Synthesis and Research of Coordination Compounds of Co (II), Ni (II), Cu (II) Salts with 2-(3-Hydroxypropyl) Benzimidazole

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ABSTRACT

A method for the synthesis of complex compounds of metals with 2-(3-Hydroxypropylbenzimidazole acetates, chlorides and nitrates of Co(II), Ni(II) and Cu(II) has been developed method for the synthesis of complex compounds of metals with 2-(3-Hydroxypropylbenzimidazole acetates, chlorides and nitrates of Co(II), Ni(II), Cu(II), as well as analysis of the composition and structure of synthesized complex compounds using modern physicochemical methods using IR spectroscopy and EDH analyses has been developed. It was found that the ligand 2-(3-Hydroxypropyl) benzimidazole is coordinated through a nitrogen atom in the imidazole ring in complexation reactions., as well as analysis of the composition and structure of synthesized complex compounds using modern physico-chemical methods using IR spectroscopy and EDH analyses. It was found that the ligand 2-(3-Hydroxypropyl) benzimidazole is coordinated through a nitrogen atom in the imidazole ring in complexation reactions.

Keywords: 2-(3-gidroksipropyl) benzimidazole, salts, elektrodonor atom, ligand, IR-spectroscopy, EDH analysis, monodentate, bidentate binding

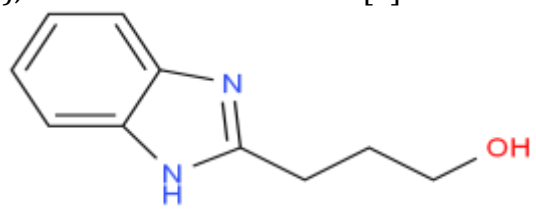
It is known that the inclusion of biometals in the composition of biologically active organic compounds not only reduces their harmful aspects, but also increases their biological activity or exhibits new biological properties in many cases. That is why synthesis of new, highly effective biopreparations and their study using modern methods are now urgent.

Currently, there are many organic and inorganic ligands that are biologically active, differ greatly in their structure and properties, contain electron-donating atoms and tend to form coordination compounds, one of the most important classes of which is benzimidazole and its derivatives are considered.

In the molecule of physiologically active compounds based on benzimidazole, strongly polarized groups with electrophilic and electrophobic reaction centers are formed, and thus they exhibit biological activity and act as the initial reagent for encapsulating enzymes or other reactive cells. This allows for the targeted synthesis of coordination compounds with a certain structure and properties [1].

Recently, benzimidazole and its derivatives have been used to create medicinal preparations that are highly active against many plant diseases.

2-(3-Hydroxypropyl) benzimidazole is a white crystalline substance, T_{Liquid} = 1640C, and it is an active ligand containing two nitrogen and oxygen. It is insoluble in a common solvent (water), and is soluble in alcohol [2].



2-(3-Hydroxypropyl) benzimidazole has three centers (two nitrogen and oxygen) that can be coordinated with metals, and it is of theoretical and practical interest through which donor atom it is coordinated in the course of the reaction.

To synthesize the complex compound $Co(L)_2 4H_2O$, 2 mol of 2-(3-hydroxypropyl) benzimidazole was added dropwise to a solution of 10 ml of alcohol from a solution of 1 mol of Co $(NO_3)_2 4H_2O$ salt in water. The reaction mixture was heated under stirring on a water bath for 40 min. Then it was left to cool.

The resulting pink precipitate was first dried in the open air, and then in a drying oven at 40^0C until the mass did not change. Product yield - 90.2%, $T_{Liquid} = 210^0$C.

Complex compounds $Ni(L)_2.4H_2O$ and $Cu(L)_2.3H_2O$ were also synthesized according to the method described above. The yield of the reaction of the pale green $Ni(L)_2.4H_2O$ complex compound is 72.9%, $T_{liquid} = 220^0$C.

The reaction yield of the dark green $Cu(L)_2 \cdot 3H_2O$ complex compound is 83.8%, $T_{liquid} = 250^0$C.

The results of the elemental analysis of the obtained complex compounds
Table -1

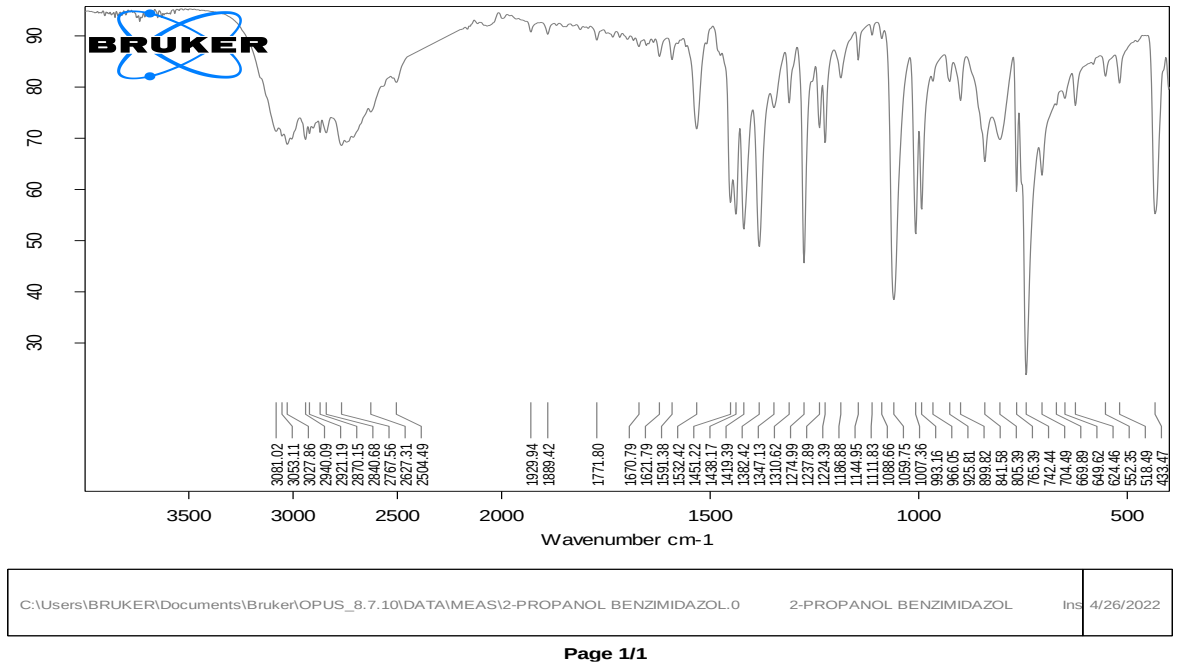
Compound	**Reaction product %**	T_{liquid} **^{0}C**	**The color**	**Found / calculated, %**				
				C	**H**	**O**	**N**	**Me**
L	95	164	White	68.00 67.90	6.90 6.80	9.10 8.90	16.01 15.90	-
$[Co(L)_2]$	92.7	210	Pink	59.00 58.80	5.00 4.99	8.00 7.87	14.00 13.96	14.00 13.99
$[Cu(L)_2]$	77.8	250	Dark green	58.30 58.27	4.80 4.77	7.80 7.79	13.60 13.57	15.50 15.48
$[Ni(L)_2]$	66.9	220	Light green	59.00 58.98	5.00 5.00	8.00 7.77	14.00 13.78	14.00 13.97

The results of the elemental analysis of the synthesized complex compounds were studied: From the results of the elemental analysis, it can be seen that the ratio is Me:L=1:2.

In the infrared spectrum of the ligand, the absorption lines belonging to the ν(C-O) bond are in the region of 1382 cm^{-1}, and the absorption lines of the ν(OH), ν_{as}(N-H) and ν_s(N-H) bonds are broad absorption in the region of 3081-2950 cm^{-1} lines were observed.

It was studied that the absorption lines related to the ν(C=N) bond in this spectrum appear in the 1621 cm^{-1} area.

Figure 1. IR- **spectrum of 2-(3-Hydroxypropyl) benzimidazole.**



The IR-spectra of the synthesized complex compounds ($Co(L)_2{\cdot}4H_2O$, $Ni(L)_2{\cdot}4H_2O$ and $Cu(L)_2{\cdot}3H_2O$) are very similar to each other, and in the 3400-2951 cm^{-1} range ν(N-H) failure to observe the absorption lines related to and the appearance of broad ν(OH) absorption lines related to water molecules in the ligand and in complex compounds instead, indicates monodentate coupling of the central ion with the ligand through the endocyclic nitrogen atom of the imidazole ring [3].

In addition, it was found that in the infrared spectrum of complex compounds, the absorption lines corresponding to ν(Me-N), which were not observed in the spectrum of the ligand, appeared in the range of 502-432 cm^{-1}.

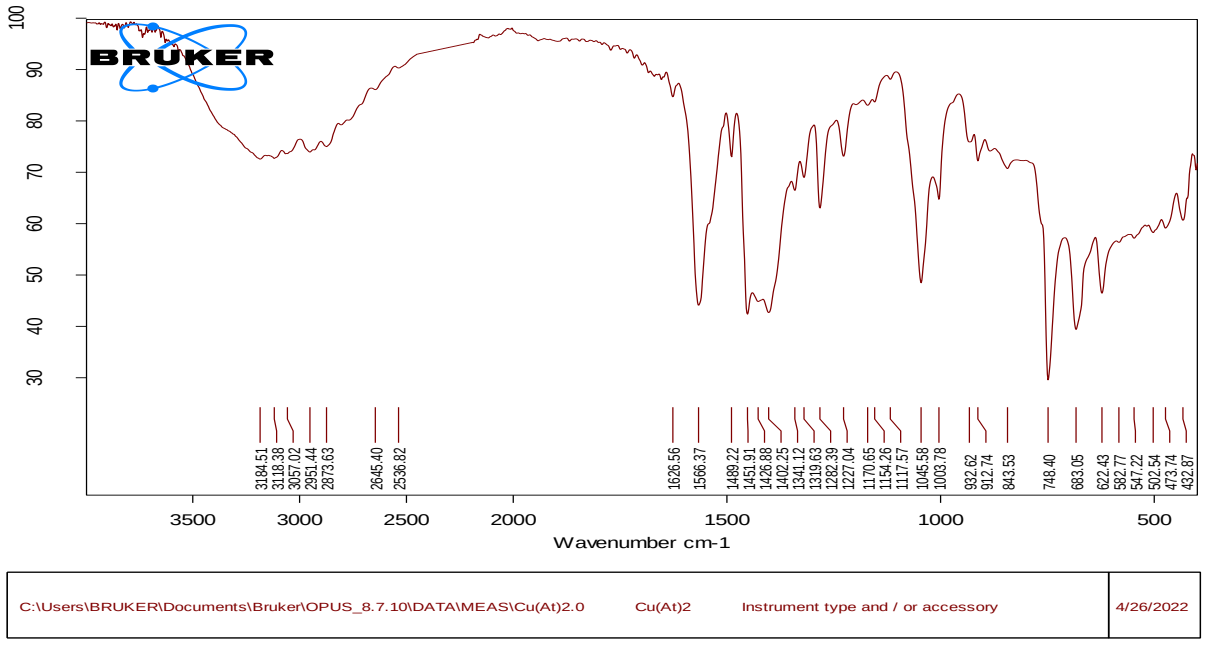
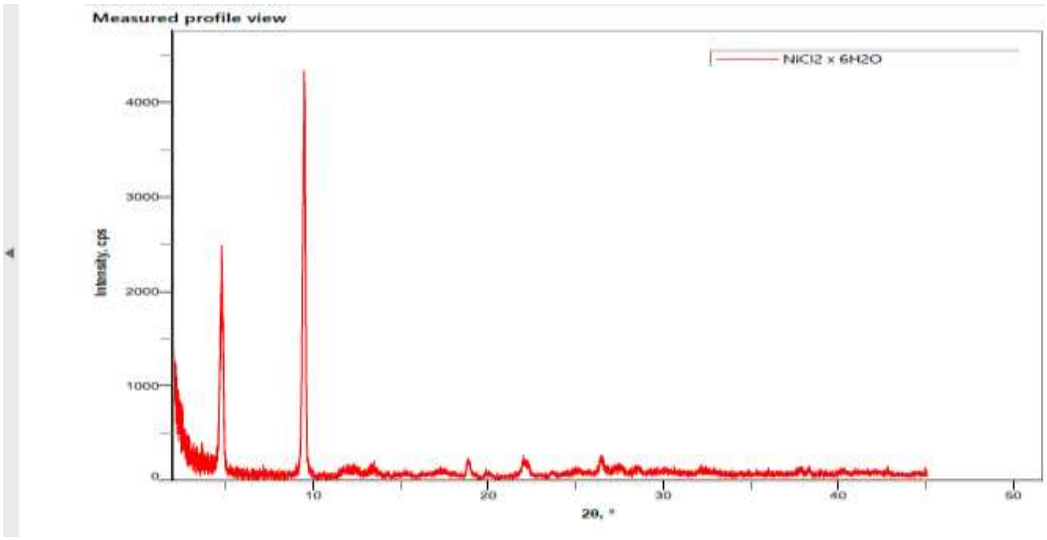


Figure 2. IR **-spectrum of $Cu(L)_2{\cdot}3H_2O$ complex compound**

Scanning electron microscopy with energy dispersive chemical analysis enables the identification of objects without changes in X-ray energy dispersive chemical analysis in terms of quantity and quality[4].

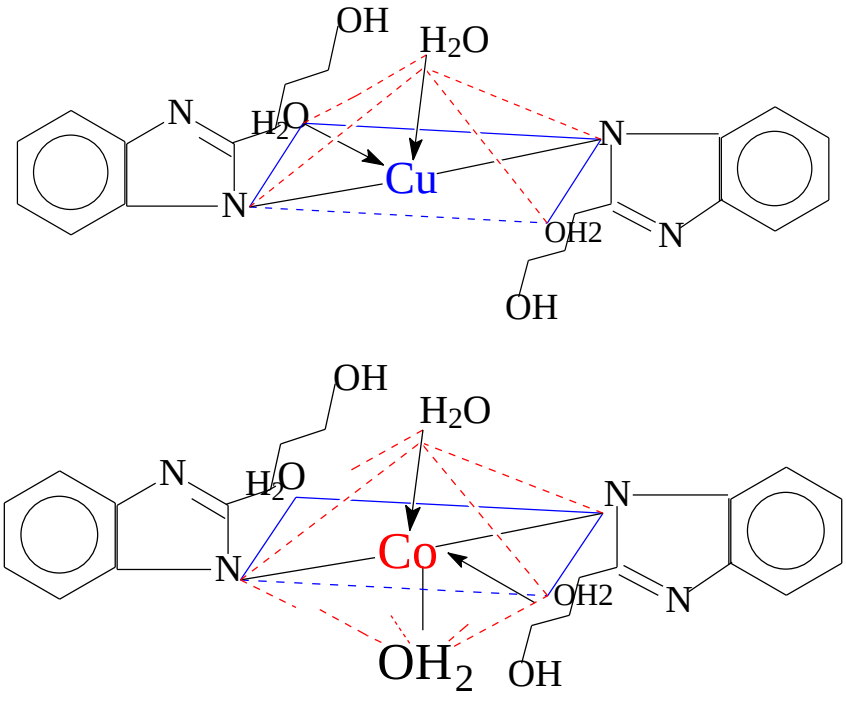


3-fig. EDX results of $Cu(L)_2 \cdot 3H_2O$ complex compound

The complex compound formed by 2-(3-hydroxypropyl) benzimidazole was studied by X-ray structure analysis. In order to determine the presence of Cu^{2+} in the synthesized $Cu(L)_2 \cdot 3H_2O$ complex compound, based on the results of electron microscopy, energy dispersive X-ray fluorescence analysis was studied.

The obtained results show that there is one metal ion (n=1) in the complex compound $Cu(L)_2 \cdot 3H_2O$ [4]. Spectra obtained from energy dispersive X-ray fluorescence analysis of complex compounds are presented in Fig. 3.

Based on the results of elemental analysis, IR-spectroscopy and EDX analysis, the spatial structures of complex compounds formed by 2-(3-hydroxypropyl) benzimidazole with Co(II), Ni(II) and Cu(II) salts were proposed as follows:



Here, (L) 2-(3-Hydroxypropyl) benzimidazole; Me – Co(II), Ni(II) and Cu(II).

Based on the obtained results, it was studied that the complex compounds $(Co(L)_2 \cdot 4H_2O$ and $Ni(L)_2 \cdot 4H_2O$ have an octahedral structure, and the complex compound $Cu(L)_2 \cdot 3H_2O)$ has a square pyramidal structure.

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