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The Effect of Secondary Metabolism Content in Plant Leaves on Mung Bean Seed Germination

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Abstract. Secondary metabolites are a class of compounds contained in the bodies of microorganisms, flora and fauna which are formed from primary metabolic processes. The aim of this research is to determine the effect of metabolism in plants on the germination process of green beans. The method used is a qualitative method with a descriptive analysis research approach, data collection using observation and documentation. The results of observations made in the provision of different water, where the green beans treated with well water grew very quickly, the green beans treated with cassava leaf water grew quite well, while the green beans treated with papaya water and guava leaf water grew slowly**.**

Keywords: Germination, Secondary Metabolism, Green Beans.

INTRODUCTION

Green beans (*Vigna radiata*) are annual plants with a short lifespan of around 60 days. Green beans are one type of legume that is widely consumed by the people of Indonesia, and the sprouts are called beans. This plant contains nutrients such as starch, protein, iron, calcium, vitamins and many more. According to Trimayora & Fuadiyah (2021) Green beans (Phaceolus radiates) are plants with the Leguminoceae family.

This plant also has properties that can facilitate bowel movements, increase appetite and be used for medicine. Green beans are one type of food crop that is widely known in tropical areas. Plants that belong to the legume family (fabaceae) have many benefits in everyday life as a source of vegetable protein. Green beans are ranked third in Indonesia after soybeans and peanuts. Green beans have vertical stems that vary in height between 30 and 60 cm depending on the variety. In the main part, the branches are lateral, round and hairy. The color of the branches and stems is green and purple. According to (Sudrajat & Siagian, 2014), mung bean sprouts contain various vitamins, namely vitamins A, C, E, and K. Vitamin C is an antioxidant that can eradicate free radicals. Mung bean sprouts also contain several minerals including: Ca, Fe, Mg, P, K, Na, Zn, Cu, Mn and Se. Mung beans are plants that belong to the Fabaceae legume family which are useful as a source of high-protein food. Mung beans belong to the Fabaceae family and have the advantage of being a source of protein-rich food. Mung beans are known as fast-growing plants because they require a relatively short growth time. According to Mahardika et al., (2023), growth involves a constant increase in size and an increase in protoplasm in cells. The seeds in their storage tissue have carbohydrates, proteins, fats and minerals that are needed as raw materials and energy for the embryo during

germination. According to Rosmaiti (2017), large and heavy seeds have more nutrient reserves than small seeds, so they are expected to grow (Haryanto, 2010).

Growth is defined as a biological change that occurs in plants in the form of irreversible changes in size (cannot return to its original shape). Development is the process of achieving maturity or a more complete level. Thus, the growth of green beans is defined as the process of increasing size (height) or volume and number of cells that cannot be changed (Pujiah, 2016).

Plants are characterized by the fact that they produce a wide variety of very different secondary metabolites, including nitrogen-free compounds (such as terpenes, polyketides, phenols, saponins, and polyacetylenes) and nitrogen compounds (such as alkaloids, amines, glycosides, cyanogens), amino groups, acid proteins, glucosinolates, alkamides, and peptides), are some of the important secondary metabolites in plants, usually from different classes and biochemical pathways, usually associated with dozens of small components that cause different mixtures between organs and sometimes individual plants. The germination process shows the beginning of life where in this process the root buds come out. Furthermore, primary growth is located in the meristem. Plants will grow longer if the meristem at the tip of the root produces cells, while secondary growth is characterized by an increase in the size and diameter of the plant based on cambium activity (Ningsih, 2019). Germination begins with the absorption of water from the environment around the seed, causing the seed coat to soften and the seed size to increase (Ardiyato et al., 2014). Secondary metabolism is synthesized in plants in tissues, organs and with the help of certain biosynthetic enzymes. The activity of certain enzymes is regulated by the appropriate genes, and gene regulation reveals the full complexity of primary metabolites. The characteristics of secondary metabolites are that secondary metabolites accumulate and are stored in high concentrations in plant organs that are important for survival and reproduction, usually around 1-3 dry rats (Nugroho & Hartini, 2020).

An example of a plant containing secondary metabolites is papaya leaves (*Carica papaya*) which contain different metabolites ranging from stems, leaves, seeds, and juice. Papaya leaves contain the enzyme papain, alkaloid carpain, pseudocarpine, glycosides, carposides and saponins (Sundarwati & Fernanda, 2019). Second, cassava leaves contain active flavonoid and phenolic compounds. Flavonoids and phenolics are secondary metabolite compounds produced by plants with various functions, one of which is as an antioxidant. Antioxidant compounds prevent free radical activity in the body by equipping free radical molecules with electrons, so that the molecules become stable (Hasim et al., 2016).

Flavonoids and saponins, compounds known in the plant world have anti-inflammatory and antibacterial roles. Both substances, namely cyclooxygenase and lipoxygenase, play a role in preventing the inflammatory cycle (Rosiana et al., 2013). Third, guava leaves (*Psidium guajava*) have compounds such as steroids, saponins, plafonoids, phenones and tannins so that they have antimicrobial and antibacterial activity (Symbolon et al., 2021). Flavonoid compounds consist of chalcones, flavones, flavonones, flavonols, isoflavones and catechins which have antioxidant effects (Sari, 2021).

Planting media and water supply are very important for germination in the process of development and growth. This is to maintain the germinating seeds to grow and develop perfectly. The planting media used in this germination is tissue, where this tissue functions as a substitute for soil. Where tissue functions as a lock for water and moisture in the germination process. The water used is water that comes from plants that have secondary metabolism content, namely guava leaves (*Psidium guajava*), cassava leaves (Maihot Esculenta) and papaya leaves (*Carica papaya*). This study aims to test the effect of water containing secondary metabolism from various types of plants given to each sample of green beans, and also with tissue media. In addition, this study was also conducted to determine how fast the growth.

RESEARCH METHOD

The method used in this study is a qualitative method with a descriptive analysis research approach. This research was conducted for one week at Mataram City, West Nusa Tenggara on September 30, 2023 to October 6, 2023. The materials used are green beans and cassava water, guava, papaya, and well water, tissue and plastic bottles. The technical data collection in this study is using observation and documentation.

RESULTS AND DISCUSSION

Based on the results of the study, the development and growth of green bean germination differed in each sample. Some grew faster and some slower, depending on the treatment given. In the germination process, there are several stages of shoot formation. The stages of germination include the first stage, namely the absorption stage, where the germinating seeds begin to absorb water around them, because there is a difference in water potential in the seeds and their environment. The second is the enzyme formation phase, where the results of this enzyme formation increase metabolism.

The third is the radical cell elongation stage, at this stage there is a radical cell elongation process that follows the emergence of the nucleus and the growth of the seeds. And the fourth is the shoot growth stage, this process includes the growth of shoots which then experience primary growth. This type of hypogean germination can be interpreted as the growth of the epicotyl which elongates so that the seed coat appears and then penetrates the surface of the soil.

The second is epigeal germination, this type of germination can be interpreted as emerging growth that produces cotyledons and epicotyls that emerge from the seeds. This is due to the elongation of the hypocotyl, causing the cotyledons to rise above the soil surface (Ayuni et al., 2022). Plant growth is influenced by environmental factors such as temperature, humidity, light and also magnetic fields (Anggraini, 2012)

Treatment of Mung Bean Germination with Papaya Leaf Water (*Carica papaya*)

Papaya leaves (*Carica papaya*) containing different metabolites ranging from stems, leaves, seeds, and juice. Papaya leaves contain the enzyme papain, alkaloid carpain, pseudocarpine, glycosides, carposides and saponins (Sundarwati & Fernanda, 2019). Based on my observations on germination using tissue media with differences in the provision of water from plants containing secondary metabolism in 3 samples, namely bottle sample 1, bottle sample 2, and borol sample 3. mung bean seeds before being used as sprouts are first soaked for a few minutes, with the aim that damaged mung bean seeds will be visible during their shape becoming larger or expanding.

This is due to the absorption of water by the mung bean seeds. The sprouts treated with papaya water, on the first day had grown shoots or lumps that would become shoots, but not all mung bean seeds in each sample were like that, only a few. watering is done depending on the humidity level of the tissue, if germination is done in a place with a hot room temperature, water can be given once a day depending on the humidity level of the tissue.

On the second day, the mung bean shoots had come out 0.6 mm long, and there were also some that were just about to form their shoots. on the third day the shoots grew longer to 1.2 cm, and there were some that were 0.4mm long. on the third day there were also 2 mung bean seeds in sample bottles 1 and 2 that rotted, this was because the mung bean seeds were not good. on the fourth day the changes in the mung bean seeds in the three samples were very clearly visible, namely the length of the three samples, some were 2.4 cm, 0.8 mm, and 0.4 mm even 0.3 mm. on the fifth day, in sample bottle 3 there was one mung bean plant that

was 5.2 cm long, while the others were still below 4cm long and all had grown well where during germination they had a small body shape.

With fibrous roots. On the sixth day, the mung bean sprouts in the three sample bottles began to look a bit wilted, the stems were small, with wilted fibrous roots. This was due to the influence of the tissue planting medium which could no longer store and absorb water perfectly, which was caused by the cellulose fibers in the tissue no longer being able to absorb water perfectly, and on the seventh day the mung bean plants died.

Day 1

Day 2

Day 3

Day 4

Day 5

Day 6

Day 7

Table 1. Average Growth of Germination with Papaya Leaves (*Carica papaya*)

Days	Sample I			Sample II			Sample III		
	H	TB	M	H	TB	M	H	TB	M
1	4	6	0	3	7	0	7	3	0
2	8	2	0	8	2	0	9	1	0
3	9	1	0	8	1	1	10	0	0
4	9	0	1	8	1	0	10	0	0
5	9	0	0	8	1	0	10	0	0
6	9	0	0	9	0	0	10	0	0
7	9	0	0	6	0	3	9	0	1
Average	3.19			3.14			3.33		
Standard deviation	3.95			4.46			4.40		

Description: H: Alive; TB: Developing Body; M: Dead.

Treatment of Mung Bean Germination with Guava Leaves (*Psidium guajava*)

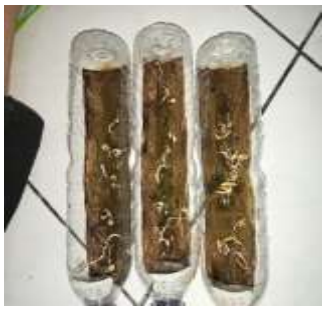
Guava leaves (*Psidium guajava*) have compounds such as steroids, saponins, plafonoids, phenons and tannins so that they have antimicrobial and antibacterial activity (symbolon et al., 2021). On the first day, the mung bean samples given guava leaf water already had shoots and lumps that would develop into stems. In sample bottle 3, there were 5 mung bean seeds that had sprouted 2 mm long, in sample bottle 2, there were 4 mung bean seeds with shoots 2 mm long, and in sample bottle 1, the mung bean seeds had sprouted and lumps that would grow into shoots.

Day 1

Day 2

Day 3

Day 4



Day 5

Day 6

Day 7

Table 2. Average Germination Growth with Guava Leaves (*Psidium guajava*)

Days	Sample I			Sample II			Sample III		
	H	TB	M	H	TB	M	H	TB	M
1	9	1	0	9	1	0	8	2	0
2	10	0	0	9	1	0	9	1	0
3	10	0	0	9	1	0	9	1	0
4	10	0	0	10	0	0	9	1	0
5	10	0	0	10	0	0	10	0	0
6	10	0	0	10	0	0	10	0	0
7	10	0	0	10	0	0	10	0	0
Average	3.33			3.33			3.28		
Standard deviation	4.73			4.54			4.39		

Description: H: Alive; TB: Developing Body; M: Dead.

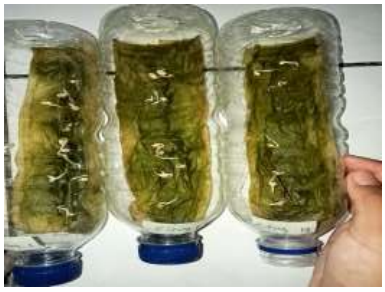
On the second day, in sample bottle 1, all shoots from mung bean seeds had grown to a length of 8mm and some were 5 mm. In sample bottles 2 and 3, all of them had grown rapidly, with shoots lengths of 7 mm. On the third day, the length of the mung bean stem did not change significantly between the 3 bottle samples, but the difference was in the roots that

grew into branches. On the fourth day, the length of the three samples had reached an average of 2.2 cm where the leaves had not yet emerged. On the fifth day, there were 3 sprouts whose leaves were already visible, the rest were not visible at all. On the sixth day, all the sprout seed samples had clearly visible leaves, but the growth structure of the stem was not upright, and was bent, while the length had reached 2.5 cm. And on the seventh day, the stem structure of the mung bean sprouts had become smaller with the root tips already brown.

Treatment of Mung Bean Germination with Cassava Leaves (*Manihot esculenta*)

Cassava leaves contain active flavonoid and phenolic compounds. Flavonoids and phenolics are secondary metabolite compounds produced by plants with various functions, one of which is as an antioxidant. Antioxidant compounds prevent free radical activity in the body by equipping free radical molecules with electrons, so that the molecules become stable (Hasim et al., 2016).

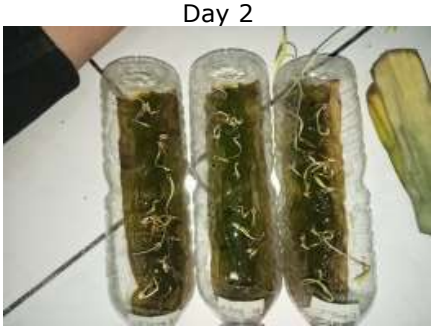
Day 1



Day 2

Day 3

Day 4



Day 5

Day 6

Day 7

On the first day of the mung bean germination process by giving cassava leaf water, shoots were seen coming out of each mung bean seed. On the second day, the length of the sprouts was 0.1 in the three bottle samples. On the third day, the length of the sprouts had reached 8mm where all the seeds in the sample grew and grew together. On the fourth day, the length of the sprouts had reached 1.2 cm with a body structure that was bent and not upright, unlike the sprouts given well water.

On the fifth day, the length has reached 1.5 cm where the leaves of all the sprouts are clearly visible where the root structure is the same as the root structure of the sprouts that were given guava water. On the sixth day, the length of the sprouts has reached 1.7 cm where

the shape of the body is still bent and not standing upright. On the seventh day, the shape of the sprout stems has begun to wilt, shrink and is no longer fresh. Where it is caused by the room temperature being too hot, causing the sprouts to wilt.

Table 3. Average Germination Growth with Cassava Leaves (*Manihot esculenta*)

Days	Sample I			Sample II			Sample III		
	H	TB	M	H	TB	M	H	TB	M
1	9	1	0	8	2	0	7	3	0
2	9	1	0	8	2	0	8	2	0
3	9	1	0	9	1	0	9	1	0
4	9	1	0	10	0	0	9	1	0
5	9	1	0	10	0	0	9	0	1
6	10	0	0	10	0	0	9	0	0
7	10	0	0	10	0	0	9	0	0
Average	3.33			3.17			3.23		
Standard deviation	4.33			4.38			3.96		

Description: H: Alive; TB: Developing Body; M: Dead.

Mung Bean Germination Treatment with Well Water

In mung beans treated with well water on the first day, shoots of 2 mm have grown, which is very fast growth compared to other treatments. On the second day, the length of the sprouts has reached 4 mm, where among the 3 sample bottles there is 1 seed that does not show any changes at all.

Day 1

Day 2

Day 3

Day 4

Day 5

Day 6

Day 7

On the third day, the length of the sprouts reaches 7 mm, the body structure is upright. On the fourth day, there are 10 sprouts that have a sprout length of 1.6cm, the other sprouts are 8mm long. On the fifth day, the sprout body is standing upright where the length is 4cm.

On the sixth day, the length of the sprouts has reached 11.2 cm with the stems of the leaves standing upright. On the seventh day, the length of the sprouts is 18 cm where the shape of the stem is no longer upright and there are leaves at each end.

According to Faezah et al., (2013), factors that affect seed germination are divided into internal and external factors. Internal factors are factors that come from within the seed, there are several things that play a role, namely the level of seed maturity, usually young seeds do not have enough vitality and do not have good germination power because the seeds do not have enough nutritional sources and the embryo is not yet fully formed. Considering the weight and size of the seed, large seeds have sufficient food reserves located in the cotyledons and begin to use these food reserves as energy for germination. Dormant seeds cannot germinate even though the environment is quite supportive of germination.

Table 4. Average Germination Growth with Well Water

Days	Sample I			Sample II			Sample III		
	H	TB	M	H	TB	M	H	TB	M
1	6	4	0	7	3	0	8	2	0
2	8	2	0	10	0	0	10	0	0
3	9	1	0	10	0	0	10	0	0
4	10	0	0	10	0	0	10	0	0
5	10	0	0	10	0	0	10	0	0
6	10	0	0	10	0	0	10	0	0
7	10	0	0	10	0	0	10	0	0
Average	3.84			3.33			3.33		
Standard deviation	4.29			4.60			4.66		

Description: H: Alive; TB: Developing Body; M: Dead.

External factors include water which is a carbohydrate decomposer in the seed cotyledons used in embryo growth. Temperature, temperature can affect the rate of seed growth, which is around 25-35 ^{o}C. Seeds can absorb oxygen through the respiration process, which encourages rapid shoot growth. The protein used in the process of decomposing cassava leaves may contain active flavonoid and phenolic compounds. High temperatures during seed storage also contribute to further seed deterioration by initiating degenerative changes, such as destabilization of enzyme activity and loss of cell membrane integrity (Moriya et al., 2015).

CONCLUSION

From the results of my observations, it was found that in the treatment with cassava leaf water, the growth of mung bean seed germination was not too fast or significant from the first to the last day. In the treatment with guava leaf water, the growth of mung bean germination was faster than cassava leaf water. In the treatment with papaya leaf water, the growth of mung bean germination was slower than guava and cassava leaves.

In the treatment with well water, the growth of mung bean germination was very fast compared to the others. So it can be concluded from the four treatments, mung bean seed sprouts grow and develop faster in the treatment with well water because it contains many minerals and nutrients that are important for plant growth.

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