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Nanotechnology approaches to study amyloid toxicity in relation to Alzheimer's disease

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Alzheimer's disease is a progressive neurodegenerative disease associated with amyloid fibril formation in the brain. The exact molecular mechanism of amyloid fibril formation and toxicity is not well understood, which delays development of novel and effective approaches to prevent and treat the disease. Past studies show that hormone "melatonin", which regulates and maintains the body's circadian rhythm, may counteract the effects of amyloid toxicity. Molecular mechanism of amyloid toxicity involves interaction of amyloid-beta peptide with lipid membrane. We used Atomic Force Microscopy (AFM), Atomic Force Spectroscopy (AFS) and Surface Plasmon Resonance (SPR) in association with microfluidic device to investigate effect of melatonin on binding of amyloid-beta to the lipid membrane. The results show that melatonin alter properties of lipid membrane counteracting effect of cholesterol. The binding of amyloid-beta to membrane was recorded in the real time and was correlated with the membrane damage that it produced. We show that melatonin readily partitions into the membrane and protects the membrane from amyloid-beta binding, which may be an important aspect in its protective mechanism against neurodegenerative diseases such as Alzheimer's.

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