

КРАТКИЕ СООБЩЕНИЯ

UDK 548.737

ZINC(II) COMPLEX OF THE CHELATING AGENT EDTA BIS(TYROSINE)

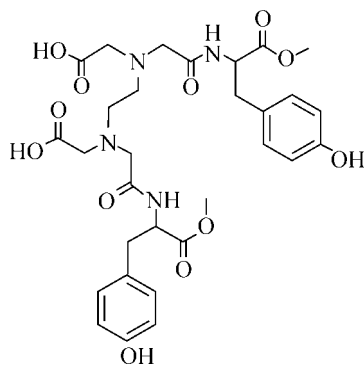
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The synthesis and results of X-ray structural analysis for a novel zinc(II) compound, $Zn(O_{12}N_4C_{28}H_{32}) \cdot 6H_2O$, are reported. The compound is triclinic, *P*1, with unit cell parameters $a = 11.0906(3) \text{ \AA}$, $b = 13.1404(3) \text{ \AA}$, $c = 14.0725(3) \text{ \AA}$; $\beta = 89.910(1)^\circ$. In contrast to the analogous Cu(II) complex, the unit cell contains two independent molecules of the Zn(II) complex and twelve independent molecules of water.

Key words: chelation therapy, decorporation agent, single crystal structure.

Introduction. Metal ion complexes of EDTA conjugates have numerous uses in medicine including as heavy metal decorporation agents, mimics for metalloenzyme studies and as contrast imaging agents. We have developed a series of metal ion chelating anti-inflammatory agents based upon the removal of deleterious redox active metal ions by EDTA analogues [1–9]. Conjugation of an anti-oxidant to EDTA enhances free radical scavenging as redox active metal ions mediate radical generation. More recently, these analogues have been demonstrated to have potential as probes for radicals and as catalytic anti-oxidants having catalase and superoxide dismutase activities. Subtle structural changes impart considerable differences in catalytic antioxidant activities [4]. As these chelators may be useful therapeutically, as mimetics for the antioxidant enzyme CuZn-superoxide dismutase, we have studied their complexes with Cu(II) [3, 6] and Zn(II) ions.



EDTA bis(methyl tyrosinate)

Experimental. Synthesis. The chelator was prepared by standard peptide synthetic methods as described previously [4]. The Zn(II) complex was prepared from an aqueous solution containing equimolar (10 mM) $ZnCl_2$ and EDTA bis(methyl tyrosinate). Clear crystals appeared after slow evaporation between one and two weeks in a yield of over 50 %.

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X-Ray Crystallography.

Data were collected on a kappa CCD diffractometer (MoK α , $\lambda = 0.71073$ Å). The structure was solved by direct methods (WinGX) and refined by full matrix least squares (SHELXL-97). Drawing was done using ORTEP-3 for Windows (20 % ellipsoids). The H atoms of the NH and OH groups were refined. H atoms for the water molecules were fixed. All other H atoms were in riding mode. The unit cell contains two independent molecules of the Zn complex and twelve independent molecules of water. The crystal structure shows that the esters have been lost upon recrystallization owing to the low pH.

A summary of the crystal structure data and structure solution parameters is given in Table 1. Full crystallographic data have been deposited at the Cambridge Crystallographic Database Centre (www.ccdc.cam.ac.uk) and are available on request quoting the deposition number (Table 1).

Results and Discussion. Comparison of the structures of the title Zn(II) complex, [ZnL]·6H₂O, and analogous Cu(II) complex, [CuL]·7H₂O [6] (available at the CCDC as deposition number 632634), of EDTA bis(tyrosine) highlights the subtleties involved in the adoption of particular conformations as dictated by different metal ions. Variances in stereochemistry, degrees of hydrogen bonding, unit cell and numbers of independent complexes are seen for the same peptoid with different metal ions (Tables 1 and 2). In the case of the Zn complex two similar but crystallographically independent complexes are formed giving rise to an approximate translational overlap observed in the structure (Fig. 1 and 2). Selected bond lengths and angles at the metal site highlight these subtleties as shown in Table 2.

Table 2

Selected bond lengths [Å] and angles [°] for CuL [6] and ZnL complexes

Bond / angle	[CuL]	[ZnL]	[ZnL]b	Bond / angle	[CuL]	[ZnL]	[ZnL]b
M—O(1)	1.980(3)	2.041(3)	2.047(3)	N(1)—M—O(3)'	94.03(15)	88.29(10)	89.32(10)
M—N(1)	2.044(4)	2.179(3)	2.174(3)	N(1)'—M—O(3)'	80.17(13)	79.18(9)	79.57(9)
M—O(3)	2.288(3)	2.130(2)	2.122(3)	O(1)—M—O(3)	95.08(15)	98.27(10)	93.64(11)
O(1)'—M—O(1)	108.0(2)	120.04(10)	120.30(11)	N(1)—M—O(3)	80.18(13)	79.97(10)	80.26(10)
NO(1)'—M—N(1)	165.76(14)	158.29(10)	158.61(11)	O(3)'—M—O(3)	172.0(2)	169.52(10)	170.35(10)
O(1)—M—N(1)	83.01(15)	80.00(10)	79.84(11)	C(3)—O(1)—M	111.1(3)	113.0(2)	114.6(2)
N(1)—M—N(1)'	87.8(2)	82.34(11)	82.38(11)	C(5)—O(3)—M	109.3(3)	114.4(2)	114.2(2)
O(1)—M—O(3)'	89.62(13)	88.61(10)	88.95(10)				

Table 1
Crystal data and structure refinement for [ZnL]·6H₂O

Empirical formula	C ₂₈ H ₃₂ N ₄ O ₁₂ Zn, 6H ₂ O
Formula weight	790.04
Temperature	173(2) K
Crystal system, space group	Triclinic, P1 (No.1)
Unit cell dimensions	$a = 11.0906(3)$ Å $\alpha = 104.894(1)^\circ$ $b = 13.1404(3)$ Å $\beta = 89.910(1)^\circ$ $c = 14.0725(3)$ Å $\gamma = 114.226(1)^\circ$
Volume	1794.80(7) Å ³
Z	2
Calculated density	1.46 g/cm ³
Absorption coefficient	0.766 mm ⁻¹
Crystal size	0.4 × 0.3 × 0.3 mm ³
Reflections collected	26496
Independent reflections	12004 [$R(\text{int}) = 0.037$]
Reflections with $I > 2\sigma(I)$	11684
Data / restraints / parameters	12004 / 3 / 955
Goodness-of-fit on F^2	1.042
Final R indices [$I > 2\sigma(I)$]	$R1 = 0.041$, $wR2 = 0.104$
R indices (all data)	$R1 = 0.042$, $wR2 = 0.105$
Absolute structure parameter	0.006(7)
Largest diff. peak and hole	2.00 and -0.60 e/Å (near Zn)
CCDC deposition number	632498

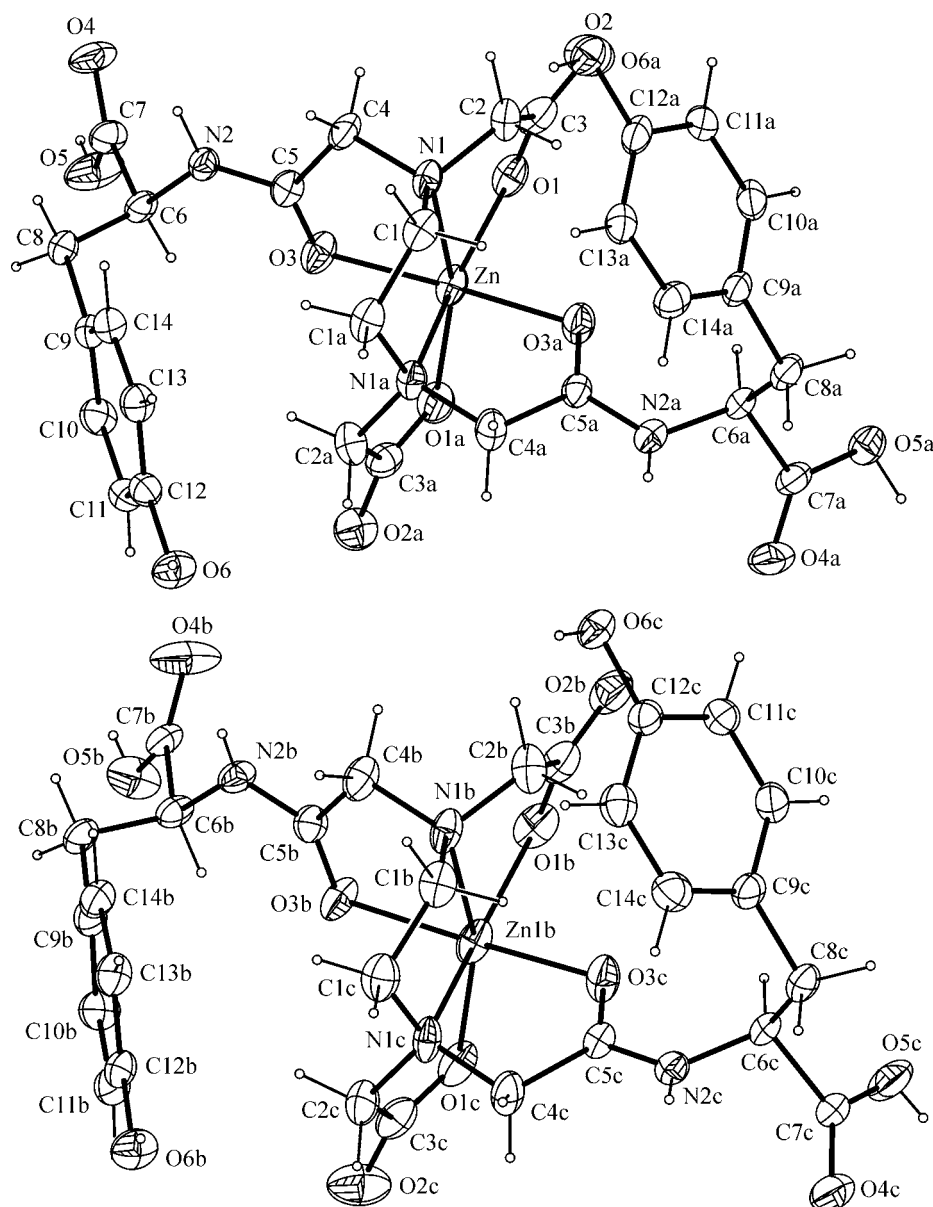


Fig. 1. Views of the two independent [ZnL] molecules in the crystal structure of the title compound showing the atomic labelling schemes

Despite all complexes having pseudo-octahedral coordination, the most pronounced differences around the metal ions are the clear Jahn-Teller effects found in the Cu(II) species which are highlighted in Table 2 for the metal-chelator bonds and associated angles. For example the bond lengths for the M—O(1) unit vary from 1.980 Å in CuL to >2.04 Å for the corresponding Zn complexes. The corresponding bond angles for the O(1)′—M—O(1) moieties of ca 120° for the ZnL species are considerably reduced to 108° for the Cu analogue. As for the analogous cupric species [6], hydrogen bonding

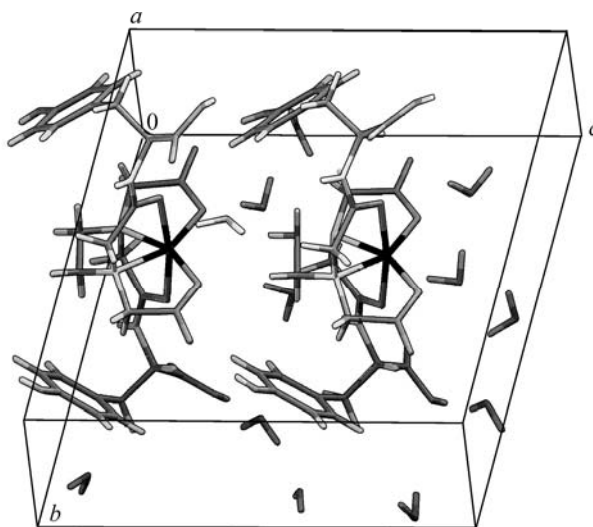


Fig. 2. Molecular packing in the [ZnL]·6H₂O crystal

appears to play a major role in crystal growth. However, in this case the independent complexes may result from torsional constraints imparted by different degrees of hydrogen bonding.

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