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Solvent Free Synthesis of Guanine, Benzoguanamine with Chromium (III) Chracterization and Antimicrobial Activity

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Abstract

Mechanochemical synthesis was used to create heterocyclic base-chromium (III) complexes. The heterocyclic compound was ground with metal (III) carbonates to create the appropriate complexes of Cr. Elemental, melting/decomposition temperature estimation, conductivity and infrared spectroscopy tests were used to characterize the produced chemical. The ligand's infrared spectroscopic investigation reveals peaks at 1674cm^{-1}, which demonstrate the existence of azomethane in guanine, and 1592cm^{-1}, which confirm the presence of azomethane in benzoguanamine, which confirms the creation of a bond between an azo group and a metal, respectively. Guanine with melting point of about 360^{0}C suggests that it is stable at high temperatures, but the breakdown temperature of the Cr complex over 360^{0}C indicates that the complex is extremely stable. The breakdown temperature of the Cr complex, which is about 270^{0}C, suggests that the complex is relatively stable at high temperatures. In contrast, the melting point temperature of the benzoguanamine ligand, which is 228^{0}C, shows that it is relatively stable at high temperatures. When the conductivity of complexes is compared to theoretical values, they are not electrolytic. At greater concentrations (1000 µg/disc and 500 µg/disc), some bacteria and fungus were resistant to the ligand and its associated complexes, but other organisms showed no response to any concentration. However, research on the anti-oxidant effect of Cr complex revealed that all species were considerably impacted, even at low concentrations (250 µg/disc).

Keywords: anti-microbial activities, an-oxidant guanine, benzoguanamine, Cr (III), solvent free synthesis.

1. INTRODUCTION

An organic compound is referred to as a heterocyclic compound if one or more of the carbon atoms in the molecule's backbone have been swapped out for an atom of another element. Examples of common hetero atoms are nitrogen, oxygen, and sulfur. In our daily lives, heterocyclic compounds are quite interesting. They are extremely important to our biological system. Applications for heterocyclic compounds in agrochemicals, medicines, veterinary goods, etc. are many. Additionally, they serve as the building blocks for the synthesis of organic molecules. Additionally, they are utilized in cleaners, developers, anti-ordinates, corrosion inhibitors, etc. Heterocyclic compounds are cyclic compounds that have one or more other atoms in a ring structure in addition to carbon. These substances might be anti-aromatic or aromatic. Widely distributed heterocyclic substances like pyramiding and purine, which are components of DNA, vitamins, and enzymes, are present in nature. Furthermore, heterocyclic molecules are crucial for human existence. They serve as crucial information brokers. Nucleosides are a component of genetic material that carry information from one generation to the next and are employed in pyrimidines and neurotransmitters. This review essay emphasizes the value of heterocyclic compounds in several aspects of our lives (Jyoti ,2018).

A subfield of solid state chemistry called mechanochemistry examines chemical reactions that take place in solids when mechanical energy is applied. Currently, it seems that mechanochemistry is a discipline with a strong theoretical underpinning and a wide variety of possible applications. We can list the following as potential viable processes: altering the properties of creating a variety of nanomaterials; a novel method of producing nanomaterials; enhancing the activity and regeneration of catalysts; altering the solubility and bioavailability of nano drugs in pharmaceuticals; controlling reaction kinetics in chemical technology; and, finally, recent developments in the synthesis of nano advanced materials. Techniques from the mechanochemical field can be utilized to improve conventional laboratory methods. A significant number of chemical improvements have been made via activation. enhancing several current techniques with better results than responses attained under scenarios that are typical. This chapter's goal is to assess and highlight current developments in the mechanochemical production of nanomaterials (Ghada *et al.*, 2017).

In view of the growing emphasis on renewable energy use and climate change, it is essential to reduce the use of dangerous chemicals in academic research, eliminate waste, and maybe even recycle them in order to produce better results in a more environmentally responsible manner. Researchers working on the creation of environmentally friendly methods will undoubtedly pay attention to the studies in the field of mechanochemistry that encompass the chemistry of grinding to ball milling, sonication, etc. A thorough summary of recent advancements in organic bond formation processes, such as carbon-carbon (C-C), carbon-nitrogen (C-N), carbon-oxygen (C-O), carbon-halogen (C-X), and others, is provided in this paper. Organometallic compounds, their catalytic uses, multicomponent procedures, and mechanochemical synthesis of heterocyclic rings are also discussed (Tapas *et al.,*2017).

Recently Schiff base of parabenzoquinone and glycine with their corresponding complexes were synthesized mechanochemically. Elemental analysis, infrared spectroscopy, the identification of the melting and decomposition temperatures, and conductivity tests were used to describe the produced chemical. The ligand's infrared spectroscopic examination reveals a peak, In the complexes of Mn, Cu, and Co, respectively, a shift to 1602cm^{-1}, 1623.15cm^{-1}, and 1635.69cm^{-1} revealed the formation of a connection from the azo-group to metal. A melting point of 128.200C for the ligand indicates that it is stable at low temperatures. The breakdown temperatures of the stable Mn, Cu, and Co complexes, in comparison, are 190^{0}C, 188.4^{0}C, and 205^{0}C, respectively. When compared to theoretical values, conductivity tests reveal that the complexes are not electrolytic. At greater concentrations (1000 µg/disc and 500 µg/disc), some bacteria and fungus were resistant to the ligand and its associated complexes, but other organisms showed no response to any concentration. However, even at modest dosages, the Co complex has a profound impact on all species (250µ g/disc) (Kurawa and Jaafar, 2021).

Adducts of a heterocyclic base and [Pyridine-Bipyridine(py), (bipy), 1,102,2'-phenanthroline] (Phen), Nickel (II) complexes of Nickel (II) complexes were produced by reacting 5-chloro-2-hydroxy acetophenone N (4) methyl thiosemicarbazone with nickel (II) chloride in the presence of a heterocyclic base. The ligand was located using spectral data from the ^{13}C, ^{1}H NMR, IR, and electronic bands. The synthesized adducts were identified by IR, ESI-MS, UV-visible, magnetic measurement, molar conductivity, TGA, and DSC.

It is demonstrated that the functionalized monothiooxamides may be crushed in a mortar or vibrating ball mill using $PdCl_2(NCPh)_2$ to produce these complex metal-organic complexes in solution. This method can provide benefits including the lack of any auxiliary materials and a significant rate and yield boost, especially for the difficult ligands. It has been demonstrated using multinuclear NMR (including 2D NMR), IR spectroscopy, and, in certain cases, X-ray diffraction that the resultant pincer complexes achieve S,N,N- or S,N,S-mono anionic tridentate coordination. A study on the progression and result of the solid-phase processes has been done using a combination of SEM/EDS analysis and other spectroscopic techniques. Early testing of several of the synthesized cyclopalladated derivatives' cytotoxic activities against various human cancer cell lines revealed their extraordinary potency, making the development of solvent-free synthesis techniques for these kinds of complexes urgently necessary (Diana, *et.al.*, 2021).

By using a mechanochemical synthesis in a ball mill, a complex bifunctional catalyst with a copper(I)/N-heterocyclic carbene and a guanidine organocatalyst was created. This method avoids the often used silver(I) complexes that are linked to large and undesirable waste generation. A novel technique based on inexpensive and easily accessible K_3PO_4 as base has been devised because prior mechanochemical conditions were not relevant due to the intended complex's bifunctional character. When dihydrogen is used as the terminal reducing agent in a number of reduction/hydrogenation reactions, the resultant complex has been demonstrated to be active (Ina, *et al.* , 2021).

Due to its potential biological uses and fascinating co-ordination chemistry, heterocyclic Schiff base metal complexes have recently attracted more and more interest. By reacting metal acetate or metal salts ($FeCl_3$, CoOAc, CuOAc, and NiOAc) with substituted heterocyclic ligands, novel heterocyclic methyl-substituted pyridine Schiff bases containing Fe(III), Co(III), Cu(II), and Ni(II) transition metal complexes have been devised and created. All newly synthesized metal complexes were examined using FT-IR, ESR, magnetic susceptibility, and TGA screening in addition to elemental analysis. These complexes' square planer and octahedral geometry, electronic spectra, and magnetic susceptibility studies all point to the (N, O) group as a bidentate ligand in their structure. The thermal stability, breakdown rate, and thermodynamic properties of the metal complexes were studied using the Freeman Carroll method. The biostatistical data on the antibacterial and antioxidant capabilities of synthesized metal complexes also provide moderate to good results (Jitendra *et al.*,2021). From $[MCp^*(\text{-}Cl)Cl]_2$ (M, =Rh), mechanochemistry offers a quick and effective way to make half-sandwich iridium and rhodium complexes. without the use of solvents, Schlenk manipulation, or inert gas protection, irand8-hydroxyquinoline-2-carbaldehyde. A mechanochemical Wittig reaction between the half-sandwich metal complex and phosphorusylide has also been used to modify the half-sandwich metal complexes after they have been created. The ^{1}H and ^{13}C NMR spectra, infrared spectroscopy, mass spectrometry, and single-crystal X-ray diffraction methods were used to provide a comprehensive description of each complex. With a wide range of functional group tolerance, the half-sandwich rhodium complexes demonstrated remarkable catalytic activity towards the amide synthesis between aldehyde and hydroxylamine hydrochloride (NH_2OHHCl) (Wei.*et.al.,* 2022).

Although Parkia speciosa (petai) pods are abundant in phenols and flavonoids, they are rarely used and are thought of as garbage. It is known that the phenolic and flavonoid content of plants has antioxidant capabilities. It is known that antioxidants have the power to fend off free radicals and lessen damage by maintaining structural integrity. The DPPH method was employed in this work to evaluate the antioxidant potential of petai pods. According to the research, the ethanolic extract of petai pods exhibited an IC50 of 75.72 ppm, indicating a potent antioxidant action.. Standardization of extracts, which includes the examination of density, water content, ash values, and quantification of total phenolic and flavonoid content, was decided upon to regulate the quality of extract. The results of the research show that the extract maintains its quality throughout storage and usage, which proved that it meets the standards for water content and ash values. There were 272.45 mg/g GAE and 243.2029 mg/g QE of total phenolics and flavonoids found. According to this study, the ethanolic extract of petai pods exhibits strong antioxidant activity, to which the high concentration of phenolic and flavonoid chemicals that already present contributed (Najma, *et al.*, 2019).

According to a recent study, metal-based antibacterial drugs are currently employed as an alternate therapy to treat infectious disorders. The study is focused on the single-pot, solvent-free synthesis of novel omeprazole (OMP) transition metal complexes, their characterisation, and their in vitro application as urease inhibitors and anti-Helicobacter pylori drugs. But none of the complexes consistently shown antibacterial action against the other strains that were put to the test. There is a -1 amoxicillin breakpoint. OMP has been demonstrated to be equally efficient against H. pylori strains that are resistant to antibiotics as well as those that are susceptible, while Co-OMP and Cu-OMP have varying degrees of success. Researchers evaluated urease inhibition by using a reference urease isolated from H. pylori. The most effective urease inhibitor was discovered to be Zn-OMP, which was followed by Cu-OMP and Co-OMP. To establish the Michaelis Menten constant and clarify the inhibition mechanism, Line weaver-Burk plots were utilized (Muhammad *et.al.* 2018).

The traditional and solvent-free methods of synthesizing Schiff base ligands and the metal complexes are investigated and contrasted. We explain the production of mixed ligand ternary Cu(II) complexes using glycine, phenylalanine, and tyrosine as Schiff base ligands with salicylaldehyde. 1,10-Phenanthroline/thiourea is another ligand that is employed in coordination with the schiffbase at an equimolar ratio. The solid state synthesis of salicylidene amino acids using a pestle and mortar is a newly developed, ecologically friendly technique for synthesis. This approach is contrasted with the usual approach, which calls for hours-long refluxing of the reactant combination in an organic solvent, in this case ethanol. IR and UV spectroscopy are two spectrum methods used to characterize the complexes. The research came to the conclusion that the creation of ligands and complexes may be done quickly, simply, and affordably using a pestle and mortar. For the complexes, antimicrobial investigations were also carried out. Both the traditional and solventless procedures yielded spectrum data for the ligands and complexes that are in good agreement with one another. The bonding of azomethine (-CH=N-) between Schiff bases based on salicylaldehyde amino acids is indicated by the IR spectral peak at roughly 1600cm^{-1}. (Deeksha and Arpan,2017).

Several spectroscopic techniques, including circular dichroism, electrospray ionization-mass spectrometry, electron paramagnetic resonance, Fourier transform infrared, UV-vis, and electron paramagnetic resonance, were used to make and examine chiral N-(2-hydroxy-1-naphthylidene) amino acid Cu(II) complexes. To further understand the selectivity and enantiomeric behavior of the complexes, the binding interaction with ct-DNA and tRNA biomolecules was investigated utilizing widely utilized optical and hydrodynamic techniques. The complexes interact strongly in the intercalative mode, according to the binding experiments, and they prefer to attach to the tRNA biomolecule over ct-DNA. Scanning electron microscopy analyses of the complexes revealed that ct-DNA/tRNA molecules developed in a range of morphologies depending on the kind and level of condensation the complexes generated. The pBR322 plasmid DNA underwent a preferred oxidative cleavage process, which was carried out by radical scavengers for reactive oxygen species that involved singlet oxygen (1O2) and superoxide anions ($O^{2\bullet}$), according to the complexes' cleavage activity. The tRNA cleavage mechanism proved that these Schiff base Cu(II) complexes had time- and concentration-dependent activity. The human breast cancer cell line (MCF-7) with a GI50 value M is the target of the complex with the highest cytotoxicity in in vitro testing. The research showed that the L-enantiomeric complexes were more tRNA molecule avid binders and appeared to be more cytotoxic (Siffeen *et al.*, 2019).

$$C_8H_7O_3N \;+ MCO_3 \longrightarrow [(C_8H_7O_3)_2]M + CO_2$$

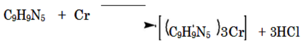
Scheme 1: general procedure of complexes synthesis

2. MATERIALS AND PROCEDURE

Pestle and motor, FTIR-8400S Fourier Transform Infrared Spectrophotometer, Flash 2000 Organic, University of Leeds, Jenway Conductivity Meter (Model 4000), WRS-IB Microprocessor Melting Apparatus, Jenway 6305 Spectrophotometer, UV-visible Apparatus, and all Analytical Grade Chemicals were used. The metal was obtained from Chromium(III) Chloride.

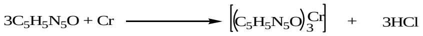
Synthesis of complexes

A grey-colored complex of tris[guanine]chromium(III) and a grey-colored complex of tris [benzoguanamine] chromium was formed after grinding metal chloride (Cr) (0.01mol) with the ligand (0.03mol) (III). The resulting complexes were purified by recrystallization in methanol, followed by in-vitro drying. (Kurawa and Jaafar, 2021).



$$C_9H_9N_5 \;+\; Cr \longrightarrow [(C_9H_9N_5)_3Cr] \;+\; 3HCl$$

Scheme 2: procedure for benzoguanamine complex



$$3C_5H_5N_5O + Cr \longrightarrow [(C_5H_5N_5O)_3Cr] \;+\; 3HCl$$

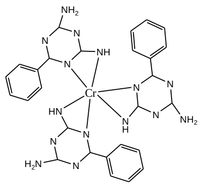
Scheme 2: procedure for synthesis of guanine complex

Anti-Microbial Activity

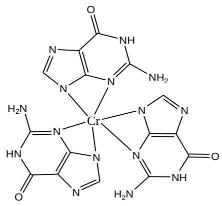
The agar well diffusion method was used to test the heterocyclic ligand and its metal complexes for their ability to inhibit the growth of four pathogenic bacterial strains, including *Streptococcus pyogenes, Bascillus subtilis, Selmonella typhi,* and *Klebsella pneumoniae*, as well as two isolates of two distinct species of fungi, *Aspergillus fumigatus* and *Candida albicans*. An uncontaminated metallic borer was used to drill the wells in the medium. The fungal isolates were transferred to the potato dextrose agar using the sterile cotton swab, whereas the bacterium strains were placed on the surface of the nutritional agar. Each well received the test chemical at the right concentration of DMSO. Other experiments were complemented with the popular antibacterial drug ciproflaxacin and the antifungal drug ketoconazole, respectively, to serve as positive controls. The plates were incubated at 37°C for 24 hours in the case of bacteria and 48 hours in the case of fungus. By gauging the size of zones that completely restrict the activity (mm) (Pooja *et al* ,2020).

Determination Anti Oxidant Property

Saif. *et.al.*, (2016).'s approach was implemented with hardly any changes. Methanol was used to dissolve 2mg of DPPH (100 ml). Serial dilutions (1000, 500, 250, 125, 61.5, 31.25, 15.6 & 7.8 µg/mol) were performed using stock solutions (1 mg/ml) in DPPH solutionthe ratio of the free ligand to its metal complexes, which was mixed, was 1:4 and let to stand for 30 minutes in complete darkness to test for any reaction byproducts. Using a UV-Vis spectrophotometer by JASCO, model V-550, the absorbance was measured at 517 nm. The determined% inhibition and different concentration values of the produced solutions were statistically evaluated using IBM SPPS software to get IC50. The acquired absorbance values were used to calculate the percentage inhibition.



proposed structure of benzoguanamine chromium complex



proposed structure of guanine chromium complex

3. RESULT

Guanine and benzoguanamine interact with chromium to produce complexes, which were later discovered to be colored as a result of charge transfer.

A band associated with v(C=N) stretching can be seen in the infrared spectral results of the ligands guanine and benzoguanamine at $1637cm^{-1}$ and $1622cm^{-1}$, respectively. Guanine and benzoguanamine complexes with chromium exhibit bands at $589cm^{-1}$ and $585cm^{-1}$, respectively, that are associated with v (M-N). Result shown in table 1 below. The ligand and the metal ions have complexed when there is a shift in the bands of the complexes to lower or higher frequencies when compared to the bands in the ligand. In addition, v(M-N), which validates complexation and is lacking in the ligand, causes additional bands to form in the complexes. Comparing the wavelengths to Siffeen *et al.*, 2019.

Table 1: Spectral Data

FTIR VALUES	υ(M-N) Cm^{-1}	υ(C=O) cm^{-1}	υ(C=N) Cm^{-1}
$[(C_5H_5O_3N_5)_3Cr]$	589	1700	1637
$[(C_9H_9N_5)_3Cr]$	585		1622
$(C_5H_5N_5O_3)$		1700	1674
$(C_9H_9N_5)$			1592

Keys: Metal = M, Wave = V.

All-grey guanine-chromium complexes and benzoguanamine-chromium complexes are the byproducts of guanine and benzoguanamine's interactions with chromium, respectively. Guanine melts at 360°C, while the chromium complex of benzoguanamine melts at 270°C. In contrast, benzoguanamine melts at 2280°C. As a result, the coordination between the core metal ion and the ligand may account for the complexes' greater decomposition temperatures than those of the ligand. A JENWAY 4010 conductivity meter was used to measure the complexes' molar conductance in DMSO solution; according to Tadewos *et. al.*, 2022, the lower value indicates that the complexes are non-electrolytes. Table 2 presents the outcomes.

Table 2: Molar Conductivity, Melting Point Temperature/Decomposition Temperature

complexes	**Melting/decomposition Temp (^{0}C)**	Molar conductivity ($\Omega^{-1}cm^{2}mol^{-1}$)
[(C5H5O3N5)3Cr]	Above 360^{0}C	136.5
[(C9H9N5)3Cr]	270^{0}C	39.8
(C5H5N5O3)	360^{0}C	
(C9H9N5)	228^{0}C	

The results of the elemental analysis showed that the ligand guanine contains 46.30% nitrogen, 39.73% carbon, and 3.29% hydrogen respectively. while the computed percentage was discovered to be 4.30, 39.63, and 3.29 correspondingly. The ligand benzoguanamine is found to have 37.39%, 57.50%, and 4.64% of nitrogen, carbon, and hydrogen, respectively. As a result, the calculated percentages are 37.43%, 57.75%, and 4.64%, respectively.

According to the results of the elemental analysis, the guanine complex of chromium contains 41.55% nitrogen, 35.60% carbon, and 2.34% hydrogen, respectively, While the calculated percentages for nitrogen, carbon, and hydrogen are found to be 41.58%, 35.64%, and 2.38%, respectively, While it is discovered that the benzoguanamine complex of chromium contains 34.12%, 52.40%, and 3.9% of nitrogen, carbon, and hydrogen, respectively, While the calculated percentages for nitrogen, carbon, and hydrogen are determined to be 34.26%, 52.80%, and 3.92%, respectively. The complexes' metal to ligand ratio was determined by elemental analysis to be 1:3 for the ligand as well as its complexes.

Guanine and its corresponding chromium complexes were also tested for solubility in a variety of solvents; the results showed that the ligand is only marginally soluble in DMF, acetone, methanol, and water, insoluble in diethylether, benzene, chloroform, and ethanol, and soluble in DMSO and n-hexane. The compound is found to be soluble in DMSO and DMF but insoluble in chloroform and benzene-hexane diethylether. It is only marginally soluble in ethanol, methanol, acetone, and water. Benzoguanamine (the ligand) was also examined for solubility in several solvents, and it was discovered that it was soluble in DMF and DMSO but only moderately soluble in water, acetone, and diethylether. It was found to be insoluble in benzene, n-hexane, chloroform, and methanol. In order to select the optimum solvent for different types of analysis, such as antibacterial, conductivity, and UV-visible, solubility is used.

Table 3: Complexes' Magnetic Susceptibility

Ligand/complexes	Xg(gmol^{-1})	Xm(gmol^{-1})	µeff (BM)	N	Property
Guanine- Cr	4.10×10^{-6}	1.45×10^{-3}	3.49	3	Paramagnetic
Benzoguanamine-Cr	4.79×10^{-6}	2.04×10^{-3}	3.6	3	Paramagnetic

$\mu \ = n\sqrt{(n+2)}$

The magnetic moment values of the guanine-chromium transition metal complex exhibit magnetic moments of Cr(III) 3.49BM and benzoguanami~~ne-~~Cr, Cr(III) 3.6B.M, respectively, which are compatible with the octahedral geometry and correspond to 3 unpaired electrons, respectively. Their electronic spectra and magnetic susceptibility tests suggest that they are octahedral complexes when compared to Jitendra et al., 2021. Additionally, they claim that a (NH_2 and N=N) group serves as a bidentate ligand in their structure. results in table 3.

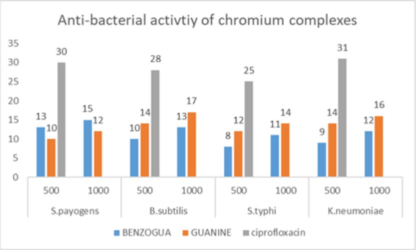


Fig 1: bar chart showing Anti-bacterial Activity of guanine and benzoguanamine of chromium complexes Inhibition Zones

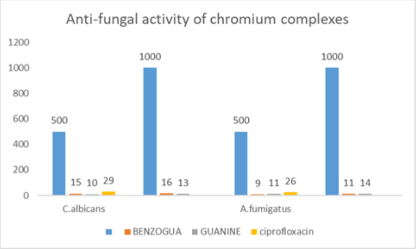


Fig 2: bar chart showing Anti-Fungal Activity of guanine and benzoguanamine of chromium complexes Inhibition Zones

Antimicrobial Result

When the experimental data was compared, it was determined that guanine and benzoguanamine chromium complexes respectively are active against all bacteria and fungus. The research showed that when you combine coordination and chelation, the activity is increase. The coordination polarity of the metal ion also lowers as a result of the metal ion's positive charge being partially shared with the donor groups in the chelate ring. As a result, metal chelates become more lipophilic, increasing their ability to penetrate a microorganism's lipid coat and kill it quickly. When chemicals enter the microbial cell, they stop the growth of bacteria and fungi by binding to the active sites of enzymes involved in biochemical activities including protein synthesis and cell respiration. In the active sites of all metal complexes, a hydrogen bond with an imino group forms, inhibiting the production of cell walls. The cytoplasmic membrane is harmed as a result of the hydrogen bond creation, and cell permeability may be changed, leading to cell death. Because the orbitals of the ligand and the chromium ions partially overlap and are shared with donor groups, the increased activity of guanine and benzoguanamine-Cr complexes suggests that the polarity of the Cr(III) ion against bacteria and fungi is truncated to a greater extent during coordination. Because the ion is readily absorbed on the cell's surface, nuclease activity is increased. The degree of plasmid DNA binding ability of the metal complexes and the nuclease activity of the complexes varied. Figures 1 and 2 demonstrate the results when compared to Leila.et. al., 2017.'s research, respectively. Transition metal ions can act as prooxidants by causing the production of ROS/RNS when combined with hydrogen peroxide or molecular oxygen. Transition metal ions in their lower oxidation states are not oxidant species by themselves. An antioxidant compound's IC50 value is negatively correlated with its antioxidant activity. The reduced antioxidant activity points to a higher IC50. Since the free radical DPPH may react with compounds that can release a hydrogen atom, it is a useful reagent for assessing the antioxidant activity.

The ability of the DPPH, one of the few purple-hued stable organic nitrogen radicals, to quench the chromium complexes with guanine and benzoguanamine was examined. This test depends on calculating the DPPH loss based on sample response. It is said to be the initial method of electron transmission. The IC50 value is a common statistic used to evaluate the antioxidant activity of test materials. The quantity of antioxidants needed to cut the initial concentration of DPPH in half is used to calculate it. Consequently, the IC50 value decreases as antioxidant activity increases. The benzoguanamine-chromium complex shown extraordinarily strong antioxidant activity when compared to Najma et al., 2019 (IC50 = 0.02 g/ml), which is equal to the reference ascorbic acid (IC50 = 3.66 g/ml). Guanine and chromium showed very little antioxidant action.

4. CONCLUSION

By using a mechanochemical process, complexes of chromium with guanine and benzoguanamine, respectively, were successfully created. Through the nitrogen of the azomethane and the deprotonated amino group, guanine and benzoguanamine were demonstrated to align to the central metal atom. The findings of elemental analysis indicate that the metal to ligand ratio (M: L) is 1:3The antimicrobial results revealed that all of the complexes are effective against two fungi, *aspergillus fumigatus* and *candida albi*cans species, as well as four bacteria, including *streptococcus pyogens*, *bascillus subtilis*, *selmonella typhi*, and *klebsella pneumoniae.* Additionally, the benzoguanamine complex exhibits strong antioxidant properties.

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