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Reaction of a 3-aryilidene-2-thiohydantoin derivative with polymeric *trans*-$[CuCl_2(DMSO)_2]_n$ complex: unexpected isomerization to dinuclear *cis*-$[\{CuCl(DMSO)_2\}(\mu\text{-}Cl)]_2$

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Abstract: The 3-arylidene-2-thiohydantoin derivative, 3-[(2-hydroxybenzylidene)amino]-2-thioxoimidazolidin-4-one, was synthesized in a two-step condensation reaction of 2-hydroxybenzaldehyde, thiosemicarbazide and ethyl chloroacetate. The ligand was structurally characterized by NMR and IR spectroscopy, as well as by elemental analysis. In the reaction of the well-known polymeric *trans*-$[CuCl_2(DMSO)_2]_n$ complex with the polydentate thiohydantoin type ligand, instead of the corresponding copper thiohydantoin complex, unexpectedly, the dinuclear *cis*-$[\{CuCl(DMSO)_2\}(\mu\text{-}Cl)]_2$ complex (**1**) was formed predominantly as the final stable product. The structure of the complex **1** was confirmed by single crystal X-ray diffraction analysis. The *cis*-complex is obtained through assisted isomerization of the *trans*-form, in which the thiohydantoin derivative has a crucial role.

Keywords: Cu(II) complex; spectroscopic characterization; single crystal X-ray analysis; antimicrobial activity.

INTRODUCTION

Thiohydantoins are important class of heterocyclic compounds. Many of them exhibit diverse biological activities, such as anticonvulsant, antitumor, anti-

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viral, antifungal, herbicidal, *etc.*[1] 2-Thiohydantoin units are attractive ligands because they can coordinate to metal ions via nitrogen and/or sulfur donor atoms.[2,3] Moreover, 2-thiohydantoins which posses different endo- and exocyclic electron-donating atoms, could act as effective polydentate ligands towards metal ions. Coordination of these compounds with transition metal ions sometimes enhances their antiviral and antitumor activity.[4]

Dimethyl sulfoxide (DMSO) is widely used as a monodentate ligand in various types of metal complexes.[5,6] Bonding of DMSO with metal ions can occur through the oxygen or through the sulphur atom. Which atom will be the donor atom can be determined through the rule of the "hardness" or "softness" of the metal centre. According to this, hard metal centres preferably bind through oxygen, and soft metal centres bind through sulphur donor atoms. X-ray crystallographic analysis of sulfoxide complexes showed that most of metal ions form O-bounded complexes with DMSO ligands, probably due to the high polarization of the S–O bond. Complexes with S-bound sulfoxides are preferred ones for the metal ions in the 8–10 groups of the periodic table of elements. On the other hand, different oxidation states of the same metal can bind through S or O, as well as S- and O-bound sulfoxides within the same complex.[7]

Applications of these metal complexes with DMSO and other sulfoxides could be described through their catalytic role, biological activity and very often as precursors in reactions of synthesis of some other coordination compounds.[8–10]

DMSO molecules in copper(II) complexes with the general formula $[CuX_2(DMSO)_2]$ (DMSO ligands in *trans* position), as well as in dicationic complex with four DMSO ligands, $[Cu(DMSO)_4](ClO_4)_2$, are coordinated mostly through the oxygen atom.[11–13] Nevertheless, the coordination of DMSO through the sulfur atom, showing quite long Cu–S bound distances, has been reported in some polymeric copper(II) complexes.[14,15] The polymeric *trans*-$[CuCl_2(DMSO)_2]_n$ complex was synthesized and spectroscopically and structurally characterized,[11,16] but the corresponding *cis*-form of the $[CuCl_2(DMSO)_2]$ complex has not been reported for a long time. Recently, formation of the dinuclear copper(II) complex, *cis*-$[\{CuCl(DMSO)_2\}(\mu\text{-}Cl)]_2$, has been reported as a consequence of decomposition of a tetranuclear $[Cu_4Cl_8(DMSO)_8(hmta)]$ complex (hmta is hexamethylenetetramine).[17]

Keeping in mind the coordination potential of 2-thiohydantoins and the significance of copper DMSO complexes, our attempt was to obtain the corresponding copper DMSO thiohydantoin complex. In this study, we report the synthesis and the spectroscopic characterization of 2-thiohydantoin type ligand, 3-[(2-hydroxybenzylidene)amino]-2-thioxoimidazolidin-4-one, and its reaction with *trans*-$[CuCl_2(DMSO)_2]_n$ complex, in which an isomerization occurs instead of coordination.

EXPERIMENTAL

Materials and methods. All chemicals and reagents are commercially available (purchased from either Sigma–Aldrich or Acros) and were used as received without further purification. Solvents were purified by distillation prior use. Anhydrous methanol was prepared by standard drying procedure. The starting complex, *trans*-$[Cu(DMSO)_2Cl_2]_n$, was prepared according to a literature procedure.[16] The purity and identity of the synthesized compounds were checked by elemental analysis and standard spectroscopic methods. IR spectra were recorded as KBr pellets on a Perkin–Elmer FT-IR spectrometer model Spectrum One over the range 4000–450 cm^{-1}. ^1H- and ^{13}C-NMR spectra were recorded on a Varian Gemini 2000 NMR spectrometer (^1H at 200 MHz, ^{13}C at 50 MHz) in DMSO-d_6 as solvent, using TMS as the internal standard. Elemental analysis was performed on an elemental Vario ELIII CHNSO analyzer in the Microanalytical Laboratory, Faculty of Chemistry, University of Belgrade. Diffraction data were collected by using ω-scan mode on an Oxford Diffraction Gemini S diffractometer, equipped with a sealed tube Mo$K\alpha$ X-ray source, and Sapphire CCD detector. Instrument control and data reduction were performed with the CrysAlisPRO.[18] Intensities were correct for the absorption effects by the multi-scan method.[19] The crystal structure was solved with the SHELXT[20] and refined with the SHELXL.[21] All non-hydrogen atoms were refined anisotropically. The methyl group hydrogen atoms were introduced in idealized positions and refined by employing the riding model which allowed refinement of the torsion angle. Their U_{iso} are approximated from U_{eq} of their parent atoms. The ShelXle software[22] was used as a graphical user interface for refinement procedures. The crystal structure model was validated by using Platon[23] and Mercury.[24]

Synthesis and characterization of 3-[(2-hydroxybenzylidene)amino]-2-thioxo-imidazolidin-4-one

The preparation of 3-[(2-hydroxybenzylidene)amino]-2-thioxoimidazolidin-4-one was done according to a previously reported protocol.[7] Salicylaldehyde (0.01 mol) and thiosemicarbazide (0.01 mol) were heated under reflux in 30 ml of methanol for 3 h and then cooled. The solid formed was filtered off, dried, and purified by re-crystallization with methanol, giving the corresponding thiosemicarbazone. A mixture of the thiosemicarbazone (0.01 mol), ethyl chloroacetate (0.01 mol) and anhydrous sodium acetate (0.03 mol) was heated under reflux in 50 ml of methanol for 6 h. The mixture was cooled and poured into cold water. The resulting solid was filtered off, washed with hot water, dried, and purified by re-crystallization with hot methanol. The structure was confirmed by elemental analysis, IR and NMR spectroscopy (Figs. S-1–S-3 of the Supplementary material to this paper).

Synthesis of cis-*[{CuCl(DMSO)$_2$}(μ-Cl)]$_2$ (**1**)*

0.76 mmol of thiohydantoin was dissolved in 10 ml of methanol under reflux. 0.76 mmol of the *trans*-$[CuCl_2(DMSO)_2]_n$ complex in 10 ml of methanol was slowly added dropwise. The mixture was heated under reflux overnight. The mixture was cooled at 0 °C and the solid was removed *in vacuo*. The off-white solid was washed with hot water. The filtrate was evaporated and the remaining solid was dissolved in a mixture of acetonitrile and chloroform (3:5). The solution was left to crystallize and two days later, big, rounded, green crystals were formed. Combustion analysis for $C_8H_{24}O_4S_4Cu_2Cl_4$: Calcd. C, 16.53, H, 4.16, S, 22.06; found C, 16.70, H, 4.35, S, 21.93. Crystallographic and refinement details are listed in Table S-I (Supplementary material).

Antimicrobial activity determination

Antimicrobial activity of the tested compounds was investigated on a panel of human pathogenic bacteria (ESKAPE panel: *Enterococcus faecium* ATCC 6037, *Staphylococcus aureus* ATCC43300, *Klebsiella pneumoniae* ATCC BAA2146, *Acinetobacter baumannii* ATCC 19606, *Pseudomonas aeruginosa* PAO1 and *Enterobacter cloacae* ATCC 13047) and fungi of *Candida* genus (*Candida albicans* SC5314, *Candida glabrata* ATCC 2001, *Candida parapsilosis* ATCC 22019 and *Candida krusei* ATCC 62528), all obtained from the National Collection of Type Cultures (NCTC) and the American Type Culture Collection (ATCC).

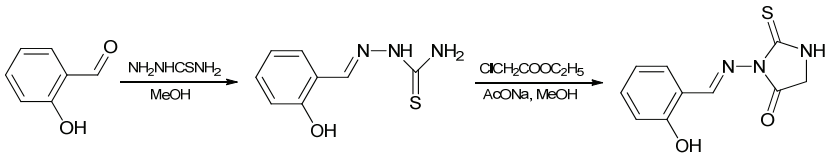
The minimum inhibitory concentrations (*MIC*s) against the tested bacteria and fungi were determined in accordance with the standard broth microdilution assay by CLSI (Clinical and Laboratory Standards Institute). Methods for Dilution Antimicrobial Susceptibility Tests for Bacteria That Grow Aerobically; Approved Standard – Tenth Edition M07-A10. CLSI)[25] and EUCAST (European Committee on Antimicrobial Susceptibility Testing, EUCAST antifungal *MIC* method for yeasts, v. 7.3.1),[26] respectively.

Bacteria and fungi were cultured in Luria-Bertani broth (Biolife Italiana s.r.l., Milano, Italy) and in RPMI 1640 medium with 2 % glucose and diluted in the respective media to give inocula with the final concentration of 5×10^5 and 10^5 CFU/ml, respectively. Stock solution of the tested compounds were made in DMSO and applied in a dose range from 1 to 250 μM. After 24-h incubation at 37 °C, the *MIC* values were determined measuring absorbance at 600 nm (OD600), using a Tecan Infinite 200 Pro multiplate reader (Tecan Group Ltd., Männedorf, Switzerland). The negative control (media only) and positive control (only microorganisms in liquid broth) on the same plate were used as references to determine the growth inhibition of bacteria. Samples with inhibition values above 90 % were classified as active agents.

RESULTS AND DISCUSSION

*Synthesis and characterization of 3-[(2-hydroxybenzylidene)amino]-2-thioxoimidazolidin-4-one and complex (**1**)*

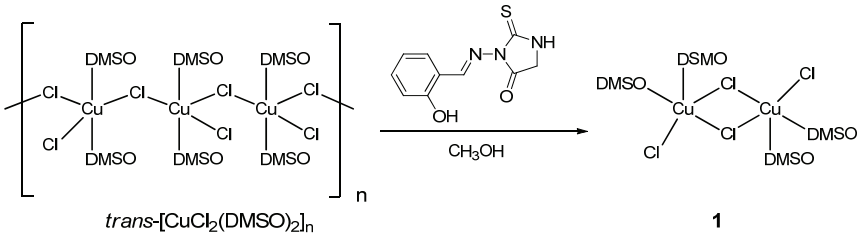
As a starting ligand for the reaction with the *trans*-$[CuCl_2(DMSO)_2]_n$ complex, a derivative of 3-arylidene-2-thiohydantoin, 3-[(2-hydroxybenzylidene)-amino]-2-thioxoimidazolidin-4-one, was used. The thiohydantoin type ligand was prepared by the previously published two step procedure (Scheme 1).[4] In the first step 2-hydroxybenaldehyde reacted with thiosemicarbazide. The obtained 2-hydroxybenaldehydethiosemicarbazone in an intramolecular cyclocondenzation reaction with ethyl chloroacetate yielded 3-[(2-hydroxybenzylidene)amino]--2-thioxoimidazolidin-4-one. Identity and purity of the synthesized compound are confirmed by elemental analysis and IR and NMR spectroscopy.



Scheme 1. Synthesis of 3-[(2-hydroxybenzylidene)amino]-2-thioxoimidazolidin-4-one.

As shown in Scheme 1, the synthesized 3-arylidene-2-tiohydantoin derivative has four potential donor atoms in its thiohydantoin nucleus: the oxygen atom of the carbonyl group, the sulphur atom of thiocarbonyl group and the two amide nitrogen atoms, as well as the exocyclic imine nitrogen atom and the oxygen atom of the phenol hydroxyl group. All these different electron-donating atoms make 3-[(2-hydroxybenzylidene)amino]-2-thioxoimidazolidin-4-one an interesting chelating ligand towards metal ions. Some complexes with transition metal ions are already prepared, such as Ag(I),[27] Hg(II),[28] Co(II),[29,30] Ni(II)[29,30] and Cu(II).[29–31]

The mononuclear *trans*-$[CuCl_2(DMSO)_2]_n$ complex was prepared according to the procedure reported by Selbin *et al.*, dissolving anhydrous copper(II) chloride in an ethanol solution of DMSO.[16] Equimolar amounts of the *trans*-$[CuCl_2(DMSO)_2]_n$ complex and 3-[(2-hydroxybenzylidene)amino]-2-thioxoimidazolidin-4-one ligand were mixed in methanol. But, in the reaction of *trans*-$[CuCl_2(DMSO)_2]_n$ complex with the polydentate 3-[(2hydroxybenzylidene)-amino]-2-thioxoimidazolidin-4-one ligand, coordination did not occur at all and the dinuclear copper(II) complex, *cis*-$[\{CuCl(DMSO)_2\}(\mu\text{-}Cl)]_2$ (**1**), was formed predominantly as the final stable product (Scheme 2). The starting thiohydantoin-type ligand is mostly recovered after the reaction.



Scheme 2. Synthesis of complex **1.**

*Crystal structure description of **1***

The molecular structure of complex **1** is depicted in Fig. 1, and selected structural parameters are listed in Table I. Structural parameters of **1** are in excellent agreement (*rmsd* of all atoms is 0.0283 Å) with those published by Vakulka and Goreshnik.[17] For the sake of more rigorous comparison, the chemical coordinates of the molecular structures (excluding hydrogen atoms), expressed as independent distances, d_i, and corresponding standard uncertainties, $\sigma(d_i)$, are calculated for both structures. Although the number of non-hydrogen atoms, N, is 24, there are only 30 independent distances ($(3N - 6)/2$), since the point group of the molecule is C_i. Differences Δp_i between pairs of independent distances in the two structures, $d(1)_i$ and $d(2)_i$, are examined in a half-normal probability plot (Fig. 2).[32] The values $\delta m_i = \Delta p_i/\sigma(\Delta p_i)$ are calculated by Eq. (1) for all indepen-

dent distances, arranged as ordered statistics, and plotted *versus* the expected values (α_i) for half-normal probability deviates. The corresponding plot is then analyzed by linear regression:

$$\delta m_i = |d(1)_i - d(2)_i| / [\sigma^2(d(1)_i) - \sigma^2(d(2)_i)]^{1/2} \quad (1)$$

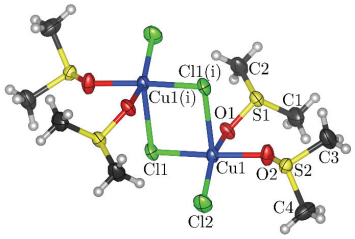


Fig. 1. Molecular structure of complex **1,** with atom labelling scheme. Symmetry code (i) $-x + 1, -y + 1, -z + 1$.

TABLE I. Structural parameters of complex **1**; symmetry code (i) $-x + 1, -y + 1, -z + 1$

Bond	Length, Å	Bonds	Angle, °
Cu1–O1	2.0082(16)	O1–Cu1–O2	83.57(7)
Cu1–O2	1.9662(18)	O1–Cu1–Cl1	88.70(5)
Cu1–Cl1	2.2631(7)	O2–Cu1–Cl2	92.71(5)
Cu1–Cl2	2.2484(7)	Cl1–Cu1–Cl2	94.40(3)
Cu1–Cl1^i	2.7164(8)	O1–Cu1–Cl1^i	91.62(6)
S1–O1	1.5322(17)	O2–Cu1–Cl1^i	91.71(7)
S2–O2	1.5300(18)	Cl1–Cu1–Cl1^i	88.44(2)
S1–C1	1.769(3)	Cl2–Cu1–Cl1^i	112.26(3)
S1–C2	1.767(3)	O1–Cu1–Cl2	155.96(6)
S2–C3	1.777(3)	O2–Cu1–Cl1	172.26(5)
S2–C4	1.765(3)	Cu1–Cl1–Cu1^i	91.56(2)

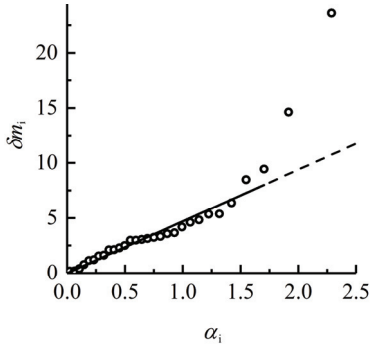


Fig. 2. Half normal probability plot of experimental deviates between two structural determination of complex **1**. The equation of the linear regression line is $\delta m_i = 4.7(2)\alpha_i - 0.01(17)$. Pearson correlation coefficient $R = 0.976$.

Results reveal that, apart from two outliers, the experimental deviates are normally distributed, indicating no significant geometrical differences between structures. The intercept (−0.01(17)), and the slope (4.7(2)) of the linear regression line, calculated after zero-weighting two outlier values, indicate the absence of systematic errors, and underestimation of the standard uncertainties of the

experimental interatomic distances by factor 4.7, respectively. It must be taken into consideration that two structures are determined at significantly different temperatures (295 K for our structure, and 150 K for structure by Vakulka and Goreshnik[17]), which affects the scale of standard uncertainties.

The crystal structure of **1** is composed of centrosymmetric dinuclear molecules, with Cu···Cu separation of 3.5827(7) Å. Cu(II) atoms are five-coordinated, by two DMSO molecules, and three chloride ions. Cu–ligand bond lengths lay in the wide range, from 1.9662(18) to 2.7164(8) Å, due to different nature of ligating atoms and the coordination polyhedron peculiarities. Coordination environment of Cu(II) atom is deformed, and can be best described as square pyramidal, so that basal plane consists of O1, O2, Cl1, Cl2, and the apical position is occupied by $Cl1^i$ (symmetry code (i) $-x + 1, -y + 1, -z + 1$). Three chloride ions constitute bonds with Cu(II) of different lengths. As expected, the shortest is the one incorporating non-bridging basal chloride ion (Cu1-Cl2 = 2.2484(7) Å); intermediate is the one incorporating bridging basal chloride ion (Cu1–Cl1 = = 2.2631(7) Å); the longest one incorporates apical chloride ion (Cl1–Cu1 = = 2.7164(8) Å).

The degree of coordination polyhedron deformation is assessed by several criteria. The simplest, Addison trigonality index,[33] which has value of 0 for a square pyramid with equal *trans*-basal angles (SPY-5), and 1 for a perfect trigonal bipyramid (TBPY-5), amounts 0.27 for complex **1**. More complex analysis by the Holmes method[34] yields slightly different degree of distortion, as percentage along Berry pseudorotation coordinate $C_{4v} \rightarrow C_{2v} \rightarrow D_{3h}$ is 39.7 (the chosen reference SPY-5 has *trans*-basal angles of 150°). Finally, when deformations were analyzed by continuous shape measures, according to which the coordination polyhedron is closer to SPY-5 (CShM = 2.175 if the *trans*-basal angles of the reference shape are 150°, and CShM = 3.005 if the *trans*-basal angles of the reference shape are 174°) then to TBPY-5 (CShM = 3.496). These CShM values point to substantial deformations from the reference shapes, and calculation of Berry pseudorotation coordinate is not reliable, as the distance of polyhedron at hand from minimal distortion path from SPY-5 to TBPY-5 is too severe. To exclude the effect of Cu–ligand bond lengths differences, and make the results comparable to Holmes method, calculation of continuous shape measures was also performed with equalized Cu–ligand bond lengths. The result shows that the polyhedron traversed 43.1 % along minimal distortion path from SPY-5 (with *trans*-basal angles of 174°) to TBPY-5, which is in good agreement with the value obtained by the Holmes method.

Molecular packing in the crystal structure of complex **1** is depicted in Fig. 3. Hirshfeld surface analysis of this complex reveals dominant intermolecular contacts. The H···H contacts are the most abundant (48 %), followed by Cl···H (31 %), and O···H (10 %), which is depicted through fingerprint plots in Fig. 4.

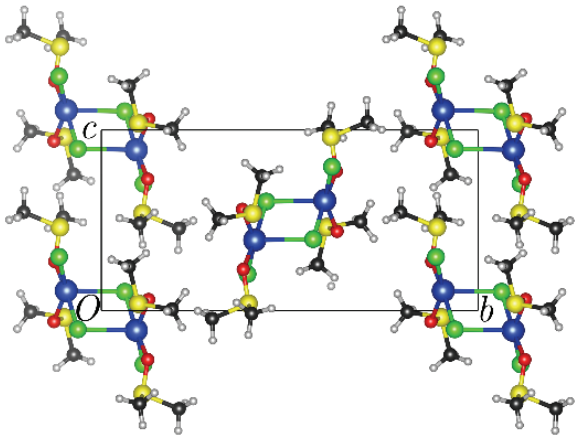


Fig. 3. Molecular packing in the crystal structure of complex **1** viewed along crystallographic *a*-axis.

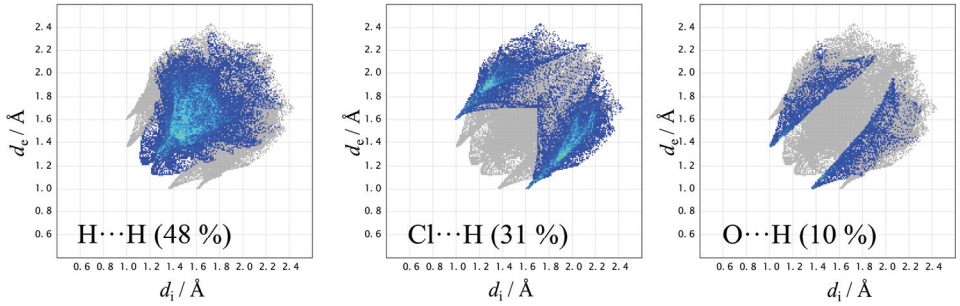


Fig. 4. Fingerprint plots of complex **1**.

The calculation of enrichment ratios, reveals that Cl···H and O···H intermolecular contacts are enriched ($E_{ClH} = 1.33$, $E_{OH} = 1.37$), S···H and H···H are slightly depleted ($E_{SH} = 0.84$, $E_{HH} = 0.91$.), while Cl···S, Cl···Cl, Cl···O, and O···O significantly or totally avoided ($E_{ClS} = 0.52$, $E_{ClCl} = 0$, $E_{ClO} = 0$, $E_{OO} = 0$) in the crystal structure of complex **1**. The Cl···H and O···H intermolecular contacts involve C3 and C4 methyl groups hydrogen atoms, as well as apical $Cl1^{i}$, and O1 atoms. Hirshfeld surface breakdown into element-specific contacts, and corresponding enrichment ratios are summarized in Table II.

Complex isomerization and stability study

Until now, only one procedure for the synthesis of complex **1** was reported, based on a specific preparation *via* decomposition of a tetranuclear $[Cu_4Cl_8(DMSO)_8(hmta)]$ complex. It should be noted that the *cis*-configuration of DMSO molecules in complex **1** was directly transferred from $[Cu_4Cl_8(DMSO)_8(hmta)]$, while the *trans*-$[CuCl_2(DMSO)_2]_n$ isomer was always

formed as the final stable product. The crystals of the template complex left under the parent solution slowly (after about one week) decomposed, while complex **1** appeared consequently. Crystals of **1** were also found to slowly decompose (after 1-2 weeks), resulting in formation of the *trans*-$[CuCl_2(DMSO)_2]_n$ complex only.[47]

TABLE II. Hirshfeld surface breakdown into element-specific contacts, and corresponding enrichment ratios for the crystal structure of complex **1**

Atom	Observed contact, %					
	Cu	Cl	S	O	C	H
Cu	0	0	0	0	0	1.4
Cl	0	0	0.4	0	0	18.0
S	0	0.4	1.5	0	0	3.5
O	0	0	0	0	0	5.3
C	0	0	0	0	0	0
H	1.3	12.5	2.5	4.8	0	48.4
	Enrichment ratio					
	Cu	Cl	S	O	C	H
Cu	–	–	–	–	–	–
Cl	–	0.00	–	–	–	–
S	–	0.52	–	–	–	–
O	–	0.00	–	0.00	–	–
C	–	–	–	–	–	–
H	–	1.33	0.84	1.37	–	0.91

In our reaction, under the given experimental conditions, complex **1** was the final stable product, as it did not decompose to the *trans*-isomer, like it was previously reported. This is supported by the fact that the initial filtrate of the reaction mixture was left to crystallize for 4-5 weeks. As crystals were not formed after the given period, the filtrate was evaporated and the *cis*-isomer was obtained through recrystallization.

The isomerization of *trans*-$[CuCl_2(DMSO)_2]_n$ to its *cis*-form occurred under the influence of the 2-thiohydantoin derivative. To confirm this, a simple control experiment was done. The reaction was repeated under the same experimental conditions, but without the 2-thiohydantoin derivative. Since in this case, the *cis*--isomer was not obtained, it is concluded that 3-[(2-hydroxybenzylidene)amino]--2-thioxoimidazolidin-4-one has a crucial role in the isomerization. Based on the results reported so far, we assume that some sort of unstable intermediate complex was formed, in which the DMSO ligands, due to their size and steric hindrance, occupy *cis*-position in respects to each other. Upon cleavage of the 2-thiohydantoin derivative, DMSO ligands retain the *cis*-configuration during the formation of dinuclear complex.

*Antimicrobial activity of **1***. The results of antimicrobial susceptibility assay showed that none of the tested compounds had antibacterial activity towards the ESKAPE pathogens and the tested *Candida* species, except of a moderate activity against *Candida krusei*. Among them, complex **1** showed better antifungal activity than *trans*-$[CuCl_2(DMSO)_2]_n$ complex on *C. krusei* ATCC 62528, showing the *MIC* value of 125 and 250 μM, respectively. Although *Candida albicans* remains the most common fungal isolate obtained from the blood of the patients with invasive fungal infection, the epidemiological studies conducted in last 20 years have demonstrated a trend toward an increased prevalence of infections with non-albicans *Candida* spp., such as *C. glabrata* and *C. krusei*.[35] Moreover, *C. krusei* was evidenced as the leading cause of candidemia in some hematologic malignancies, especially in the patients with neutropenia caused by chemotherapy.[35] Taken together, these data indicate that the tested complexes may be regarded for further derivatization, aimed to improve their anticandidal activity.

Our further investigation will be directed to the resolving of the mechanism of this reaction and the role of the presence of the starting thiohydantoin type ligand in the isomerization of *trans*-complex to *cis*-form by theoretical methods.

CONCLUSION

A 3-arylidene-2-thiohydantoin derivative, 3-[(2-hydroxybenzylidene)-amino]-2-thioxoimidazolidin-4-one, was synthesized and fully characterized. In the reaction of the thiohydantoin with the polymeric *trans*-$[CuCl_2(DMSO)_2]_n$ complex, instead of the corresponding copper-thiohydantoin complex, the dinuclear *cis*-$[\{CuCl(DMSO)_2\}(\mu\text{-}Cl)]_2$ (**1**) was obtained. The structure of the complex was fully characterized by X-ray crystallography and a deeper insight into the structure and molecular packing was achieved. The complex **1** showed moderate antimicrobial activity against *Candida krusei*. Decomposition of the *cis*-complex to the more stable *trans*-form was not observed and the *cis*-isomer was found to be the final stable product. A clear role of the thiohydantoin derivative in the isomerization of the complex is implied, since no isomerization occurred in the absence of the thiohydantoin.

SUPPLEMENTARY MATERIAL

Additional data are available electronically at the pages of journal website: https://www.shd-pub.org.rs/index.php/JSCS/index, or from the corresponding author on request. Crystallographic data associated with this publication are deposited with the Cambridge Crystallographic Data Centre under the CCDC Number 2023294. They can be obtained free of charge via https://www.ccdc.cam.ac.uk/structures/.

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ИЗВОД

РЕАКЦИЈА ДЕРИВАТА 3-АРИЛИДЕН-2-ТИОХИДАНТОИНА СА ПОЛИМЕРНИМ *trans*-[$CuCl_2(DMSO)_2]_n$ КОМПЛЕКСОМ: НЕОЧЕКИВАНА ИЗОМЕРИЗАЦИЈА У ДИНУКЛЕАРНИ *cis*-[{$CuCl(DMSO)_2$}(μ-Cl)]$_2$

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3-Арилиден-2-тиохидантоински дериват, 3-[(2-хидроксибензилиден)амино]-2-тиоксоимидазолидин-4-он, је синтетисан у двостепеној кондензационој реакцији 2-хидроксибензалдехида, тиосемикарбазида и етил-хлорацетата. Лиганд је структурно окарактерисан NMR и IR спектроскопијом, као и елементалном анализом. У реакцији добро познатог полимерног *trans*-[$CuCl_2(DMSO)_2]_n$ комплекса са овим полидентатним лигандом тиохидантоинског типа, уместо одговарајућег тиохидантоинског комплекса бакра(II), неочекивано је настао динуклеарни *cis*-[{$CuCl(DMSO)_2$}(μ-Cl)]$_2$ комплекс (**1**) као главни, коначни, стабилни производ. Молекулска структура комплекса **1** је одређена рендгенском структурном анализом. *cis*-Комплекс је добијен потпомогнутом изомеризацијом *trans*-облика, у којој тиохидантоински дериват има пресудну улогу.

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