Utilization of selenium in baglog waste to increase antioxidant and storability of broccoli

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Abstract. Baglog waste contains cellulose, which can absorb selenium. Selenium can increase antioxidants and vegetable storability. This study aims to determine the selenium content of baglog waste in increasing antioxidants and broccoli storability. The study was conducted from May to July 2019 in Cipadung Village, Cibiru District, Bandung using the Completely Randomized Design (CRD) consisted of 5 treatments and 5 replications. The treatment was media A = 100% baglog waste, B = baglog waste mixture 25%: 75% rice husk charcoal, C = baglog waste mixture 50%: 50% rice husk charcoal, D = baglog waste mixture 75%: 25% rice husk charcoal, E = 100% rice husk charcoal (control). The results showed that the combination of 75% baglog waste media with 25% rice husk charcoal was able to increase antioxidants by IC50 28.34 ppm and storability for four days at room temperature. 75% baglog waste with 25% rice husk charcoal can be used as a medium for supplying selenium to get good antioxidants and storability of broccoli.

1. Introduction
Selenium is a micronutrient that contains antioxidants for the body [1]. The higher the selenium content in the soil, the greater the selenium absorbed by plants [2]. Selenium produces antioxidant enzymes such as glutathione peroxidase (GPX), thioredoxin reductase. The glutathione peroxidase enzyme found in selenium helps prevent damage caused by free radicals [3]. Broccoli is one type of vegetable that contains lutein and glutathione which are antioxidants [4]. The content of selenium can be increased in the presence of cellulose in oyster mushroom media (Baglog) [5].

Baglog waste can be utilized as a hydroponic substrate medium because baglog has organic cellulose, hemicellulose, fiber, lignin, organic carbohydrate fiber [6]. Cellulose function group can adsorb selenium so that it can bind selenium [7,8]. Besides containing baglog cellulose waste has a soft texture and can hold water [6].

Baglog oyster mushroom waste has good water storability so that it can as a hydroponic substrate media. Hydroponic substrate media not only has excellent water storage, but the media used must be porous [9]. Rice husk charcoal is a medium that has high porosity properties. Combination baglog oyster mushroom waste with rice husk charcoal will increase water aeration and porosity in the growing [10]. Rice husk charcoal is able to bind nutrients needed for plant metabolism such as the availability of...
selenium in growing media [11]. The combination of 25% baglog media with organic material can influence the leaf area and the weight of broccoli [12].

The use of combination baglog oyster mushroom waste media and rice husk charcoal contains cellulose and lignin. The presence of cellulose in this growing medium affects the accumulation of selenium, which will be absorbed by broccoli to increase antioxidant content.

2. Methods
The research method used was an experimental method with a Completely Randomized Design. The treatment consisted of 5 treatments (A, B, C, D dan E) with 5 replications. The treatment plan used i.e.

A = Baglog waste (BW) 100%.
B = Combination 25% baglog waste (BW) with 75% rice husk charcoal (RHC)
C = Combination baglog waste 50% (BW) with 50% rice husk charcoal (RHC)
D = Combination baglog waste 75% (BW) with 25% rice husk charcoal (RHC)
E = Rice husk charcoal (RHC) 100%

Observed parameters were supporting parameters and main parameters. Supporting parameters consist of measurements of temperature and humidity and observation of pests and diseases that begin 7 day after plant harvest. The main parameters consist of the antioxidant content of broccoli (ppm) with a UV-Vis spectrophotometer at a wavelength of 515 nm and the storability of broccoli (day). The analysis of data used analysis of variance (Anova) for Completely Randomized Design. If the value significantly different among the variables, then post-test analysis used Duncan Multiple Range Test in 5% applied.

3. Results and discussion

3.1. Broccoli antioxidant content
Antioxidant activity testing was performed using the DPPH method using a UV-Vis spectrophotometer. The activity test of broccoli flower extract was carried out on DPPH free radicals, which were measured by each absorption of the solution from 5 sample treatments with a UV-Vis spectrophotometer at a wavelength of 515 nm. The classification of antioxidants is divided into 5: < 50 ppm (Very strong), 50-100 ppm (Strong), 100-150 ppm (medium), 150-200 ppm (poor), and >200 ppm (very poor) [13].

Table 1. IC₅₀ value of broccoli flower extract.

| Treatment | IC₅₀ value (ppm) | Antioxidant power |
|-----------|------------------|-------------------|
| A (100% BW) | 36.85 | Very strong |
| B (25% BW : 75% RHC) | 43.47 | Very strong |
| C (50% BW : 50% RHC) | 32.99 | Very strong |
| D (75% BW : 25% RHC) | 28.34 | Very strong |
| E (100% RHC) | 77.94 | Strong |

The antioxidant power of each treatment is very strong, due to the influence of the media mixture using baglog oyster mushroom waste that provided cellulose. Cellulose has a functional group that can absorb selenium [7]. Thus the fungus baglog media provides selenium, which functions in producing antioxidants in broccoli plants.

IC 50 value is the amount of antioxidant activity in a sample, the value needed by the sample to inhibit 50% of free radicals so that the best antioxidant activity was in the combination of 75% baglog waste with 25% rice husk charcoal with a value of 28.34 ppm (Table 1). Antioxidant activity of broccoli flower ethanol extract has antioxidant activity value with IC 50 value of 4,998.1 ppm, including very poor category [14].
3.2. Storability of broccoli

Broccoli has very low endurance after harvesting, and the flower buds will quickly open and develop. The color of the flower will quickly change from green to yellow. The fast respiration rate characterizes these vegetables because the flower part is an organ composed by young tissues and is very active in biological processes [15].

![Broccoli color after four day of storage](image)

From observations of the broccoli storability after harvesting there were differences among the treatment given. The early harvest color of broccoli was dark green, and after being stored at room temperature for four days, the color of broccoli turned yellowish. Only 100% baglog waste medium (Figure 1). But in this medium, the size of broccoli is tiny when compared to the others media. This is because baglog waste has a higher water absorption capacity resulting in media compaction [16]. Solid media affect root growth so that nutrient absorption is inhibited in these plants [17]. Inhibition in the absorption of nutrients leads to decreasing of flowers formation and yield [15].

The combination of 75% baglog waste medium with 25% rice husk charcoal increased broccoli antioxidants (Table 1) and able to maintain the freshness of the color of broccoli flowers (Figure 1). Cellulose-containing baglogs increase the content of broccoli selenium. The content of selenium can increase N uptake in plants [18]. Nitrogen (N) has the role to produce proteins and other substances in the process of cell formation and play a role in the formation of chlorophyll [19] so that N uptake can increase the green color of broccoli flowers for four days of storage (Figure 1).

4. Conclusion

75% baglog waste with 25% rice husk charcoal can be used as a medium for supplying selenium to get good antioxidants and storability of broccoli.

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