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ANTIOXIDANT ACTIVITIES OF THE SCHIFF'S BASE LIGANDS AND THEIR METAL COMPLEXES

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ABSTRACT

Antioxidant activity is the ability of compounds to inhibit, delay, or prevent the oxidation of substrates by scavenging free radicals and neutralizing reactive oxygen species (ROS), thereby protecting cells from oxidative stress and damage. It works by donating electrons or hydrogen atoms to stabilize free radicals, reducing cellular damage, and slowing aging. Mechanisms: These include scavenging free radicals, inhibiting the formation of ROS, repairing oxidative damage, and breaking radical chain reactions. Types: Antioxidants can be enzymatic (e.g., superoxide dismutase, catalase, glutathione peroxides) or non-enzymatic (e.g., vitamin C, vitamin E, polyphones, flavonoids). Sources: Natural antioxidants are found in fruits, vegetables, spices, and herbs. Common sources include berries (anthocyanins), citrus fruits (Vitamin C), nuts/seeds (Vitamin E), and green tea. Measurement: Activity is often measured through assays such as DPPH, H2O2 scavenging, and Total Antioxidant Capacity (TAC). Significance: These activities are crucial for preventing chronic diseases linked to oxidative stress.

KEYWORDS: Aspects of antioxidant activity include, Free radicals, DPPH & ABTS Assy.

INTRODUCTION

A comparative study of the ligands and their complexes indicates that most of the metals chelate exhibit higher antimicrobial activity than that of the free ligand. The increased antifungal activity of metal chelate with increase in concentration is due to the effect of metal

ion on the normal cell process.[1] Such increased activity of the metal chelate can be explained on the basis of overtone's concept[2] and chelating theory.[3]

Adipic hydrazides are versatile nitrogen containing heterocyclic compounds, possessing broad spectrum of biological and pharmacological activities such as hypotensive[4], anticancer, anti-HIV, anti-inflammatory[5], analgesic, antiviral, antitubercular, antimicrobial, anti-bacterial, antipyretic, antimitotic, anticonvaulsant[6], anticoagulant, anti-fibrillatory, cardiac stimulant and diuretic.[7] The quinoline have been tested successfully against cancer and HIV virus.[8] Their synthetic analogues possess antimalarial, hypolipidemic and antiproliferative activities.[9] The coordination chemistry of adipic hydrazide ligands has received much attention because of its biological implications. The complexes show enhanced antitumor, antifungal and antibacterial activities compared to the free ligand.[10] Quinolines are opportunistic infections with pneumocystis carinii and toxoplasma gondii are a major cause of morbidity and mortality in patients with the acquired immune deficiency syndrome.[11] The sensitivity of the gram positive bacterial to the tested quinolines was higher than that of gram negative bacteria.[12]

2-amino-5-iodo benzoic acid hydrazide derivatives exhibit very potent antifungal and antibacterial activities.[13] These 2-amino-5-iodo benzoic acid derivatives are covered the area of biological interest of this compounds have extended recently to various microbial activities such as analgesic, diuretic, anti-inflammatory, anthelmintic, antipruritic activities[14] and this class of compound showed in vitro selective anti-helicobacter pylori activity[15] A series of racemic 2-amino-5-iodo benzoic acid were synthesized as hybrid molecules of the two major prototypical hallucinogenic drug classes, the phenethylamines and the tryptamines/ ergolines. Although it was hypothesized that these new agents might possess high affinity for the serotonin receptor subtype, unaccepted affinity for muscarinic receptor was observed.[44] The 2-amino-5-iodo benzoic acid hydrazide Schiff bases and complexes show good microbial activities and better adsorption and fluorescence properties.[16]

ANTIOXIDANT ACTIVITY

a) Materials and method: DPPH radical scavenging activity

The scavenging effect of purified ligands and its complexes for DPPH radical was estimated using the method of Liyana-Pathirana and Shahidi. A solution of 0.135 mM DPPH in methanol was prepared and 5.0 ml of this solution was mixed with 0.5 ml of different ligands and complexes in different concentrations (5 mg is taken using IC_{50} value). Standard

antioxidants were taken 5 mg each. The reaction mixture was vortexed thoroughly and left in the dark at room temperature for 30 min. The absorbance of the test samples were measured spectrophotometrically at 517 nm. Standard antioxidants were used as positive controls. The ability to scavenge DPPH radical was calculated by the following equation.

$$Free\ radical\ scavenging\ activity\ (\%) = \frac{A\ control - A\ sample}{A\ control}\ X\ 100$$

Where $A_{control}$ is the absorbance of free radical solution (DPPH/ABTS) + methanol. A_{sample} is the absorbance of free radical solution with ligand and complexes/standard antioxidant.

b) ABTS radical scavenging assay

The stock solutions of 7 mM ABTS solution and 2.4 mM potassium per sulfate solution. The fresh working solution was prepared by mixing the two stock solutions in equal quantities and allowing them to react for 12 h at room temperature in the dark. The solution was then diluted by mixing 1 ml ABTS solution with 60 ml methanol to obtain an absorbance of 0.706±0.001 units at 734 nm using the spectrophotometer. 0.5 ml of different ligands and complexes in two different concentrations (5 mg is taken using IC_{50} value). Standard antioxidants were taken 5 mg each (0.5 ml) was allowed to react with 5 ml of the ABTS solution and the absorbance was taken at 734 nm after 30 min using the spectrophotometer. The ABTS scavenging capacity of the ligand and its complexes was calculated by using the above described formulae.

RESULT AND DISCUSSIONS

a) Free radical scavenging activities (DPPH Assay and ABTS Assay)

DPPH radical scavenging activity of the ligands and its complexes, compared with standard antioxidants. The results revealed that ligands and its complexes are having higher scavenging activity at 5 mg ml^{-1} (26 & 71%, 39 & 56%, 42 & 51%, 38 & 70%, 48 & 67%, 31 & 52 %, 26 & 64%, 38 & 60% for L^1 to L^8 ligands and its complexes respectively). Gallic acid, tannic acid, ferullic acid, vitamin-A, vitamin-C and Vitamin-E showed 88%, 70%, 21%, 85%, 70% and 86% scavenging activity respectively (Fig.1). In ABTS radical scavenging activity the results were fast and effective scavengers and this activity was compared with antioxidants. The percentage inhibition was 38 & 69%, 48 & 71%, 34 & 56%, 26 & 72%, 42 & 68%, 35 & 55%, 34 & 65%, 44 & 75% for for L1 to $\mathbf{L^8}$ ligands and its complexes respectively at 5 mg ml (Fig.-2). In contrasts to vitamin-C, vitamin A, ferullic acid, tannic acid, gallic acid and vitamin-E showed increasing activities of 17%, 26%, 42%, 65%, 84%

and 89% respectively. The ligands and its complexes were fast and effective scavengers of the free radicals. Higher concentrations of the ligands and its complexes showed more effective in quenching free radicals in both the systems. The scavenging of the ABTS radical by the ligands and its complexes was found to be higher than that of DPPH radical. Factors like stereo selectivity of the radicals or the diffusiblity of the ligands and its complexes in different testing systems have been reported to affect the capacity of ligands and its complexes to react and quench different radicals. Some compounds which have ABTS scavenging activity did not show DPPH scavenging activity. In this study, the ligands and its complexes showed strong scavenging activities against both DPPH and ABTS radicals. This study showed the capability of the ligands and its complexes to scavenge different free radicals in different systems, indicating that they may be useful therapeutic agents for treating radical-related pathological damage.

In conclusion, ligands and its complexes, showed antioxidant properties indicate that it could serve as broad specific free radical scavenger.

Table 1: Antioxidant activities of the Schiff's base ligands L^1 to L^8 and their metal complexes (DPPH assay).

Ligand/Complex	% Activity of ligand	% Activity of complex
L^1 Cu	26	71
L^2 Co	39	56
L^3 Ni	42	51
L^4 Zn	38	70
L^5 Cd	48	67
L^6 Hg	31	52
L^7 Mn	26	64
L^8 Fe	38	60
Standard	**% activity**	
Gallic acid	88.3	
Tannic acid	70.8	
Ferullic acid	21.6	
Vitamin-A	85.8	
Vitamin-C	70.3	
Vitamin-E	86.4	

Standard antioxidants: GA: Gallic acid, TA: tannic acid, FA: ferullic acid, V-A: Vitamin A, V-C: Vitamin C, V-E: Vitamin E.

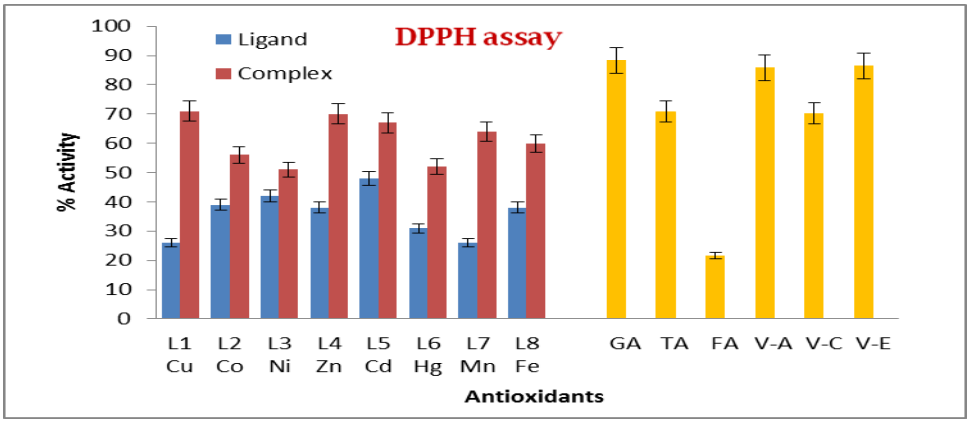

Figure-1: DPPH Assay.

Table 2: Antioxidant activities of the Schiff's base ligands L^1 to L^8 and their metal complexes (ABTS Assay).

Ligand/Complex	% activity Ligand	% activity Complex
L^1 Cu	38	69
L^2 Co	48	71
L^3 Ni	34	56
L^4 Zn	26	72
L^5 Cd	42	68
L^6 Hg	35	55
L^7 Mn	34	65
L^8 Fe	44	74
Standard Antioxidant	**% activity**	
Gallic acid	84	
Tannic acid	65	
Ferullic acid	42	
Vitamin-A	26	
Vitamin-C	17	
Vitamin-E	89	

Standard antioxidants: GA: Gallic acid, TA: tannic acid, FA: ferullic acid, V-A: Vitamin A, V-C: Vitamin C, V-E: Vitamin E.

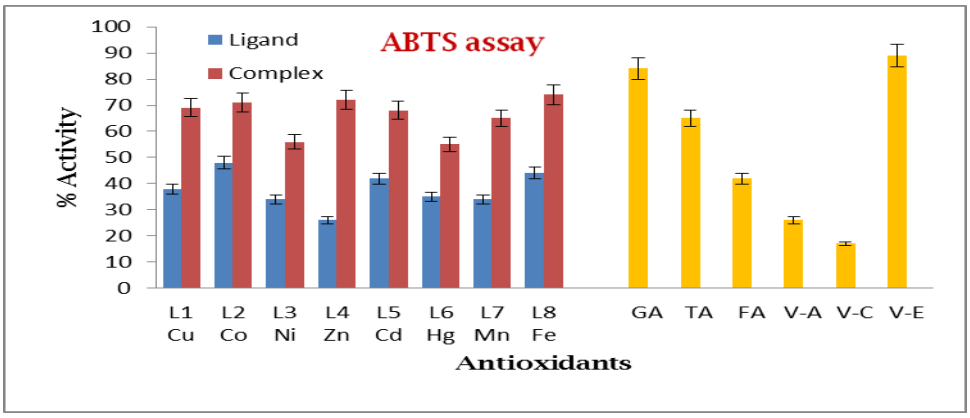

Figure-2: ABTS Assay.

CONCLUSION

ligands and its complexes, showed antioxidant properties indicate that it could serve as broad specific free radical scavenger.

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