Contribution ID: **54** Type: **Poster**

Green Synthesis of Silver Nanoparticles Using Natural Capping Agents: UV-Vis study and pH-Dependent Size Control

In the realm of nanotechnology, the synthesis of nanoparticles with unique properties and applications continues to be a subject of intense research. Due to its higher electrical as well as thermal conductivity, strong anti-biocidal activities and higher catalytic activity for oxidation of ethylene, silver nanoparticle (Ag-NP) has become intensively studied metal nanoparticles. In this work, we present a novel approach to the green synthesis of Ag-NPs using three natural capping agents: Hibiscus rosa Sinensis, Tulsi (Ocimum sanctum), and green tea (Camellia sinensis). These capping agents, known for their rich phytochemical composition, serve as both reducing and stabilizing agents in the synthesis process. Here, Silver solution served as the precursor material in the synthesis process.

The synthesized AgNPs were characterized using UV-Vis spectroscopy, revealing distinct signature peaks at 443 nm, 448 nm, and 491 nm for Hibiscus rosa Sinensis, Tulsi, and green tea, respectively. These peaks indicate the successful formation of AgNPs. Notably, the observed blue shift of the wavelength suggests variations in the sizes of the AgNPs produced with each capping agent, with Hibiscus rosa Sinensis yielding smaller-sized nanoparticles compared to the other two agents.

Additionally, we investigated the pH of the capping agents prior to synthesis, finding values of 6.67, 5.54, and 5 for Hibiscus rosa Sinensis, Tulsi, and green tea, respectively. These pH measurements revealed an interesting correlation between the alkaline character of the capping agent and the resultant nanoparticle size. This observation provides valuable insights into the pH-dependent control of AgNP size during green synthesis.

Our findings highlight the potential of natural capping agents in tailoring the properties of silver nanoparticles for various applications. This work offers a deeper understanding of the green synthesis process and its pH-dependent size modulation, paving the way for innovative nanomaterial design and utilization in diverse fields.

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Session Classification: Technical Session 03

Track Classification: Track 02