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Development, Characterization and Optimization of Nutrient Dense Ready-To-Fry (RTF) Foxtail Millet Fried Product

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ABSTRACT: This study aimed to develop, characterize, and optimize nutrient-dense ready-to-fry (RTF) Foxtail Millet Fried Product. Foxtail millet is a nutritious and gluten-free cereal that has received increasing attention for its health benefits. The pellets were prepared by extrusion technology, and their nutritional composition, physicochemical properties, and sensory attributes were evaluated. The effects of process parameters, including feed moisture content, screw speed, and barrel temperature, on the quality of the pellets were also investigated. The results showed that the foxtail millet pellets had high protein, dietary fiber, and mineral content, making them a promising source of nutrients. The optimized process parameters for producing pellets with desirable properties are found. The sensory evaluation indicated that the foxtail millet pellets were well-accepted by consumers, suggesting their potential as a healthy and convenient snack food. Overall, this study provides valuable insights into the development of nutrient-dense RTF foxtail millet fried products, which could contribute to the diversification and valorization of this cereal in the food industry.

KEYWORDS: Foxtail Millet, Pani Puri Pellets, Ready to Fry, Fried Product, Health.

I. INTRODUCTION

Snack consumption has increased its popularity shown by their widespread presence in supermarkets. Snack foods comprised a very large variety of items including potato chips, popcorn, crackers, nuts and extruded snacks. For many years, nutritionists have been concerned about snack eating behavior of teenagers. They frequently consume between meal snacks thus, their diets were nutritionally unsound. Snacks based on cereals and grains were the most widely consumed snack food items, and many of these were low in nutrient density and high in calories and/or fat content. The demand for ready-to-eat convenient food items is rising due to changing lifestyle. To cater the need, a range of frozen food products is being introduced in the market continually[1].

The major reasons for enhanced use and range of frozen foods are increased desire for convenience in terms of time required for food preparation, decreasing family size, increased levels of disposable income, wider travel abroad and adaptability of consumers towards of different cuisines. Snack foods have emerged as one of the main entries in the food market that can be adapted to consumer needs. However, maintenance of quality of this product is of key importance to the continued development of this sector. Quality and safety of snack food are the aspects affecting the overall consumer acceptability in terms of flavor, texture, aroma, color and appearance besides microbiological safety and nutritional quality[2].

Ready-to-Fry (RTF) snacks have become increasingly popular among consumers in recent years due to their superior texture quality, good sensory characteristics, and easy availability at low cost. Snacks are valuable food products that offer numerous benefits in terms of production, packaging, handling, transportation, storage, and shelf-life. The food industry has a great deal of potential to improve consumer acceptability and nutritional value by making changes to ingredients, methodology, and process parameters[3].

II. REVIEW OF LITERATURE

Abah et al.,(2020) studied that millet is an important nutritious ancient minor cereal food crop. This work reviews the composition, functional properties and food application of millet grains. The review shows that this cereal grains is a good source of carbohydrate and starch, with minute proteins, fat, vitamins and other nutrients. The functional

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properties of the cereal grains (Millet) was also evaluated and the findings gotten from various authors shows that the grains has a good functional properties in terms of their bulk density, oil absorption capacity, water absorption capacity, least gelatinization temperature and host of others. The pasting properties were also researched on and various authors attested to the potentiality of the grains in terms of the pasting properties[4].

Addo-Tham et al.,(2020) studied that food safety and food-handling practices of street food vendors in Ejisu-Juaben Municipality of Ghana. *Advances in Public Health*, 2020, 1-7. Street foods have become a major source of cooked food for most households and individuals in many developing countries including Ghana. However, the rising concern about food-borne illness has questioned the knowledge of the street food vendors to constitute safety practices for food handling. This study assessed the knowledge of street food vendors on food safety and food-handling practices in the Ejisu-Juaben Municipality of Ghana. The study used a cross-sectional mixed approach involving 340 participants selected by simple random sampling[5].

Albuquerque et al.,(2020) analysed that street food is popular in Eastern Europe, but its diversity and nutritional value are unknown. This study aimed to characterise the street food environment in Chişinău, Moldova, including the vending sites and vendors, food availability and nutritional composition of foods and beverages. All street food vending sites (single point of sale) located in a 1-km buffer centred on the main public market were systematically selected. Data on vending sites' characteristics (mobility, type of physical set-up and access to electricity), operating periods and food availability were collected[6].

Amadou, I. (2022) entitled that millets are a major food source in arid and semi-arid parts of the world. Millets are good sources of energy as well as protein, fatty acids, minerals, vitamins, dietary fibre and polyphenols. Nowadays millets are used mainly throughout the world as a functional ingredient into many processed foods. The millets are good source of compounds having bioactivities, such as phenolic acids, glycosylated flavonoids along with good protein composition, antioxidants, and antimicrobial[7].

Sharma, N., & Niranjana, K. et al (2018) defined that Foxtail millet contains a pertinent amount of nutritional components, especially starch, protein, vitamins, and minerals. Due to the coarse nature of foxtail millet grains, the digestible portion constitutes about 79%, and the remaining undigestible part of the grain contains relatively high levels of fiber as well as some anti-nutritional components. Foxtail millet, like most millets, is also a good source of crude fiber, helps in the digestive process and helps to induce bowel movement, thus producing a laxative effect that is beneficial for a healthy digestive system. All these nutritional properties have made foxtail millet an important ingredient for preparing noodles, nourishing gruel or soup, brewing alcoholic beverages, cereal porridges, and pancakes in China. In addition to its nutritional properties, foxtail millet has also shown to possess several health benefits like prevention of cancer, hypoglycemic, and hypolipidemic effects[8].

Twinomuhwezi et al., (2020) analysed that millets are a group of highly varied small-seeded grasses (Poaceae) widely grown around the world as cereal crops for fodder and human food. Millets are important crops in the semiarid tropic of Africa and Asia. The crop is favored because of its productivity and short growing season in dry, high-temperature conditions. The most widely cultivated millet is pearl millet (*Pennisetum glaucum*), which is an important crop in India and parts of Africa. Finger millet (*Eleusine coracana*), proso millet (*Panicum miliaceum*), and foxtail millet (*Setaria italica*) are also important crop species. Millet flour can be used as a porridge; ingredient in seeded bread; it can replace gluten-containing cereals for people who are affected by gluten-related disorder[9].

Teferi, S. C. et al., (2020) deals with street food as food obtained from a street side vendor, often from a makeshift or portable stall and it feeds millions of people daily with a wide variety of foods that are relatively cheap and easily accessible. Street food is intimately connected with take-out, junk food, snacks, and fast foods but it is not protected against insects, dust etc; which may harbor foodborne pathogens. Pathogens present in street vended foods come from different sources and practices, such as, improper food handling, improper waste disposal, contaminated water and improper storage temperature and reheating[10].

III. METHODOLOGY

Preparation of Foxtail Millet and Wheat Flour:

The Foxtail Millet and Wheat were sorted to remove any extraneous matter before the grains were dry-milled into flour using an attrition mill. The resulting flour was then stored in an airtight container in a cool environment until it was needed for further analysis[11].

Ready To Fry Pellet Making Process Flow Chart

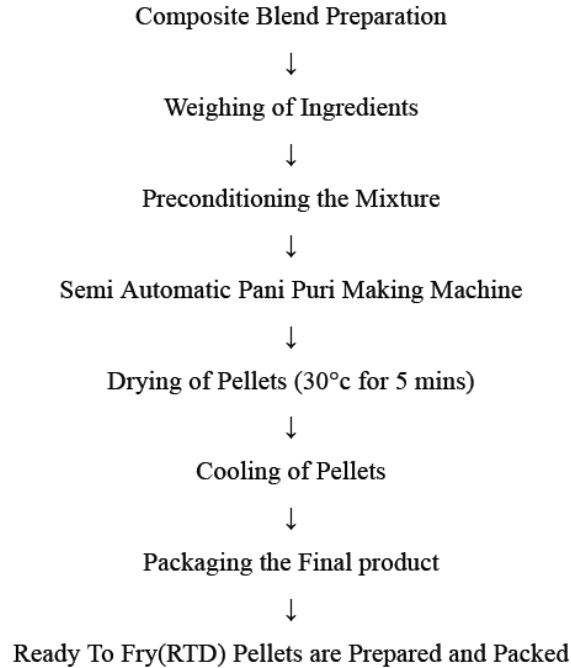


Figure 1. Ready To Fry Pellet Making Process

Procedure

Step 1: Weighing of Ingredients:

Gathered all the necessary ingredients for the composite blend and weighed them according to the recipe.

Step 2: Preparing and Preconditioning the Mixture:

Blended the ingredients together in a electric mixer and formed a homogeneous blend. The dough is mixed until it reaches the desired consistency.

Step 3: Semi-automatic pani puri making machine.

Transferred the dough to the feed hopper of a semi-automatic panipuri making machine and passed through a conveyor belt to achieve a uniform sheeting.

Step 4: Cutting/Moulding the sheet dough:

The sheet of dough is then cut/mould pressed into small round pellets using a rotating die moulder.

Step 5: Drying of Pellets:

The freshly extruded pellets were then transferred to a drying chamber and oven dried at 30°C for 5 minutes to reduce the moisture content. This helps to prolong the shelf life of the pellets and prevent spoilage.

Step 6: Cooling of Pellets:

Once the drying process is complete, the pellets were then cooled at 14°C using a cooling tray in chiller

Step 7: Packing & Storing the Final product - Ready To Fry (RTF) Millet Pellets:

The cooled pellets were then packed into vacuum pouches or containers suitable for storage and transportation. This product can be labelled and marketed as ready-to-fry (RTF) Millet puri pellets, which can be fried in hot oil to produce a crispy and delicious snack[12].

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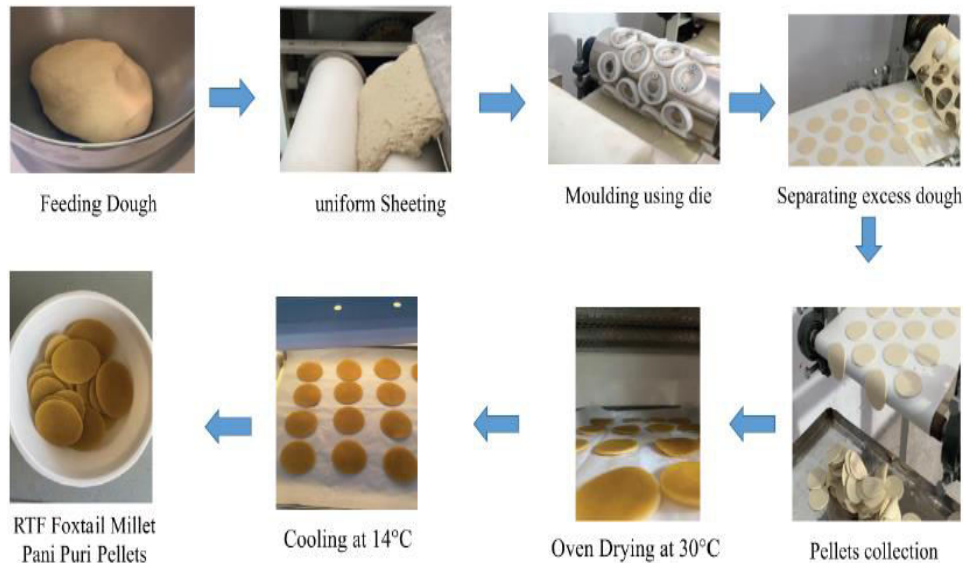


Figure 2 Development of Foxtail Millet Pellets

The air frying process for the foxtail millet pani puri pellets was carried out at a temperature of 185°C. Technically, air frying is a cooking method that uses hot air circulation to cook food instead of oil. In the case of the pellets, the hot air circulated around the food to cook it evenly and give it a crispy texture, without the use of excess oil. During the frying process, the pellets were placed in the air fryer basket and the temperature was set to 185°C. The pellets were then cooked for approximately 10 minutes, until they turned golden brown and crispy. The air fryer uses a fan to circulate hot air around the food, which cooks the food evenly from all sides. This results in a healthier and less oily version of the traditional fried pani puri. The final result was a delicious and crispy foxtail millet pani puri[13].

The Foxtail Millet and Wheat were sorted to remove any extraneous matter before the grains were dry-milled into flour using an attrition mill. The resulting flour was then stored in an airtight container in a cool environment until it was needed for further analysis. The Foxtail Millet-Wheat composite flour was formulated by blending different proportions of Foxtail Millet and Wheat flour with other specified ingredients. Pellet Production process was performed by Aruthra Food Machineries, Coimbatore using a semi-automatic panipuri making machine. The machine was operated at a consistent speed for each combination of parameters.

IV. EXPERIMENTAL RESULTS

The 2:2:1 combination of wheat flour, foxtail millet flour, and semolina is the ideal combination for making wheat pani puri pellets due to several technical reasons. Firstly, wheat flour is rich in gluten, which gives the pellets their characteristic crispness and enhances their texture. Foxtail millet flour, on the other hand, has a low gluten content but is high in antioxidants, minerals, and vitamins, which make the pellets healthier. Semolina, which is coarsely ground durum wheat, has a granular texture that improves the crunchiness of the pellets. Secondly, the ratio provides the right balance of ingredients to achieve the desired sensory characteristics. Wheat flour provides the required gluten, foxtail millet flour adds nutritional value, and semolina enhances the texture.

The combination also imparts a nutty flavor and aroma to the pellets. Samples 10 and Sample 11 in the ratio of 1:1:0 and 2:2:0 has no semolina. Semolina is rich in gluten which provide structure to the product. The pellets made from this combination has very hard texture and no puffiness because of absence of gluten Samples 2 and Sample 12 in the ratio of 0:1:1 and 0:2:2 has made only by Foxtail millet and no wheat flour. The pellets made from this combination has less flavour because of absence of wheat flour Remaining samples has been noticed slightly less crispiness, puffiness and more hardness Finally, the 2:2:1 ratio is ideal because the combination ensures that the pellets are not too hard or too soft, but just the right consistency for consumption. In summary, the 2:2:1 combination of wheat flour, foxtail millet flour, and semolina is the ideal combination for making wheat pani puri pellets due to its nutritional value, flavor, texture, and aro.

V. CONCLUSION

The fried product made of foxtail millet showed to have high nutritional value than the normal fried product made up of maida. Research shows that the combination of the ingredients used for the development effect the Puffing characteristics of the Snack Food. The optimization process was carried out to find the best combination and 2:2:1 had

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leading nutritional value. The sample was also subjected for shelf life testing and it was found to have a shelf life of 21 days without any preservatives. This Snack with foxtail millet substitutes the unhealthy snack food. In future the optimization can be developed by the addition of substitutes to prevent the fat content in the snack. Also a wide variety of millets can be used for tasty and healthy snack food.

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