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A Study of Edible Cutleries by Using Sorghum Flour

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Abstract: Plastic cutlery may be a convenient alternative, catastrophic to the environment, and detrimental to health. The presence of toxins and carcinogens that can quickly be ingested into the body is a petroleum by-product. As toxins and carcinogens can leech into food through the natural ecosystem, the processing of plastic cutlery has become harmful for the environment as plastics consume plenty of space and clog the landfills annually. The notion of biodegradable cutlery has been seeded by the recent ban on plastics and by the threat to the environment. While India has only seen 1 big edible cutlery entrepreneur, many other suppliers will emerge with time and demand. This research helps us to understand that consumers are aware of the harmful effects of plastic disposable cutlery use. The researcher, therefore, wishes to come up with edible cutleries that do not affect the ecosystem. The goal of this study is to raise awareness of the environmental effects of the use of plastic cutlery. Therefore, to create the edible cutleries, the investigator tests the mixture of sorghum flour, wheat flour and rice. Since it is made from natural sources, it is known as entirely degradable. The investigator prepared three samples in this study to produce the edible cutleries to observe which samples will produce better edible cutleries. By using steel cutlery, the product is formed. The samples are then tested for water absorption and soil burial examination. For commercialized purposes, to get the same shape, edible cutlery should be properly moulded and some flavor can be applied to it depending on customer demand.

Keywords: Edible Cutleries, Plastic Cutleries, Biodegradable Cutleries, Sorghum Flour, Water Absorption, Soil Burial Test

1. Introduction

Cutlery has been one of the most basic, but very effective, food consumption devices produced and used worldwide. It is claimed that spoons are one of the oldest eating facilities that human beings have used and are made of natural elements such as wood, animal bones, seashells. The first recorded evidence of spoons was in England far back in the year 1259.

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At that time, spoons were not merely used for eating, but often used to represent wealth and influence in ceremonies. By the turn of the 18th century, forks and knives for consuming food were also added. Silver was the most common metal for cutlery since, before the advent of stainless steel, it was non-reactive to most foods. For most of the cutlery, stainless steel was the chosen metal, as it was simple to maintain, non-reactive and durable. It significantly lowered the prices of cutlery with the introduction of plastics into the market and made its availability very simple at the same time. For people to choose from, a lot of variations and sizes were added, such as cups, bowls, spoons, forks, knives, etc. The price of stainless-steel cutlery today is much higher than plastic or edible cutlery.

The use of these plastics and the issue of disposing of them is a major problem that is currently being seen in our world. So, I'm going to come up with maximum natural edible, and to do so, it's fully biodegradable and does not require any special conditions. Moreover, at the end of the meal, it can be eaten. If it is hot or cold, strong or liquid, it can be used to eat all kinds of food; you can have a hot soup with it at the same time as cold desserts. This could theoretically lead to plastic cutlery being substituted, but not traditional metal cutlery.

The idea of edible cutleries was first introduced in India as an advertisement product in 2010 by an organization called Bakey's [1]. The merchandise has been further produced and the company is now able to supply 50,000 units a day as of 2016 and has earned worldwide orders of 25 million units. Although bamboo-based, sugar-based and corn-based spoons are reported in numerous reports, this study will only specialize in cutleries based on sorghum. Sorghum is an ancient African crop that utilizes little water and its super absorbent properties for cultivation [2]. According to Mr. Narayana Peesapaty, a former ICRISAT researcher, sorghum needs 60 times less water than rice [3]. Sorghum-based edible cutleries are also a potential competitor to the single plastic cutlery that plagues the ecosystem of the planet. Single-use plastic cutlery contributes 4.24 percent of the marine litter on European beaches in line with the figures provided by the ecu Commission in 2016 [4].

Sorghum is the key ingredient being hired. Compared to rice, it takes 60 times less water to develop sorghum [5]. In 95.00 % of the world's arable land [6], the crop has the power to rise.

Sorghum has a super absorbent capacity that makes it extremely flexible to use edible cutleries, i.e. it would not only be suitable for rice or wheat-based cuisine that is popular in Bangladesh, but it will complement frozen dessert, yogurt, and soup type well, because it does not degrade in hot or cold liquids.

1.1 Problem Statement

Cutlery is a collective term used to describe the instruments used for food or drink preparation and handling. They form part of the 'utensil' general phrase. Cutleries are typically made of plastic, steel or aluminium. But the issue is how quickly plastic cutlery can be disposed of, which has contributed to tremendous environmental waste from plastic cutlery.

A type of plastic known as polystyrene is made from most plastic cutlery. More generally, polystyrene or extended polystyrene is known as Styrofoam. Recycling is really hard to do. Many communities actually do not provide recycling of Styrofoam and so plastic cutlery placed in a recycling bin is typically either sorted out at the recycling plant and sent to a landfill or thrown away without recycling or other uses being considered.

This has caused this disposable cutlery to be deposited in waters such as lakes, rivers and seas, contaminating the waterways. And to make matters worse, these are the same sources used to provide domestic water, industrial water, and drinking water.

The aim of my research is to come up with edible cutlery that can be eaten after your meal. They are able to degrade in any outside environment if they are not ingested, since they do not have strict

degradation criteria. They can decay within 10 days or be ingested by other animals in a normal setting where the spoons are exposed to nature, similar to a biscuit that can be thrown outdoors.

1.2 Project Objective

The specific objectives of this project include:

- To research the exact quantity of the product used to make edible cutlery.
- Identification of the expense of making edible cutlery
- To compare the ability of edible cutlery and plastic cutlery to resist water absorption test and soil burial test.

1.3 Project Scope

Most of the cafe in the hometown of the researcher have plastic cutlery for their client to take away their meals. Then all the plastic cutlery is thrown away in the garbage bin. This adds to the rising amount of waste. The worst thing is that plastic cutlery is non-degradable wastes, and many people are aware of it, but no one cares about stopping using it either. People are now too busy to reduce their burden but have not realized that it can affect the condition of the environment. The explanation for this study is that the researcher wants to minimize the use of plastic cutlery by proposing edible cutlery that is more environmentally friendly and wants to raise awareness among people around them as well.

2. Methodology

In this report, the primary concern is to eliminate plastic cutlery by replacing it with edible cutlery that can be consumed after use and easily deteriorated as well. It will be made from natural ingredients in order to manufacture edible cutlery, where the commodity is developed as the core element of wheat, rice and sorghum. On account of its natural characteristics, the ingredient is picked. Other than that, the ingredients can easily be obtained in this country as well.

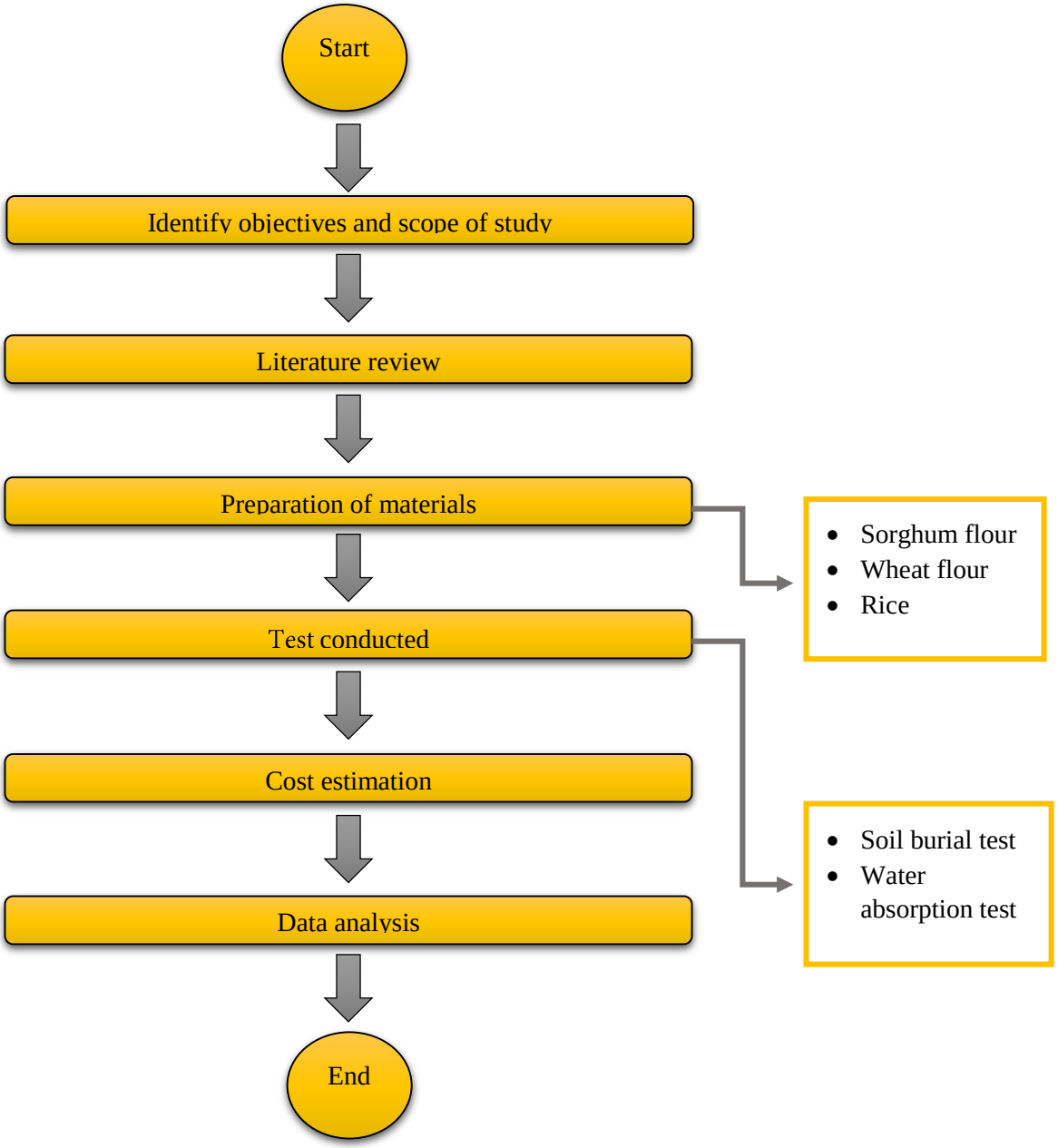

Figure 1: Methodology Chart

2.1 Materials

Wheat, rice and sorghum (jowar) were bought from any supermarket at the researcher's hometown

- Wheat flour
- Sorghum flour
- Rice

2.2 Methods

Sorghum contains a super absorbent capacity that makes it extremely flexible to use edible cutleries, that is, it would not only be ideal for rice or wheat-based cuisine, but it will complement frozen dessert, yogurt, and soup form well, since it does not degrade in hot or cold liquids. The process of baking an edible cutlery and reworking it is shown below.

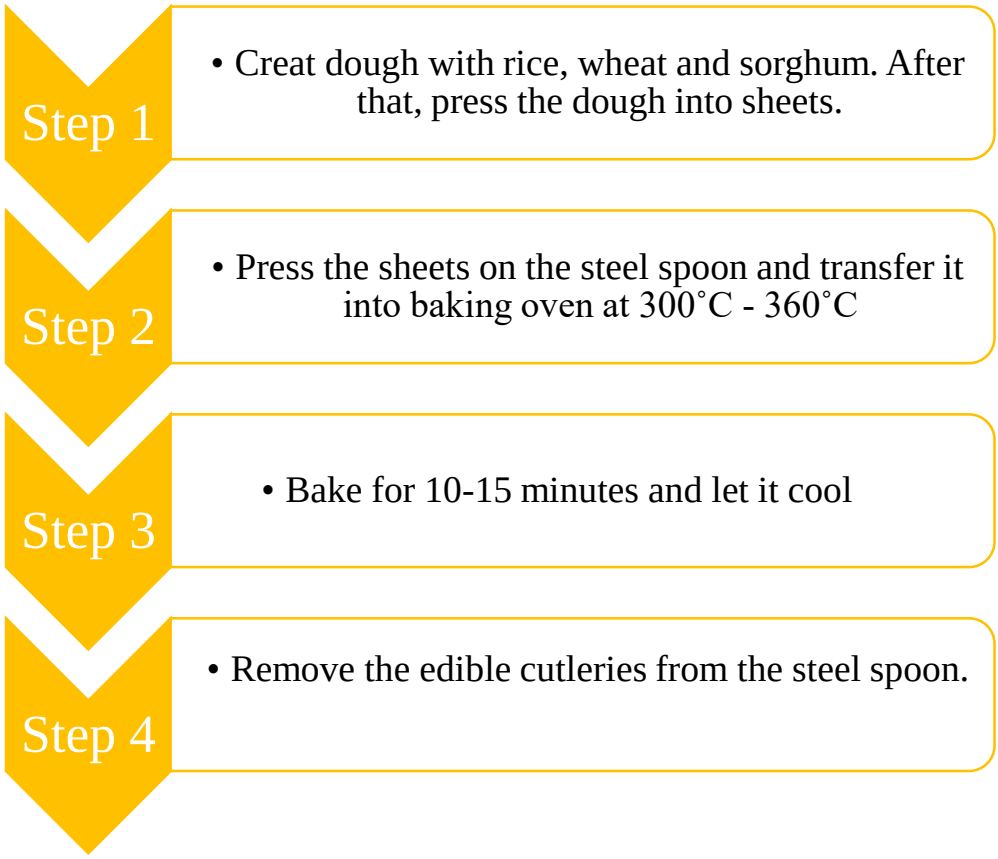

Figure 2: Baking process of Edible Cutleries

To determine which quantity would provide the best result for edible cutleries, the researcher decided to make it into three distinct quantities of mixture between the ingredients sorghum flour, wheat flour and rice. Each of the specimens is able to produce 20-30 pieces of edible cutlery. The sum of difference between the ingredients shown in the table below.

Table 1: Samples of edible cutleries

Ingredients	Sample				
	1	2	3	4	5
Sorghum flour (g)	100	150	100	100	50
Wheat flour (g)	150	100	100	200	100
Rice (g)	100	100	150	50	200
Water (cups)	1	1	1	1	1
Observations	Sturdy and water resistance	Sturdy and water resistance	Sturdy and water resistance	Dry looking but fragile	Dry looking but too hard

Based on Table 1, the researcher continues with the analysis using samples 1, 2 and 3, as these three were found to be stable and water resistant relative to the other ratios. In order to obtain the most effective method of manufacturing edible cutlery, these three ratios are then compared.

3. Results and Discussion

The researcher tested the edible cutleries produced by using two tests which are soil burial test and water absorption test.

3.1 Water Absorption Test

Three samples of edible cutlery were tested for water absorption and three of the samples were made from various ratios of sorghum flour, wheat flour and rice. Within 60 minutes, Table 2 shows the weight of edible cutlery and Table 3 shows the average percentage of water absorption.

Table 2: Water absorption of edible cutleries

Time (min)	Weight (g)									
	Sample 1			Sample 2			Sample 3			Plastic
	1	2	3	1	2	3	1	2	3	
0	19.49	18.02	23.28	23.26	17.89	18.42	19.29	23.30	16.60	9.81
10	21.45	22.15	23.90	23.91	18.19	18.78	19.73	24.03	17.04	9.81
20	21.98	22.75	24.52	24.23	18.40	19.23	20.08	24.60	17.37	9.81
30	22.30	23.19	24.99	24.87	19.12	19.56	20.38	24.97	17.84	9.81
40	22.86	23.67	25.24	25.11	19.46	19.71	20.87	25.31	18.08	9.81
50	23.21	24.08	25.88	25.68	19.89	20.05	21.24	25.67	18.41	9.81
60	23.98	24.57	26.13	25.98	20.02	20.34	21.66	25.91	18.91	9.81

Table 3: Average Percentage of water absoption

Time (min)	Average Water Absorption (%)			
	Sample 1	Sample 2	Sample 3	Plastic
0	0	0	0	0
10	11.10	2.18	2.72	0
20	13.94	3.83	4.83	0
30	15.96	6.63	6.76	0
40	18.08	7.89	8.57	0
50	20.10	10.14	10.36	0
60	22.87	11.35	12.32	0

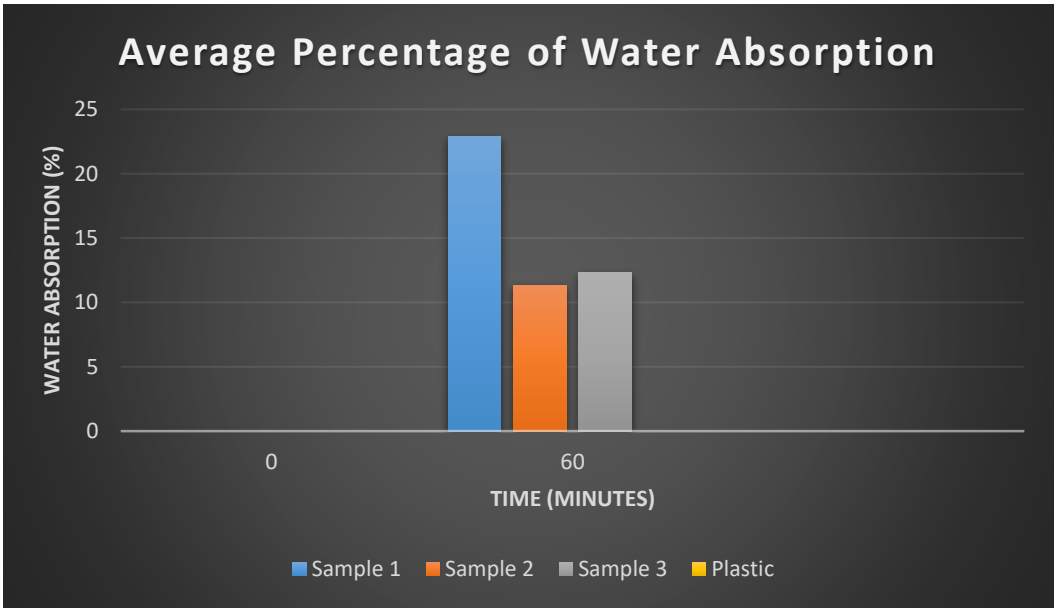

Figure 3: Graph of Average Percentage of Water Absorption

It can be analyzed from the graph obtained in Figure 3 that Sample 1 had a higher percentage of water absorption than Sample 2 and Sample 3. Sample 1 consisted of 150 g of wheat flour and 100 g of rice and sorghum flour, respectively. The higher volume of wheat flour is possibly the cause of more water being consumed by the sample. Sample 2 and Sample 3, however, have about the same water absorption percentage. Sample 2 had a high sorghum flour content, while Sample 3 had a high rice content. In Sample 2, the lower percentage of water absorption was seen, with the final reading of the percentage being just 11.35 % relative to Samples 1 and 3. With 22.87 percent, Sample 1 had the higher percentage of water absorption and Sample 3 was 12.32 percent. This showed that there was a lack of moisture or fat in the sorghum flour and it made for a long shelf life without the need for extra preservatives and without easy deterioration in the liquid.

3.2 Soil Burial Test

The test conducted for the edible cutleries made from sorghum flour, wheat flour and rice to get the biodegradability rate. The result obtained as in Table 4 after 24 hours.

Table 4: Biodegradable rate of edible cutleries

Sample		Initial weight (g)	After 24 hours (g)	Average Biodegradability rate (%)
Sample 1	1	23.26	31.48	33.89
	2	18.19	24.21	
	3	19.49	25.89	
Sample 2	1	15.31	20.19	26.15

	2	20.13	24.52	
	3	18.32	23.11	
Sample 3	1	18.42	23.33	25.37
	2	13.45	16.05	
	3	19.13	24.56	
Plastic		9.81	9.81	0

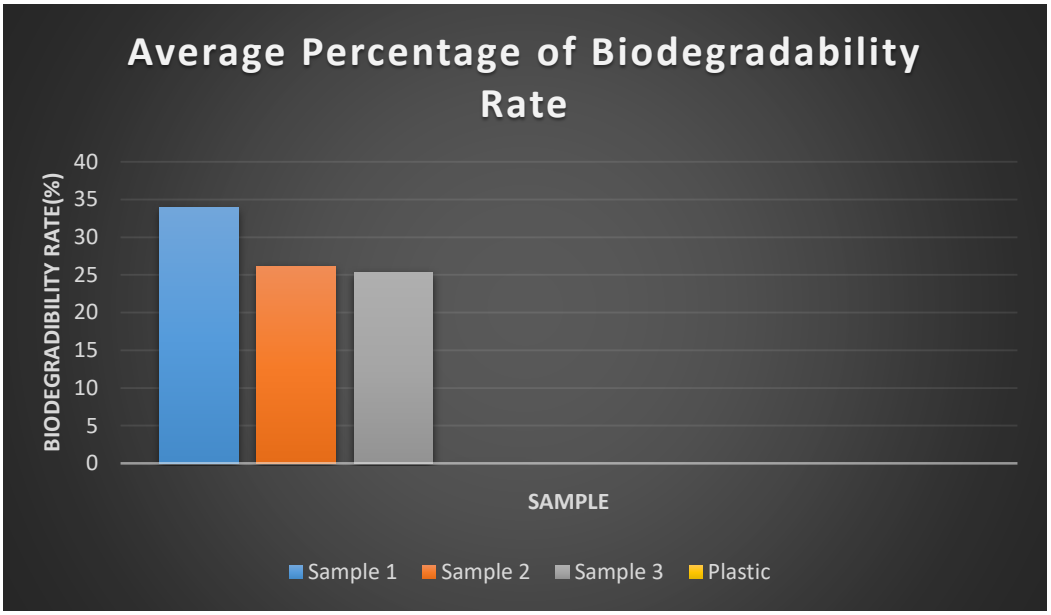

Figure 4: Graph of Average Biodegradability Rate

The edible cutlery from these three samples did not display a vastly different biodegradability rate from the graph obtained in Figure 4. Perhaps the explanation for this was that all three samples used natural ingredients without preservatives or additives. So, this makes it easier to mix the edible cutlery with water. The rate of biodegradability is therefore also influenced by heavy rain. Here in the researcher's hometown, from early November until December, we had rainy days. The soil, as well as the edible cutlery, can absorb water from the rain. The more soil moisture, the quicker the deterioration takes place. The weight of the edible cutlery has increased due to the absorption of moisture during the soil burial examination. Nevertheless, before weighing them, the researcher chooses to let the edible cutleries dry in order to ensure that the moisture has not affected the weight of the edible cutleries.

3.3 Strength Test

Both of the samples were checked in hot water to assess the capacity of the edible cutlery to consume hot soup. Just by submerging the edible cutleries into a cup of hot water and waiting for how long it takes to become soggy and brittle was this test performed manually. It is known from the observation that these three samples can withstand more than 30 minutes of hot water. Sample 2,

however, tends to have greater strength as it is capable of resisting hot water for more than 1 hour in total. This is perhaps due to the higher sorghum flour content in the sample relative to the other two samples.

4. Conclusion

There are several suggestions in this report that the investigator would like to propose. Because of the lack of facilities at home, the development and testing of edible cutlery is carried out manually. For the production of edible cutlery of the same scale, molding machines should be used. In this study, the researcher used manual method where the researcher made the edible cutleries by placing the dough on the steel spoon and bake it with temperature 300 ˚C – 360 ˚C. The manual approach is less preferable since it was unable to deliver exactly as the shape was intended. Other than that, the composition of the material used can also be altered to make it stronger and look better. In order to decide the best composition for edible cutlery, the composition can be varied by trials and errors process. It is also possible to incorporate edible cutlery with several flavors depending on the interest of the consumer, such as sugar and cinnamon.

Acknowledgement

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