

Supplementary materials

# New Cu<sup>+2</sup> Complexes with N-Sulfonamide Ligands: Potential Antitumor, Antibacterial, and Antioxidant Agents

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**Table S1.** Selected bond lengths (Å) and angles (°) for the complex **C1**.

Bond	d (Å)	Bond	d (Å)	Angle (°)	Angle (°)
N2A-C11A (thiadiazole)	1.315	N2B-C11B (thiadiazole)	1.323	N1A-S1A-O2A 8	N1B-S1B-O2B 107.30
N3A-C12A (thiadiazole)	1.299	N3B-C12B (thiadiazole)	1.297	N1A-S1A-O1A 3	N1B-S1B-O1B 112.76
C11A-S2A (thiadiazole)	1.752	C11B-S2B (thiadiazole)	1.745	N1A-S1A-C8A 1	N1A-S1A-C8A 106.73
C12A-S2A (thiadiazole)	1.736	C12B-S2B (thiadiazole)	1.731	O2A-S1A-C8A 2	O2B-S1B-C8B 105.94
N2A-N3A (thiadiazole)	1.380	N2B-N3B (thiadiazole)	1.388	O1A-S1A-C8A 6	O1A-S1A-C8A 106.08
N1A-C11A	1.355	N1B-C11B	1.342	O1A-S1A-O2A 6	O1B-S1B-O2B 117.32
N1A-S1A	1.602	N1B-S1B	1.601	C11A-N1A-S1A 7	C11A-N1A-S1A 121.99
S1A-O2A	1.441	S1B-O2B	1.437	N2A-C11A-N1A 2	N2B-C11B-N1B 120.40
S1A-O1A	1.452	S1B-O1B	1.441	S1A-C11A-N1A 4	S1B-C11B-N1B 128.24
S1A-C8A	1.759	S1B-C8B	1.775	N2A-Cu1-O1W	N2B-Cu1-O1W 92.20

Cu1-N2A	2.012	Cu1-N2B	2.013	N2A-Cu1-O3W	88.99	N2B-Cu1-O3W	87.89
Cu1-O1W	2.002			O2W-Cu1-O3W	92.09	O2W-Cu1-O1W	86.61
Cu1-O2W	2.435						
Cu1-O3W	1.982						

**Table S2.** Selected bond lengths (Å) and angles (°) for complex **C2**.

Bond	d (Å)	Angle	(°)
N2-C11 (thiadiazole)	1.323	N1-S1-O2	113.10
N3-C12 (thiadiazole)	1.273	N1-S1-O1	106.52
C11-S2 (thiadiazole)	1.757	N1-S1-C8	106.04
C12-S2 (thiadiazole)	1.741	O2-S1-C8	107.06
N2-N3 (thiadiazole)	1.386	O1-S1-C8	106.75
N1-C11	1.332	O1-S1-O2	116.71
N1-S1	1.590	C11-N1-S1	120.62
S1-O2	1.444	N2-C11-N1	120.86
S1-O1	1.447	S1-C11-N1	129.05
S1-C8	1.770	N2-Cu1-O1W	96.87
Cu1-N2	1.987	N2-Cu1-N4	86.81
Cu1-O1W	2.285	O1W-Cu1-N4	91.67
Cu1-N4	2.064		

**Table S3.** Hydrogen bonds geometries in investigated crystals (Å, °).

Structure	D-H...A	D-H	H...A	D...A	<(D-H...A)
Complex C1	O1W-H1WB...O2B	0.872	2.135(4)	2.965(3)	158.8(8)
	O2W-H2WB...N1A	0.858	2.163(2)	2.893(1)	142.8(3)
	O2W-H2WA...N1B	0.859	2.219(1)	2.927(3)	139.6(1)
	C3B-H3B...O1B	0.930	2.498(1)	3.317(2)	147.0(5)
	C2B-H2B...S2B	0.930	2.826(4)	3.722(1)	161.9(5)
	C19-H19B...O1A	0.960	2.512(3)	3.457(6)	168.5(6)
Complex C2	O1W-H1WA...O1	0.850	2.118(4)	2.950(1)	165.7(8)
	O2D-H2D...O1B	0.970	2.546(6)	4.773(4)	143.9(1)

**Table S4:** Minimum inhibitory concentration of copper complexes.

Bacterial strains	MIC (mg/l)	
	C1 complex	C2 complex
<i>Staphylococcus aureus</i> ATCC 6538P	0.289	0.202
<i>Bacillus cerreus</i> ATCC 14579	0.304	0.293
<i>Escherichia coli</i> ATCC 10536	0.231	0.184
<i>Pseudomonas aeruginosa</i> ATCC 27853	0.196	0.089

**Table S5.** The influence of complex C2 on biochemical parameters

Group	ALAT (U/L)	ASAT (U/L)	Total protein (g/dL)	Albumin (g/dL)	Creatinine (mg/dL)	Urea (mg/dL)
Male	44.27±1.25	169.48±3.66	5.88±0.31	3.29±0.42	0.56±0.12	19.36±2.12
Female	56.49±2.18	195.29±4.21	6.12±0.14	3.87±0.55	0.67±0.15	21.27±3.23

Normal values: ALAT 26-77U/L, ASAT 54-269 U/L, Total protein 3.5-7.2g/dL, Albumin 2.5-4.8g/dL, Creatinine 0.3-1 mg/dL, Urea 12-28 mg/dL (Mean±S.E.M.) (n=5) [48]

**Table S6.** The influence of complex C2 on erythrogram

Group	RBC ( $10^{12}/L$ )	HGB (g/dL)	HCT (%)	MCH (pg)	MCHC (g/dL)	MCV (fl)	RDWs (fl)
Male	9.19±0.63	13.62±1.022	43.28±2.01	16.25±0.17	32.86±0.49	47.26±1.99	34.37±1.03
Female	9.54±1.03	14.71±1.21	45.06±2.88	16.78±0.76	32.83±0.55	48.98±2.63	36.29±1.25

RBC: red blood cells; HGB: haemoglobin; HCT: hematocrit; MCH: mean corpuscular haemoglobin; MCHC: mean corpuscular haemoglobin concentration; MCV: mean corpuscular volume; RDW: red blood cells distribution width; Normal values: RBC 7-12.5  $10^{12}/L$ , HGB 10.2-16.6 g/dL, HCT 39-49 % (Mean±S.E.M.) (n=5) [48]

**Table S7.** The influence of complex C2 on leukogram

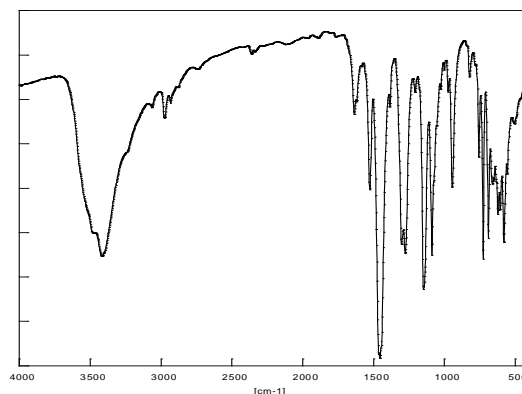
Group	WBC ( $10^9/L$ )	LYM ( $10^9/L$ )	GRA ( $10^9/L$ )	MID ( $10^9/L$ )
Male	9.67±1.21	6.51±0.99	2.42±0.89	0.29±0.07
Female	10.55±1.01	6.98±0.76	2.82±1.03	0.33±0.15

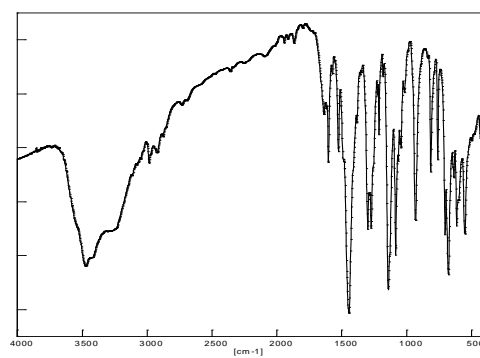
WBC: white blood cells; LYM: lymphocytes; GRA: granulocytes; MID: middle cells; Normal value: WBC 6-15  $10^9/L$  (Mean±S.E.M.) (n=5) [48]

**Table S8.** The influence of complex C2 on thrombogram

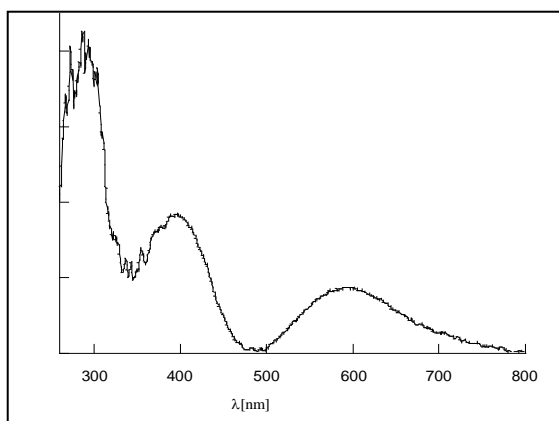
Group	PLT ( $10^6/L$ )	PCT (%)	MPV (fl)	PDWs (fl)
Male	922.20±100.11	0.62±0.12	6.78±0.34	7.33±0.19
Female	944.96±136.39	0.75±0.24	7.59±0.82	8.99±1.06

PLT: total platelet count; PCT: platelet hematocrit; MPV: mean platelet volume; PDWs: platelet distribution width; Normal value: PLT 800-1100  $10^6/L$  (Mean±S.E.M.)(n=5) [48]

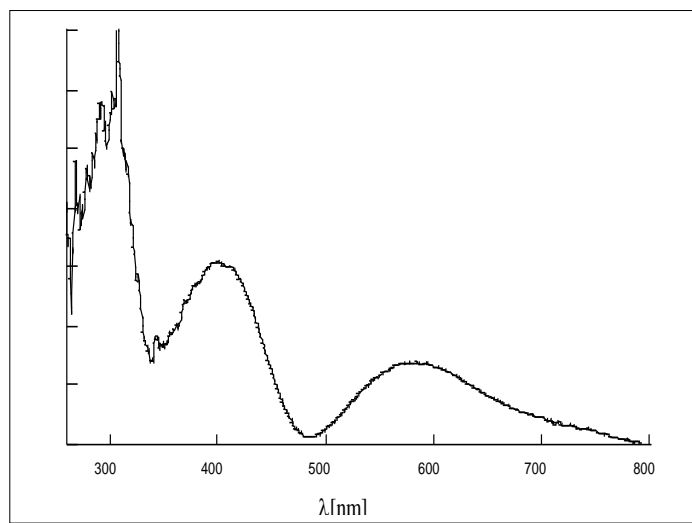
**Figure S1.** IR spectrum of the complex C1



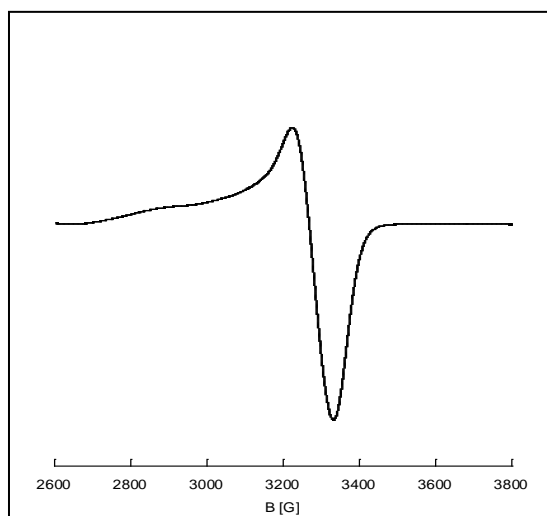
**Figure S2.** IR spectrum of the complex **C2**



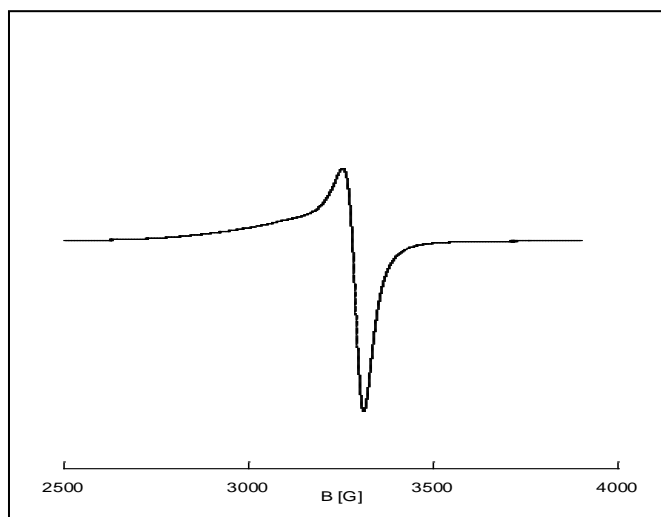
**Figure S3.** UV-VIS spectrum of the complex **C1**



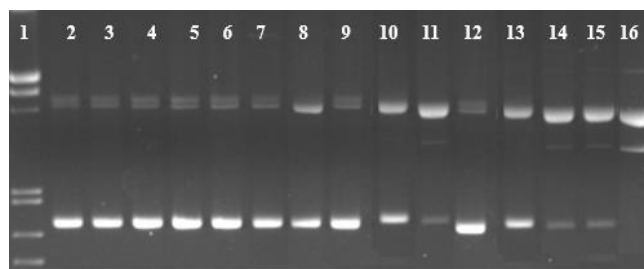
**Figure S4.** UV-VIS spectrum of the complex **C2**



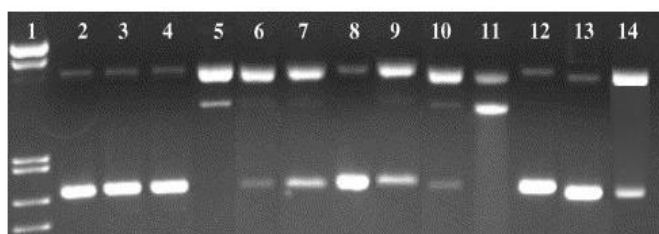
**Figure S5.** RES spectrum of the complex **C1**



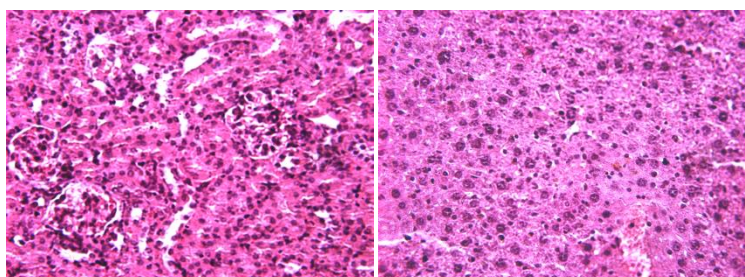
**Figure S6.** RES spectrum of the complex **C2**



**Figure S7.** Electroferogram in agarose gel of the pUC18 plasmid treated with CuSO<sub>4</sub>, the C1 and C2 complexes and bis(o-phenanthroline) copper(II).  
 1.base marker; 2.control; 3.control+red.; 4.5μM CuSO<sub>4</sub>+red.; 5.10μM CuSO<sub>4</sub>+red.; 6.15μM CuSO<sub>4</sub>+ red.; 7.20μM CuSO<sub>4</sub>+red.; 8. 5μM C1+red.; 9.10μM C1+red.; 10.15μM C1+red.; 11.20μM C1+red.; 12. 5μM C2+red.; 13.10 μM C2+red.; 14.15 μM C2+red.; 15.20μM C2+red.; 16.20μM [Cu(phen)<sub>2</sub>]<sup>2+</sup>+ red.



**Figure S8.** Electroferogram in agarose gel of the pUC18 plasmid treated with the C1 and C2 complexes and various inhibiting agents.  
 1.base marker; 2. control; 3. complex C1 10μM without inhibitors+ reducing agents ; 4. complex C2 10μM without inhibitors+ reducing agents; 5. C1 + DMSO+ reducing agents; 6. C1 + SOD + reducing agents; 7. C1 + distamycin + reducing agents; 8. C1 + neocuproine + reducing agents; 9. C1 + NaN<sub>3</sub> + reducing agents; 10. C2 + DMSO+ reducing agents; 11. C2 + SOD + reducing agents; 12. C2 + distamycin + reducing agents; 13. C2 + neocuproine + reducing agents; 14. C2 + NaN<sub>3</sub> + reducing agents





**Figure S9.** Histological analyses of renal cortical (left) and hepatic lobe (right). HE (x200)