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REVIEW ON PHENYLENE DIAMINE (PREPARATION, REACTIONS, BIOLOGICAL APPLICATIONS, BIO-USES)

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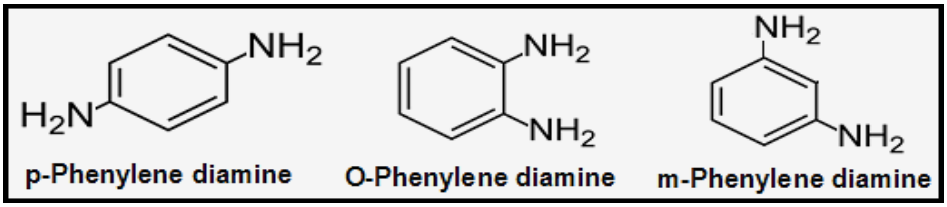
ABSTRACT

This Review explained the Bio-chemical compound known as Phenyl diamine, which is known for its Bio-importance and properties in many well-known drugs and pharmacies, as it is considered a basic substance in many bio- compounds and the basic nucleus in bacterial, fungicidal antibodies to its composition derived from
the benzene ring. Also this survey involved alternative method of preparation ,reactions ,some of its applications in many fields like in drugs, in bacteriology field ,other Bio-applications.

***KEYWORDS**: phenyl diamine, para-phenyl diamine, Biological ,bio-compound.*

INTRODUCTION

Phenylene diamine is an organic chemical compound, its formula $C_6H_4(NH_2)_2$ with three formula (ortho, para, meta). This derivative of aniline is a white solid, but samples can darken due to air oxidation., It is an aromatic amino compound that has three isomers of one chemical formula, which are ($C_6H_8N_2$) and a molecular weight of (108.14).



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Formula of Phenylene diamine

Ortho-phenylenediamine is a solid compound with a yellowish brown color that is poorly soluble in water and is easily soluble in alcohol, ether and chloroform. Its melting point ranges between (103-104) C° and its boiling point ranges between (256-258 C°). As for meta-phenylene diamine, it is a white solid compound that becomes red when exposed to air, its density is (1.139 g / cm^3), and its melting point ranges between (62-63 C°) and its boiling point ranges between (284-287 C°) and it is soluble in (Water, acetone, ethanol, methanol, chloroform and poorly soluble in carbon tetrachloride, ether and isopropanol). Para-phenylenediamine is a solid compound with a white color that tends to redness, reddens in color when exposed to air, its melting point ranges between (145-147 C°) and its boiling point is (267 C°) and it is soluble in (water, alcohol, chloroform and ether). Phenylenediamine is used to synthesis of dyes and is used during dyeing of hair and as an appearance in color photography and in analytical chemistry. This substance should be stored in airtight containers in a cool, dry and dark place., it has toxic properties :

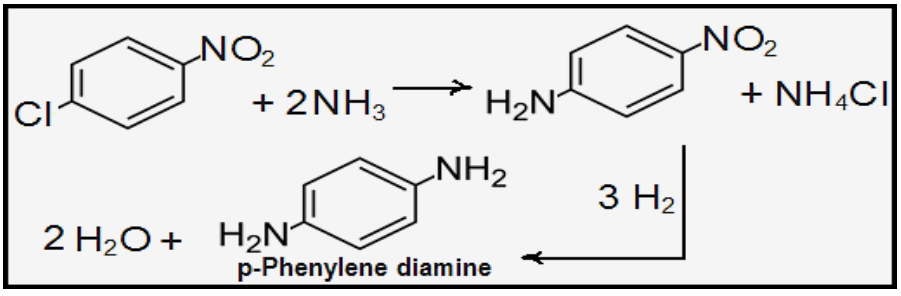
Table (1): Toxicity of phenylene diamine

Toxicological Concentration	
LD 50 oral	LD50 Rat 80 mg/kg
LD 50 dermal	LD50 Rabbit > 7940 mg/kg

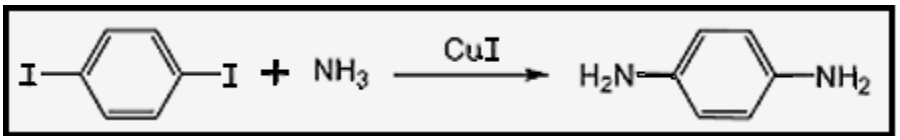
Preparation Methods of Phenylene Diamine:

1. Via substitution reaction of 2-Nitrochlorobenzene is reacted with ammonia and the resulting

   2-aminonitrobenzene is then hydrogenated:



2. Via Reaction para-di iodobenzene with ammonia in presence of CuI.

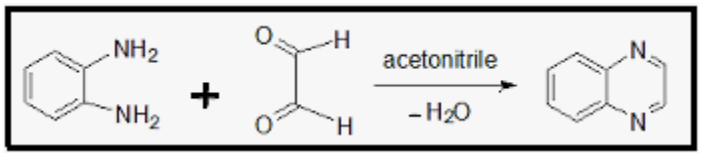


3. **Via reduction of nitro compounds:** by (Fe , $ZnCl_2$, $SnCl_2$/ HCl , …..)

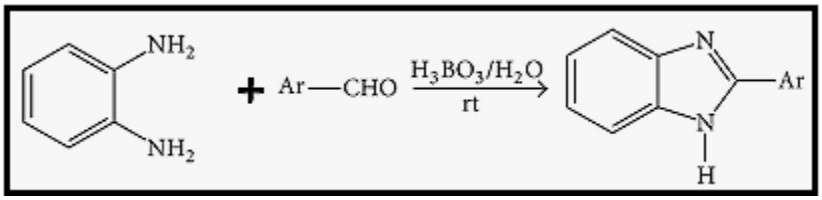
Reactions of Phenyl Diamine:

o-Phenylenediamine condenses with ketones and aldehydes to give rise to a variety of useful products. Reactions with carboxylic acids and their derivatives afford benzimidazoles. The herbicide benomyl is made in this manner. Also, quinoxalinedione may be prepared by condensation of *o*-phenylenediamine with dimethyl oxalate. Condensation with xanthate esters affords mercaptoimidazoles, There are several reaction for phenylene diamine :

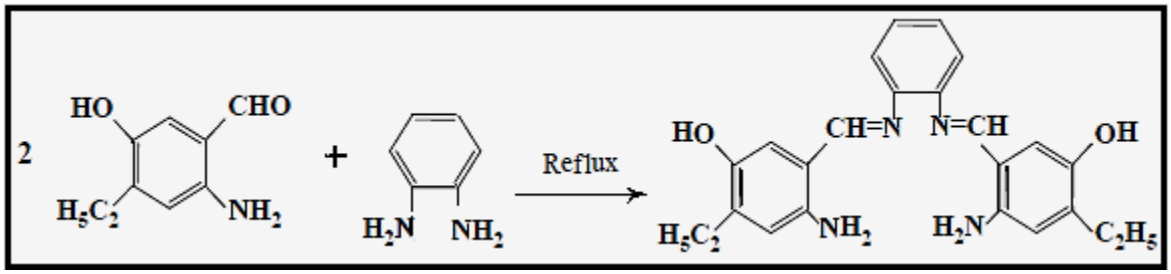
1. **Reaction with benzil to formation cyclic compounds.**

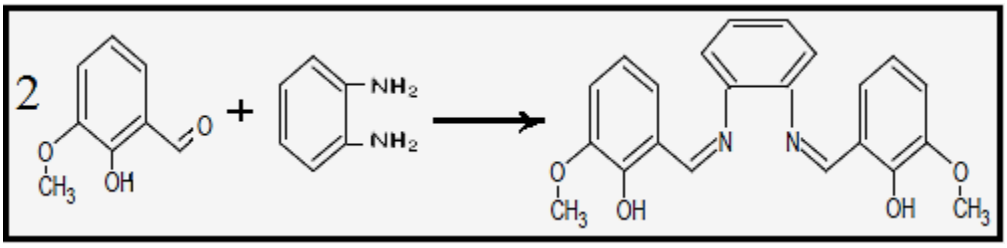


2. **Reaction with Aldehyde to formation Cyclic Compounds:** in presence of (H_2SO_4 , or H_3PO_4 , $POCl_3$, ……).

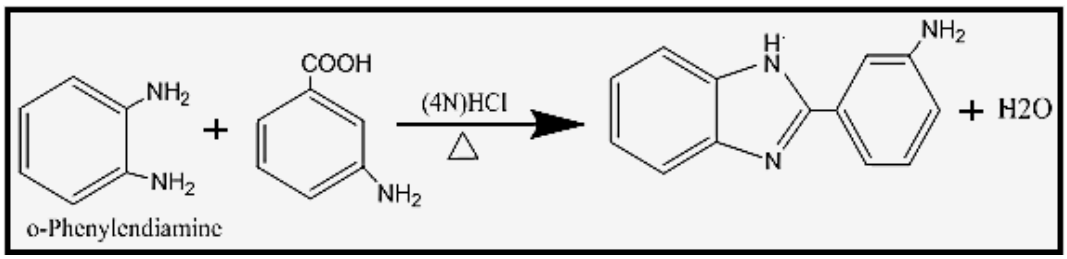


3. **Reaction with Aldehydes or Ketones** to formation Schiff bases (Imine Compounds).

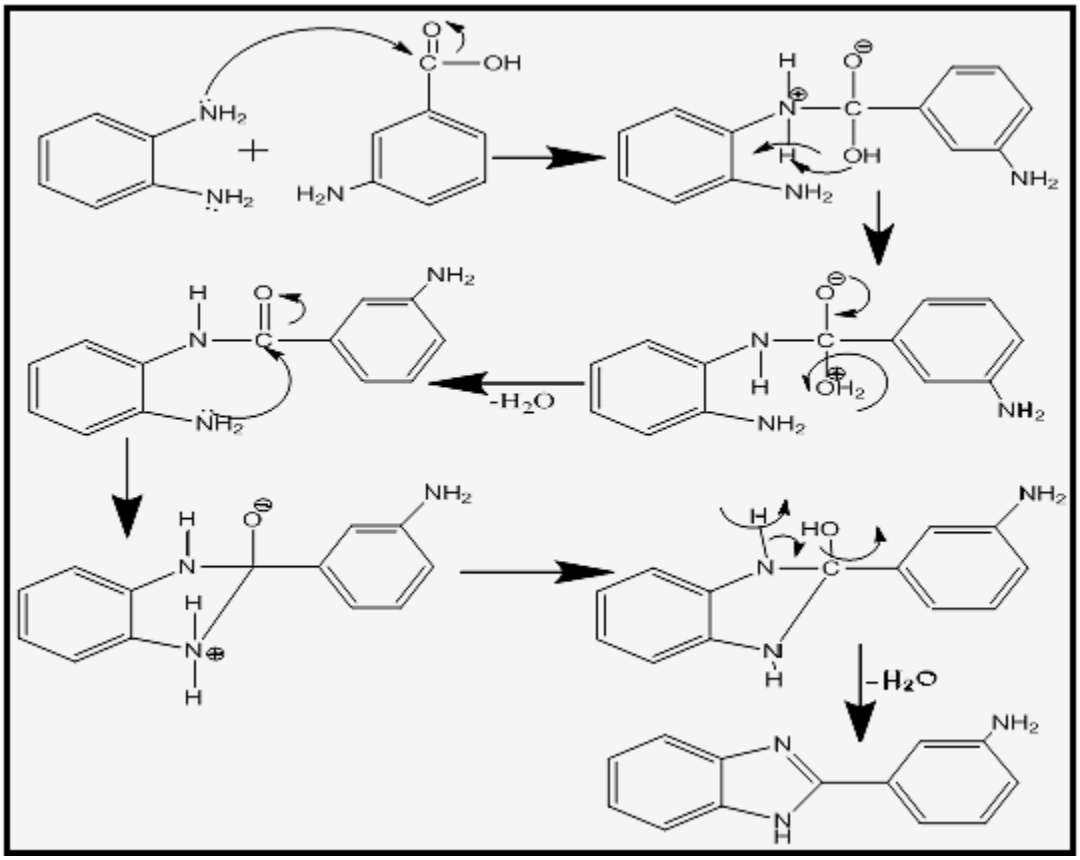




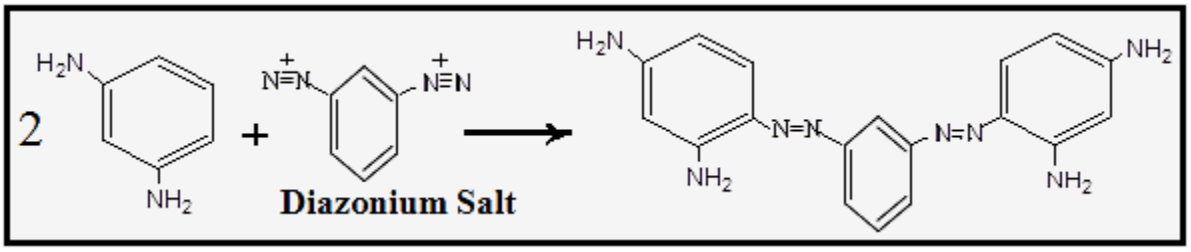
4. **Reaction with Carboxylic acid to formation Cyclic Compounds:** in presence of (4 N of HCl) with refluxing for (5 -7)hrs.



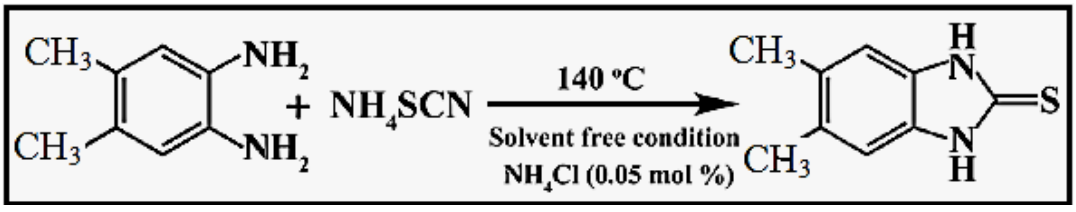
Mechanism:



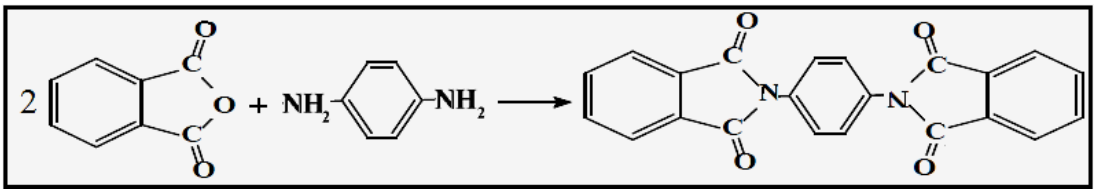
5. **Reaction with Diazonium Salts** to formation Azo Compounds.



6. **Reaction with Thiocyanate** to formation 2-mercaptobenzimidazole derivatives.

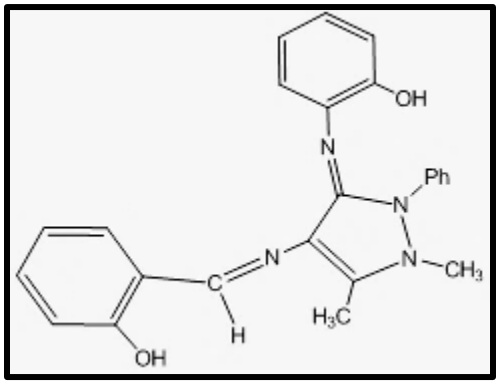


7. **Insertion Reaction :** by substitution of (O)-atom by (N)-atom via insertion reaction.

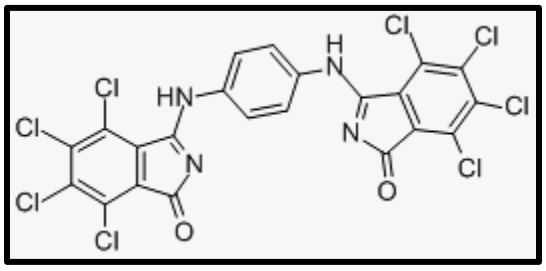


Biological Applications of Phenyl Diamine Derivatives :

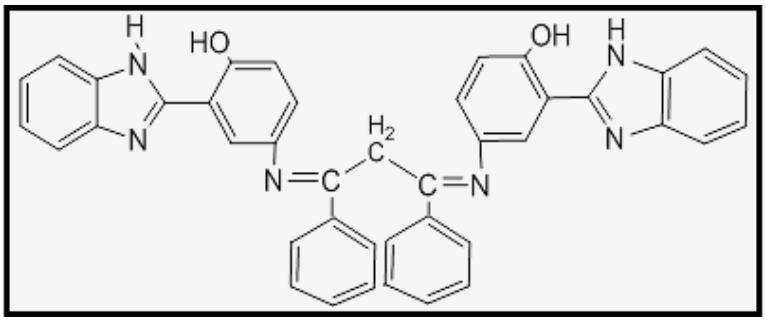
Phenylene diamine derivatives are used as antioxidants in rubber products. Treatment with nitrous acid gives benzotriazole, a corrosion inhibitor. Condensation of substituted *o*rtho-phenylenediamine with various diketones is used in the preparation of a variety of pharmaceuticals.



Antimalaria Compound derived from phenylene diamine



Antibacterial Compound derived from phenylene diamine



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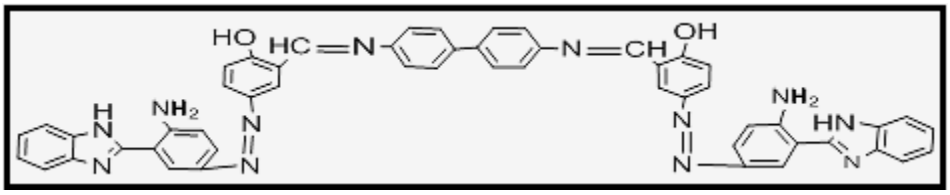
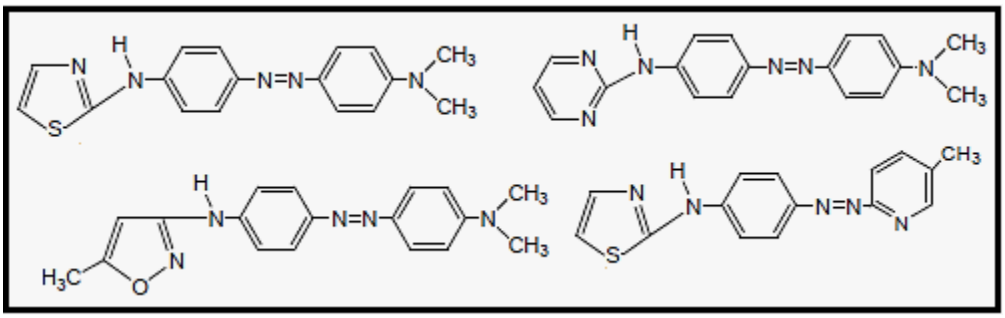
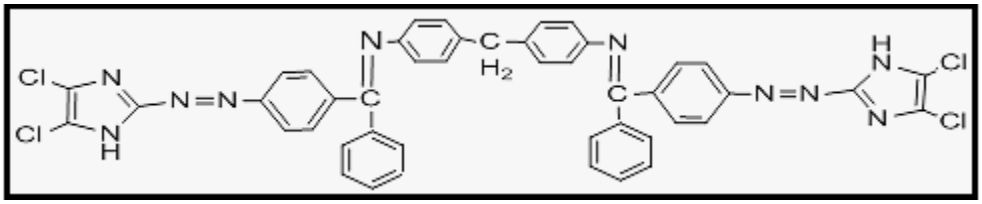
Antifungal Compound derived from phenylene diamine



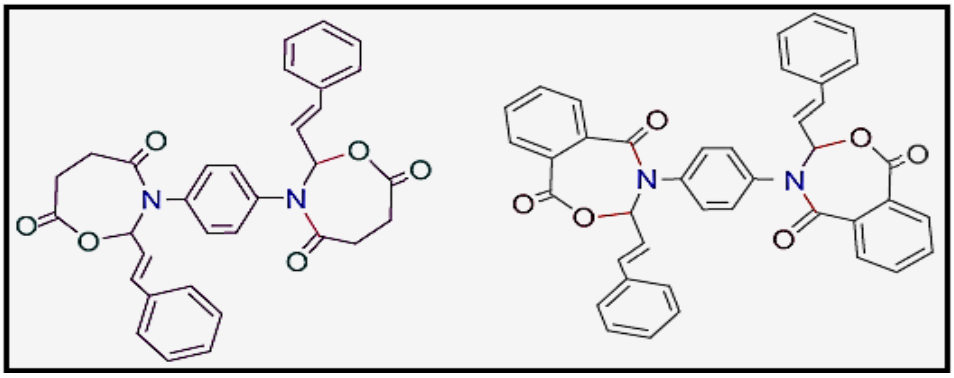
Antitumor Compound derived from phenylene diamine



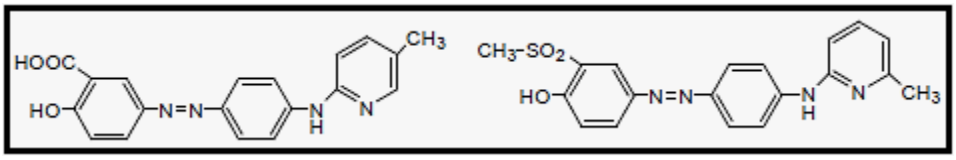
Anticancer Compounds derived from phenylene diamine



Antioxidant Compound derived from phenylene diamine



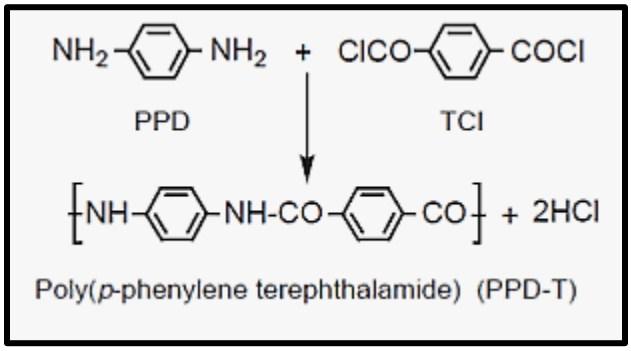
Hypnotic Compound derived from phenylene diamine



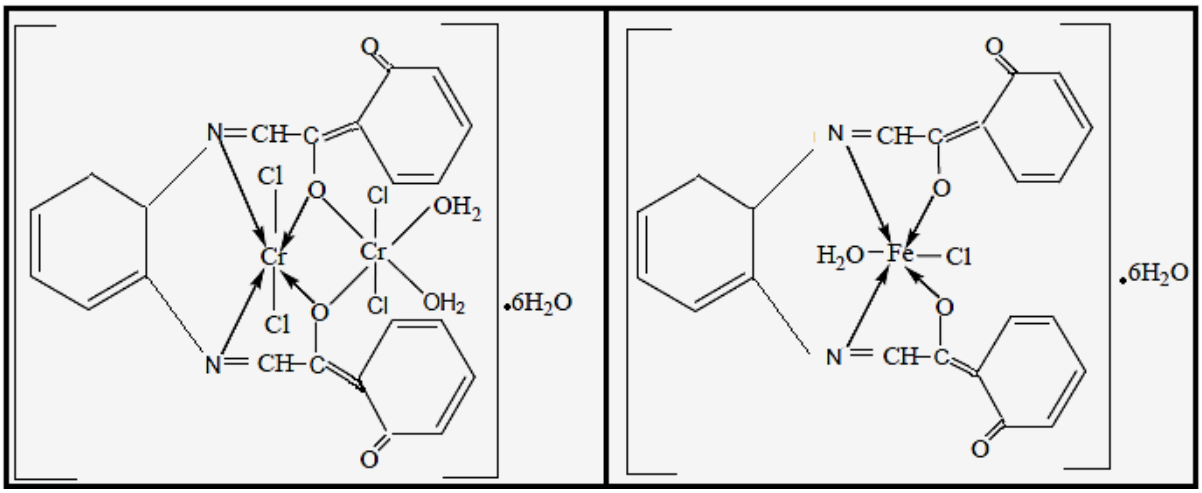
Antifungal Compound derived from phenylene diamine

Bio-Chemical Applications :

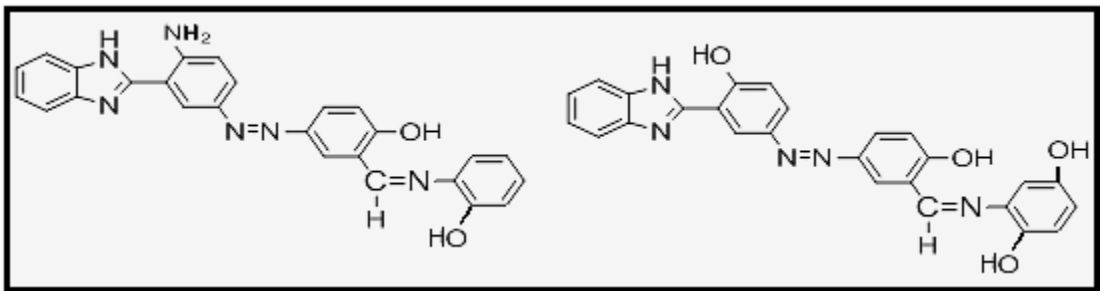
In coordination chemistry, phenylenediamine is an important ligand precursor. Schiff base derivatives, like those derived from salicylaldehyde, are excellent chelating ligands. Oxidation of its metal-phenylenediamine complexes affords the diimine derivatives, which are intensely colored and often exist in multiple stable oxidation states., There are many applications of phenylene diamine derivatives in bio-field and chemical fields like as a ligands , dyes ,….other applications.



Phenylene diamine in Synthesis of Polymers and as a bio-compound



Phenylene diamine in Formation of Complexes



Phenylene diamine in Synthesis of Ligands

CONCLUSION

Several biosynthesis routes lead to the phenylene diamine as required for the formation of bioorganic compounds as a pharmaceutical drugs .Also it is used to synthesis of dyes and is used during dyeing of hair and as an appearance in color photography and in analytical chemistry

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