



EVALUATING THE EFFECTIVENESS OF THE C-ECOFORHOME COMPOSTER FOR INSTITUTIONAL BIOWASTE PROCESSING



PROCJENA UČINKOVITOSTI C-ECOFORHOME KOMPOSTERA ZA INSTITUCIONALNU OBRADU BIOLOŠKOG OTPADA

Maša Buljac, Nediljka Vukojević Medvidović, Josip Radić, Sanja Perinović Jozić, Petra Ključarić, Ena Miloloža
University of Split, Faculty of Chemistry and Technology, Ruđera Boškovića 35, 21 000 Split, Croatia; corresponding author: Masa.Buljac@ktf-split.hr

INTRODUCTION

With increasing concerns about sustainable waste management, composting has proven to be an effective method for organic waste disposal and resource recovery. By transforming organic waste into nutrient-rich material, composting contributes to soil enrichment and reduces environmental pollution. This study investigates the composting process using the handmade C-EcoForHome composter enriched with an inoculant.

EXPERIMENTAL

Initial biowaste (substrate): collected from the Iskrice Kindergarten, Skalice Primary School, Škmer Association, Kliper Institution and the Commercial School in Split.

Experiments are divided into following steps:

Step 1: Analysis of biowaste composting process in three composters

Step 2: Analysis of leachate produced during composting

Step 3: Maturation of the pre-compost



Fig. 1. C-EcoForHome composter and compost piles in: a) Škmer Association; b) Kliper; c) Commercial School; d) Iskrice Kindergarten; e) Skalice Primary School

Maturation set up: mixing 50 g of compost with 100 g of soil, maturation time = 15 days. Soil 1 - used in agriculture; Soil 2 - not used in agriculture.

All analysis were performed by using Standard methods.

RESULTS AND DISCUSSION

1. Analysis of biowaste during fermentation and maturation

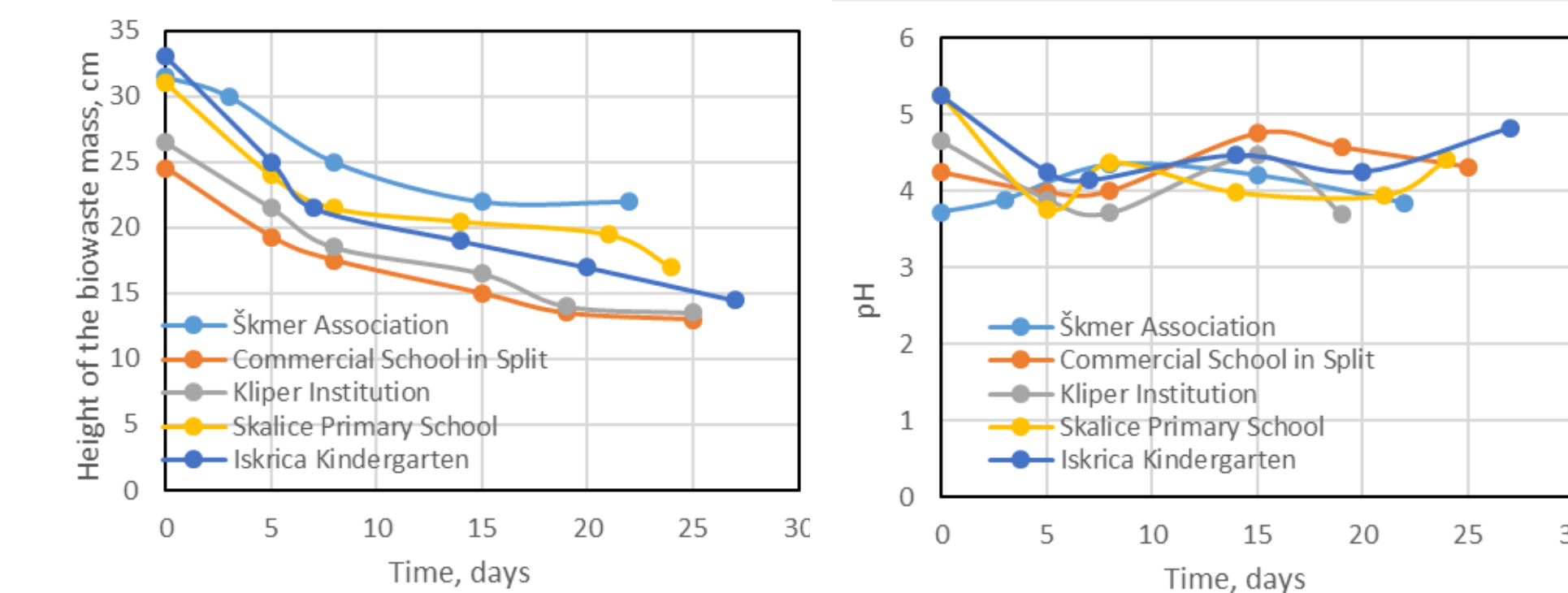


Fig. 2. Change of the biowaste mass (a) and pH (b) during anaerobic fermentation.

The reduction in biowaste mass is evident (Fig. 2.a) in all educational institutions. A decline in pH values is noticeable during the first 5-10 days, except in Škmer Association (Fig. 2b), since one third of the total mass of biowaste was orange and lemon peel. The pH values fluctuate within the range of 3.71–5.24. Under anaerobic conditions, decreasing acidity serves as an indicator of organic matter fermentation.

Table 1. Comparison of physicochemical parameters of the initial biowaste, obtained pre-compost, soil used for maturation before and after maturation with pre-compost addition

Samples		pH	G, $\mu\text{S cm}^{-1}$	w(H ₂ O), %	w(DM), %	w(VM), %	w(C), %	w(N), %	C/N ratio
Škmer Association	Initial biowaste	3.72	291	79.04	20.04	96.42	53.59	1.225	43.76
Commercial School		4.24	320	82.89	17.11	92.92	51.61	1.985	25.99
Kliper Institution		4.65	298	83.70	16.30	90.28	50.12	1.212	41.34
Skalice Primary School		5.24	423	85.09	14.91	92.40	51.34	1.452	35.36
Iskrice Kindergarten		5.24	294	79.20	20.80	91.73	50.90	2.565	19.85
Pre-comp Škmer Association	fermentation	3.84	743	76.08	23.92	93.87	52.15	1.848	28.21
Pre-comp Commercial School		4.32	1241	73.34	26.66	93.67	52.04	3.280	15.87
Pre-comp Kliper Institution		3.71	840	69.60	30.40	94.51	52.46	0.960	54.71
Pre-comp Skalice Primary School		4.41	902.5	74.27	25.73	92.64	51.46	1.664	30.92
Pre-comp Iskrice Kindergarten		4.83	1530	75.64	24.36	89.11	49.50	2.21	22.36
Soil 1	Pre-compost maturation	8.13	143.50	24.28	75.72	14.33	7.96	0.51	15.67
Soil 2		8.95	74.90	7.41	92.59	8.78	4.88	0.23	31.63
Soil 1 + Pre-comp Škmer Association		8.43	171.70	25.96	74.04	18.27	10.11	0.639	15.80
Soil 2 + Pre-comp. Škmer Association		8.64	145.30	14.84	85.16	9.30	5.17	0.332	15.55
Soil 1 + Pre-comp. Commercial School		8.10	206.0	13.88	86.12	15.08	8.37	0.514	16.28
Soil 2 + Pre-comp. Commercial School		8.81	186.30	4.59	95.41	10.38	5.86	0.255	23.01
Soil 1 + Pre-comp. Kliper Institution		8.85	128.30	10.32	89.68	17.15	9.71	0.403	24.11
Soil 2 + Pre-comp. Kliper Institution		8.77	109.85	4.08	95.92	13.26	7.37	0.293	25.14
Soil 1 + Pre-comp. Skalice Primary School		8.50	222.50	28.08	71.92	13.87	7.70	0.542	14.20
Soil 2 + Pre-comp. Skalice Primary School		8.83	134.25	10.74	89.26	8.73	4.85	0.320	15.14
Soil 1 + Pre-comp. Iskrice Kindergarten		7.70	315.50	28.98	71.02	13.90	7.69	0.612	12.56
Soil 2 + Pre-comp. Iskrice Kindergarten		8.92	179.75	14.95	85.05	9.90	5.50	0.304	18.11

pH - pH values, G – el. conductivity in $\mu\text{S cm}^{-1}$, w(H₂O) – 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, NTU
Škmer Association	-	-	-	-
Commercial School	852	3.99	21.60	635.0
Kliper Institution	575	4.15	22.35	348.8
Skalice Primary School	362	4.52	18.26	331.7
Iskrice Kindergarten	73.6	4.3	24.7	340.0

Škmer association - the amount of leachate produced is minimal, i.e. insufficient for analysis

Results in Table 1 indicate the following: substrates from different educational institutions produced different leachate volumes due to differences in initial composition. pH values are slightly more acidic, with high conductivity (indication of greater concentration of dissolved ions) and high turbidity (likely due to a higher amount of suspended particles).

Results in Table 2 indicate the following:

- The pH of all pre-compost, except for Škmer association, decreased due to acidification during fermentation.
- The electrical conductivity of all pre-compost showed a significant increase, suggesting the release of soluble compounds.
- The moisture content decreases, while dry matter increases. Volatile matter and carbon content oscillate in the range of 89.11–96.42% and 49.50–53.59%, respectively. An increase in nitrogen content is observed, except in Kliper and Iskrice Kindergarten, reflecting microbial activity and organic matter transformation. Opposite behavior is observed for the C/N ratio, a decrease for all pre-compost except for Kliper and Iskrice Kindergarten..

After pre-compost maturation in both Soils, the following is observed: even the moisture content in pre-compost is higher (in range 69.60-76.08%) compare to its value in Soils (24.28% for Soil 1 and 7.41% for Soil 2), after their mixing in ratio Pre-compost : Soil = 1 : 6 and 15 days of maturation, moisture content values is showing decreased significantly, while dry matter content increase. The reason for this behavior is that during maturation, no additional adjustment of moisture was done. However, values of volatile matter and carbon content in mixed mixture after 15 days of maturation slightly oscillate in comparison with its initial values in parent soils (volatile matter for Soil 1 and Soil 2 are equal 14.33% and 8.78%, respectively).

FTIR analysis gave a very complex spectrum of each solid sample (initial biowaste and pre-composts) due to the large number of organic molecules (carbohydrates, proteins, fats, and other smaller organic or inorganic molecules) found in the used fruits and vegetables of initial biowaste. In the collected leachate, water is the component that dominates with its intense absorption bands in FTIR spectra of all liquid samples.

CONCLUSION

Biowaste fermentation in the handmade C-EcoForHome composter can successfully manage biowaste in various educational institutions, resulting in pre-compost with satisfying physicochemical properties, which is then matured and decomposed in the soil. Results indicate small oscillation in obtained pre-compost in relation to initial bio-waste composition. Taking into account that mixing is not required during biowaste fermentation, this method of biowaste treatment can be used for the management of biowaste in educational institutions and thus contribute to a sustainable waste management system.