Original Research Article

Assessment of sensory and nutritional attributes of finger millet-based traditional food products of Assam, India

ABSTRACT

Background: Millet based diets contain multiple health promoting components and considered as climate-resilient course grain cereals. The United Nations designated 2023 as the 'International Year of Millets' to spotlight the resilience and health benefits of these climate-adaptable crops. In line with this, the Shree Anna (Millet) Gram Yojana was initiated to promote millet production and consumption, aiming to combat malnutrition. An essential aspect of this initiative is the substitution of millet for rice in traditional recipes, a strategy for sustainable food and nutritional security. This study, conducted by the AICRP on Women in Agriculture at Assam Agricultural University, Jorhat, focused on utilizing Finger Millet (Eleusine coracana) in Assam's traditional food products—Burbhuria pitha, Pat pitha, Tel pitha, and Mithoi. **Aim:** Evaluating the quality of these millet-based food products in terms of organoleptic properties and nutritional composition. **Methodology:** A nine-point hedonic scale was used to conduct sensory evaluations by ten trained and semi-trained panelists from the Department of Food Science and Nutrition, and nutritional composition was examined. ICAR WASP software was utilized to analyze the data using the Completely Randomized Design method. **Results:** Results indicated that Finger Millet substituted for rice in traditional food products of Assam received higher acceptability scores and exhibited improved nutritional profiles compared to control products. **Conclusion:** This study underscores the potential of value-added products with Finger Millet to enhance flavour, texture, taste, and nutritional value of traditional foods, offering benefits to the populace of Assam.

Keywords: Finger millet, nutritional composition, rice, traditional, Assam

INTRODUCTION

Millets, a small-seeded grass that has been cultivated for thousands of years and is a major source of food for both humans and livestock, belong to the *Poaceae* family of plants. They were first domesticated and cultivated around 10,000 years ago. Originating in Africa and Asia, their cultivation dates back to approximately 7000 BCE (Singh, 2023). Throughout history, millets have been embraced by ancient civilizations worldwide as essential dietary staples. Similarly, in India, pearl millet, finger millet, and sorghum were fundamental components of the diet, even during the era of the Indus Valley Civilization (Tripathi and Vyas, 2023). At present, these plant genetic resources serve as an essential food source in many areas of the world, particularly in arid and semiarid regions. India cultivates a diverse range of millet varieties, including Pearl Millets, Sorghum, Finger Millet, Foxtail Millet, Kodo Millet, Barnyard Millet, Proso Millet, Little Millet, and Pseudo Millets like Buckwheat and Amaranths. The largest in India's total millet production was shared by Pearl millet (Bajra), Sorghum (Jowar), and Finger Millet (Ragi). India stands as the largest producer of millets globally, contributing 40% of the total global production. Following India, Niger (11%) and China (9%) are the other significant millet-producing countries worldwide. The major millet productions in India are Bajra accounting for

62%, Jowar for 26%, Ragi for 9%, and Small millets for 3% (APEDA, 2023-24). Among all millets cultivated in India, finger millet demonstrates the highest productivity, yielding approximately 1640 kg per hectare (Nautiyal *et al*., 2023).

Millet based diets contain multiple health promoting components when compared to Rice and wheat based diets, lacking in several minerals, dietary fibre, and antioxidants (Kumar and Kumar, 2020). They have elevated amounts of macro and micronutrients, including essential amino acids, proteins, carbohydrates, dietary fibre, and phytochemicals (Sarita and Singh, 2016). Millets have the potential to provide food and nutritional security globally due to their high concentrations of minerals, dietary fibre, vitamins, and phytochemicals with medicinal benefits. Additionally, their low glycemic index and bioactive flavonoids make them effective in managing diabetes, hyperlipidemia, and reducing the risk of cardiovascular disease (Nithiyanantham *et al*., 2016).

Millets hold significant potential for sustainability across various dimensions of agricultural, environmental, and nutritional domains. Therefore, it is an ideal crop for providing food as well as nutritional security in developing countries like Africa and Asia (Antony *et al*., 2018). The potential health and nutritional benefits of millet offer a sustainable solution to combat malnutrition and promote food and nutrition security, especially in vulnerable communities. Additionally, their long shelf life enhances food security by providing a stable food source during times of scarcity. In light of recent global challenges such as the climate changes, economic recession, and geopolitical conflicts, ensuring food security has become increasingly critical. Overall, the revival and promotion of millets can significantly contribute to sustainable agricultural development and food security in India and beyond (Jain *et al*., 2024). Keeping in view the nutritional richness, resilience to adverse conditions, and potential for sustainable agriculture,the International Year of Millet 2023 was initiated globally by the Food and Agricultural Organization of the United Nations (FAO), aims to spotlight the significance of millets as a vital food crop and promote their cultivation and consumption globally. India, being a major contributor to millet production, proposed the idea of designating 2023 as the "International Year of Millets" to spotlight the importance of these grains. The initiative seeks to raise awareness about the numerous health benefits of millets, enhance food security, and foster sustainable agriculture practices. To support this cause, the Indian government has launched the National Millet Mission to showcase its expertise in millet cultivation and processing while highlighting the nutritional advantages of these crops (Jain *et al*., 2024). In line with this, the Shree Anna (Millet) Gram Yojana was initiated to promote millet production and consumption, aiming to combat malnutrition. An essential aspect of this initiative is the substitution of millet in traditional recipes, a strategy for sustainable food and nutritional security.

Finger millet or Ragi (*Eleusine coracana*) locally called '*Marua Dhan*' in Assam renowned for its high fiber content and abundant reserves of phosphorus, vitamins A and B, and amino acids, it provides notable health benefits for individuals dealing with constipation, hypertension, and cardiovascular ailments. It is rich in dietary fibre and nutrients such as amino acids, polyphenols, phytates and minerals like iron (Chandra *et al*., 2016) and calcium (Sharma *et al*., 2017) and known for its health benefits such as anti-ulcer, antiinflammatory, anti-diabetic, anti-tumerogenic and anti-atherosclerogenic making it a 'Functional food' (Chandra *et al*., 2016).

The culinary tradition of a society reflects its depth of taste and adherence to traditions, and the Assam exhibit richness and sophistication in this aspect (Kalita, 2022). The Assamese community exhibit remarkable diversity in their use of snacks that are not only prepared in various ways but also offer significant health benefits. These snacks have been a part of

Assamese culture since ancient times and are not only flavorful but also contribute to the rich cultural heritage of the region. Given the high production of paddy in Assam, varieties of snacks were made from different rice varieties such as *Til pitha, Chunga pitha, Ghila pitha, Xutuli pitha, Dhup pitha, Bhapot diya pitha, Pheni pitha,* and *Pani pitha,* etc (Bora, 2020). Furthermore, Assam is renowned for its assortment of*Mithoi* (ladoos) made from pithaguri (rice flour), jaggery, coconut, sesame seeds, and other ingredients, which represent traditional sweets deeply ingrained in Assamese culture. *Pani pitha* or *Kholasapori pitha* or *Burbhuria pitha* made from rice flour holds a special place as a beloved Assamese delicacy. By incorporating Finger millet into rice-based meals, the diet can be diversified, offering a wider array of nutrients crucial for overall health as well as enhancing food and nutritional security for the population of Assam. Finger millet have significant nutritional advantages over rice thus suitable for improving the overall nutritional quality of the diet and addressing potential deficiencies, particularly among vulnerable populations such as children and pregnant women. Considering, the wider array of potential nutritional and health benefits of Finger millet as well as a means of nurturing the culinary heritage of Assam, the research study was undertaken to assess sensory and nutritional attributes of finger millet-based traditional food products of Assam namely, *Burbhuria pitha, Pat pitha*, *Tel pitha*, and *Mithoi* to provide a healthier dietary snack option to the populace of Assam for household food and nutrition security.

2. MATERIALS AND METHODS

2.1 Raw ingredients

The study was conducted by the All India Coordinated Research Project on Women in Agriculture at Assam Agricultural University, Jorhat, Assam. For the present study, paddy

Mulagabharu, an intermediate amylose containing rice with 20.40±1.08mg/100g (Chatterjee and Das, 2018), moisture content (11.06%), energy (359.79Kcal/100g), crude fibre protein (12.80g/100g), crude fat (1.24g/100g), crude fibre (1.59g/100g), total carbohydrate (80.02g/100g) and total minerals (1.01g/100g) (Thakuria and Baruah, 2023) was selected and procured from Regional Agricultural Research Station (RARS), Titabar, Assam and processed into flour with some modifications (Gogoi *et al.*, 2020) (Figure 1). The Finger millet seeds with moisture (8.63g/100g), crude protein (7.45g/100g), crude fat (1.78g/100g), total minerals (2.91g/100g), crude fibre (4.82g/100g), total carbohydrate (68.23g/100g) and energy (318.72Kcal/100g) (Khatonair and Das, 2021) was procured from the local farmer of Majuli, Jorhat and processed to flour (Karuppaswamy, 2013) (Figure 2). The flours were stored in air-tight containers for product development and nutritional analysis. Other ingredients such as whole wheat flour, jaggery,ghee, oil, salt,and black pepper required for the development of Finger millet incorporated traditional food products of Assam were procured from the local market.

Paddy (*Mulagabharu*)

⇩

Cleaned and milled

⇩

Washed and soaked in water for 2 hours followed by sun drying till 12% moisture content

⇩

Ground in a mixer grinder

⇩

Sieved through 100 mesh size sieve

⇩

Stored in an airtight container

Figure 1. Processing of Paddy (*Mulagabharu*) into flour

Finger millet seeds

⇩

Cleaned and dehusked

⇩

Ground in a mixer grinder

⇩

Sieved through 100 mesh size sieve

⇩

Stored in an airtight container

Figure 2. Processing of finger millet into flour

2.2 Formulation and development of the Finger millet incorporated traditional food products

Four distinct sets of traditional rice-based food products incorporating finger millet were developed (Table 1) using processed flours and various ingredients. These products include *Burbhuria pitha* (a type of pancake made from rice flour, water, and salt), *Tel Pitha* (prepared from rice flour and jaggery batter and deep-fried in oil), *Pat Pitha* (made from a dough of rice flour, jaggery, and grated coconut, flattened between banana leaves), and *Mithoi* (made from rice flour, jaggery syrup, and black pepper). Traditional versions of *Burbhuria Pitha*, *Pat Pitha*, *Tel Pitha*, and *Mithoi*, which used only rice flour as the main ingredient, were used as controls. The standard preparation methods for these traditional food products are shown in Figure 3, Figure 4, Figure 5 and Figure 6 respectively.

TABLE 1. Formulation of the Finger millet incorporated local traditional rice based food products of Assam

TABLE 1a. Formulation of the Finger millet incorporated *Burburi Pitha*

Treatment	**Level of incorporation**	
	Rice flour (g)	**Finger millet (g)**
BP control	100	-
FBP_1	80	20
FBP_2	60	40
FBP_3	50	50

BP control- Burbhuri Pitha Control; FBP- Finger millet Burbhuri Pitha

TABLE 1.b. Formulation of the Finger millet incorporated *Tel Pitha*

Treatment	Level of incorporation			
	Rice flour (g)	Wheat flour (g)	Finger millet (g)	Jaggery (g)
TP control	50	10	-	40
FTP_1	50	-	10	40
FTP_2	40	-	20	40
FTP_3	30	-	30	40

TP control- Tel Pitha control; FTP- Finger millet Tel Pitha

TABLE 1.c. Formulation of the Finger millet incorporated *Pat Pitha*

Treatment	Level of incorporation			
	Rice flour (g)	Finger millet (g)	Jaggery (g)	Coconut (g)
PP control	80	-	10	10
FPP_1	60	20	10	10
FPP_2	40	40	10	10

FPP Control - Finger millet Pat Pitha control; FPP- Finger millet Pat Pitha

TABLE 1.d. Formulation of the Finger millet incorporated *Mithoi*

Treatment	Level of incorporation		
	Rice flour (g)	Finger millet (g)	Jaggery (g)
PM control	80	-	20
FPM_1	60	20	20

FPM_2	40	40	20

PM control- Moka Mithoi control; FM- Finger millet Poka Mithoi

Raw ingredients mixed (100g)

⇩

Water (200ml) and salt (2g) added to the mixer and stirred to avoid lump formation

⇩

Oil (1ml) added to the batter and mixed thoroughly

⇩

Oil (1ml) brushed on a heated pan and ladle of batter (60 ml) poured on the heated pan

⇩

Shallow fried for 1 minute by turning at every 30 seconds

⇩

Ready to serve

Figure 3. Flow diagram of preparation of Burbhuri pitha

Mixed all the raw ingredients (60g)

↓

Jaggery (40g) syrup and salt (1g) added to the mixer and stirred to avoid lump formation

↓

Deep fried by pouring a ladle of batter (50ml) till golden brown

↓

Ready to serve

Figure 4. Flow diagram of preparation of Tel pitha

Raw ingredients mixed (80g) and salt added (1g)

↓

Lukewrm water (100ml) added to the mixer and dough prepared

↓

Balls prepared stuffed with jaggery (10g) and coconut mixer (10g)

↓

Flattened between banana leaves brushed with oil (1ml)

↓

Steamed for 15 minute

↓

Ready to serve

Figure 5. Flow diagram of preparation of *Pat pitha*

Roasted the flour (80g) for 5 minute

⇩

Jaggery (20g) syrup, ghee (5ml) and black pepper (1g) added to the roasted flour

⇩

Stirred continuously to avoid lump formation

⇩

Balls prepared

⇩

Ready to serve

Figure 6. Flow diagram of preparation of *Mithoi*

2.3 Organoleptic evaluation of developed Finger millet incorporated traditional food products

The developed Finger millet incorporated traditional products were evaluated in the Department of Food Science and Nutrition, College of Community Science, Assam Agricultural University for their sensory qualities. The panelists scored different products prepared from incorporating Finger millet based on their appearance, texture, taste, flavor and overall acceptability by using nine-point Hedonic rating scale (Peryem and Pilgrim, 1957), where 9 indicated "like extremely" and 1 indicated "dislike extremely."

2.4 Colour measurement of the developed Finger millet incorporated traditional food products

Colour values are determined by using hunter lab scan XE model (M/S Hunter associate laboratory Inc., Reston -V.A., USA) with a view angle of 2°. Colour values of the samples were determined by the hunter system L*, a*, b* values. In the hunter system 'L' indicates brightness or whiteness, positive 'a' value indicates redness and negative value indicates greenness. Positive 'b' value indicates yellowness and negative 'b' indicates blueness. The colour intensity was calculated using the equation given by Lamberts *et al*., 2006.

2.5 Determination of the best variations of the developed Finger millet incorporated traditional food products

A total of four sets of formulated traditional dishes were developed by incorporating Finger millet into rice i.e., *Burbhuria pitha, Pat pitha, Tel pitha,* and*Mithoi*. Based on the organoleptic evaluation, one formulation was selected from each set of formulated millet incorporated food products. The best formulations were analyzed in triplicates for proximate composition and calcium using the standard operating procedures.

2.6 Nutritional composition of the best variations of the developed Finger millet incorporated traditional food products

The proximate parameters namely crude protein, crude fat, crude fiber and total carbohydrate were analyzed using three replications by A.O.A.C. (2010), whereas, energy content was calculated based on the formula reported by Gopalan *et al*., 2000. The moisture content was determined using electronic moisture analyzer (Aczet MB 400). The calcium content was determined by flame photometry using flame photometer according to the method of A.O.A.C, 2000. A stock solution of calcium having concentration 200 ppm was prepared by dissolving 500 mg $CaCO_3$ in 1000 ml distilled water. A few drops of (1:1) HCl were to be added to dissolve the $CaCO_3$. From the stock solution another three solutions having concentration 50 ppm, 100 ppm and 150 ppm were prepared by appropriate dilution. The solutions were now placed under the Nebuliser and reading was taken. The concentration of calcium present in the sample was calculated from the standard curve and expressed as mg Ca/100 g sample.

2.7 Statistical Analysis

The data was analyzed in a completely randomized design using SPSS software (26 version). Mean and standard deviation for the various parameters were computed. Analysis of Variance (One-way ANOVA) was employed to assess the various parameters of the Finger millet incorporated products.

3 RESULTS

3.1 Organoleptic evaluation

The sensory characteristics of the developed Finger millet incorporated products are presented in Table 2. Among them, *Burbhuria pitha* control (BP control) and Finger millet incorporated *bhurbhuria pitha* (FBP_2) obtained the overall acceptability score of 7.80±0.63 and 7.80±0.91 respectively and were similar ($p \geq 0.05$). No significant difference at 5% level were found among the sensory characteristics (taste and flavor) between *Burbhuria pitha* control (BP control) and Finger millet incorporated *bhurbhuria pitha*. The overall acceptability of *Tel pitha* control (TP Control) was found highest followed by Finger millet incorporated *Tel pitha* (FTP_1). The colour, texture and flavour of Finger millet incorporated *Tel pitha* were statistically similar with the *Tel pitha* control. The taste, texture, appearance, flavor and overall acceptability of finger millet incorporated *Pat pitha* showed no significant difference with the control. The *Pat pitha* control (PP Control) showed the highest score (7.70±0.48) for colour than finger millet incorporated Pat pitha. The taste, texture and overall acceptability parameters of sensory characteristics were highest for Finger millet incorporated *Mithoi* than control (PM Control). The colour, appearance and flavour of Finger millet incorporated *Mithoi* and *Mithoi* control were found similar ($p \geq 0.05$). Though colour of finger millet incorporated *Burbhuria pitha* and *Pat pitha* products was different from control, yet it was acceptable and liked by panelists. Majority of organoleptic characteristic of finger millet incorporated products were in the category of 'liked moderaTely to liked very much'. Therefore, finger millet incorporated *Burbhuria pitha, Tel pitha, Pat pitha* and *Mithoi* could be prepared by supplementing with rice without altering much of their characteristics. Based on the organoleptic evaluation, the best formulation of finger millet incorporated *Burbhuria pitha* (FBP_2), *Tel pitha* (FTP_1), *Pat pitha* (FPP_2) and *Mithoi* (FPM_2) were selected and were analyzed for nutritional composition.

TABLE 2. Organoleptic evaluation of the developed Finger millet incorporated local traditional rice based recipes of Assam

Finger millet incorporated traditional recipes		Colour	Appearance	Taste	Texture	Flavour	Overall acceptability
Burbhuria Pitha	BP Control	7.80±0.42^{a}	7.50±0.52^{a}	7.50±0.70^{a}	8.00±0.47^{a}	7.90±0.31^{a}	7.80±0.63^{a}
	FBP$_1$	7.60±0.51^{a}	7.50±0.52^{a}	7.60±0.69^{a}	7.80±0.42^{a}	7.90±0.31^{a}	7.10±0.73^{b}
	FBP$_2$	7.60±0.51^{a}	7.50±0.52^{a}	7.90±0.87^{a}	7.80±0.42^{a}	7.90±0.31^{a}	7.80±0.91^{a}
	FBP$_3$	7.10±0.56^{b}	6.20±0.78^{b}	6.90±0.31^{a}	5.30±0.67^{b}	7.70±0.48^{a}	6.50±0.52^{b}
	CD$_{(0.05)}$	0.46	0.54	NS	0.46	NS	0.65
Tel Pitha	TP Control	7.40±0.51^{a}	7.80±0.63^{a}	7.40±0.51^{a}	8.00±0.47^{a}	7.90±0.31^{a}	8.40±0.69^{a}
	FTP$_1$	7.30±0.48^{a}	7.50±0.52^{ab}	7.60±0.51^{a}	7.90±0.31^{a}	7.80±0.42^{a}	7.40±0.84^{b}
	FTP$_2$	6.90±0.73^{a}	7.10±0.56^{b}	7.60±0.51^{a}	7.60±0.84^{a}	7.80±0.42^{a}	6.90±0.73^{bc}
	FTP$_3$	6.80±0.63^{a}	6.20±0.91^{c}	6.90±0.56^{b}	7.40±0.96^{a}	7.80±0.42^{a}	6.10±0.73^{c}
	CD$_{(0.05)}$	NS	0.61	0.48	NS	NS	0.71
Pat Pitha	PP Control	7.70±0.48^{a}	7.60±0.51^{a}	7.30±0.94^{a}	7.70±0.48^{a}	7.80±0.63^{a}	7.70±0.48^{a}
	FPP$_1$	7.30±0.48^{b}	7.20±0.78^{a}	7.70±0.94^{a}	7.10±0.73^{a}	7.60±0.69^{a}	7.60±0.69^{a}

	FPP_2	7.30±0.48^{b}	7.10±0.73^{a}	7.70±0.67^{a}	7.10±0.73^{a}	7.60±0.51^{a}	7.70±0.67^{a}
	$CD_{(0.05)}$	0.42	NS	NS	NS	NS	NS
Mithoi	M Control	7.30±0.82^{a}	7.20±0.63^{a}	6.90±0.73^{b}	6.80±0.78^{b}	7.70±0.67^{a}	7.00±0.66^{b}
	FM_1	7.60±0.51^{a}	7.40±0.51^{a}	7.57±1.05^{a}	7.60±0.69^{a}	7.70±0.82^{a}	7.60±0.51^{ab}
	FM_2	7.80±1.22^{a}	7.50±0.52^{a}	7.80±0.63^{a}	7.70±0.48^{a}	7.70±0.67^{a}	8.20±0.78^{a}
	$CD_{(0.05)}$	NS	NS	0.76	0.68	NS	0.61

BP control- Burbhuri Pitha Control; FBP- Finger millet Burbhuri Pitha; TP control- Tel Pitha control; FTP- Finger millet Tel Pitha; PP Control - Pat Pitha control; FPP- Finger millet Pat Pitha; M control- Mithoi control; FM- Finger millet Mithoi

Values are mean ± SD of 3 replication

Means with different superscript within the same row are significantly different at p≤0.05

NS- Non significant

3.2 Colour measurements

Colour measurements and change in colour in the developed Finger millet incorporated *Burbhuria pitha, Pat pitha, Tel pitha,* and*Mithoi* in terms of Hunter Colour Lab values are presented in Fig 7. It was observed that the colour values of all the developed products were statistically different (p≤0.05) and the L* values which correspond to lightness decreased gradually with increase level of incorporation of Finger millet flour for all the Finger millet incorporated products. The decrease in L* values of *Tel pitha,* and*Mithoi* as compared to controls might be due to the incorporation of jaggery. Similar observation was also reported by Kumar *et al.*, 2021 in jaggery incorporated biscuits where, the L* value decreased due to dark colour of jaggery. The colour intensity was also found higher in controls for each of the traditional food products in comparison to the intense of chroma of the Finger millet incorporated products. The decrease in colour intensity with increase in darker colour products with addition of Finger millet flour was also reported in waffles (Chaitra *et al.*, 2020).

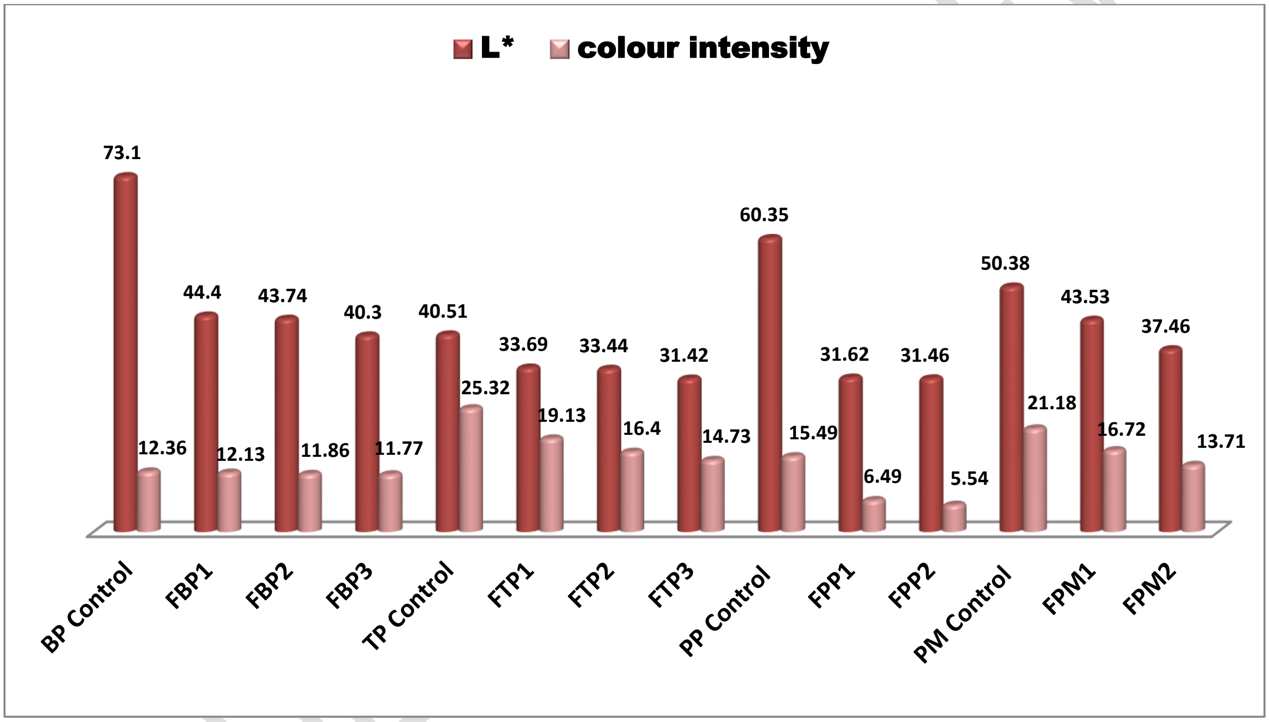


Figure 7. Colour measurement of the developed Finger millet incorporated food product

In Hunter Colour Lab L* indicates lightness or darkness (0= black, 100= white), Colour intensity [c*= (a^{*2}+b^{*2})1/2], where a* indicates the hue on the green-to-red axis (negative value= greenness, positive value= redness), b* indicates the hue on the blue-to-yellow axis (negative value= blueness, positive value= yellowness),

Values are mean ± SD of 3 replication

Means with different superscript within the same row are significantly different at $p \leq 0.05$

NS- Non significant

3.3 Nutritional Composition

The nutritional composition of the developed traditional finger millet incorporated traditional food products *Burbhuria pitha, Pat pitha, Tel pitha,* and *Mithoi*were analysed and compared (Table 3). The moisture content in the value-added products of Finger millet was significantly (p≤0.05) lower than the controlled products. Low moisture indicates that flours can be stored for longer periods without spoilage, hence showing better shelf stability(Adegunwa *et al.,* 2014).The energy content in *bhurbhuria pith*a and *Pat pitha*were notably lower compared to the controlled products, whereas the energy content in *Tel pitha* and *Mithoi*showed no significant difference. This study is on par with the variation done by Verma *et al.*, (2015) that can be attributed to the energy content of foxtail millet flour and rice flour, which were found to be 349 and 352 Kcal/100 g respectively. A statistically significant difference in energy content between these grains was observed at a 5% level of significance.

The crude protein levels in the value-added products of Finger millet were significantly lower (p≤0.05) compared to the controlled product, potentially attributed to factors such as processing likely due to the hydrolysis of native proteins into lower molecular weight proteins or peptides and an increase in enzyme activity and also the protein contain in rice is lower than finger millet. The crude fat levels in the products of Finger millet have increased and do not display significant differences compared to the controlled product, except in the case of B*bhurbhuria pitha*, likely due to the addition of oil during its preparation. This increase could be attributed to the hydrolysis of lipids and oxidation of fatty acids occurring during the cooking.

The crude fibre content in the products of Finger millet are significantly higher than the controlled products, in a study conducted by Ramashia *et al*. (2021) on native and fortified finger millet reported the crude fiber content to be from 1.90 ± 0.01 to 2.16 ± 0.51% as compared to wheat flour, This suggests that finger millet could provide additional dietary fibre in the diet. while in case of *Pat pitha* and *Mithoi*its significantly higher than the controlled products except in case of *Tel pitha* which is non – significant with the controlled product . The total carbohydrate content in the value-added products of Finger millet are significantly higher in *Bhurbhuria pitha* than the controlled product, which can be due to the carbohydrate content (73.47%, 72.97%) of finger millet flour was higher than wheat flour (Ibrahim et al., 2021). This indicates that, it could serve as a good source of energy, while in case of *Pat pitha* and *Mithoi* its significantly lower than the controlled products except in case of *Tel pitha* which was found non – significant with the controlled product. The calcium levels in the traditional products of Finger millet exhibit a significant increase compared to the controlled product. Specifically, *Mithoi* demonstrated the highest calcium content, followed by *Pat pitha*, *Tel pitha*, and *Bhurbhuria pitha* in comparison to the controlled product. This is similar to a study done by Jamale *et al*., 2022,where the incorporation of ragi flour in cookies leads to an elevation in calcium content.

TABLE 3. Nutritional Composition of the best variations from the developed Finger millet incorporated local traditional rice based recipes of Assam

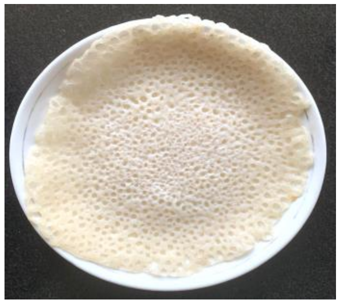
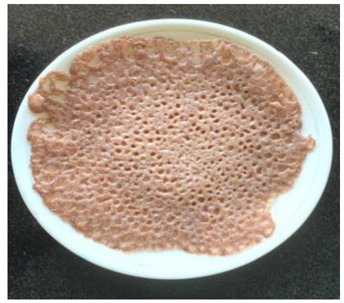
Finger millet incorporated traditional recipes		Moisture (%)	Energy (Kcal/100 g)	Crude protein (g/100 g)	Crude fat (g/ 100 g)	Crude fibre (g/100 g)	Total carbohydrate (g/100 g)	Calcium (mg/100 g)
Burbhuria Pitha	BP Control	19.86±0.48[a]	388.01±1.13[a]	9.59±0.23[a]	1.81±0.09[b]	1.81±0.09[b]	0.70±0.06[a]	83.19±0.48[b]
	FBP_2	14.18±0.25[b]	371.82±1.03[b]	4.17±0.21[b]	2.39±0.22[a]	2.39±0.22[a]	1.40±0.14[b]	81.47±0.28[a]
	$CD_{(0.05)}$	0.875	2.461	0.516	0.399	0.249	0.891	0.531
Tel Pitha	TP Control	9.46±0.24[a]	391.89±3.19[a]	5.68±0.30[a]	3.59±0.34[a]	0.54±0.09[a]	84.19±0.48[a]	18.57±0.29[b]
	FTP_1	7.65±0.25[b]	358.89±50.94[a]	4.66v0.28[b]	3.26±0.21[a]	0.62±0.15[a]	85.04±0.23[a]	47.05±0.45[a]
	$CD_{(0.05)}$	0.563	NS	0.667	NS	NS	NS	0.874
Pat Pitha	PP Control	13.13±0.79[a]	362.9±1.72[a]	7.4±0.16[a]	2.59±0.07[a]	0.72±0.01[b]	77.43±0.11[a]	10.40±0.23[b]

	FPP_2	8.13±0.57[b]	344.1±1.86[b]	5.54±0.33[b]	2.62±0.19[a]	1.38±0.15[a]	74.58±0.40[b]	47.05±0.45[a]
	$CD_{(0.05)}$	1.571	4.068	0.590	NS	0.246	0.671	0.825
Mithoi	M Control	5.21±0.66[a]	381.3±1.31[a]	5.67±0.19[a]	1.45±0.15[a]	0.48±0.17[b]	86.37±0.06[a]	17.44±0.19[b]
	FM_2	2.46±0.17[b]	381.3±1.31[a]	3.52±0.25[b]	1.51±0.26[a]	1.39±0.15[a]	83.35±0.40[b]	78.41±0.22[a]
	$CD_{(0.05)}$	1.101	NS	0.520	NS	0.373	0.656	0.484

Values are mean ± SD of 3 replication

Means with different superscript within the same row are significantly different at $p \leq 0.05$

NS- Non significant

Burbhuria pitha	 **BP Control**	 **FBP_1**	 **FBP_2**	 **FBP_3**
Tel pitha	 **TP Control**	 **FTP_1**	 **FTP_2**	 **FTP_3**

Pat pitha	 **PP Control**	 **FPP_1**	 **FPP_2**
Mithoi	 **FPM Control**	 **FPM_1**	 **FPM_2**

Figure 8. Developed Finger millet incorporated food products of Assam

4. CONCLUSION

The value addition of millets to traditional rice-based recipes of Assam enhances food security by providing a nutritious supplement to diets reliant on rice. This integration offers a holistic approach to addressing food and nutritional security challenges in the region, while also building more resilient food systems for the future. By incorporating finger millet into traditional recipes, which has been found to have higher acceptability scores and improved nutritional profiles, the overall nutritional quality of the products can be increased. By incorporating finger millets with rice, we can more effectively tackle protein malnutrition and metabolic disorders like diabetes.

Disclaimer (Artificial intelligence)

Option 1:

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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Details of the AI usage are given below:

1.

2.

3.

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