



The study of the main nutrients quantity in soil improved by Acacia leaves bio-extract
and Cassia leaves bio-extract

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Abstract

The objective of this research is to study the quantities of nitrogen, phosphorus, and potassium in bio-extracts from Acacia leaves and Cassia leaves. Additionally, to investigate the efficiency after using bio-extracts from both sources in improving soil quality.

From the study, it was found that bio-extracts from Acacia leaves and Cassia leaves had similar physical characteristics. However, after soil enhancement, it was observed that the soil treated with Cassia leaf bio-extract was better at absorbing nutrients compared to soil treated with Acacia leaf bio-extract.

Keywords: Bio-extract, Acacia leaf bio-extract, Cassia leaf bio-extract, Main soil nutrients

Introduction

Nowadays, people prioritize consuming food for health, especially vegetables. However, the use of pesticides in cultivation has led to chemical residues in vegetables. Therefore, growing vegetables by oneself has become a popular choice for consumers who want to eat chemical-free produce. Cultivating kitchen garden vegetables to grow appropriately with a delightful taste and cost-effectively can be done in various ways. Another great method is through the application of bio-extract, this method widely chosen by farmers for nurturing and enriching plant nutrients for optimal growth. Besides, it has low production costs and farmers can choose their primary ingredients for making the bio-extract.

Acacia are small shrubs that are popular and often used as side dishes in various dishes. They are commonly consumed fresh with long, flat green leaves and brown ripe pods. They are consumed as tender shoots and green pods. They contain nutrients such as nitrogen, phosphorus, calcium, and iron. Thus using Acacia leaves to make bio-extract is beneficial for plants.

Cassia is one of the vegetables that can be consumed as food and herbs. The characteristics of Cassia leaves are feather-shaped leaves arranged alternately. The leaves are dark green with serrated edges with 5-12 pairs of lobed leaves. The flowers and tender flowers can be made into cassia curry. Additionally, Thai farmers commonly use mature leaves of cassia plants to make bio-extract.

From the survey, it was found that both Acacia leaves and Cassia leaves can be used to make bio-extract. By choosing to use the leaves of these plants for the fermentation process contain suitable nutrients and help the growth of various vegetables. Therefore, the researchers are interested in studying the bio-extract made from Acacia leaves and Cassia leaves to compare the nutrients and effectiveness after applying the bio-extract to the soil instead of using chemical fertilizers, which can be harmful to soil quality in the long term.

Methods and materials

1.1 Equipment

1. Blender
2. Scale
3. Plastic tank to contain bio-extract - 2 pieces
4. Plastic cups
5. Stirrer
6. Moisture and pH meter
7. Nitrogen, phosphorus, and potassium meter
8. Distilled water
9. Clear plastic wrap for covering containers
10. Rubber band

1.2 Materials

1. Acacia leaves
2. Cassia leaves
3. Pineapple
4. Brown sugar
5. Water
6. Dry loamy soil

Part 1: Study the Physical Characteristics of bio-extract from Acacia Leaves and Cassia Leaves

1. Preparation of Pineapple Microbial Inoculant

- 1.1. Chop pineapple into small pieces, totaling 500 grams, and put them into a container.
- 1.2. Add 150 grams of brown sugar.
- 1.3. Pour 2 liters of water and stir until the sugar dissolves.
- 1.4. Ferment for at least 7 days to let the microbes to synthesize nutrients from the brown sugar.

2. Preparation of bio-extract from Acacia Leaves and Cassia Leaves

- 2.1. Blend 500 grams each of Acacia leaves and Cassia leaves with 3 liters of water, then pour the mixture into separate fermentation containers.
- 2.2. Add 500 milliliters of pineapple microbial inoculant to each fermentation container.
- 2.3. Add an additional 1.5 liters of drinking water.
- 2.4. Add 500 grams of brown sugar into each fermentation container.
- 2.5. Stir until the sugar dissolves, then cover the fermentation containers with lids and store them in a dark place.

3. Observation of the Physical Characteristics of bio-extract from Acacia Leaves and Cassia Leaves

3.1. Study the topic for comparing the difference of bio-extract.

3.2. Observe the color, scent, and sediment of both bio-extracts, then record the observations.

Part 2: Study the quantity of Nitrogen, Phosphorus, and Potassium in bio-extract from Acacia Leaves and Cassia Leaves.

1. Analysis of Nitrogen, Phosphorus, and Potassium Levels in bio-extract

1.1. Take 100 milliliters of bio-extract from Acacia leaves and bio-extract from Cassia leaves separately and place them into beakers.

1.2. Immerse a “JXCT brand JXBS-3001”; nitrogen, phosphorus, and potassium meter into the distilled water to ensure accuracy and stability of the device.

1.3. Wipe the tips of the electrodes with a tissue and then immerse them into each type of bio-extract.

1.4. After one measurement, rinse with distilled water, wipe with a tissue, and repeat the measurement and record the measurement results.

Part 3: Study of Nitrogen, Phosphorus, and Potassium Levels in Soil Enhanced with bio-extract from Acacia Leaves and Cassia Leaves

1. Preparation of Soil for Soil Enhancement

1.1. Place dry loamy soil into a plastic cup.

1.2. Measure 200 milliliters of bio-extract.

1.3. Pour the measured soil into a mixing container and add the measured bio-extract.

1.4. Pour the pre-measured bio-extract onto the soil in the mixing container.

1.5. Mix the soil and bio-extract thoroughly.

1.6. Transfer the soil mixed with bio-extract back into the plastic cup.

1.7. Cover the cup with clear plastic wrap and secure it tightly with a rubber band.

2. Analysis of Nitrogen, Phosphorus, and Potassium Levels in Soil Enhanced with bio-extract

2.1. Use a nitrogen, phosphorus, and potassium meter to measure the soil in distilled water to ensure accuracy and stability.

2.2. Wipe the tips of the electrodes with a tissue, then immerse them into the soil treated with both bio-extracts.

2.3. After one measurement, rinse with distilled water, wipe with a tissue, and repeat the measurement. Record the results.

Results and data

1. Study of the Physical Characteristics of bio-extract from Acacia Leaves and bio-extract from Cassia Leaves.
2. Investigation of the Levels of Nitrogen, Phosphorus, and Potassium in bio-extract from Acacia Leaves and bio-extract from Cassia Leaves.
3. Examination of the Levels of Nitrogen, Phosphorus, and Potassium in Soil Amended with bio-extract from Acacia Leaves and bio-extract from Cassia Leaves.

Part 1: Study of the Physical Characteristics of bio-extract from Acacia Leaves and bio-extract from Cassia Leaves.

Table 1: The physical characteristics

Duration of fermentation	Acacia leaves bio-extract			Cassia leaves bio-extract		
	Color	Scent	Sediment	Color	Scent	Sediment
10 days	green	rank	floating	brownish-green	rank, bitter	floating
20 days	yellowish-green	acidic	settled	brown	alcoholic	settled
30 days	brown	foul smell	settled	dark brown	foul smell	settled

From Table 1, During the 10-day fermentation period, sediment floats on the water surface. The color and scent of both bio-extracts remain consistent with the original plant scent. By day 20, bio-extract from Acacia leaves turns yellowish-green and acquires an acidic smell. Meanwhile, bio-extract from Cassia leaves becomes brown in color with alcohol smell. The sediment that once floated now settles at the bottom of the container. As the bio-extracts reach 30 days of fermentation, The sediment still settles. Bio-extract from Acacia leaves turns brown and smells similar to fermented fruit, while bio-extract from Cassia leaves becomes dark brown and carries a similar smell.

Part 2: Study of nitrogen, phosphorus, and potassium levels in bio-extract from Acacia leaves and bio-extract from Cassia leaves

Table 2: shows nitrogen, phosphorus, and potassium levels in both types of bio-extract

Type of bio-extract	Average amount of Nitrogen, Phosphorus and Potassium (PPM)					
	15-day period			30-day period		
	N	P	K	N	P	K
Acacia leaves bio-extract	104.2	125.4	306.6	88.8	148	366.4
Cassia leaves bio-extract	87.2	112.8	305.2	102.8	137.4	343.4

From Table 2, it is observed that as the fermentation period increases, the amount of nitrogen, phosphorus, and potassium in both bio-extracts also increase. At the 15-day period, the average quantity of nitrogen, phosphorus, and potassium in bio-extract from Acacia leaves are 104.2 PPM, 125.4 PPM, and 306.6 PPM, respectively. Meanwhile, in bio-extract from Cassia leaves, the average quantity of nitrogen, phosphorus, and potassium are 87.2 PPM, 112.8 PPM, and 305.2 PPM, respectively. After 30 days of fermentation, the average amount of nitrogen, phosphorus, and potassium further increase. The average quantity of nitrogen, phosphorus, and potassium in bio-extract from Acacia leaves are 88.8 PPM, 148 PPM, and 366.4 PPM, respectively. On the other hand, the average amount of nitrogen, phosphorus, and potassium in bio-extract from Cassia leaves are 102.8 PPM, 137.4 PPM, and 343.4 PPM, respectively.

It can be concluded that at both the 15-day and 30-day period, bio-extract from Acacia leaves has a higher average quantity of phosphorus and potassium compared to bio-extract from Cassia leaves.

*The initial levels of nitrogen, phosphorus, and potassium in bio-extract from Acacia leaves are 65 PPM, 82 PPM, and 104 PPM, respectively. Meanwhile, in bio-extract from Cassia leaves, the initial levels are 27 PPM, 37 PPM, and 89 PPM, respectively.

Part 3: Studying the average quantity of Nitrogen, Phosphorus, and Potassium of soil mixed with Acacia leaves bio-extract and Cassia leaves bio-extract.

Table 3: The levels of nitrogen, phosphorus, and potassium in improved soil by using Acacia leaves bio-extract and Cassia leaves bio-extract.

Type of bio-extract used in soil improvement	Average quantity of nitrogen, phosphorus and potassium (PPM) and pH of improved soil by 30 days bio-extract			
	N	P	K	pH
Acacia leaves bio-extract at 30 days	29.6	47.2	156.4	7.5
Cassia leaves bio-extract at 30 days	56.6	69.8	194.6	7.5

From Table 3, it is observed that the pH levels of the soil that mixed with both bio-extracts is the same, which is 7.5, to be suitable for plant growth. However, the levels of nitrogen, phosphorus, and potassium differ. In the 30-day period, the average nitrogen, phosphorus, and potassium levels in the soil with Acacia leaves bio-extract are 29.6 PPM, 47.2 PPM, and 156.4 PPM, respectively. On the other hand, the soil mixed with Cassia leaves bio-extract has average nitrogen, phosphorus, and potassium levels of 56.6 PPM, 69.8 PPM, and 194.6 PPM, respectively.

It can be concluded that the soil with Cassia leaves bio-extract has a higher average quantity of nitrogen, phosphorus, and potassium compared to the soil treated with fermented Acacia leaves bio-extract.

*Initial levels of nitrogen, phosphorus, and potassium in the soil were 5 PPM, 7 PPM, and 18 PPM, respectively.

Discussion

1. Physical Characteristics Study

After 30 days of fermentation, both Acacia leaves bio-extract and Cassia leaves bio-extract exhibit distinct physical characteristics. Acacia leaves bio-extract appears brown with a scent resembling fermented broth, while Cassia leaves bio-extract is dark brown with a similar scent. Initially, both extracts showed similar physical attributes. The re-emergence of an alcohol-like scent in the fermented extracts results from the breakdown of sugars by bacteria. Additional sugar can further enhance this aroma.

2. Study of nitrogen, phosphorus, and potassium levels in bio-extract from Acacia leaves and bio-extract from Cassia leaves

Over 30 days, the levels of nitrogen, phosphorus, and potassium increased continuously in both Acacia and Cassia leaves bio-extracts. Acacia leaves bio-extract had average nitrogen, phosphorus, and potassium levels of 88.8 PPM, 148 PPM, and 366.4 PPM, respectively, while Cassia leaves bio-extract had levels of 102.8 PPM, 137.4 PPM, and 343.4 PPM, respectively. These values differed significantly between the two extracts.

3. Studying the average quantity of Nitrogen, Phosphorus, and Potassium of soil that mixed with Acacia leaves bio-extract and Cassia leaves bio-extract.

After 30 days of application, soil treated with both Acacia leaves bio-extract and Cassia leaves bio-extracts showed a pH of 7.5. The soil that has Acacia leaves bio-extract had average nitrogen, phosphorus, and potassium levels of 29.6 PPM, 47.2 PPM, and 156.4 PPM, respectively, while Cassia leaves bio-extract-mixed soil had levels of 56.6 PPM, 69.8 PPM, and 194.6 PPM, respectively. Additionally, the pH remained at 7.5. Soil mixed with Cassia leaves bio-extract that had higher levels of nitrogen, phosphorus, and potassium.

Conclusion

From the study, it was found that both extracts had no significant differences in the physical characteristics and the quantities of nitrogen, phosphorus, and potassium at 30 day-period fermentation. However, when both types of fermented extracts were applied to soil, it was discovered that the soil had a better ability to absorb nutrients from the Cassia leaves bio-extract, by having a higher levels of nitrogen, phosphorus, and potassium compared to soil mixed with Acacia leaves bio-extract.

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