

Studies on physico-chemical properties of papad prepared from different cultivar of pearl millet

ND Kalange, UD Chavan, PM Kotecha, PA Pawase

Department of Food Science and Technology, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India

Abstract

The present investigation on “Studies on Physico-Chemical properties of papad prepared from different cultivar of pearl millet” was undertaken with the objective to study nutritional composition of pearl millet papad and to identify the superior genotype of pearl millet for papad preparation. Newly released pearl millet varieties such as *Dhanshakti*, *Phule Mahashakti*, *Phule Aadishakti* and one local rice were used for present investigation. The *Dhanshakti* content 12.50 per cent moisture, 12.25 per cent protein, 5.48 per cent fat, 1.21 per cent crude fiber, 10.66 mg/100 g iron and 52.18 mg/100 g calcium. The *Phule Mahashakti* content 12.30 per cent moisture, 11.59 per cent protein, 5.68 per cent fat, 1.31 per cent crude fiber, 10.31 mg/100 g iron and 51.40 mg/100g calcium. The *Phule Aadishakti* content 12.33 per cent moisture, 11.16 per cent protein, 5.50 per cent fat, 1.19 per cent crude fiber, 10.83 mg/100g iron and 54.58 mg/100g calcium. The rice local market sample used for control content 11.50 per cent moisture, 7.97 per cent protein, 5.45 per cent fat, 0.32 per cent crude fiber, 1.8 mg/100g iron and 18.30 mg /100 g calcium. The experiment were carried out in Factorial Randomized Design, 11 treatments, 3 replications and two packaging material up to 90 days storage study. After primary sensory evaluation treatment T₈ (80% pearl millet flour with 20% rice flour) of *Dhanshakti* variety, T₅ (50% pearl millet flour with 50% rice flour) of variety *Phule Mahashakti* and *Phule Aadishakti* were selected. Among this three selected treatments papad prepared from *Dhanshakti* variety shows best results. Papad prepared from *Dhanshakti* variety contains 10.20 per cent moisture, 11.13 per cent protein, 5.47 per cent fat, 1.02 per cent crude fiber, 45.40 mg/100g calcium and 8.88 mg/100g iron.

During storage study the chemical parameter such as moisture content of papad was increases in both packaging material and the chemical parameter such as protein, fat, crude fiber, calcium and iron were decreased in both packaging material and this might be due to increase in moisture percentages but the product packed in LDPE material showed better results as compare to product stored in PP material.

Keywords: pearl millet, nutritional value, pearl millet papad, physico-chemical properties

Introduction

Pearl millet is consumed in the form of leavened and unleavened breads, porridges, boiled or steamed food and beverages. Various types of traditional health food can be prepared from pearl millet such as *bhakar*, *Roti*, *Bundi laddu*, *Burti*, *Chakli*, *Chiwada Dive*, *Kharibundi*, *Khichadi*, *Masala papad*, *Thalipeeth and Vade*. Pearl millet has been recommended for several therapeutic purposes, as it has been found to inhibit tumour development (Huang and Ferraro, 1982) [6], control blood pressure and plasma low-density lipoprotein cholesterol levels (Asp NG., 1996) [3] and possesses anti-allergenic characteristics. Due to its high fibre content, pearl millet is also recommended for the treatment of severe constipation, stomach ulcers, and weight loss. The major categories of traditional foods where pearl millet can be effectively used like fermented and unfermented flatbreads, fermented and unfermented thin and thick porridges, steamed and boiled products, snack foods, alcoholic and non-alcoholic beverages. Cakes, cookies, pasta, a parboiled rice-like product and snack foods have been successfully produced (Schober *et al.*, 2005) [16].

Pearl millet is nutritionally superior to major cereals with respect to energy value, proteins, fat and minerals. It provides more energy than wheat, as the oil content, at 4.2 per cent, is higher (Klopfenstein and Hosoney, 1995, Mc Donough *et al.*, 2000; Malik *et al.*, 2002; Sehgal and Kawatra, 2006) [8, 12, 10, 17].

Materials and Methods

The experiment was conducted in the laboratory of Department of Food Science and Technology, Post Graduate Institute at Mahatma Phule Krishi Vidyapeeth, Rahuri during the year 2019-2020.

Packaging material

The packaging materials like polypropylene (PP) and low density polyethylene (LDPE) were purchased from the local market.

Ingredients

The grains of three pearl millet varieties viz., *Dhanshakti*, *Phule Mahashakti* and *Phule Aadishakti* were purchased from All India Coordinated Research Project on Pearl millet, Dhule. Local variety of rice and other ingredients were purchased from local market of Rahuri.

Table 1: Ingredients required for pearl millet papad preparation

Sr. No.	Ingredients	Quantity
1.	Pearl millet and rice flour mixture	1 kg
2.	Salt	32 g
3.	Papad khar	10 g
4.	Black pepper	1.200 g
5.	Sesame seed	20 g
6.	Asafoitida	0.50 g
7.	Water (as per requirement)	1000 ml

Treatment Details

Based on preliminary trials, the experimental work plan was prepared with details of the treatment as given in table no. 2

Table 2: Treatments for preparation of papad with combinations of rice flour

Treatments	Pearl millet flour (%)	Rice flour (%)
T ₀	00	100
T ₁	10	90
T ₂	20	80
T ₃	30	70
T ₄	40	60
T ₅	50	50
T ₆	60	40
T ₇	70	30
T ₈	80	20
T ₉	90	10
T ₁₀	100	00

Method

Procedure for pearl millet papad preparation

The procedure for preparation of pearl millet papad is shown in fig. 1.

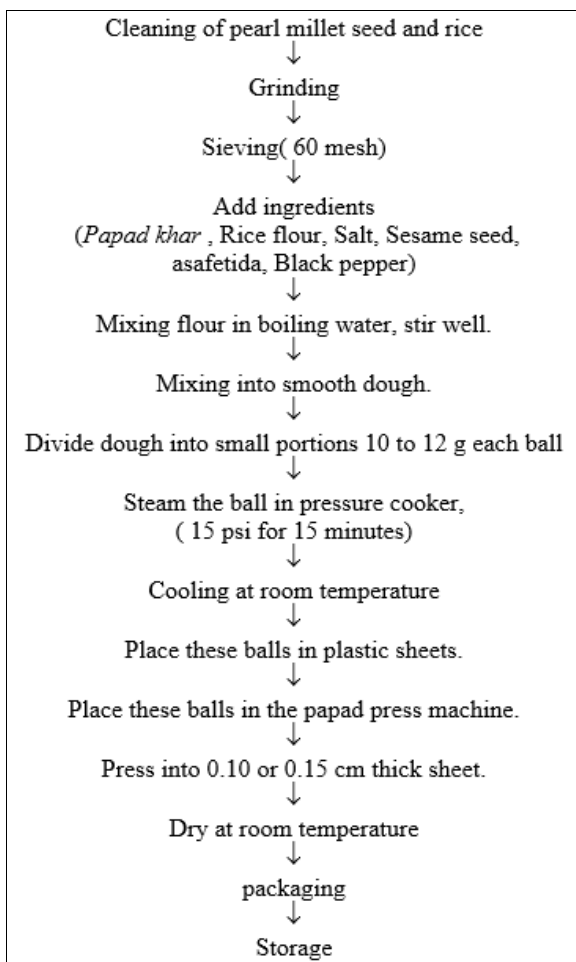


Fig 1: Flow chart for preparation of pearl millet papad
Physico-chemical analysis of raw material

The method described in A.O.C.C. (2000) [2] for determining moisture was used. The protein content of papad was estimated by determining total nitrogen content using standard Micro-Kjeldhal method and fat content of the papad estimated by the soxhlet method A.O.A.C (2000) [2]. The crude fiber content in the product was estimated by

A.O.A.C. (2000) [2]. Calcium content of selected sample was estimated by EDTA method and iron were analyzed using atomic absorption spectrometry (AAS).

Packaging and storage of cookies

All selected treatments were packed in polypropylene (PP) and low density polyethylene (LDPE) and stored for 90 days. The samples were drawn at an interval of 30 days and evaluated for chemical quality.

Statistical analysis

All experiments were carried out by using Factorial Completely Randomized Design (FCRD). The data obtained in the present investigation were analyzed for the statistical significance according to the procedure given by Rangaswamy (2010) [15].

Results and Discussion

Physical properties of pearl millet grains and rice

Table 3: Physical properties of pearl millet grains and rice

Physical parameter	Dhanshakti	Phule Mahashakti	Phule Aadishakti	Rice
1000 kernel wt. (g)	9.90	10.30	10.00	21.30
Colour	Dark grey	Light grey	Brownish grey	White
True density (kg/m ³)	1.12	1.31	1.22	1.52
Bulk density (kg/m ³)	0.76	0.84	0.75	0.80
Porosity (%)	47.76	48.30	46.20	47.07

Seeds of *Dhanshakti* variety bears dark grey colour while the colour of variety *Phule Mahashakti* is light grey and *Phule Aadishakti* is brownish grey coloured variety. The porosity values of *Dhanshakti*, *Phule Mahashakti*, *Phule Aadishakti* and rice are all according to Mohsenin, 1970. Thousand seed weight of variety *Dhanshakti*, *Phule Mahashakti* and *Phule Aadishakti* recorded by using method given by Waseem, (2012) [21]. Bulk density of variety *Phule Mahashakti* was 0.84 kg/m³ which was higher than any other two varieties.

Chemical compositions of pearl millet and rice grains

Table 4: Chemical composition of raw material

Chemical composition	Dhanshakti	Phule Mahashakti	Phule Aadishakti	Rice
Moisture (%)	12.50	12.30	12.33	11.50
Protein (%)	12.25	11.59	11.16	7.97
Fat (%)	5.48	5.68	5.50	5.45
Crude fiber (%)	1.21	1.31	1.19	0.32
Iron (mg/100g)	10.66	10.31	10.83	1.8
Calcium (mg/100g)	52.18	51.40	54.58	18.30

*Each value represents the average of three determinations

The results on chemical composition of raw material i.e. Pearl millet and rice are comparable with findings reported by other scientists such as Kulthe *et al.* (2016) [9], Nithya *et al.*, 2007 [14], Ullah *et al.*, 2016 [20], Azhari *et al.*, 2017 and Kirti and jha, 2017 [7]. The values are also comparable with Serna-Saldivar and Rooney (1995) [18] and Souchi, Fuchmann and Kraut, 1986 [19]; Eggum, 1967, 1977, 1979 [5]

Selection of best combination for preparation of pearl millet papad from different cultivars

On the basis of organoleptic properties (Colour and appearance, flavour, texture, taste and overall acceptability) Treatment T₈ (80% pearl millet flour + 20% rice flour) selected for *Dhanshakti* variety, Treatment T₅ (50% pearl millet flour + 50% rice flour) selected for *Phule Mahashakti* variety and treatment T₅ (50% pearl millet flour + 50% rice

flour) selected for *Phule Aadishakti* variety

Physical characteristics of papad prepared from pearl millet

The present result showed that the pearl millet flour mixed with different proportion of rice flour can be used for papad preparation with good physical and chemical properties.

Table 5: Physical characteristics of papad prepared from pearl millet.

Treatments	Colour of papad	No. of papad/kg	Thickness of papad (mm)	Diameter of papad before frying (cm)	Diameter of papad after frying (cm)	Expansion (%)	Wt. of papad (g) before frying	Wt. of papad (g) after frying	Oil absorption (%)
T ₀	White	60.000	0.061	7.500	12.400	65.300	4.190	7.390	76.4
T ₁	Faint grey	65.000	0.076	6.667	10.300	54.65	6.120	7.580	23.9
T ₂	Dark grey	58.000	0.061	9.000	12.457	38.33	5.080	6.990	37.6
T ₃	Whitish grey	59.000	0.070	10.000	11.150	11.50	5.190	7.090	36.6
Mean	-	60.5	0.067	8.29	11.57	-	5.145	7.265	-
C:D	-	2.208	0.002	1.363	0.136	-	0.019	0.019	-
S.E(m)	-	0.667	0.001	0.412	0.041	-	0.006	0.006	-
S.E(d)	-	0.943	0.001	0.582	0.058	-	0.008	0.008	-
C:V	-	1.903	1.493	8.599	0.613	-	0.194	0.138	-

*All results are mean value of five replications

T₀: Standard rice papad (100% rice flour),

T₁: Papad prepared from *Dhanshakti* variety (80% pearl millet flour: 20% rice flour),

T₂: Papad Prepared from *Phule Mahashakti* (50% pearl millet flour: 50% rice flour),

T₃: Papad Prepared from *Phule Aadishakti* (50% pearl millet flour: 50% rice flour)

Chemical composition of fresh pearl millet and rice papad

Results for moisture per cent of all selected treatment ranges between 10.12 -11.30 per cent. Similar results were found by Math *et al.* (2004) [11]. *Dhanshakti* variety of pearl millet is protein rich variety. The fat content was obtained for papad prepared from rice was 5.45 per cent. Papad prepared from *Phule Aadishakti* variety of pearl millet had highest amount of fat and this might be due to equal content *Phule Aadishakti* flour and rice flour. Obtained results showed quite similarity with Serna- saldivar and Rooney (1995) [18]. Fiber per cent was obtained in T₁ treatment i.e.

1.02 per cent. For selected treatments of T₂ and T₃ analyzed crude fibers were 0.80 and 0.72 per cent. *Phule Aadishakti* is calcium rich variety but in treatment T₁, proportion of pearl millet flour used was higher i.e. 80 per cent that's why papad of T₁ treatment shows maximum percentage of calcium than T₃. The results obtained for iron content for *Dhanshakti* papad, *Phule Mahashakti* papad and *Phule Aadishakti* papad were 8.88, 6.05, 6.30 mg/100g respectively. The papad prepared from *Dhanshakti* variety had higher iron content. Obtained results showed similarity with Aisha and Jamuna (2015) [1].

Table 6: Chemical composition of fresh dried pearl millet and rice papad

Sample	Moisture (%)	Protein (%)	Fat (%)	Crude fiber (%)	Calcium (mg/100g)	Iron (mg/100g)
T ₀	11.30	6.85	5.45	0.30	18.10	1.82
T ₁	10.20	11.13	5.47	1.02	45.40	8.88
T ₂	10.17	9.77	5.55	0.80	34.85	6.05
T ₃	10.12	9.56	5.62	0.72	36.44	6.30
Mean	10.44	9.32	5.52	0.71	33.69	5.76
C: D	0.036	0.033	0.039	0.035	0.040	0.038
S.E(m)	0.012	0.011	0.013	0.011	0.012	0.012
S.E(d)	0.016	0.016	0.016	0.015	0.017	0.016
C:V	0.192	0.204	0.360	2.565	0.062	0.346

*Each value represents the average of three determinations

T₀: Control rice papad (100% rice flour),

T₁: Papad prepared from *Dhanshakti* variety (80% pearl millet flour: 20% rice flour),

T₂: Papad prepared from *Phule Mahashakti* (50% pearl millet flour: 50% rice flour),

T₃: Papad prepared from *Phule Aadishakti* (50% pearl millet flour: 50% rice flour).

Effect of packaging material and storage period on chemical composition of pearl millet papad during storage

Selected treatments of pearl millet papad remained in good condition at ambient temperature during the entire storage

period of 3 months. The papad stored in Low Density Polyethylene bags (LDPE) showed good quality than Polypropylene (PP) during three months of storage

Table 7: Effect of packaging material and storage period on chemical composition of pearl millet papad during storage

Parameter	Moisture (%)	Protein (%)	Fat (%)	Crude fiber (%)	Calcium mg/100g	Iron Mg/100g
Treatment						
T ₀	11.78	6.27	5.13	0.17	17.56	1.50
T ₁	10.78	10.56	5.16	0.84	44.30	7.18
T ₂	10.72	9.27	5.20	0.63	33.20	5.91
T ₃	10.70	9.19	5.32	0.58	34.50	5.44
S.E. \pm	0.005	0.005	0.005	0.026	0.08	0.005
CD at 5%	0.013	0.013	0.015	0.075	0.23	0.013
Packaging material						
P ₀	10.99	8.86	5.22	0.57	33.01	5.16
P ₁	11.00	8.79	5.18	0.55	31.76	4.85
S.E. \pm	0.003	0.003	0.003	0.019	0.058	0.003
CD at 5%	NS	0.009	0.010	NS	0.166	0.009
Storage period						
C ₁	10.55	9.23	5.46	0.61	33.14	5.48
C ₂	11.06	8.81	5.20	0.57	32.46	5.13
C ₃	11.38	8.43	4.94	0.49	31.56	4.41
S.E. \pm	0.004	0.004	0.004	0.023	0.072	0.004
CD at 5%	0.012	0.012	0.012	0.065	0.203	0.012
Interaction						
T ₀ P ₀ C ₁	11.35	6.80	5.40	0.27	18.08	1.80
T ₀ P ₀ C ₂	11.90	6.10	5.12	0.20	18.05	1.50
T ₀ P ₀ C ₃	12.10	5.93	4.98	0.13	18.03	1.30
T ₀ P ₁ C ₁	11.40	6.78	5.35	0.21	17.90	1.70
T ₀ P ₁ C ₂	11.80	6.03	5.02	0.15	16.50	1.45
T ₀ P ₁ C ₃	12.15	5.90	4.92	0.11	15.90	1.25
T ₁ P ₀ C ₁	10.30	11.10	5.45	0.99	45.30	8.80
T ₁ P ₀ C ₂	10.95	10.92	5.18	0.93	44.70	7.90
T ₁ P ₀ C ₃	11.13	9.80	4.90	0.81	43.30	6.50
T ₁ P ₁ C ₁	10.35	10.98	5.40	0.95	44.90	7.50
T ₁ P ₁ C ₂	10.90	10.50	5.15	0.89	43.70	6.90
T ₁ P ₁ C ₃	11.25	9.08	4.83	0.78	42.90	5.50
T ₂ P ₀ C ₁	10.20	9.70	5.50	0.75	34.85	6.00
T ₂ P ₀ C ₂	10.75	9.18	5.19	0.66	33.50	5.70
T ₂ P ₀ C ₃	11.13	8.98	4.95	0.57	32.80	4.90
T ₂ P ₁ C ₁	10.30	9.60	5.47	0.68	33.40	5.90
T ₂ P ₁ C ₂	10.78	9.13	5.13	0.61	32.80	5.60
T ₂ P ₁ C ₃	11.18	8.96	4.90	0.55	31.90	4.30
T ₃ P ₀ C ₁	10.15	9.50	5.61	0.70	36.40	6.25
T ₃ P ₀ C ₂	10.74	9.34	5.37	0.62	35.70	5.80
T ₃ P ₀ C ₃	11.25	9.02	5.03	0.53	34.50	5.50
T ₃ P ₁ C ₁	10.35	9.45	5.57	0.67	34.30	5.90
T ₃ P ₁ C ₂	10.70	9.08	5.20	0.51	33.80	5.10
T ₃ P ₁ C ₃	11.05	8.78	5.00	0.47	32.30	4.10
S.E. \pm	0.011	0.012	0.012	0.064	0.202	0.012
CD at 5%	0.032	0.033	0.033	NS	0.576	0.033

*All results are results of ten replications

Where,

- T₀: Control (Standard) rice papad (100% rice flour)
 T₁: Papad prepared from *Dhanshakti* variety of pearl millet (80% pearl millet flour: 20% rice flour)
 T₂: Papad prepared from *Phule Mahashakti* variety (50% pearl millet flour: 50% rice flour)
 T₃: Papad prepared from *Phule Aadishakti* variety (50% pearl millet flour: 50% rice flour)
 P₀: LDPE packaging material
 P₁: PP packaging material
 C₁: Storage study at 30 days,
 C₂: Storage study at 60 days,
 C₃: Storage study at 90 days.

Conclusion

The result showed that the papad prepared from *Dhanshakti* variety i.e. T₈ (80% pearl millet flour and 20% rice flour)

had better results as compared to prepared from *Phule Mahashakti* and *Phule Aadishakti* variety. It is evident from all the physical, chemical properties. Papad prepared with 80 per cent pearl millet flour of *Dhanshakti* variety and 20 per cent rice flour is the best in all aspects and also has good frying quality like puffiness, crispiness and expansion as compare to other therefore, from the present investigation it is concluded that the variety *Dhanshakti* released by MPKV, Rahuri is best suited for the papad snack product preparation.

References

1. Aisha SA, Jamuna P. Antioxidant properties of digestive enzyme-treated fibre-rich fractions from wheat, finger millet, pearl millet and sorghum: A comparative evaluation. *Cogent Food and Agriculture*. 2015; 1:1073875.

2. AOAC. Official Method of Analysis, 18th edition. Association of Official Analytical Chemist. Washington DC, 2000,454.
3. Asp NG. Dietary Carbohydrate Classification by Chemistry and Physiology. *Journal of Food Chemistry*. 1996; 7:9-14.
4. Azhari AMN, Adiamo OQ, Awad RM, Babiker EE. Changes in chemical composition and total energy as affected by fermentation and/or cooking of pearl millet flour supplemented with moringa or fenugreek seeds flour. *International Food Research Journal*. 2016; 24(4):1562-1570.
5. Eggum BO. The nutritional value of rice in comparison with other cereals. In proceedings, workshop on chemical aspects of Rice grain quality. Los Bunos, Laguna, The Philippines IRRI, 1979, 91-111.
6. Huang MT, Ferraro T. Phenolic compounds in food and their effects on health II. In Phenolics compounds in food and cancer prevention, Huang, M T., Ho, C. T., Lee, C. Y.; American Chemical Society, Washington D.C Hulse. Laing and Pearson. 1980: United States National Research Council/National Academy of Sciences. USDA/HNIS. 1982; 507:8-34.
7. Kirti RJ, Jha SK. Development of pearl millet-based pasta as a functional food, 2017. <http://krishikosh.egranth.ac.in/handle/1/5810038390>
8. Klopfenstein CF, Hosoney RC. Nutritional properties of sorghum and the millets. In D.A.V. Dendy (Ed.), *Sorghum and millets: chemistry and technology*, 1995, 125-168.
9. Kulthe AA, Thorat A, Lande SB. Influence of different carotene sources on quantity of beta carotene enriched pearl millet cookies. *Advances in Life Science*. 2016; 5(3):5477-5482.
10. Malik M, Singh U, Dahiya S. Nutrient composition of pearl millet as influenced by genotypes and cooking methods. *Journal of Food Science and Technology*. 2002; 39(5):463-468.
11. Math RG, Velu V, Nagender A, Rao DG. Effect of frying condition on moisture, fat and density of papad. *Journal of Food Engineering*. 2004; 64(2):429-434.
12. Mc Donough C, Rooney M, Lloyd W, Serna-Saldivar SG. The millets. *Cereal Sci. Technol*. 2000; 99:177-210.
13. Mohsenin NN. Physical properties of plant and animal materials. Gordon and Breach Science Publishers, New York, 1970, 51-83.
14. Nithya KS, Ramachandramurthy B, Krishnamoorthy VV. Effect of processing methods on nutritional and anti-nutritional qualities of hybrid (COHCU-8) and traditional (CO7) pearl millet varieties of India. *Journal of Biological Science*. 2007; 7(4):643-647.
15. Rangaswami R. A Textbook of Agriculture Statistics, Second edition, New Age International Publisher. New Delhi, 2010, 234-458.
16. Schober TJ, Messerschmidt M, Bean SR, Park SH, Arendt EK. Gluten-free bread from sorghum: Quality differences among hybrids. *Cereal Chemistry*. 2005; 82:394-404.
17. Sehgal AS, Kawatra A. Nutritional evaluation of pearl millet-based sponge cake. *Journal of Food Science and Technology*. 2006; 43(3):312-313.
18. Serna M, Saldivar S, Rooney LW. Structure and chemistry of sorghum and millets. In *sorghum and millets: Chemistry and technology*, 1995, 69-124.
19. Souci SW, Fuchmann W, Kraut H. Food composition and nutrition tables 1986/87, 3rd rev. ed. Stuttgart, Wissen Schaftloche Verlagsgeseil schaft.
20. Ullah TS, Saeed F, Arshad NBMU, Anjum FM, Afzaal M, Ullah A, *et al.* Assessment of therapeutic potential of pearl millet iron fortified cookies through animal modeling. *Asian J. Chem*. 2016; 28(11):2545-2548
21. Waseem MM. Studies on popping and flecking characteristics of selected sorghum cultivars. M. Tech. Thesis. College of Food Technology, Dr. Vasant Naik Marathwada Krishi Vidyapeeth, Parbhani, 2012.