

Ecotoxicological Effects of Chronic Paracetamol Concentration to Seed Germination of Tomato (*Solanum Lycopersicum L.*)

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1. Background Information

- Pharmaceutical pollution due to inappropriate disposal of drug waste threatens biota as it **accumulates in plants** and **contaminates food chain**.
- The experiment investigates the **impact of chronic Paracetamol (PCM) concentration to seed germination percentage of tomato**.
- The study urges to implement **effective disposal process** from pharmaceutical manufacturing and **medicine take-back program** as initiative towards sustainability.
- The study evaluates **progression of sustainable development goals** to resolve effects of pharmaceutical pollution resulting from human action.

2. Research Objective

- Investigate relationship between chronic PCM concentration and seed germination percentage of tomato by using statistical T-test.
- Investigate mean germination time of tomato seed when treated with PCM concentration and water.
- Investigate further effect of PCM concentration to tomato plant in terms of flaccidity.

6. Conclusion

3. Hypothesis

- There is **no significant difference** between mean Set A and Set B where Set A is tomato seed treated with chronic concentration and Set B treated with water.
- The experiment hypothesizes Set A has **lower seed germination percentage** compared to Set B

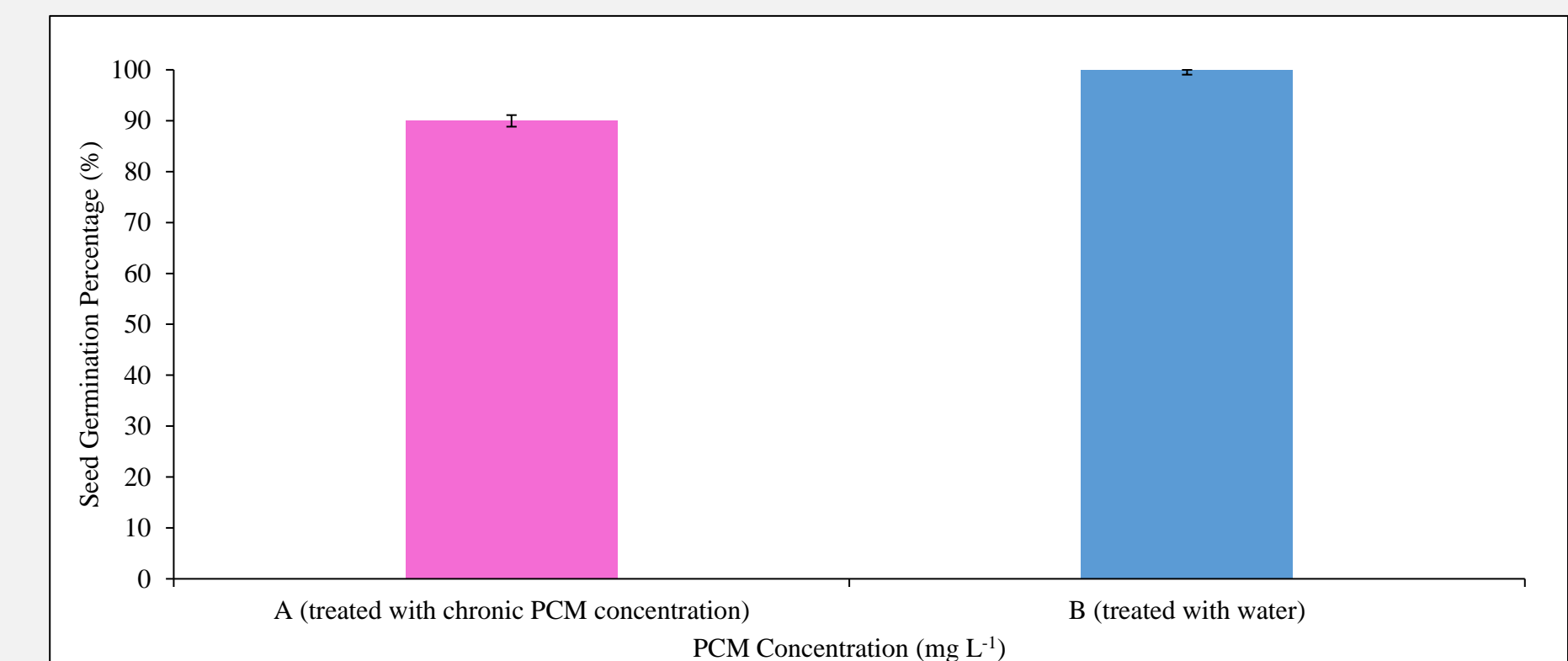
4. Methodology

- **Hands-on experiment**
 - 30 tomato seeds is treated with chronic PCM concentration (22.4 mg L^{-1}) (1) and water respectively
- **Observation**
 - After 14 days, any changes in terms of turgidity of tomato seedlings are recorded.
- **T-test**
 - At 95% confidence level, mean Set A and Set B is compared and calculate p-value to accept/reject null hypothesis.
- **Calculation**
 - Mean germination time, standard deviation and seed germination percentage is calculated after 14 days experiment.

- This experiment concludes chronic PCM concentration insignificantly impose negative impact on seed germination percentage of tomato as ecotoxicological effects of PCM is more vigorous to seedling growth in terms of stem and root length. However, PCM is shown to reduce mean germination time as well as seed germination percentage.

5. Discussion

- Null hypothesis is accepted, $p > 0.05$. There is no significant difference between mean Set A and Set B.
- Generally, active pharmaceutical ingredient (API) demonstrate weak effects to seed germination of tomato seed (2,3).
- Set B has higher seed germination percentage. Hypothesis is supported. PCM molecules aerobically undergoes oxidation, producing toxic metabolite that causes damage to mitochondria and mitochondrial proteins (4).



- **Mean germination time of Set A is lower** because PCM is shown to promote germination in tomato (5) due to its nitrogenous characteristic.
- Set A flaccid faster due to inhibition of chlorophyll accumulation and photooxidative breakdown (1).