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Development of Edible Spoons: An Alternative for Single-use Plastic

[1]Priyanka Kumbhar, [2]Manasi Satpute

[1] Master's in Nutrition and Food Processing, [2] Master's in Nutrition and Food Processing

[1] PG Department of Food Science and Nutrition,

[1] S.N.D.T College of Home Science, Pune, India

Abstract: Plastic has become a very essential part of our life for a long time. Even though their use is beneficial, it has many disadvantages personally and globally. The use of single-use plastic is increasing day by day due to its low cost and availability. There may not be a huge impact of the disadvantage on a personal level but globally it has shown detrimental effects. The study aimed to find a better alternative for these single-use plastics which are biodegradable, edible, and sustainable. Three types of edible spoons were developed with the combination of Wheat flour, Ragi flour, and Rice flour as main ingredients i.e. Plain spoons, Savoury spoons, and Sweet spoons. Spoons were baked at 180°C for 25 minutes in an oven. In total 2 trials for plain spoons and 3 trials for savoury and sweet spoons were taken with variations. The spoons were tasted by 12 untrained sensory panel members. According to sensory results, the second trial of plain spoons and the third trial of savoury and sweet spoons was more acceptable. The spoons were tested for sogginess which was dipped in tomato soup and it took approx. 1 and ½ hours for a soggy surface. The developed edible spoons can be a better and more sustainable choice as it is biodegradable and can alternate the use of single-use plastic.

IndexTerms **- Single-use plastic, edible spoons, alternative, biodegradable, edible, sustainable.**

I. INTRODUCTION

Plastic is a polymer which contains elements like Carbon, Nitrogen, Hydrogen, Chlorine and Sulfur. While plastic has many valuable uses, we have become addicted to single-use or disposable plastic with severe environmental consequences. **[3]** Around world 1 Million plastic bottles are used and 5 Trillion single-use plastic bags are used worldwide every year. Today, India produces about 300 million tons of plastic every year. **[5]** That's nearly equivalent to the weight of entire human population. More than 99% of plastics are produced, from chemicals derived from oil, natural gas and coal, all of which are dirty and non-renewable resources. Rivers carry these single-use plastic waste from deep inland to the sea which affect the marine life also.

The benefits of plastic in food industries are undeniable. The material is cheap, lightweight and easy to make. These qualities have led to a boom in the production of plastic over the past century. Much of the plastic that produced is designed to be thrown away after being used only once that being Single-use plastic bags, food packaging, bottle, straws, containers, cup and cutlery like spoons, forks etc. As a result, plastic packaging accounts for half of the plastic waste in the world. **[4]**

In 1988, the Society of Plastic Industry introduced the Resin Identification Code (RIC) system which divided plastic resins into 7 different categories to allow consumers and recyclers to identify different plastic types. **[2]** The number are stamped inside the triangle of arrows on bottom. As a general rule, the numbers that are safe for use with food are 1 PET [Polyethylene terephthalate], 2 HDPE [High-Density polyethylene], 4 LDPE [Low-Density polyethylene] and 5 [Polypropylene]. The ideal type of plastic used for use for long-term food storage is high-density polypropylene which is indicated by the "2" symbol.

Currently, about 40 Billion plastic utensils are used just within the USA within a year. About 500 Million plastic straws are thrown away in the U.S alone every day. In India, 80% of total plastic consumption is discarded as waste and official statistic says the country generates 25,940 tons of plastic waste daily. At least 40% of this waste is uncollected. **[5]**

As we are aware of plastic contains complexes, several of which are neurotoxins and carcinogens. Those leach in the food. In fact, even though they are food grade cutlery, the leaching is within permissible levels of 60ppm. When we know substances that leach can cause cancer and impact our nervous system, why used it?

To provide an alternative for disposable cutlery inventor Narayana Peesapaty came up with an idea called "Edible Cutlery" in 2010. The idea struck him when he spotted a few people using khakra to pick up food served on a flight. Later, he was familiarized with Rotis made by sorghum which is heard and tough in texture. He had to soak them in dal foe while till it turned softer to consume. This pushed him to work on an organic spoon made of food as an alternative to plastic spoons. **[1]**

Edible cutlery is cutlery that can be used to consume food and that can be consumed after use is called edible cutlery. And if not consumed it can decompose within days. They make cutlery with dough made from a mixture of sorghum, rice, and wheat flour, kneaded with hot water. These are baked to make them crisp, hard, and moisture-free. They provided different flavors like Plain, Sweet, Savory, and other flavors including Ginger-Cinnamon, Ginger-Garlic, Cumin, Celery, Black pepper, Mint-Ginger, and Carrot-Beetroot. These spoons will soften up, if you leave them in liquid foods hot or cold for more than 10 minutes, in portions dipped only. **[1]**

We got inspired by Narayana Peesapaty to make these Edible Cutlery keeping overuse of single plastics in mind. We make the spoons with Wheat Flour, Ragi Flour, and Rice Flour. We used ragi flour instead of sorghum flour because ragi is rich in calcium, a rich source of fiber, and also gives wood-like color to the spoons. Rice flour gives toughness to the spoons. We developed spoons in 3 flavors Plain, Savory, and Desserts spoons (sweet).

II. RESEARCH METHODOLOGY:

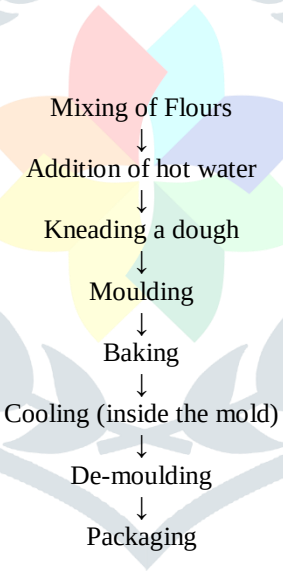
A study titled "Development of Edible Spoons: An Alternative for Single-use Plastic" was undertaken to;

1. To replace single-use plastic cutlery.
2. To provide nutritious option.
3. To provide 100% natural and biodegradable spoons.
4. To provide Eco-friendly product.

2.1 Standard Recipe:

The standard recipe was taken from the "Bakeys" website brand of an edible spoon which was invented by Narayana Peesapaty. **[1]** The spoons were made from Wheat Flour, Sorghum Flour, and Rice Flour.

Standard Recipe Flowchart:



2.2 Plain Spoons:

The plain spoons were made by mixing wheat flour, ragi flour, rice flour, oil, sugar, salt, and water. Powdered sugar was used. The dough was prepared using water and baked. Total two trails were taken for plain spoons (T1&T2). It was observed that in T1 the spoons were soft because a thick layer of dough was pressed into the silicone mould and the baking temperature was also low (150°C for 15 min). So T2 was taken where the thin layer of dough was pressed in the aluminum moulds which was baked at 180°C for 25 min.

Table 1: Ingredients of Plain Spoons

Ingredients	Amounts
Wheat Flour	50
Ragi Flour	15
Rice Flour	15
Oil	1 tsp.
Sugar	1 Tbsp.
Salt	1Tbsp.
Water	As per requirement

2.3 Savory Spoons:

These spoons were made by mixing wheat flour, ragi flour, rice flour, herb mix that were bought from the market, salt, oil, and water. The dough was prepared using water and baked at 180°C for 25 min. Three trials were performed (T1, T2 & T3). In T1 & T2 the spoons were made using different concentrations of herb mix. While in T3 the spoons were served with hot tomato soup to know their acceptability.

Table 2: Trials of Savory Spoons

Ingredients	T1	T2	T3 (with tomato soup)
Wheat Flour	50	50	50
Ragi Flour	15	15	15
Rice Flour	15	15	15
Herb mix	10	15	15
Oil	1 tsp.	1 tsp.	1 tsp.
Salt	As per taste	As per taste	As per taste
Water	As per requirement	As per requirement	As per requirement

2.4 Sweet Spoons:

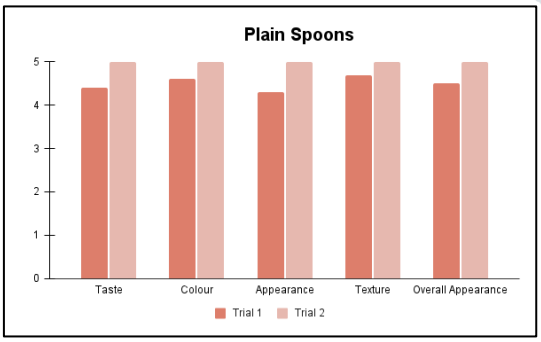
The spoons were made by mixing wheat flour, ragi flour, and rice flour as major ingredients. The dough was prepared using water and baked at 180°C for 25 min. A total of three trials were performed T1, T2, and T3. T1 was made using honey while T2 brown sugar. T3 was made using the mixture of both.

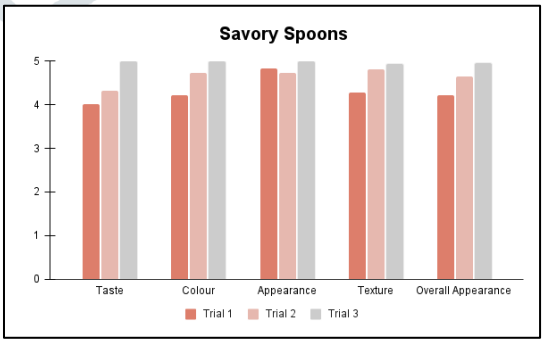
Table 3: Trials of Sweet Spoons

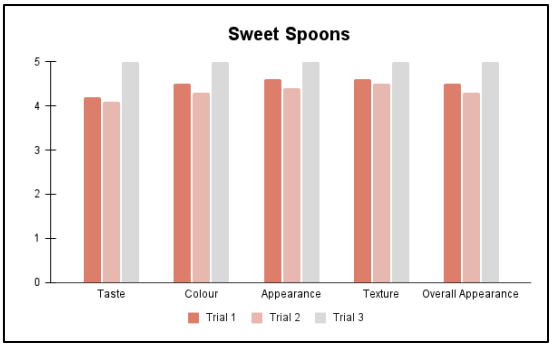
Ingredients	T1 (Honey)	T2 (Brown sugar)	T3 (with both)
Wheat Flour	20	50	50
Ragi Flour	10	15	15
Rice Flour	10	15	15
Honey	10ml	-	-
Brown sugar	-	10	-
Both	-	-	5g + 5ml
Oil	1 tsp.	1 tsp.	1 tsp.
Water	As per requirement	As per requirement	As per requirement

III. Result and Discussion:

The plain, savory and sweet spoons were tasted by 12 untrained sensory panel members using 5 point hedonic scale. 1 being poor while 5 is excellent. The data collected from the sensory testing was converted to graphs as follows:







The following table contains score keys for sensory:

Table 4: 5-Point Hedonic Scale

Scale3	Score
1	Poor
2	Fair
3	Good
4	Very good
5	Excellent

Test for sogginess:

The savory spoons were dipped in the hot tomato soup for sogginess. It was observed that the spoon which was dipped in tomato soup and it took approx. 1 and ½ hours for a soggy surface.

IV. CONCLUSION:

Edible spoon is a new concept in the market which is the best alternative to plastic spoons. In the market, edible spoons are made of wheat flour, rice flour, and jowar flour whereas in our product instead of jowar flour ragi flour was added as we wanted to increase the nutritional value of the product as well as to give a nice look to the product.
Trials were performed to make the product more nutritious and to give a finished look to the spoons. Ragi flour was added to enrich the calcium content of the product as ragi is rich in calcium. The spoons were made with the addition of mixed herbs to give a savory flavor to spoons which can be used to consume mainly spoons but any savory product. Spoons were also made with the addition of brown sugar to give a sweet taste and honey was also added to give good texture as this both gives a sweet taste there for these spoons are used to consume any type of desserts. Trails were performed for plain spoons which had a neutral taste to the product and therefore can be used to consume any type of product.
Various trials for product formulation were performed. Best trials for sweet, savory, and plain flavors were finalized. Texture and color were improved with variations in the amounts of ingredients in the product.
For the packaging of the product G- a flute cardboard box was used.
The product was evaluated on sensory parameters on a 5-point hedonic scale to determine its consumer acceptability. According to the given scores, it can be concluded that the product was highly acceptable to all sensory parameters.
This product can be made available online, wholesale as well in retail shops. As this product is the best alternative to plastic spoons consuming food with these spoons it will prevent further damage to the environment. We believe by consuming these edible spoons there will be a change toward eliminating plastic.

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