

Biorefinery of phosphorus from eutrophic water: A circular economy approach

Balázs Kristóf

kristofbalu@gmail.com

Kisvárdai Bessenyei György Secondary School, Hungary

1. INTRODUCTION

Phosphorus is a vital nutrient for plant growth, playing a crucial role in various physiological processes, including energy transfer, nucleic acid synthesis, and root development. As an essential component of DNA, RNA, and ATP, phosphorus is indispensable for the overall health and productivity of plants. Despite its significance, phosphorus is considered a non-renewable resource with limited global reserves. The primary source of phosphorus is phosphate rock, and the extraction and production processes are energy intensive. The finite nature of phosphorus resources raises concerns about its future availability and sustainability, emphasizing the need for efficient phosphorus management.

2. AIMS

Examine the phosphorus removal ability of *Pistia stratiotes* and *Lemna minor*.

3. METHODS AND MATERIALS

Our trial of growing consisted of 5 treatments per plant species. Each pot was filled with 8 Liters of various water types: tap water, tap water with phosphorus concentrations of 5 mg/L and 50 mg/L, 1/2 strength Hoagland solution, and wastewater from the biodome. The experiment extended over 6 weeks, with pots being monitored every three days to record parameters such as phosphorus content, water temperature, pH, electrical conductivity. Upon conclusion of the experimental duration, plants were carefully removed from their respective pots and rinsed with distilled water to eliminate any surface debris. Phosphorus contents in plant tissues, leaf protein, and fiber fractions were determined using the ascorbic acid method (Sparks et al., 1996) after digestion by the mixture of HNO_3 and H_2O_2 .

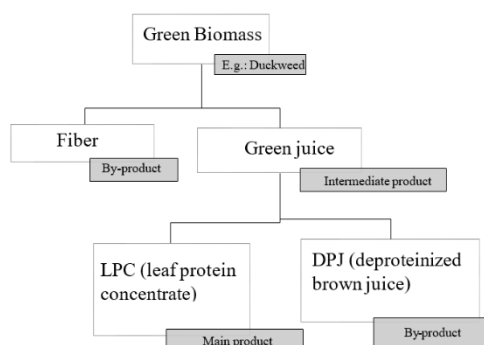


Figure 1. Scheme of the whole process of leaf protein isolation

The green biomass was divided into 2 products with extraction, with the help of a twin gear juicer machine. The green juice was then coagulated into LPC and DPJ.

4. RESULTS

Only plants cultivated in wastewater were selected for further processing towards leaf protein isolation and the production of brown juice, as the plant materials from the other treatments were relatively small in size.

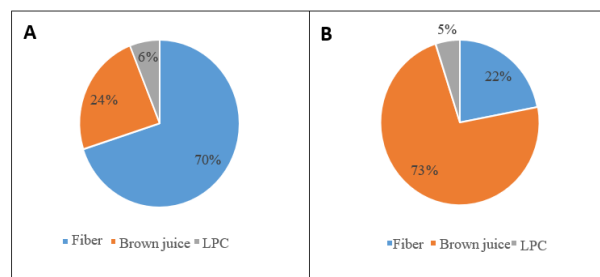


Figure 2. Yields of different fractions obtained by biorefinery process of fresh biomass of: A) *Pistia stratiotes* and B) duckweed (*Lemna minor*)

Processing fresh biomass of *Pistia stratiotes* yielded 6% leaf protein concentrate (LPC), 70% fiber, and 24% brown juice (Figure A). Fiber, leaf protein, and brown juice fractions represented 22%, 5%, and 73%, respectively (Figure B).

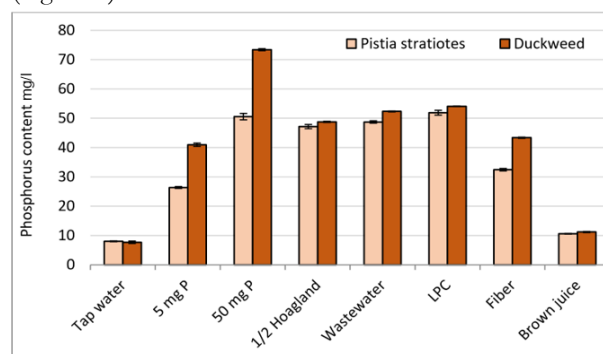


Figure 3. The phosphorus content of the plants and the fractions

As for the phosphorus removing experiment both aquatic plants accumulated considerable amounts of phosphorus in their tissues. *Lemna minor* was more effective in most cases. Making it a very useful tool to prevent and mitigate the effect of eutrophication in still waters.

5. CONCLUSIONS

In summary, we can say that based these, aquatic plants are suitable for reducing the phosphorus content of eutrophic waters. They can be useful members of aquatic ecosystems with their photosynthetic activities. After processing, the high-nutritional brown juice extracted from them could also be used as biofertilizer.

6. REFERENCES

Harper, D., 1992. Eutrophication of Freshwaters