“Can a simple natural seed – Moringa oleifera replace costly chemicals in water purification?”

National Science Fair Synopsis

Level : *Middle*

Category: *Environmental Science / Applied Chemistry / Applied Biology*

Submitted By: *Mohammed Adhil*

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Introduction

Water that contains disease-causing organisms is unsafe for humans. Today, protecting health and the environment has increased the need for safe and effective water disinfection. Many methods are used, such as precipitation, incineration, electro-deionization, flocculation, coagulation, reverse osmosis, ion-exchange, membrane filtration, UV radiation, advanced oxidation, and biological treatment. However, these methods often face problems like high cost, limited efficiency, and negative environmental impacts.

One of the most important steps in water and wastewater treatment is coagulation and flocculation. Coagulants neutralize charges on tiny suspended particles, forming larger clumps (agglomerates). Flocculation makes these clumps heavier, helping them settle faster. Common coagulants include iron salts, aluminium, lime, magnesium carbonate, and polymers such as PAC and polyferric sulfate.

Problem

While effective, **chemical coagulants can cause serious issues**. For example, *aluminium-based coagulants have been linked to Alzheimer's disease*, and *flocculants can create alkaline water, toxic sludge, and incomplete removal of harmful substances*. These methods are also too *costly* for many developing nations.

Need for Natural purifier

Because of these drawbacks, there is a growing demand for natural coagulants and flocculants. They are low-cost, safe, widely available, easy to use, and environmentally friendly. Natural coagulants produce much less sludge—up to five times lower—and this sludge is biodegradable. This makes them a promising ***solution for affordable and sustainable water purification***.

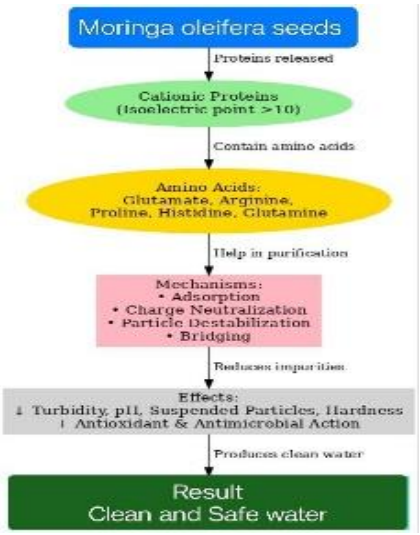
Water Treatment with Moringa

Moringa oleifera (MO), also known as horseradish or drumstick tree, is one of the most effective ***natural primary coagulants for water treatment***, comparable to alum. It grows abundantly in tropical and subtropical regions such as India, Sri Lanka, Africa, Burma, Central and South America, Singapore, Mexico, and Southeast Asia.

Every part of the tree is useful, but the seeds are especially important. The powdered seeds are non-toxic and reduce water turbidity, pH, suspended particles, and hardness. Their action is due to cationic proteins with a low molecular mass and an isoelectric point >10. These proteins, rich in glutamate, arginine, proline, histidine, and glutamine residues, neutralize charges, destabilize colloids, and promote adsorption, bridging, and charge neutralization.

In addition, MO seeds show antioxidant and antimicrobial properties, which help in bacterial removal. Because of these active phytochemicals, Moringa seeds are highly effective in purifying drinking water, murky river/pond water, and industrial wastewater.

Moringa Seeds → Cationic Proteins → Amino Acids → Mechanisms → Effects → Result (Clean & Safe Water)



Hypothesis

"Can a simple natural seed- Moringa oleifera replace costly chemicals in water purification?"

Materials Required

- Moringa oleifera seeds (drumstick seeds)
- Dirty/turbid water samples (from pond or prepared by mixing soil in water)
- Beakers or clear plastic bottles (for holding water samples)
- Mortar and pestle /mixer grinder (to crush seeds)
- Clean cloth or muslin (for filtering)
- Measuring spoon and cup (to measure seed powder and water)

Methodology

.i) ***Preparation of Moringa Seed Powder***

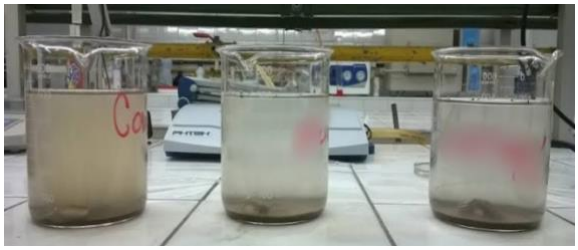
- ❖ Remove the shells from the Moringa seeds to obtain the white kernels.
- ❖ Dry the kernels completely (sun-dry or air-dry).
- ❖ Grind them into a fine powder using a grinder or mortar and pestle. And a sieve if needed.

ii) ***Treatment of Water Samples***

- ❖ Take equal amounts of turbid/dirty water in 3–4 beakers (e.g., 500 ml each).
- ❖ Label them as:

- ➢ Control (No treatment)
- ➢ Low Dose (e.g., 0.5 g Moringa powder)
- ➢ Medium Dose (e.g., 1 g Moringa powder)
- ➢ High Dose (e.g., 2 g Moringa powder)

- ❖ Mix the Moringa seed powder with a small amount of clean water to make a paste/slurry.
- ❖ Add this paste into the respective beakers and stir well for about 5–10 minutes.



iii) Flocculation and Sedimentation

- ❖ Leave the treated water undisturbed for 1–2 hours.
- ❖ Observe the formation of flocs (clumps of dirt and impurities) at the bottom.
- ❖ After sedimentation, I will carefully decant (pour out) the clear water from the top into another clean container.

iv) Observation and Testing

I will compare the clarity of water in each beaker.

Note down:

- Turbidity (clearer or still cloudy?).
- Color changes.
- Odor differences.

I will record the time taken for sedimentation in each sample.

Sample	Amt of Moringa Powder	Time (min) Allowed for Sedimentation	Water Clarity	Turbidity level	Floc Formation	Colour change	Observation
1.Control							
2.Sample 1							
3.Sample 2							
4.Sample 3							

Data Analysis

1. Recording Observations

- ✓ I will write down my observations for each sample in a table.
- ✓ I will check water clarity, turbidity, color change, floc formation, and pH.

2.Comparing Results

- ✓ I will compare the water before and after adding Moringa seed powder.
- ✓ I will look at which sample becomes the clearest and has the least turbidity.

3. Tables and Charts

- ✓ I will make a table to record all my values.
- ✓ I will draw a bar graph to show which sample gave the best water purification.

4.**Conclusion from Data**

- ✓ I will find out which amount of Moringa seed powder works best.

- ✓ I will also explain if there were any problems or things that did not work well.

Risk and Safety Precautions

1. Risk Assessment

- Handling dirty or pond water may expose the student to germs or bacteria, which could cause minor infections.
- Using a mortar and pestle or grinder has a slight risk of injury if not handled carefully.
- Ingesting untreated or partially treated water can be harmful.

2. Safety Precautions

- I will wear clean gloves while handling dirty water to avoid direct contact with germs.
- I will make sure all containers and utensils are clean before use.
- I will crush Moringa seeds carefully to avoid spilling or accidents.
- I will allow the water to settle completely before filtering to prevent stirring up sediment.
- I will filter the water slowly through a clean cloth to separate impurities safely.
- I will not drink the water directly; if I need to test it, it will be boiled first.
- I will wash hands thoroughly after completing the experiment.

References

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http://naturalsociety.com/moringa-oleifera-tree-purify-water/

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