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MARIGREEN

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In this issue:

Making compost from marine residues

Blue Compost

Why blue compost?

A growing human population needs more food, and the majority of this food will come from soil-based agriculture. The health of agricultural soils have been in decline almost since humans first began to plow the soil. Much of the decline in health is due to the loss of soil organic matter and essential plant nutrients, either to runoff, volatization, or from the annual harvest of crops. Industrial fertilizers have been used to supply crops with the essential nutrients nitrogen (N), phosphorus (P), potassium (K), and others. However, this does little to prevent the loss of organic matter, which is just as essential for the long-term health and function of agricultural soil.

Adding compost to soil is one of the best methods to improve soil health. Compost is the result of the thermophilic, aerobic decomposition of organic residues such as biosolids, farmyard manure, food waste, garden residues, etc. Finished compost is stable and rich in carbon. It can also contain essential plant nutrients, beneficial microorganisms, and other compounds that are good for plants and soil. While not as widespread, compost can be made from residues of seaweed, fish, and other marine sources. These residues are available in large quantities in coastal regions around the globe and are often under-utilized. Composting these residues could reduce the need for mineral fertilizers while adding organic matter to exhausted soils. To learn out more about making compost from marine residues, we conducted a lab-scale experiment with seaweed and fish residues at the Norwegian Centre for Organic Agriculture (NORSØK).

Examples of marine residues. Top: Algae fiber and Leca; middle left: ground fish bone; middle right: mussels; bottom: fishmeal.

This issue is a summary of the article Cabell et al., 2024 *Suitability of Residues from Seaweed and Fish Processing for Composting and as a Fertilizer (https://www.mdpi.com/2071-1050/16/16/7190).*

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The composting experiment

We had two primary research questions we wanted to answer:

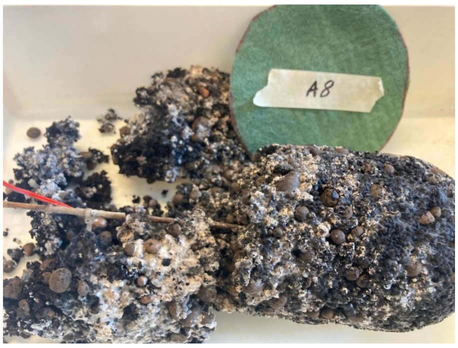
1. Can compost made with exclusively marine residues reach thermophilic temperatures (> 45 ° C) during decomposition, and to what degree do they decompose?
2. Are these composts suitable as fertilizers?

To answer these questions we designed an experiment using Dewar flasks and five marine feedstocks. Dewar flasks are well-insulated "thermoses" that are commonly used in a standardized method for assessing compost maturity (the "Rottegrad" method). The feedstocks were dried and ground rockweed (GS) (*Ascophylum nodosum*), an algae fiber (AF) that remained after a chemical extraction of the rockweed (both from MG partner Algea AS), cod (*Gadus morhua*) head bones (FB), dried cod fishmeal (FM), and out-sorted blue mussels (MU) (*Mytilus edulis*) from MG partner Norgesskjell. These feedstocks were mixed in six combinations (treatments) and divided into triplicates for a total of 18 flasks, with the two rockweed materials serving as the carbon sources and the three fish/mussel materials providing the majority of the nitrogen. Lightweight clay aggregates (brand Leca®) were used as the bulking agent to give porosity to the mixtures. The total volume in each flask was 2075 ml.

Example of a compost mixture: Algae fiber, fishmeal, and Leca.

Dewar flasks filled with compost.

The feedstocks were combined in amounts to give the mixtures a start C/N ratio of 25, a moisture content (MC) of 65%, and a bulk density (BD) of 750 g/L. The temperature in the flasks was automatically monitored and registered every hour, and the feedstocks and mixtures were characterized before, during, and after active composting. The flasks were emptied and refilled on days 31 and 62, with the contents being thoroughly mixed and samples taken each time. The flasks were emptied for the final time on day 92.



Algae fiber and fishmeal after the first round of therrmophilic composting.

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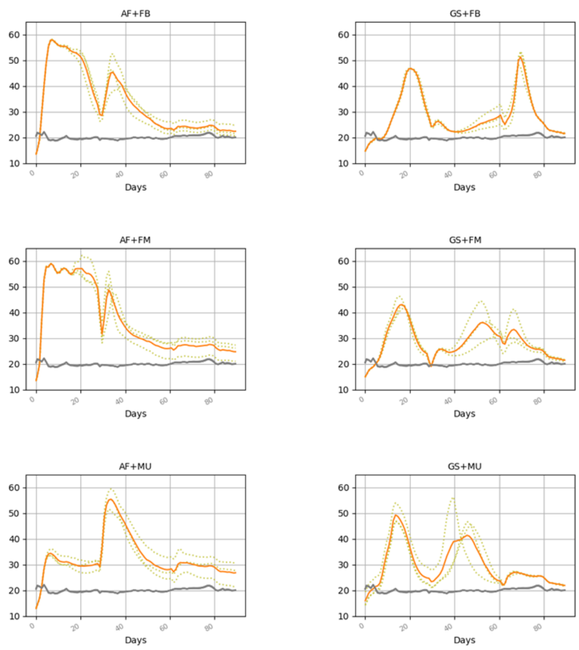
Results

Composting

All treatments reached thermophilic temperatures, and the treatments with AF had temperatures over 55 °C (hygienization). Treatments with AF were warmer than GS and maintained the heat longer.



Temperature curves in the six treatments. Left side (from top): AF + FB, AF + FM, AF + MU; right side (from top): GS + FB, GS + FM, GS + MU.

All treatments showed evidence of decomposition and had reductions in MC, weight, volume, BD, loss on ignition (LOI), C/N ratio, and concentration of total carbon. pH and concentration of total nitrogen increased in all treatments. These changes are typical for organic matter during composting. Electrical conductivity (EC), i.e., total salt content, was high to begin with and increased in the treatments with AF whereas it decreased in the GS treatments.

The pH was approximately 9.5 for AF and just under 7 for GS at the start and near or above 10 for AF and between 6.8 and 8.2 for GS at the end of the experiment.

By most measures, the combination of AF + FM performed best as a compost. It reached the highest temperatures, maintained them longer, and exhibited the greatest reduction in volume. AF + FB was a close second. They also had the two lowest C/N ratios at the end of the experiment (15 and 17). The treatments with GS had in general lower reductions in LOI, volume, and total C, and C/N ratios were 24 at the end.

Fertilizer value

None of these composts contained enough nitrogen to be considered a full-value fertilizer, but most did contain sufficient amounts (or more) of most of the macronutrients Mg, Ca, S, K, and in one case P. The treatments with AF were particularly high in Mg and K, and those with GS were high in S. Treatments with AF and MU were high in Ca. Adding an N-rich material to these composts would improve their balance and applicability.

Application of these composts can have drawbacks. One challenge is the high salt content as evidenced by the high EC values in all treatments and Na concentrations in the composts with GS. This is not necessarily a problem in humid climates, but care should be taken to apply them in climates with high evapotranspiration. Alternatively, efforts could be made to leach out the salt before or during composting. Seaweed has high concentrations of As and Cd. This can result in limitations on the amount of compost that can be applied to agricultural soil.

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