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FRUIT PEEL ECOENZYMES AND BIOSAKA AS EFFICIENT AND EFFECTIVE NUTRIENTS IN ORNAMENTAL PLANTS USING AQUEOUS MEDIA

EKOENZIM KULIT BUAH DAN BIOSAKA SEBAGAI NUTRISI YANG EFISIEN DAN EFEKTIF PADA TANAMAN HIAS MENGGUNAKAN MEDIA AIR

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Abstract

Air pollution from toxic exhaust gases from various human activities, such as the remains of motor vehicles, factories, and even gas released by organic waste, is dangerous for human health, especially the lungs. To minimise the impact of air pollution, ornamental plants such as *Epipremnum aureum* with efficient care and water media are considered, especially for urban areas. Nutrition is the main factor in plant growth, so striving for safe organic nutrients is necessary. The ecoenzymes and biosaka effectively promote plant growth and are safe for human health. The research was carried out with a complete randomised block experimental design with one factor, the type of nutrient solution, consisting of three levels: control in the form of water, ecoenzyme solution 1 mL L-1 water, and biosaka solution 1.5 mL L^{-1} water, with six replications. The research showed that the highest results were significant in the number of shoots, shoot length, and root number of *Epipremnum aureum* were influenced by the biosaka solution, followed by the ecoenzyme solution and the control, respectively. Adding biosaka and ecoenzyme solutions can become an efficient and effective source of nutrients in the planting medium, and using water will minimise air pollution.

Keywords: biosaka, ecoenzymes, organic waste, air pollution.

Introduction

Air pollution has become a severe problem, largely due to human activities. As per Law Number 32 of 2009 concerning Environmental Protection and Management, environmental pollution is the entry or introduction of living creatures, substances, energy, and other components into the environment by human activities so that it exceeds the environmental quality standards set by established authorities (Saly and Metriska 2023). The more people in cities, the more ecological problems there will be. According to IQAir (a technology company that records air quality in the world), in 2022, Jakarta was the city with the 12th worst air quality in the world (Fedora and Ariaji 2023). Air pollution is increasing, so efforts are needed to minimize its negative impact on living creatures (Hermana *et al*, 2021; Utomo *et al*, 2023). The causes of air pollution are in the land transportation sector, contributing 46%; the industrial sector, 43%; and the agricultural sector, 14%, including organic waste (Fedora and Ariaji 2023; Utomo *et al.* 2023).

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Organic waste is a byproduct of fruit peels, wood, food waste, and leaves, which microorganisms can break down during decomposition. In 2016, the amount of waste generated in Indonesia reached a staggering 65.2 million tons/year (Central Statistics Agency, 2018). According to data from the Ministry of Environment and Forestry (KLHK), in 2020, waste generation in Indonesia reached an even higher 72 million tons/year. This data underscores the urgency of the situation, with around 36% or around 9 million tons of waste not being managed annually. One type of waste that dominates waste generation is organic waste from household waste, namely 32.5% (KLHK, 2020). The Jabodetabek megapolitan area is the area that produces the most waste in Indonesia, with an amount of 21.2 tons of waste per year, which is dominated by organic waste/household waste, which also includes fruit peels, which is around 44.5% (Handono, 2010). Waste, such as stale rice and fruit peels, often arises from households because they are leftovers for basic human needs (Wafi *et al.* 2022). However, it is important to note that between 50% and 70% of the fruit skin is often thrown away and unused after the inside is taken or consumed. This is a significant loss, considering that fruit peels, which can decompose in the environment, actually contain antioxidants, an antidote to free radicals (Rusman 2019) and utilize it to improve plant health as its nutrition.

Proper organic waste management, especially fruit and vegetable waste, prevents adverse environmental and health impacts (Syamsiah *et al.* 2021). Thus, the scale of the waste problem is significant, and using fruit peel waste as an alternative raw material source for liquid organic fertilizer can be a crucial step in addressing these environmental problems (Marjenah *et al.* 2018). Liquid organic fertilizer, or POC, is a nutrient-rich solution produced from the fermentation of organic materials essential for plant growth and development. Its use reduces reliance on chemical fertilizers, which can harm the environment. Using fruit waste as a raw material for POC can increase the availability of essential macro and micronutrients for plant absorption (Kristianto *et al.* 2023). This fruit waste POC contains essential nutrients and aids in cost reduction, making it a financially savvy choice for farmers (Chaniago *et al.* 2021).

One type of processed waste product that can be used as a liquid fertilizer is ecoenzyme. Ecoenzymes are a type of organic compound produced from the fermentation process of organic waste, such as vegetable and fruit peels, with a mixture of carbohydrates (sugar) and water through a three-month fermentation process (Septiani *et al.* 2021; Faj'ria *et al.* 2023; Yuliani *et al.* 2023). The uniqueness of eco enzymes is that they do not require large areas or special containers for fermentation. Mineral water bottles can be used as fermentation containers, supporting the *reuse concept* to protect the environment (Pebriani *et al.* 2022).

Besides ecoenzymes, biosaka is another versatile nutrient that can be used in various applications. Biosaka is an elicitor containing chemical compounds that can induce physiological responses, enhance plant morphology, and send positive signals to the cell membranes in the roots, boosting their energy and productivity. The benefits of biosaka are significant; it can repair plant cells, reduce the need for independent chemical fertilizers, deter pests, and enhance soil fertility. Importantly, numerous scientific studies have shown that the use of biosaka can substantially reduce chemical fertilizers and pesticides by around 50-90% while also increasing production compared to treatment without biosaka addition (Napitupulu *et al.* 2023).

Therefore, it is essential to study the effectiveness of eco-enzymes and biosaka as ingredients to increase plant nutrition, especially those grown in water. These innovative solutions not only enhance plant health but also have the potential to support the Sustainable Development Goals (SDGs) program significantly. By reducing air pollution and mitigating the effects of greenhouse gases, ecoenzymes and biosaka can play a *crucial role in* achieving SDG 13, which is focused on handling environmental change.

Materials and Methods

This research was carried out in the Agronomy laboratory from November to December 2023. The materials used in the research were ecoenzyme solutions, biosaka, *Epipremnum aureum* stalks, and water. The tools used were 500 mL plastic glasses and lids, stem scissors, beakers, measuring cups, and pH meters. The ecoenzyme solution is obtained from ecoenzymes that have been previously made, namely made with a ratio of water: fruit peel: brown sugar of 10:3:1 (10 litres of water, 4.5 kg fruit

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peel: 1.5 kg palm sugar). The fruit peels used are pomelo, banana, papaya, pineapple, water guava, and kawista. The biosaka, on the other hand, is made using five types of wild plants such as krokot (*Portulaca* L.), tapak liman (*Elephantopus scaber*), babadotan (*Ageratum conyzoides*), anting-anting (*Acalypha indica*), and patikan kebo (*Euphorbia hirta*), which are kneaded in 2 litres of water.

The research experiment was carried out based on a one-factor, Completely Randomized Design (CRD) experimental design, focusing on the type of nutrient solution with three levels of treatment: control containing water, 1 mL L^{-1} of eco-enzyme liquid, and 1,5 mL L^{-1} of biosaka liquid. Six replications were used, resulting in 18 experimental units containing 90 experimental samples. The parameters observed were the number of shoots, shoot length, roots, and live plants over 30 days. The quantitative data were meticulously analyzed based on the RAL experimental design, and the observational data were subjected to a thorough analysis of variance (ANOVA). The Tukey test at the 5% level was conducted if a significant difference was found. The data analysis, carried out using Excel software, was thorough, ensuring the validity and reliability of the findings.

Results and Discussion

Our analysis of the *Epipremnum aureum* plant reveals fundamental differences in its growth parameters. These include the number of shoots, shoot length, and root length as shown in Table 1.

Table 1. Measurement Results of *Epipremnum aureum* Plants

Treatment	Average Number of shoots %	Average shoot length %	Average Root Length
Control	1.2 c	1.88 c	1.17 c
Biosaka	2.3 a	4.33 a	3.30 a
Ecoenzymes	1.5 b	2.94 b	2.65 b

Note: numbers followed by the same letter indicate that they are not significantly different based on the results of the Tukey comparison test at the 5% level.

In Table 1, the biosaka and ecoenzyme treatments significantly influence plant growth compared to the control treatment, with the best results obtained in the treatment with the addition of biosaka, followed by ecoenzymes. The control treatment had a lower shoot number, shoot length, and root length than the biosaka and ecoenzyme treatments. The ecoenzyme treatment had a more significant effect in improving or increasing the plant growth process, underscoring the importance of our research findings. In contrast, the control treatment had no additional effect on plant growth due to limited nutrients in the water. In addition, control treatments are usually designed to provide a basis for comparison or reference, not to influence the observed variable (Suwandi, 2023). The difference in results was due to the addition of saccharides and ecoenzymes directly affecting the observed variables, while there was no difference in the control treatment.

Biosaka is an elicitor proven to trigger plant growth and development. Elicitors are chemical substances that trigger the production of secondary metabolites in plants so that they can overcome abiotic and biotic stresses (Junairiah *et al.* 2014; Ansar *et al.* 2023). The Biosaka elicitor has shown significant increases in plant production yields regarding plant height, number of leaves, and weight of shallot bulbs (Adiwijaya and Cartika 2023). The increase in production yields is also supported by the effectiveness of nutrient absorption in plants. The Biosaka elicitor has been proven to increase the efficiency of absorption of needed nutrients, especially macronutrients. Providing biosaka elicitors increases the absorption of N, P, and K nutrients in Inpago 13 Fortiz rice plants by 4.05%, 0.46%, and 1.68%, respectively (Kartika *et al.* 2013). It increases the production of corn plants by 50% and saves fertilizer by 50-60% (Maruapey *et al.* 2023).

The increase in live plant percentage (Table 2, Figure 1, Figure 2) is due to the application of biosaka and ecoenzymes, which is a significant discovery compared to the control treatment. This increase is attributed to chemical compounds such as phytohormones in biosaka and flavonoid and phenolic compounds in ecoenzymes. Our tests have shown that biosaka is a reservoir of hormones, fungi, and high-endophytic bacteria containing PGPR and growth regulators (Ansar *et al.* 2023; Azhimah *et al.* 2023). These findings could potentially revolutionize plant growth and agriculture.

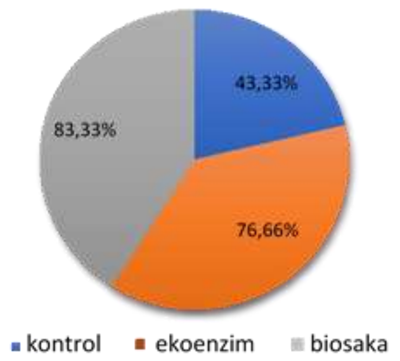

Figure 1. Increase in the percentage of live plants in the ecoenzyme and biosaka solution

Data on the number of living plants shows that whether pothos is planted with water media and treated with ecoenzymes had a survival percentage of 76.66% higher than the control. This significant improvement in survival is attributed to the role of ecoenzymes. These compounds contain antioxidants that inhibit cell death and anti-inflammatories to overcome cell damage. Ecoenzymes also contain antioxidants and antibacterials that neutralize wastewater (Janarthanan *et al.* 2020) and indoor air and kill bacteria (Mavani *et al*. 2020). Orange peel ecoenzymes have anti-inflammatory power because they can inhibit leukocyte levels in the bodies of mice (Fatimah *et al.* 2022). Meanwhile, the use of biosaka as an elicitor that can protect plants from pests and diseases, which contains biological compounds, can increase phytoalexins and abiotic triggers of UV light, metal ions, hormones, and resistance coding molecules (Reflis *et al.* 2023).

Biosaka and ecoenzymes, when used as plant nutrients in water media, are efficient even for plant roots submerged in water. Their application significantly boosts plant fertility and prevents stress-induced plant mortality (Figure 1). This is a clear testament to their efficiency, especially for plant roots submerged in water, which are at risk of stress from ROS (*reactive oxygen species*).

Table 2. Percentage of Live Plants

Treatment	Number of dead plants	Number of living plants	Live plants %
Control	13	17	43.33 c
Biosaka	7	23	83.33 a
Ecoenzymes	5	25	76.66 b

Note: numbers followed by the same letter indicate that they are not significantly different based on the results of the 5% Tukey test

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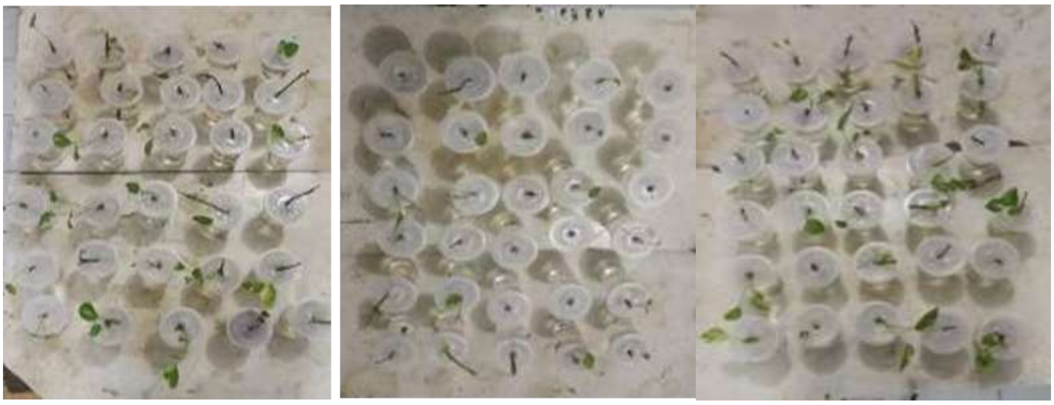

Figure 2. Biosaka 1.5 mL L^{-1}, control (water), ecoenzyme 1 mL L^{-1} (left to right).

Biosaka and ecoenzymes show that these two solutions can be used as adequate plant nutrients in water media and are efficient for planting in narrow areas which do not require intensive handling. Besides, providing biosaka and ecoenzyme solutions makes plants grow more fertile and prevents plant death due to stress (Figure 1). Plant roots submerged in water will experience stress because of *reactive oxygen species* (ROS) from free radical compounds produced by environmental stress. Biosaka and ecoenzymes containing flavonoid compounds can prevent free radicals with small molecules that accept and give electrons or free radicals, thus forming new, stable compounds. Flavonoid compounds are antioxidants for cancer, anti-microbial, anti-viral, photosynthetic, and growth regulators. In the context of this research, 'in *vitro' refers to experiments conducted outside of a living organism,* often in a laboratory setting. In these experiments, flavonoid compounds can capture ROS oxygen compounds and increase metal ions (Puspitasari *et al.* 2016). It also contains compounds that can form stable phenoxy radicals in the oxidation process as antioxidants (Mangko *et al.* 2020). Ecoenzymes can be used as liquid fertilizer, pest and disease repellent (Utami *et al.* 2020; Yulistia and Chimayati 2021; Mahdia. A *et al.* 2022). Ecoenzymes contain several secondary metabolites, such as flavonoids, quinones, saponins, and alkaloids (Vama and N. Cherekar 2020). Flavonoid compounds in ecoenzymes can act as free radical scavengers and potentially reduce plant damage in tolerance mechanisms to abiotic stress, including salinity stress. The benefits of ecoenzymes are known to increase yields in Sanren1 shallot cultivation, root length, and many leaves (Hasanah *et al.* 2022; Novianto 2022).

Using ecoenzymes and biosaka solutions, besides increasing plant growth and development and absorbing nutrients, thereby increasing plant production, can also significantly reduce the costs of using inorganic fertilizers, pesticides, and insecticides in plant cultivation. Which benefits not only the environment but also your bottom line. By minimizing the negative impact of these materials, you are taking a responsible and cost-effective approach to plant cultivation. Increasing plant growth will also reduce the impact of air pollution, such as carbon monoxide and carbon dioxide from vehicles, industrial, and household exhaust, which pollute the air and affect greenhouse gases. In the future, using ecoenzymes and biosaka will also support *Sustainable Development Goal* (SDG) number 13 related to handling climate change.

Conclusion

The application of biosaka and ecoenzyme solutions, particularly at concentrations of 1.5 mL L^{-1} and 1 mL L^{-1}, significantly enhances plant growth. These solutions, rich in saccharides and ecoenzymes, act as potent nutrients in the planting medium, stimulating the growth of plants capable of absorbing carbon dioxide and nitrogen monoxide gas. This intriguing finding paves the way for further exploration and application in the field of environmental science.

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