriles, which are valuable building blocks for synthesizing heterocyclic compounds [2], amino acids [3], diamines [4], and amides [5]. In addition to its various biological applications [6–10], researchers were very interested in this preparation as they looked for additional synthesis techniques using different chemicals [11–14]. Some of the problems with these methods are that they are hard to set up, take a long time to react, use toxic catalysts, and need an inert atmosphere. Therefore, we are still working to come up with new organic transformations. We have successfully displayed a straightforward, highly effective, and pragmatic technique for producing α-amino nitriles. This method combines secondary amine, carbonyl, and cyanide in a one-pot, three-component coupling process. With the catalyst, p-toluene sulfonic acid was added in very

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https://doi.org/10.36037/IJREI.2024.8201

small quantities to the mixture and lengthy reaction times. This method showed ease of preparation and simple conditions for conducting the reaction, in addition to a good amount of product with high purity.

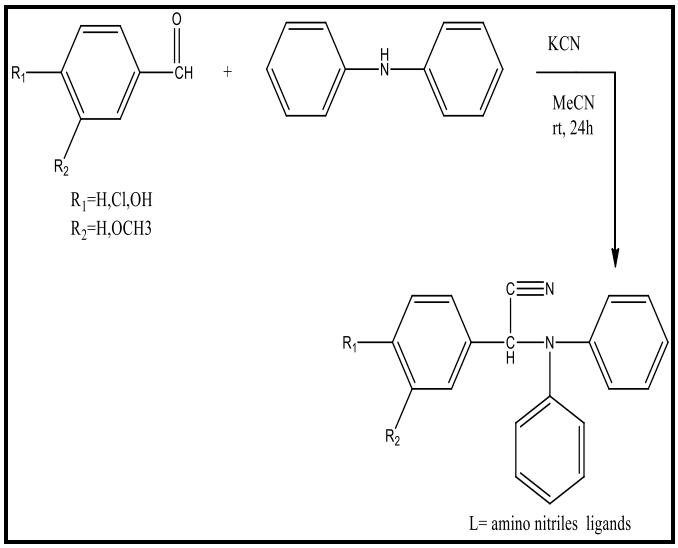
2. Experimental

2.1 Materials and Instruments

All chemicals have been purchased from Fluka and Aldrich companies—melting points via hot-stage Gallenkamp. The spectra were determined using a Broker (FT-IR) and proton-nuclear magnetic resonance recorded at Isfahan University of Technology, Iran, using a Bruker spectrophotometer at 400 MHz and DMSO-d6 as solvent.

2.2 Synthesis of α- amino nitriles ligands

Add 10 mmol of aldehyde derivatives to 13 mmol of diphenylamine, dissolve the mixture in acetonitrile (15 mL), and keep stirring for half an hour. Then, KCN (15 mmol) was added to the round-bottom flask. The resulting mixture was stirred for one day. The precipitate of aminonitrile was then washed with water, filtered, and dried. The product was recrystallized from ethanol to give the final product ligands [15] (L1–L3). The existence of a nitrile group was determined by treating a tiny concentration of alpha-aminonitrile with a 10% NaOH solution, and ammonia liberation was determined using wet red litmus paper [16].



Scheme (1): Synthesis of α-amino nitriles ligands.

Table 1: Physicochemical properties of synthesized derivatives

No.	Formula weight	M. wt (g mole^{-1})	Color	Melting point	Yield %
L_1	$C_{20}H_{15}ClN_2$	318	White	220-225	88
L_2	$C_{21}H_{18}N_2O_2$	330	Green	240-245	95
L_3	$C_{20}H_{16}N_2$	284	Orange pale	255-260	80

2.3 Biological Activity

We report in this study the biological efficacy of using a PDA medium to study the mycelium growth of Pleurotus fungus in the control plate by adding three concentrations of prepared ligands (0.015, 0.02, and 0.03) g/L. Good results were observed with the mycelium growth as the plates were fully colonized [4, 5]. In addition to the absence of biological contamination during mycelium growth and sterilization, time was reduced from 30 to 10 minutes.

3. Results and Discussion

Our study aims to find a new, effective way to make α-amino nitriles using secondary amines and see if it can treat certain fungi (Pleurotus fungi). The results were very good with all the prepared compounds (L1-L3), and using a PDA medium containing potato extract is a good nitrogen source for fungus because it contains a mixture of different proteins. The three essential points have been identified after incubating the prepared compounds in patri plates for seven days at 25 °C. The first one is that the patriotic plates were fully colonized. The second one is the absence of any unwanted biological contamination. The last point is that the sterilization time was reduced to 10 minutes.

3.1 Spectral data of the synthesized α-amino nitriles ligands (L1-L3)

3.1.1 IR spectra

To study the spectrum of the prepared compounds, a comparison was made to the peaks of the compounds that were used in the preparation, as they had distinct groups, such as the secondary amine (-NH) group, which appeared in different areas of the spectrum between 3200 and 3400 cm-1, and the carbonyl group of aldehyde, which occurred at 1650 and 1700 cm-1. These groups disappeared entirely after the interaction, and a new peak between 2100 and 2250 cm-1 emerged due to the nitrile group. This is evidence of the success of the interaction, and in addition to, aromatic and aliphatic peaks *ν(*C-H) for all the synthesized ligands occurred at 2900–3100 cm-1 [17].

3.1.2 1H-NMR spectra

All the prepared organic compounds in Figs. 1–3 participated in the characteristic reaction; the C-H of the aliphatic group appeared at 5 and 5.8 ppm, while the C-H of the aromatic group appeared at 9–7.5 ppm as a multiple. The second ligand was distinguished by an OH group, which appears at approximately 11 ppm. In addition to that, OCH3 appeared as a singlet around 3.5 ppm [18, 19].

3.2 Biological study

Resistance of antibiotic is a common public health issue as infections become more resistant to treatment. The Pleurotus fungus contains Pleuromutilin compounds that function as antibiotics against bacteria that cause disease by inhibiting protein synthesis by binding to the peptidyl transferase in bacteria. Antibiotic resistance can arise through a variety of methods, including changes to an antibiotic's target site or metabolic pathway, reduced drug accumulation in a cell, or inactivation. As a result, a new method is required, and the development of effective antibacterial materials is urgently required. Mycelium growth of pleurotus fungi on secondary amine derivatives has proved to be good for mycelium growth of pleurotus fungi, as the plates were fully colonized [20].

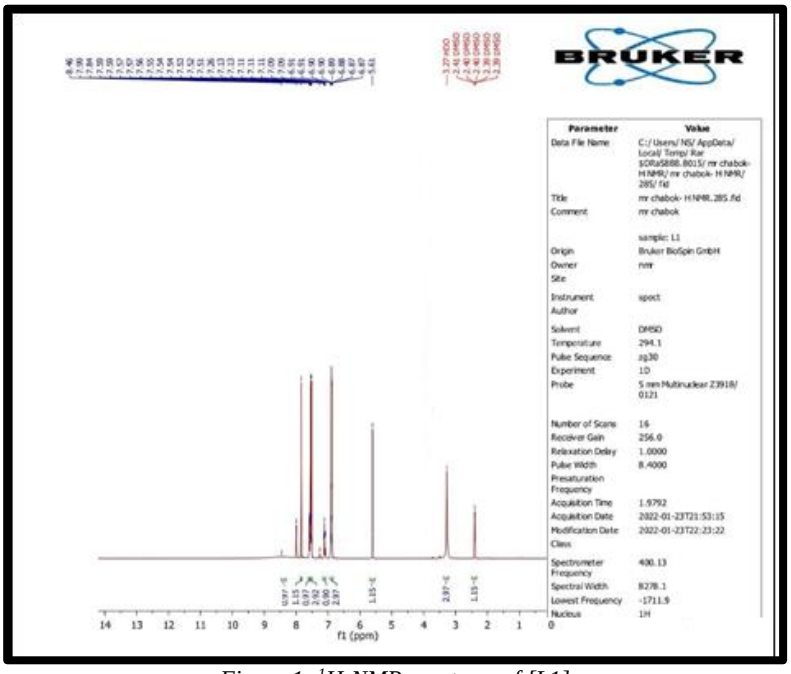


Figure 1: ^{1}H-NMR spectrum of [L1]

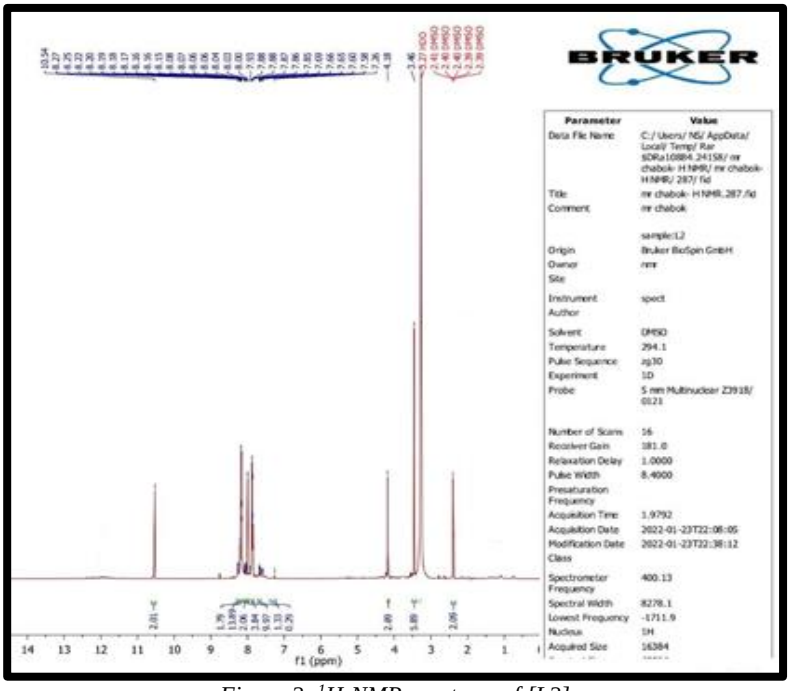


Figure 2: ^{1}H-NMR spectrum of [L2]

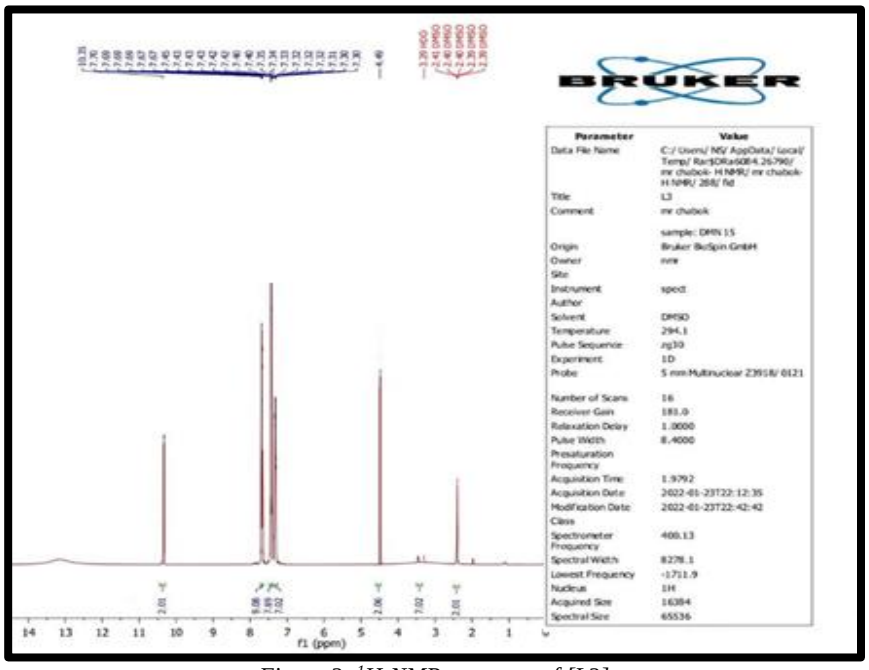


Figure 3: ^{1}H-NMR spectrum of [L3]

In addition to the absence of biological contamination during mycelium growth, sterilization time was reduced from 30 minutes to 10 minutes, which gave promising results in the future for the preparation and application of such compounds [21].

Figure 4: Mycelium growth in patri plates before the addition of (L1-L2-L3) ligands

4. Conclusions

In conclusion, we have shown that the Strecker reaction is a straightforward, effective, and helpful way to make alpha-aminonitriles. Three ligands were made using this method. Biological activity was tested against Pleurotus fungi by using PDA as a medium. Good results were shown, as Petri plates were fully colonized without biological contamination. The method is easy and simple, does not require difficult preparation conditions, and produces a product of high purity and excellent quantity.

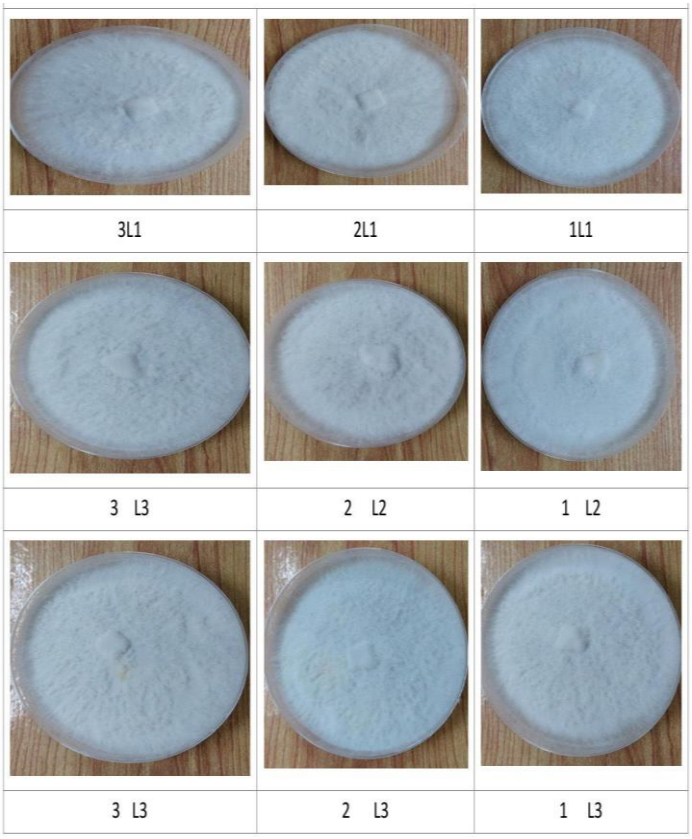


Figure 5: Mycelium growth in patri plates with (L1-L2-L3) ligands.

Acknowledgements

Authors are thankful to support received for this project to the Department of Chemistry, College of Sciences Forensic DNA Research and Training Center Al-Nahrain University.

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***Cite this article as*:** Asmaa A. Jawad, Zaid H. Mahmoud, Rukaibaa Ali Chechan, Abbas Khudhair Abbas, Haider K. Hussein, Randa Mohammed, Nadhum Hussen Safir, Local chemical compounds: synthesis and characterization with antibiotic application, International Journal of Research in Engineering and Innovation Vol-8, Issue-2 (2024), 47-51.
https://doi.org/10.36037/IJREI.2024.8201.