

# 新規化合物 2-(9-anthylmethylamino)ethyl-appended 1,4,7,10-tetraazacyclododecane

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## A new 2-(9-anthylmethylamino)ethyl-appended 1,4,7,10-tetraazacyclododecane

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**ABSTRACT** : A new 2-(9-anthylmethylamino)ethyl-appended cyclen, L<sup>3</sup> (1-(2-(9-anthylmethylamino)ethyl)-1,4,7,10-tetraazacyclododecane)(cyclen=1,4,7,10-tetraazacyclododecane), was synthesized and characterized for a new Zn<sup>2+</sup> chelation-enhanced fluorophore, in comparison with previously reported 9-anthymethylcyclen L<sup>1</sup> (1-(9-anthylmethyl)-1,4,7,10-tetraazacyclododecane) and dansylamide cyclen L<sup>2</sup>. L<sup>3</sup> showed protonation constants log  $K_{ai}$  of 10.57±0.02, 9.10±0.02, 7.15±0.02<2, and <2. The log  $K_{a3}$  value of 7.15 was assigned to the pendant 2-(9-anthylmethylamino)-ethyl on the basis of the pH-dependent <sup>1</sup>H NMR and fluorescence spectroscopic measurements. The potentiometric pH titration study indicated extremely stable 1:1 Zn<sup>2+</sup>-L<sup>3</sup> complexation with a stability constant log  $K_s(\text{ZnL}^3)$  (where  $K_s(\text{ZnL}^3)=[\text{ZnL}^3]/[\text{Zn}^{2+}][\text{L}^3]$  (M<sup>-1</sup>)) of 17.6 at 25°C with  $I=0.1$  (NaNO<sub>3</sub>), which is translated into the much smaller apparent dissociation constant  $K_d(=[\text{Zn}^{2+}]_{\text{free}}[\text{L}^3]_{\text{free}}/[\text{ZnL}^3])$  of 2 × 10<sup>-11</sup> M with respect to 5 × 10<sup>-8</sup> M for L<sup>1</sup> at pH 7.4. The quantum yield ( $\Phi=0.14$ ) in the fluorescent emission of L<sup>3</sup> increased  $\Phi=0.44$  upon complexation with zinc(II) ion at pH 7.4 (excitation at 368 nm). The fluorescence of 5 μM L<sup>3</sup> at pH 7.4 linearly increased with a 0.1-5 μM concentration of zinc(II). By comparison, the fluorescent emission of the free ligand L<sup>1</sup> decreased upon binding to Zn<sup>2+</sup> (from  $\Phi=0.27$  to  $\Phi=0.19$ ) at pH 7.4 (excitation at 368 nm). The Zn<sup>2+</sup> complexation with L<sup>3</sup> occurred more rapidly (the second-order rate constant  $k_2$  is 4.6 × 10<sup>2</sup> M<sup>-1</sup> s<sup>-1</sup>) at pH 7.4 than that with L<sup>1</sup> ( $k_2=5.6 \times 10^1 \text{M}^{-1} \text{s}^{-1}$ ) and L<sup>2</sup> ( $k_2=1.4 \times 10^2 \text{M}^{-1} \text{s}^{-1}$ ). With an additionally inserted ethylamine in the pendant group, the macrocyclic ligand L<sup>3</sup> is a more effective and practical zinc(II) fluorophore than L<sup>1</sup>.

抄録 新規化合物、A new 2-(9-anthylmethylamino)ethyl-appended cyclen(L<sup>3</sup>)を合成し、亜鉛との相互作用と、亜鉛錯体を形成する際の蛍光を検討した。その結果、微量亜鉛検出化合物として、すでに合成した二つのサイクレン誘導体9-anthymethylcyclen (L<sup>1</sup>)や dansylamide cyclen (L<sup>2</sup>)よりも、生体 pH で亜鉛に対する選択性に優れ、錯体生成は速いことが判った。

新規化合物は、生体内の微量亜鉛の検出試薬として期待される。

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