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UTILIZATION OF *Citrus hystrix* PEELS AS NATURAL COAGULANT FOR THE REDUCTION OF TURBIDITY

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INTRODUCTION

- Water pollution is a critical global issue caused by population growth, industrialization which increased wastewater discharge into the water bodies.
- Conventional wastewater treatments like coagulation- flocculation are effective but rely on chemical coagulants which are costly, generate toxic sludge, pose health and environmental risks.
- In contrast, natural coagulants derived from agricultural waste provide a sustainable, cost-effective and eco-friendly alternative.
- *Citrus hystrix* (kaffir lime) peels are abundant, biodegradable and rich in bioactive compounds with coagulating properties, showing strong potential for reducing water turbidity.
- The study aims to determine the potential and to characterize the *Citrus hystrix* peels as natural coagulant in turbidity reduction.
- By utilizing plant-based coagulants, this research supports green, cost-effective water treatment solutions while repurposing agricultural waste.

METHODOLOGY

Sample Collection

- Water sample were collected from UMK Jeli Lake pond.
- The kaffir lime peels were collected from stalls near UMK Jeli Campus.

Preparation of the coagulant

- Wash → Air-dry (2 hrs) → Oven-dry (105 °C, 24 hrs) → Grind → Sieve (125 µm)
- Extract with NaOH, NaCl at 2M concentration and Distilled water.
- The best solvent was determined based on the highest turbidity removal performance and test for other parameters.

Jar Test

pH	Dosage (mg/L)	Mixing speed (rpm) and mixing duration (min)
2, 4, 6, 8, 10, 12 (the optimum pH was determined by the turbidity removal)	10 mg/L, 30 mg/L, 50 mg/L, 70 mg/L, 90 mg/L, 110 mg/L and 150 mg/L	

Mixing	Mixing speed (rpm) and mixing duration (min)	Settling duration (min)
A	200 rpm – 3 min 60 rpm – 20 min	30
B	180 rpm – 3 min 30 rpm – 20 min	60
C	120 rpm – 3 min 10 rpm – 20 min	120

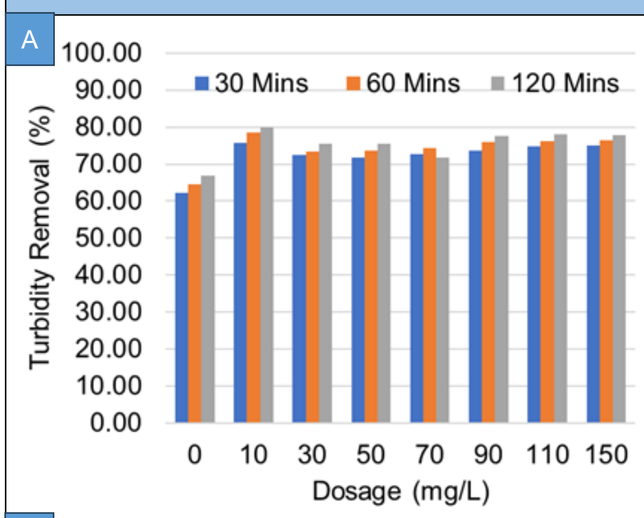
Characterization of Kaffir lime peels
SEM and FTIR

DISCUSSIONS

- Extraction of kaffir lime peels with NaOH at 2M was successfully reduced the turbidity from 27.7 NTU to 18.67 NTU (31.11%).
- Extraction using NaOH at 2M improved coagulation efficiency– extracted more bioactive compounds such as flavonoids and cellulose which enhancing turbidity removal compared to NaCl and distilled water.
- Figure 2 showed the removal turbidity was achieved in condition of pH 6 with at a dosage 10 mg/L. pH 6 was known as the optimum pH.
- The optimum conditions was achieved at low dosage – Maximum turbidity removal (94.05%) was obtained at 10 mg/L, pH 6, and slow mixing (Set C), showing high efficiency even at minimal coagulant use compared to other Set.
- SEM and FTIR was analyzed to confirmed the porous structure and the presence of the functional groups that contribute to effective floc formation.
- This approach provides a low-cost, eco-friendly alternative to chemical coagulants, supporting waste valorization and sustainable water treatment.

RESULTS

A



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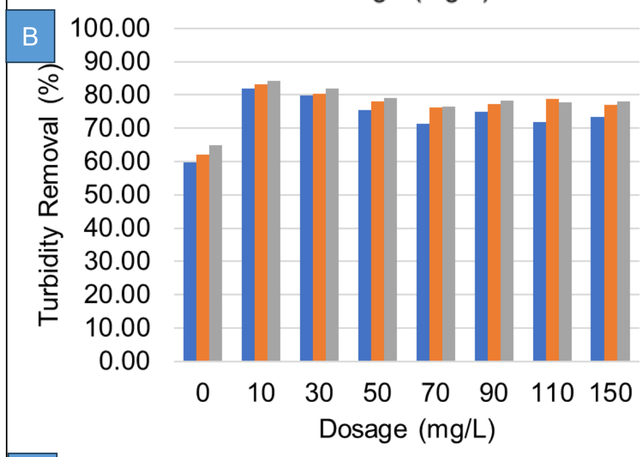

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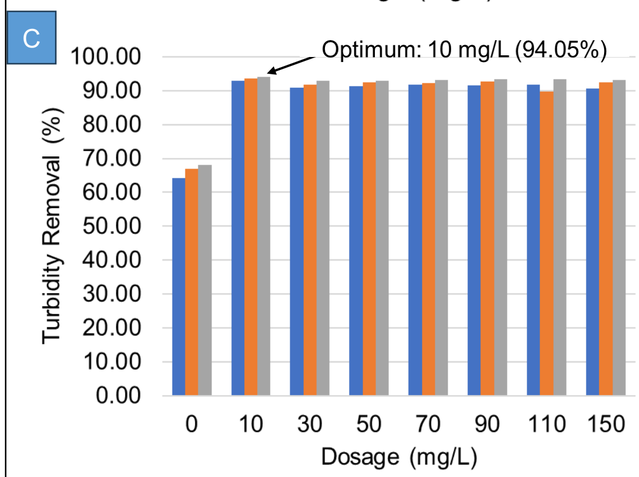

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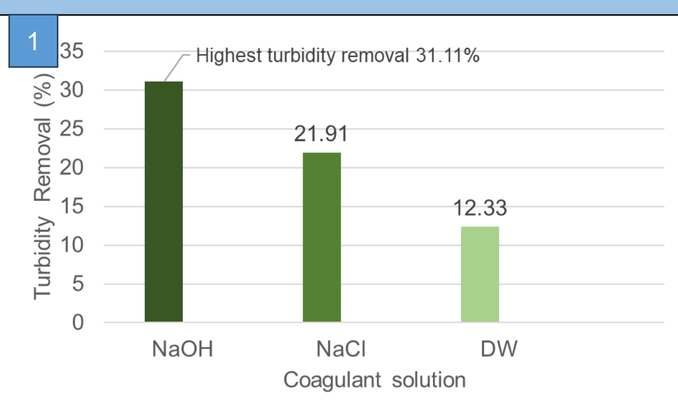

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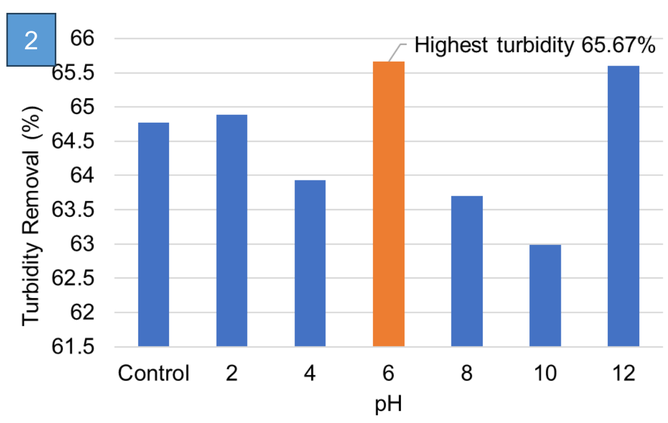
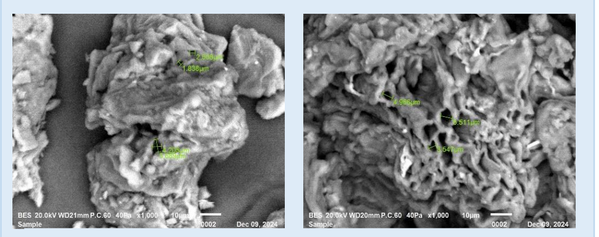


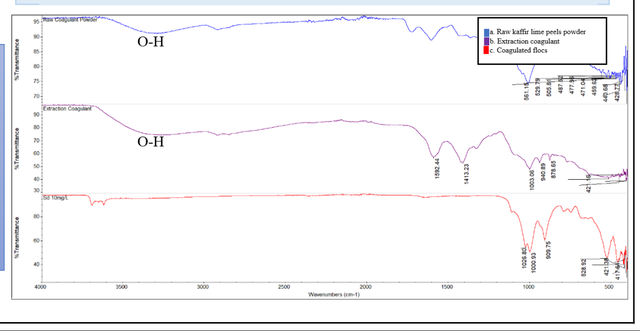
Characterization of Kaffir lime peels

SEM



(a)Raw kaffir lime peels (b) Extracted kaffir lime peels

FTIR



CONCLUSION

Citrus hystrix (kaffir lime) peels, prepared through a simple and sustainable process, demonstrated great potential as a natural coagulant by achieving 94.05% turbidity removal at an optimal dosage of 10 mg/L and pH 6. Extraction with 2 M NaOH significantly enhanced coagulation efficiency by releasing more active compounds. SEM and FTIR analyses confirmed the porous surface morphology and bioactive functional groups responsible for effective coagulation. These findings validate kaffir lime peels as an eco-friendly, cost-effective alternative to chemical coagulants, aligning with waste valorization, circular economy principles, and sustainable water treatment practices

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