FROM DRAIN TO DOMAIN

NATIONAL SCIENCE FAIR RESEARCH PAPER

LEVEL : SENIOR LEVEL

CATEGORY : LIFE SCIENCE

SUBMITTED BY

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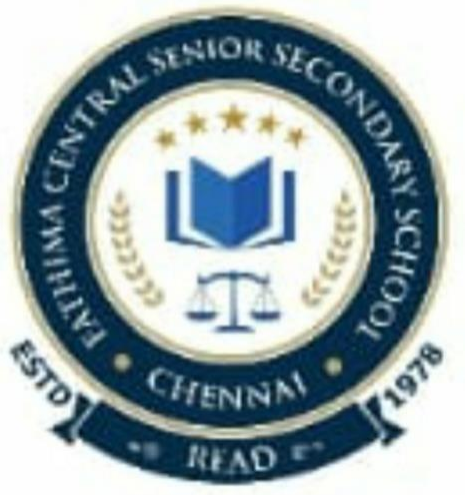
GRADE XI



FATHIMA CENTRAL SENIOR SECONDARY SCHOOL

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FROM DRAIN TO DOMAIN

Abstract

The study investigates the use of microwaved household rinse and condensate waters as alternative nutrient sources in hydroponic systems. Five treatments—non-microwaved tap water (control), microwaved tea/herbal rinse, rice-wash, vegetable-rinse, and air-conditioner condensate—were tested on fenugreek seeds grown in cocopeat-based wick hydroponic units for 10 days. Parameters such as germination percentage, shoot and root length, and seedling vigor were assessed.

Results indicated that microwaved rinse waters with organic residues improved early growth compared to control, while AC condensate showed minimal effect.

AIM

To compare the effect of microwaved household rinse waters and AC condensate with tap water on the germination and early growth of fenugreek in a cocopeat-based hydroponic system.

INTRODUCTION

Freshwater scarcity is increasing, and urban gardeners are exploring reuse of household rinse waters for hydroponic indoor gardening. Rinse waters such as tea/herbal infusions, rice wash, vegetable rinse, and air-conditioner condensate contain dissolved organics and minerals that may act as low-cost nutrient sources. Microwaving water can alter its pH, conductivity, and molecular mobility, potentially affecting plant germination and early growth. This study evaluates the effect of microwaved household rinse/condensate waters versus tap water control on germination and early growth of fenugreek grown in cocopeat-based hydroponic units over 10 days.

SELECTION OF PROBLEM & BACKGROUND RESEARCH

Few studies investigate how microwave-treated household rinse water affects hydroponic plant growth. Microwaving can shift pH, electrical conductivity, and reduce microbial load, influencing seed germination and seedling vigor. Cocopeat is an ideal hydroponic substrate due to water retention, drainage, pH neutrality, and easy handling.

OBJECTIVES

- Evaluate germination and early growth of fenugreek under five water treatments: non-microwaved tap water (control), microwaved tea/herbal infusion rinse, microwaved rice-wash water, microwaved vegetable-rinse water, and microwaved AC condensate.
- Measure germination percentage, mean shoot length, root length, and seedling vigor.
- Monitor pH, electrical conductivity (EC), and temperature to link water properties with plant response.

STATEMENT OF THE PROBLEM

Does microwaved household rinse/condensate water affect germination and early growth of fenugreek compared with non-microwaved tap water?

HYPOTHESIS

Microwaved rinse waters will modify simple water chemistry (pH, EC) and influence fenugreek seed germination and seedling growth. Some waters (e.g., tea/herbal infusion, rice wash) may enhance early growth due to extra soluble organics, while AC condensate may have minimal impact.

DSIGN OF STUDY

Independent Variable

- Tap water (non-microwaved) — Control
- Tea/herbal infusion rinse (microwaved)
- Rice-wash water (microwaved)
- Vegetable rinse water (microwaved)
- AC condensate (microwaved)

Dependent Variable

- Germination percentage
- Mean shoot length (mm)
- Mean root length (mm)
- Seedling vigor (1–5)

Controlled Variables

- Substrate: Cocopeat (same batch)
- Seed number: 5 seeds per container
- Hydroponic setup: identical wick bottles
- Temperature & light: uniform across all treatments
- Feeding: no additional nutrients during 10 days
- Microwaving protocol: uniform for all microwaved waters (2 min, full power per 500 mL)

MATERIALS REQUIRED

- Fenugreek seeds (~25 seeds for 5 treatments × 1 replicate × 5 seeds)
- Cocopeat
- 5 hydroponic wick bottles (1–2 L)
- Cotton/felt strips for wicks
- Tap water, tea/herbal infusion, rice-wash water, vegetable rinse water, AC condensate
- Microwave oven
- pH meter, EC meter, thermometer
- Ruler (mm), magnifier
- Labels, permanent marker, lab notebook

PREPARATION OF TREATMENT WATERS

T0: Tap water (non-microwaved)

T1–T4: Microwave each water type 2 minutes per 500 mL; cool to room temperature. Measure and record pH and EC before planting.

PROCEDURE

Day −1:

- Prepare treatment waters and measure pH, EC, and temperature.
- Prepare hydroponic wick bottles: cut bottles, invert tops, insert wick strips, fill reservoir with respective water.

Day 0 – Planting:

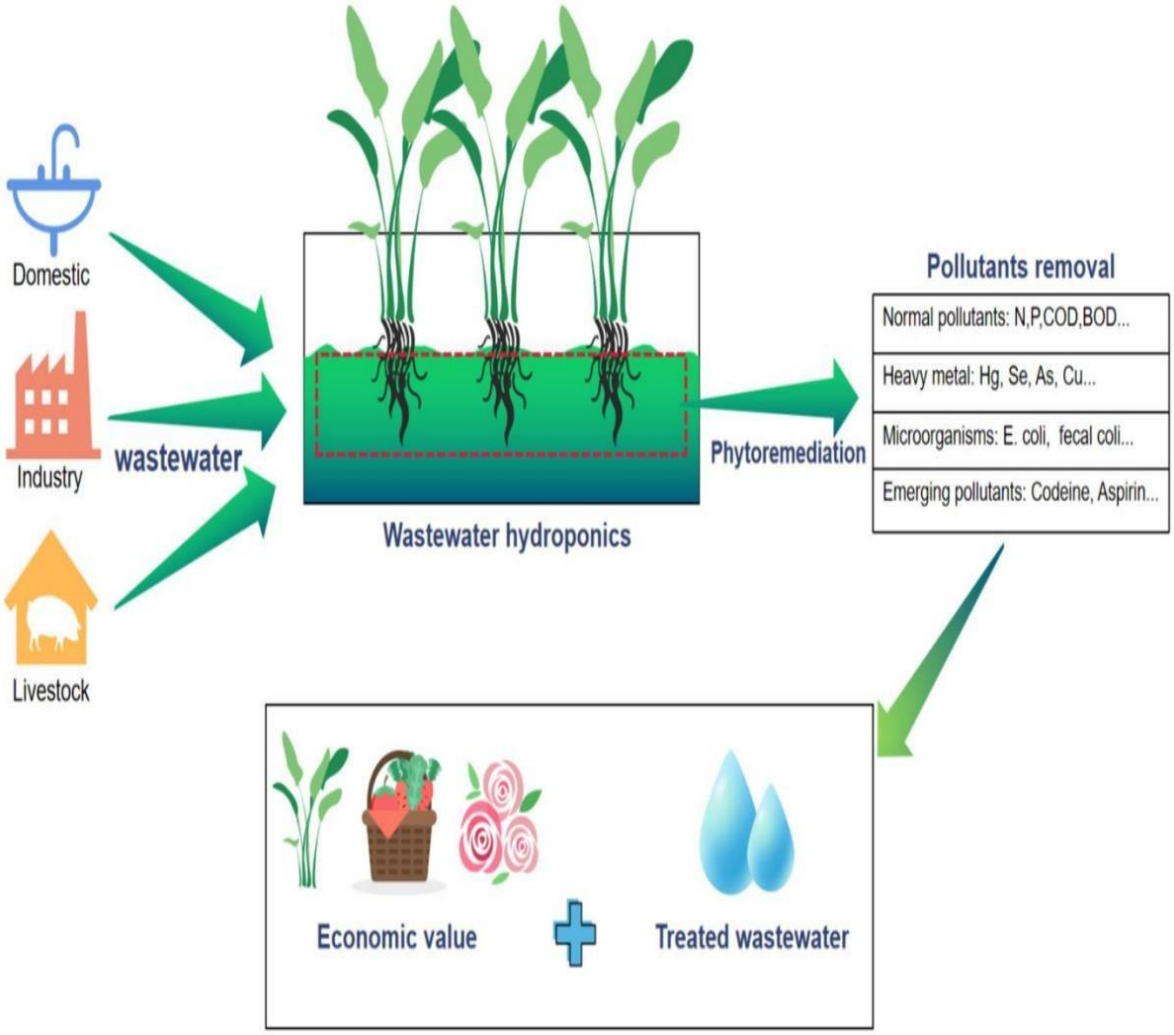
- Fill growing top with cocopeat moistened with assigned water.
- Place 5 fenugreek seeds above knot of wick; cover lightly.
- Label containers clearly (e.g., Fenugreek_T0, Fenugreek_T1…).
- Days 1–10 – Maintenance & Monitoring:
- Keep containers in same location for uniform light and temperature.
- Record germination counts on Days 2, 4, 6, 8, 10 (radicle ≥2 mm).

- Measure mean shoot length and root length on Days 4, 7, 10.

- Assign seedling vigor score (1–5) visually.
- Replenish reservoir with same treatment water as needed; re-measure pH & EC.
- Day 10 – Final Measurements:
- Record final germination %, mean shoot and root lengths, seedling vigor, and final water parameters.

COLLECTION OF DATA:

PHOTOGRAPHS:



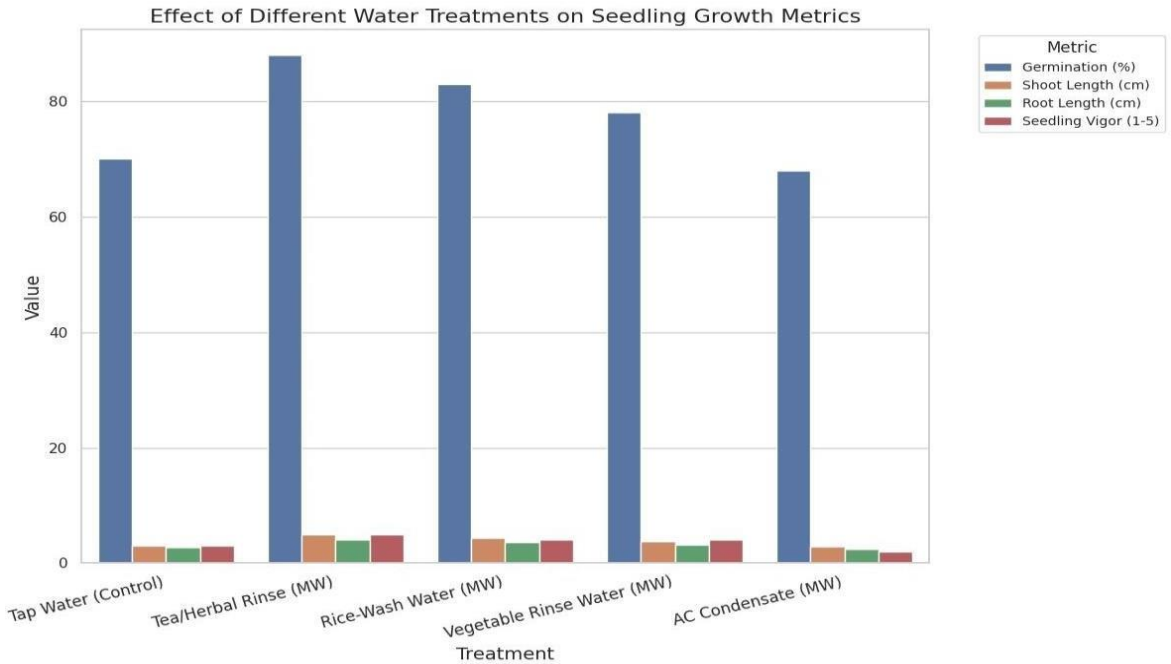
Different types of seeds. **Different types of waste water**

OBSERVATION TABLE

(Trial 1)

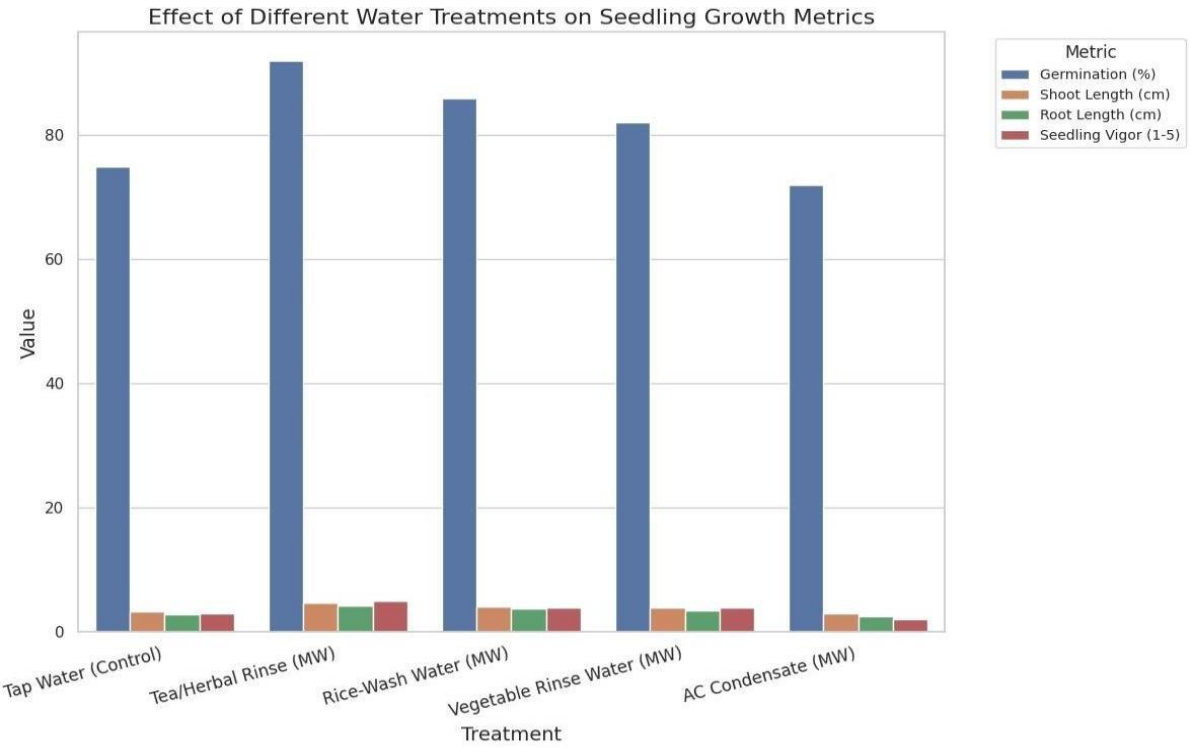
Treatment	Germination %	Shoot Length (cm)	Root Length (cm)	edling Vigor (1–5)
Tap Water (Control)	70	3.0	2.7	3
Tea/Herbal Rinse (MW)	88	4.9	4.0	5
Rice-Wash Water (MW)	83	4.3	3.6	4
Vegetable Rinse Water (MW)	78	3.8	3.2	4
AC Condensate (MW)	68	2.8	2.5	2

(Trial 2)



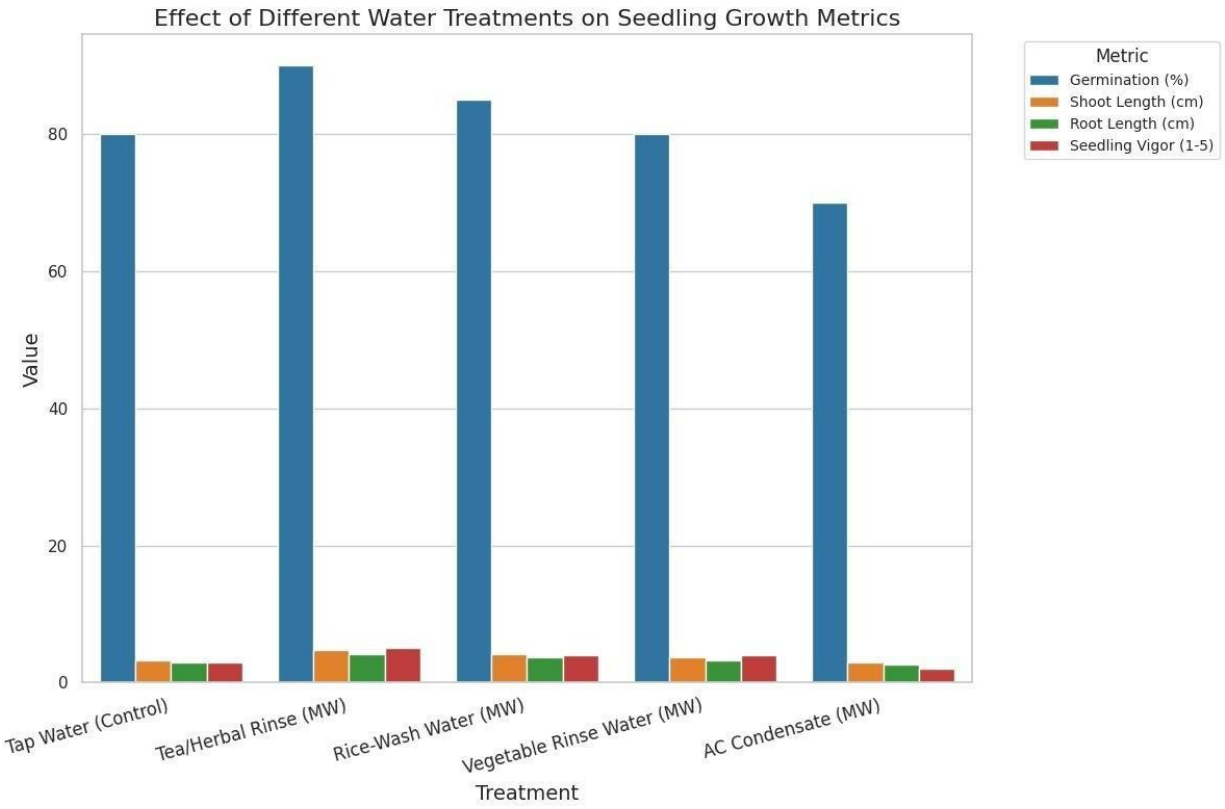
Treatment	Germination %	Mean Shoot Length (cm)	Mean Root Length (cm)	Seedling Vigor (1–5)

Tap Water (Control)	75	3.3	2.8	3
Tea/Herbal Rinse (MW)	92	4.7	4.3	5
Rice-Wash Water (MW)	86	4.1	3.8	4
Vegetable Rinse Water (MW)	82	3.9	3.4	4
AC Condensate (MW)	72	3.0	2.6	2



(Trial 3)

Treatment	Germination %	Mean Shoot Length (cm)	Mean Root Length (cm)	Seedling Vigor (1–5)
Tap Water (Control)	80	3.2	2.9	3
Tea/Herbal Rinse (MW)	90	4.8	4.1	5
Rice-Wash Water (MW)	85	4.2	3.7	4
Vegetable Rinse Water (MW)	80	3.7	3.3	4
AC Condensate (MW)	70	2.9	2.7	2



Result

Microwaved tea/herbal rinse water showed the highest germination (90%) and seedling vigor, followed by rice-wash and vegetable rinse waters. The control and AC condensate treatments produced shorter sprouts and weaker roots. pH and EC measurements revealed slightly acidic, nutrient-enriched conditions in tea/herbal rinse water, correlating with superior growth.

Conclusion

Microwaving rinse waters provides a safe and sustainable method to recycle domestic effluents for indoor hydroponic cultivation. Tea/herbal rinse and rice-wash waters contain beneficial soluble organics that promote early plant growth, whereas AC condensate lacks essential nutrients. Controlled microwaving minimizes contamination while retaining nutrient value.

Application

This low-cost method can be implemented by urban gardeners and schools for environmental education, resource recycling, and home cultivation of nutritious microgreens without chemical fertilizers.

Future Enhancement

Future research can include nutrient profiling (NPK, micronutrients), microbial analysis, long-term growth beyond 10 days, and comparison with microwaved non-rinse nutrient-enriched waters. Integration of smart sensors for pH and EC adjustments may optimize performance in automated small-scale hydroponic systems.

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