



Development and Optimization of Biodegradable Chitosan Beads Encapsulating Olive Stone Wooden Residues Ash for Application as Controlled Release Fertilisers

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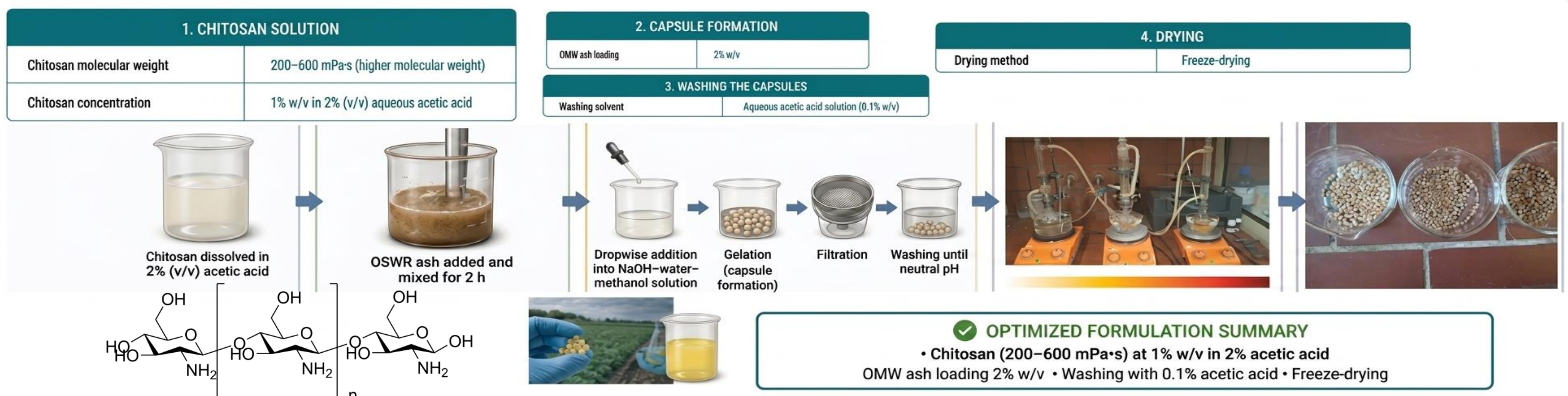
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Introduction

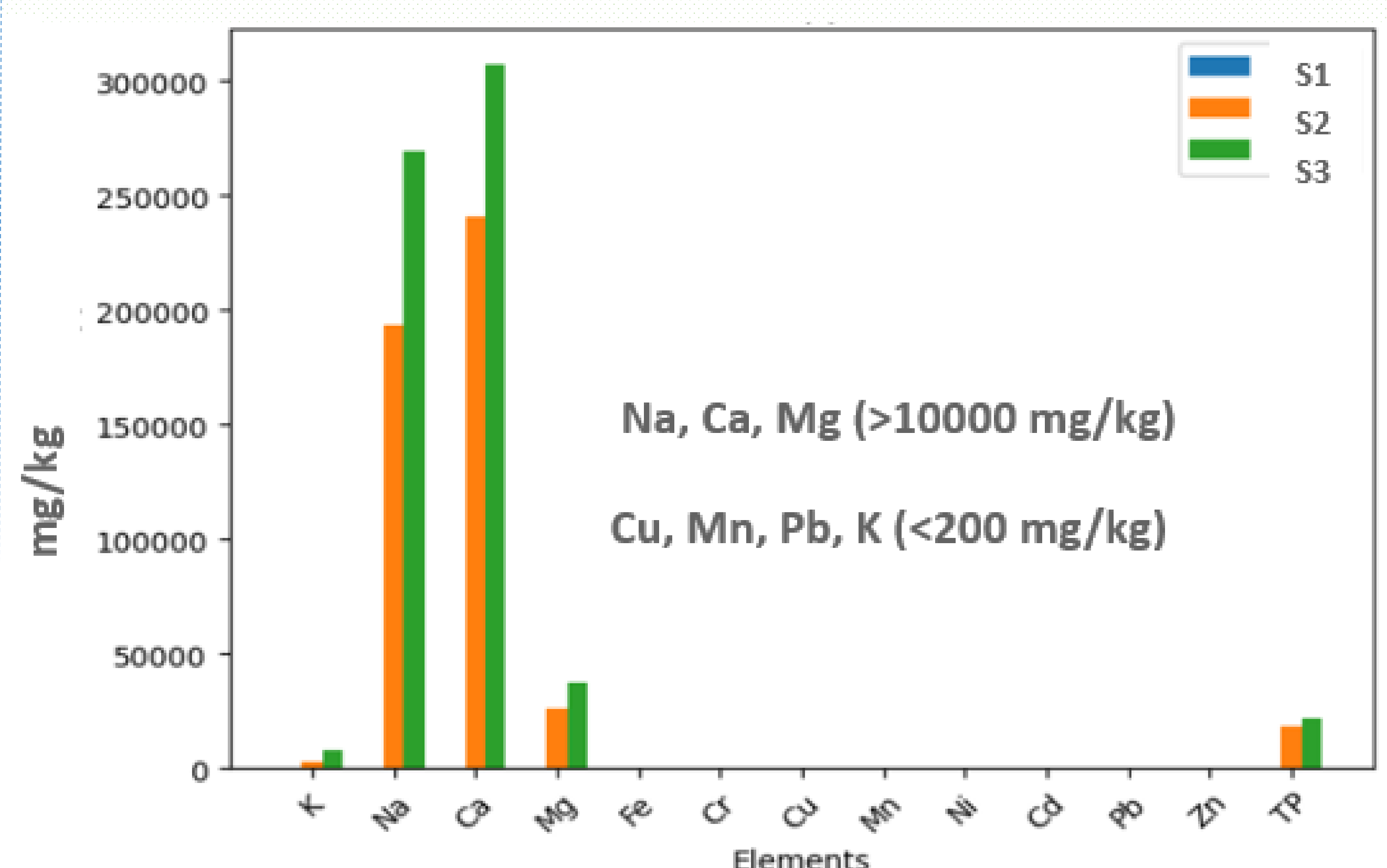
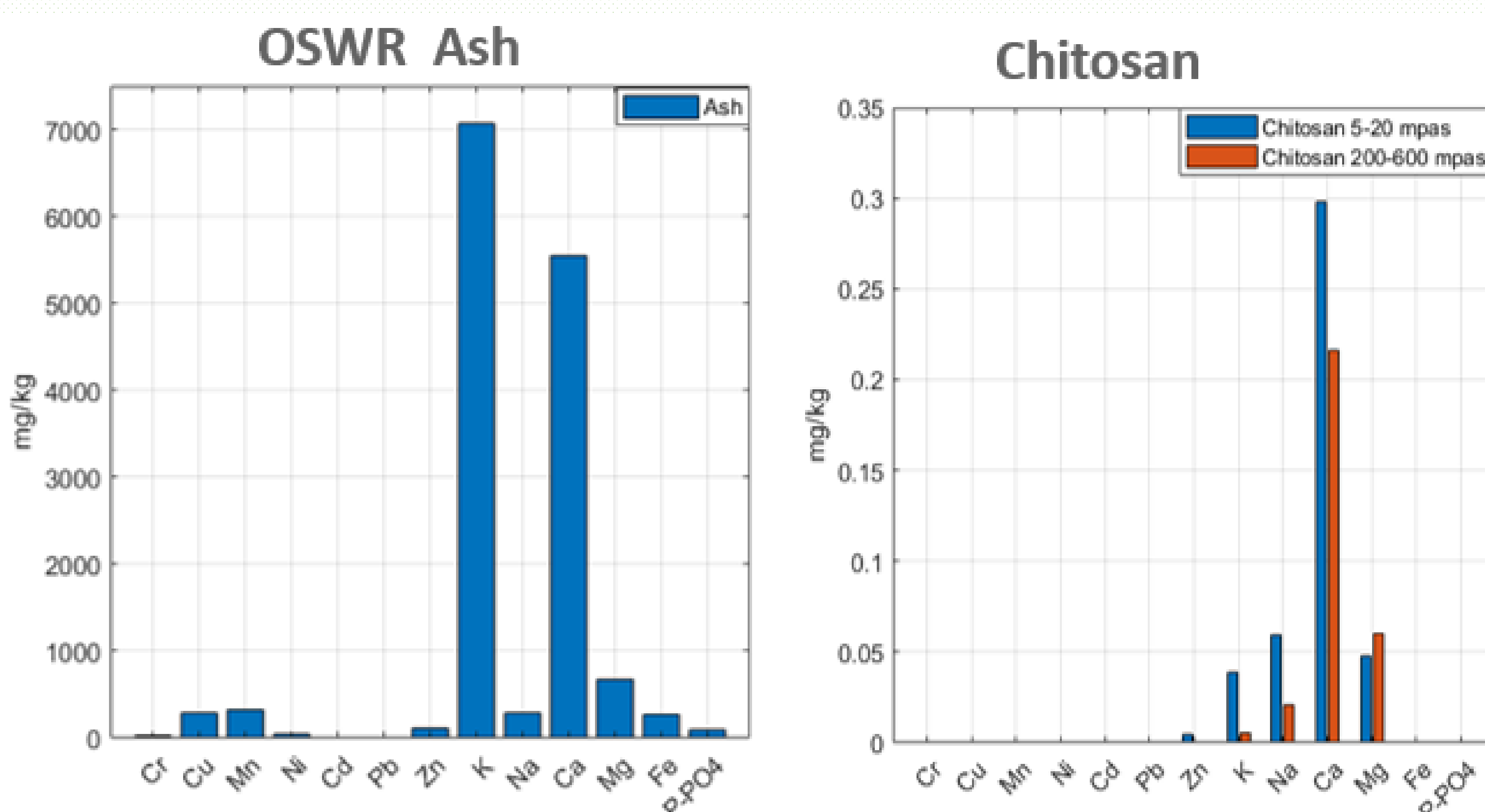
The development of controlled release fertilisers (CRFs) has gained significant attention as a sustainable strategy to enhance nutrient use efficiency and reduce environmental impact. In this study, biodegradable chitosan-based coatings were developed and optimized encapsulating Olive Stone Wooden Residues (OSWR) ash as a functional additive. The system aims to combine waste valorisation with fertiliser delivery through a bio-based encapsulation approach.

Material & Methods



Results & Discussion

Atomic Absorption Spectroscopy Results



AAS analysis revealed that OSWR ash is rich in potassium and calcium (~5000–7000 mg/kg), with moderate concentrations of Fe, Cu, and, whereas chitosan exhibited negligible mineral content (<0.3 mg/kg), confirming its high purity.

Release studies, conducted using a method adapted from EN 13266, were performed on beads produced under optimized conditions. The results, determined via atomic absorption spectroscopy, demonstrated a gradual and controlled release profile of **K, Na, Ca, and Mg**, supporting the functionality of the developed system as a controlled-release fertilizer (CRF).

Conclusions

The study demonstrates the successful development of biodegradable chitosan-coated fertilisers incorporating OSWR ash as a nutrient source. The optimized system provides enhanced encapsulation, mechanical stability, and potential for controlled nutrient release. This approach promotes the valorisation of agro-industrial waste and contributes to sustainable agricultural practices by improving fertiliser efficiency and reducing environmental impact.

Sample Code	Chitosan Type (Viscosity)	Chitosan Concentration (% v/v)	OSWR Ash Type	OSWR Ash loading (% w/v)
S1	High MW (200-600 mpa s)	1	Blank	-
S2	High MW (200-600 mpa s)	1	Ash 1	2
S3	High MW (200-600 mpa s)	1	Ash 2	2

The optimized chitosan- OSWR capsules effectively retained essential nutrients such as K, Na, Ca, and Mg, indicating successful encapsulation. The use of higher molecular weight chitosan improved capsule stability, while glutaraldehyde cross-linking significantly enhanced mechanical strength through the formation of stable chemical bonds.

Acknowledgements

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