

# Biodegradable Cutlery Using MoringaPod Husk: An Alternative to Conventional Plastic Cutlery

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**Abstract:-***Moringaoleifera* or drumstick tree belongs to Moringaceae family and it is the most commonly found tree in tropical and subtropical region of south Asia. Due to the nutritional importance of each and every part of the tree it is also, known as the “Miracle tree”. The moringa pod husk is inedible but the pod pulp and seeds can be consumed. The deseeded and depulped moringa pod contains crude fiber, cellulose, hemicelluloses in significantly high amount. Since, the inedible pod husks are waste material it can be utilized by up cycling it into useful products. Therefore, sustainable approach was used to develop biodegradable cutlery using *M.oleifera* pod husk powder as it can serve as a better alternative to single use plastic cutlery.

The drumstick pod husk powder was subjected to mild acid treatment and gentle bleaching and the obtained pulp, was casted into moulds and micro-waved. On completion of this process biodegradable cutlery was obtained. Further, biodegradability of this cutlery was observed. This same methodology can be extrapolated to develop more eco-friendly products other than cutlery.

**Keywords:***MoringaOleifera* (Drumstick), *MoringaPod Husk*, *Biodegradable Cutlery*, *Sustainable Approach*, *Plastic Cutlery*.

## I. INTRODUCTION

*Moringa olieifera* is the most widely cultivated species of the Moringaceae family[1], [2]. Moringa tree is an exceptionally nutritious tree with a variety of potential uses[3], [4].A drumstick tree pod contains pulp and seeds which are consumed but the pod husk are not consumed[5].The pod husk has a very high content of crude fiber, cellulose, hemicelluloses[6]. This aspect of the drumstick pod waste was extrapolated to develop biodegradable cutlery (spoons) as it can serve as a better alternative to single use plastic cutlery.Though plastic cutlery is a convenient option it is hazardous to the environment.

In India the plastic industry is worth 3000-4000 crores. In 2016 India produced more than 15000 tons of plastic waste every day[7]. Single use plastic includes food packaging, straws, plastic spoons, forks, knives. Other than this there is plastic packaging which is used for packing electronics and also, the products delivered to our door steps are packed in plastic. Plastic cutlery is a major part of plastic

waste produced worldwide. Recycling, reusing, reducing and up-cycling such large amount of plastic waste is a major issue the world is facing.

It has become essential to find and develop alternatives to the existing conventional plastic cutlery. This study focuses on developing single use biodegradable cutlery using drumstick pod husk by gentle chemical processing and analyzing the biodegradability by soil burial method.

## II. MATERIALS AND METHODS

### ➤ Preparation of Moringa pod husk powder: -

Moringa (Drumstick) pods collected were fully matured and healthy from trees in my residential area. The pods were washed with water and dried. The dried pods were deseeded and pulp was removed using knife. The remaining pod husk was used for study. The pod husk was chopped into pieces of equal length and dried in hot air oven for 24 hours. The dried pods husks were ground in a grinder, and the powder obtained was used for the study.



**Fig 1** Dried Moringa pod husk

### ➤ Procedure to make Biodegradable cutlery

The method used was adapted from Shuna Cheng[8] and slightly modified. The pod husk powder obtained is subjected to mild acid hydrolysis in 0.1N HCl for 2 hours in water bath then cooled. After cooling the pH is adjusted to 9.5 by using NaOH solution. Several washings with water were given to get rid of HCl, NaOH and extractives from the pulp. The obtained pulp was grinded. Bleaching procedure on pulp was done using sodium hypochlorite for 4 hours at 60°C. The obtained pulp was washed several times with water. Thick slurry was made of this pulp. The slurry was casted in moulds shaped like spoons and the moulds

containing the slurry was micro waved for 4 minutes. Microwaving of the slurry dries and hardens it and the shape

is maintained. The spoons were removed from the mould.



➤ *Biodegradability test*

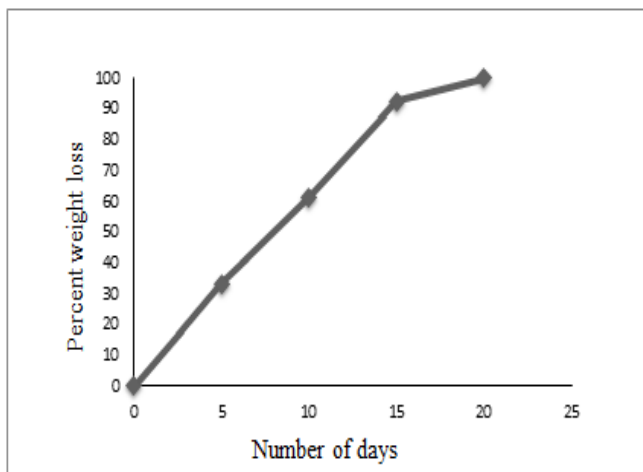
Biodegradability was tested by soil burial method[9]with slight modifications. Soil (1000g) was taken in a pot. The developed spoon was weighed and buried in the soil. The weight of the spoon was taken at regular intervals of time (5 days) to check for weight loss. Percent weight loss as a function of number of days was determined by the equation given below and a graph was plotted as in (Fig 3).

$$\text{Percent weight loss} = \frac{\text{Initial wt. of the spoon} - \text{Final wt. after 5 days}}{\text{Initial wt. of the spoon}} \times 100$$

### III. RESULT



**Fig 2-** Biodegradable Cutlery (spoons) made from Moringa pod husk powder



**Fig 3 -** Percent weight loss as a function of number of days in soil.

According to (Fig 3) percent weight loss of the spoons buried in soil for biodegradation was found to be 100 percent on the 20<sup>th</sup> day.

### IV. DISCUSSION

This study is about biodegradable cutlery developed from Moringa pod husk. Biodegradable cutlery (spoons) was developed by isolating cellulose. The pod husk was given gentle chemical treatment and casted in moulds to produce cutlery (Fig 2). The biodegradability test was done using soil burial method and it was found that cutlery made of pod husk biodegrades in 20 days (Fig 3).

### V. CONCLUSION

Drumstick (*Moringa oleifera*) is a rich source of wide range of nutrients such as protein, calcium, vitamins, carotenoids, flavonoids, alkaloids, tannins, phenolic acids, fatty acids[2]. Apart from this the Drumstick pod husk contains a significantly high amount of fiber, cellulose, hemicelluloses. But the pod husk is not consumed and serves as waste material. This aspect of pod husk was extrapolated in this study to develop biodegradable cutlery which degrades in a short time period (20 days). Since, the developed cutlery biodegrades in such a short time period it can serve as a promising alternative for the conventional plastic cutlery which is hazardous to the environment.

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