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Impact of Y_2O_3 and Sm_2O_3 doping on the radiation shielding properties of lead-borate glasses

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ABSTRACT

This study examined the radiation shielding efficacy of the PbO_2-BaO-CaO-B_2O_3-Y_2O_3-Sm_2O_3 glass system. Four glass composites were synthesized, designated as YSm0.25 (10 % PbO_2, 0.25 % Y_2O_3, 0.25 % Sm_2O_3 and 59.5 % B_2O_3), YSm0.5 (13 % PbO_2, 0.5 % Y_2O_3, 0.5 % Sm_2O_3 and 56 % B_2O_3), YSm0.75 (16 % PbO_2, 0.75 % Y_2O_3, 0.75 % Sm_2O_3 and 52.5 % B_2O_3), and YSm1 (19 % PbO_2, 1 % Y_2O_3, 1 % Sm_2O_3 and 49 % B_2O_3). The gamma-ray attenuation properties were evaluated experimentally utilizing a narrow-beam transmission setup with standard sealed isotopes ^{133}Ba, ^{137}Cs, ^{22}Na and ^{60}Co (356–1332 keV) with a 2" × 2″ NaI(Tl) scintillation detector. The experimental mass attenuation coefficients (G_{MAC}) were compared with theoretical estimates of these parameters from Phy-X/PSD and good agreement of the experimental G_{MAC} was evident with deviations of <6 %. The results indicated the higher concentrations of PbO_2, Y_2O_3 and Sm_2O_3 increased the density which improved the overall shielding efficiency. The G_{MAC} decreased as the photon energy increased, which aligned with the known energy dependence of gamma interactions. For the most shielded glass composition (YSm1), the half-value layer (HVL) at 662 keV was 1.88 cm which was considerably lower for the other samples. The radiation protection efficiency (G_{RPE}) values at a thickness of 1 cm decreased with energy from 42.62 to 48.78 % at 356 keV from samples and 16.64–20.52 % at 1332 keV. YSm1 displayed the highest attenuation capability, the lower mean free path, and transmission factor at all energies investigated.

1. Introduction

Radiation shielding is an important part of nuclear safety, medical physics, space science, and industrial radiography. The primary purpose of radiation shielding is to reduce or attenuate, the intensity of ionizing radiation to adequately protect people, equipment, and the environment. Ionizing radiation, including neutron radiation, X-ray and gamma radiation, has enough energy to break apart molecules and atoms. The appropriate shielding members must be designed for radiotherapy units, nuclear reactors, imaging systems, and radioactive waste (Boukhris et al., 2021; EL Azzaoui et al., 2025; Mhareb et al., 2020; Rasul et al., 2025; Yorulmaz et al., 2024).

It is important to know the types of ionizing radiation in selecting shielding materials. Alpha and beta particles are easily stopped by, respectively, paper (alpha particles) or a thin layer of metal (beta particles). Gamma rays and neutrons penetrate materials - and so, specifically, they would require therefore denser materials to attenuate it. Since gamma rays are electromagnetic waves, they are difficult for other wave forms as they penetrate much deeper than particles. Materials are thus needed with a high atomic number (Z) and high density to provide effective shielding (Dong et al., 2022; Hamad et al., 2021; Kabamakli et al., 2025; Yesmin et al., 2017).

For many years lead (Pb) has served as the shielding material of choice for X-ray and gamma-ray radiation due to its high atomic number

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Full-length article

Influence of rare-earth Nd_2O_3 on the optical performance and radiation protection efficiency of TeO_2-based glasses

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Keywords: Tellurite–borate glass, Rare-earth doping, Optical properties, Uv–vis spectroscopy, Radiation protection materials

The TeO_2-B_2O_3-BaO–Nd_2O_3 series of glasses was synthesized by the melt-quenching method at 1100 °C. Then, a systematic study of these glasses was carried out to determine their optical and gamma-radiation shielding performance. The optical transmission of the glass evaluated using UV– Vis absorption spectroscopy showed significant absorption of UV light within a range of approximately 340 nm - 370 nm, and many Nd^{3+} *f*-f transitions were noted at various wavelengths between 400 nm - 900 nm (except 431 nm, 475 nm, 514 nm, 586 nm, 683 nm, 748 nm, and 805 nm). Doping of Nd^{3+} ions confirmed that rare-earth ions were incorporated without phase separation. In terms of optical characteristics, increased optical basicity (from 1.248 to 1.259) and decreased optical electronegativity (from 0.903 to 0.882) were observed as the Nd_2O_3 concentration increased, indicating increased electron-donating ability and polarizability of the glass network. An evaluation of the gamma-ray shielding features of the prepared glasses at 0.015–15 MeV was performed using the Phy-X/PSD software. The

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Enhanced optoelectronic properties of single-walled carbon nanotubes via functionalization with pyridine-based Y-shaped chromophores

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Two-photon absorption
Z-scan
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ABSTRACT

In this investigation, we undertook the surface modification of single-wall carbon nanotubes (SWCNTs) utilizing various Y-shaped chromophores derived from pyridine. The structural properties of the chromophores, along with the functionalization of the SWCNTs, were substantiated through spectral and analytical methodologies. The functionalized SWCNTs (denoted as P1 and P2) exhibited enhancements in zeta potential and demonstrated low polydispersity indices (PDI), in addition to showcasing remarkable photophysical and thermal attributes. The nonlinear optical (NLO) characteristics and optical limiting behaviours of SWCNT, SWCNT-P1, and SWCNT-P2 were assessed by employing the Z scanning technique, utilizing a nanosecond laser pulse with an excitation wavelength of 532 nm. Open-aperture measurements revealed that the two-photon absorption coefficients for all samples are in the order of 10^{-10} m/W. The onset optical limiting behaviour observed is ascribed to two-photon absorption phenomena, with a notably low initiation threshold of 10^{12} W/m^2. Among the compounds examined, SWCNT-P2 exhibited the most pronounced nonlinear absorption coefficient of 1.46×10^{-10} m/W alongside the minimal onset optical limiting threshold of 1.65×10^{12} W/m^2. Theoretical calculations and detailed characterizations of the optical, thermal, and morphological properties confirmed the efficacy of the functionalization. The findings underscore the enhanced performance of chromophore-functionalized SWCNTs for NLO applications, highlighting their potential in photonics and optoelectronics for protecting optical sensors and devices from intense laser radiation.

1. Introduction

In contemporary research, the synthesis of materials exhibiting optoelectronic characteristics has become indispensable for the progression of photonics, optoelectronics, and optical limiting technologies. In this context, the role of nanoparticles has been extensively investigated, with single-walled carbon nanotubes (SWCNTs) standing out due to their remarkable electronic and thermal properties [1–3]. These attributes render them highly applicable across a diverse array of applications, ranging from optoelectronic devices to energy storage systems [4,5]. The primary limitation associated with SWCNTs is their propensity for aggregation, poor dispersion in conventional solvents, and the challenges involved in controlling their surface interactions. To address this issue and fully harness the potential of SWCNTs, the functionalization techniques are considered optimal, particularly when organic chromophores are covalently bonded to their surface, resulting in enhanced solubility and tunable optical properties [6,7].

Chromophores based on pyridine and pyrimidine that exhibit donor-π-acceptor characteristics, in conjunction with strong electron-withdrawing groups, serve as electron-deficient sites. The interaction between these sites and electron-rich groups such as SWCNTs fosters substantial interactions between them [8,9]. The robust π-conjugated system within the chromophores manifests both linear and nonlinear optical (NLO) behaviours. The Y-shaped configuration facilitates multiple points of attachment to SWCNTs, which contributes to increased stability, improved dispersion, and enhanced photophysical and electrical properties through the interactions between the covalently bound chromophores and SWCNTs [10]. Multi-walled carbon nanotubes

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Y-shape pyridine-based D-π-A chromophores for improved nonlinear optical properties and optical limiting in polyurethanes

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ABSTRACT

In this work, we have synthesized Y-shape D-π-A conjugated chromophores namely 4,4′-(4-(4-nitrophenyl)-pyridine-2,6-diyl)-diphenol (VL) and 4,4′-(4-(2,4-dinitrophenyl)-pyridine-2,6-diyl)-diphenol (VM) and polymerized with 1,4-diisocyanatobenzene and 2,4-diisocyanato-1-methylbenzene to get four different polyurethanes. The structural characterization of chromophores and polymers were confirmed through various spectroscopic and analytical techniques such as FTIR, NMR, LCMS and MALDI-TOF. The dipole moment and energy bandgap between HOMO and LUMO of the optimized chromophores were theoretically calculated using DFT method. These polymers showed high glass transition temperatures ranging from 259 °C to 390 °C. The nonlinear optical properties of these polymers were measured by using open-aperture Z-scan (Nd:YAG) at wavelength of 532 nm and a laser pulse of 9 ns. The polymers exhibited reverse saturable absorption due to two-photon absorption process. Among these polymers, VM2 showed the highest nonlinear absorption coefficient of 11.89 $\times 10^{-11}$ m/W and lowest optical limiting threshold of 0.43 $\times 10^{12}$ W/m^2. The developed polymers were found be a suitable candidate for optical limiting applications.

1. Introduction

Nonlinear optics (NLO) has become a very intensive domain in research due to its potential respond to high intensity light, which leads to phenomena such as frequency doubling and optical limiting [1–3]. Over the past decades, the research on NLO active materials has increased continuously because of their significance application in optical switching, optical limiting, data-storage, optical communication, dynamic holographic, harmonic generator etc. [4,5]. Although many applications, there are number of issues addressed before they commercialize [6,7], such as, high dipole moment, planar in structure, nonlinearity and very low optical loss [1]. Two photon absorption (TPA) is a second order process and it is higher order compared to one photon absorption (1PA); it requires high intensity light source to attain significant absorption rate. Where as in multiphoton absorption, one or more photon absorptions take place at a time [8]. Two photon fluorescence microscopy is a powerful imaging technique that have deeper penetration strength and low photodamage, which is very useful in study of biological samples especially in neuroscience, cell biology [9] and photodynamic therapy [10].

To fulfil the NLO property, a considerable number of materials have been developed with transition metal complexes, organometallic complexes, semiconductors, chalcogenide glasses and organic compounds. Among all materials, Organic NLO materials have more advantage compared to inorganic materials, because of its ease of processing, rapid response time, large NLO absorption coefficients, least cost and so on. Additionally, the optical properties of organic nonlinear optical (NLO) materials can be readily change by adjusting their donor-site and acceptor-site in parent compound [11]. For instance, the band gap can be easily tuned just by varying the donor groups like methyl, amine, dimethylamine, diethylamino, methoxy and acceptor groups like cyanide, sulfonyl, nitro and chloro groups with extended π-conjugation to bring strong nonlinearity and also lead to a change in dipole moment to bring large polarizability [12–15].

Over the last few decades, chromophores containing polymers have been focused on NLO applications owing to their better thermal

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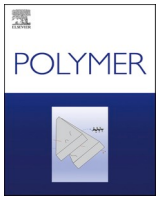

Y-shape triazine-based D-π-A chromophores and polyimides for improved nonlinear optical properties and optical limiting

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ABSTRACT

In this article, we have systematically synthesized and characterized a series of symmetrical triazine based Y-type chromophores and polymerized them with pyromellitic dianhydride monomer to yield respective polyimides. The density functional theory (DFT) calculations and photophysical measurements were performed to analyze the bandgap and electrostatic potential of the chromophores. The thermal properties of synthesized polymers were studied using differential scanning calorimetry and thermogravimetry analysis to understand the thermal behavior of the polymers. The nonlinear optical properties of the synthesized chromophores and polymers were measured using a Q-switched Nd:YAG laser (9 ns, 532 nm, 10 Hz) by Z-scan approach. A significant improvement was observed in the effective two-photon absorption and optical limiting. It was found that all the chromophores and polymers have exhibited good nonlinear optical properties and that could be employed for optical limiting applications. Among the all compounds, FNP showed high nonlinear absorption co-efficient of 1.12×10^{-10} m/W and low optical limiting threshold of 1.67×10^{12} W/m^2. Thus, these polymers could be of potential candidate for commercial exploitation of optical limiting applications.

1. Introduction

Nonlinear optical (NLO) materials are pivotal in the progression of photonics and optoelectronic technologies due to their distinctive interactions with light. As indicated in prior scholarly reports, the behavior of NLO materials diverges significantly from that of linear optical materials [1]. Linear optical materials exhibit a response to incident light that is directly proportional to the strength of the electric field; conversely, NLO materials display a nonlinear relationship that can give rise to various phenomena, including second and third order harmonic generation, two-photon or multiphoton absorption, and photoinduced refractive index changes. These phenomena are critically important for applications involving frequency doubling or conversion, optical limiting, and the development of optoelectronic devices [2,3]. At present, the field of NLO materials is rapidly expanding, particularly in the context of optical limiting applications. Optical limiting devices are engineered to safeguard sensitive components, such as optical sensors and human eyes, from exposure to high-intensity light and among other threats [4]. They significantly attenuate light intensity when it surpasses a defined threshold, thereby averting potential catastrophic failures. The optical limiter encompasses various mechanisms for passive intensity regulation, including reverse saturable absorption, two-photon absorption (TPA), induced scattering, free-carrier absorption, and nonlinear refraction [5].

The advancement of optical limiting technologies has catalyzed the pursuit of innovative materials, thereby substantially enhancing research into NLO materials [6]. In order to attain effective optical limiting functionalities, a multitude of materials has been investigated to optimize their NLO properties. Notable materials documented in the scholarly literature comprise metal clusters [7], phthalocyanine [8], metal organic frameworks [9], organometallic complexes [6], as well as nano and hybrid materials [10,11]. Specifically, organic compounds such as conjugated metallophthalocyanines [12] and polymers have demonstrated pronounced nonlinearity alongside elevated optical damage thresholds [13].

In light of their superior NLO properties, organic materials encounter

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Transition Metal (II) Complexes of (*E*)-*N*-(4-methylbenzylidene)-2-((*Z*)-(4-methylbenzylidene)amino)benzamides: Synthesis, Characterization and their Biological Evaluation

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Abstract: A novel series of transition metal (II) complexes (5a-h) were conveniently synthesized via reaction of important transition metals (Co, Cu, Zn, Ni) with (E)-N-(4-methylbenzylidene)-2-((Z)-(4-methylbenzylidene)amino)benzamide Schiff base (3) which was previously synthesized by reacting 2-aminobenzohydrazide (1) with 4-methylbenzaldehyde (2). The synthesized metal complexes' structure was elucidated by IR, NMR, mass, and elemental analysis. Additionally, we also evaluated the antioxidant, antimicrobial and antifungal activity of the synthesized metal complexes. The bioassay of the novel transition metal complexes envisioned that compounds5eand5c showed better antimicrobial activity than the free ligand, and compounds5g and 5a showed good activity against most bacterial strains. On the other hand, hydrated metal complexes 5b, 5d, 5f, and 5h showed moderate to good antimicrobial activity. In comparison with ascorbic acid, most of the metal complexes showed moderate to good antioxidant activity. The current bioassay was investigated and proved that the compounds 5e and 5c as antimicrobial agents act on highly resistant strains of microbes.

Keywords: metal (II) complex; Schiff's base; antimicrobial; ascorbic acid.

1. Introduction

Schiff's base is a sub-class of organic imines considered secondary aldimines or ketimines, depending upon the structure [1]. A new era has started in coordination chemistry since 1869 after Schiff's elegant synthesis of azomethane complexes of copper(II) from preformed metal, salicylaldehyde, and primary amine [2]. Schiff base is formed as a condensation product of primary amine with carbonyl compounds [3]. This was first reported by Schiff [4], which contains the >C=N- group, which is also called azomethine or imine. The >C=N- group, combined with more such groups or others like phenolic –OH or amino groups, can effectively form metal complexes. The Schiff-based metal complexes have shown evidence of importance significant in inorganic and organic chemistry due to their biological activity. In recent years several reports are published on the preparation of these compounds and their application [5]. Schiff bases of aliphatic aldehydes are comparatively unstable and readily undergo polymerization, whereas aromatic aldehydes possessing effective conjugation are

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MINI-REVIEW ARTICLE

Biodegradable Polymers and their Applications: A Review

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Abstract: Polymers have an endless scope due to their flexibility, amendment, and modification with the organic and inorganic compounds. There is an intense competition between natural and synthetic biodegradable polymers concerning biodegradability and compatibility with modern technology. Biodegradable polymers play a significant role in sustaining humanity on the earth due to non-environmental hazards. These polymers play a crucial role in biomedicine technology, such as tissue engineering, preparation of different scaffolds, drug delivery systems, industrial sector, agriculture, and food packaging. Here, we probed on various applications, challenges, and the limitations of biodegradable polymers in life.

Keywords: Biodegradable polymers, natural polymers, synthetic polymer, biomedical applications, technologicals applications, agriculture, packaging applications.

1. INTRODUCTION

Most developed and developing countries are exceptionally concerned with the hazards caused to the environment by synthetic polymers. These polymers either degrade or benefit the environment. Due to the non-degradability of synthetic polymers, one has to think of an alternative polymer source as these polymeric materials find a wide variety of applications in day-to-day life. In the early 1980s, most of the polymers used by humankind were non-biodegradable polymers, which subsequently caused an increase in environmental pollution. These facts made the researchers search the biodegradable polymers and enhance their compatibility using natural biodegradable polymers. The problem lies in the lack of either the latest technology or the cost of the manufacturing of degradable polymers. Hence, there is a necessity to have a novel standpoint on the design, properties, and proper functions of these polymers to develop strategies for future development [1]. There are two fundamental reasons behind the cooperative thought regarding polymers obtained from renewable resources; environmental concerns and petroleum resources being finite. Many biodegradable sources are available for the transition from synthetic to renewable sources.

Synthetic polymers are derived from non-renewable petroleum sources, while natural polymers are widely available from renewable supplies [2]. Biodegradation occurs through the enzymatic action accompanied by slow chemical deterioration associated with organisms. Degradation involves mainly three steps: bio-deterioration, bio-fragmentation, and assimilation. The combined effort of microbial communities with other decomposer organisms and abiotic factors converts the biodegradable materials into smaller fractions known as biodeterioration. Microorganisms produce catalytic agents (*i.e.*, enzymes and free radicals) that cleave polymeric molecules. In recent years, biodegradable polymers have been utilized in various areas, including tissue regeneration (GTR) [3], drug delivery [4], bio-medicine [5], 3D printing [6], cosmetic sensory [7], food packaging [8], agriculture [9], enzyme immobilization, tissue engineering scaffold, nanotechnology, and technological application [10]. There is a need to understand biodegradable polymers and their applications in the information age.

The above-mentioned reports reveal the biodegradable polymers' deep-seated role in biomedical, agricultural, and industrial applications. Improved biocompatibility of biodegradable polymers is crucial for tissue engineering, drug delivery, biomedicine, 3D printing, cosmetics, and sensory applications.

2. GENERALITIES OF BIODEGRADABLE POLYMERS

Humans synthesize polymers and the naturally available polymers. These natural polymers are found in various biomaterials; a few crucial materials are lignin, cellulose, starch, proteins, nucleic acid, and chitin. Biodegradable materials are the "green materials" of the future; they have been widely used and have a greater scope as they are biocompatible and biodegradable. The question that arises is, what are biodegradable polymers? Biodegradable polymers quickly degrade and give rise to some simplest molecules through the

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Assessment Of Physico-Chemical Parameters In Ground Water & Surface Water In And Around Afzalpur Taluk In Kalaburagi District, Karnataka, India

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Abstract: In this study, through the analysis of ground water and surface water samples collected from five places in Afzalpur taluk, Kalaburagi district in Karnataka, India. These ground water and surface water samples are collected on June 19th 2024. The main purpose of this analysis is to determine the quality of the ground water and surface water samples collected in Afzalpur taluk. In this water samples we have analysed some physicochemical parameters and heavy metal concentrations. Water samples have been collected by grab sampling. Samples have been collected in sampling bottles made up of PET which is coloured to protect from light, avoiding photosynthesis and preservation of certain compounds. For surface water samples, the sampling bottles were first rinsed with the sample water for about 3 times, after that the bottle is immersed into 10cms below the water surface, and surface water samples are collected. For ground water samples, water is made to run out for about 10 minutes and the sampling bottle is rinsed with sample water for about 3times, and ground water samples are collected. The physicochemical parameters and heavy metal concentrations of ground water and surface water samples collected were analysed in the Global Environment and Mining Services Laboratory, Hosapete, Vijayanagara district, Karnataka. Some of the Physicochemical parameters determined in this analysis are pH, Conductivity, Total Dissolved Solids (TDS), Turbidity, Total Hardness as CaCO3, Calcium(Ca), Magnesium(Mg), Sulphate(SO4), Sodium(Na), Potassium (K), Carbonates, Bicarbonates, Nitrate Nitrogen(NO3), Chloride(Cl), Fluoride(F). Some of the heavy metal concentrations determined are Zinc(Zn), Copper(Cu), Iron(Fe), Lead(Pb), Manganese(Mn), Nickel(Ni). All the analysed data were compared to the WHO standards, ISO standards and IS standards for ground water samples. For surface water samples G.S.R 422 (E) Limits. The main goal of this analysis is to know about the water quality of that particular area were the samples are collected and to know about whether the water samples collected is suitable for drinking purposes**.**

***KEY WORDS*:** Physicochemical studies, heavy metal concentrations, surface water, ground water, water quality analysis.

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Research Article

Exploring the phytochemical composition and Ethnomedicinal attributes of Aerva Lanata: A comprehensive study

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Abstract

Aerva Lanata (L.) *Juss*, commonly recognized as Mountain Knotgrass in southern India, is renowned for its documented medicinal properties steeped in Hindu mythology, known as Pashanabheda (stone breaker) in Sanskrit and belonging to the Amaranthaceae family, this plant addresses urolithiasis, the formation of stones in the urinary tract. Various plants, including Punarnava (tar vine), Bergenia ligulata, Shigru (Moringa oleifera), Varuna (Crataevanurvala), Kantkari (Solanum Xanthocarpum), Kushmanda seeds (Benincasa hispida), Coriander (Coriandrum sativum), and Jasmine (Jasminum auriculatum), are employed for treating kidney stones. This study focuses on the phytochemical screening of Aerva lanata leaves through extraction using solvents such as Hexane, Ethyl acetate, ethanol, methanol, and water. Employing the Soxhlet extraction method, a conventional technique for extracting phytochemical constituents, the study reveals the presence of tannins, saponins, flavonoids, phenolic compounds, and coumarins. Despite the widespread traditional use of these plants in local areas, the research underscores the medicinal properties found in every part of the Aerva lanata plant, including the stem, leaves, flowers, roots due to that there is by analytical tools such as HPLC, Mass spectroscopy and furthermore carried out antimicrobial studied for each fraction were illustrated. Much needed for researcher to explore phytochemical constituents and identified studied their bioactivities.

Keywords: Extraction, isolation, analytical instrument and biological studies.

INTRODUCTION

Within diverse natural habitats, numerous medicinal plants play pivotal roles in addressing a wide range of health issues. Yet, a considerable segment of society remains uninformed about these plants and their curative capabilities due to limited awareness. Aerva lanata Juss, popularly referred to as Mount Knotgrass, stands out as one such botanical treasure, teeming with therapeutic attributes. This investigation delves into the isolation and characterization of bioactive compounds from Aerva lanata Juss (Figure 1) and assesses their potential health benefits. Notably, Aerva lanata Juss is esteemed as one of the Dasapushpam(**Bhowmik et al., 2012; Goyal et al., 2011; Gr et al., 2013; Haritha et al., 2021; Maharana & Dadhich, 2016; Nirumand et al., 2018; Patel et al., 2011; Sahu et al., 2013)**, the ten revered flowers of Kerala. Known in Sanskrit as Pashanabedha, which translates to "stone breaker,"

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REVIEW

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Plants based materials as the antifungal and antibacterial agents

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ABSTRACT

The medicinal plants are a distinguished source of our earth, which cannot be replaced even though many developments in science and technology have been. Plants are very rich in bio-medicinal properties, as well as fabrication applications. Natural product materials play a vital role in curing many diseases without having many side effects; that's why many researchers were working on phytochemistry. Plant organo-compounds such as quinine, alkaloids, polypeptides, lectins, coumarin, terpenoids, flavones, flavonoids, flavonols, fatty acids, tannins, and essential oils are metabolites for biological activities. In this review, plant materials and plants part, which are responsible for antimicrobial activity, have been discussed.

1. Introduction

1.1. Historical perspective

Plants are a fundamental part of our universe; it has shown their potentiality since primordial time. Human beings are so connected to the natural resource that life cannot exist on the earth. Plant-based materials have been used as a classical resource for traditional medicine and pharmaceutical drugs for a long time; they have played a vital role in treating all kinds of diseases that infect humans and farm animals. Pesticides traditionally used at large scales are synthetic chemicals that have non-target action as well along some of them have persistence in the environments.

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To overcome these problems for the last two decades, intensive effort has been made by agricultural and botanical researchers to discover chemical compounds from plant origin having an antibacterial and antifungal activity (Sofowora, 1993; Egamberdieva et al., 2017). Most chemically synthesized compounds are halogenated, hazardous, and toxic to the environment and living organisms. It is very indispensable to have naturally occurring compounds be used as drugs. Synthetic pesticide, along with fungicides, has been used to control diseases and harmful organisms; however, most of these synthetic compounds exhibit teratogenicity, mutagenicity, carcinogenicity, phytotoxicity, and residual effects (Bajaj and Ghosh, 1975).

"Evolution" is a process by which all living organisms live here and flourish with many modifications adaptations are the biggest boon that the mother earth has blessed us with. As rightly said in Bhagavad-Gita, that "Every flora must be seen as the incarnation of God". There are different tales in many civilizations that are close to the plant kingdom and its uses to the human race. Ancient people knew the wisdom of nature and its uses. Plants and plant products have proved to be the biggest resource next to air and water, and of course, all three are interconnected within. The plant kingdom has not only given the food resources but they have been used as the

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Synthesis and Characterization of Transition Metal(II) Complexes Derived from (E)-N-(4-Methylbenzylidene)-2-((Z)-(4-Methylbenzylidene) Amino)Benzamides: Investigation of Biological Activities

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ABSTRACT

We synthesized a novel series of transition metal(II) complexes 5a-h by reacting key transition metals (Co, Cu, Zn, Ni) with the Schiff base 3, derived from (E)-N-(4-methylbenzylidene)-2-((Z)-(4-methylbenzylidene)amino)benzamide. Schiff base 3 was previously prepared by reacting 2-aminobenzohydrazide 1 with 4-methylbenzaldehyde 2. The structures of the metal complexes were characterized using IR, NMR, mass spectrometry, and elemental analysis. We evaluated the synthesized metal complexes for antioxidant, antimicrobial, and antifungal activities. Notably, compounds 5e and 5c exhibited enhanced antimicrobial activity compared to the free ligand. Compounds 5g and 5a showed significant activity against various bacterial strains. Additionally, the hydrated metal complexes 5b, 5d, 5f, and 5h demonstrated moderate to good antimicrobial activity. In terms of antioxidant activity, most of the metal complexes displayed moderate to good activity comparable to ascorbic acid. Our bioassay results highlighted compounds 5e and 5c as effective antimicrobial agents against highly resistant microbial strains.

Keywords: Metal(II) complex; Schiff's base; DPPH radicals; antimicrobial; ascorbic acid.

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