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Effect of Indoor Hydroponic Technique on the Growth and Development of High-quality Tissue Culture Plantlets of *Labisia pumila* Clone FaFaF01

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ABSTRACT

Labisia pumila, known as Kacip Fatimah, is a valuable medicinal herb traditionally used to support women's health and explored for urban cultivation. This study evaluates the hydroponic performance of an elite clone of *L. pumila* (FaFaF01), developed through over a decade of research and development by the Forest Research Institute Malaysia (FRIM). This clone cultivated for the production of raw materials and commercial herbal products. The experiment was conducted at the Department of Physics, Faculty of Science, University of Malaya (UM), as part of a collaborative research project between FRIM and UM. The study aimed to assess the growth performance and phytochemical yield of *L. pumila* under controlled indoor hydroponic which beyond conventional field planting. Plantlets were grown in a hydroponic system under low-temperature, controlled humidity, and LED lighting conditions, promoting energy efficiency. Vegetative growth was monitored over 48 weeks, and both biomass and bioactive compounds were evaluated. The elite clone showed robust growth performance in both front and rear planting positions, with total phenolic content (TPC) recorded at 3335 ± 23.1 mg GAE/100g dry weight (front) and 2258 ± 34.0 mg GAE/100g dry weight (rear), indicating very high and high phenolic levels, respectively. The findings demonstrate that *L. pumila* performs well in indoor hydroponic systems while retaining its medicinal value. Therefore, it is recommended

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as a versatile plant for vertical landscaping, indoor decoration, and green interior applications. Its integration into indoor environments may contribute to lowering ambient temperatures and enhancing environmental quality in institutional settings.

Keywords: Growth performance, indoor cultivation, medicinal herb, phenolic content, versatile plant

INTRODUCTION

Hydroponics enables rapid growth without soil, using substrates such as coco peat, jiffy pellets, rockwool, perlite, or clay pellets. Zig-zag vertical systems improve nutrient delivery, reduce water use, and limit pests. *L. pumila*, a Malaysian medicinal herb for women's health, shows antioxidant, antimicrobial, anticancer, anti-inflammatory, and phytoestrogenic properties (Calapai et al., 2007; Karimi et al., 2011), but is sensitive to light, moisture, and temperature. To meet raw material demand, the FRIM developed the elite clone FaFaF01 with stable growth and high phytochemical yield. In this study, FaFaF01 was cultivated indoors (28 °C, 975 lux, 85% humidity) for 48 weeks, confirming strong vegetative growth, biomass stability, and high total phenolic content (TPC) under controlled hydroponics (Resh, 2012).

Problem Statement

Few studies have applied hydroponics to *L. pumila* indoors. Prior research focussed on in vitro propagation (Rasdi et al., 2013), CO_2 enrichment (Ibrahim et al., 2011), and nutrient manipulation (Ismail et al., 2011). Effects on growth and metabolite retention under indoor hydroponics remain limited.

Research Questions

Few studies have applied hydroponics to *L. pumila* indoors. Prior research focussed on in vitro propagation (Rasdi et al., 2013), CO_2 enrichment (Ibrahim et al., 2011), and nutrient manipulation (Ismail et al., 2011). Effects on growth and metabolite retention under indoor hydroponics remain limited.

MATERIALS AND METHODS

Construction Hydroponic System

The hydroponic system was constructed using the Nutrient Film Technique (NFT), consisting of five stacked layers for planting as illustrated in Figure 1. Each layer contained eight individual planting pots arranged in a row.

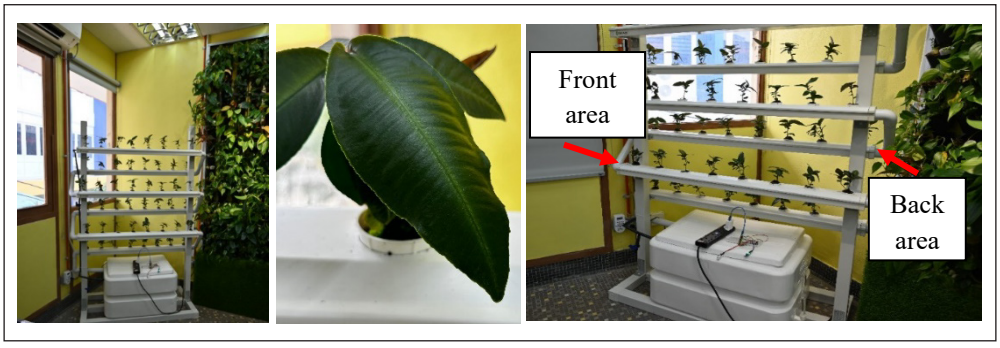

Figure 1. Experimental design of hydroponic system was arranged into two distinct position which front and back within the indoor grow area

RESULTS AND DISCUSSION

Growth of *L. pumila* showed no significant variation across planting positions as shown in Table 1, with only slight leaf size trends likely due to microclimatic effects common in vertical systems (Resh, 2012).

Table 1
One-way ANOVA assessing growth across four time points (Month 3, 6, 9, and 12) indicated no significant variation over time ($p > 0.05$)

Growth Parameter	F-statistic	p-value	Significance
Height	1.81	0.305	Not significant
Number of Leaves	1.25	0.403	Not significant
Leaf Length	1.88	0.296	Not significant
Leaf Width	5.52	0.099	Approaching significance
Collar Diameter	1.43	0.367	Not significant

The stable growth of clone FaFaF01 underscores its versatility as an indoor plant. *L. pumila*, a rainforest understorey herb adapted to low light combines compact form with high medicinal value, making it ideal for vertical gardens and interior landscaping. Indoor plants also reduce temperature and improve air quality (Lohr et al., 1996) positioning FaFaF01 as both a functional medicinal resource and sustainable green interior species.

As shown in Figure 2, the dried biomass of *Labisia pumila* clone showed no significant difference between front and back positions under indoor hydroponics ($p > 0.05$), indicating uniform growth conditions. Similar findings in controlled-environment and IoT-based hydroponic systems (Blunk et al., 2023; Gao et al., 2025; Sowmya et al., 2024) support the species' reliability for compact hydroponic, greening, and ornamental applications.

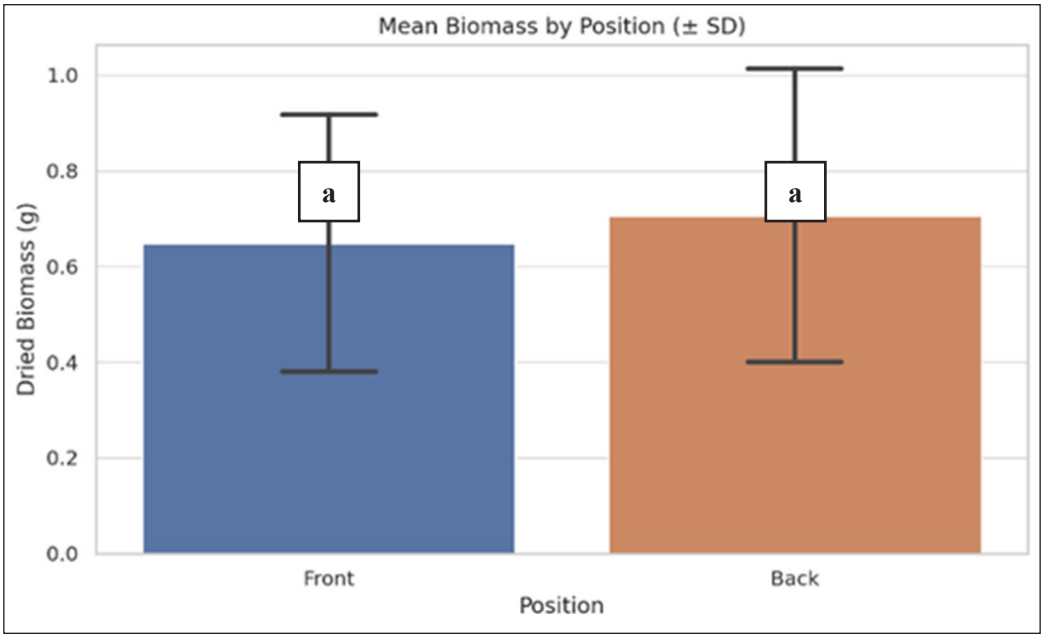

Figure 2. Dried biomass of *Labisia pumila* planted in an indoor hydroponic system with two planting positions

As shown in Figure 3, *Labisia pumila* clone FaFaF01 showed strong bioactive potential which high total phenolic content of 3335 ± 23.1 mg GAE/100 g DW. Growth media strongly influenced phenolic accumulation (Farah Fazwa et al., 2020), while controlled environments enhanced secondary metabolite production (Ismail et al., 2011). Overall, FaFaF01 is valuable for ornamental use, antioxidant-rich applications and its commercial value for green interiors.

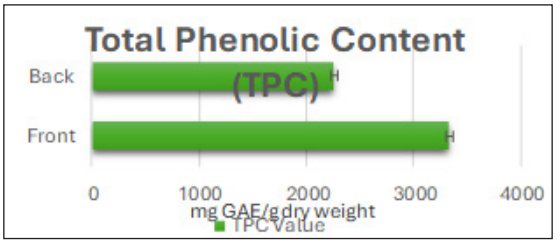

Figure 3. Total phenolic compound of *Labisia pumila* planted in an indoor hydroponic system with two planting positions

CONCLUSION

This study found that *L. pumila* clone FaFaF01 maintained stable growth, biomass, and high TPC under indoor hydroponics. Plant traits were uniform, with only minor leaf width

variation. High TPC confirmed strong medicinal value, while compact form and low-light tolerance highlight potential for vertical gardens, green walls, and indoor use. FaFaF01 is thus a promising dual-purpose plant for ornamental greening and sustainable bioactive production.

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