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RESEARCH ARTICLE

# A study on food waste utilization for fertilizer production: Analysis of physical and chemical properties

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**ABSTRACT**

Food waste is generated daily in every household worldwide, posing significant challenges to waste management. Disposal in landfills consumes substantial land, water, and fertilizer resources while releasing methane gas that contributes to global warming. This study investigated the nutrient content and physicochemical properties of biofertilizer produced via the Bokashi composting system. Physical characterization focused on liquid fertilizer concentration and moisture content. Results showed that liquid fertilizer from the Bokashi bin had a higher concentration at outdoor temperature, although the yield was lower (0.0073 ratio) than at room temperature. Moisture content in samples at the room temperature was 99.27% higher than those stored outdoors. However, degraded film samples at outdoor temperature had a greater average weight (9 g) compared to room temperature (5 g). The fertilizer was analyzed for nitrogen (N), phosphorus (P) and potassium (K) concentrations. For chemical characterization, total nitrogen content was measured using the Kjeldahl method according to Malaysian Standard MS 417: Part 3: 1994. The results showed that the thin film fertilizer contained 0.3% nitrogen, which is higher than that of the liquid fertilizer. Phosphorus content was determined using UV-Visible Spectroscopy at 740 nm, with the liquid fertilizer at room temperature showing a higher phosphorus concentration of 4.117 mg/L. Potassium concentration in the film fertilizer was found to be 156.1 mg/L, as analyzed using Atomic Absorption Spectroscopy (AAS). These findings highlight the potential of Bokashi-based and films bio-fertilizers as a sustainable solution for nutrient recovery and food waste reduction.



## 1. INTRODUCTION

Food waste, a global issue that is widespread, encompasses a wide range of foodstuffs that are discarded due to damage, inedibility, or excess. According to one study, agricultural processes can generate different types of waste (Sarker et al., 2023). On a global scale, agricultural waste management is a crucial strategy, as it is a critical factor for humans, animals, and plants. The objective of this study is to investigate the physicochemical properties and nutrient composition of Bokashi-derived biofertilizers. Specifically, it examines liquid fertilizer concentration, moisture content, and NPK values under different storage conditions, with the aim of evaluating their potential as sustainable alternatives for nutrient recovery and effective food waste management (Wainaina et al., 2020). The increasing global population drives higher food production, inevitably contributing to greater volumes of waste (Phibunwatthanawong et al., 2019). When disposed of in landfills, food waste decomposes and releases harmful greenhouse gases. Alternatively, it can be transformed into valuable fertilizer by recycling nutrients through composting or anaerobic digestion, which may also generate renewable energy. While Bokashi composting is widely recognized as an efficient method for organic waste treatment, systematic evaluations of nutrient profiles and physicochemical properties of its biofertilizers under varying conditions remain limited (Li et al., 2021). In particular, comparative insights into the performance of liquid and film fertilizers, especially with respect to their NPK content, are still underexplored for sustainable nutrient recovery applications (Khalil et al., 2022).

Fertilizers derived from agricultural waste, such as banana peels, eggshells, fish bones, and food waste, offer multiple benefits (Ahmed et al., 2021). It enriches soil with essential nutrients like nitrogen, phosphorus, and calcium, enhancing plant growth and yield (Sugiharti et al., 2021). This eco-friendly approach reduces landfill waste and greenhouse gas emissions, promoting sustainable agriculture (Thirumala et al., 2022). Moreover, using biodegradable organic matter improves soil structure, microbial activity, and moisture retention. Such practices support circular economy models by converting waste into valuable bio-resources (Chen et al., 2022).

Composting involves the natural breakdown of organic matter into nutrient-rich soil (Pajura et al., 2023). For example, as assessed by Koller et al. (2013), the polyhydroxyalkanoates (PHA) and their follow-up products can be processed to create a variety of products that can be marketed for a wide range of applications. They have potential in agro-industrial applications such as fertilizer manufacturing (Bogusz et al., 2021). The integrated production of poly(3-hydroxybutyrate) PHB and ethanol from banana residues as agro-industrial waste. Expense PHB is run using glucose obtained in the stage hydrolysis from banana pulp, while the peel is exploited to produce ethanol.

Ethanol and PHB have theoretical values of 238 and 31.5 kg/ton, respectively. Fruit pomace and leftover fried oil used coffee powder, distillery spent, and margarine waste are additional food wastes utilized in the production of PHA. Food waste (FW), due to its relatively stable nature and high fermentable sugar content, is considered an excellent substrate for producing PHA. Through anaerobic digestion, this waste can be converted into biogas and nutrient-rich digestate. These environmentally friendly approaches not only minimize waste but also enhance soil quality, support healthier plant growth, and contribute to a circular food production system. For instance, food waste has been extensively studied as a feedstock for biological hydrogen production via dark fermentation. Nevertheless, the high moisture content in food waste poses challenges, as it raises concerns among local communities regarding potential emissions into the air. Despite this, anaerobic digestion remains a promising and increasingly adopted technology. The high biodegradability and moisture content of food waste make it particularly suitable for generating biogas and producing digestate, which can serve as soil amendments or nutrient sources (Jayanti et al., 2022).

Digestate is high in nitrogen (N), phosphorus (P), potassium (K), and essential micronutrients. It supports sustainable agriculture by improving soil fertility and reducing reliance on chemical fertilizers. Composting is another viable method, in which microbial activity transforms food waste into humus-like substances that enrich the soil (Nik Yusuf, 2023). Both methods help close the loop of the food production cycle, reducing landfill pressure and greenhouse gas emissions. These biofertilizers contain essential plant nutrients and beneficial microorganisms that enhance soil fertility and promote plant growth by facilitating organic matter recycling.

Bokashi is a traditional Japanese composting technique that utilizes Effective Microorganisms (EM) such as lactic acid bacteria, yeast, and phototrophic bacteria to ferment organic waste in an anaerobic, sealed environment. Unlike conventional aerobic composting, Bokashi generates minimal odour and significantly reduces greenhouse gas emissions. It also shortens the decomposition period while preserving essential nutrients in the compost (Huang et al., 2023).

The resulting product, known as Bokashi pre-compost, can be buried in soil for further degradation or processed to extract a nutrient-rich liquid biofertilizer. This liquid contains water-soluble nutrients and plant growth regulators like auxins and cytokinin's (Phooi et al., 2023). Bokashi fermentation improves soil microbial diversity, a key factor in sustaining soil fertility and plant health. The EM in the Bokashi mix serves as a natural inoculant, promoting a balanced microbial ecosystem in both soil and plants. As a sustainable composting method, Bokashi supports environmentally friendly agricultural practices by enhancing soil structure and crop resilience (Samaras et al., 2024).

## 2. MATERIALS AND METHODS

Food waste was collected from Taman Pinggiran UMK, Jeli, Kelantan. This study aims to produce organic fertilizer using food waste, including materials such as fruit peels, discarded vegetables, eggshells, and coconut residues (Tombarkiewicz et al., 2022). The production process of the organic fertilizer is analyzed from three main aspects, focusing on both physical and chemical properties. From the physical standpoint, which is the outdoor temperature (30 - 40°C) and room temperature (27-30°C), continuous observations are conducted throughout the composting process to monitor changes in the organic fertilizer from the Bokashi technique and the thin-film material, which is produced from hand sheet machines. The parameters that were used in this research are the effects of the temperature and the types of fertilizer, which were the fertilizer in liquid form by the Bokashi technique and the fertilizer by using in film form. From the chemical perspective, analysis is carried out on both the fermented organic fertilizer and the degraded film to determine their chemical compositions. This includes evaluating the nutrient content of the end products, particularly nitrogen (N), phosphorus (P), and potassium (K). These measurements allow for comparative assessment of the nutrient values present in both the organic fertilizer (using Bokashi methods) and the bio-based thin films. The thin films were prepared by a hand sheet machine by combining waste banana peel, eggshells, and glycerol. These two types of fertilizer, which are

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liquid fertilizer, which is produced by the Bokashi method, and thin films, which degrade in composite soil for a month, were tested for the determination of N, P & K content.

A dedicated empty trash bin was provided to separate specific types of food waste for collection. Only certain types of food waste were allowed to be disposed of in this bin, such as dry food scraps, fruit peels, eggshells, and discarded vegetables. Additionally, we collected coconut residue from a coconut milk stall in Lakota, Jeli, Kelantan. The food waste was gathered over a period of two days only. This was to prevent the attraction of maggots. On the third day, the collected food waste was placed into a bucket pile. The equipment used included an 18L plain white bucket pile, Bokashi (purchased from a nursery shop), mesh steel, and a plastic water tap.

### 2.1. Process of Liquid Fertilizer using Bokashi and Thin Films

The method was carried out at the UMK wood workshop, chosen for its suitable environment, free from weeds and overgrowth. The production of liquid fertilizer requires exposure to both outdoor and indoor temperatures. To accommodate this, the selected area had to be clean and well-maintained. The Bokashi composting system utilizes a bucket pail and mesh steel, with the mesh acting as a separator to filter the liquid fertilizer from the decomposing food waste. After a month, the liquid drained from the bin was collected and stored in two parameters, as stated, which are placed in outdoor and room temperature. The bucket pail was securely covered to protect the contents from insect intrusion and heavy rain, while the indoor composting bin was similarly sealed to prevent pests.

To aid decomposition, food waste was shredded into small pieces before being placed into an 18L container designated for liquid fertilizer. The waste was layered alternately with Bokashi bran, that purchased under which brand name of Bokashi Organko, following an approximate ratio of 2 inches of food waste to 3 inches of Bokashi. This layering continued until a sufficient thickness was achieved. No additional watering was needed, as the mixture already contained enough moisture for fermentation.

For thin films preparations, the waste banana peel and eggshell were separately cut into smaller pieces and boiled for 20 min before drying in an oven at a temperature of 80 ˚C for 30 min. These pieces were then ground using a mechanical blender into fine powder sizes ranging from 80 - 100 µm. The banana peel, eggshells, and glycerol were blended in formed into thin films by using a hand sheet machine at Wood Laboratory, UMK Kampus Jeli.

The list of samples of composition is listed in Table 1. The samples used are liquid fertilizer and thin films (for mulching film applications). The value of NPK nutrition in the compost soil produced by liquid fertilizer and films was investigated.

**Table 1**: The samples used in the fertilizer nutrition investigation.

| Samples (Symbol) | Content of agricultural waste |
|---|---|
| LFOT (Liquid fertilizer at outdoor temperature) | Dry food scraps, fruit peels, eggshells, and discarded vegetables of Bokashi methods at outdoor temperature |
| G1OT (Thin films fertilizer at outdoor temperature) | Films contain glycerol 10% and banana peel at outdoor temperature |
| GIE3 OT (Thin films fertilizer at outdoor temperature) | Films contain glycerol 10%, banana peel and eggshell 3% at outdoor temperature |
| (LFRT) (Liquid fertilizer at room temperature) | Dry food scraps, fruit peels, eggshells, and discarded vegetables of Bokashi methods at room temperature |
| G1E5 RT (Thin films fertilizer at room temperature | Films contain glycerol 10%, banana peel and eggshell 5% at room temperature |
| G1E10 RT (Thin films fertilizer at room temperature) | Films contain glycerol 10%, banana peel and eggshell 10% at room temperature |

### 2.2. Determination of Nitrogen (N), Phosphorus (P) and Potassium (K) content

The total N in the liquid fertilizer and film-degraded sample was calculated using the Kjeldahl method, based on the Malaysian Standard. There are three major steps in the Kjeldahl procedure: digestion, distillation, and titration. First, 1.0 g of the liquid fertilizer sample and degraded film was weighed into a 50 mL Kjeldahl digestion tube. A measuring cylinder was used to add 12 mL of concentrated sulfuric acid ($H_2SO_4$) into the digestion tube. A Kjeldahl Cu catalyst tablet was then added to each tube.

The samples were then heated at 400°C for 3 hours in a digestion block until the solution turned colourless. After heating, the samples were left to cool for 15 minutes. During the cooling phase, 80 mL of distilled water and 50 mL of 40% sodium hydroxide (NaOH) were added to initiate the distillation process.

For the distillation, a receiver solution was prepared by combining 30 mL of 4% boric acid, 1.75 mL of methyl red, and 2.5 mL of bromocresol green in a 250 mL conical flask. The 4% boric acid solution was made by dissolving 10 g of boric acid ($H_3BO_3$) in 250 mL of distilled water and mixing until fully dissolved. The receiver flask was properly positioned, and during distillation, the solution's colour shifted from red to green.

For the titration step, 0.01 M sulfuric acid ($H_2SO_4$) was prepared by diluting 0.54 mL of concentrated acid into a

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1-liter volumetric flask. Titration was performed until the solution changed colour from green to pink. The nitrogen content in the sample was calculated using the following formula:

$$\% \text{ Nitrogen: } \frac{(T-B)x\ N\ x\ 14.01}{Wt\ x\ 10}$$

where:

T = Volume of 0.001 M $H_2SO_4$ titrated for the sample (ml)

B = Digested blank titration volume (ml)

N = Molarity of $H_2SO_4$

14.0 = Atomic weight of N

$W_t$ = Weight of sample (g)

For the determination of phosphorus (P) content, each liquid fertilizer and degraded film sample was precisely weighed to about 2 g and placed into a 250 mL conical flask. A diluted hydrochloric acid (HCl) solution was created by combining 60 mL of HCl with 40 mL of distilled water. Subsequently, 10 mL of the diluted HCl was introduced to each of the six samples contained in 250 mL conical flasks.

Following this, 26 mL of $H_2SO_4$ was added to each flask, which equates to 4.33 mL of $H_2SO_4$ per sample. A magnetic stir bar was then inserted into each flask, and the mixture was stirred at 50 rpm for a duration of 45 minutes. The samples were maintained in a fume hood for a period of 7 hours. The samples were then filtered using filter paper. A volume of 20 mL of the filtered digest was combined with 4 mL of ammonium molybdate solution. This mixture was subsequently subjected to a double-boiling process on a hot plate for 30 minutes. The data was analyzed using Ultraviolet-Visible Spectroscopy (UV-Vis), with the wavelength of maximum absorbance noted at approximately 740 nm.

For the Potassium (K) content of fertilizer, the samples weigh 2.5 g of the liquid fertilizer and the degraded film sample into separate beakers. Add 100 mL of distilled water to each beaker and boil for 30 minutes. After boiling, dilute each sample in a 250 mL conical flask with an additional distilled water which is 100 mL, and mix thoroughly. Next, filter each sample using a syringe filter to remove any solid particles. The resulting filtrate was analysed using Atomic Absorption Spectroscopy (AAS) to measure the concentration of available potassium (K).

## 3. RESULT AND DISCUSSION

### 3.1 The physical characterization of liquid fertilizer and degraded films (nitrogen, phosphorus & potassium)

For the fertilizer nutrients, it shows the findings concerning liquid fertilizer and degraded films indicate that both underwent alterations. In terms of colour, both changed to a dark brown shade. The liquid fertilizer emitted a strong fermented odour, while the degraded films only produced a scent reminiscent of earthy soil. When it comes to texture, the liquid fertilizer at room temperature (LFRT) resulted in a significant amount of leachate, whereas in outdoor conditions (LFOT), it yielded only a small volume of thick liquid. As for the degraded films, they disintegrated into soil-like particles at outdoor temperatures, but at room temperature, they did not break down and instead became moldy (Figure 1).


**Figure 1:** Physical characterization of a) liquid fertilizer, b) thin films before it is converted into fertilizer, c) liquid fertilizer, d) thin films after converted into fertilizer in one month exposed in Bokashi method and in compost soil, e) Bokashi compost before 2 weeks fermentation and f) Bokashi compost after 3 weeks fermented

The physical characterization included was by appearance by the naked eyes as shown in Table 2. In this study, the moisture content at outdoor temperatures was found to be higher on average compared to samples at room temperature. Specifically, the average weight of degraded material at outdoor temperatures was 9 grams, while the average weight of degraded material at room temperature was 5 grams for both liquid and film fertilizers. This means that more degradation occurred at outdoor temperatures, potentially due to the differences in environmental conditions such as temperature and humidity.

**Table 2**: The physical appearances samples of fertilizer after one month exposed.

| Samples (Symbol) | Physical appearance |
|---|---|
| Liquid fertilizer at outdoor temperature (LFOT) | Black liquid formed |
| Thin films fertilizer at outdoor temperature (G1OT) | Brown color into small particles |
| Thin films fertilizer at outdoor temperature (G1E3 OT) | Brown dark color |
| Liquid fertilizer at room temperature (LFRT) | Black liquid formed |
| Thin films fertilizer at room temperature (G1E5 RT) | Black color |
| Thin films fertilizer at room temperature (G1E10 RT) | Brown color |

### 3.2 Chemical characterization of liquid fertilizer and degraded films (nitrogen, phosphorus & potassium)

This study analysed the nitrogen content in liquid fertilizer and thin film under room temperature conditions, using the MS417: Part 3:1994 method. As stated in Table 3, the results show that liquid fertilizer (LFOT) contains 0.1% nitrogen, while thin film has a higher nitrogen concentration of 0.3%. The liquid fertilizer contains 0.1% nitrogen, which can cause plant growth to be suboptimal.

They are rich in potassium (K) and moderate in phosphorus (P), but very low in nitrogen (N). When used in fertilizer, banana peel enhances root development, flowering, and fruiting rather than leafy growth. For liquid fertilizer, liquid fertilizer produced by Bokashi leachate and compost tea was investigated. The nutrients are more soluble and readily available, particularly nitrogen in ammonium/nitrate form and potassium as $K^{+}$. While for film fertilizer, NPK nutrients are encapsulated or adsorbed within a matrix. Release is controlled and sustained, minimizing N losses through evaporation or leaching.

Based on Yingying et al. (2024), the commercial fertilizers typically contain 20–46% nitrogen by weight, depending on the formulation. The optimal yield was achieved with 150 kg N $ha^{-1}$ for maize yield. The formation of liquid fertilizer was produced at an optimal temperature, which is at room temperature storage, as its liquid form prevents microbial activity (Thirumala et al., 2022). Conversely, the thin film (GIE10 RT) shows a higher nitrogen concentration that remains intact, but its physical changes into mold growth for a month reflect potential challenges in maintaining its integrity in humid conditions.

**Table 3:** Total nitrogen of fertilizers

| Results of nitrogen (N) | Total nitrogen in percentage (%) |
|---|---|
| LFOT | 0.1 |
| G1OT | 0.2 |
| G1E3 OT | 0.1 |
| LFRT Liquid Fertilizer | 0.1 |
| G1E5 RT | 0.2 |
| G1E10 RT | 0.3 |

Phosphorus is an essential nutrient for plant growth, particularly in root development and energy transfer. This study aims to assess the level of available phosphorus in liquid fertilizer and thin film under two temperature conditions, room temperature and outdoor temperature (Khan et al., 2023).

Table 4 shows the results of phosphorus (P) content, which was conducted by using UV-Vis methods. Therefore, the available phosphorus analysis was conducted using absorbance readings at a wavelength of 740 nm, providing an estimate of the amount of phosphorus available for plant uptake. The results indicate that phosphorus concentration in liquid fertilizer at room temperature is higher compared to the thin film. Liquid fertilizer at room temperature (LFRT) has a higher phosphorus content (4.117 nm), while at outdoor temperature, the phosphorus content slightly decreases (0.909), possibly due to precipitation or nutrient loss through evaporation (Ding et al., 2017). These findings suggest that temperature can influence the stability and availability of phosphorus in liquid fertilizer, but in thin films, phosphorus tends to remain in a bound form. The factors that most affect the fertilizer formation were temperature, moisture content, and pH. The optimal temperature for fertilizer formation was 37°C. Therefore, selecting the appropriate fertilizer medium and controlling temperature in storage and application can help optimize phosphorus availability for better plant growth.

**Table 4:** Total absorbance of phosphorus (P).

| Results of phosphorus (P) | Total phosphorus in wavelength (nm) (high sensitivity in near-infrared range) |
|---|---|
| LFOT | 0.909 |
| G1 OT | 0.747 |
| G1E3 OT | 1,709 |
| LFRT | 4.117 |
| G1E5 RT | 2.463 |
| G1E10 RT | 1.927 |

Potassium (K) is a vital nutrient in fertilizers that significantly enhances plant health and productivity. Potassium also strengthens plant stems and roots, promotes enzyme activation, and improves resistance to diseases and environmental stress. Additionally, it enhances flowering, fruit

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development, and crop quality by aiding in sugar and nutrient transport (Marek et al., 2019). Its presence ensures better yield, taste, and shelf life of produce. Overall, potassium is essential for optimal plant growth and resilience.

Table 5 displays the potassium (K) concentration (mg/L) across various samples, including liquid fertilizer (LF) and thin film/degraded films (G1) under room temperature (RT) and outdoor temperature (OT) treated samples. The data demonstrates how sample type and treatment influence potassium content. The lowest potassium concentration was observed in LFOT (13.31 mg/L). G1OT (28.3mg/L) and G1E3OT (27.89mg/L) showed slightly higher potassium concentrations.

**Table 5:** Total absorbance of potassium (K).

| Results of potassium (K) | Total potassium (K) in (mg/L) |
|---|---|
| LFOT | 13.31 |
| G1 OT | 28.3 |
| G1E3 OT | 27.89 |
| LFRT | 53.5 |
| G1E5 RT | 147.8 |
| G1E10 RT | 156.1 |

The results highlight the influence of sample type and treatment conditions on potassium content. The lowest potassium level was detected in LF OT (13.31 mg/L), while slightly higher concentrations were observed in G1 OT (28.3 mg/L) and G1E3 OT (27.89 mg/L). A notable increase was found in LF RT (53.5 mg/L), suggesting that room temperature enhances potassium retention. The highest concentrations were observed in G1E5 RT (147.8 mg/L) and G1E10 RT (156.1 mg/L), indicating significant nutrient enrichment. These findings confirm that room temperature treatment effectively increases potassium concentration, particularly in the G1E10 RT sample. This highlights the potential of controlled temperature treatment to improve nutrient availability compared to untreated LF OT, offering practical insights for optimizing fertilizer applications. The summary details of the highest fertilizer content for nitrogen (N), phosphorus (P), and potassium (K) are summarized in Table 6. It summarizes that thin film fertilizer showed the highest nitrogen (N) content at 0.3%, indicating its effectiveness in supplying essential growth nutrients. For phosphorus (P), the highest absorption peak (4.117 nm) was recorded in the liquid fertilizer, suggesting better phosphorus availability in liquid form. Potassium concentration peaked at 156.1 mg/L, which is the G1E10 RT of thin film fertilizer treated at room temperature, demonstrating the treatment's ability to retain and enhance potassium content. These findings highlight the complementary nutrient strengths of both fertilizer types and emphasize the effectiveness of room temperature treatment in maximizing potassium enrichment, which is vital for plant health and productivity.

**Table 6**: The summarizes values of chemical composition of nitrogen, phosphorus, and potassium of fertilizer from agricultural waste.

| Parameters | Highest percentage of liquid fertilizer /thin films fertilizer (%) |
|---|---|
| Nitrogen (N) (percentage %) | 0.3 % (Thin films fertilizer) |
| Phosphorus (P) (wavelength nm) | 4.117 (Liquid fertilizer) |
| Potassium (K) (mg/L) | 156.1 (Thin films fertilizer at room temperature) |

### 3.1 Effects of temperature for fertilizer concentrations (N, P, K)

Utilizing agricultural waste to produce bio-fertilizers presents an environmentally friendly approach to combat soil degradation, especially when integrated with the Bokashi composting method, as shown in Figure 2. Agricultural by-products like fruit peels, rice husks, and oil palm residues are abundant in organic matter and vital nutrients. When subjected to Bokashi—a composting technique based on fermentation that employs effective microorganisms (EMs)—these materials decompose swiftly under anaerobic conditions, thereby retaining nutrients and inhibiting harmful pathogens (Neves et al., 2021). This method produces a nutrient-dense bio-fertilizer capable of revitalizing degraded soils by boosting microbial activity, enhancing water retention, and increasing organic carbon levels. The research shows that the fertilizer produced by using the Bokashi technique exhibits improved structure and pH balance. Additionally, this technique shortens composting duration and reduces odours, making it applicable in both rural and urban settings (Kang et al,. 2021). The final product serves not only as a fertilizer but also as a soil conditioner, mitigating the impacts of erosion, over-cultivation, and chemical misuse. In summary, this method is in harmony with sustainable agricultural practices, minimizing waste, improving soil fertility, and supporting circular economic initiatives. Its scalability and cost-effectiveness render it particularly advantageous for smallholder farmers and community-driven green innovation projects in areas grappling with soil degradation and waste management issues. As shown as discussed above shows that the optimal temperature for resulting in higher NPK content was at room temperature, which is in a range temperature 37°C.

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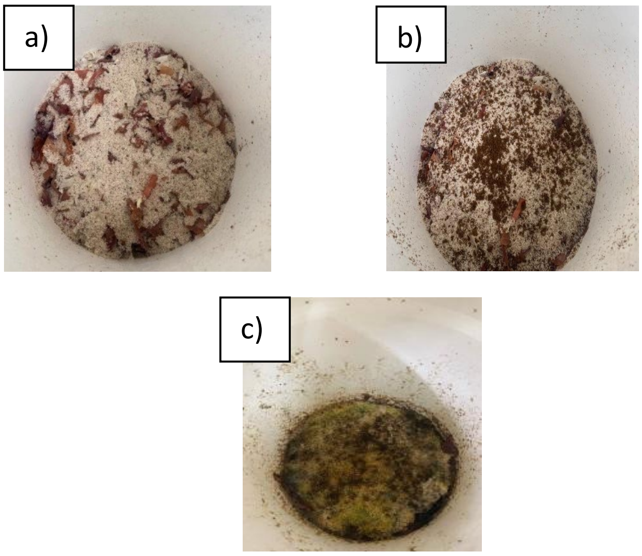


**Figure 2:** The bio-fertilizer from waste agricultural products by using the Bokashi compost system. a) Bokashi system, where the food waste is mixed with Bokashi, and b) Fertilization at 0 week: c) Bokashi compost after 3 weeks fermented.

## 4. CONCLUSION

The objectives of this research were to assess the ability of organic fertilizer to provide nutrients to plants using a bokashi system. Next, to evaluate the physical and chemical properties of organic fertilizer. For total nitrogen analysis, which better is thin films at room temperature. This can make it more nutrient-rich. Although thin film develops mold under humid conditions, it maintains its nitrogen content without degradation, making it more effective in retaining nutrients over time. Therefore, the suitable phosphorus availability is liquid fertilizer in a temperature-controlled room due to its highest absorbance value (4.117 nm) as discussed. Moreover, the thin films G1E10 RT with 156.1 mg/L show the best potassium concentration. This is because it ensures more effective nutrient availability and making the thin film method superior for applications requiring enriched potassium content.

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