Supplementary Material (SM)

Exploring The Co-composting Potentials of Raw Grease Traps and Grease Trap-Derived Soaps: Insights into Grease Trap Modification, Calcium Supplementation, and Microbial Community Analysis

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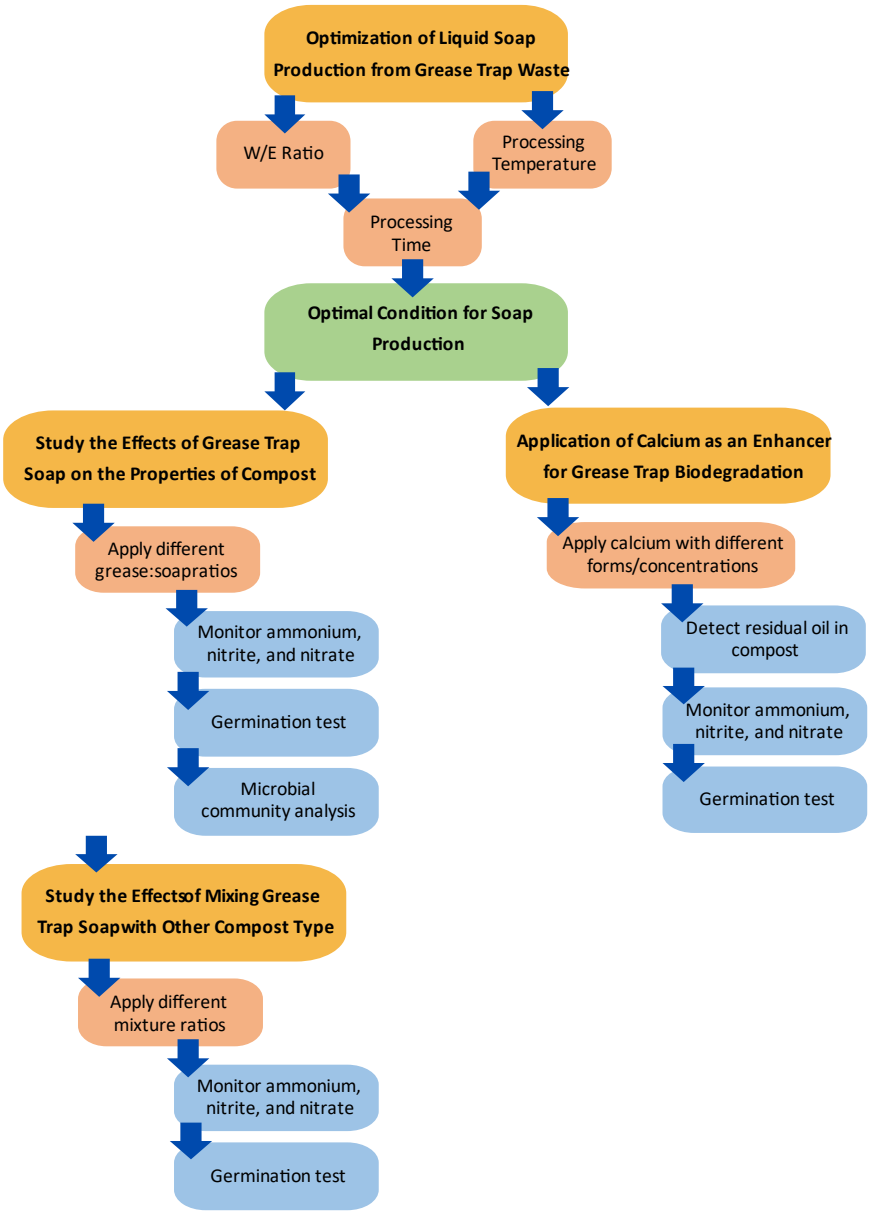
SM 1 Saponification

First, 2 g of grease trap waste were placed into a 125 mL Erlenmeyer flask, and then 25 mL of 0.5 N KOH in ethanol solution was added to the sample. The mixture was shaken in a water bath shaker at 125 rpm and 80 °C for 90 minutes. Upon completion of the process, 0.1 mL of phenolphthalein was added, and the sample was titrated with 0.5 N HCl solution. The volume of HCl solution required to change the color of the sample from pink to colorless was recorded. The saponification value was then calculated from the obtained value using Eq. S1.

$$\text{Saponification} = \frac{[\text{Mw} \times (\text{V}_\text{B} - \text{V}_\text{T}) \times \text{N}]}{\text{W}} \quad \text{(Eq. S1)}$$

where M_w is the molecular weight of KOH (56.11 g mol^{-1}), VB is the volume of 0.5 N HCl solution required for the control sample (mL), V_T is the volume of 0.5 N HCl solution required for the sample (mL), N is the concentration of HCl solution (0.5 N), and W is the weight of the grease trap waste (g).



SM 2 Flow chart illustrating the experimental process and the parameters analyzed at each step of this research.

SM 3 Properties of grease trap soap produced according to Optimal A condition for 3 h

Properties	Values
Density	1.01 g mL^{-1}
Soap content	24.4% by weight
pH	8.0
CMC concentration	0.078 %w/v
CMC of grease trap soap	25.29 mN m^{-1}

SM 4 Effect of operation time on soap yield

There were 2 optimal conditions, which were Optimal A and Optimal B under 1 hour. The effect of operation time on soap yield of Optimal A and Optimal B was evaluated as shown in Figure S1. Grease trap soap produced under Optimal A condition at the processing time of 3 hours (Figure S2) was selected for the properties analysis.

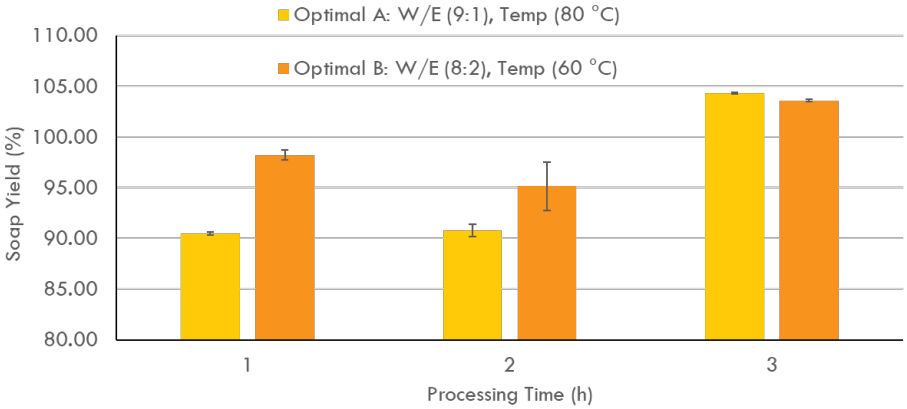


Figure S1 Effects of processing time on soap yield from grease trap waste under Optimal A and Optimal B conditions.

Figure S2 Grease trap soap produced under Optimal A condition at the processing time of 3 hours.

SM 5 Properties of grease trap soap

Liquid soaps derived from grease trap waste, containing 20% soap by weight, were tested for their critical micelle concentration (CMC), which is the concentration at which surfactants begin to aggregate into micelles. This CMC represents the minimum concentration at which liquid soap can effectively function as a surfactant. The CMC point was characterized by an abrupt change in the slope of the graph depicting the relationship between soap concentration and surface tension, as illustrated in Figure S3. For other soap properties were illustrated in Table S1.

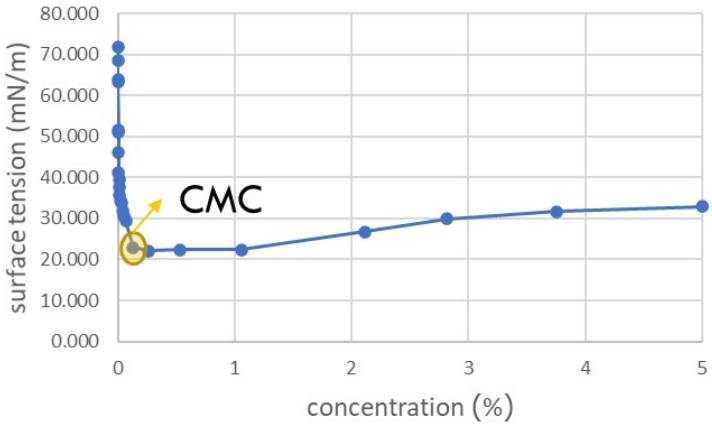


Figure S3 The relationship between surfactant concentration and surface tension for determining the CMC point of grease trap soap.

SM 6 HPLC-ELSD analysis of residual oil content in compost

Five grams of dried compost was extracted by 50 mL of isopropanol for 3 hours. The liquid fraction was analyzed the residual oil content using HPLC-ELSD. A Shimadzu-HPLC with auto injector (model Shimadzu-10Avp, Japan) and a Sedere-ELSD (model Sedex 75, France) were operated under the following conditions: a C18 column, 5 µm, 4.6×250 mm (Inertsil® ODS-3, Japan) was warmed to 70 °C; the mobile phase was a mixture of methanol and isopropanol (gradient elution: starting at 100% methanol and ending at 15% methanol after 30 minutes) with a flow rate of 0.75 cm^3 min^{-1}; the detection temperature and pressure of the ELSD were 40 °C and 210-220 kPa, respectively; and the injection volume was 0.2 mm^3. The HPLC-ELSD chromatograph of polar compound and residual grease trapped waste in compost was shown in Figure S4.

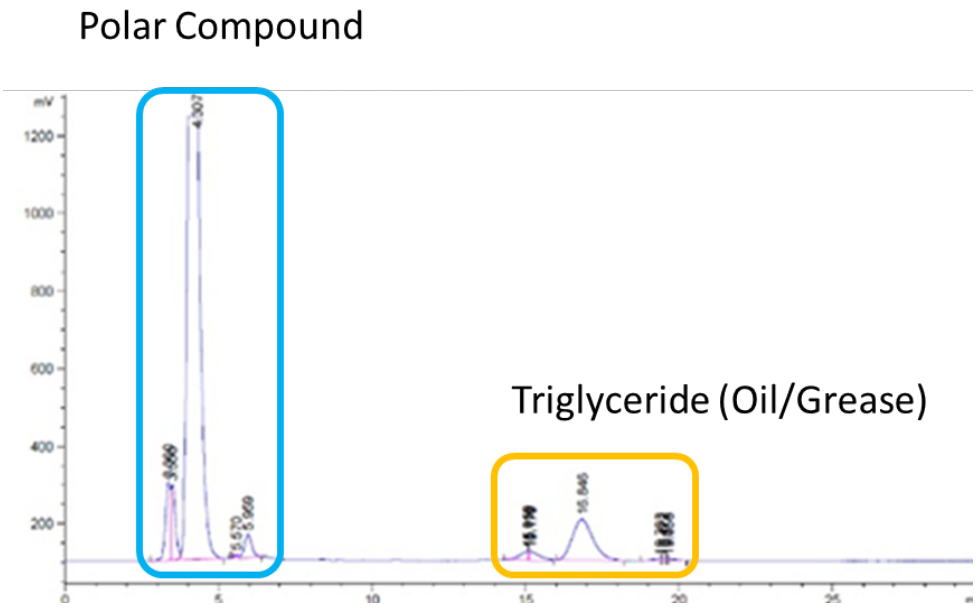


Figure S4 HPLC-ELSD chromatograph of grease trap compost at initial stage.