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**Original Research Article**

# Utilization of Banana Peel, Rice Washing Water, Onion Skins, and Eggshell as Fertilizer for Tomato Plants (*Lycopersicum esculentum* Mill.)

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**Abstract:** This study aims to find the benefits of household liquid organic waste as plant fertilizer. Liquid organic waste fertilizer is made using banana peel, rice washing water, onion skin, and egg shells. Banana peel (100 g), onion skin (50 g), and egg shells (5 shells) are finely chopped and then soaked in rice washing water (500 ml). The mixture is used to fertilize tomato seedlings in polybags containing 1 kg of soil. The results showed that fertilization carried out once in 5 days increased tomato growth parameters, but did not affect chlorophyll levels. Thus, it can be concluded that liquid organic waste fertilizer from banana peel, rice washing water, onion skin, and egg shells has the potential to be used as tomato plant fertilizer.

**Keywords:** Organic fertilizer, banana peel, rice water, onion skin, eggshell, tomato plants.

## 1. INTRODUCTION

Organic waste is one of the biggest challenges facing the world. On land, atmospheric organic waste is known to be a source of greenhouse gas emissions (GHG) in the atmosphere. In aquatic environments, organic waste undergoes aerobic and anaerobic decomposition. Aerobic pollution causes water to lose oxygen, while anaerobic decomposition produces gases that are harmful to aquatic organisms [1].

To reduce the environmental impact of organic waste, experts around the world are trying to recycle and/or process household organic waste into more useful materials [2,3]. One of the efforts that is widely researched in utilizing organic waste is to use it as plant fertilizer [4].

In tropical countries like Indonesia, banana peels and rice washing water are household waste that is thrown away, thus contributing to organic waste in the environment [5,6]. In addition, organic waste that is also often thrown away is onion skins and egg shells. As part of our efforts to find benefits from such organic waste, we use them as fertilizer for tomato plants.

Rice washing water has been proven to be able to be used as a fertilizer with properties similar to NPK fertilizer. Rice washing water has been proven to be able to be used as a fertilizer with properties similar to NPK fertilizer [7]. Rice washing water is known to be rich in phosphorus, calcium, nitrogen, manganese, iron, magnesium, and potassium [8,9]. Meanwhile, banana peel waste is also known to contain various nutrients such as phosphorus, iron, calcium, magnesium, sodium, zinc, copper, potassium, and manganese [10]. Eggshells are known to contain the following substances: sodium, potassium, zinc, manganese, iron, and copper [11]. Onion (*Allium cepa. L*) skin is also an organic waste that is rich in phosphorus which is needed for plant root growth [12].

## 2. MATERIALS AND METHODS

### 2.1 Preparation of Liquid Fertilizer

Banana peel (100 g), onion skin (50 g), and egg shells (5 shells) are finely chopped then put into an airtight container. Rice washing water (500 ml) then added and stirred until evenly mixed. The container is tightly closed and left for 7-10 days until the smells sour like fermented cassava and the color of the liquid changes to brown. The liquid is filtered and stored in a plastic bottle for further application to plants.

### 2.2 Tomato seedling preparation

Tomato seeds are first soaked in warm water for approximately 30 minutes which aims to sort out good and bad seeds. Next, tomato seeds are sown on wet paper so that they are moist until shoots grow. Tomato seedlings that have grown shoots are then transferred to a polybag that containing 1 kg of soil media. Each polybag is labeled according to the treatment. The polybags are then placed randomly according to a completely random design. Fertilization is done in the morning by pouring fertilizer on the soil in polybags.

### 2.3 Experimental Design

By using a completely randomized design, the prepared liquid waste fertilizer is used to fertilize tomato plants (*Lycopersicum esculentum* Mill.) with the following treatments:

- Positive control: tomato plants treated with NPK fertilizer;
- Treatment 1: tomato plants are fertilized once every 3 days;
- Treatment 2: tomato plants are fertilized once every 5 days;
- Treatment 3: tomato plants are fertilized once every 7 days.

### 2.4 Experimental parameters

The parameters recorded and analyzed in this experiment were plant height, leaf area, wet weight, dry weight, and chlorophyll a and b levels. Plant height was measured weekly on the stem starting from the ground surface to the growing point of the plant using a ruler. Leaf area was measured using the gravimetric method. The leaves were placed on plain HVS paper and drawn and then cut according to the leaf replica. Wet weight measurement begins by removing the plant from the polybag. The plant is cleaned from the remaining soil attached to the plant roots. After that, the plant is weighed using a digital scale. The dry weight of the plant is measured after the fresh plant is oven-dried until its weight is constant.

A total of 0.1 grams of leaves were ground until smooth using a mortar, then 10 ml of 96% ethanol was added. The extract was filtered using filter paper and then put into a test tube. The absorbance of the chlorophyll extract was measured at wavelengths (λ) of 648 and 664 mm. Chlorophyll content is expressed in milligrams per liter and is calculated based on the following equation:

Chl-a = (13.36.λ664 – 5.19.λ648) mg/l
Chl-b = (27.43. λ 648 – 8.12. λ 664) mg/l
Chl $_{Total}$ = (5.24.λ664 + 22.24 λ648) mg/l

### 2.5 Data Analysis

The data obtained were analyzed using ANOVA and then continued with a post hoc test using the honest significant difference test (HSD) at a 5% level of significance.

## 3. RESULTS AND DISCUSSION

### 3.1 Plant growth parameter

The impact of treatment using liquid waste fertilizer containing banana peel, rice washing water, onion skins, and eggshell on tomato growth is presented in Table 1.

**Table 1: Growth parameter of tomato plant (*L. esculentum*) after treated liquid waste fertilizer**

| Treatment* | Plant height (cm) | Leaf area ($cm^2$) | Wet weight (g) | Dry weight (g) |
|---|---|---|---|---|
| Positive control (NPK) | $67.7 \pm 1.32^{c}$ | $23.1 \pm 2.51^{b}$ | $39.8 \pm 3.48^{b}$ | $3.68 \pm 1.11^{b}$ |
| LWF once in 3 days | $45.5 \pm 1.64^{a}$ | $18.1 \pm 1.09^{a}$ | $24.3 \pm 3.83^{a}$ | $1.92 \pm 0.46^{a}$ |
| LWF once in 5 days | $66.5 \pm 1.04^{c}$ | $21.9 \pm 3.36^{b}$ | $36.6 \pm 5.20^{b}$ | $2.83 \pm 0.78^{ab}$ |
| LWF once in 7 days) | $54.1 \pm 1.72^{b}$ | $17.1 \pm 1.28^{a}$ | $29.5 \pm 2.73^{a}$ | $2.07 \pm 0.48^{a}$ |
| *LWF: liquid waste fertilizer containing banana peel, rice washing water, onion skins, and eggshell | | | | |

Based on the data in Table 1, it can be said that liquid waste fertilizer from banana peel, rice washing water, onion skins, and eggshells provides a positive effect, although it is still below the effect of NPK fertilizer. This fertilizing effect is something natural because the liquid waste fertilizer ingredients provided do contain relatively complete macro and

micronutrients. As is known, household liquid waste contains many nutrients such as phosphorus, calcium, magnesium, sodium, and potassium that are important for plants [13, 14]. It has been proven that tomato plants can produce more yields by providing organic fertilizer from household waste [15,16].

The question is why the effect is not related to the frequency of fertilization. Fertilization given every 5 days showed the highest growth effect on tomatoes, while fertilization every 3 days showed the lowest growth rate. This result is in line with the findings of Yunitasari *et al.* (2025) who fertilized tomato plants every 4 days, 7 days, and 10 days. The results showed that the frequency of fertilization that gave the best results was every 7 days. Fertilization less or more than 7 days did not produce optimal results [17]. The effect of fertilization frequency on tomato plant growth has been proven to be quite significant [18]. Meanwhile, Feng *et al.*, (2023) found that the best fertilization time for tomatoes is every 6 days because it can provide the best water-saving in the soil. [19].

### 3.2 Chlorophyl Content

The results of measuring chlorophyll content in tomato plants after being treated with liquid waste fertilizer are presented in Figure 1.

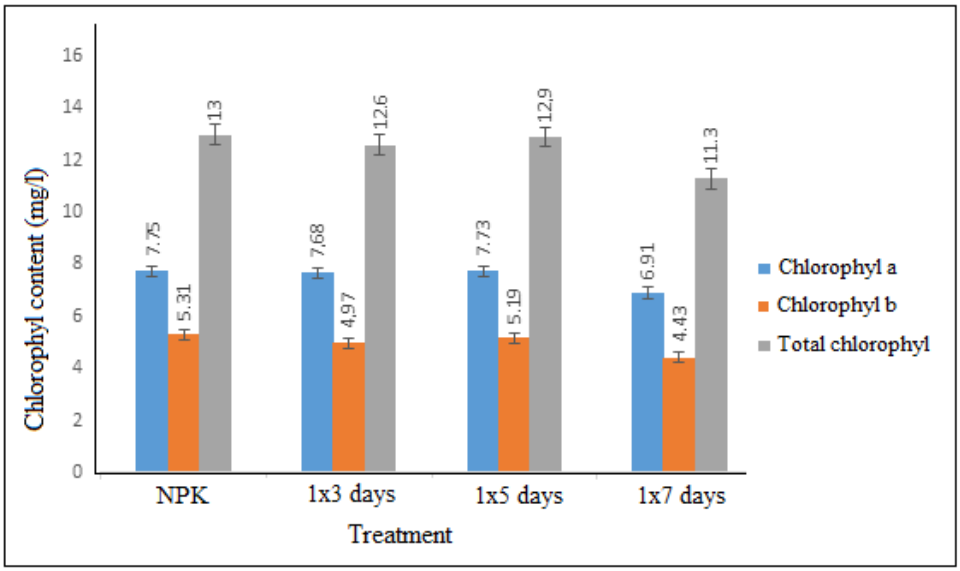


**Figure 1: Chlorophy content in tomato plants after treated with liquid waste fertilizer**

There was no statistically significant difference in the content of chlorophyll a, chlorophyll b, and total chlorophyll in tomato plants given NPK chemical fertilizer and liquid waste fertilizer. This result is not something strange because research using N fertilizer on tomatoes conducted by Andaresta *et al.* (2022) also showed similar results. [20]. But other studies by Kasinath *et al.* (2014) using magnesium fertilizer and Alves *et al.* (2018) showed the opposite results, where tomato plants experienced increased chlorophyll levels and harvest yields [21, 22].

## 4. CONCLUSION

The results of the study showed that liquid waste fertilizer containing banana peel, rice washing water, onion skins, and eggshell did not affect the chlorophyll content of tomato plants but could increase their growth parameters. Thus, it can be concluded that household liquid waste fertilizer has the potential to be used as fertilizer for tomato plants.

**Compliance with Ethical Standards**

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