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Towards Sustainability and Waste-to-Wealth Approach: Development of Metallic Nanoparticles for Anti-Bacterial Applications using Local Palm Tree Waste

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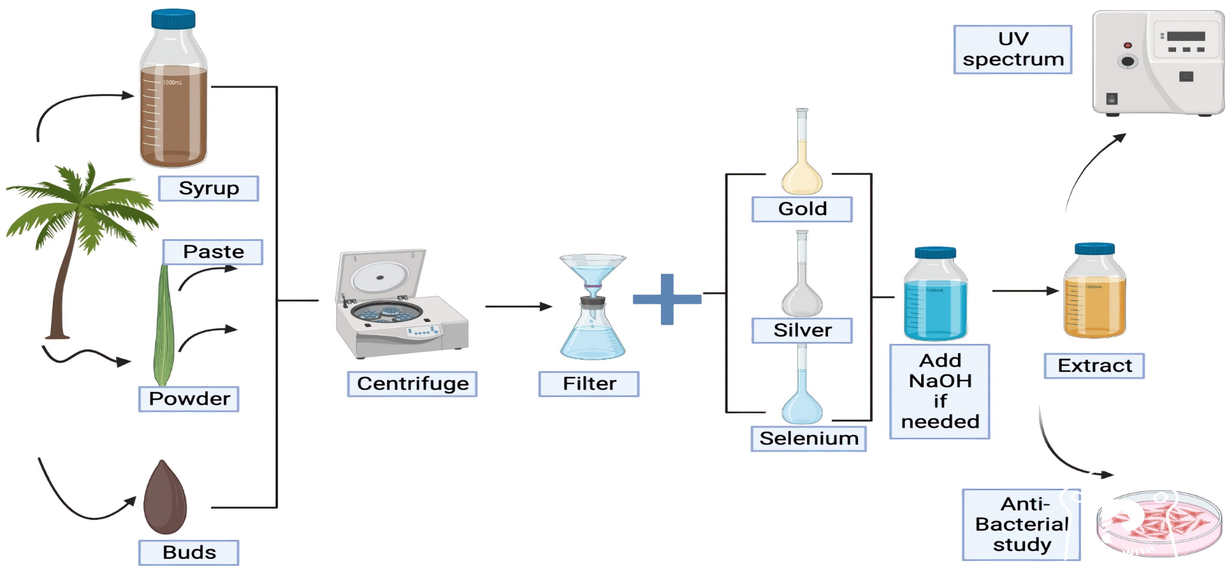
INTRODUCTION & AIM

- Antimicrobial resistance (AMR) is a significant global issue. Bahrain faces a global challenge in tackling antimicrobial resistance (AMR), with an age-standardized mortality rate associated with AMR that ranks 87th out of 204 countries [1].
- The primary causative pathogens implicated in this issue are Staphylococcus aureus and Escherichia coli [1].
- Development of nanoparticles by green methods has gained considerable research attention in medical applications such as cancer therapy, tissue engineering, and target-specific drug delivery due to non-toxicity, surface functionality, and stability.
- This approach provides benign materials with desired properties (antibacterial, antifungal, antibiofilm, antimalarial, and anticancer) for advanced biomedical applications. palm trees are rich in polyphenols which can act as both reducing and stabilizing agents [2]. In this study we aim to synthesize an anti- Bacterial agent using local palm tree Waste.

METHOD



1. Palm extract taken from leaves, buds, and date syrup underwent centrifugation and filtration.
2. The extracts were added to metal salts.
3. Formation of nanoparticles was confirmed by measuring the surface plasmon resonance peak using a UV-VIS spectrophotometer.
4. The prepared solutions were analyzed using UV spectrum and Anti-Bacterial Study.
5. Antibacterial properties of silver nanoparticles on Escherichia coli and Staphylococcus aureus were studied using the Hinton-Broth method.

RESULTS & DISCUSSION

UV-Vis Spectroscopy

UV-Vis Spectroscopy and TEM confirmed the presence of nanoparticles in all prepared solutions.

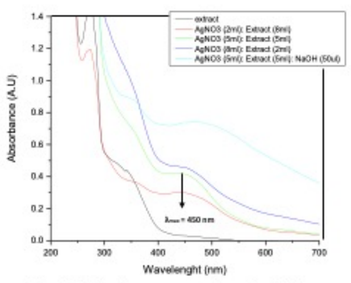


Fig1 Palm Leaves extract + Silver

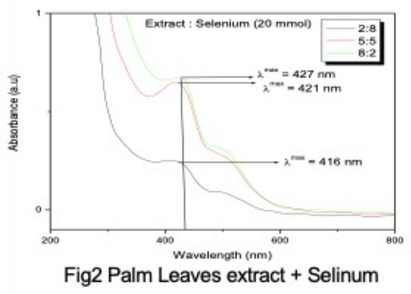


Fig2 Palm Leaves extract + Selinum

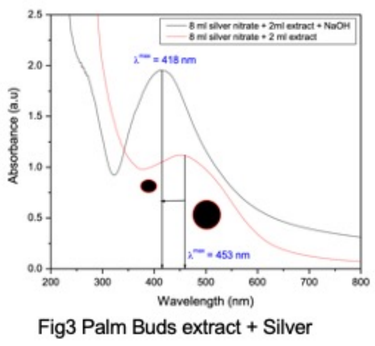
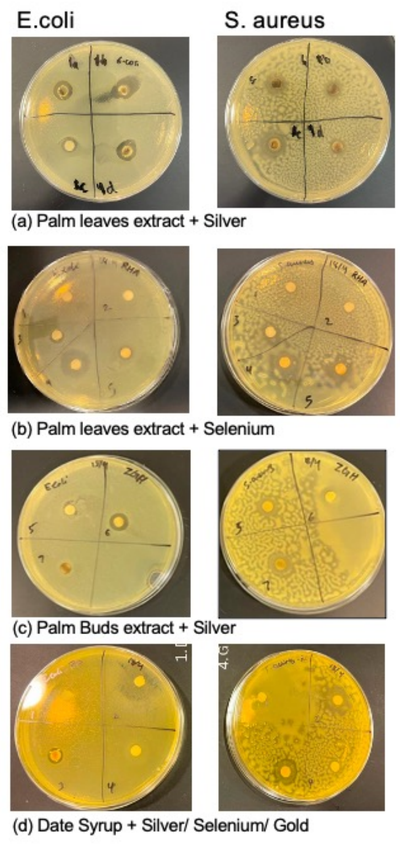


Fig3 Palm Buds extract + Silver

- The prepared solutions were analyzed using UV-Vis Spectroscopy to detect and characterize the synthesized nanoparticles.
- In palm leaves+ silver salt soultion the Surface plasmon resonance (SPR) peak was around 450nm which indicates the presence of silver nanoparticles.
- 428 nm peak was observed in palm leaves+ selenium which is representative of selenium.
- 1:1 extract-salt had the highest peaks.
- Palm Buds+ silver salt only had a peak of 453nm. While with the addition of NaOH the peak value reached 418nm confirming the presence of silver nanoparticles.

Anti-Bacterial Effect

Fig4 disk diffusion susceptibility test



- Anti-Bacterial effect was assessed using the disk diffusion method.
- Greatest antibacterial activity was seen against E.coli which can be evidenced by the large clear zone of inhibition.
- On the other hand, zone of inhibition of S.aureus was less defined indicating disturbance to bacterial growth, with minimal killing of bacteria.
- 1:1 extract-salt had the greatest anti-bacterial effect.

Palm tree green nanoparticles has anti-bacterial effects especially against gram negative bacteria

CONCLUSION

Using palm leaves, buds, and date syrup, silver and selenium nanoparticles showed disruption of bacterial growth in gram-positive staphylococcus aureus & significant anti-bacterial effect against gram-negative Escherichia coli. Next, we aim to examine the effect of the synthesized nanoparticles on wider range of pathogenic bacteria. Material sustainability and conversion of waste to advanced materials was successfully demonstrated in this project.

REFERENCES

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2. Mohamad NAN, Arham NA, Junaidah J, Hadi A, Idris SA. Green Synthesis of Ag, Cu and AgCu Nanoparticlesusing Palm Leaves Extract as the Reducing and Stabilizing Agents. IOP Conference Series: *Materials Science and Engineering*. **2018**;358(1):012063.