Sensory Analysis of Cookies Made Using Different Types of Millet

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Abstract*— Millets are a remarkable source of nutrients. They are drought resistant, yielding very good productivity even in water-scarce areas, and are generally considered processing friendly. Identifying the edible potential of millets, numerous manufacturers around the world have been churning out innovative product formulations. The current study was undertaken to develop three distinct varieties of cookies, each made entirely of three different types of millet flour. The cookies were made with pearl millet flour, finger millet flour, and sorghum flour. To evaluate the acceptability of the cookies, sensory data obtained from the consumer panel using a 9-point hedonic test were statistically examined. The cookies' sensory properties, such as appearance, texture, flavor, aftertaste, and overall acceptability, were assessed. The results revealed that pearl millet cookies were more acceptable in terms of appearance, aftertaste, and flavor and were chosen as the best formulation.

I. INTRODUCTION

Millets are ancient cereal grains that belong to the *Poaceae* family, commonly known as the grass family. They have been produced and consumed in Africa and Asia's developing countries for at least 5000 years. When compared to other common cereals, millets are rain-fed, hardy grains with minimal water and fertility requirements. They are divided into two types: naked grains and husked grains. The three popular millets Finger millet (*Ragi*), Sorghum *(Jowar*), and Pearl millet (*Bajra*) are known as "naked grains" because they lack hard, indigestible husks. After harvest, these millets do not require processing; they merely need to be cleaned and used. They are popular even today and widely cultivated in our country. Hence, they are also called Major millets). Other millets with an indigestible seed coat, such as Foxtail Millet (*thinai*), Little Millet (*saamai*), and Kodo Millet (*varagu*), are known as "husked grains." The husk must be removed before the grain is acceptable for human eating.

Millets are highly nutritious, fiber-rich grains that have several health benefits. They are also high in antioxidants and have a low glycaemic index which makes them slow-digesting foods. They do not create a massive surge in blood sugar and hence can help in diabetes prevention and management. Further, millets are gluten-free, which makes them a perfect replacement for wheat-based foods and people with gluten intolerance. They are high in calcium, iron, phosphorus, and other micronutrients.

The last couple of decades has witnessed growing attention from governments and industry alike regarding the role played by millets in the prevention of malnutrition, diabetes, and some other lifestyle-related conditions. The consumption among the Indian public however has continued to remain fairly low due to a lack of knowledge about millets' nutritional benefits. Increasing consumer awareness, encouraging cultivation by farmers and new product development are some means by which their consumption can be increased.

Among the different baked products, Cookies are Ready-To-Eat (RET), convenient, inexpensive, and also have better shelf-life. It is popular with people of all ages and can be found practically anywhere. Refined wheat flour, fat, and sugar are the major ingredients in cookie making. Over the years this staple grain was lost somewhere in the era of urbanization and overdependence on refined and processed foods. We need to start relishing our traditional foods to reap their incredible nutrient profile. This study aimed to make healthy cookies with millet flour instead of refined wheat flour and analyze their sensory quality.

II. IMPLEMENTATION

The present study was carried out to understand the sensory quality of the cookies prepared with millet flour instead of refined wheat flour. The choice of millet used was based on their health benefits and high fiber content. These millets are especially found in retardation of carbohydrate absorption and impaired glucose tolerance as they will help in the management of the certain type of diabetes (e.g., non-insulin-dependent diabetes mellitus). Dietary fiber components also bind bile salts, thereby promoting cholesterol excretion from the body and thus reducing blood cholesterol levels and food toxins in the gut. The millets used are called naked grains because they lack hard, indigestible husk.

- Pearl millet

Pearl Millet (*Bajra/Kambu*) is one of the oldest cultivated crops since prehistoric times and ranks as the sixth most important grain in the world. Its scientific name is *Pennisetum glaucum*. It is a cereal crop grown on a very large scale in India. This millet is a good source of phosphorus, which is necessary for the construction of the body's cells. It contains the same amount of protein as wheat. Prolamine is the most abundant component of the protein, followed by globulins and albumins. Among the amino acids, tryptophan content is high and lysine is too low. Iron, thiamin, riboflavin, and niacin are all abundant in bajra. It is second to barley as far as magnesium and zinc content is concerned. Furthermore, pearl millet is the only grain that contains substantial amounts of chromium. It has the highest folic acid amongst all the cereals, which makes it the food of choice for pregnant women. As pearl millets are high in antioxidants, they provide significant protection against free radical-mediated illnesses such as cancer, arthritis, cardiovascular disease, diabetes, and Alzheimer's disease.

- Finger millet

Finger millet, commonly known as Ragi, is a popular millet produced in many parts of India and Africa. Its scientific name is *Eleusine coracana*. In India, it ranks sixth in production after wheat, rice, maize, sorghum, and bajra. This millet is rich in protein. The major proteins of ragi are prolamins and glutelin and they appear to be adequate in all essential amino acids. Finger millet is a wonderful source of natural calcium, which aids in the building of bones in both growing youngsters and the elderly. It is now known that phytates, polyphenols, and tannins can contribute to millet foods' antioxidant activity, which is a crucial role in health, ageing, and metabolic illnesses. It has been discovered that a finger millet-based diet is beneficial to diabetics since it includes more fiber than rice and wheat. Also, the study found that a diet based on whole finger millet has a lower glycaemic response i.e., lower ability to increase blood sugar levels. This is due to the presence of factors in finger millet flour that lower digestibility and absorption of starch. Ragi flour is recommended as a weaning meal due to its high nutritional value, particularly in southern India. Finger millet is a very good source of natural Iron and its consumption helps in the recovery of Anaemia. The ingestion of finger millet aids in the natural relaxation of the body. It is useful in cases of anxiety, depression, and sleeplessness.

- Sorghum

Sorghum/Jowar/Cholam, prized as a fiber-rich healthy alternative to refined flour or all-purpose flour is cultivated extensively in India. Its scientific name is *Sorghum bicolor,* a common species of jowar. Native to Africa, it is an important cereal crop, used mainly for food, animal fodder, and manufacturing alcoholic beverages and biofuels. Jowar is a drought and heat-resistant plant which grows in an arid region and forms the staple grain for poor and rural people. The wealth of nutrients in jowar makes this cereal one of the most commonly used grains since time immemorial. Jowar is loaded with protein, carbohydrates, and dietary fiber which promotes growth and development. It is an ideal cereal in weight watchers' diets and also regulates diabetes. Loaded with calcium, iron, phosphorus, potassium, and sodium, these minerals fortify the bones, strengthen the immunity and keep diseases at bay. Apart from this, jowar also contains appreciable amounts of vitamins thiamine, niacin, folate, and riboflavin which are known to boost overall health. The presence of potent antioxidants in jowar is greatly valued as it prevents the risk of several types of cancer. Jowar also aids in the smooth functioning of the digestive system owing to its abundance of dietary fiber. It is valued as one of the best foods in the world as it is gluten-free and meets about 48% of the dietary fiber recommendation of a normal adult. Furthermore,

the regular addition of jowar can help to avert bloating, constipation, flatulence, indigestion, cramping, diarrhea, and gastrointestinal woes.

In the current study, sugar was replaced with jaggery powder as Jaggery contains more nutrients than refined sugar. Jaggery is used to make several Indian desserts and is known as a healthy replacement for sugar, primarily because it is unprocessed.

III. METHODOLOGY

For this study, three types of cookies were developed using three different types of millets. The millets were cleaned and milled into a fine flour in milling machinery. Type A of cookies was produced from 100% pearl millet flour, type B of cookies produced from 100% finger millet flour, and type C of cookies was produced from 100% sorghum flour. The other ingredients were similar for all three cookies such as ghee, jaggery powder, vanilla essence, baking soda, salt, cornflour, and milk. The steps and the composition of ingredients are similar for all three types of cookies. Only the baking time was varied according to the type of millet flour used.

Table 4 Ingredients for cookies

Ingredients	Measurement
Flour (all three types)	1 cup
Ghee	½ cup
Jaggery powder	½ cup
Vanilla essence	1 tsp
Baking soda	½ tsp
Salt	¼ tsp
Cornflour	1 tbsp
Milk	2 tbsp

- Procedure

Take a bowl, and mix the ghee and jaggery powder until it becomes fluffy. Then add the vanilla essence and combine it with the ghee and jaggery mixture. This is the primary step for all three types of cookies.

- Pearl millet cookies - type A

For pearl millet cookies, pearl millet flour is sifted in along with all the other dry ingredients such as baking soda, salt, and cornflour into the ghee and jaggery mixture made. Then add the binding agent milk to combine it all in the form of dough. Place the dough in the refrigerator for about 15 minutes and scoop out the dough in a baking tray and flatten it. Put the tray in the pre-heated oven at 180^{o}C for about 25 – 30 minutes.

- Finger millet cookies – type B

For this cookie's finger, millet flour is used in the place of pearl millet flour and the remaining steps are the same. These cookies are baked in a preheated oven for about 20 – 25 minutes.

- Sorghum cookies – type C

This cookie was made with sorghum flour instead of pearl/finger millet flour and the same procedure as above was followed. The baking time was about 15-20 minutes in a preheated oven at 180^{o}C.

IV. SENSORY EVALUATION

The cookies prepared using the different combinations of millet flour were subjected to sensory evaluation for various quality attributes such as appearance, texture, flavor (taste and aroma), aftertaste, and overall acceptability. A total of 34 consumer panelists carried out the evaluation. A 9-point Hedonic scale was employed in which 1 represented the least score (dislike extremely) and 9 the highest score (like extremely).

Table 5 Mean value of the sensory score

Types of cookies	Appearance	Texture	Flavor	Aftertaste	Overall acceptability
Type A	8.17	7.88	8.17	8.23	8.11
Type B	7.94	7.61	7.91	7.85	7.82
Type C	8.08	7.82	7.94	8.08	7.98

V. RESULT AND DISCUSSION

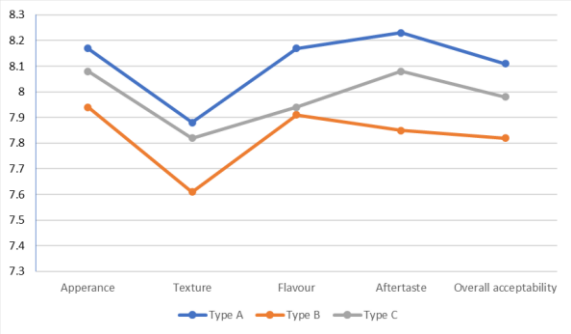

Fig.8 Sensory characteristics scores for all types of cookies

The mean scores varied from 7.61 to 8.23 (Table 5). In terms of appearance, Type A (Pearl millet) cookies were preferred the most with 8.17 out of 9 followed by Type C (Sorghum) cookies with 8.08 and Type B (Finger millet) cookies with 7.94. Type B (Finger millet) cookies had a hard texture (7.61), whereas Type A (Pearl millet) cookies had a good texture (7.88), and Type C (Sorghum) cookies had a second-best texture (7.82). In terms of flavor, Type A (Pearl millet) cookies received the highest rating of 8.17, Type B (Finger millet) cookies received the lowest rating of 7.91, and Type C (Sorghum) cookies received the second-highest rating of 7.94. Type A (Pearl millet) cookies had the best aftertaste (8.23), followed by Type C (Sorghum) cookies (8.08), and Type B (Finger millet) cookies (7.85). When comparing Type B (Finger millet) cookies to the other two, it was observed that Type B (Finger millet) cookies were the least desired and enjoyed with 7.82, whilst Type A (Pearl millet) cookies were the most preferred and loved with 8.11, followed by Type C (Sorghum) cookies with 7.98. The texture and general acceptance factors received the lowest scores, while the appearance parameters received the best. Furthermore, there was no appreciable change in sensory qualities such as texture, overall acceptability, or appearance across three different varieties of cookies made with different millet flour variations. Interestingly, the sensory ratings of type A cookies were higher in all parameters when compared to the other two types of cookies, and it was judged to be extremely acceptable (Fig.5). Likewise, type B cookies were found to be the least acceptable compared to type C cookies. In conclusion, type B cookies received the lowest grades in all of the sensory characteristics. Therefore, according to these findings, it is stated that the incorporation of pearl millet flour and sorghum flour cookies is desirable and has better acceptability compared with finger millet flour cookies, which resulted in moderate overall acceptability.

CONCLUSION

From our study, it is clear that pearl millets cookies were highly acceptable than the other two cookies. This study further illustrated that the quality of cookies, in terms of texture and flavor, could be improved with finger millet flour. The use of millet flour in cookie making and other products used would greatly enhance the nutritional profile.

Pearl millets are recommended because they are gluten-free, enriched with vital nutrients, and the best plant-based protein source. Finger millets, on the other hand, are considered to be one of the most nutritious cereals because they are high in protein and minerals, particularly calcium, and they are a strong source of iron. According to experts, jowar is high in protein, carbohydrates, dietary fiber, calcium, iron, phosphorus, potassium, and sodium. All of these millets help to promote development and growth. It has been reported to decrease cholesterol, improve gastrointestinal health, and prevent cancer due to its high fiber content. It also aids in the reduction of blood pressure and the risk of diabetes. It is believed that substituting hundred percent millet flour for refined wheat flour in the preparation of cookies is a healthy option for improving its nutritional quality and characteristics. It may be concluded that the millet-based cookies are moderately acceptable in terms of all the sensory metrics and are commercially viable. Thus, they can be employed in the formulation and development of a variety of nutritionally enriched value-added healthier products to combat malnutrition.

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