JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Integrating Traditional *Atta Laddoo* with Millets to Encourage Sustainable Global Wellness

Ms. Saloni Singh [1] and **Dr. Prabhjot Kaur** [2]
[1 & 2] Assistant Professor Home Science
Guru Nanak Girls College, Yamunanagar

Abstract

Nutritionally, millets are comparably better than several of the key cereal grains. They are rich in physiologically-active substances and offer a wide range of health benefits like high antioxidant level, high fiber, low glycemic index as well as are gluten-free. Millets are an excellent source of energy, protein and minerals. *Laddoo* is a ball-shaped sweet that is popular in India. It is often served at religious or festive events. The objectives of the study were to execute innovations in traditional recipes in order to achieve sustainable global wellness and to create novel, affordable products with higher amount of macronutrients and micronutrients.

Laddoos are traditionally made with *atta*. An experimental attempt was made to create a millet-based value added *laddoo* wherein *atta laddoo* was taken as control recipe and T1 *ragi* ladoo and T2 *bajra* ladoo. Standardisation of the recipes was done before preparation in sanitised laboratory settings. The panelists' organoleptic evaluation was complemented by proximate analysis performed in laboratory settings. The sensory evaluation found the experimental versions of ladoos quite acceptable. As compared to the nutritive value assessment of control *atta laddoo* recipe, *ragi laddoos* have shown higher levels of protein, calcium and fiber. The findings also displayed that each serving of *bajra laddoo* had 9.28 g of protein, 71.4 µg of β-carotene and 5 mg of iron as opposed to the control recipe's 7.68 g, 46.3µg and 3.99 mg, respectively.

By including millet into traditional recipes, such as old favourites, people can embrace the traditional flavours while adopting healthier dietary practise. It is advantageous for people who want to choose foods that are less harmful to the environment and for people who are concerned about their health. In our diets, millets are going to be a major ingredient as long as we prioritise global wellness and environmental sustainability.

Keywords: millets, *laddoo*, innovations, protein, calcium, fibre

Introduction

Millet is a member of the Poaceae family and has been used for human consumption and fodder for approximately 10,000 years. It grows well in dry, hot climates and produces small, seeded grasses. The three nations with the highest yields are China, India and Niger, whereas Asia and Africa are the main growers, as reported by the Food and Agriculture Organization of the United Nations (FAO).There are several types of millet that are cultivated, such as foxtail millet, proso millet, finger millet and pearl millet. Many macronutrients, minerals (iron, zinc, phosphorus, calcium, potassium) and vitamins are found in higher concentrations in millet than in rice and wheat.

Due to lack of awareness, millets are often disregarded as a primary food source despite their high nutritional value. Yet, due to mounting evidence that millets improve human fitness, their significance in the field of

biomedical research has grown significantly. However, millets are very nutritious, slightly rounded grains that are mostly composed of fat (1.5–5%), protein (7–11%) and crude fiber (2–7%). Millets also include significant levels of zinc, magnesium, iron, calcium and vitamin B and are gluten-free.

In response to India's proposal, the United Nations has formally declared 2023 to be the "International Year of Millets." In India, 2018 was previously observed as the "National Year of Millets." The statements aim to promote millets' high-quality, environmentally sustainable production and raise community awareness of their significance for food security and sustainable global wellness.

Over one-third of the global population consumes millet. In certain areas where millets are cultivated and underutilized, traditional users use them as a food source. A procedure is used in the processing to formulate products that are fortified and have value added.The availability of various prepared products such as those that are ready to use, cook, and eat will encourage non-millet consumers to consume more millets. This experimental effort has been conducted to concentrate on the salient features of millet and health advantages.

Millets: Traditional Food

For babies and young children in the African continent, millet is a staple food that is steam-cooked into thick and thin porridge (Obliana, 2003). A well-known traditional dish from south India is upma. Although wheat semolina is used to make upma, pearl millet semolina is also utilized. It has significant nutritional and sensory value (Balasubhramaniam et al., 2012). Instead of using whole milk powder, sugar and flavorings, malt flour and skim milk powder are used to make the mentioned above malt-formulated drinks. It is extremely nutrient-rich and used to make energy drinks for people of all ages (Verma and Patel, 2003). When compared to wheat and related goods, the glycemic index of pearl millet-based chapattis, biscuits, quick idli and dhokla was lower, ranging from 48.0 to 58.1 (Mani et al., 1993). Due to their high nutrient content, millets can be used extensively in the manufacturing of foods such as dietary foods, baby foods and snack foods. More and more millet products, like millet porridge, millet wine and millet nutrition powder in both grain and flour form, are becoming a common sight in people's daily lives (Subramanian and Viswanathan 2007; Liu and others 2012).The most popular fermented foods in India are idli and dosa. Due to its significance as human food, most other fermented foods are likewise quite well-liked and utilized globally (Mugocha et al., 2000; Gotcheva et al., 2001). In Africa, kodo millet is made into lactic acid-fermented porridge, other fermented drinks and porridge that have been fermented.

Consumption of Millets in India

The National Nutrition Monitoring Bureau (NNMB, 2006) reported that while consumption of millets was nearly non-existent in the states of Kerala, West Bengal, Orissa and Tamil Nadu, where rice is the primary staple, it was higher in the states of Gujarat (maize, pearl millet), Maharashtra (sorghum) and Karnataka (finger millet). Compared to Karnataka (75 g/CU/day), Madhya Pradesh (32 g/CU/day) and Andhra Pradesh (16 g/CU/day), Gujarat and Maharashtra consumed more millets (200 and 132 g/CU; consumption unit is a coefficient and 1 CU corresponds to an energy requirement of 2400 kcal/day of an Indian male doing sedentary work). Orissa (1 g/CU/day) and Tamil Nadu (3 g/CU/day) both displayed extremely low consumption levels.

Objectives

1. To execute innovations in traditional recipes in order to achieve sustainable global wellness.

2. To create novel, affordable products with higher amount of macronutrients and micronutrients.

Literature Review

Finger Millet: A Nutrient Powerhouse

A staple grain in regions of India and Eastern and Central Africa is finger millet, also known as Eleusine coracana. In terms of minerals, dietary fiber and essential amino acids, finger millet is more nutrient-dense than most cereal grains, according to the US National Research Council (1996). Additionally, finger millet has a number of phenolic chemicals that have antioxidant effects. The flour of the finger millet plant (*Ragi*, Eleusine coracana) is used to make porridge from boiled groats; it is also used to malt beer alternatives. Foods made with the flour are generally blended with cereals. Protein, iron, calcium, phosphorus, fiber and vitamin content are all abundant in it. Compared to all cereals, food grains have higher levels of fiber and calcium; and their iodine concentration is reputed to be the highest. Finger millet's useful components, such as resistant and slowly digesting starches, have made it more significant due to shifts in consumer knowledge of health advantages and changes in the scenario around the usage of processed foods.

Ragi has the highest quality protein, phosphorus, vitamin A, vitamin B complex and the necessary vital amino acids. *Ragi* is therefore a healthy food option for growing kids, expectant mothers, the elderly and the ill. The biggest amount of calcium, along with antioxidants and phytochemicals, are found in *ragi*, which facilitates easy digestion. Hence, it aids in diabetic patients' blood glucose regulation. Because of the fiber's size and the slow pace of digestion, we feel fuller after having fewer calories, which may help us avoid overindulging in calories.Because of its low sugar content and gradual release of glucose and sugar into the bloodstream, *ragi* is regarded as the perfect food for those with diabetes. Diet has a significant impact on one's health and well-being, and mounting research suggests that particular dietary components may help prevent chronic conditions including heart disease, cancer and neurological illnesses. It has reignited consumer interest in creating created products that are "natural, functional, and nutritional," as well as those of researchers and food product processors.

Benefits of Finger Millet for Health

Finger millet has been gaining popularity due to its hypoglycemic properties as well as the antioxidant and antibacterial properties of its polyphenols. Diabetes patients have been demonstrated to have lower blood sugar levels and to tolerate finger millet better than rice for a considerable amount of time. Because *ragi* digests slowly and hence takes longer for the carbohydrates to be absorbed, it is a great diet for fat people. Eating *ragi*-based meals curbs the persistent need to eat, which lowers calorie intake. In addition, despite a restricted food intake, it provides an appropriate amount of calcium, phosphorus, iron, vitamin B1, vitamin B2 and prevents malnutrition. Eating *ragi* can significantly lower one's risk of osteoporosis and fractures. An amino acid found in *ragi* called tryptophan helps regulate weight growth by reducing overeating. The *ragi*'s fiber content makes you feel fuller for longer and its slower rate of digestion lets you consume fewer calories. This aids in the weight loss process. Tryptophan, an amino acid found in *ragi*, is a great natural relaxant that can assist with sadness, anxiety and sleeplessness. Additionally useful in managing migraine headaches is the amino acid. People with diabetes can benefit from eating a finger millet-based diet because it has higher fiber content than wheat and rice.

Pearl Millet's Nutritional Value

The Poaceae family includes the versatile cereal crop known as pearl millet (Pennisstum glaucum). In many regional Indian languages, it is widely referred to as *Bajra*, *Bajri*, *Sajje*, *Kambu*, *Kamban*, *Sajjalu*, etc.

Compared to other cereal crops like wheat, rice, maize and sorghum, pearl millet has a better nutritional value due to its deep root system, which allows it to draw nutrients from the soil. This crop has high levels of iron, zinc, magnesium, copper, manganese, potassium and phosphorus in terms of minerals. With a high fiber content of 1.2 grams per 100 grams and a calorific value of 361 kcal/100 grams, it is a rich source of energy (Singh et

al. 2018). Pearl millet has a greater protein level (Tylor and Emmabux, 2008) and is a rich source of calcium, magnesium, folic acid, vitamin B and vitamin A (Pattanashett et al. 2016).

Benefits of pearl millet for health Due to its comparatively low glycemic index, which allows for a slower rate of glucose production and a more gradual digestion than other foods, pearl millet is beneficial for diabetic patients (Asp, 1996). This can maintain steady blood sugar levels for extended periods of time. The pericarp and grain testa of pearl millet contain phenolic chemicals, specifically flavonoids, which have been shown to suppress the growth of tumors (Huang and Ferraro, 1992). Its strong iron and zinc content may aid in boosting HB and shielding against the anemia illness (Vanisha et al., 2011).

Pearl millet is a gluten-free grain that can be used as an option for patients with celiac disease to follow a gluten-free diet and have a normal, healthy lifestyle (Jukanti et al. 2016). Phosphorus is abundant in pearl millet. Both the development of ATP, our body's energy currency and the growth and development of bones depend heavily on phosphorus (Malik, 2015). Because the lignin and phytonutrients in pearl millet are strong antioxidants, they help prevent heart-related illnesses. Because of this, pearl millet is thought to be beneficial for heart health (Dayakar Rao et al., 2017).

Methodology

Due to its numerous health benefits and capacity to address issues such as sustainable agriculture, malnourishment and food security, millets have gained attention once more in recent times. Consequently, there has been a noticeable surge in the innovation of new millets recipes that are more appetizing and suitable for modern diets. *Laddoos* are traditionally made with *atta*. An experimental attempt was made to create a millet-based value added *laddoo* wherein *atta laddoo* was taken as control recipe and two experimental recipes were planned and developed i.e. T1 *ragi* ladoo and T2 *bajra* ladoo. Standardisation of the recipes was done before preparation in sanitised laboratory settings. The panelists' organoleptic evaluation was complemented by proximate analysis performed in laboratory settings.

I. ***Atta Laddoo***
II. ***Ragi Laddoo***
III. ***Bajra Laddoo***

Fig. 1: Preparation of *Laddoos* in Laboratory

I. *Atta Laddoo*

Traditionally prepared with whole wheat flour, sugar and ghee, *atta laddoos* are a sweet snack for winter. Whole wheat flour is known in India as "*atta*," and *laddoos* are delicious balls. In North Indian households, whole wheat *laddoo* is the most popular sweet snack throughout the long winter months.The health benefits of whole grain flour are numerous. Whole grain flour is an excellent source of vitamins, minerals and fiber. Regular use of these *laddoos* lowers the risk of obesity and heart disease and encourages the growth of healthy skin and hair. It has shown to be advantageous for the digestive system as well. Whole wheat *atta* has an abundance of nutrients. In most nations, it is a staple diet. It has higher vegetable protein content than other cereals.

Fig. 2: Control *Atta Laddoo*

Table 1: Ingredients for *Atta Laddoo* (C)

S. No.	Ingredients	Quantity (g/ml)
1.	*Atta*	50
2.	Jaggery	25
3.	Milk	10
4.	Sugar powder	25
5.	Coconut powder	10
6.	Ghee	10
7.	Cardamom powder	1

Steps for making *Atta Laddoo*:

1. Put *atta* floor in a broad pan or kadai with a thick bottom.
2. Continued roasting the *atta* flour in the pan over a low heat or sim. To ensure that the flour is roasted evenly, you must stir frequently.
3. Roasted till the colour changes and the *atta* flour began to smell wonderful.
4. Next, mixed the flour with ghee.
5. The ghee will start to melt and combine with the flour.
6. Continued to roast, tossing, for an additional five to seven minutes.
7. After that, put the pan down and turn off the flame. Added powdered cardamom.
8. Added sugar powder and jaggery powder next.
9. Mixed all the ingredients well.
10. Added milk and thoroughly mix everything once more.
11. Using a fixed portion of the ingredients, formed it into *laddoos*.
12. Used the remaining mixture to make all *atta laddoos* in this manner.
13. *Atta laddoos* should be kept in an airtight jar or container. Presented them as a delectable treat to the panellists.

II. *Ragi Laddoo*

Ragi laddoo is a satisfying, nutritious and incredibly healthful treat. *Ragi laddoo* has a high calcium, iron and fiber content. Ghee, jaggery and *ragi* flour are the ingredients of the popular Indian sweet dish *ragi laddoo*. In addition to being delicious, this lovely dessert has several health advantages.The calcium and iron contents of *ragi laddoo*, which support bone health and energy production and fight anemia, are especially noteworthy. It is low in fat and also contains protein and antioxidants. You can satiate your sweet taste and nourish your body at the same time when you enjoy *ragi laddoo*.

Fig. 3: *Ragi Laddoo*

Table 2: Ingredients for *Ragi Laddoo* (T1)

S. No.	Ingredients	Quantity (g/ml)
1.	*Ragi*	30
2.	Besan	20
3.	Jaggery	25
4.	Milk	10
5.	Sugar Powder	25
6.	Coconut powder	10
7.	Ghee	10
8.	Cardamom powder	1

Steps for making *Ragi Laddoo*:

1. Placed *ragi* flour in a broad pan or kadai with a thick bottom.
2. Continued roasting the *ragi* flour in the pan over a low heat or sim. To ensure that the flour is roasted evenly, you must stir frequently.
3. Roasted till the color changes and the *ragi* flour began to smell wonderful.
4. Next, mixed the flour with ghee.
5. The ghee will start to melt and combine with the flour.
6. Continued to roast, tossing, for an additional five to seven minutes.
7. After that, put the pan down and turned off the flame. Added powdered cardamom.
8. Added the sugar powder and jaggery powder next.
9. Mixed in incredibly well.
10. Added the milk and thoroughly stirred everything once more.
11. Using a fixed portion of the ingredients, formed it into *laddoos*.
12. Used the mixture to make all *ragi laddoos* in this manner.
13. *Ragi laddoo* should be kept in an airtight jar or container. Presented them as a delectable treat to the panellists.

III. *Bajra Laddoo*

Bajra laddoos, which are composed of jaggery, are nutritious. Winter months are the ideal time to eat these *laddoos* since jaggery in them keeps those who frequently eat them warm. Our *bajra laddoos* are clearly advantageous since they are reasonably priced and give you the ideal amounts of fiber and calcium. Although *laddoos* are frequently given to nursing moms as a backbone strengthener, they actually supply a lot of balanced energy.

Fig.4: *Bajra Laddoo*

Table 3: Ingredients for *Bajra Laddoo* (T2)

S. No.	Ingredients	Quantity (g/ml)
1.	*Bajra*	30
2.	Besan	20
3.	Jaggery	25
4.	Milk	10
5.	Sugar Powder	25
6.	Coconut powder	10
7.	Ghee	10
8.	Cardamom powder	1

Steps for making *Bajra Laddoo*:

1. Placed *bajra* flour in a broad pan or kadai with a thick bottom.
2. Continued roasting the *bajra* flour in the pan over a low heat or sim. To ensure that the flour is roasted evenly, you must stir frequently.
3. Roasted till the color changes and the *bajra* flour began to smell wonderful.
4. Next, mixed the flour with ghee.
5. The ghee will start to melt and combine with the flour.
6. Continued to roast, tossing, for an additional five to seven minutes.
7. After that, put the pan down and turned off the flame. Added powdered cardamom.
8. Added the sugar powder and jaggery powder next.
9. Mixed in incredibly well.
10. Added the milk and thoroughly stirred everything once more.
11. Using a fixed portion of the ingredients, formed it into *laddoos*.
12. Used the mixture to make all *bajra laddoos* in this manner.
13. *Bajra laddoo* should be kept in an airtight jar or container. Presented them as a delectable treat to the panellists.

Results

A graphical representation of the comparative analysis of millet recipes has been created, as well as a tabular presentation of the findings of incorporating millet into traditional *laddoo* to increase its nutritious value. The

approximate values in C. Gopalan's 1990 book Nutritive Value of Indian Foods correspond with the nutritive value tables. Tables and numbers from the proposed millet *laddoo* cost comparison study are also included below.

A. Nutritional Value Calculation of Control and Experimental *Laddoos*

The nutritional values of the two different millet *laddoos* were computed using the criteria of the present study. There was evidence of increased quantities of iron, protein, calcium and β-carotene in both millet *laddoo* recipes.

Table 4: Nutritional Value Calculation of *Atta Laddoo* (C)

S. No.	Ingredients	Quantity (g/ml)	Energy (kcal)	Carbohydrate (g)	Protein (g)	Fat (g)	Fibre (g)	β- carotene (µg)	Calcium (mg)	Iron (mg)
1.	*Atta*	50	170.5	34.7	6.05	0.85	0.95	14.5	24	2.45
2.	Jaggery	25	95.75	23.75	0.4	0.03	-	-	20	0.66
3.	Milk	10	11.7	0.5	0.43	0.65	-	4.8	21	0.02
4.	Sugar powder	25	99.5	24.85	0.03	-	-	-	3	0.03
5.	Coconut powder	10	66.2	1.84	0.68	6.23	0.66	-	40	0.78
6.	Ghee	10	90	-	-	10	-	27	-	-
7.	Cardamom powder	1	2.29	0.42	0.10	0.02	0.20	-	1.3	0.05
	Total		536	86.06	7.68	17.77	1.81	46.3	109.3	3.99

Table 4 shows the macronutrients and micronutrients included in present per serving of *atta laddoo*. The data indicates that the energy content of each serving is 536 Kcal with 86.06 grams of carbohydrates, 7.68 grams of protein, 17.77 grams of fat and 1.81 grams of fibre in it. On the contrary, the micronutrient contribution is made up of 46.3 µg of β-carotene, 109.3 mg of calcium and 3.99 mg of iron.

Table 5: Nutritive Value Calculation of *Ragi Laddoo* (T1)

S. No.	Ingredients	Quantity (g/ml)	Energy (kcal)	Carbohydrate (g)	Protein (g)	Fat (g)	Fibre (g)	β-carotene (µg)	Calcium (mg)	Iron (mg)
1.	*Ragi*	30	98.4	21.6	2.19	0.39	1.08	12.6	103.2	1.17
2.	Besan	20	74.4	11.96	4.16	1.12	0.24	-	11.2	1.06
3.	Jaggery	25	95.75	23.75	0.4	0.03	-	-	20	0.66
4.	Milk	10	11.7	0.5	0.43	0.65	-	4.8	21	0.02
5.	Sugar powder	25	99.5	24.85	0.03	-	-	-	3	0.03
6.	Coconut powder	10	66.2	1.84	0.68	6.23	0.66	-	40	0.78
7.	Ghee	10	90	-	-	10	-	27	-	-
8.	Cardamom powder	1	2.29	0.42	0.10	0.02	0.20	-	1.3	0.05

	Total		**538**	**84.92**	**8.98**	**18.43**	**2.18**	**44.4**	**199.7**	**3.77**

Table 6: Nutritive Value Calculation of *Bajra Laddoo* (T2)

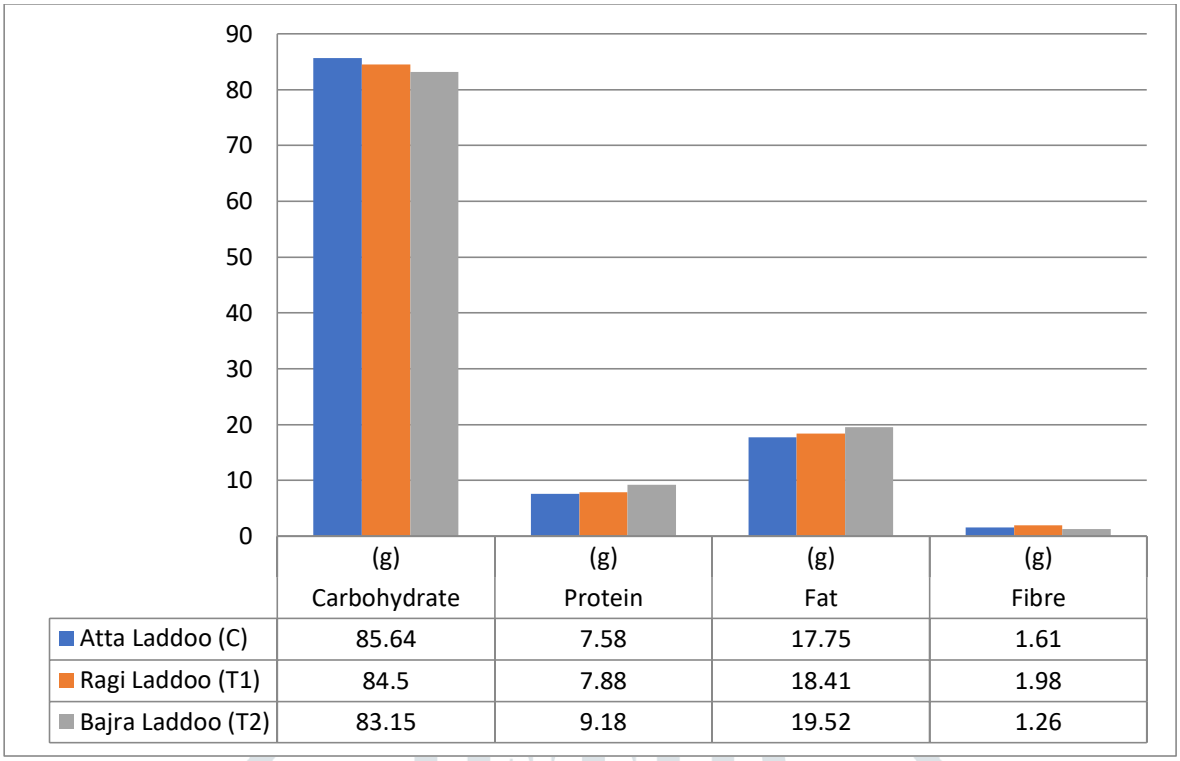
S. No.	Ingredients	Quantity (g/ml)	Energy (kcal)	Carbohydrate (g)	Protein (g)	Fat (g)	Fibre (g)	β-carotene (µg)	Calcium (mg)	Iron (mg)
1.	***Bajra***	**30**	**108.3**	**20.25**	**3.48**	**1.5**	**0.36**	**39.6**	**12.6**	**2.4**
2.	**Besan**	**20**	**74.4**	**11.96**	**4.16**	**1.12**	**0.24**	**-**	**11.2**	**1.06**
3.	**Jaggery**	**25**	**95.75**	**23.75**	**0.4**	**0.03**	**-**	**-**	**20**	**0.66**
4.	**Milk**	**10**	**11.7**	**0.5**	**0.43**	**0.65**	**-**	**4.8**	**21**	**0.02**
5.	**Sugar powder**	**25**	**99.5**	**24.85**	**0.03**	**-**	**-**	**-**	**3**	**0.03**
6.	**Coconut powder**	**10**	**66.2**	**1.84**	**0.68**	**6.23**	**0.66**	**-**	**40**	**0.78**
7.	**Ghee**	**10**	**90**	**-**	**-**	**10**	**-**	**27**	**-**	**-**
8.	**Cardamom powder**	**1**	**2.29**	**0.42**	**0.10**	**0.02**	**0.20**	**-**	**1.3**	**0.05**
	Total		**548.29**	**83.57**	**9.28**	**19.54**	**1.46**	**71.4**	**109.1**	**5**

Table 5 displays the macronutrients and micronutrients of *ragi laddoo* (T1). Results indicated that incorporating millets to *laddoo* has increased its protein, calcium and fiber content. Each serving offers 538 kcal of energy and furnishes 84.92 grams of carbohydrates, 8.98 grams of protein, 18.43 grams of fat and 2.18 grams of fiber according to the table. On the other hand, *ragi laddoo* has the following micronutrients per serving: 199.7 mg of calcium, 3.77 mg of iron and 44.4 µg of beta-carotene. This is a nutrient-dense recipe.

Table 6 displays the macronutrient values of *bajra laddoo*: 548.29 kcal of energy, 83.57 grams of carbohydrates, 9.28 grams of protein, 19.54 grams of fat and 1.46 grams of fiber included in each serving. Micronutrients include 5mg of iron, 109.1 mg of calcium and 71.4µg of β- carotene.

Table 7: Macronutrients' Comparison of Control and Experimental *Laddoo* Recipes

S.No.	Recipe	Carbohydrate (g)	Protein (g)	Fat (g)	Fibre (g)
1.	***Atta Laddoo* (C)**	**86.06**	**7.68**	**17.77**	**1.81**
2.	***Ragi Laddoo* (T1)**	**84.92**	**8.98**	**18.43**	**2.18**
3.	***Bajra Laddoo* (T2)**	**83.57**	**9.28**	**19.54**	**1.46**



	(g) Carbohydrate	(g) Protein	(g) Fat	(g) Fibre
Atta Laddoo (C)	85.64	7.58	17.75	1.61
Ragi Laddoo (T1)	84.5	7.88	18.41	1.98
Bajra Laddoo (T2)	83.15	9.18	19.52	1.26

Fig. 5: Macronutrients' Comparison of Control and Experimental *Laddoo* Recipes

An examination of the macronutrient comparison and nutritional value evaluation of all three recipes is shown in Table 7 and Figure 5. Because millet has so many health benefits, these *laddoos* are a great option for people of all ages. As compared to the nutritive value assessment of control *atta laddoo* recipe, *ragi laddoos* have shown slightly higher levels of protein and fiber with 7.88 grams and 1.98 grams as compared to 7.58 grams and 1.61 grams respectively present per serving of the control *atta laddoo* recipe. The findings also displayed that each serving of *bajra laddoo* had 9.2 grams of protein as opposed to the control recipe's 7.6 grams of protein present in each serving of *atta laddoo*. Thus, these millet *laddoos* offer a better nutritional value to the consumers.

Table 8: Micronutrients' Comparison of Control and Experimental *Laddoo* Recipes

S.No.	Recipe	β- carotene (µg)	Calcium (mg)	Iron (mg)
1.	*Atta Laddoo* (C)	46.3	109.3	3.99
2.	*Ragi Laddoo* (T1)	44.4	199.7	3.77
3.	*Bajra Laddoo* (T2)	71.4	109.1	5.00

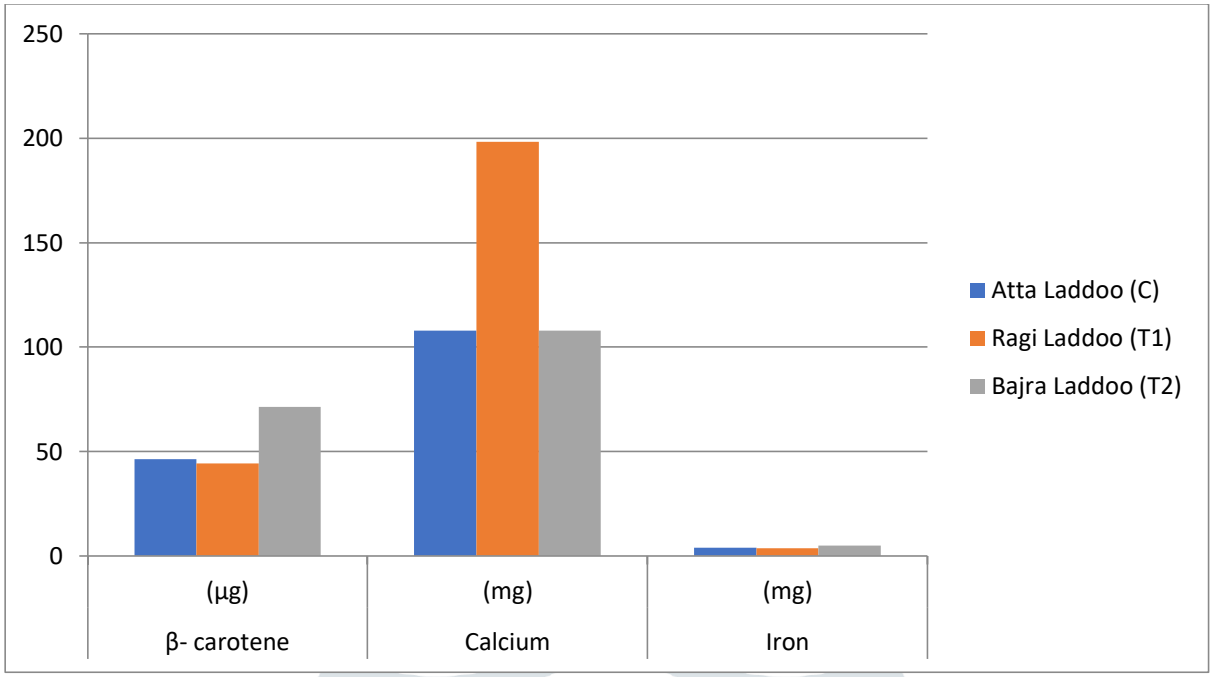


Fig. 6: Micronutrients' Comparison of Control and Experimental *Laddoo* Recipes

The comparison of micronutrient assessment of the nutritional worth of all the three *laddoo* recipes C, T1, and T2 is shown in Table 8 and Figure 6. It was clearly evident that addition of millets has appraised the content of calcium in *ragi laddoo* with 198.4 mg present per serving as opposed to 108 mg of control *laddoo* recipe. Likewise, it has been shown that *bajra laddoo* has got increased contents of all three compared micronutrients: β-carotene, calcium as well as iron. The micronutrient values of *bajra laddoo* can be utilized wisely to *atta*in global wellness among the community.

B. Cost Calculation of Control and Experimental *Laddoo* Recipes

Tables 9 to 11 below display the results of the cost-value calculations for one experimental recipe and the two types of millet *laddoo*. The values of the three types of *laddoos* (*atta*, *ragi*, and *bajra*) were found to be Rs. 15.05, Rs. 17, and Rs. 16.7 respectively. These values are affordable for everyone. The usage of millets has not, however, resulted in an excessive price increase. Rather, the taste, variety and nutritional value of this popular traditional dish will be significantly enhanced by these innovations and value-additions, opening up new economic opportunities for suppliers. These additions will also enhance community health thereby *atta*ining global wellness.

Table 9: Cost Analysis of Control *Atta Laddoo* (C)

S.No.	Ingredients	Quantity (g/ml)	Price per kg/unit	Cost (Rs.)
1.	*Atta*	50	35	1.75
2.	Jaggery	25	50	1.25
3.	Milk	10	60	0.6
4.	Sugar powder	25	50	1.25
5.	Coconut powder	10	180	1.8
6.	Ghee	10	700	7
7.	Cardamom powder	1	1400	1.4
			Total	15.05

Table 10: Cost Analysis of *Ragi Laddoo* (T1)

S. No.	Ingredients	Quantity (g/ml)	Price per kg/unit	Cost (Rs.)
1.	*Ragi*	30	80	2.4
2.	Besan	20	65	1.3
3.	Jaggery	25	50	1.25
4.	Milk	10	60	0.6
5.	Sugar powder	25	50	1.25
6.	Coconut powder	10	180	1.8
7.	Ghee	10	700	7
8.	Cardamom powder	1	1400	1.4
			Total	17.0

Table 11: Cost Analysis of *Bajra Laddoo* (T2)

S. No.	Ingredients	Quantity (g/ml)	Price per kg/unit	Cost (Rs.)
1.	*Bajra*	30	70	2.1
2.	Besan	20	65	1.3
3.	Jaggery	25	50	1.25
4.	Milk	10	60	0.6
5.	Sugar powder	25	50	1.25
6.	Coconut powder	10	180	1.8
7.	Ghee	10	700	7
8.	Cardamom powder	1	1400	1.4
			Total	16.7

Table 12: Cost Comparison of Control and Experimental *Laddoo* Recipes

S. No.	Recipes	Cost (Rs)
1	*Atta Laddoo* (C)	15.05
2	*Ragi Laddoo* (T1)	17.00
3	*Bajra Laddoo* (T2)	16.70

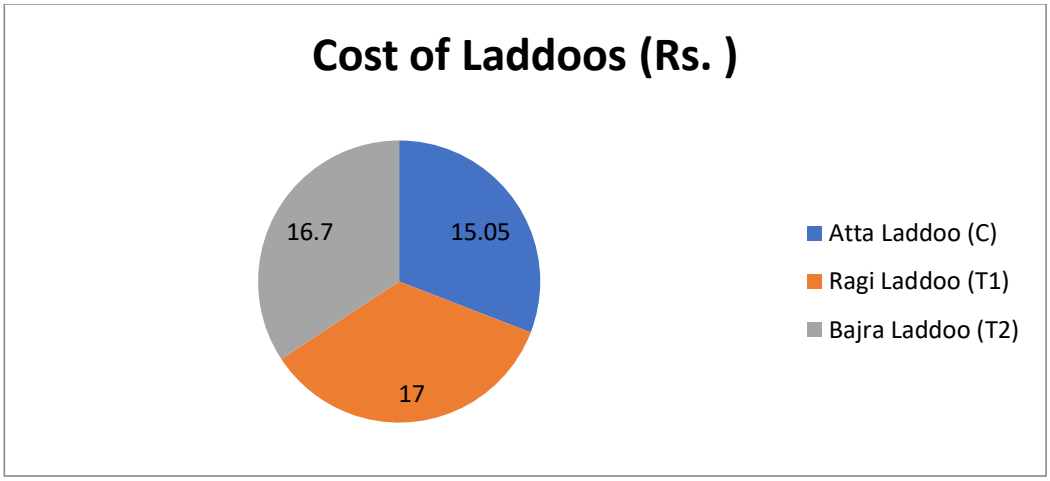


Fig. 7: Cost Comparison of Control and Experimental *Laddoo* Recipes

Table 12 and Fig. 7 present comparative cost assessment of the three ladoo recipes. The pie chart demonstrates that the two suggested millet *laddoo* recipes and the one control *atta laddoo* are almost similar in terms of cost per serving. This infers that replacement of traditional *atta* with millets has not posed any burden on the pockets of consumer in terms of financial constraints. However, the nutritional gain is worth the value addition and incorporation of millets in traditional *laddoos*. Inclusion of millets in our diet through recipes like *laddoo* allows us to enjoy a delightful and healthy dish while supporting the environment and our overall well-being. For a change, they make tasty and nutritious snacks that everybody may enjoy.

C. Sensory Evaluation of Control and Experimental *Laddoos*

Seven semi-trained panelists of varying ages conducted a sensory evaluation using a 9-point hedonic scale to determine whether the millet *laddoo* were considered acceptable. Texture, aroma, color, appearance, taste and overall acceptability were the organoleptic features rated on a Hedonic rating scale from 1 to 9. The mean values of various sensory attributes have been summarised in Table 13.

Table 13: Comparison of Organoleptic evaluation of Control and Experimental *Laddoos*

S. No. / Sensory Attributes / Recipe	Texture and Aroma	Colour and Appearance	Taste	Overall Acceptability
1.	***Atta Laddoo* (C)**	**7.72**	**7.84**	**8.02**	**7.86**
2.	***Ragi Laddoo* (T1)**	**7.80**	**7.82**	**7.50**	**7.70**
3.	***Bajra Laddoo* (T2)**	**7.90**	**8.01**	**8.20**	**8.03**

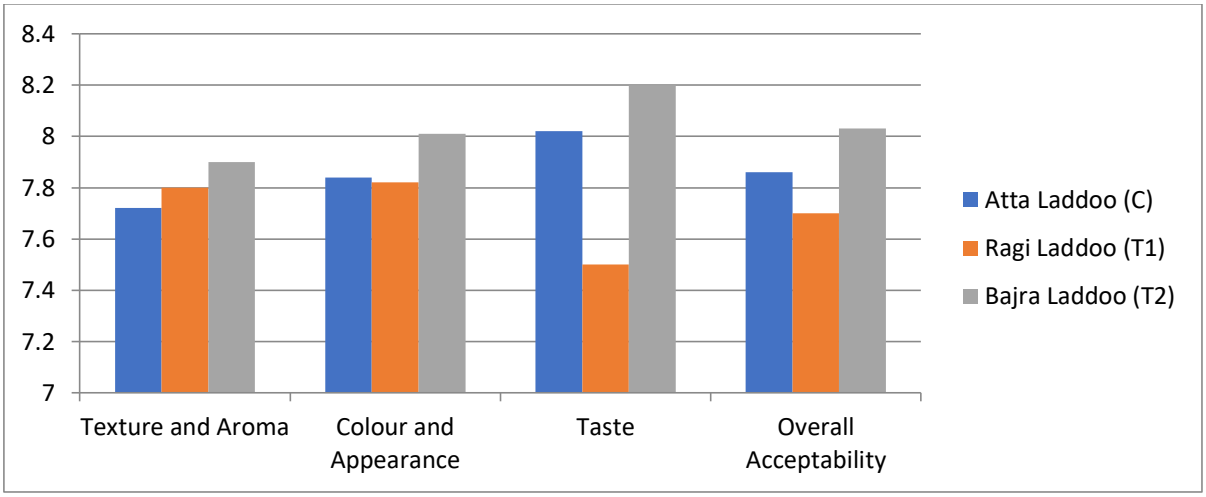


Fig. 8: Comparison of Organoleptic evaluation of Control and Experimental *Laddoos*

Table 13 and Figure 8 display the results of sensory evaluation of all the three *laddoos* as scored by the panellists. It is quite evident that there has been a positive impact of replacement of tradition *atta* with millets. *Bajra laddoo* has scored the highest position in all the sensory attributes with an overall acceptability of 8.03 as compared to 7.86 of the control *atta* ladoo. However, *ragi* ladoo has shown appraise in texture and aroma as compared to control recipe but was not able to get better scores in other attributes. But overall acceptability of *ragi laddoo* was almost similar to the traditional *atta laddoo*. To get the nutritive benefits from these millet *laddoos*, few attributes can be neglected too.

Conclusion

The popularity of millet-based recipes in response to the growth in diet-related diseases in the modern day demonstrates the growing need for better food options. Because of its great nutritional value and potential to prevent illness, millets are becoming a popular addition for people who want to improve their general health and well-being. People can make healthier dietary choices and yet enjoy their favorite flavors by including millet into a range of recipes, including time-honored favorites. The desire for healthy food options is expanding due to the rise in diet-related diseases, as seen by the popularity of millet-based recipes.

Millets are a great option for those trying to cut back on their intake and for those who want to be more environmentally conscious because they are a nutritious replacement that can be added to popular traditional dishes. As long as we prioritize the sustainability of our planet and our own well-being above all, millets will undoubtedly continue to be a mainstay of our meals. The results of our study on the nutritional content of millet *laddoos* indicate that these are nutrient-dense and possibly healthier food selections.

References

1. Asp, N.G. (1996). Dietary Carbohydrate: Classification by Chemistry and Physiology, Journal of Food Chemistry, 7:9-14.
2. Balasubramanian S. et al. (2012). Development and shelf-life evaluation of pearl millet based upma dry mix. Food Sci. Tech. J. DOI: 10.1007/s13197-012-0616-0.
3. Gotcheva et al. (2001). Monitoring the fermentation of the traditional Bulgarian beverage Boza. International Journal of Food Science & Technology. 36. 129-134. 10.1046/j.1365-2621.2001.00429.
4. Huang, M. T. and Ferraro, T. (1992). Phenolics compounds in food and cancer prevention In: Phenolic Compounds in Food and Their Effects on Health II, ACS Symposium Series, 507:8–34.
5. Jukanti A K et al. (2016). Crops that feed the world Pearl Millet (Pennisetum glaucum L.): an important source of food security, nutrition and health in the arid and semi-arid tropics. Food Sec. 8:307–329.

6. Kumar S et al. (2023). A Comprehensive Review on Millets: A Potential Source of Energy and Nutrients for Health. International Journal of Environment and Climate Change. 13. 2531-2538. 10.9734/ijecc/2023/v13i92487.
7. Liu J et al. (2012). Determination of the volatile composition in brown millet, milled millet and millet bran by gas chromatography/ mass spectrometry. Molecules 17:2271–82.
8. Liu R H (2007). Whole grain phytochemicals and health. J. Cereal Sci. 46:207–19.
9. Malik S. (2015). Pearl Millet-Nutritional Value and Medicinal Uses. International Journal of Advance Research and Innovative Ideas in Education, 1(3): 414-418.
10. Mishra P, Prakash H. G. et al. (2021). Nutritional Quality of Millets and their Value Added Products with the Potential Health Benefits: A Review. Int. J. Curr. Microbiol. App. Sci. 10(10): 163-175. Doi: https://doi.org/10.20546/ijcmas.2021.1010.019.
11. Mugocha et al. (2000). Fermentation of a composite finger millet-dairy beverage. World Journal of Microbiology and Biotechnology. 16. 341-344. 10.1023/A: 1008929403215.
12. Obilana, A. B. (2003). Overview: importance of millets in Africa. In: Belton P S, Taylor J R N, editors. Proceeding of the Workshop on the Proteins of Sorghum and Millets: Enhancing Nutritional and Functional Properties for Africa. 2–4 April 2003. Pretoria, South Africa. Available from <http://www.afripro.org.uk>. Accessed July 2004.
13. Pattanashetti et al. (2016). Pearl millet. Genetic and Genomic Resources for Grain Cereals Improvement, pp 253–289.
14. Sabuz A. A, Rana Md. R, et al. (2023). Health- Promoting Potential of Millet: A Review, Volume 10 Issue 2.
15. Shanmugam S et al. (2013). Finger Millet (*Ragi*, Eleusine coracana L.). A Review of Its Nutritional Properties, Processing, and Plausible Health Benefits. Advances in food and nutrition research. 69. 1-39. 10.1016/B978-0-12-410540-9.00001-6.
16. Singh N et al. (2018). Nutri Cereal Pearl millet: Way Forward. Int. J. Curr. Microbiol. App. Sci. 7(6): 578-581.
17. Subramanian S and Viswanathan R. (2007). Bulk density and friction coefficients of selected minor millet grains and flours. J Food Eng 81(1):118–26.
18. Taylor J R N and Emmambux M N (2008). Products containing other speciality grains: sorghum, the millets and pseudocereals. Technology of functional cereal products. University of Pretoria, South Africa, pp 290.
19. Vanisha et al. (2011). Potential Functional Implications of Pearl millet (Pennisetum glaucum) in Health and Disease. Journal of Applied Pharmaceutical Science 01 (10); 2011: 62-67 ISSN: 2231-3354. 1.
20. Verma et al. (2012). Nutritional security and value added products from finger millets (*ragi*), Journal of Applicable Chemistry, 1 (4):485-489.Mani et al. (1993). Glycemic index of some commonly consumed foods in western India. Asia Pacific J. Clin. Nutr. 111–114.