

# FORMULATION OF NATURAL FERTILIZER FROM DIFERENT FRUIT AND VEGETABLE PEELS TO ACCESS THE GROWTH OF PLANTS AND ITS APPLICATION *IN-VITRO*.

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**Abstract:** Fertilizers are any organic or inorganic material of natural or synthetic origin that is added to soil to supply one or more nutrients essential to plant. Organic farming is the method of cultivation and growing agricultural crops using biological pest control and fertilizers which are derived from animal and plant waste. The method was developed due to fact that chemical fertilizers have negative effect on ecosystem. Hence as an alternative to chemical fertilizer, natural fertilizers can be made from plant waste as these are also rich source of nutrients and minerals. The project aims at making fertilizers as formulation that can be used for growing crops as alternative to chemical fertilizer.

The waste such as green pea pods, papaya, jackfruit and onion peels can be used for the purpose of making natural fertilizer. Peels of Onion, Papaya, Jackfruit and Peas were formulated in the form of powder, extract and mixed formulation. Three different concentration of each were applied in soil as a natural fertilizer. Spinach seeds were used to test effect of natural fertilizer on growth of the plant. Plant growth was measured after four weeks of application of fertilizer. In-vitro seed germination was carried out by supplementing fertilizer in the form media in Plant Tissue Culture. This if successfully implemented can also be used as one formulation media for in-vitro propagation of plants. Also, the extracts can be used as one novel media for the growth of industrially important fungi as from the results obtained it supported the growth of fungi.

**Keywords:** Fertilizer, Peels, Formulations, Plant Tissue Culture.

## I. INTRODUCTION

The increasing generation of food waste and its management constitute a major concern. In the world around 100 million tonnes of food, mainly coming from homes but also from food markets, are wasted annually. In many cases, uncontrolled open dumping, burning and land filing of waste are used as cheap solid waste management technique but this situation produces direct and indirect greenhouse gas emissions and other impacts in the environment and the human health therefore, the management of this waste must be quick and efficient. The high concentrations of organic matter and nutrient contents of food waste can be used as organic fertilizer for agricultural purpose. Fertilizers are one of the most important elements of modern agriculture and the application of fertilizer in agriculture can increased the production of food and other plant materials. Fertilizers are used in agriculture to enhance the natural fertility of soil. Fertilizers are any organic substances added to the soil that contain vital plant nutrients such as nitrogen, phosphorus and potassium that are crucial in plant growth. Fertilizers are classified as Natural or Organic fertilizers and Synthetic or Chemical fertilizers.

Natural fertilizer possess little to no risk of toxic build ups while chemical fertilizers are hazardous. The method was developed due to fact that chemical fertilizers are hazardous for plant growth, human health and environment. Organic fertilizers are natural fertilizers that are made up from animals, plants and minerals. They are crucial in agricultural sector because they have positive effect on soil without damaging plants. The main objective of our study was to formulate natural fertilizer from food waste so as to increase the growth of agricultural crops (Mercy S et al 2014). In the project, the waste in the form of peel/outer covering was collected from food market such as *Pisum sativa* (pea pods), *Carica papaya* (papaya), *Artocarpus heterophyllus* (jackfruit) and *Allium cepa* (onion) for the purpose of making natural fertilizers. The fertilizer was applied in the form of powder and extract. The spinach seeds were used as a test plant to check the effective concentration of powder and extract. These peels also can be used for growing industrially important fungi as they contain organic matter and nutrients. This if successfully implemented can also be used as one formulation media for in-vitro propagation of plants, which will be efficient and cost effective.

## II. MATERIALS AND METHODS

### 2.1 Collection of Samples

Fruit and Vegetable peels of Papaya, Pea Pods, Jackfruit and Onion were collected from local vendors of Bhayander, Nalasopara and Goregoan in the month of June and July.

### 2.2 Processing of Fruit and Vegetable peels

Collected fruit and vegetable peels were washed thoroughly with tap water to remove the dirt and soil. The washed peels were cut into small pieces and dried in hot air oven at 60-65°C until a constant weigh was obtained. The dried fruit and vegetable peels were powdered individually, sieved and stored at room temperature in air tight containers.



**Fig.no.1. Fruit and vegetable peel powder (A: Papaya peel, B: Pea pod powder, C: Jackfruit powder, D: Onion peel powder)**

### 2.3 Extraction of active compounds

Extraction of active compounds was carried out by Soxhlet extraction method. This method is used to check the secondary metabolites present in fruit and vegetable peels. The solvent used was methanol as it is highly polar solvent. About 12-13 cycles of soxhlet extraction were carried out and the extract was collected into petri plate and dried in hot air oven for 2 days. Further the dried extract is used for phytochemical analysis.

### 2.4 Phytochemical Analysis

For detection of active compounds present in samples, phytochemical analysis was carried out. (K.S Banu, L. Cathrine, 2015)

### 2.5 Preparation of Fruit and vegetable peel extract

Each formulation was prepared in distilled water in different quantities:

1g of peel powder of Papaya, Pea-pod, Jackfruit and Onion were taken separately and 100ml of distilled water was added to each flask and mixed thoroughly for the 3 days on rotary shaker. This was considered as F1 formulation.

3g of peel powder of Papaya, Pea-pod, Jackfruit and Onion were taken separately and 100 ml of distilled water was added to each flask and mixed thoroughly for the 3 days on rotary shaker. This was considered as F2 formulation.

5g of peel powder of Papaya, Pea-pod, Jackfruits and Onion were taken separately and 100ml of distilled water was added to each flask and mixed thoroughly for the 3 days on rotary shaker. This was considered as F3.

After 3 days the extract of all formulations were filtered and stored separately for further analysis.

### 2.6 Application of Fruit and Vegetable peels Powder and Extract in soil.

The formulations were applied in soil and properly mixed for uniform distribution. Control i.e., soil without fertilizer and three replications were maintained for each formulation. After 7 days, spinach seeds were sown on various pots. Each pot sown with 5-6 seeds and water was poured every day. Results were observed after 4 weeks of inoculation. The germination rate was calculated by the formula:

$$\text{Germination Percentage\%} = \frac{\text{Total seeds germinated}}{\text{total seeds used}} \times 100$$

### 2.7 Application of mixed formulation in soil.

Effective concentration obtained from individually plant result was used for mixed formulation. The mixed formulation of powder and extract were applied in soil and mixed properly. A Control without fertilizer in soil and three replications were maintained for mixed formulation. After 7 days, spinach seeds were sown in the pot. Each pot sown with 5-6 seeds and water was poured every day. Results were observed after 2 weeks of inoculation.

### 2.8 Preparation of media for plant tissue culture

Plant tissue culture was carried out to test the fruit and vegetable peel powder for growth of plants. 3 different concentrations (1%, 3% and 5%) were used to prepare the media. For 1%, 1gm of powder was mixed with 100ml of distilled water and 1.4 gm agar was added which was then digested. This was then autoclave at 121°C for 20 min and cooled. This was the media prepared which was then used for in-vitro propagation of spinach seeds. The MS half media was used as control. The germination rate was calculated by the formula:

$$\text{Germination Percentage\%} = \frac{\text{Total seeds germinated}}{\text{total seeds used}} \times 100$$

### 2.9 Fruit and vegetable peels as the novel media for growth of fungi

The suspension of 4 days old cultures of fungi namely *Aspergillus niger* and *Penicillium chrysogenum* were used to check the growth of fungi on peel powder as a media source. The spore suspension was prepared in sterile saline solution (0.85 % sodium chloride). The fungal cultures were inoculated into 50 ml of saline and incubated at room temperature for 5 hours. About 4.0 grams of fruit peel powder were added into the 100 ml of distilled water and sterilized by autoclaving at 121°C for 15 minutes. After sterilization, the fruit peel powder broths were cooled and the 1 ml of prepared fungal spore suspension was added. The each flask was incubated at room temperature for 3 days. The presence or absence of the fungal growth was visually observed.

**III. RESULTS AND DISCUSSION**

**3.1 Results of Phytochemicals:**

The phytochemical study of the different samples has been summarized in table no.2. The phytochemical analysis of the samples showed the presence of alkaloids, carbohydrates, saponins, terpenoids and flavonoids. From all the samples it was seen that majority of the phytochemicals were present in onion followed by jackfruit whereas pea pods showed the presence of alkaloid and saponins only. The protein and lipid were found to be absent in all samples.

Test	Papaya	Pea Pods	Jackfruit	Onion
Alkaloids	+	+	+	+
Phenol	-	-	+	+
Terpenoids	+	-	+	+
Saponin	+	+	+	+
Proteins	-	-	-	-
Lipid	-	-	-	-
Flavonoids	+	-	-	+
Carbohydrates	+	-	+	+

Key: Present=+ Absent= -

Table no.1. Results of Phytochemicals

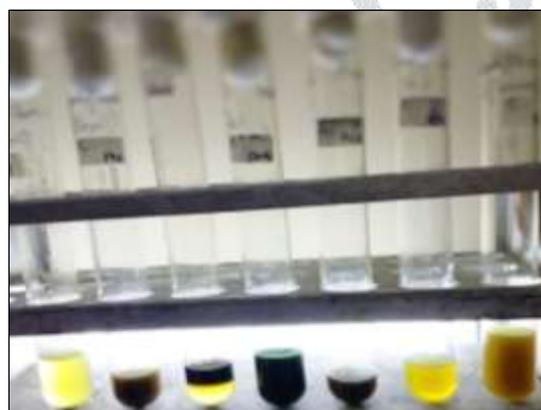


Fig.No.2. Phytochemical analysis of papaya



Fig.No.3. Phytochemical analysis of pea pods



Fig.No4. Phytochemical analysis of jackfruit



Fig.No.5 Phytochemical analysis of onion

**3.2 Result of plant growth:**

The germination percentage for all the samples was found to be 100%. From table no. 3 it could be seen that for papaya sample, the maximum and overall good growth was observed for 3% extract and 5% powder as compared with control while that for pea pods from table no.4, 3% powder and 5% extract were found to appropriate concentrations. The table no. 5 shows the appropriate concentrations of 3% powder and 5% jackfruit extract for maximum and good growth as compared to other concentrations of same plant extract. 3% powder and 3% extract of onion peels showed the the maximum and overall good growth as compared to other concentration of same extract and control (Table no.6).

Parameters	Extract			Powder			Control
	1%	3%	5%	1%	3%	5%	
Length of shoot (cm)	7	8	7	5	7	8	3.3
Length of root (cm)	3	5	3	2.5	3	4	1.2
No. Of lateral root hair	6	4	9	8	7	6	5
Colour of leaves	Green	Green	Green	Green	Green	Green	Green
No. Of leaves	4	4	4	5	5	5	3
Overall Growth (cm)	10	13	10	7.5	10	12	4.4

Table no.2. Result of Plant growth in Papaya peels



Fig.No.6. Plant growth in papaya Extract



Fig.No.7. Plant growth in Papaya Powder

Parameters	Extract			Powder			Control
	1%	3%	5%	1%	3%	5%	
Length of shoot (cm)	4	6	6	5.5	7	5	3
Length of root (cm)	5	4	7	6	5	6	4
No. Of lateral root hair	6	5	7	5	8	7	5
Colour of leaves	Green	Green	Green	Green	Green	Green	Green
No. Of leaves	3	4	4	4	4	4	4
Overall Growth (cm)	9	11	13	11.5	12	11	7

Table no.3. Result of Plant growth in pea pods peels



Fig. No.8. Plant growth in pea pod Extract



Fig.No.9. Plant growth pea pod powder

Parameters	Extract			Powder			Control
	1%	3%	5%	1%	3%	5%	
Length of shoot (cm)	3	3	4	5	4	4	3
Length of root (cm)	5	6	7	8	7	5	5
No. Of lateral root hair	8	6	10	12	14	9	8
Colour of leaves	Green	Green	Green	Green	Green	Green	Green
No. Of leaves	4	4	4	4	4	2	4
Overall Growth (cm)	8	9	12	13	12	9	8

Table no.4. Result of plant growth in Jackfruit peels



Fig.No.10. Plant growth in jackfruit Extract



Fig.No.11. Plant growth in Jackfruit Powder

Parameters	Extract			Powder			Control
	1%	3%	5%	1%	3%	5%	
Length of shoot (cm)	5	6.3	6	5.6	7.8	7.5	5
Length of root (cm)	4	4.8	4.1	4	4.6	4.2	3
No. Of lateral root hair	11	12	12	14	18	11	9
Colour of leaves	Green	Green	Green	Green	Green	Green	Green
No. Of leaves	4	5	5	4	4	4	4
Overall Growth (cm)	9	11.1	10.1	9.6	12.4	11.7	8

Table no.5. Result of plant growth in Onion peels



Fig.No.12. Plant growth in Onion Extract

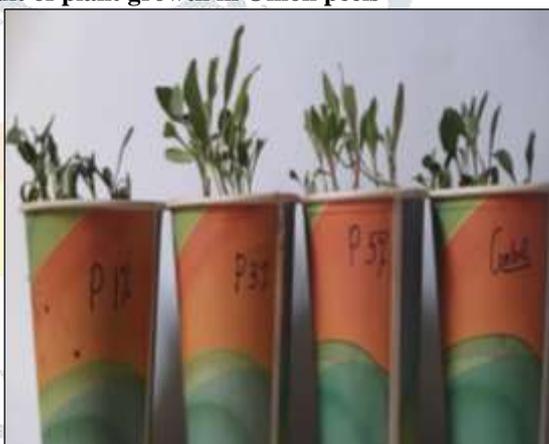


Fig.No.13. Plant growth in Onion Powder

**3.2.2 Result of Mixed formulation:**

The effective concentration of fertilizer of the four samples when altogether mixed and applied into the soil and seeded with spinach seeds, the results obtained showed more growth relative to control as well as with respect to individual concentration (Table no.7).

Parameters	Extract	Powder	Control
Length of shoot (cm)	5	5	3
Length of root (cm)	4	1.5	2
No. Of lateral root hair	7	5	4
Colour of leaves	Green	Green	Green
No. Of leaves	3	2	2
Overall growth (cm)	9	6.5	5

Table no.6. Result of mixed formulation



**3.2.3 Result of Plant tissue culture:**  
 Table no.8 explains the germination rate of seeds when compared with control i.e. MS half that media containing

only fertilizer was effective in growing plants as MS half does not showed germination. From the table 1% of papaya and peapod extract was found to be effective, while for onion maximum growth was observed for 5%. For jackfruit out of all concentrations, 1% was found to be effective. The figures in bracket indicate germination percentage.

	Papaya	Pea pod	Jackfruit	Onion
1%	4/30 (13.3%)	2/30 (6.66%)	5/30 (16.66%)	24/30 (8%)
3%	0/30 (0%)	0/30 (0%)	2/30 (6.66%)	0/30 (0%)
5%	0/30 (0%)	0/30 (0%)	2/30 (6.66%)	3/30 (10%)
MS half (control)	0/30 (0%)	0/30 (0%)	0/30 (0%)	0/30 (0%)

**Table no.7. Result of plant tissue culture**

**Fig.No.15. Plant tissue culture showing growth of test plant in media supplemented with 1% of papaya powder**

**Fig.No.16 Plant tissue culture showing growth of test plant in media supplemented with 1% of pea pod powder**

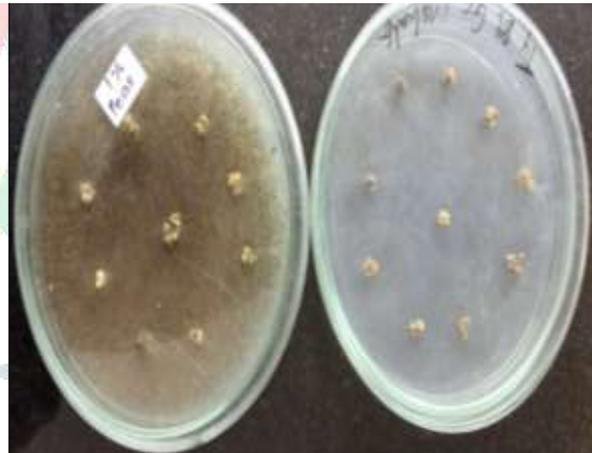
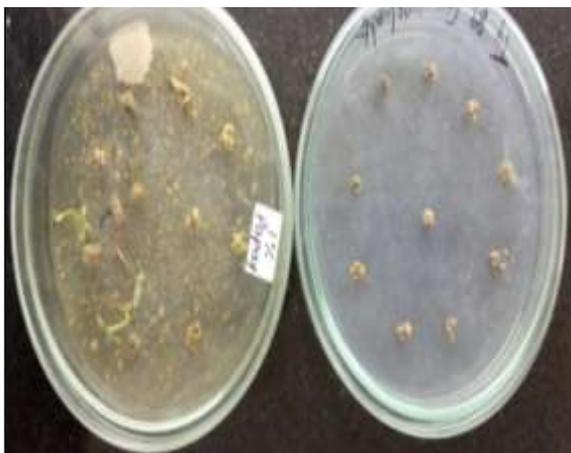




Fig.No.17. Plant tissue culture showing growth of test plant in media supplemented with 1%, 3% and 5% of Jackfruit powder

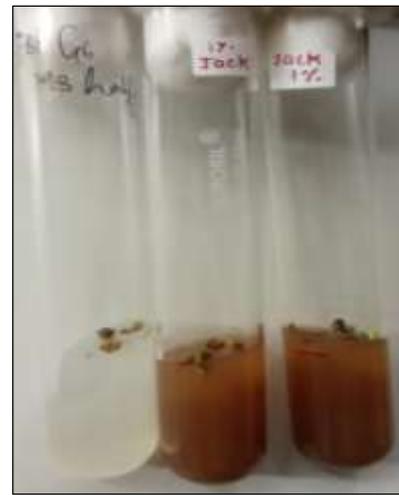


Fig.No.18. Plant tissue culture showing growth of test plant in media supplemented with 1% of Jackfruit powder

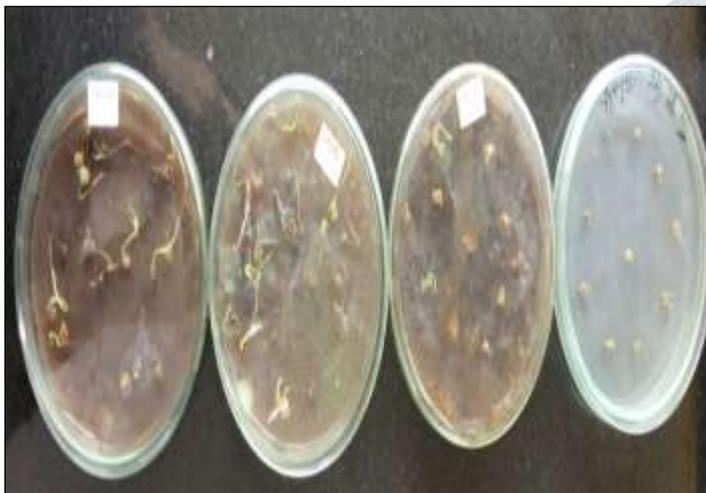


Fig.No.19. Plant tissue culture showing growth of test plant in media supplemented with 1% and 5% of Onion powder



Fig.No.20. Plant tissue culture showing growth in 1% of Onion powder

**3.2.4 Result of Fungal Growth:**

Table no.9 shows the growth of fungi on plant extracts as applied as media for supporting the growth of fungi. It can be seen that with the exception of pea pods sample, the rest of the three samples viz. papaya, jackfruit and onion peels extract supports the growth of fungi.

Fruit and vegetable peel	<i>Aspergillus niger</i>	<i>Penicillium chrysogenum</i>
Papaya	+	+
Pea Pod	-	-
Jackfruit	+	+
Onion	+	+

Table no.8. Result of fungal growth



Fig.No.21. Fungal growth in papaya peels extract (*Penicillium chrysogenum* and *Aspergillus niger*)

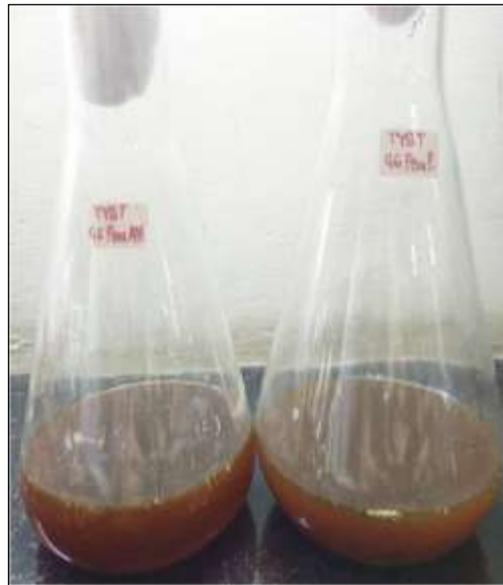


Fig.No.22. No fungal growth in pea pod peel extracts (*Penicillium chrysogenum* and *Aspergillus niger*)



Fig.No.23. Fungal growth in jackfruit peels extract (*Penicillium chrysogenum* and *Aspergillus niger*)

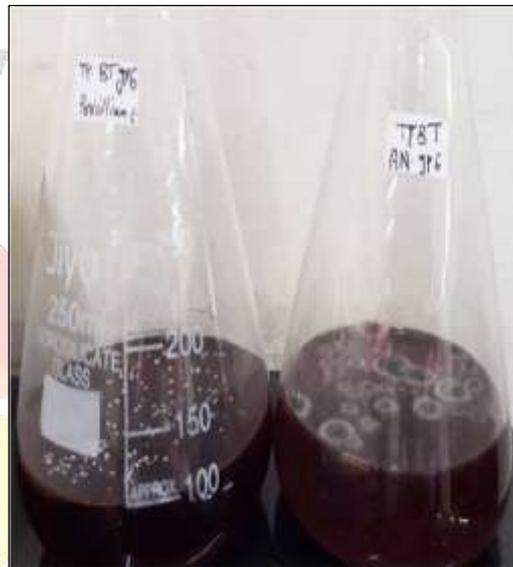


Fig.No.24. Fungal growth in onion peels extract (*Penicillium chrysogenum* and *Aspergillus niger*)

#### IV. CONCLUSION

Phytochemical study on the different peel waste was carried and the analysis showed the presence of majority of phytochemical constituents with maximum detection in onion only with the exception of lipids and protein which were found to be absent in all samples. The powder and extracts were applied separately and the effective concentrations found for both types and each sample were used for further inclusion in the formulation of fertilizer. Fruit and vegetable peels powder applied in soil showed increased growth of plants when compared to the control (only distilled water and no formulation) hence it can be concluded that fruit and vegetables peels can be used as natural fertilizer. The less concentration showed less growth as compared to control which may be due the fact that the low concentration may not provide the essential nutrients which are necessary for the growth of the plants. When the effective concentration of fertilizer of the four samples is altogether mixed and applied into the soil and seeded with test plant (spinach seeds), the results obtained are that the mixed fertilizer showed more growth relative to control. This indicates that this mixed formulation might be highly effective and used to achieve higher growth rates.

The results of *in-vitro* germination rate of seeds when compared with control indicate that media containing only fertilizer was effective in growing plants as control did not showed germination. The effective concentrations found from germination rate can be used further in combination to be formulated as plant tissue culture media. The two fungal species used showed growth on all media with the exception of pea pods which suggest that extracts used can be used for the growth of fungi by using as alternative material in the formulation of culture media for fungi.

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