

论文  
骨螺紫及其铜配合物与人血清白蛋白相互作用的光谱学研究

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摘要:

采用荧光光谱法、紫外光谱法和傅里叶红外光谱法(FTIR)研究了模拟生理条件下人血清白蛋白(HSA)与骨螺紫(Mx)及其铜配合物(Mx-Cu<sup>2+</sup>)的相互作用。根据荧光猝灭数据, 二元体系与三元体系中的作用机制均为静态猝灭, 在Cu<sup>2+</sup>存在下, HSA与Mx之间的结合常数与结合位点数明显加大, 结合两个体系的紫外吸收光谱可知, 在三元体系中, Cu<sup>2+</sup>与Mx形成配合物后再与HSA发生作用; 根据Förster能量转移理论, 求得Mx及Mx-Cu<sup>2+</sup>与HSA上氨基酸残基间的距离分别为 $r=2.82$  nm和 $r=2.53$  nm, 三元体系能量转移效率 $E'$ 大于二元体系 $E$ , 说明Cu<sup>2+</sup>在结合作用中可能起到了能量转移介质的作用; 对 $\Delta\lambda=60$  nm时的同步荧光光谱的分析表明, 在Mx及Mx-Cu<sup>2+</sup>作用下, HSA色氨酸残基的微区构象发生了变化, 色氨酸残基所处环境的极性增加; 运用FTIR技术定量测定了HSA与Mx及Mx-Cu<sup>2+</sup>作用后二级结构的变化, 发现2个体系中HSA二级结构变化情况基本一致,  $\alpha$ -螺旋结构明显减少约8%,  $\beta$ -折叠也减少约1%, 而 $\beta$ -转角和无规卷曲分别增加了约6%和4%。说明对HSA二级结构造成影响的主要因素是Mx, 它与HSA的结合使蛋白质分子中的肽链部分展开, 二级结构从 $\alpha$ -螺旋和 $\beta$ -折叠向 $\beta$ -转角和无规卷曲结构转变, 分子结构的松散程度增加。

关键词: 骨螺紫及其铜配合物; 人血清白蛋白; 荧光光谱; 傅里叶红外光谱; 二级结构

Spectroscopic Studies on the Interaction of Murexide and Murexide-Copper Complex with Human Serum Albumin

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Abstract:

The interactions of human serum albumin(HSA) with murexide(Mx) and murexide-copper complex(Mx-Cu<sup>2+</sup>) were investigated by fluorescence spectroscopy and Fourier transform infrared spectroscopy (FTIR) under simulative physiological conditions. The results show Mx and Mx-Cu<sup>2+</sup> could quench the intrinsic fluorescence of HSA by static quenching and hydrophobic interaction was the predominant intermolecular force. The binding constant of Mx and HSA was increased in the presence of copper(II). According to fluorescence resonance energy transfer(FRET), the distancer between donor(HSA) and acceptor(Mx and Mx-Cu<sup>2+</sup>) were calculated to be 2.82 and 2.53 nm, the ternary system energy transfer efficiency  $E' >$  binary system  $E$ , which showed the copper ion acts as the energy transfer agency. The synchronous fluorescence and FTIR study suggested that Mx and Mx-Cu<sup>2+</sup> can cause almost the same changes in the secondary structure of HSA. Upon binding with Mx or Mx-Cu<sup>2+</sup> complex, the  $\alpha$ -helix structure was reduced more than 8%, the  $\beta$ -sheet reduced 1%, while the  $\beta$ -turn increased 6%, and the random coil increased 4%. The results show that the main factor of secondary structure changing is Mx.

Keywords: Murexide and murexide-copper complex; Human serum albumin; Fluorescence spectroscopy; Fourier transform infrared spectroscopy; Secondary structure

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