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Development and Quality Evaluation Of Edible Cutlery Using Flour Blends

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Abstract- Edible cutlery is an innovative and novel concept which is likely to attract consumers and researcher alike in the near future. It is a natural product with no preservatives, additives, emulsifiers or fats and are just and are just flours kneaded with water. Nowadays plastics are banned to use as it is not a bio-degradable one and dapping plastics in ground will causes severe damage to ground water table and many gases are produced by it. Millets are a group of highly variable small- seeded grasses, widely grown around the world as cereal crops for fodder and human. Among the minor millets, pearl millet and foxtail millet, in cereal wheat, and in tuber, cassava has been selected as the base ingredients to manufacture edible cutlery because of the following reason, there are an excellent source of starch and fibre.

Keywords: Bio-degradable, Edible cutlery, Minor millets, No preservatives, Starch and fibre.

INTRODUCTION

Edible cutlery is an intriguing notion that is expected to captivate both customers and researchers in the near future. Edible cutlery is composed of flours derived from various millets and grains. It is a natural product devoid of preservatives, additives, emulsifiers, or fats, consisting just of flours combined with water. Utilizing edible and eco-friendly silverware would reduce plastic accumulation in the environment, since it is biodegradable and decomposes readily in soil. In contrast, plastic cutlery is produced using chemicals that may be detrimental to both the environment and human health [1]. Edible cutlery may be consumed post-use or allowed to degrade. It does not overshadow the flavor of the dish being ingested. It is produced from grain flour and is economically viable [8]. It is healthy and devoid of preservatives and chemical substances [2]. Millets are a diverse genus of small-seeded grasses used globally as cereal crops for both livestock feed and human consumption. Finger millet, foxtail millet, cereal wheat, and Moringa oleifera have been chosen as the primary materials for the production of edible cutlery because to its exceptional content of starch and fiber. Edible cutlery represents the subsequent advancement in biodegradable edible coatings. It consists of flours and is a natural product devoid of preservatives, additives, emulsifiers, or fats, being just flours combined with water. It may be taken post-usage or allowed to disintegrate, and it does not overpower the flavor of the meal being ingested. Due to its production from food grain flour, it is cost-effective and healthy.

The term "cutlery" was first documented in the 14th century, and by the 17th century, it had become a fundamental component of the eating experience (Tomkin, 2023). The history of cutlery extends to the era of early humans. Primitive people used natural items such as stone, wood, shells, and bones from animals and fish to store and distribute food. Wooden spoons have been used in rituals since the early 1200s in England, serving not only as utensils for consumption but also as symbols of riches and position. With the onset of the 'Industrial Age' in the 18th century, metal cutlery emerged as the norm among the wealthy. Silver was the metal of choice due to its non-reactivity with most meals. Plastic dinnerware and cooking equipment emerged post-World War II, at a period when metal was scarce. In the 1960s, companies started the production of plastic cutlery as a more economical alternative to conventional silverware. These disposable plastic utensils are designed for one-time use, hence obviating the need for cleaning and maintenance, and conserving valuable resources like as water and energy (Datta et al, 2021). Cutlery exists in several varieties, each tailored for distinct functions. The predominant varieties of cutlery consist of knives, forks, and spoons. Knives are used for cutting and slicing, whilst forks are utilized for spearing and securing food. Spoons are used for scooping and serving meals. Plastic cutlery is practical for use, distribution, and storage; yet, its disposal poses significant challenges. The use

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of plastic cutlery is contributing to an increase in solid waste generation, notably plastic trash. Which are discharged into the environment and contaminate the ecosystem. Disposing of solid trash in waterbodies has led to considerable ecological repercussions, especially when plastics enter the food chain via bioaccumulation (Goutam Roy et al, 2021). Plastic items discarded in landfills degrade into microplastics as a result of environmental influences. Landfills may contaminate groundwater, and precipitation can lead to the pollution of other water bodies. Microplastics, defined as particles measuring 5 mm or less, are prevalent in soil, air, rivers, lakes, and oceans, mostly resulting from the surface weathering of plastic waste. Furthermore, anthropogenic materials such as disposables, microbeads, and virgin pellets infiltrate the aquatic environment. The variety of animal species capable of consuming or interacting with microplastics will expand as their size diminishes (Lebreton & Andrady, 2019). While an attractive option, plastic cutlery poses serious risks to environmental integrity and human health. Petroleum derivatives often include toxins and carcinogens that are readily ingested by humans and may induce cancer. The disposal of plastic cutlery has detrimental environmental effects, since plastics occupy significant landfill area and contribute to plastic trash annually, potentially leaching chemicals and carcinogens into food via the natural ecosystem. Kabir et al., 2021. The Times of India reports that India generates 22,000 tons of plastic garbage from plastic cutlery provided with meals via online delivery services. The recent ban on plastics and the associated environmental hazards prompted the concept of biodegradable cutlery. “Biodegradable” denotes the capacity of substances to decompose via the activity of microorganisms, such as bacteria or fungus, either aerobically or anaerobically, while being absorbed into the natural ecosystem. Biodegradable cutlery may be either edible or inedible. Edible cutlery refers to utensils that are consumable and have a certain nutritional value. Materials undergo chemical disintegration during biodegradation by bacteria or other biological agents. A biodegradable material may be metabolized by bacteria and transformed into organic compounds. It is an essential procedure in trash disposal and environmental management. Patil and Sinhal (2018) assert that durability, user-friendliness, biodegradability, alternatives to metal and plastic, novelty, and originality needed the development of biodegradable cutlery. Cutlery designed to replace plastic utensils that is consumable is referred to as edible cutlery. These plant-based utensils are seen as a more healthful substitute for plastic ones. Chopsticks, spoons, forks, knives, and sporks are among the most often used utensils for consuming food worldwide.

LITERATURE REVIEW

The history of cutlery

The use of natural materials such as stone, wood, and shells by early humans for food distribution signifies the start of cutlery history. Metal cutlery became standard among the affluent with the onset of the Industrial Age in the 18th century. Silver was the metal of choice due to its non-reactivity with most meals. The introduction of stainless steel, characterized by its durability, affordability, and ease of manipulation, made metal cutlery more accessible to the general populace. Plastic tableware and cooking utensils emerged post-World War II, at a period of metal scarcity. In the 1960s, companies started the production of plastic cutlery as a more economical alternative to conventional dinnerware. Plastic utensils were designed for single-use and subsequent disposal. Consequently, less cleaning and maintenance were necessary, hence preserving essential resources such as water and energy. The affordability of disposable plastic cutlery has heightened its demand in fast food establishments and related businesses. With the advent of the new century, fast food establishments and convenience meals emerged as the favored supper option for the occupants of the hamster cage. This therefore resulted in the production and subsequent disposal of plastic cutlery and silverware into the environment, so contaminating the ecosystem [8].

Edible Utensils: Origins and Prospects

The concept of edible cutlery was first proposed in India in 2011 by Narayana Peesapati, a former scientist at the International Crops Research Institute for the Semi-Arid Tropics in Hyderabad. The event occurred on a flight from Ahmedabad to Hyderabad. He saw a passenger extracting shrikhand, a delightful Gujarati delicacy, using a khakra. This post-graduate in forestry management contemplated the use of plastic utensils, which he had previously eschewed. Mr. Narayana's experience at a train station a few years before was unsettling for him. In a little restaurant, he ordered Idli-Sambhar, which the waiter served with plastic spoons. He noted that the spoon was greasy and had not been well washed. Subsequent to that event, he felt further motivated to provide a superior and healthier alternative. Narayana demonstrates the heightened risk that plastic, a derivative of petroleum, presents to human health. The existence of several toxins in plastic elevates the probability of chemicals

infiltrating the human body. Plastic utensils provide hazards to both the environment and human health. He attempted to construct a three-dimensional spoon by compressing chapati dough between two spoons. Narayana said that it rapidly got saturated, particularly when he immersed it in water. He started experimentation with various flour mixtures and ultimately developed one that maintained its form even in boiling liquid for over 20 minutes [14].

MATERIALS AND METHOD

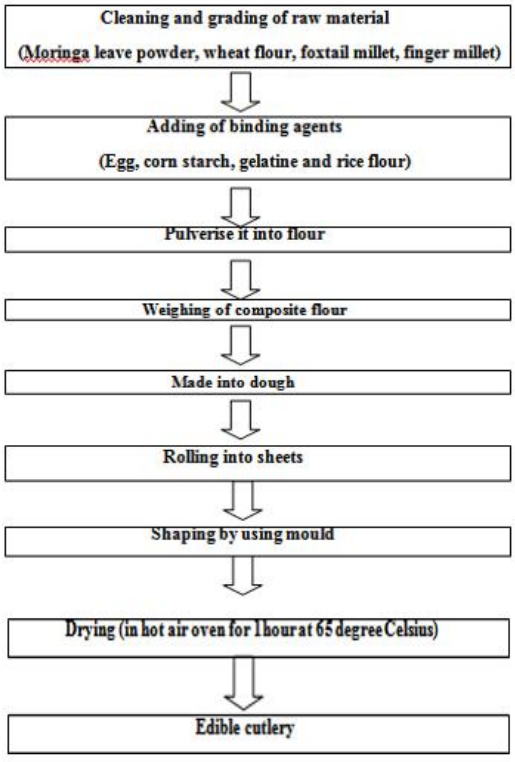
Raw ingredients include foxtail millet, finger millet, wheat, and rice flour, which were sourced from the local market. Stainless steel molds were procured for the production of edible cutlery. The millets were washed to eliminate dust and extraneous debris, then ground into a fine powder using a roller mill. The flour was sifted to achieve a fine consistency and is kept in a stainless steel container for extended shelf life. Moringa oleifera leaf powder is produced by dehydrating the leaves in a cabinet drier. The dehydrated leaves are pulverized using a crusher.

A. Preparation Of Edible Cutlery

The first study was conducted using foxtail millet, finger millet, wheat, and rice, with Moringa oleifera as the principal component. The technique included standardization to determine the appropriate proportions of substances for the creation of edible cutlery. Nine trials were conducted between 60°C and 100°C, with a temperature increment of 5°C for each trial.

The components and their composition ratios were adjusted based on the resultant product from each testing. The drying process was conducted in a hot air oven. Flours of foxtail millet, finger millet, wheat, and rice were measured in suitable proportions to total 30 g, to which Moringa oleifera leaf powder was included. A binding agent was also included [1]. An adequate volume of water (about 13 ml) was incorporated into the composite flour and well combined to get a uniform dough. The dough was formed into a sheet and molded in a stainless steel spoon. The molded dough was placed in a hot air oven for drying. Edible cutlery was extracted from the dryer after full drying and molded into a stainless steel spoon form. The molded dough was placed in a hot air oven for drying. Edible cutlery was removed from the dryer at completion.

B. Production Of Edible Cutlery



Flow chart for the production of edible cutlery

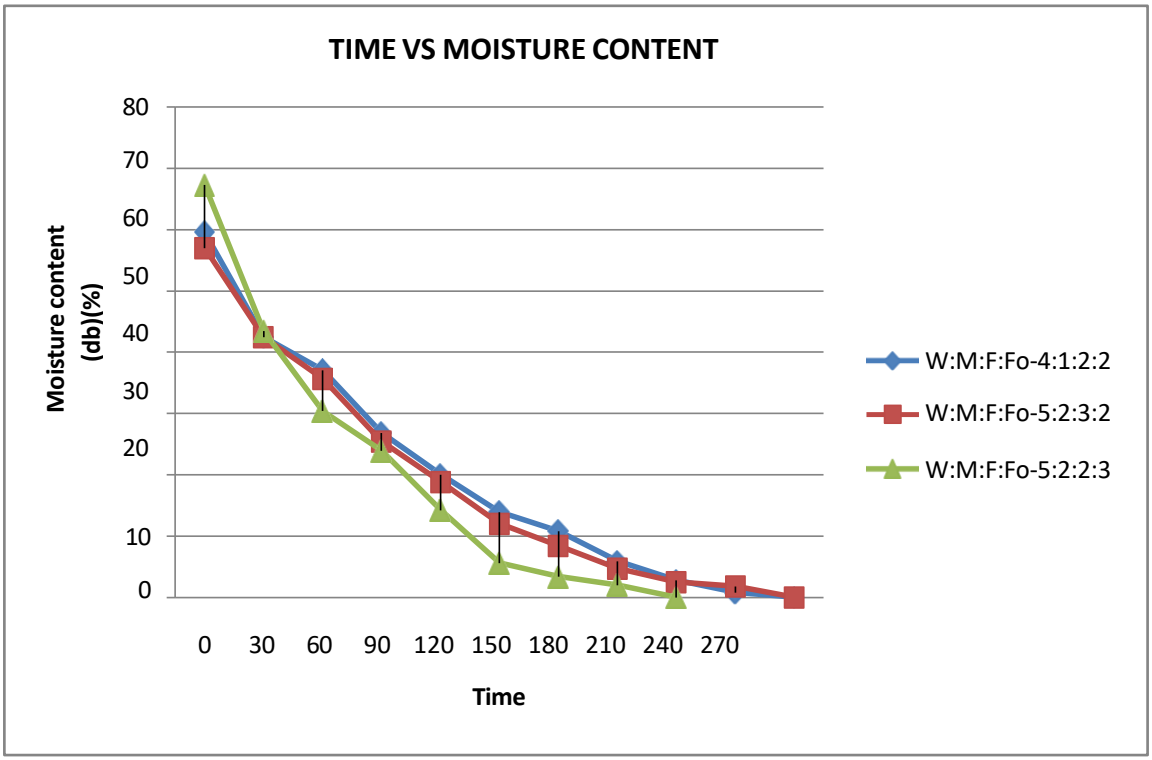
RESULT

The physical and drying qualities were assessed, and a proximate analysis was conducted for edible cutlery. Moisture Content: The moisture content of the sample was assessed by drying it in a hot air oven. The temperature of the hot air oven may be set to 65°C, and samples are maintained for one hour. The moisture content of the sample is assessed by recording weight measurements at 10-minute intervals. The moisture loss was determined to be 95%.

Ash Content: To determine the ash content, the sample is subjected to a muffle furnace at 550°C for three hours, after which the initial and final weights of the sample are recorded. The decrease in weight indicates the ash content of the sample. The ash content was determined to be 0.05%. Drying properties of wheat flour: Moringa leaf powder: finger millet flour: foxtail millet flour in a ratio of 4:1:2:2 at 70°C.

Time	Edible spoon weight(g)	Moisture removed	Moisture Content (wb) (%)	Moisture Content (db) (%)	Drying rate (g/min)	Moisture ratio
0	10.29	0.72	37.31778	59.53488372	0.048	1
30	9.19	0.29	29.81502	42.48062016	0.019333	0.8125
60	8.84	0.1	27.0362	37.05426357	0.006667	0.622396
90	8.81	0.28	21.14914	26.82170543	0.018667	0.450521
120	7.74	0.31	16.66667	20	0.020667	0.335938
150	7.35	0.15	12.2449	13.95348837	0.01	0.234375
180	7.15	0.16	9.79021	10.85271318	0.010667	0.182292
210	6.83	0.06	5.56369	5.891472868	0.004	0.098958
240	6.63	0.03	2.714932	2.790697674	0.002	0.046875
270	6.5	0.03	0.769231	0.775193798	0.002	0.013021
300	6.45	0	0	0	0	0

1. Time vs Moisture content at 70ºC



DISCUSSION

Moisture content and moisture-related microbial proliferation are significant factors leading to food degradation in underdeveloped nations. Dehydration or desiccation of food diminishes the moisture content that facilitates microbial proliferation, hence mitigating this issue [13]. Methods for measuring moisture content in agricultural food items, including high-moisture fruits and vegetables cultivated in underdeveloped nations. Total Ash refers to the inorganic residue that remains after the combustion or full oxidation of organic materials in a meal sample. The determination of ash content in food is a component of proximate analysis for nutritional assessment and serves as a significant quality feature for some food items. Ashing is the first phase in the preparation of a sample for targeted elemental analysis. This laboratory activity employs the dry ashing method with a muffle furnace to ascertain the ash level of various food items. The calculation of moisture content is provided to convey ash content data on both a wet weight basis and a dry weight basis [15]. The drying features of food indicate that drying is one of the most ancient methods of food preservation. Traditional drying processes are currently used on a commercial basis for the desiccation of various food items. Various drying techniques include distinct benefits and limits. Both natural and artificial techniques have been used to preserve precious goods [16].

Physiological attributes, The physical qualities of food ingredients are crucial for the development of novel products. The physical characteristics of foods, including thermal, mechanical, rheological, dielectric, barrier properties, and water activity, are crucial for the effective design of food processing, handling, and storage systems. Proteins are extensively used as food components due to their functional attributes, including emulsification, gelation, thickening, foaming, and the ability to bind fats and flavors [15].

A transparent water solution of carbohydrate was put into a tiny tube using a pipette. A container of water was also provided. An aqueous phenol solution was added, and the mixture was agitated [14]. Concentrated sulfuric acid was swiftly introduced into the tube to ensure effective mixing of the stream. Starch is an exception, since it may be quantitatively assessed by enzymatic breakdown to glucose using particular enzymes (amylases), followed by the quantification of the liberated glucose. Insoluble dietary fiber, soluble dietary fiber, and total dietary fiber are mostly comprised of non-starch polysaccharides. Techniques for quantifying total dietary fiber and its constituents include the elimination of digestible starch via amylases and the extraction of digestible protein by protease, resulting in a non-digestible residue [17].

Proteins play a crucial role in the formation and maintenance of the human organism and, with carbohydrates and lipids, serve as energy-providing components in the diet. Moreover, proteins perform several activities in the body, including enzymatic activity and the movement of nutrients and other biological molecules across cellular membranes. To sustain these vital activities, it is essential to provide the body with high-quality proteins via nutrition. Insufficient consumption of dietary proteins with necessary amino acids causes heightened turnover of muscle proteins, resulting in diminished growth and muscle mass loss. Impaired immunity, together with diminished hormonal and enzymatic activity, may later ensue [17].

The rising global prevalence of obesity, type 2 diabetes, and cardiovascular disease may be attributed to sedentary lifestyles and suboptimal dietary choices. Regulatory bodies in several nations now mandate that corporations include new targets. The intake of saturated fat compared to polyunsaturated oil has been unequivocally shown to elevate cholesterol levels in people. Nonetheless, saturated fats provide the necessary functionality in several dietary items [16]. Complicating the situation, apprehensions over sustainability, vegetarianism, genetically modified organisms, animal welfare, and religious convictions significantly restrict our supplies of saturated fat. unappealing front-of-package labeling for their goods that clearly disclose quantities of salt, sugar, and fat (or saturated fat). Following the elimination of partly hydrogenated fats, saturated fat has This study will examine recent advancements in our comprehension of the nano and mesoscale structure of fats, which underpins their physical functioning, and compare it to that of fat mimetics [18].

CONCLUSION

Edible cutlery, a natural nutritional product without of preservatives, composed of millet flour. A preliminary trial was conducted to standardize the ingredients for the design and production of edible cutlery [14]. Iron insufficiency is the most prevalent nutritional deficit globally, resulting in significant public health ramifications. The pathogenesis is complicated, characterized by a sustained imbalance of food intake, absorption, and bodily requirements, resulting in iron deficiency anemia. If manifested during gestation, it substantially affects pregnancy

outcomes. Low birth weight is a primary characteristic, and such infants face a heightened risk of developing anemia in later life [12]. Incorporating Moringa oleifera into edible cutlery may mitigate anemia in children.

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