SUSTAINABLE APPROACHES TO BIOWASTE MANAGEMENT: TOWARDS A GREENER FUTURE

Održivi pristupi upravljanju biootpadom: Prema zelenijoj budućnosti

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INTRODUCTION

The management of biowaste is an important aspect of sustainable waste treatment, which aims to reduce environmental impact and improve resource utilization.
In this study, the anaerobic fermentation of biowaste using effective microorganisms (EM) in a manually constructed anaerobic reactor is investigated.

EXPERIMENTAL

Initial biowaste (substrate): finely shredded cabbage and potato peels
Addition of efective microorganism: 1%.

Experiments were performed in hand-made anaerobic reactors with a spin for casting off the resulting leachate. During experiments, which lasted 28 days, the following were monitored:

1: Analysis of biowaste
2: Analysis of leachate produced during fermentation

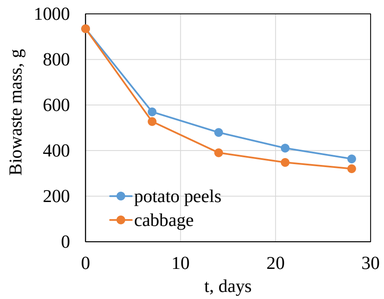
All analysis were performed by using Standard methods

Fig. 1. Hand-made anaerobic reactor with a spin

Fig. 2. Initial biowaste: a) finely shredded cabbage; b) finely shredded potato peels

RESULTS

1. Analysis of biowaste during fermentation



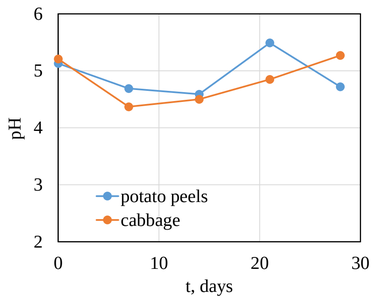


Fig. 3. Change of the biowaste mass (a) and pH (b) during anaerobic fermentation.

The reduction in biowaste mass is evident (Fig. 3.a), with a slightly greater decrease observed in the presence of cabbage. The pH decreases during the first 14 days (Fig. 3. b), followed by a slight increase, fluctuating between 4.37–5.49. Under anaerobic conditions, decreasing acidity serves as an indicator of organic matter fermentation.

Table 1. Comparison of physicochemical parameters of the initial biowaste and obtained precompost after 28 days of fermentation

Samples		pH	G, μS cm^{-1}	w(H_2O) %	w(DM) %	w(VM) %	w(C) %	w(N) %	C/N ratio
Potato peels	Initial	5.13	592	18.00	82.00	80.37	44.65	3.05	14.64
Cabbage	Initial	5.21	545	10.40	89.60	89.68	49.82	2.88	17.30
Potato peels	After 28 days	4.72	589	28.82	71.18	61.95	34.41	3.50	9.83
Cabbage	After 28 days	5.27	583	12.82	87.18	85.56	48.09	3.81	12.62

pH - pH values, G – el. conductivity in μS cm^{-1}, w(H_2O) – moisture content in %, w(DM) – dry matter content in %; w(VM) – volatile matter content in percentage, w(C), carbon content in percentage, C/N ratio – ratio of carbon and nitrogen.

2. Analysis of leachate produced during composting

Table 2. Comparison of physicochemical parameters of compost leachate

Samples	Volume of collected leachate, ml	pH	El. conductivity mS cm^{-1}	Turbidity
Potato peels	557	4.65	15.83	695,67
Cabbage	549	4.27	11.2	792.33

Results in Table 2 indicate the following: both substrates produced similar leachate volumes, indicating comparable moisture release. Cabbage leachate has a lower pH, making it more acidic, while potato peels exhibit higher conductivity, suggesting a greater concentration of dissolved ions. Cabbage leachate is more turbid, likely due to a higher amount of suspended particles.

Results in Table 1 indicates the following:

- The pH of potato peels decreased due to acidification during fermentation, while cabbage showed minimal variation, indicating different microbial activity and organic acid production between the two substrates.
- The electrical conductivity of potato peels remained stable, whereas cabbage showed a slight increase, suggesting the release of soluble compounds.
- The moisture content increased significantly in potato peels, likely due to organic matter breakdown, while cabbage retained more structural integrity and water retention capacity.
- A greater reduction in volatile matter was observed in potato peels compared to cabbage, indicating a faster degradation rate.
- Both substrates showed a decrease in carbon and an increase in nitrogen content, reflecting microbial activity and organic matter transformation.
- The C/N ratio decreased in both cases, suggesting effective fermentation and improved substrate stabilization for further composting or soil application.

CONCLUSION

The results indicate that different biological materials, such as cabbage and potato peels, undergo distinct microbiological fermentation and degradation processes, which affect their chemical and physical characteristics. Although both substrates produce similar amounts of leachate, differences in pH values, electrical conductivity, and particle content point to specific microbiological processes occurring in each. Potato peels undergo a faster degradation process, which is associated with a greater reduction in volatile matter, while cabbage maintains greater structural stability and water retention capacity. Both materials show a decrease in the C/N ratio, indicating successful fermentation and stabilization of organic matter, making them suitable for further composting or agricultural application.

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