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Quality Analysis of Pearl Millet based Value-Added Indian Breakfast

Savita, *B Amita, S Veenu and K Asha
Department of Foods and Nutrition, I. C. College of Home Science
CCS Haryana Agricultural University, Hisar, Haryana, India

ABSTRACT

Pearl millet (*Pennisetum glaucum*) has been recognized for its nutritional value and resilience to harsh environmental conditions. *Jamun* seed powder is gaining attention for its potential health advantages, including anti-diabetic properties, antioxidant effects, and anti-inflammatory activities. The *Jamun* seed powder was incorporated in breakfast products at 20% levels replacing pearl millet flour. The sensory evaluation was performed by 9 Hedonic scale and the most acceptable type of products compared with control for performing nutritional composition such as proximate, minerals, in vitro digestibility, phtyic acids and polyphenols. The findings of the sensory studies revealed that *Jamun* seed powder incorporation in *Chapatti* (15%) and *Dalia* (20%) good acceptability, with minimal impact on sensory attributes and *Upma* showed a decline in acceptability at 20% *Jamun* seed powder. The addition of *Jamun* seed powder led to an increase in crude fiber (1.87 to 2.57 %), minerals like calcium (33.84 to 74.23 mg/100gm) phosphorus (158.53 211.06 mg/100gm), and zinc (1.71 to 3.53 mg/100gm), offering potential health benefits to consumers. Moreover, the decrease in phytic acid (592.23 to 487.53 mg/100gm) content indicated improved mineral bioavailability, while the rise in polyphenols (231.09 to 456.97 mg/100gm) content showcased the antioxidant potential of the fortified breakfast products. The *in-vitro* studies revealed that the protein digestibility of the products decreased (60.06 to 41.47 %) and starch digestibility was not as significant with the incorporation of *Jamun* seed powder. The findings highlight the potential of these value-added breakfast products to offer enhanced nutritional content and functional benefits, particularly for those following diabetic diets.

Key Words: Acceptability, Bajra, Breakfast products, *Jamun* seed, Nutrition.

INTRODUCTION

Pearl millet (*Pennisetum glaucum*) is a nutritious and drought-resistant cereal crop with its ability to thrive in harsh environmental conditions, and plays a crucial role in ensuring food security and sustenance for millions of people, especially in arid and semi-arid regions of India (Singh, 2003). Additionally, the crop possesses various health-promoting attributes, including a high content of dietary fiber, essential minerals, and antioxidants (Kaushik and Grewal, 2017; Vaijapurkar *et al,*2015)

Jamun, (Sygium cumini) also known as Indian blackberry, is a tropical fruit with a unique mix of nutrients and bioactive compounds, making it a valuable candidate for functional food formulations. *Jamun* seeds, in particular, are rich in polyphenols, antioxidants, (Raza *et al,*2015) and other phytochemicals that have been associated with various health benefits, including anti-diabetic, anti-inflammatory, and antimicrobial properties (Banu and Jyothi, 2016; Sidana *et al,*2016). Integrating *Jamun* seed powder into pearl millet-based breakfast products could not only enhance their nutritional value but also provide potential health advantages.

This experiment aims to conduct a comprehensive quality analysis of three pearl millet-based Indian breakfast items (*Chapatti,*

Corresponding Author's Email: amita.beniwal.hdj19@aau.ac.in

Dalia, and *Upma*) fortified with different concentrations of *Jamun* seed powder. The study evaluated the sensory acceptability, proximate composition, mineral content, in-vitro digestibility, and levels of phytic acid and polyphenols in the developed value-added breakfast products. The incorporation of *Jamun* seed powder into pearl millet-based breakfast products has the potential to create value-added, nutrient-dense alternatives that cater to diverse dietary needs and preferences. Furthermore, the research outcomes may pave the way for developing functional foods that can play a role in the prevention and management of chronic health conditions, especially diabetes, which is a major public health concern in India.

MATERIALS AND METHODS

Procurement of material

The CCS, HAU, Hisar department of Genetics and Plant Breeding was contacted to obtain the pearl millet variety (HC 10). Pearl millet grains and *Jamun* fruits were cleaned, seeds separated, and dried at 55°C, then ground into powder for storage.

Breakfast product development

Types of *chapatti* and *dalia* are such as Control (100g pearl millet flour), Type I (*Jamun* seed powder (10g), pearl millet flour (90g), Type II (*Jamun* seed powder (15g), pearl millet flour (85g), Type III (*Jamun* seed powder (20g), pearl millet flour (80g).

Chapatti

Ingredients: Pearl millet flour, *Jamun* seed powder, water (70 ml), salt (½tsp) used in equal amount in all types of developed *chapatti.*

Method

Sieved pearl millet flour, *jamun* seed powder and salt. Prepared soft dough by adding small amount of warm water slowly to the flour mixture. Divide dough into equal portions and made round balls, made flat *chapatti.* Cook *chapatti* on a hot griddle from both the sides until golden brown and applied ghee on each *chapatti*.

Dalia (salted)

Ingredients: Pearl millet flour, *Jamun* seed powder, sweet corn kernels (5g), carrot (10gm, green peas (10g), salt (1g), red chili and turmeric powder (½tsp), water (for boiling).

Method

Boiled pearl millet grits in a pan and blanched all the vegetables in another pan. Roasted *jamun* seed powder on griddle. Put ghee to a wok, added blanched vegetables and fried for a minute. Added *jamun* seed powder and all the spices along with some water in the wok. Added boiled pearl millets grits, stirred continuously and cooked for 2-3 minutes.

Upma

Ingredients: Pearl millet grits, semolina*, Jamun* seed powder, salt (1g), oil (15ml), Mustard seeds and *Urad dal* (½tsp), Curry leaves (5), onion (10g), green chili (1g), carrot (15g), green peas (10g), water (160ml). The types of *upma* such as Control (100g pearl millet grits (50g), Semolina (50g), Type I (*Jamun* seed powder (10g), pearl millet grits (45g), semolina (45g), Type II (*Jamun* seed powder (15g), pearl millet grits (42.5g), semolina (42.5g), Type III (*Jamun* seed powder (20g), pearl millet grits (40g), semolina (40g).

METHOD

Roasted pearl millet grits, semolina and *jamun* seed powder, and kept aside. Boiled pearl millet grits, carrots and peas in pressure cooker till two whistles. In another pan heated oil and added mustard seeds. After the crackling of mustard seeds, added *urad dal*, peanuts. Fried for a minute. Added curry leaves and then onion and green chillies. Fried till onions gets slightly golden in colour. Added semolina and *jamun* seed powder and stirred for 2-3 minutes. Added boiled pearl millet grits and vegetables along with the rest of the water. Simmered the *upma* for 2-3 minutes. Kept stirring so that *upma* does not stick to the pan. Garnished with coriander leaves and served.

Sensory evaluation

The *upma, dalia, chapatti* were subjected to sensory evaluation using 9-point hedonic scale by a semi-trained panel comprising of 10 judges. All the acceptable biscuits were subjected to nutritional analysis (Peryam *et al*, 1957).

Nutritional analysis

AOAC, (2000) standard methods of analysis were used to establish the proximate composition of biscuits. After samples were dried at 60°C until their weight remained constant, the moisture content was assessed. The automatic KEL-PLUS CLASSIC DX apparatus was used to estimate crude protein using the micro-Kjeldahl method. Utilizing the Soxhlet extraction device, crude fat was calculated. The standard technique of analysis was used to calculate the crude fiber and ash contents (AOAC, 2000). According to Lindsay and Norwell's (1969) approach, the total mineral content was calculated. The modified Mertz *et al*. (1983) approach was used to estimate in-vitro protein digestibility; Singh *et al* (1982) method was used to determine starch digestibility. Phytic acid in the samples was evaluated using Davies and Reid's method from 1979, and Singh and Jambunathan's method from 1981 was applied to extract the polyphenols. The quality evaluation data were statistically analysed, using mean, standard error and ANOVA according to the standard method (Sheoran and Pannu, 1999).

RESULTS AND DISCUSSION

Organoleptic acceptability of pearl millet based *jamun* seed incorporated products (Table 1)

In the breakfast products, as the percentage of *Jamun* seed powder increased (from Type I to Type III), there was a gradual decrease in the mean scores for all attributes (Color, Appearance, Aroma, Texture, Taste, and Overall acceptability) but the products were acceptable up to 20% level of supplementation. This suggests that higher concentrations of *Jamun* seed powder negatively impacted the overall sensory appeal of the pearl millet-based products. The decrease in acceptability scores could be attributed to several factors such as the change in color and appearance could be a result of the color of *Jamun* seed powder or alterations in the product's visual appeal due to its incorporation.

Chapatti: The mean overall acceptability scores of control *chapatti* were significantly highest (7.86) followed by the mean scores of Type I and Type II *chapatti* (7.26 and 6.77), both under 'liked moderately' category whereas Type III *chapatti* was in the category of 'liked slightly' with mean overall acceptability scores of 6.20.

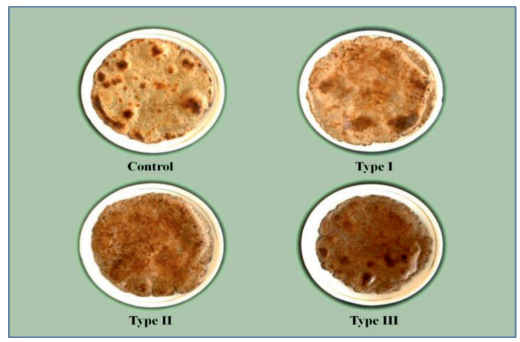

Plate 1: *Chapatti*

Dalia: the control and Type I *dalia* acceptability scores fell under the category of 'liked very much'. All the sensory parameters of Type II *dalia* and aroma, texture and taste of Type III *dalia* were in the category of 'liked moderately' while the color, appearance and overall acceptability mean scores of Type III *dalia* were under 'liked slightly' category.

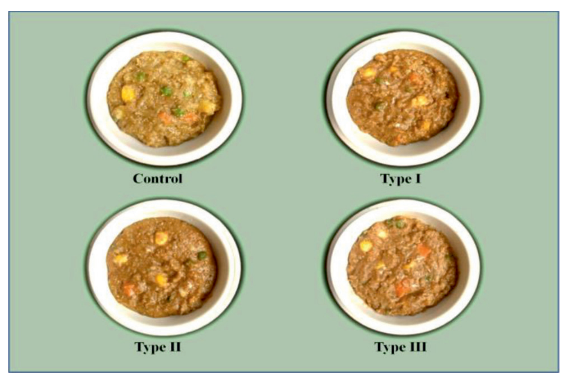

Plate 2: *Dalia*

Upma: All sensory parameters of Type I *upma* fell under that category of 'liked very much'. The overall acceptability scores of Type I upma were highest (7.98, 'liked very much') followed by the control (7.92, 'liked very much'), Type II (7.19,

Table 1. Mean scores for organoleptic acceptability of pearl millet based *jamun* seeds incorporated products.

Product	Color	Appearance	Aroma	Texture Taste	Overall acceptability	
Chapatti						
Control	8.00±0.21	6.70±0.33	7.80±0.20	7.80±0.20	7.80±0.20	7.86±0.20
Type I	7.30±0.21	7.10±0.28	7.50±0.17	7.60±0.16	6.80±0.29	7.26±0.19
Type II	6.65±0.15	6.70±0.33	7.10±0.22	7.00±0.25	6.40±0.30	6.77±0.21
Type III	6.00±0.21	6.20±0.42	6.40±0.27	6.70±0.30	5.70±0.34	6.20±0.24
C.D.(P≤0.05)	0.57	NS	0.62	0.67	0.82	0.61
Dalia						
Control	8.10±0.18	8.00±0.21	7.80±0.25	7.90±0.23	8.20±0.20	8.00±0.19
Type I	7.60±0.22	7.70±0.21	7.60±0.22	7.60±0.22	7.70±0.26	7.64±0.20
Type II	6.80±0.25	6.70±0.26	7.00±0.21	7.00±0.21	6.70±0.26	6.84±0.20
Type III	6.30±0.26	6.20±0.25	6.70±0.15	6.70±0.21	6.50±0.34	6.48±0.16
C.D.(P≤0.05)	0.66	0.68	0.61	0.63	0.78	0.54
Upma						
Control	8.40±0.16	8.30±0.21	7.90±0.10	7.60±0.22	7.40±0.27	7.92±0.14
Type I	8.10±0.23	8.30±0.21	8.10±0.23	7.60±0.27	7.80±0.33	7.98±0.19
Type II	7.35±0.15	7.35±0.15	7.55±0.22	7.05±0.16	6.65±0.28	7.19±0.16
Type III	6.50±0.17	6.50±0.17	7.10±0.23	6.50±0.22	6.40±0.16	6.60±0.14
C.D.(P≤0.05)	0.52	0.54	0.59	0.64	0.77	0.45

Type I, Type II and Type III chapatti contained 10, 15 and 20 per cent *Jamun* seed powder, Control did not contain *jamun* seed powder, Values are mean ± SE of ten independent determinations

'liked moderately') and Type III (6.60, 'liked moderately'). The study provided valuable insights into the potential challenges of incorporating *Jamun* seed powder into these pearl millet-based products without compromising their organoleptic acceptability. Further research and formulation adjustments might be necessary to improve the sensory appeal while retaining the potential health benefits of *Jamun* seeds in these products. The other studies reported by Priyanka and Mishra *et al* (2015) and Mahalakshmi *et al* (2022) showed that supplementation of *Jamun* seed powder at 10% level in value added products (biscuits, snacks) were organoleptically acceptable. On the contradictory, the Thorat and Khemnar (2015) reported that *Jamun* seed powder up to 40% level of incorporation in cookies was organoleptically acceptable.

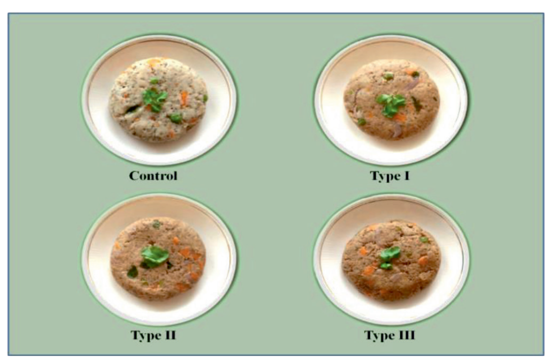

Plate 3: *Upma*

Nutritional analysis of pearl millet based *jamun* seeds incorporated breakfast products

Proximate

The data (Table 2) show the proximate composition (expressed as a percentage of dry matter) of pearl millet-based traditional breakfast products, namely *Chapatti, Dalia, and Upma*. The moisture content of *Chapatti, dalia* and *upma* decreased (ranged 25.83 to 68.34%) slightly with the addition of *Jamun* seed powder, but the difference was not statistically (24.90 to 67.69% in type I) significant (NS).Crude Protein content (8.53 to 12.43%) showed a decreasing (7.36 to 11.46%) trend with the increasing concentration of *Jamun* seed powder in *chapatti* and *dalia* but no significant differences recorded in upma. Ether extract (7.77 to 17.10%) exhibited a significant (7.25 to 16.66%) decrease (P<0.01) with the addition of *Jamun* seed powder. Ash content remained relatively consistent across all samples (2.27 to 3.14%), with no significant difference (2.20 to 2.98 % in control) observed. Crude fiber content significantly increased (P<0.01) in *chapatti, dalia* (1.87 to 2.34%) nut no significant in *upma* (2.30 to 2.57%) as the percentage of *Jamun* seed powder increased. Overall, the results demonstrate that the addition of *Jamun* seed powder to the pearl millet-based traditional breakfast products can influence their nutritional profile. While there is a reduction in protein and fat content, the increase in crude fiber content is an encouraging aspect. These findings can be valuable for consumers and food manufacturers looking to develop healthier breakfast options enriched with the potential health benefits of *Jamun* seeds. Further research and taste tests could help optimize the formulation to strike a balance between nutritional enhancement and sensory acceptability. The findings of this study were consistent with previous research on the incorporation of *jamun* seed powder in value added products. Mahalakshmi *et al* (2022) reported an increase in nutrients content in value added products without loss in the physiochemical and medical properties of *jamun* seed powder. The results of breakfast control products were in agreement with the result reported by Dayakar *et al* (2018).

Table 2. Proximate composition of pearl millet based *jamun* seeds incorporated traditional breakfast products (% dry matter basis)

Products	Moisture	Protein	Fat	Ash	Crude fiber
Chapatti					
Control	25.83±0.90	9.31±0.34	7.77±0.13	2.20±0.04	1.87±0.07
Type I	24.90±0.26	8.71±0.01	7.25±0.18	2.27±0.80	2.17±0.09
t-value	1.72^{NS}	2.96^{NS}	3.99**	1.22^{NS}	4.51**
Dalia					
Control	68.34±0.45	12.43±0.20	17.10±0.10	2.57±0.10	2.03±0.14
Type I	67.69±0.47	11.46±0.47	16.66±0.07	2.75±0.14	2.34±0.08
t-value	1.72 ^{NS}	3.25*	6.00**	1.81 ^{NS}	5.24**
Upma					
Control	57.10±0.30	8.53±0.45	16.10±0.10	2.98±0.12	2.30±0.30
Type I	57.04±1.33	7.36±0.40	15.77±0.09	3.14±0.16	2.57±0.11
t-value	0.06 ^{NS}	3.69*	4.15**	1.33 ^{NS}	1.49 ^{NS}

Type I, Type II and Type III contained 10, 15 and 20 per cent *Jamun* seed powder , Control did not contain *jamun* seed powder, Note: * - significant (P<0.05), **- significant (P<0.01), NS - non significant, Values are mean ± SE of three independent determinations

Table 3. Total mineral content of pearl millet based *jamun* seeds incorporated traditional breakfast products (mg/100g, dry matter basis)

Products	Calcium	Phosphorus	Iron	Zinc	Magnesium
Chapatti					
Control	33.84±0.44	161.51±1.03	6.05±0.12	3.04±0.12	88.56±1.60
Type I	50.91±0.06	158.53±2.05	6.26±0.10	3.52±0.30	91.85±0.96
t-value	66.44**	2.23 NS	2.27 NS	2.51 NS	3.04*
Dalia					
Control	55.33±5.67	211.06±5.76	7.28±0.10	2.70±0.09	154.90±1.96
Type I	70.35±3.09	192.55±2.88	7.35±0.06	3.09±0.11	149.65±3.95
t-value	4.02**	4.97**	1.06 NS	4.70**	2.05 NS
Upma					
Control	59.16±0.56	181.23±1.35	6.23±0.20	1.71±0.02	79.03±0.35
Type I	74.23±2.22	172.66±2.14	6.45±0.07	2.30±0.06	79.70±0.94
t-value	11.36**	5.85**	1.70 NS	14.63**	1.14 NS

Type I, Type II and Type III contained 10, 15 and 20 per cent *Jamun* seed powder , Control did not contain *jamun* seed powder, Note: * - significant (P<0.05), **- significant (P<0.01), NS - non significant, Values are mean ± SE of three independent determinations

Mineral

The data (Table 3) revealed that calcium content significantly increased (P<0.01) in the presence of *Jamun* seed powder (Type I, 50.91 to 74.23 mg/100gm) compared to the controls (33.84 to 59.16mg/100gm) of breakfast products. Phosphorus content ofcontrol and Type I of *dalia* was 211.06 and 192.55mg/100g and *upma* was 181.23 and 172.66mg/100g. Significant difference in phosphorus content was found in control and Type I *dalia* and *upma* whereas control and Type I of *chapatti* showed no significant difference. A non significant difference was observed between the iron content of control (6.05 to 7.28 mg/100gm) and Type I (6.26 to 7.35 mg/100gm) of breakfast products. Zinc content of control and Type I of *dalia* was 2.70 and 3.09mg/100g and *upma* was 1.71 and 2.30mg/100g. Significant difference was observed between zinc of control and Type I *dalia* and *upma* whereas control and Type I of *chapatti* showed no significant difference. The magnesium content of control and Type I of breakfast products ranged from 79.03 to 154.90mg/100g and 79.70 to 149.65mg/100g. Significant difference was observed between control and Type I treatment of *chapatti* whereas in *dalia* and *upma* the difference was not significant. The incorporation of *Jamun* seed powder in pearl millet-based traditional breakfast products positively influenced their mineral content, particularly in terms of calcium, phosphorus, zinc, and, in some cases, iron. Phosphorus is a mineral that is abundant in millets (Devi *et al* 2011) and other mineral such as zinc, calcium, and magnesium. It includes necessary amino acids and vitamins, which support its medicinal qualities, as well (Rao *et al* 2017). This result is consistent with Balasubramaniam’s (2013) and Rao *et al* (2017) claim that millets are a good source of iron and calcium respectively. The breakfast products (idli, dosa, idiyappam, kichadi, kozhukattai) with millets at different ratio developed are good source of minerals. These results indicate that the addition of *Jamun* seed powder can enhance the nutritional value of these breakfast items, making them more nutrient-dense and potentially contributing to improved overall health.

In vitro studies and Phytic acid and polyphenols

The data (Table 4) regarding *in-vitro* protein digestibility showed a significant (45.60 to 60.06%) decrease (P<0.05) with the addition of 10% *Jamun* seed powder (Type I, 41.47 to 56.19%) in *chapatti and dalia* but non-significant difference were recorded in *upma* (58.15 to 54.12%). *In vitro* starch digestibility exhibited a significant decrease in *chapatti* and *upma* (P<0.05) in samples with *Jamun* seed powder but did not show a significant difference in *dalia*. *In vitro* starch digestibility in controls and Type I treatments of traditional breakfast products ranged from 20.66 to 27.73 mg maltose released/g and 22.69 to 32.49 mg maltose released/g. Phytic acid content significantly (481.37 to 592.23mg/100gm) decreased (P<0.01) with the addition of *Jamun* seed powder (Type I, 455.34 to 533.46 mg/100gm)) in all products. Polyphenols content significantly increased (P<0.01) in *chapatti* and *upma* with *Jamun* seed powder but a non significant difference was recorded in *dalia.* The polyphenols content ranged from 244.26 to 456.94 mg/100g in Type I treatment and 231.09 to 445.44 mg/100g in controls of breakfast products. The incorporation of *Jamun* seed powder into pearl millet-based traditional breakfast products affected their nutritional and bioactive components. While in-vitro protein and starch digestibility decreased in some cases, the reduction in phytic acid content and the increase in polyphenols content are promising findings. These changes may contribute to improved mineral bioavailability and enhanced antioxidant potential, making the products potentially more nutritious and health-beneficial. Further studies on the in-vivo effects of these changes and the overall impact on human health are warranted to support these findings.

CONCLUSION

The nutritional analysis of the developed breakfast products showcased the potential for enriching the products with essential nutrients. The addition of *Jamun* seed powder led to an increase in minerals like calcium, phosphorus, and zinc, offering potential health benefits to consumers. Moreover, the decrease in phytic acid content

Table 4. *In-vitro* studies, phytic acid and polyphenols of pearl millet based *jamun* seeds incorporated traditional breakfast products (dry matter basis)

Products	*In-vitro* studies		Phytic acid (mg/100g)	Polyphenols (mg/100g)
	Protein digestibility (percent)	Starch digestibility (mg maltose released/g)		
Chapatti				
Control	45.60±2.11	20.66±0.76	592.23±7.00	445.44±2.15
Type I	41.47±1.06	22.69±0.74	533.46±3.85	456.94±2.32
t-value	3.02*	3.28*	12.73**	6.28**
Dalia				
Control	58.15±0.35	24.52±1.11	522.37±1.19	378.89±2.40
Type I	54.12±1.09	26.35±0.61	487.53±2.58	381.14±1.09
t-value	6.03**	2.49 NS	21.22**	1.47 NS
Upma				
Control	60.06±1.35	27.73±0.56	481. 37±1.06	231.09±0.25
Type I	56.19±2.45	32.49±5.76	455.34±5.07	244.26±3.20
t-value	2.38 NS	1.42 NS	8.69**	7.08**

Type I, Type II and Type III contained 10, 15 and 20 per cent *Jamun* seed powder , Control did not contain *jamun* seed powder, Note: * - significant (P<0.05), **- significant (P<0.01), NS - non significant, Values are mean ± SE of three independent determinations indicated improved mineral bioavailability, while the rise in polyphenols content showcased the antioxidant potential of the fortified breakfast products. The in-vitro studies demonstrated that the protein digestibility of the products decreased with the incorporation of *Jamun* seed powder. However, the decrease in *in-vitro* starch digestibility was not as significant, indicating that the functional properties of the products remained largely intact, making them viable as diabetic-friendly food options. The findings highlight the potential of these value-added breakfast products to offer enhanced nutritional content and functional benefits, particularly for those following diabetic diets. The results of this study hold significant implications for the food industry and public health initiatives, fostering the adoption of nutritious and sustainable dietary choices among the Indian population.

REFERENCES

AOAC (2000). *Official Methods of Analysis*. Association of Official Analytical Chemists, Washington, D.C. USA.

Balasubramanian S (2013). Possessing of millets. *Paper presented at National Seminar on Recent Advances in processing, utilization and nutritional impact of small millets.* Madurai Symposium, Thamukkam Grounds, Madurai, 13 September.

Banu J and Jyothi A (2016). Hypoglycemic and Hypo Cholesterolemic Effect of Eugenia Jambolana (Kala Jamun) Spicy Mix on Type II Diabetic Subjects. *Imperial J Interdisciplinary Res* **2** (4): 850-857.

Davies N T and Reid H (1979). An evaluation of the phytate, zinc, copper, iron and manganese contents of, and Zn availability from, soya based textured- vegetable-protein meat- substitutes or meat- extenders. Bri J Nut 41(3): 579-589.

Dayakar R, Sangappa B, Vishala A D, Arlene C G D and Tonapi V A (2016). *Technologies of Millet Value Added Products. Centre of Excellence on Sorghum.* ICAR-Indian institute of Millets Research. Rajendranagar, Hyderabad, India.pp 48.

Devi P B, Vijayabharathi R, Sathyabama S, Malleshi N G and Priyadarisini V B (2011). Health benefits of finger millet (*Eleusine coracana* L.) polyphenols and dietary fiber: a review. *J Food Sci and Technol* **51**(6): 1021-1040.

Kaushik I and Grewal R (2017). Antinutrient and Mineral Content of Thirteen Different Varieties of Pearl Millet Locally Grown in Haryana, India. *Int J Curr Microbiol App Sci* **6**(5): 2136-2143.

Lindsey W L and Norwell M A (1969). A new DPTA Tea soil test for zinc and iron. *Agron Abst* 61: 84.

Mahalakshmi R, Devisri S, Wins J A, Ganguly P, Chawla N and Ahamed M I N (2022). Formulation of value-added products from jamun seed without loss in the physicochemical and medical properties.*Turkish J Physiotherapy and Rehabilitation* **32** (2).

Mertz E T, Kiresis A W and Sxtell J D (1983). In vitro digestibility of protein in major food cereals. *Fed Proc 32*(5): 6029.

Peryam D R and Pilgrim F J H (1957). Hedonic scale method of measuring food preferences. *Food Technol* pp. 9-14.

Priyanka and Mishra A A (2015). Development And Quality Evaluation Of Jamun Powder Fortified Biscuits Using Natural Sweeteners. Int J Sci Engineering Technol (3): 796-801.

Rao B D, Bhaskarachary G D, Arlene C G, Sudha D V, Tonapi A (2017). *Nutritional and Health Benefits of Millets.* Indian council of Millets Resaearch, IIMR, Hyderabad

Raza A, Ali M A, Nisar T, Qasrani S A, Hussain R and Sharif M N (2015). Proximate composition of Jamun (*Syzygium cumini*) fruit and seed. *American-Eurasian J Agric & Environ Sci* **15** (7): 1221-1223.

Sheoran O P and Pannu R S (1999). *Statistical Package for agricultural workers*. "O. P. Stat" College of Agriculture, Kaul, CCS Haryana Agricultural University, Hisar. India.

Sidana S, Singh V B, Meena B L, Beniwal S, Singh K and Kumar D (2017). Effect of *Syzygium cumini* (jamun) seed powder on glycemic control: A double-blind randomized controlled trial. *J Med Soc* **31**: 185-189.

Singh G (2003). *Development and Nutritional Evaluation of Value Added Products from Pearl Millet* (*Pennisetum glaucum)*. Ph.D Thesis, CCSHAU, Hisar, India.

Singh U and Jambunathan R (1981). Studies on desi and kabuli chickpea (Cicerarietinum) cultivars, level of protease inhibitors, level of polyphenolic compounds and in vitro protein digestibility. *J Food Sci* **46**: 1364-1367.

Singh U, Khedekar M S and Jambunathan R (1982). Studies on desi, kabuli chickpea cultivators. The level of amylase inhibitors, levels of oligosaccharides and in vitro starch digestibility. *J Food Sci* **47**:510.

Thorat A V and Khemnar M B (2014). Development and Sensory Evaluation of Jamun Seed Powder Fortified Cookies. *Int J Sci Res* **4**(10): 184-187.

Vaijapurkar K R, Rudrawar B D, Dambalkar V S and Poojari V R (2015). Development and standardization of bajra (Pennisetum glaucum) biscuits with added pomegranate peel powder and their physical and sensory attributes. *Int J Sci Res* **4**(10): 952-956.

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