The quality of composts prepared in automatic composters from fruit waste generated by the production of beverages

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Ensuring the processing of food waste from the production of food and beverages in automatic composters can be difficult because of the physical and chemical properties of input raw materials. Frequently, the final product does not meet the requirements for composts according to the European Compost Network "ECN Guidelines for the Use of Quality Compost in Growing Media". The problems include the low pH value (3-4) and increased salinity (concentrations of sodium and chlorides), which increases the value of conductivity in the input raw materials. The final product has problematic concentrations of humic acids, which are too low, and the content of toxic pesticides. The following pesticides were identified in composts produced from the waste raw materials obtained from the production of beverages: imazalil, chlorpyriphos and prochloraz, which are typical for the protection of citrus fruits. The presence of terpenes represents one of the key parameters influencing phytotoxicity of composts. The toxicity of terpenes depends on solubility. Altogether, 45 chemical compounds from the group of terpenes were identified in fruit waste. Additions of sawdust to the fruit waste participate with 50% in the decrease of the number of compounds containing terpenes compared with the input fruit waste. In the input material, D-limonene (5.20 g/kg), myrcene (2.06 g/kg), and linalool (1.80 g/kg) belong to the most important monoterpenes. Due to their lipophilic properties, limonene and myrcene cause lower inhibition of seed germination and inhibition of root growth compared with oxygenated monoterpenes (linalool), which are soluble in water.

It is possible to modify the input food waste for automatic composters, thus influencing the composting process to create the compost that is harmless for the environment from the point of view of phytotoxicity utilizable for safe agricultural and horticultural applications. Optimization of the input food waste from the production of beverages was performed by adding bulk materials such as sawdust and clay minerals (bentonite). After the addition of bulk materials, the final product has up to a two-fold increase in the number of identified organic compounds. Approximately 180 organic compounds were identified in composts without the addition of bulk materials, while after the addition, it was up to 380 organic compounds. More than one-third of these additional compounds are derived from humic acids. The composts with the addition of bulk materials have significantly increased humification index, humic acid content, and organic compounds, indicating the resistant components from the input raw materials (lignin, waxes, e.g. methoxyphenols, alkanes and alkenes) which belong to the components of the stable humic acids. At the same time, the concentrations decrease for organic compounds indicating saccharides (furfural), hemicellulose (2-furanmethanol, 2-hydroxypropanone and 5-methyl-2-furancarboxaldehyde). The addition of sawdust also significantly influenced the decrease in terpenes concentrations in the final product. During composting of fruit waste, concentrations of myrcene and D-limonen decreased by 55 and 65%, respectively, while for linalool, it decreased merely by 18%. Only after the addition of 50% of sawdust, the linalool concentration decreased in the final product by 70% to the value of 45 mg/kg, which is, according to the information in the literature, still not sufficient from the point of phytotoxicity (< 8.54 mg/L).

Both polar and non-polar chemical compounds were identified in the compost leachates and input fruit waste using SBSE extraction. Thus, the known number of organic compounds influencing the ecotoxicity of the aqueous leachate increased significantly. After the SBSE extraction, the transfer from the compost to the aqueous leachate represents 109 g/kg of dry matter. For composts with the addition of 20% of sawdust, it is 29 g/kg, and for 50% of sawdust, it is 23 g/kg. The addition of sawdust to fruit waste causes a decrease in the concentrations of terpene alcohols, carboxylic acids, aldehydes, ketones, and terpenes. Due to the leaching of polyphenolic compounds and tannin from sawdust, their concentrations in compost increase. This procedure makes it possible to create higher quality products with a lower impact on the environment and to utilize side products and thus contribute to the fulfilment of the circular economy principles.