Application of Different Fruit Peels Formulations as a Natural Fertilizer for Plant Growth

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Abstract

India is the world's second largest producer of fruits and vegetables. Huge quantities of lignocellulosic biomass are produced every year during cultivation, harvesting, processing and consumption of agricultural products. Fruits after consumption leave a peel which is a nuisance to the environment as a solid waste. In this article, commonly available large volume-fruit peels. This project emphasizes on using the waste generated from fruits. Fruit peels of banana, sweet lime, papaya and pineapple were used. The fruit peels were air dried and powdered. A formulation of the fruit peel was made to be used as a natural fertilizer. The peel powder was mixed with soil in a 1:1 ration individually. The physical and chemical characteristics of the peel powder mixed soils were determined. Surface sterilized moong seed were inoculated and their growth was checked for a week. The fruit peel extract was used to check the growth on the moong seeds *in vi*tro for a week. The seeds were grown MS media supplemented with the fruit peel extract. The grown plantlets were checked for root length, shoot length, no of leaves, protein content and carbohydrate content. In vitro propagation of shoots was used to test the utilization of fruit peel extract as a natural growth enhancer. Shoots were grown on fruit peel formulated media without and with growth hormones.

Keywords: Fruit peels, Fertilizers, Growth Hormones, MS Media, Callus

Introduction

Waste generation and accumulation is one of the major concerns for the future generations. Solid waste comes from various sources including food, animal, hazardous, industrial, medical, mineral wastes, etc. Urban waste includes household garbage, construction and demolition debris, sanitation residues, trade, industrial refuse and biomedical solid waste (CPCB, 2000). India produces 300 to 400g of solid waste per person per day in a town. To clear such a large mass of solid waste generated daily is a major concern of cities, which could lead to a serious situation due to the toxicity and unavailability of dumping grounds (Vilas, 2015).

Fruit Peel (FP) waste are produced in a large scale in food processing and agriculture industries which has become a serious environmental concern. India is the second largest producer and consumer of fruits, which is also an indication of the generation of million tons of fruit waste per year (Sharma *et al*. 2011, Patel 2012).These immense quantities of waste food commodities also contribute to immense environmental problems as they decompose in landfills and emit harmful greenhouse gases (Venkat, 2011; Vilariño *et al.*, 2017). Followed by household garbage, fruit and vegetable processing units commonly produce the highest wastes into the environment (Gowe, 2015).

Fruits contain a high amount of antioxidants that are essential for our health (Faria *et al.*, 2006). Organic fertilizers are of animal and plant origin. Inorganic fertilizes are usually wholly manufactured, as in the case of sulphate of ammonia; or they may be processed from a mined or quarried mineral, as in the of ground limestone. Fertilizers are provided in varying proportions. These inorganic fertilizers may in some cases contribute to soil losing its fertility. Good fertility is fundamental to successful plant growth, and the application of fertilizes and manures is an essential graining act activity. The maintenance of adequate levels of nutrients in soil is essential for healthy plant growth.

In the present study, the utilization of fruit peels for the effective growth of plants was checked. Different fruit peels such as Apple, Pine apple, Sweet lime and Banana were used. These are waste products which may contribute to increase in waste. We have made a small attempt to utilize this waste to make a natural fertilizer.

Materials and methods

Raw material:

Collection and Processing Of Fruit Peels

Fruit peel (FP) waste from apple, banana, sweet limes and pine apples were collected separately from household kitchen and fruit juice shops in Kalyan. Collected fruit peels were washed thoroughly with tap water to remove the unwanted material including seeds. The washed peels were cut in to small pieces and air dried in sunlight for a few days. The dried fruit peels were powdered individually, sieved and stored at room temperature (Figure 1).

Figure 1: Peels after air dried in sunlight for 20 days. The dried fruit peels were powered individually, sieved and stored in room temperature.

Collection and processing of soil Sample:

The soil was collected from the garden of B.K Birla college Kalyan (w), Thane district. The collected soil was stored in the laboratory under open condition. The soil contained clay, pebbles, and hence the soil was sieved to remove the pebbles and rock pieces. The soil samples were air-dried. This dried soil was packed in sterile polythene bags.

Effect of fruit peel powder mixed in soil

Formulations of the fruit peel powder and soil was made – 1gm FP powder + 85 gm of soil. The FP powder and soil was mixed properly mixed for uniform distribution. Control and three replications were maintained for each formulation. Moong *(Vigna radiata)* seed were Surface sterilized using 1% bavistin and were sown in various pots. Each pot was sown with 5 seeds. The pots were watered regularly. Results were observed after 7 days of inoculation. The soil was analyzed for various physical and chemical parameters. The plantlet obtained were analyzed for carbohydrate content (Sadashivam, 2004) and Protein content (Lowry *et al.*, 1951)

Effect of fruit peel extract on moong seeds

Preparations of fruit peel extract:

Formulations of FP powder extract were made in distilled water as described in Table 1. It was crush in a mortar and pestle to make a paste. It was filtered through a muslin cloth and transferred into a beaker. It was allowed to evaporate in boiling water bath for 1hour. The solution was cooled and made a final volume to 1mg% using sterile Distilled water.

The bavistin sterilized moong seeds with placed in sterilized petri plates layered with filter papers. 2 ml of the F1 formulation for each FP extract was added to individual petriplates. The plates were kept under regulated light and dark period for 7 days. Controls using sterile distilled water were subjected to the same conditions. The plantlets obtained were analyzed for the root length, shoot length, germination percentage.

Table 1: Formulations for various Fruit peel powder extracts

Sr. no.	Fruit peel powder	F1 (g)	F1peel power extract
1	Apple	1g	1g+100mL
2	Banana	1g	1g+100mL
3	Sweet lime	1g	1g+100mL
4	Pineapple	1g	1g+100mL

Formulation of media by fruit peel powder for *invitro*propagation of plant

In vitro propagation of shoots was done to checkthe fruit peel powder for the growth of plants. 0.1 gm of each fruit peel powder was mixed with 100 ml of distilled water. The pH of the media was adjusted to 5.8-5.9. 0.8 % agar agar powder was added for gelling (Hi Media, Mumbai, India) and transferred to small conical flask, autoclaved at 121°C for 20 min and cooled.

Well grown shoots of Moong*(Vigna radiata)*were collected and surface sterilized with $HgCl_2$ (0.1%) for 1 minutes and thoroughly rinsed with sterile distilled water to remove the traces of $HgCl_2$. 2 cm length of excised shoots were placed on sterile blotting paper, dried and inoculated on the fruit peel media supplemented with IAA (1 mg/l) and BAP (1 mg/l) respectively and control was maintained without hormones. All cultures were maintained at 25 ± 2° C and grown under 16 hours photoperiod provided by cool white fluorescent tubes. Results were observed after 15 days of incubation (Mercy *et al.*, 2014).

Results and Discussion

Fruit peel (FP) waste from apple, banana, sweet limes and pine apples were collected separately, washed thoroughly with tap, air dried in sunlight for a few days. The dried fruit peels were powdered individually, sieved and stored at room temperature (Figure 2).

Figure 2: Fruit peel powders

Effect of fruit peel powder mixed in soil

The moong bean seeds were grown in pots containing formulation of peel powder and soil in the ration of – 1gm FP powder + 85 gm of soil. The plantlets obtained were analyzed for protein and carbohydrate content (Figure 3).

Figure 3: Moong bean seeds grown in soil supplemented with fruit peel powder

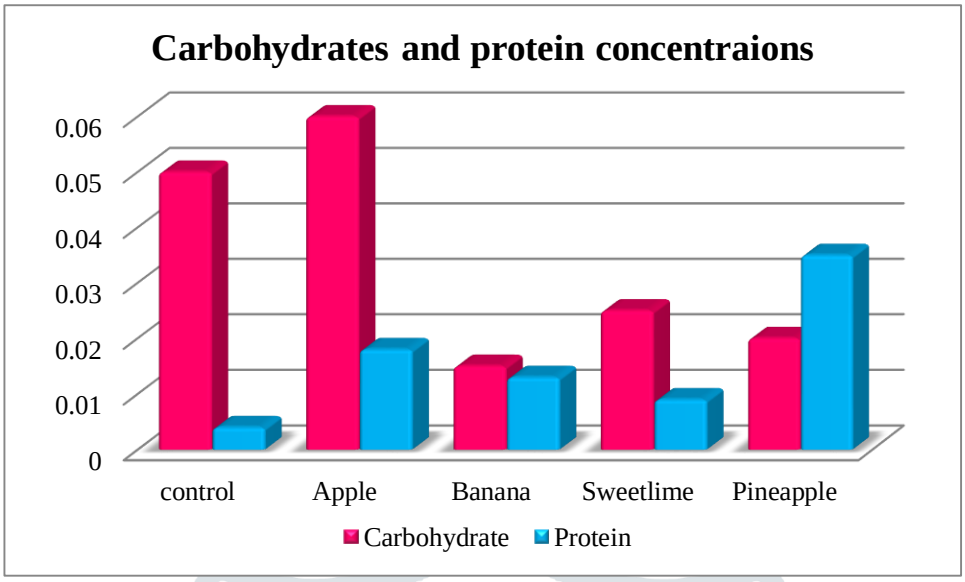

Figure 4: Effect on the carbohydrate and protein content in plantlets after growing in Fruit peel extracts in mg/ml

The crude extract supported 100 per cent germination, early leaf emergence and a maximum plumule length. The concentration of proteins in the plantlets increased when the plantlets were grown in soil containing apple peel powder whereas the concentration of carbohydrates in the plantlets increased when the plantlets were grown in soil containing pineapple peel powder (Figure 4).The soil containing the various FP powders was analysed for physical and chemical properties (Table 2).

Table 2: Physical and chemical parameters of soil supplemented with fruit peel powder

Soil sample	pH	Bulk Density (W/V)	Specific Gravity	Moisture Content (%)	Akalinity (mg/l)	Carbon Content (%)	$CaCO_3$ Content (%)
Control	4.6	0.732	0.631	5.0	100	0.625	7.5
Apple	4.0	0.715	0.645	12.4	150	0.671	10.5
Banana	5.0	0.833	0.681	6.1	200	3.318	10
Pineapple	4.0	0.667	0.657	10.6	250	1.0975	4.5
Sweetlime	4.0	1.11	0.473	4.9	50	3.623	19

Formulations of FP powder extract were made in distilled water and prayed on the moong bean seeds in sterile Petri plates. After one week, the plantlet obtained were analyzed for the root length, shoot length, germination percentage (Figure 5; Figure 6; Table3).

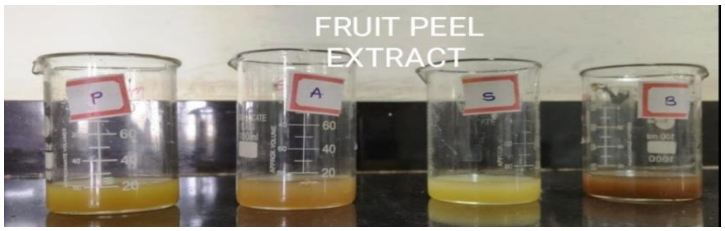

Figure 5: Different fruit peel extracts

Figure 6: Plantlets grown in Petri plates in presence of fruit peel extracts

Table 3: Shoot length and root length along with percentage germination of the plantlets

Name of Plant	Shoot Length	Root Length	Live	Viability (%)
Control	5.38	5.32	5	100
Apple	5.52	3.14	5	100
Banana	7.2	3.8	5	100
Sweetlime	6.54	5.4	5	100
Pine Apple	5.24	3.76	5	100

The data summarized in Table 3 show that fruit peel decoction increased plant length to 7.2cm respectively. While the plants grown in distilled water (control) showed a plant length of 52.3 cm. It was seen that the shoot length increased when Banana peel extract was added whereas root length increased when Sweet lime peel extract was added

In vitro propagation of shoots was done to check the fruit peel powder for the growth of plants. The plantlets were grown for a period of 7 days and the shoot length and root length was measured. It was seen that effect of apple peel powder was maximum (Figure 7; Table 4).

Figure 7: Shoots grown in media supplemented with fruit peel powder

Table 2: Shoot length and root length along with percentage germination of the plantlets grown in media supplemented with fruit peel powder

Name Of Plant	Shoot Length	Root Length	Live	Viability (%)
Control	5.38	5.18	5	100
Apple	8.52	7.14	5	100
Banana	7.2	3.8	5	100
Sweetlime	6.11	5.14	5	100
Pine Apple	5.24	3.76	5	100

CONCLUSION

Peels of banana, sweet lime, apple and pineapple are highly rich in potash, ion, zinc, etc. The powder of fruit peels extract was used as a natural fertilizer, along with fenugreek seeds to test the use of fruit peel powder as a natural growth enhancer (Mercy *et al.*, 2014). Similar effect was observed by Tam and Tiquia (1994) while using spent litter to enhance seed germination rate. Fruit waste provides a high amount of nutrients for inhabiting microbes. However, they are prone to strong odors during the process of decomposition. The high moisture content of fruit waste makes it highly costly to dispose off (McGuckin *et al.*, 1999). The breakdown of organic material of compost is performed by aerobic microorganisms which are present in the soil. These organisms utilize the complex nutrients of the compost and release the essential minerals into soil which enhances the crop yield which in turn provides healthy and nutritious food to mankind (Kalpana *et al.*, 2011). Results of this work showed that fruit peel waste has a high potential to enhance plant growth. The use of domestic waste as plant growth promoter ingredient would be one of the best measures to reduce the accumulation and protect the environment.

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