DIPARTIMENTO FARMACIA

Dottorato di ricerca in Scienza del Farmaco e delle Sostanze Bioattive

UNIVERSITÀ DI PISA

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terrà un seminario dal titolo:

"Optical-based bioanalytical assays for drugs quality control and diagnostic applications"

Giovedì 20 Giugno 2025
Ore 15,00
Aula Magna
Dipartimento di Farmacia
Via Bonanno, 6

Organizzatrice: Prof.ssa Maria Minunni

Abstract

OPTICAL-BASED BIOANALYTICAL ASSAYS FOR DRUGS QUALITY CONTROL AND DIAGNOSTIC APPLICATIONS

The critical need for precise, accessible chemical quantification, underscored by the pandemic's demands for virus/antibody detection and vaccine validation, drives innovation in bioanalytical chemistry. This research focuses on developing novel optical-based assays to enhance clinical diagnostics and pharmaceutical quality control, leveraging the advantages of UV-Vis and fluorescence techniques: ease of use, non-destructiveness, and potential for label-free detection.

Key advancements include harnessing the unique photoluminescent properties of copper nanoclusters (CuNCs). Their affordability, low toxicity, large Stokes shifts, and biocompatibility enable highly sensitive detection of trace analytes in complex biological matrices. This capability was successfully applied to quantify human serum albumin, a crucial biomarker for conditions like albuminuria.

To address challenges in nanomaterial synthesis, a novel highly fluorescent biomaterial was developed through serotonin self-oxidation and polymerization. Characterized spectroscopically, electrochemically, and via mass spectrometry, this fluorophore demonstrated high quantum yield. Its strong emission enabled a sensitive quenching-based optical method for quantifying copper ions (Cu(II)) in human urine, offering potential for diagnosing copper-dependent diseases.

For essential pharmaceutical analysis, innovative colorimetric methods were designed. A novel assay quantified the Parkinson's drug levodopa through the first isolation and stabilization of purple melanochrome, characterized by mass spectrometry. This assay proved directly applicable for monitoring levodopa and dopamine levels in human urine. Its counterpart, carbidopa, was quantified in pharmaceutical formulations using a selective vanillin condensation reaction forming yellow 4-hydroxy-3-methoxybenzaldazine.

Collectively, these optical strategies – utilizing CuNCs for protein detection, a serotonin-derived fluorophore for metal ions, and specific colorimetric reactions for pharmaceuticals – significantly advance the sensitivity, reliability, and accessibility of diagnostic tools and drug quality control methods for clinical and pharmaceutical applications.