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Dehydrated Food Waste and Leftover for Trench Composting

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ABSTRACT

The growing global population has a persistently negative impact on the economy and ecology due to food waste. This topic has recently received much attention from around the world. For both homes and the food processing industry, recycling food waste is crucial to waste management. This study aims to show how dehydrated food scraps and leftovers can be used as raw materials for trench compost to enhance soil quality and reduce leachate and greenhouse gas emissions. The results showed that the pre-treatment and air temperature significantly affected the finished trench compost products' EC, pH, and nutrient content. Pretreated dried leftover at 80°C after trench compost was found to have the highest value of CNH, S (36.53%), and micronutrients (0.103404%) when compared to micronutrients in the final product of pre-treatment dried leftover at 80°C after trench compost that was (0.057273%). Dehydrated leftovers from trench compost were thought to have

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nutrient content that would improve soil quality, slow decomposition, and reduce odor, thus enabling more frequent trash collection.

Keywords: Drying, food waste, leftovers, trench composting

INTRODUCTION

Food waste is a complicated issue that can negatively impact several aspects of sustainability, including the climate, economy, and social situations (Ismail et al., 2021). For authorities in developing nations, managing food waste is the most challenging problem (Mohammed et al.,2017). Approximately one-third of the food consumed, or 1.32 billion metric tons, went missing or was wasted (Sulaiman & Ahmad, 2018). In recent years, the growing amount of food waste in Malaysia has brought many problems that affect the country's solid waste management system (W. J. Lim et al., 2016). Growing amounts of solid waste, including that produced by homes, businesses, and farms, are being dumped in unhygienic landfills, endangering the public's health and environment(Chhandama et al., 2022; Sharma et al., 2022).

The primary constituents of food waste consist of fruits and vegetables, accounting for 79% of the total, with fish and meat following at 8%, noodles and rice at 5%, bread and other baked goods at 6%, and dairy products at 2%. Food waste is recognized as a key method for energy recovery and composting on a global scale, given that it often contains proteins (15%–25%), lipids (13%–30%), and carbohydrates (41%–62%) as its main components. (Slopiecka et al., 2022). The critical technical parameters that define the characteristics of food waste include the water content (74%–90%), carbon-to-nitrogen ratio (C/N ratio) ranging from 14.7 to 36.4, total solids content (TS) between 17% and 29%, and volatile solid content (VS) ranging from 17% to 26%.(Lelicińska-Serafin et al., 2023).

The water content of food waste is one of the more important factors because it breaks down quickly, along with agricultural waste. These days, drying techniques are used by both developed and developing countries to decrease their reliance on fossil fuels, improve the efficiency of urban food waste, and clean up waste sites (Pilnáček et al., 2021). Food waste's high water and nutrient content makes it easy to decompose into high-quality compost. Food waste can be used to make bio-compost, improve soil fertility, and make up for an organic matter deficit (S. L. Lim et al., 2016). However, using organic waste with a high moisture content during the composting process eventually results in major issues like increased emissions of greenhouse gases, leachate, and odor (Ahmed & Gupta, 2010).

Dehydrated food waste has become more manageable in terms of food waste management as environmental pollution is becoming more widely recognized (Wang et al., 2018). The most crucial factors for dewatering food waste and reducing the overall mass of waste can be achieved within the constraints of the waste management plan by using drying techniques to lower the mass of water in food waste (Noori et al., 2022). The increased moisture content during the composting process promotes the growth of bacteria, yeasts, and mold, as well as the production of leachate and odor that is harmful to the environment. They offer several benefits because dehydrated organic materials are light, low moisture content, odorless, and biologically inert. Due to its high quality and low moisture content, dehydrated food waste is more acceptable for storage and transportation than innovative recycling techniques like anaerobic digestion or composting (Ayilara et al., 2020).

Composting involves removing and reusing organic material to change the soil's composition and structure (Keng et al., 2020). Various composting methods are available to turn organic waste into fertilizer (Li et al., 2013). Food waste is broken down using worms in a process called vermicomposting. By maintaining the vitality and health of the soil, this technique helps rural agricultural areas (Gong et al., 2018). Vermicomposting encourages the growth and spread of advantageous microorganisms in the soil ecosystem by supplying nutrients and improving soil aeration (Karmegam et al., 2021). Additionally, if food is scarce, too wet or dry, or the bin is overheated, this method could result in the large-scale or small-scale death of worms (Yatoo et al., 2021).

Anaerobic digestion is also a requirement to produce bokashi compost. Most fertilizer is used for rice bran, rapeseed meal, rice husks, sugar molasses, and water. The Bokashi method uses effective microorganisms to ferment feedstocks. The degradation process is facilitated and expedited using Effective Microorganisms (EM). The breakdown of organic material occurs over two to four weeks. This process's result can be used to feed and rehydrate the soil (Filho, 2022). It needs to be consistently supplemented with Bokashi bran or another EM inoculation to be effective. Odor issues could arise if this process is not appropriately managed (Lew et al., 2021).

Composting in trenches or pits is another method for managing organic waste (Taiwo, 2014). This inexpensive method only needs raw materials like kitchen scraps or other wastes like leaves and grass clippings. After that, there will not be any further expenses for the compost area because the soil will naturally begin to compost. Composting is typically done in a garden, which makes it easier for the compost to be transferred to established plants (Paritosh et al., 2017). Trench composting is a recommended approach for processing dehydrated food waste. Unlike compost piles, trench composting does not necessitate monitoring moisture levels, aeration, or sifting (https://compost.bc.ca/).

The study aims to examine the effects of leftovers and dry food waste in the final product to improve soil quality in terms of pH, EC, and nutrient concentrations. The collected samples underwent a five-minute pre-treatment using distilled hot water. The leftovers were then exposed to hot air drying at three distinct temperatures (80, 90, and 100°C). After that, leftovers and dried food waste were combined with garden soil in a 5/3 ratio to create trench compost, which was then stored in a compost box for four weeks.

The results will lead to a good consensus on reconfiguring solid waste management since the most recent food waste treatment policy emphasizes waste production reduction and less recycling (Ravindran & Jaiswal, 2016).

MATERIALS AND METHODS

Material

The material used in this research is food waste and leftovers. Food waste was obtained from different sources, as indicated in Figure 1(a) from the Sri Serdang community; various food wastes included vegetables like onion peeled, cucumber, spinach, tomatoes, lettuce, and fruits like banana peels, papaya, apple cores, and orange that were not properly consumed, also the leftovers included rice, bread, noodle, and different vegetable as indicated in Figure 1(b) obtained from Sri Kembangan restaurants. This study collected food waste and leftovers until a mass of about 100g each. The particle size of raw materials (food waste and leftovers) is 10mm, cut manually with a knife, and unusable waste materials are to be ready for pre-treatment.

(a)

(b)

Figure 1. (a) Food waste; and (b) leftovers for trench composting

Pre-treatment

The raw materials were soaked in warm water at 70°C for five minutes during the pre-treatment process. Pre-treating organic waste is expected to improve drying kinetics because the oil and unnecessary coating were removed during pre-treatment from the samples with no impurities covered, which introduced higher moisture removal.

Drying Process

Both treated and untreated food waste and leftovers were dried in a laboratory oven with constant air conditions set to 80°C, 90°C, and 100°C. The amount of moisture lost was tracked throughout the drying process.

Preparation of Trench Compost

After the drying process, dried food waste and leftovers were ground with a blender until it was changed to powder, and then mixed with garden soil at 5:3 ratios (20 g:12 g), and all mixed material composted in a plastic bin by the dimension of this tray is 30 cm (length), 10 cm (height) and 12 cm (width) (Inckel et al., 2005). The bins were kept in a room with ambient air of about 30°C for four weeks. Consequently, all samples were closed with newspaper to avoid contact with insects like flies. After the composting period, the trench compost was gathered using a 2 mm sieve tray. The tray was then stirred gently with sifted flour from side to side. The trench compost is dropped by leaving bigger particles size and tiny stones behind. The procedure was repeated until all samples were passed. This process guarantees a uniform texture of the trench compost and lowers the size of the particle from coarse to fine.

Physiochemical Analysis

Conducting a physical and chemical analysis of compost made from food scraps and leftovers is possible. The physical property analysis of the trench compost includes the pH value, total nitrogen, total sulfur, total carbon, identification of micronutrients (Cu, Ca, Mg, K, and Zn), and electric conductivity.

Liquid Extraction from Dehydrated Food Waste and Leftover Fertilizer

After trench compost, the dehydrated food waste and leftovers were subjected to a liquid extraction process with distilled water in a 1:10 (w/v) ratio and kept at room temperature for 24 hours. After that, the pH was measured with a pH meter, and EC was measured with an Electric conductivity (EC) detector.

pH Value

After being taken off, the pH meter cap was inserted into the sample solution (liquid region). The pH value was determined and noted. This procedure was completed for every sample of trench compost. Eutech Instruments provides a pH tutor bench meter for use in laboratories. The pH range was 0.00 to 14.00, with a relative accuracy 0.01. This research used the pH meter to determine the potential hydrogen of trench compost (Jones, 2001).

Electric Conductivity (EC)

Distilled water was used to clean the EC detector before use. The EC detector was then calibrated, and the reading was recorded. Before using the EC detector addition, the national samples were thoroughly cleaned with distilled water after recording the EC reading. This step was carried out for all trench compost samples. The electrical conductivity is determined at room temperature, validated in solutions of 1.0, 0.1, and 0.01 D KCl (aq). The measured electrical conductivities were within 0.5% of the values used as a standard (Gong et al., 2018). This research used an EC detector to detect the electric conductivity of soil and trench compost samples.

Determination of CHNS

The final product of dried food waste and leftover after trench compost was used to calculate the percentages of carbon (C), Sulphur (S), hydrogen (H), and nitrogen (N). The elemental analysis was performed using a flashed model I 112 with helium gas as the carrier gas, and the ultimate analysis was performed according to ASTM standards (ASTM M373-02) (Thompson, 2008). The CHNS machine (FLASHEA1112 SERIES) determined a sample's nitrogen, hydrogen, and sulfur levels. It typically operates at high temperatures, eliminating components from the sample.

Analysis of Macro and Micro-elements

For concertation of Cu, K, Ca, Mg, and Zn, the samples of (dehydrated food waste and leftovers after trench compost) were sent to the Analytical Laboratory 2, UPM Faculty of Agriculture, to be analyzed in an Atomic Absorption Spectrophotometer. The samples were sent in liquid form and extracted using the Dilute Double Acid (DDA) method. The DDA extraction procedure from the solid started by mixing with a 0.05 standard solution of hydrochloric acid (HCl) and a 0.025 standard solution of Sulfuric acid (H_2SO_4) (Mylavarapu et al., 2014). First, a 5.0 g sample was weighed and placed into a falcon tube. Afterward, 25 mL of DDA extracting reagent was added into the tube and shaken for 15 minutes at 180 rpm using an end-to-end shaker. Then, the solution was filtered with filter paper. The filtered sample was collected in a 50mL plastic vial and sent to an Atomic Absorption Spectrophotometer (AAS). Dilution (10×) using distilled water for the nutrients can be conducted. The Autoanalyzer machine is used to conduct soil and trench compost environmental analyses, and its design is based on the segmentation of an air bubble stream continuously running.

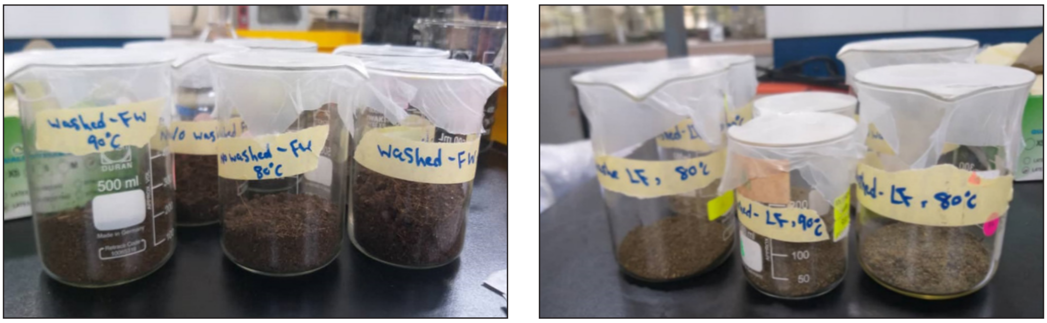
RESULTS AND DISCUSSION

Compost Soil Properties

The composition of compost in the soil can have a significant impact on the soil's physiochemical properties, nutrient availability, and plant growth. Composting strategically on deteriorated urban soils may have a beneficial influence on the soil's quality.

Physicochemical Analysis of Trench Compost

Figures 2(a) and 2(b) show the final product of dehydrated food waste and leftovers after the composting period. The trench compost was collected to analyze the changes in the physicochemical characteristics of several parameters, such as pH, electrical conductivity (EC), total carbon (TC), total hydrogen (TH), total nitrogen (TN), total Sulphur (TS), and micronutrients (Zinc, Calcium, Potassium, Copper, and Magnesium).



(a) (b)

Figure 2. Harvested product from dehydrated food waste for: (a) food waste; and (b) leftovers after trench compost

Determination of pH and Electroconductivity (EC)

Figures 3 and 4 display the pH value in the final product for dried food waste and leftovers at various temperatures. The results showed that the pre-treatment and air temperature had a significant impact on the pH and EC of the final products (bio-compost). At 80°C, the pH of dried food waste pretreated was 5.72, whereas the pH of food waste that had not been pretreated was 5.61 at the same temperature. The pH value for pretreated dried food waste at 100°C after the compost was 5.47, while for non-pretreated food waste at the same temperature was 5.25.

The samples that dried at a high temperature had a lower pH value in the final product. However, pre-treatment had a positive impact because the pretreated sample had a higher pH value than the non-pretreated sample. The final dried food waste product had a high electrical conductivity value. Pre-treatment and air temperature appear to have a major impact as well. Pretreated food waste exhibited a greater electro-conductivity range of

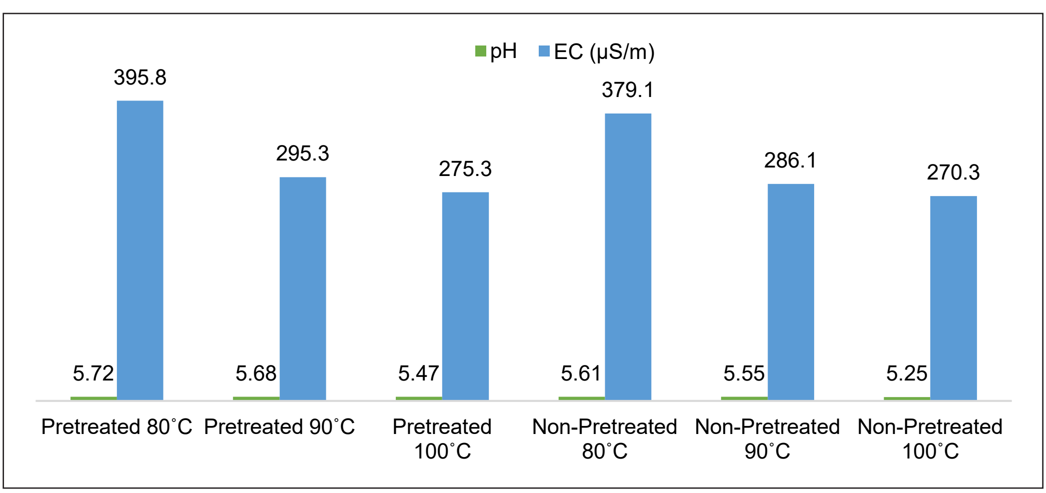


Figure 3. The electrical conductivity and pH of dehydrated food waste in the final product

275.3–395.8 µS/cm compared to non-pretreated food waste, which had a range of 270.3–379.1 µS/cm. When the temperature rises, the electrical conductivity of both pre-treated and non-pre-treated food waste decreases, as shown in Figure 3.

The pH and electrical conductivity of leftovers at various drying temperatures after finishing trench compost are shown in Figure 4. At 80°C and 90°C, the pH of pretreated dried leftovers was 5.33, while the pH of non-pretreated leftovers was 5.31 and 5.28, respectively. The pH value for pretreated dried leftovers after composting at 100°C was 5.24, while the pH value for non-pretreated leftovers at the same temperature was 5.17. However, pre-treatment had a positive impact because the pretreated sample had a higher pH value than the non-pretreated sample. Furthermore, pre-treatment leftovers had a larger electro-conductivity range of 216.6–225.1 µS/cm than non-pretreated leftovers, which had a 164.6–180.9 µS/cm range. Conversely, pre-treatment enhances the breakdown rates of carbohydrates, calcium, potassium, chloride, and sulfate and increases the substrate's surface area. This process releases more ions as dissolved salts and other inorganic compounds elevate the electroconductivity (Silva et al., 2020). Furthermore, thermal washing pre-treatment over an extended period degrades carbohydrates in food waste into shorter-chain components more readily digestible by bacteria (Chua et al., 2019).

According to the findings, the fertilizer was highly acidic due to naturally acidic fruits and vegetables such as tomato, carrot, and apple peel in the raw material. There were similar findings in the food waste characterization reported by (Ho & Chu, 2019). The metabolic breakdown of organic acids during the composting process can lead to an increase in pH value. This phenomenon is often attributed to the process of ammonification, where nitrogen (N) is converted into ammonium (NH_4^+) or ammonia (NH_3) (Ramli et al.,2023).

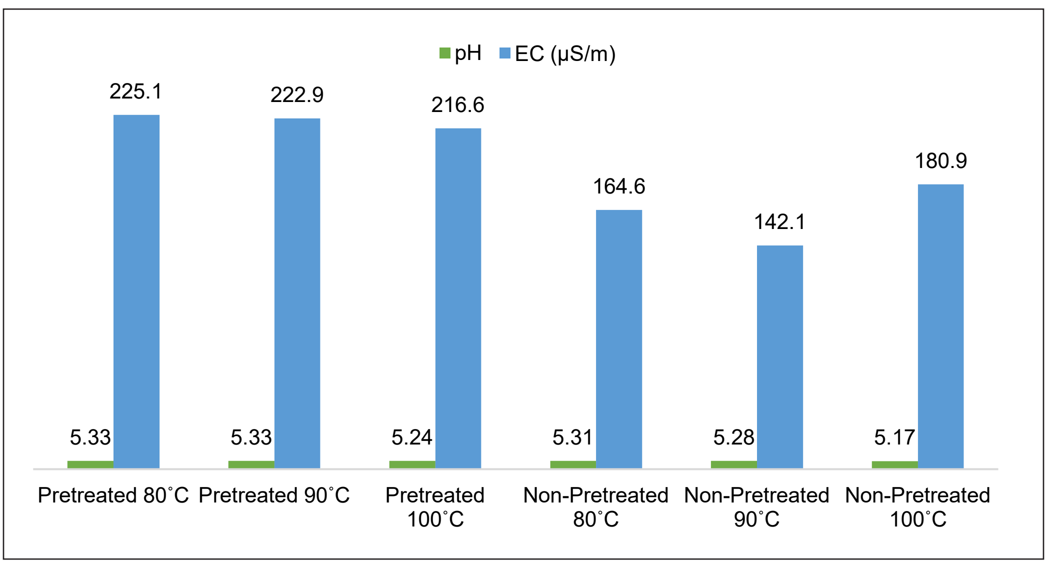


Figure 4. The electrical conductivity and pH of dehydrated leftovers in the final product

The final product will be affected if the raw material contains acidic fruits or vegetables. The pH of dehydrated organic waste fertilizer products ranges between 4.6 and 4.8, while the EC value ranges between 4.83 and 7.64 S/m. The high salt content, particularly the Na content, contributed to the high EC content of fertilizer. The sodium level of the food waste fertilizer products ranged between 0.54% and 0.67%, corresponding to the human diet (O'Connor et al., 2022). The health of plants and the proliferation of soil microorganisms are inextricably linked to soil pH. Most plants thrive in slightly acidic to neutral soils (pH 5.5–7). Blueberries are an example of a plant that thrives in acidic soils with a low pH of 4.5–5.5. Dehydrated food waste fertilizer with low pH is suitable (Schroeder et al., 2020).

Determination of Micronutrients

Micronutrients aid in plant growth and development. Crops require micronutrients such as Ca, K, Cu, Mg, manganese, and zinc. This study evaluated dehydrated food waste and leftover fertilizer products as micronutrients, as shown in Tables 1 and 2 and Figures 5 and 6.

Table 1 and Figure 5 show the micronutrient content of dried food waste fertilizer after trench composting. According to the result, air temperature and washing pre-treatment had a significant impact on the value of nutrients in the samples. The nutrient content decreased when the air temperature increased, but pretreated samples had a higher value than non-pretreated samples. Pretreated food waste at 80°C, 90°C and 100°C after trench compost recorded micronutrient Potassium (391.2, 348.5, and 220.3) mg/L, Calcium (109.8, 88.78, and 83.43) mg/L, Copper (0.98, 0.68, and 0.58) mg/L, Magnesium (58.35, 57.95, and 57.45) mg/L, and Zinc (11.4, 8.67, and 6.58) mg/L respectively. While non-pretreated food waste at same temperatures had lower value: Potassium (244.1, 205.3, and 144.5) mg/L, Calcium (69.72, 55.84, and 34.51) mg/L, Copper (0.18, 0.13, and 0.07) mg/L, Magnesium (57.22, 57.04, and 55.74) mg/L, and Zinc (6.10, 5.29, and 5.17) mg/L respectively.

According to previous research, dehydrated food waste fertilizers have a high nutritional concentration, which helps plants develop. A wide variety of plant growth-promoting microorganisms can be found in dehydrated food waste fertilizer products. Fertilizer items inoculated with the plant mutualistic *Aspergillus* sp. strain UY2015 11 improved the

Table 1
Chemical properties of dehydrated food waste fertilizer at various air temperatures

FW	Temperature (°C)	K (mg/L)	Ca (mg/L)	Cu (mg/L)	Mg (mg/L)	Zn (mg/L)
Pretreated	80	391.2*	109.8*	0.98*	58.35*	11.4*
	90	348.5	88.78	0.68	57.95	8.67
	100	220.3	83.43	0.58	57.45	6.58
Non pretreated	80	244.1	69.72	0.18	57.22	6.10
	90	205.3	55.84	0.13	57.04	5.29
	100	144.5	34.51	0.07	55.74	5.17

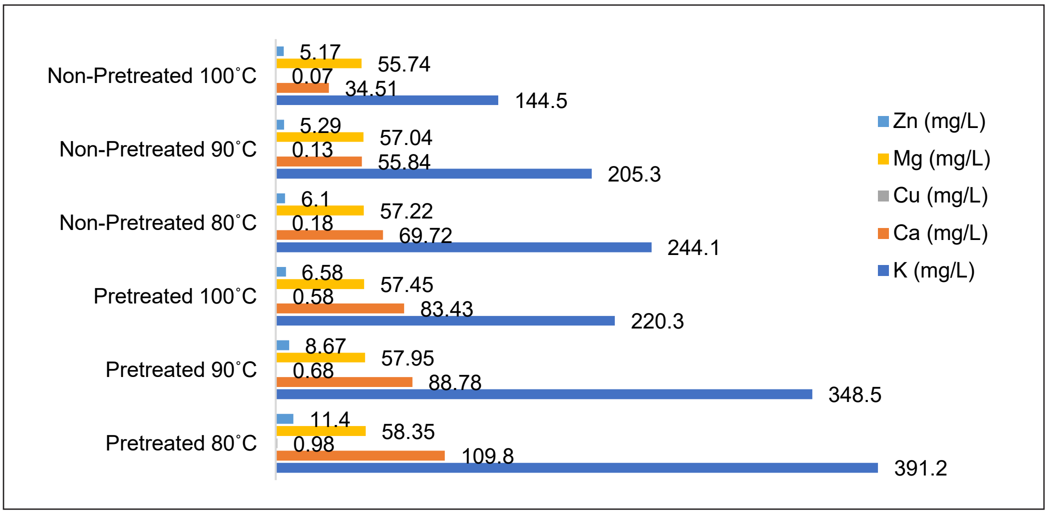


Figure 5. Micronutrients of dehydrated food waste fertilizer at various air temperatures

value of nutrients accessible in the soil. The product may also be able to prevent or treat some disorders (Liu et al., 2015). The micronutrient, made from dehydrated food waste fertilizer, increased soil respiration. Increased soil microbial activity occurs when dried food waste fertilizer items are added. Because of this, the nutrients in food waste fertilizer products were readily available for microbial respiration, as shown by substrate-induced respirate(O'Connor et al., 2022).

Dried food waste with low moisture content aids in composting by managing water content and providing an excellent input material without pathogens and with appropriate amounts of carbon and nitrogen (Sotiropoulos et al., 2015). Considering that the quantity of dry food waste recorded micronutrients are 14.2% (C), 0.42% (N), 7.1% (H), 0.02% (P), and 0.4% (K) (Han, 2017). Therefore, it is highlighted that dehydrated food waste is utilized as a source material in the composting process from food waste.

Table 2 and Figure 6 shows the Pretreated leftovers at 80°C, 90°C and 100°C after trench compost recorded micronutrient Potassium (880.1, 713.5, and 659.1) mg/L, Calcium (83.99, 72.98, and 71.38) mg/L, Copper (1.88, 1.60, and 0.95) mg/L, Magnesium (53.12, 52.76, and 52.04) mg/L, and Zinc (14.95, 13.44, and 9.26) mg/L respectively. At the same time, non-pretreated leftovers at same temperatures had lower value: Potassium (385.5, 339.9, and 329.7) mg/L, Calcium (44.18, 43.47, and 24.50) mg/L, Copper (0.94, 0.28, and 0.10) mg/L, Magnesium (51.66, 51.65, and 49.78) mg/L, and Zinc (8.74, 7.15, and 5.28) mg/L respectively. Compared to dried leftover samples after trench compost, pretreated leftovers at 80°C had the highest value of micronutrients. Based on the information provided, it can be determined that at lower temperatures, the amount of nutrients in the feedstock remains consistent compared to higher temperatures of 90°C and 100°C.

Table 2
Chemical properties of dehydrated leftover fertilizer at various air temperatures

LF	Temperature (°C)	K (mg/L)	Ca (mg/L)	Cu (mg/L)	Mg (mg/L)	Zn (mg/L)
Pretreated	80	880.1*	83.99*	1.88*	53.12*	14.95*
	90	713.5	72.98	1.60	52.76	13.44
	100	659.1	71.38	0.95	52.04	9.26
Non-pretreated	80	385.5	44.18	0.94	51.66	8.74
	90	339.9	43.47	0.28	51.65	7.15
	100	329.7	24.50	0.10	49.78	5.28

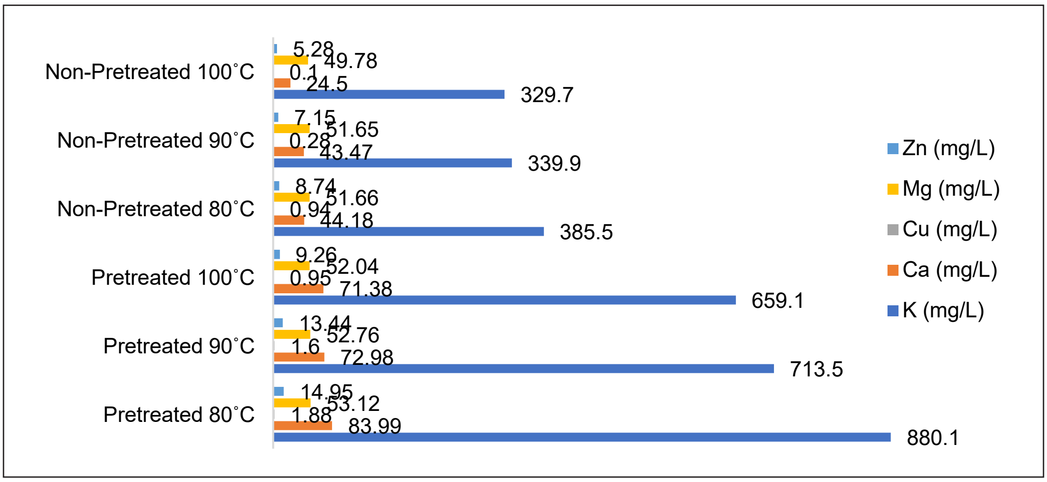


Figure 6. Micronutrients of dehydrated leftover fertilizer at various air temperatures

Determination of CHNS

Dehydrated food waste and leftovers after trench composting were analyzed using a CHNS analyzer, and the results were recorded in Tables 3 and 4, as well as Figures 7 and 8. The highest Carbon recorded was 23.76% in pretreated dry food waste at 80°C, while the lowest was 17.43% in non-pretreated dried food waste at 100°C. Also, the highest value of Nitrogen was recorded in the same sample of pretreated dried food waste at 80°C fertilizer with 1.68%, and the lowest was 1.09 for non-pretreated dried food waste at 100°C fertilizer after trench compost. Based on Table 3, Sulfur was higher in the pretreated food waste at 80°C than in pretreated and non-pretreated food waste fertilizer at 90°C and 100°C.

According to the result, the final product of dehydrated leftovers at 80°C had the highest value of CHNS: Carbon 29.54%, Hydrogen 5.12%, and Nitrogen 1.58, respectively. After composting, the Sulphur value was 0.29% for all the dried leftover samples. The air temperature and pre-treatment had a considerable impact on the nutrient content of the final product. The results show that samples dried at a higher temperature had lower C, N, and S content. The pretreated samples also had a higher nutrient content value than the non-pretreated samples. The same result was reported in proven research when air temperatures were increased to 150–200°C; the mineralization rate from organic wastes tended to decrease dramatically (Moritsuka & Matsuoka, 2018).

As composting progressed, the nitrogen content increased while the total Carbon content decreased, resulting in a corresponding decrease in the CN ratio. Carbon is

Table 3
Determination of CHNS in dehydrated food waste fertilizer at various air temperatures

FW	Temperature (˚C)	C (%)	H (%)	N (%)	S (%)
	80	23.76*	4.10	1.68*	0.19*
Pre-treated	90	23.34	4.11*	1.64	0.14
	100	20.20	4.10	1.50	0.12
	80	23.74	4.11*	1.68*	0.17
Non pre-treated	90	21.01	4.12	1.22	0.13
	100	17.43	3.98	1.09	0.12

Table 4
Determination of CHNS in dehydrated leftover fertilizer at various air temperatures

LF	Temperature (˚C)	C (%)	H (%)	N (%)	S (%)
	80	29.54*	5.12*	1.58	0.29
Pretreated	90	28.36	5.10	1.26	0.29
	100	23.23	5.10	1.18	0.29
	80	28.92	5.11	1.63*	0.29
Non-pretreated	90	25.08	5.12*	1.34	0.29
	100	24.99	4.19	1.50	0.29

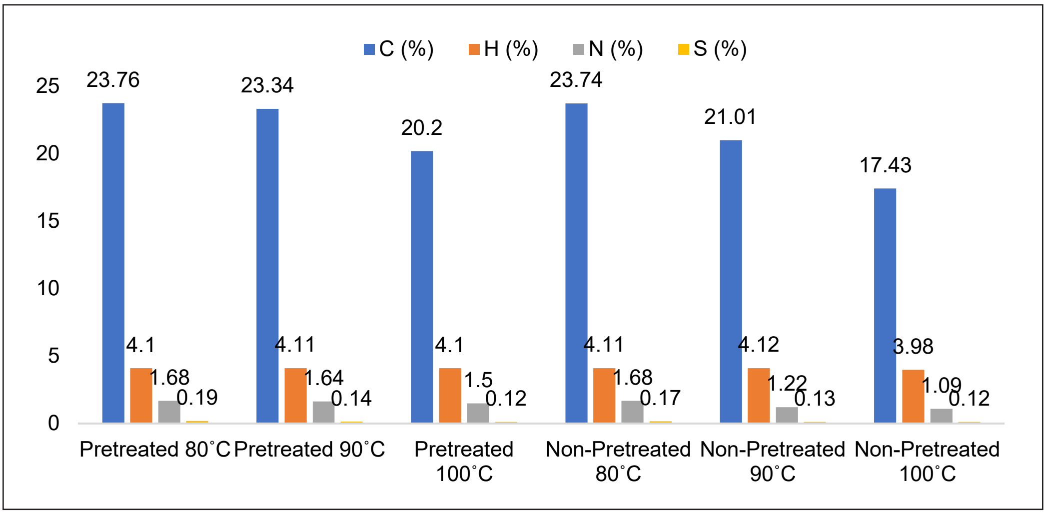


Figure 7. Value of CHNS in dehydrated food waste fertilizer at various air temperatures

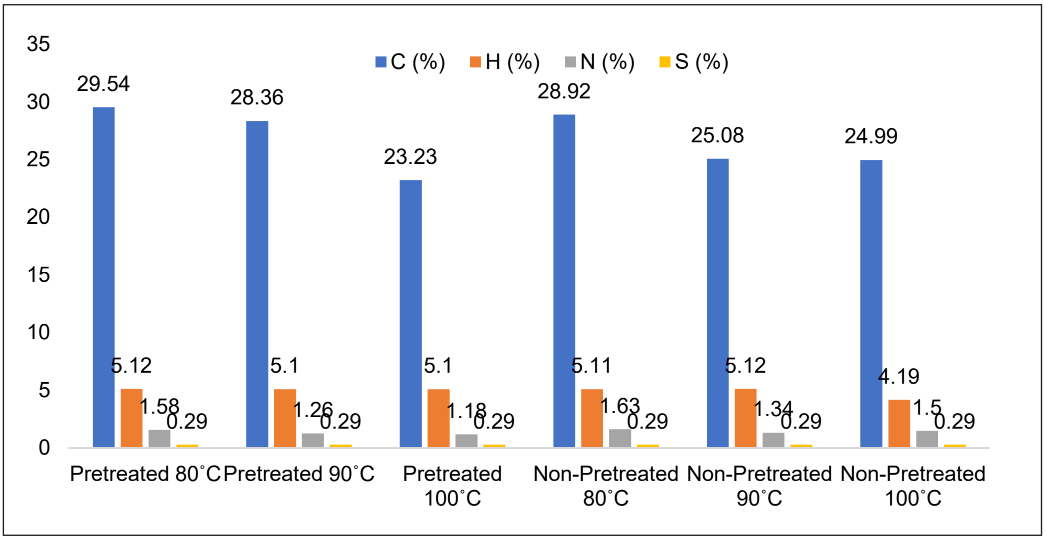


Figure 8. Value of CHNS in dehydrated leftover fertilizer at various air temperatures

the primary energy source, while nitrogen is essential for microbial population growth (Shahudin et al., 2011). Composting can increase the amount of carbon in the soil, but it is critical to use a good composting approach to preserve the carbon reserves in the soil for a long time (Beesley, 2012). Dehydrated waste before composting can help solve this problem because the bacteria will grow quickly, have the greatest biodegradation activity, and provide enough energy to heat the compost. Compared to moist compost, tobacco leaf waste composting has the highest carbon-to-nitrogen content (20.1) and can be stored for a long time (Zhao et al., 2017).

Overall, the mixture of carbon, nitrogen, and sulfur showed great promise value in the final product that can be used to improve soil quality as a fertilizer (Srivastava et al., 2011). Although the ideal C/N ratio is between 30 and 40, much research has demonstrated that a C/N ratio of less than 20 can also benefit composting. After composting, the dried food waste had a total carbon content of 31% and a Sulphur content of 0.11%, which can provide essential nutrients to plant soil (Firdaus et al., 2018).

According to the findings in Table 5 and Figure 9, pre-treatment had a substantial effect on drying time, net mass, and nutritional content for each sample. Pretreated food waste and leftovers dried more quickly than non-pre-treated samples, and samples had a lower mass value after drying due to increased moisture loss. Because the pre-treatment removed the impurity of salt and oil from the surface of the food waste and leftovers, allowing moisture from the sample slab to escape into the atmosphere. A comparison of food waste and leftovers demonstrates that all leftover samples had a higher weight value than food waste. Furthermore, the presence of salt and oil can disrupt the composting process. Salt hinders the breakdown of organic matter due to its sodium content, making it difficult for

Table 5
Comparison of the food waste and leftovers drying time, net weight after drying, and nutrient content after trench composting

Temperature	Treatment	FW Net Weight mi (g)	LF Net Weight, mi (g)	FW Time (min)	LF Time (min)	Total of CNHS FW	Total of CNHS LF
80°C	Washed	6.9	20.9	140	135	29.73	36.53
	Not washed	9	28.1	180	150	29.7	35.93
90°C	Washed	4.3	19.3	120	120	29.23	35.01
	Not washed	5.2	26	150	150	26.48	31.83
100°C	Washed	3	9.2	110	115	25.92	29.22
	Not washed	4.1	24.6	135	130	22.62	30.97

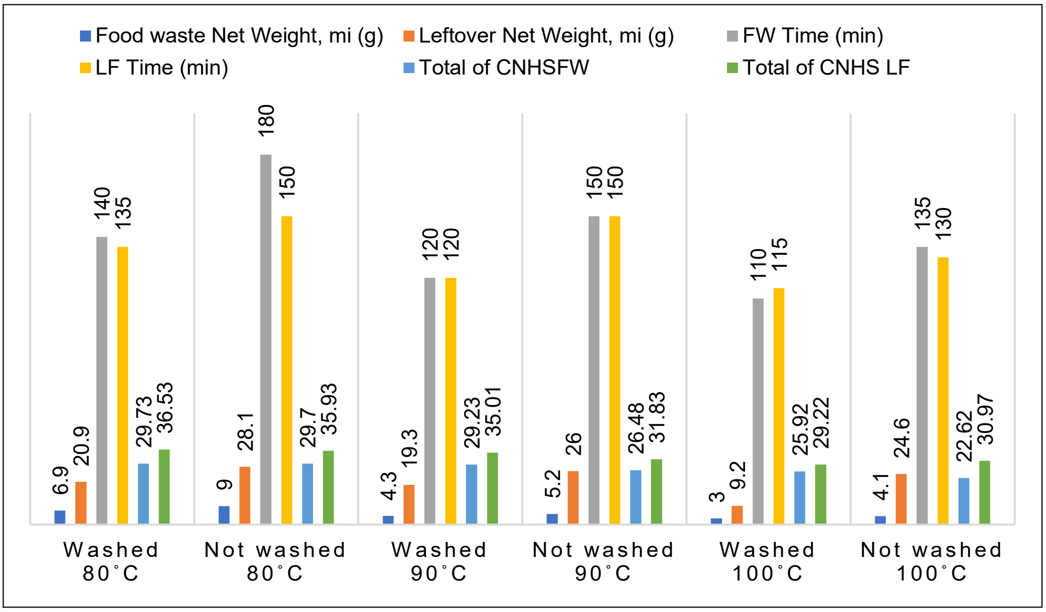


Figure 9. Comparison of the food waste and leftovers drying time, net weight after drying, and nutrient content after trench composting

beneficial microorganisms to thrive. Consequently, this can prolong the composting process and produce an unhealthy end product (Han, 2017). Additionally, oil inhibits airflow during composting, leading to water buildup within the compost (Sánchez et al., 2023).

The net weight of pre-treated leftovers after the drying process at 80°C for 135 minutes was 20.9 g, and the net weight of non-pretreated leftovers at the same temperature was 28.1 g, and it took 150 minutes to dry. The net weight of pre-treated food waste at 80°C was 6.9 g, and it took 140 minutes to dry; the non-pretreated food waste after the drying process at the same temperature was 9 g. As a result, food waste took a longer drying time than leftovers. However, leftovers had a higher net weight after drying than food waste samples. Also, at 90°C and 100°C, food waste net weight was 4.3 g and 3 g, respectively. At the same time, The net weight of non-pretreated leftovers after drying at the same temperatures was 19.3 g and 9.2 g, which was higher than food waste. Due to food waste made up of more juicy fruits and vegetables, in this case, dried more and had a lower net weight. However, leftovers had a larger net weight after drying since they consisted of bread, rice, and noodles (O'Connor et al., 2021).

As a result, the final product of both samples was highly acidic. pH values for food waste ranged from 5.25 to 5.75, and leftovers were in the range of 5.17 to 5.33. However, the electrical conductivity of food waste was (270.3 to 395.8) S/m higher than leftover (180.9 to 225.1) S/m. Carbon, nitrogen, and sulfur are compost's three most significant elements. The resulting amount of CNHS and micronutrients in the final product of leftovers was higher than the food waste final product after trench compost.

The nutrient level of compost is directly proportional to the quality of its input material. The food waste in this study includes rotten vegetables and fruits. But leftovers included rice, bread, noodles, and a variety of vegetables and fruits. In this case, leftover final products were richer than food waste. The highest values of C, N, H, and S (36.53%) and micronutrients (K = 880.1 mg/L, Cu = 1.88 mg/L, Ca = 83.99 mg/L, Cu = 1.88 mg/L, Zn = 14.95 mg/L and Mg = 53.12 mg/L) were found in the final product of pretreated dried leftovers at 80°C. Micronutrients from food waste were lower than they were. Substance waste in the same condition resulted in a final product that contained 29.73% total CNHS and micronutrients (K = 392.2 mg/L, Cu = 0.98 mg/L, Ca = 109.8 mg/L, Zn = 11.4 mg/L and Mg = 58.35 mg/L). The nutrient content dropped significantly for sample food waste and leftovers that were dried at a higher temperature. The final product of pretreated leftovers at 80°C had the highest nutrient content than other parameters, 90°C and 100°C.

Composting source materials, such as organic waste, at high temperatures before composting might decrease dried nutritional content and delay decomposition (Khalida et al., 2022). Since raw materials are unable to decompose properly, the final product will lack the required nutritional content for plants. In this case, controlling the moisture content is a difficult task in the composing process; for composting to be successful, the moisture content of the source material must be stabilized; it should be in the optimal range of (55–65) (Chauhan et al., 2021). The nutrient contents such as Nitrogen (N), potassium (K), phosphorus (P), and many others are highly beneficial to the soil and plants. These nutrients are in adequate quantities in the original waste and can be used as raw material in composting. For instance, nitrogen is essential for leafy vegetables like Chinese kale as it ensures the growth of healthy leaves (Ramli et al., 2023). In general, the findings of this study indicate that both dehydrated food waste and leftovers from trench composting can be used as fertilizers to improve soil health and crop productivity. However, additional effort is required to optimize the application of dehydrated food waste.

CONCLUSION

In conclusion, one of the greatest ways to reduce waste management is to dehydrate food waste and leftovers according to the product. Food waste's lower moisture content can help control the water content of the organic substrate during the composting process. Furthermore, leftovers and purified dry food waste have enough nitrogen and carbon contents, are pathogen-free, and can be used as a compost feedstock. The highest values of C, N, H, and S (36.53%) were found in the final product of pretreated dried leftovers at 80°C, along with higher micronutrients. It was higher than food waste micronutrients. In contrast, the final food waste product contained micronutrients and 29.73% of total CNH under the same conditions. The nutritional value of food waste and leftovers dried at a higher temperature was lowered. The dried leftovers produced at 80°C had more nutrients than those produced at 90°C and 100°C. It is more appropriate for use as a fertilizer in this instance. This study found that the high nutrient and carbon content of dehydrated food waste and compostable residues makes them suitable for fertilizers.

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