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# Characterisation of Soilless Substrates Blended from Coco Peat and Burned Rice Husk via Particle Size Distribution Analysis

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## ABSTRACT

Soilless media is widely employed in modern agriculture to facilitate efficient water management, enhance nutrient uptake, and mitigate soil-borne diseases. When different soilless media are blended in varying compositions, their physical and hydrological properties change, directly impacting crop yield and growth performance. Understanding the combination effect of coco peat (CP) and burn rice husk (BRH) concerning particle size distribution suitability for the potting medium is essential. This study aims to evaluate the particle size distribution of blended soilless substrates composed of CP and BRH at various compositions. The analysis of variance (ANOVA) test was deployed to assess significant differences between particle sizes among the treatments. Particle distribution curves were further analysed for particle diameter at selected cumulative mass distribution, median, standard deviation, mass relative span, kurtosis and skewness. Results indicated that most samples consist of fines and medium particle size, positive fine skewed, and signified by mesokurtic and leptokurtic. The combination of CP and RBH at different ratios has changed the coarse (> 2.3 mm), medium (2.3 to 0.6 mm) and fine (< 0.6 mm) particle size composition. This study demonstrated that the combination of CP and BRH improved particle distribution size by increasing the medium and fine-size particles. This finding provides valuable information on physical changes in particle size due to the blend of CP and BRH for potting soilless media. Understanding soilless media characteristics would guide farmers in managing better irrigation practices for precision irrigation or IoT smart farming for optimum agricultural production.

Keywords: Burn rice husk, coco peat, particle size, sieve analysis, soilless



## INTRODUCTION

Soilless substrate cultivation in agriculture refers to planting crops without soil as growing media. It is reported that 3.5% of the crop production in the world utilised soilless media as cultivation media (Joshi *et al*., 2022). The soilless substrate as growing media has been applied by modern farmers since around 40 years ago (Gruda, 2022), where soilless cultivation practice saves irrigation water, eases plant nutrition monitoring and increases crop production (Joshi *et al*., 2022). With the rapid advancement of nanotechnology, soilless substrates have been enhanced and enriched for the production of nanoproducts, as well as amended with biochar to increase their value (Igiebor *et al*., 2023; Gruda, 2020; Huang & Gu, 2019). In horticulture, soilless media is commonly used in two forms: either in solid media, such as coco peat, vermiculite, perlite, pine bark, sawdust, gravel, and rockwool, or in liquid systems (nutrient film technique, deep water culture, deep flow technique, aeroponic, and wicking). The application of soilless media in horticulture can enhance sustainability and promote the optimum use of agricultural waste production (Gruda, 2020).

The irrigated agriculture sector is facing pressure due to global water scarcity. It is estimated that approximately 1.2 billion people live in areas of physical scarcity, while another 1.6 billion faces economic water scarcity (Zhu & Wang, 2013). The shortage and limitation of water resources for irrigation and the lack of a clear understanding of the properties of soilless media have decreased water use efficiency and crop water productivity (Kanda *et al*., 2020). A comprehensive and intensive knowledge of the particle size distribution and soilless substrate properties is vital in designing and managing irrigation systems to maximise crop water use efficiency and water productivity. Enhancing water use efficiency in crops requires assessing a substrate's ability to retain and release water for plant use (Fields *et al*., 2014).

Coco peat (CP) is a relatively new growing medium (Duggan-Jones *et al*., 2013), and it has been produced and applied in modern agriculture for soilless media worldwide. Although coco peat have almost the same microstructure regardless of their country of production, their particle size and physical properties vary (Fornes *et al*., 2003; Duggan-Jones *et al*., 2013). Coco peat is characterised by low hydraulic conductivity (0.1 cm/s) and low bulk density (0.09 g/cm$^3$), but its water-holding capacity is high as 912.54% (Yahya *et al*., 1997; Ilahi & Ahmad 2017). Due to these properties, it can hold the water for longer. Burn rice husk (BRH) is a biochar produced from the pyrolysis process and is another alternative for soilless media (Jusoh *et al*., 2021). The CP and BRH are agricultural wastes that are widely available in Malaysia since paddy and coconut are among the essential major crops in Malaysia. It is estimated that the area cultivated with paddy and coconut in Malaysia in 2020 is 644,854 hectares and 84,942 hectares, respectively (Department of Agriculture, 2021).

Fornes *et al*. (2017) reported that variations in biochar particle size did not alter its chemical properties or microporosity but significantly affected its water-holding capacity. The biochar's pH and electrical conductivity ranges are still within the acceptable tolerance for plant-growing substrates (León-Ovelar *et al*., 2022). Biochar can also be used as a soil amendment in growing media to change the substrate's physical properties by reducing the larger-sized components and altering the chemical properties of the substrate (Huang & Gu, 2019; Jahromi *et al*., 2020). In Malaysia, past research was carried out, and soilless media was used to test the crop in the field. Among the crops tested are chilli (Berahim *et al*., 2016; Zakaria *et al*., 2020), Misai Kucing (Ya'Acob *et al*., 2021), tomato (Ali *et al*., 2003a, 2003b; Mahamud & Manisah, 2007), vegetables (Ismail *et al*., 2004; Ismail & Ann, 2004) and rice (Samsuddin *et al*., 2014). However, various soilless media were used, such as coconut coir dust, sago waste, rice straw compost and empty fruit bunch compost. As Duggan-Jones, Nichols, and Woolley (2013) mentioned, particle size distribution's impact on agricultural productivity involving various soilless media and their combination in different ratios is poorly understood.

Although the literature reports the application of various soilless media, there is still a dearth of knowledge and paucity of data on the possibilities of coco peat, burn rice husk and their combination to create appropriate potting media for the production of horticulture crops in the Asian region. We hypothesised that different combinations of CP and BRH could change the particle distribution size of soilless media and hence change the soilless media properties. This study aimed to characterise the particle size distribution of the blended soilless substrate from CP and BRH at different compositions. In addition, this study sought to answer the questions: a) What is the characteristic of blended soilless media on percent finer and volumetric distribution subjected to particle size separation and b) What is the effect of leaving oven-dried soilless media on its weight.

## MATERIALS & METHODS

The study was conducted at the Process Laboratory Unit, Faculty of Chemical Engineering Technology, Universiti Malaysia Perlis, Arau, Perlis, Malaysia (6º26'27" N, 100º13'59'' E). The experiment was conducted in July 2022.

### Soilless Media Preparation

The CP and BRH were supplied by Pertubuhan Peladang Titi Tinggi (Padang Besar, Perlis) and Nurain Athirah Company (Ayer Hitam, Kedah), respectively. Before application, CP was screened and passed through a 3.5 x 0.5 cm sieve at the initial level to separate CP from coco coir and debris. CP and BRH were air-dried for at least seven days under a rainhouse shelter to reduce moisture. CP and BRH were used in this study since both soilless media are common and readily available to Malaysian farmers in tropical countries (Shanmugasundaram *et al*., 2014). The mixture or composition of the treatments was based on dry weight, and the detailed description is shown in Table 1.

**Table 1.** The composition of the treatments

| Treatment | Media Compositions |
|---|---|
| 1 | 100% Coco peat |
| 2 | 100% Burn Rice Husk |
| 3 | 50% Coco peat + 50% Burn Rice Husk |
| 4 | 30% Coco peat + 70% Burn Rice Husk |
| 5 | 70% Coco peat + 30% Burn Rice Husk |

### Particle Size Determination and Data Analysis

The particle size of the soilless samples (T1, T2, T3, T4 and T5) was analysed using a 2.5 horsepower automatic sieve shaker (NL Scientific, Model NL 1015X/005, Malaysia). The procedures of particle size distribution were based on EN 15428 (2007). Before sieving, the samples were oven dried at 105 ºC for 72 hours using a drying oven (Binder, Model FD 115, Germany). The oven-dried moisture content of the samples was calculated based on Equation 1, (Eq. 1).

$$\text{Moisture Content (\%)} = \frac{\text{(Wet Weight Sample-Dried Weight Sample)}}{\text{Dried Weight Sample}} \times 100 \quad \text{Eq. (1)}$$

A set of 10 individual woven sieves with stainless steel frames, excluding pan with the size of 10, 5, 2.3, 1.18, 0.6, 0.3, 0.25, 0.15, 0.075, and 0.025 mm, were stacked with the larger opening diameter on the top and smaller diameter on the bottom. The pan was positioned at the lowest part of the sieve arrangement to collect the finest particles. The automatic sieve shaker was set to shake for 5 minutes, and all samples were repeated thrice, as suggested by Bartley *et al*. (2022). The weight of the empty sieve and soil retained in each sieve at two decimal places were measured using a digital balance (Kern, Model 572-39, Germany). The total mass of the initial and final samples should be nearly identical, where a loss of more than 2% is considered unsatisfactory. The sieving process is repeated if the sample loss exceeds 2%. Before beginning of a new sieving process and reweighing the sieves, they were meticulously cleaned three times: first using a brush, followed by empty sieving with a mechanical shaker, and finally, another thorough brushing before their subsequent use in the sieving operation.

The percent finer for each sample was plotted against aperture size on the semi-logarithmic scale to obtain a respective particle size distribution. The semi-logarithmic scale was applied to the aperture size to ease the reading of smaller particle sizes. The mass relative span (MRS) was calculated using Equation 2 (Eq. 2). The median was measured as the distribution at $D_{50}$. Standard deviation (SD) was measured using Equation 3 (Eq. 3). Skewness (SK) and kurtosis (KU) represented distribution shape and were formulated in Equation 4 (Eq. 4) and Equation 5 (Eq. 5), respectively. The $D_5$, $D_{10}$, $D_{16}$, $D_{25}$, $D_{50}$, $D_{75}$, $D_{84}$, $D_{90}$ and $D_{95}$ are the particle diameters (in mm) at 5%, 10%, 16%, 25%, 50%, 75%, 84%, 90% and 95% of the cumulative mass distribution respectively calculated from particles distribution curve.

$$MRS = \frac{(D_{90} - D_{10})}{D_{50}} \qquad Eq.(2)$$

$$SD = D_{84} - \left(\frac{D_{16}}{2}\right) \qquad Eq.(3)$$

$$SK = \frac{D_{16} + D_{84} - 2D_{50}}{2(D_{84} - D_{16})} + \frac{D_5 + D_{95} - 2D_{50}}{2(D_{95} - D_5)} \qquad Eq.(4)$$

$$KU = \frac{D_{95} - D_5}{2.44\,(D_{75} - D_{25})} \qquad Eq.(5)$$

In a separate experiment, the soilless samples were placed in a plastic container of 11 cm diameter and 5 cm height with three replications to observe the weight changes of dried soilless media. All the samples were arranged in a completely randomised design with three replications and placed into the trays at room temperature. The weight measurement was made at 10:00 a.m. daily for seven days. The container was loosely covered with a lid to prevent media losses caused by wind.

### Statistical Analysis

One-way analysis of variance (ANOVA) test via SPSS software Version 25 was deployed to assess significant differences between particle sizes. The Duncan Multiple Range Test was carried out for mean comparison at p=0.05 if significant differences were detected from the ANOVA model. A paired sample T-test was also conducted to compare the mean volume and weight of soilless media before and after sieving work. The descriptive analysis reported in this study was based on the selected parameters suggested by Bartley *et al*. (2022).

## RESULTS & DISCUSSION

Figure 1 illustrates particle distribution curves of the different soilless media compositions. The particle size distribution curve describes the sample percentage that passes through each selected sieve size. Most tested samples retained the middle-range sieve size, whereas some retained the finer size. Single BRH has the highest fine particle percentage, whereas CP has the highest percentage of coarse particles. Regarding uniformity, single BRH samples are uniformly graded soilless media that can be noticed from steeper curves compared to the other treatments. Conversely, a single CP sample consisted of more particle size heterogeneity where the distribution curve is broader compared to other treatments. From this study, adding BRH increases the medium and fine particle size percentage, where it can be observed that the combined ratio treatment curves have shifted between the single CP and single BRH curves.

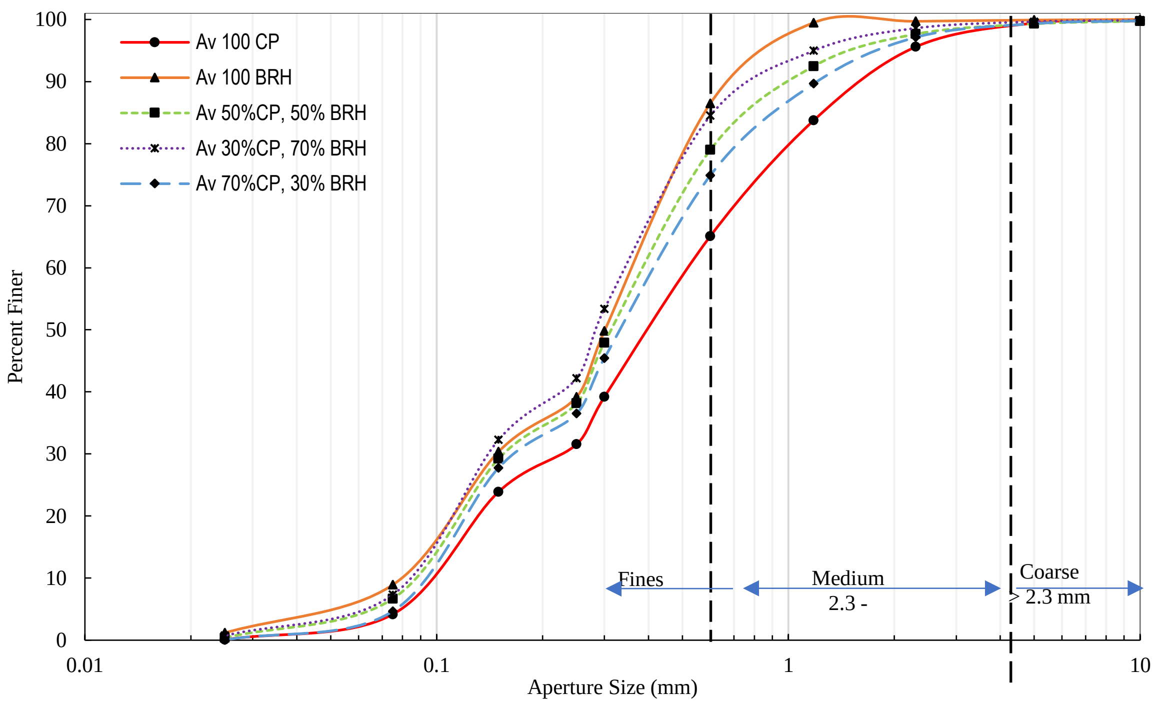


**Figure 1.** Particle distribution curve of soilless media based on average (av) samples replication. The vertical dash lines separate the aperture size according to categories

**Table 2.** Descriptive statistics and selected particle size diameter from particle distribution curve

| Parameters | Treatment | | | | |
|---|---|---|---|---|---|
| | T1 | T2 | T3 | T4 | T5 |
| $D_5$ (mm) | 0.079±0.002 [a] | 0.050±0.001[b] | 0.065±0.002[c] | 0.063±0.001[c] | 0.075±0.001[a] |
| $D_{10}$ (mm) | 0.098±0.001[a] | 0.080±0.000[b] | 0.087±0.002[c] | 0.084±0.001[c] | 0.092±0.001[d] |
| $D_{16}$ (mm) | 0.127±0.003[a] | 0.100±0.000[b] | 0.113±0.003[cd] | 0.106±0.004[bc] | 0.120±0.000[ad] |
| $D_{25}$ (mm) | 0.167±0.007[a] | 0.137±0.003[b] | 0.137±0.003[b] | 0.133±0.003[b] | 0.153±0.003[c] |
| $D_{50}$ (mm) | 0.393±0.009[a] | 0.303±0.003[b] | 0.310±0.006[b] | 0.287±0.003[c] | 0.330±0.000[d] |
| $D_{75}$ (mm) | 0.827±0.017[a] | 0.480±0.000[b] | 0.537±0.009[c] | 0.477±0.003[b] | 0.600±0.010[d] |
| $D_{84}$ (mm) | 1.267±0.033[a] | 0.563±0.003[b] | 0.707±0.017[c] | 0.587±0.007[b] | 0.863±0.022[d] |
| $D_{90}$ (mm) | 1.667±0.033[a] | 0.670±0.010[b] | 1.030±0.085[c] | 0.750±0.017[b] | 1.300±0.000[d] |
| $D_{95}$ (mm) | 2.267±0.176[a] | 0.813±0.007[b] | 1.500±0.100[cd] | 1.267±0.033[c] | 1.767±0.033[d] |
| SD | 1.203±0.034[a] | 0.513±0.003[b] | 0.650±0.015[c] | 0.5343±0.006[b] | 0.803±0.022[d] |
| MRS | 3.992±0.117[a] | 1.945±0.029[b] | 3.035±0.221[c] | 2.324±0.067[d] | 3.661±0.002[a] |
| SK | 0.600±0.013[a] | 0.218±0.006[b] | 0.474±0.015[c] | 0.418±0.005[d] | 0.542±0.008[e] |
| KU | 1.356±0.089[a] | 0.912±0.017[b] | 1.470±0.086[a] | 1.436±0.036[a] | 1.554±0.058[a] |

The values are represented as mean ± standard error. The values with different superscript letters in the same row represent significant differences ($p < 0.05$). T1 is 100% Coco peat, T2 is 100% Burn Rice Husk, T3 is 50% Coco peat + 50% Burn Rice Husk, T4 is 30% Coco peat + 70% Burn Rice Husk, T5 is 70% Coco peat + 30% Burn Rice Husk, SD is standard deviation, MRS is Mass Relative Span, SK is skewness, and KU is kurtosis. $D_5$, $D_{10}$, $D_{16}$, $D_{25}$, $D_{50}$, $D_{75}$, $D_{84}$, $D_{90}$ and $D_{95}$ are the particle diameters in mm at 5%, 10%, 16%, 25%, 50%, 75%, 84%, 90% and 95% of the cumulative mass distribution respectively.

The combination between CP and BRH resulted in the diversity of particle size composition. The particle sizes of soilless substrate were categorised into three groups, which are coarse particle size (> 2.3 mm), medium particle size (2.3 to 0.6 mm) and fines particle size (< 0.6 mm).

More parameters were extracted from the particle distribution curve to understand the tested samples further and get more detailed information. Table 2 summarises the descriptive statistics and selected particle size diameter of the samples. The single CP and BRH have differed significantly regardless of their particle size diameters ($D_5$ until $D_{95}$). Their particle diameter sizes also varied, where CP had a particle size diameter range between 0.079 and 2.267 mm while BRH ranged between 0.050 and 0.813 mm. The composition of CP and BRH at the same level (T3) showed that particle size diameter at around median size ($D_{25}$ and $D_{50}$) is not significant compared to the single composition of BRH. Inversely, the smaller ($D_5$ until $D_{16}$) and higher ($D_{75}$ until $D_{95}$) particle size diameters showed significant differences compared to the single composition of BRH. At median size ($D_{50}$), both T4 and T5 significantly differ from single CP and single BRH, indicating that all treatments consist of various particle sizes at the median point. T4 showed almost no significant difference at the fine and medium size compared to single BRH, where it inherits the particle size distribution nearly the same as single BRH. The bigger portion of CP in T5 makes it differ significantly at medium size instead of finer size.

The standard deviation (SD) indicated a significant difference between T1, T3 and T5. However, no differences in SD values in T2 and T4. As the proportion of BRH increased, the soilless media showed a deviation in particle size from a single CP. The mass relative span (MRS) for T1 and T5 was insignificant, whereas MRS for T2, T3 and T4 differed significantly. The magnitude of MRS is an indicator of distribution width (Bitra *et al*., 2009). An increasing proportion of BRH increased the SD and MRS values of the soilless media. It is reasonable and parallel to the effective size parameter ($D_{10}$), where adding fine-size particles gives significant effective size values except for minor changes in T3 & T4. The effective size for all samples indicated that 10% of the particle size of soilless media is smaller than 0.08 mm, and 90% is larger than 0.08 mm. Based on Boggs (2009) classification, the soilless media from T2, T3, and T5 were identified as moderately well-sorted, while T5 and T1 were classified as moderately sorted and poorly sorted, respectively. Lower values of SD and MRS generally suggest a more uniform and well-graded particle size distribution, which is often preferred for consistent and predictable media properties.

All soilless media yielded strongly fine skewed (SK >+0.3) except T2, which was classified as fine skewed. The mean skewness showed a significant difference for all treatments, and T1 had the highest skewness value. Lowering the CP proportion shifted the soilless media towards a fine-skewed characteristic due to the availability of a finer texture. Interestingly, lowering CP in the soilless media composition did not result in a significant difference in mean kurtosis (KU), as shown in T1, T3, T4, and T5. The KU value of T2 differs significantly compared to others. KU signifies the sharpness or peakedness of a grain size distribution curve. Single BRH (T2) was classified as "mesokurtic" since the KU value was 0.912, indicating a normal particle size distribution. Soilless media of T1, T3 and T4 were classified as "leptokurtic" since KU values varied between 1.356 and 1.554. The result indicates that "leptokurtic" soilless media had positive kurtosis where particle size is distributed larger at the tail, and the tail is fatter than the normal distribution curve. Determining skewness, kurtosis, and leptokurtic characteristics is important for understanding particle size distribution and its impact on the physical properties of soilless media. Fine-skewed media indicates that most particles are smaller, which can affect water retention and drainage. Such distributions may help retain more water, benefiting plants that require a consistent moisture supply. In the context of soilless media, leptokurtic distributions suggest a predominance of certain particle sizes, which can help create consistent air spaces and ensure predictable water movement. Media with leptokurtic characteristics may provide stable physical properties, reducing the risk of waterlogging or excessive drying. This stability is especially beneficial for young plants or seedlings that need consistent moisture levels.

**Table 3.** Comparison between volume and weight before and after sieving

| Treatment | Volume (mL) | | Weight (g) | |
|---|---|---|---|---|
| | Before Sieving | After Sieving | Before Sieving | After Sieving |
| T1 | 1183.33±16.67$^a$ | 1514.10±9.61$^b$ | 100.26±0.08$^a$ | 100.42±0.19$^a$ |
| T2 | 780.00±0.00$^a$ | 894.40±8.96$^b$ | 100.36±0.10$^a$ | 100.48±0.05$^a$ |
| T3 | 810.00±20.82$^a$ | 972.17±40.30$^b$ | 100.48±0.21$^a$ | 100.53±0.14$^a$ |
| T4 | 746.67±20.28$^a$ | 916.00 ± 8.79$^b$ | 100.19 ± 0.10$^a$ | 100.34 ± 0.05$^a$ |
| T5 | 916.67 ± 12.02$^a$ | 1192.87 ± 42.45$^b$ | 100.27 ± 0.04$^a$ | 100.51 ± 0.17$^a$ |

The volume and weight values are displayed as mean ±standard error. The values with different superscript letters in the same row represent significant differences at the 95% confidence interval. T1 is 100% Coco peat, T2 is 100% Burn Rice Husk, T3 is 50% Coco peat + 50% Burn Rice Husk, T4 is 30% Coco peat + 70% Burn Rice Husk, T5 is 70% Coco peat + 30% Burn Rice Husk.

Adding BRH could increase water-holding capacity by increasing micropore space between soilless media particles (Gonnella & Renna, 2021). The particle size distribution indicates that adding BRH increases the medium and fine particle size percentage where the combination ratio treatment curves have shifted between the CP and BRH curves. As explained by Altland *et al*. (2018) and Fields *et al*. (2018), manipulation of soilless properties is possible by mixing different types of soilless media. The properties of soilless media, such as available water, air space, bulk density, total porosity, container capacity, nutrient availability, pH, electrical conductivity, microbial activities and cation exchange capacity, deviate from its original conditions (Gabriel *et al*., 2009; Huang & Gu, 2019). This result also indicated that although all the samples have a particle size smaller than 2.0 mm, they are composed of various fine particle sizes. The suitable particle size of soilless media is between 0.25 and 0.5mm (CANNA, 2021).

Volumetric analysis is one of the alternative presentations of soilless media, which can give more explicit pictures of the tested samples (Albaghdady & Alabadi, 2021). Figure 2 presents the distribution of soilless volume and weight based on their respective aperture size. All treatments have the highest volume and weight at the particle size of 0.3 mm. Table 3 shows the volume and weight comparison before and after the sieve analysis. A Paired samples t-test was performed to determine the effect of sieving on volume and weight changes of soilless media. The results indicate a significant difference between the original and after-sieving volumes.

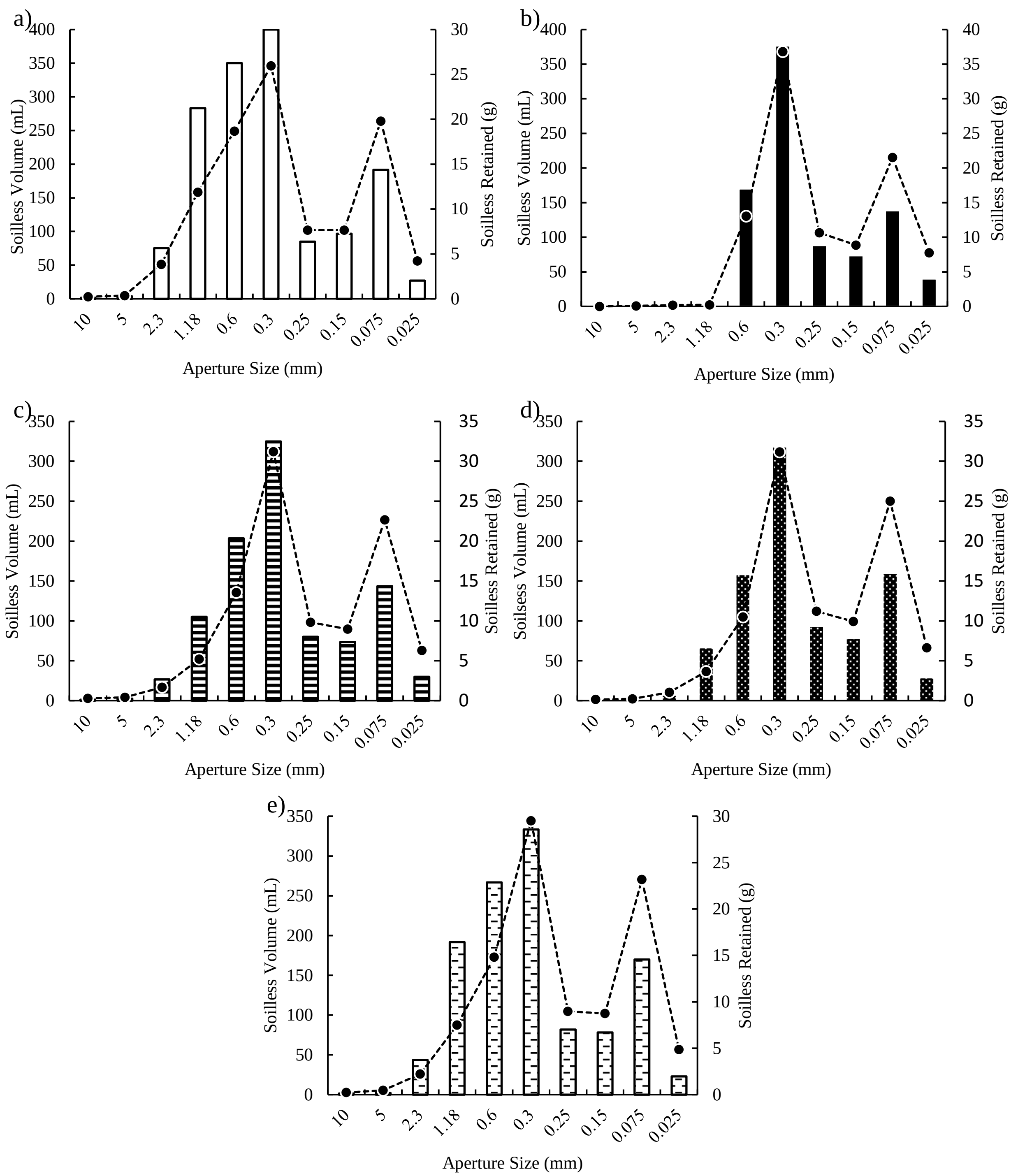


**Figure 2.** The volume of soilless media in individual sieve aperture size for a) T1-100% CP, b) T2- 100% BRH, c) T3-50% CP & 50% BRH, d) T4-30% CP& 70% BRH, and e) T5-70% CP& 30%BRH. The bar shows the soilless volume (mL), while the dashed line represents the weight of soilless retained (g)

However, no significant difference was detected between weight values before and after sieving.

Although the weight of the samples has no changes in their magnitude before and after the sieving process, the volume of the sample might change significantly. Similarly, the same result was reported by Zazirska *et al*. (2021), where there were statistical differences in particle size distribution in volumetric distribution. By separating particle sizes according to their respective size, the volume of soilless media has increased between 14 and 30%. The lowest and highest increment volumes were detected in single BRH (T2) and 70% coco peat + 30% burn rice husk (T5), respectively. It can be understood that if the proportion of BRH decreases while the ratio of CP increases in a soilless container in dry condition, the volume of soilless media will automatically increase. This is due to the larger coarse particle size of CP, which occupies more space. BRH has almost fine particles, so the volume change is small.

Observation of weight changes of the oven-dried samples for seven days is shown in Figure 3. The range of weight changes of the samples generally varies between 0 and 3%. The weight change trends for combination mixtures (T3, T4 and T5) showed increasing trends up to day four of air drying. After day four, they showed slightly decreasing trends at the constant level. Coco peat media (T4) showed a steady and stable increase in moisture during observation. However, T2, which is 100% BRH, showed different pattern trends of weight changes compared to other treatments. The T2 samples became drier until day four, and the weight changes remained constant (± 0.5). The result indicates that fully CP media can absorb moisture from the air, which causes its weight to increase slightly. However, full BRH showed the opposite result compared to other treatments. BRH media showed almost constant weight, and the air could make the BRH somewhat drier than it was in its initial condition, which is indicated by deficit weight changes.

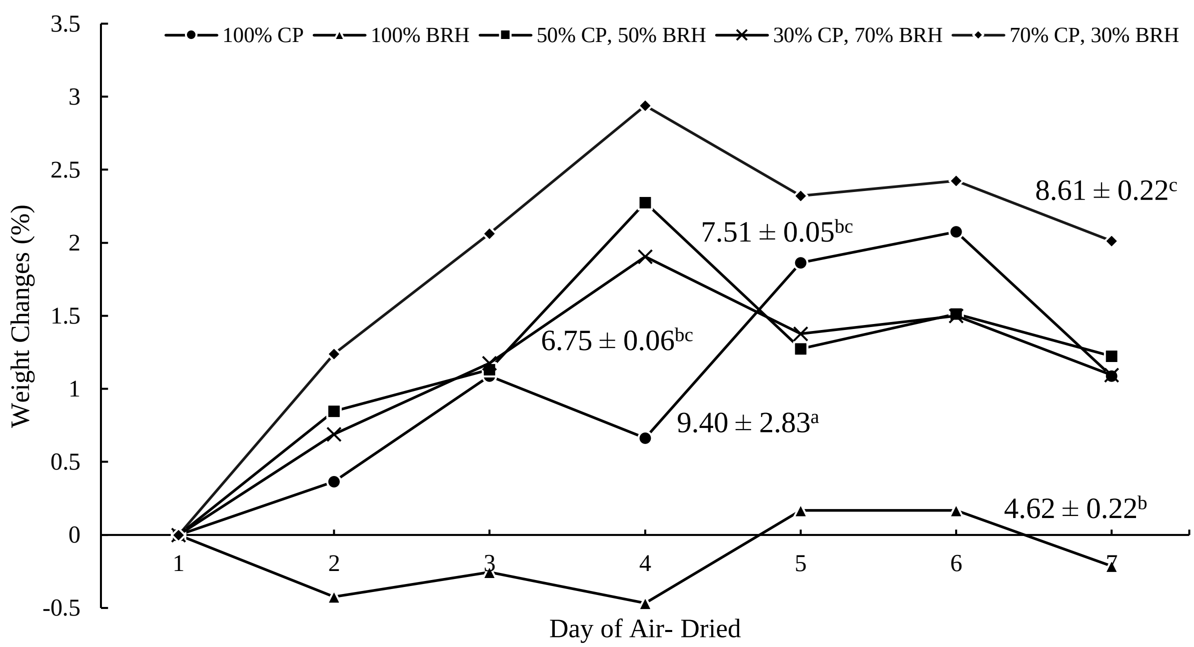


**Figure 4.** Weight changes of oven-dried samples after seven days of air drying. Mean ± SD with a different letter at the graph line are significantly different at $p<0.05$

Although this study provides valuable information on the particle distribution curve, especially for combination or mixture between CP and BRH, it lacks related information on neither the physical nor chemical characteristics of the tested soilless media. This study is limited and valid for clean coco peat since we screened the coco peat from coconut coir and debris before use. In real situations, the coco peat received by the farmer might not be clean, or low quality since the production of coco peat and quality control vary between factories. Deploying different soilless media in horticulture might not affect crop yield but saves irrigation water (Elakiya & Arulmozhiselvan, 2024; Gruda, 2022).

## CONCLUSION

This study used the particle size distribution analysis via mechanical sieve analysis to characterise the soilless substrate from coco peat, burn rice husk and its combination. This study scrutinised the effects of mixing coco peat and burn rice husk on the particle distribution curve of soilless media for pot planting. Results have demonstrated that a single coco peat has a heterogeneous particle size distribution, whereas a single burn rice husk is more homogenous in its particle size distribution. Blending coco peat and burn rice husk at different compositions resulted in a shifting particle distribution curve between a single coco peat and burn rice husk. However, all soilless media treatments consist of a major proportion of fines to medium size, which is suitable for growing media. The combination of different media will change the particle size distribution and hence expected to alter the physical, hydrological, chemical, and biological properties of manipulated soilless media. In addition, the high proportion of coco peat (70%) in a mixture sample of soilless media that air dried for more than seven days produced significant weight loss compared to other treatments. This study provides beneficial information on the fundamentals of precision irrigation for crops planted in the soilless substrate. Future research should explore the long-term effects of different coco peat and burned rice husk blends on crop performance, including factors such as water use efficiency, nutrient retention, and root growth. Given that sensor-based moisture measurements often require soil-specific calibration, further studies should assess the suitability of these soilless media for accurate moisture monitoring to ensure precise irrigation control. Additionally, it is recommended to study the chemical properties of these blends to better understand how they interact with plant nutrient uptake.

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