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RESEARCH ARTICLE

PHYSICO-CHEMICAL ANALYSIS AND ORGANOLEPTIC EVALUATION OF PAPADS PREPARED FROM JOWAR MILLET FLOUR

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ABSTRACT

The study was conducted in the laboratory of the Department of Food Science, Periyar University, Salem, to determine the chemical composition, texture and flavor. Papads were prepared from black gram, incorporating jowar millet flour. All the ingredients were collected from the local market. Five different types of papads were prepared using 0%, 5%, 10%, 15%, 20% jowar flour with other ingredients. The product was analyzed for proximate composition, physical and chemical analysis and organoleptic evaluation. The result revealed that moisture, protein, fat, ash and total carbohydrate content in the dried papads samples were found in the range of 7.06 to 8.36%, 8 to 16%, 4.05 to 5.3%, 2.5 to 4.5% and 67.34 to77.89% respectively. The samples were highly acceptable by the subjects and physical properties were almost same with control papads. No remarkable changes in moisture content, texture and flavour were observed up to 6 months of storage in ambient condition (27 to 35°C) indicating that the products were shelf-stable up to 6 months.

INTRODUCTION

Sorghum is the primary food crop of rural people of Karnataka and Maharastra states. It is grown both in rainy and post rainy seasons. The productivity of rainfed sorghum has increased from 741 kg/ha to 1375 kg/ha during 1970 to 2000. Even though there is steep rise in productivity, the area under rainfed sorghum has decreased from 13 lakh hectares during 1970 to 4.5 lakh hectare during 2000. Jowar an important staple food crop in Africa, South Asia and Central America. Jowar is the 5th major cereal crop in the world after wheat, rice, maize and barley. Globally, it produces approximately 70 million metric tons of grains from about 50 million hectares of land (ICRISAT Annual Report, 1996).

In India Sorghum millet or jowar is grown in Maharashtra, Karnataka, Madhyapradesh, Andhra Pradesh, Gujarat and Tamil Nadu. Jowar is rich in carbohydrate and B-complex vitamins. It is poor in Vitamin A and rich in dietary fiber. Compared to rice, jowar is richer in protein but the equality is not as good as rice protein. Since cereal and legume proteins are complementary to other jowar and any legume in the ratio of 70:30 will give better nutritional value (Srilakshmi 2003). It provides more 85% of all human energy. Today, it is the dietary stable of more than 500 million people in more than 30 countries. Decrease in area of rainfed sorghum is because of decline in consumption of this coarse cereal owing to change in food habits, increase in standard of life and consumer's preference to rice and wheat. Moreover, rainfed sorghum crop is usually caught in the rains at the time of maturity during September resulting in discolored grains due to molds on the grains as such the sorghum grains are not completely covered by glumes unlike other cereals like wheat, paddy and maize.

This impairs nutritive value and fetches low price, and thus makes it low remunerative crop. However, there is lot of demand for high biomass producing sorghums, which meet the demand of dairy farmers by supplying green fodder. Further there is a lot of scope for sweet sorghum from which ethanol will be produced and utilized for mixing with petrol in automobiles. Sweet sorghums are known for their high biomass production when grown during rainy season. Realizing the increasing requirements for fodder due to increase in the animal population and greater demand for milk products and for ethanol there is urgent need to initiate research work on sweet sorghum and to identify the genotypes which are either high fodder yielding or suited for ethanol production or else suited for both purposes. If so, rainy sorghum area can be diverted for production of forage and ethanol production. The present study illustrated the chemical and physical analysis and organoleptic studies of papads with a view to determine the chemical composition, organoleptic evaluation and shelf life.

MATERIALS AND METHODS

Jowar flour

Mature jowar grains were winnowed remove chaff ,dust and other foreign materials and washed twice with

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water . The cleaned jowar grains were then dried under sun and it's grained into fine powder. Then the flour was packed in a high density polethene bags, sealed &stored.

Black gram flour: Black gram flour was processed which free from immature and field damage. Using grain cleaner, the foreign materials were removed. The clean and fresh black gram grinded in a huller mill. The black gram flour was packed in a high-density polythene bags, sealed and stored.

Mung flour : Mung flour (10.1% moisture and 24.5% protein) used in the study was commercial mung flour (Norani Flour Ltd, 277 Tejgaon Industrial Area, Dhaka).

Grasspea flour : Khasari flour was processed from BARI khasari-1 varieties, free from immature and field damage. Using grain cleaner, the foreign materials were removed. The clean and fresh grasspea flour grinded in a huller mill. The grasspea flour was packed in a high-density polythene bags, sealed and stored.

Chemicals and solvents and ingredients

Chemicals and solvents used in the study were of analytical reagent grade and water was glass-distilled unless specified otherwise. Cumin seeds, asafetida, sodium carbonate, sodium bi carbonate, black pepper and other ingredients were procured from the local market.

Basic formulation of papads

Five different types of papads formulations were prepared by substituting jowar flour instead of black gram flour and the composition is given in Table 1.

Table 1. Formulas of jowar based papads

Ingredients (%)	S1	S2	S3	S4	S5
Jowar	-	5	10	15	20
Black gram (mashkoli dhal)	25	20	15	10	05
Grasspea dhal(Khasari dhal)	50	50	50	50	50
Mungbean dhal	25	25	25	25	25
Black cumin	0.5	0.5	0.5	0.5	0.5
Common sault	0.6	0.6	0.6	0.6	0.6
Black pepper	0.5	0.5	0.5	0.5	0.5
Cumin seeds	0.5	0.5	0.5	0.5	0.5
Water	50	50	50	50	50
Mustard oil	12.5	12.5	12.5	12.5	12.5

S1-Control; S_2- 5 percent incorporation of Jowar millet flour; S_3- 10 percent incorporation of Jowar millet flour; S4- 15 percent incorporation of Jowar millet flour; S5- 20 percent incorporation of Jowar millet flour

Preparation of Papads from Jowar Millet Flour

Papad is an important snack food item prepared from the flour. The preparation involves gelatinization of the jowar flour with minimum quantity of water. The jowar flour was mixed with requisite quantity of other ingredients as shown in Table1. All the ingredients were mixed in a mixture to make dough. After 30 min. resting the dough was divided into balls of about 2-3 cm dia weighing 5-6 gm. These were rolled into thin circular discs of about 1 mm thickness using rolling pin. The papads were dried in drier at 50°C. The dried papads at this stage contained about 12-13% of moisture. The dried papads were then packed in polythene bags. These dried papads were consumed by deep frying in oil. The final products usually undergo 2-3 times expansion on frying. It is crisp and can be consumed as a side dish. The preparation of jowar papads is presented in Figure 1.

Mixing (All the ingredients)
↓
Doughing
↓
Making small round shape dough
↓
Rolling
↓
Drying in the drier (50°C-1 hr)
↓
Packaging
↓
Frying

Figure 1. Flow chart for production of jowar papads

Chemical analysis of papads

Processed papad samples were analyzed for moisture content, ash, fat, protein and total carbohydrate. All the determinations were done in triplicate and the results were expressed as the average value.

Moisture content

Moisture content was determined adopting AOAC (1984) method as following:

$$\% \text{ Moisture content} = \frac{\text{Loss in weight}}{\text{Weight of sample}} \times 100$$

Ash

Drying the sample at l00°C and charned over an electric heater. It was then ashed in a Muffle furnace at 550°C for 24 hrs. It was calculated using the following formula:

$$\% \text{ Ash content} = \frac{AW}{IW} \times 100$$

Where, AW = Weight of ash and IW = Initial weight - dry matter

Fat

AOAC (1984) method using soxhlet apparatus was used to determined crude fat content of the samples. The percent of crude fat was expressed as follows:

$$\% \text{ Crude fat} = \frac{\text{Weight of dried ether soluble material}}{\text{Weight of sample}} \times 100$$

Protein

Protein content was determined using AOAC (1975) method. Percentage of nitrogen and protein calculated by the following equation:

$$\% \text{ Nitrogen} = \frac{T_S - T_B \times \text{Normally of acid} \times \text{meq. of N2}}{\text{Weight of sample (in gram)}}$$

Where, Ts = Titre volume of the sample (ml), T_B = Titre volume of Blank (ml), Meq. of N_2 = 0.014 and % Protein = Nitrogen × 5.7

Total carbohydrate

Total carbohydrate content of the samples were determine as total carbohydrate by difference, that is by subtracting the measured protein, fat, ash and moisture from 100 (Pearson, 1976).

Physical Characteristics of Papads

Various physical parameters of dough such as kneading time, appearance and dough weight are analyzed for 5 types of papads developed using millets, pulses and its blends. About raw papads their diameter, width of the papads and percentage of expansion after frying are assed using ISI (1972) methods. Time taken for frying each variety of papads after complete doneness is also assessed. Oil content of the each papads (25) is assessed using standard technique.

Organoleptic Evaluation of the Papads

The developed papads fried in the refined oil at 175±2° C were served to a group of 30 semi-trained panelists for the evaluation of colour, texture, taste, aroma and overall acceptability on a 9 point hedonic scale with a scores ranging from 9to1 where scores 9 to1 represented like extremely and dislike extremely respectively was used for evaluating the developed papads.

Storage studies of papads

The papads along with control sample were stored at ambient temperatures (27°C to 35°C) for a period of 6 months. The stored papads were analyzed initially at an interval of 15 days up to one month, then at an interval of 30 days for the rest period. During storage studies the change in moisture content, texture and flavour were observed.

RESULT AND DISCUSSION

Proximate composition of jowar flour, mung flour, mashkalai flour (black gram) and khasari flour: The moisture, protein, fat, ash and total carbohydrate content of jowar flour were 11.9%, 10.4%, 1.9%, and 72.6% respectively (Table 2). These findings are in agreement with those reported by Gopalan et al. (1971), Krishna and Geervani (1996), Kawamura (1967) and Wolf (1984). The moisture, protein, fat, ash and total carbohydrate content of black gram flour were 10.9, 24.0, 1.4, 0.9 and 62.8%, respectively (Table 2). The mung flour contained 10.1% moisture, 24.5% protein, 1.2% fat, 0.8% ash and 63.4% total carbohydrate (Table 2). The khasari flour contained 10.0% moisture, 28.2% protein, 0.6% fat, 2.3% ash and 58.9% total carbohydrate (Table 2). The little variations observed may be due to the varietal difference, seed quality, agro-ecological condition, fertilizer use, extent of drying, storage conditions, methods of analyses etc.

Table 2. Composition of Jowar flour, Black gram flour and Rice flour

Components	Jowar flour	Black gram flour	Mung flour	Khasari fiour
Moisture (%)	11.9	10.9	10.1	10.0
Protein (%)	10.4	24.0	24.5	28.2
Fat (%)	1.9	1.4	1.2	0.6
Ash (%)	1.6	0.9	0.8	2.3
Total carbohydrate (%)	72.6	62.8	63.4	58.9

Chemical composition of papad: In the present study 5 different samples of papads were S1 (control papad), S2 (50% khasari flour, 25% mung flour, 20% mashkalai flour and 5% jowar flour containing papad), S3 (50% khasari flour, 25% mung flour, 15% mashkalai and 10% jowar flour containing papad), S4 (10% khasari flour, 25% mung flour, 50% mashkalai and 15% jowar flour containing papad) and S5 (50% khasari flour, 25% mung flour, 05% mashkalai and 20% jowar flour containing papad).

Moisture Content: The moisture content of 5 different papad samples processed with different levels of jowar flour, black gram was in the range of 10.33 to 10.10% (Table 3). The table 3 also showed that the moisture content of control papads was highest than those of jowar flour fortified papads.

Table -3: Chemical composition

Papad samples	Moisture (%)	Protein (%)	Fat (%)	Ash (%)	Total carbohydrate (%)
S1	10.33	24.13	1.06	1.53	62.95
S2	10.20	23.92	3.14	1.49	60.86
S3	10.17	23.45	2.59	1.45	60.95
S4	10.13	22.97	2.11	1.23	63.03
S5	10.10	21.86	1.43	1.04	64.7

Protein Content: The protein content of 5 different papads samples S1, S2, S3, S4 &S5 were 24.13, 23.92, 23.45, 22.97 and 21.86% respectively. The result (Table 3) also shows that the protein content was slightly increased due to increased percentage of jowar flour.

Fat Content: The fat content of processed jowar papad sample S1, S2, S3, S4 &S5 were 1.06, 3.14, 2.59, 2.11 and 1.43% respectively. From table 3, it is evident that the fat content of jowar papads and control papad were different. Fat content was high (3.14) in S2 and lowest in S1.

***Ash Content*:** The ash minerals content of different papads samples S1, S2, S3, S4 &S5 were 1.53, 1.49, 1.45, 1.23 and 1.04 % respectively. The maximum ash was found in sample S1 (1.53) and lowest in sample S5.

Total Carbohydrate: The total carbohydrate content of different samples S1, S2, S3; S4 &S5 were 62.95, 60.86, 60.95, 63.03 and 64.7% respectively. From table 3, it may be noted that the total carbohydrate content of papads variations was higher than control papad. The variation in the carbohydrate content of the papads may result from the difference in the level of protein, fat, ash and moisture content.

Table - 4: Physio - Chemical Properties of Papads

Criteria	Variations				
	S1	**S2**	**S3**	**S4**	**S5**
Diameter of raw papads (cm)	5	4.6	4.4	4.7	4.5
Width of raw papads(mm)	0.74	0.81	0.73	0.87	0.83
Kneading time (min) of papads	4	4	4	3.5	4
Cooking time (sec) of papads	10	8	10	11	11
Oil content of papads (g)	0.3	0.3	0.4	0.3	0.2
Diameter of fried papads (cm)	7.2	6.2	6.3	6.8	6.6
Width of fried papads (mm)	1.38	1.27	1.24	1.30	1.32

The Physio-Chemical Properties of the papads are given in table 4. The diameter of S4 variety was found to be maximum with a value of 4.7cm and 6.8cm respectively. Regarding width of the raw and fried papads, the highest value of 0.87 mm &1.30mm respectively was obtained for S4 variety. Regarding kneading time for jowar papads, the maximum time of 4 minutes was taken

Table 5: Mean Acceptability Scores of Jowar Papads

Type of variation	Appearance	Colour	Flavour	Texture	Taste	Overall acceptability
S_1	8.80±0.42[b]	8.90±0.31[b]	8.70±0.48[b]	8.80±0.42[b]	9.00±0.00[d]	8.90±0.31[b]
S2	8.30±0.67[ab]	6.70±0.48[a]	8.10±0.73[ab]	7.50±1.26[a]	7.90±0.99[bc]	8.90±0.78[a]
S3	8.00±0.47[a]	6.50±0.52[a]	7.90±0.73[a]	7.00±1.24[a]	7.10±1.10[ab]	7.90±0.87[a]
S4	7.90±0.73[a]	6.40±0.51[a]	8.00±0.81[ab]	6.50±1.08[a]	8.10±0.87[c]	8.30±0.67[ab]
S5	7.90±0.73[a]	6.70±1.05[a]	7.70±1.15[a]	7.30±1.05[a]	6.60±1.07[a]	8.00±0.66[a]
F-ratio	3.780	27.450	2.130	6.541	10.468	3.202
P-value	0.010*	0.000**	0.093[NS]	0.000**	0.000**	0.021*

**-Significant at 0.01% level; *-Significant at 0.05% level; NS-No significant
Values with different superscripts are significantly different from each other on application of Duncan multiple Range test.

Table 6. The effects of storage time on physio-chemical properties of jowar papad

Period of storage (days)	Papad sample	Observations			Remarks
		Moisture content (%)	Texture	Flavour	
0	S1	10.33			
	S2	10.23			
	S3	10.20	Crisp	Good	Good
	S4	10.13			
	S5	10.04			
15	S1	10.35			
	S2	10.27			
	S3	10.23		Good	Good
	S4	10.16	Crisp		
	S5	10.09			
30	S1	10.35			
	S2	10.27			
	S3	10.20	Crisp	Good	Good
	S4	10.16			
	S5	10.06			
60	S1	10.36			
	S2	10.28			
	S3	10.23	Crisp	Good	Good
	S4	10.16			
	S5	10.06			
90	S1	10.37			
	S2	10.30	Crisp	Good	Good
	S3	10.28			
	S4	10.16			
	S5	10.06			
120	S1	10.39			
	S2	10.30			
	S3	10.26	Crisp	Good	Good
	S4	10.23			
	S5	10.17			
150	S1	10.40			
	S2	10.36			
	S3	10.30	Crisp	Good	Good
	S4	10.26			
	S5	10.21			
180	S1	10.43			
	S2	10.37			
	S3	10.31	Less crisp	Slight rancid	Freshness declined
	S4	10.26			
	S5	10.20			

by S2, S3, S5 variations. About the mean time taken for frying the maximum time (11sec) is taken by S4and S5 variations. The mean value of oil up taken by the jowar papads were more(0.4g) by S3 variation compare to the rest of the variation.

The mean acceptability score obtained by the sensory evaluation of jowar papads are in table 5. Among the different variations of jowar papad control has got a highest score of 8.80 followed by the variation S2 with a score of 8.30 and the least core 7.90 is obtained by both the variation S4 and S5for the appearance attributes. Regarding the colour attributes the highest score 8.90 is obtained by control with the following variation S2 with the scores of 8.10. The texture attribute was found to be maximum for the control with a score of 8.80 and the followed by the variation S2 with the score of 7.50. Regarding the taste attribute, the highest score of 9.00 is obtained by the control which is followed by the variation S4 with the score of 8.10. The overall control with a score of 8.90 and is followed by the variation S4 with a score of 8.30.

Duncan's test reveals that there was significant difference between standard and other variations for colour for texture attributes. For appearance attributes the significant difference between standard and S2 and also the significant difference exists for the variation standard with S2, S3. Regarding the taste attribute there was significant difference between standard and S2, S4 & S5.

Storage studies of dried jowar papad

The shelf life of the processed papad was studied for a period of 6 months at ambient conditions (room temperature). No remarkable change in moisture content, texture and flavour were observed upto 6 months of storage. After 5 months of storage greater increase in moisture content was noticed. The papad samples became less crisp and also developed rancid flavour. The processed jowar fortified papad samples were shelf-stable up to 5 months of storage at ambient conditions. The effects of storage time on physio-chemical properties of jowar papad are shown in Table 6.

CONCLUSION

Jowar flour was prepared in a Huller mill from dehulled, treated and dried jowar. Similarly black gram flour, mung flour, and grasspea flour were prepared in a Huller mill. The moisture, protein, fat, ash and total carbohydrate content of Jowar flour were 11.9%, 10.4%, 1.9%, and 72.6%, respectively. The moisture, protein, fat, ash and total carbohydrate content of black gram flour were 10.9, 24.0, 1.4, 0.9, 1.6 and 62.8%, respectively. The protein, fat, ash, carbohydrate content of grasspea flour 10.0, 28.2, 0.6, 2.3 and 58.9%. The papad shows high acceptability score compare with control product. No remarkable change in moisture content, texture and flavour were observed up to 6 months of storage in ambient conditions indicating that the products were shelf-stable up to 6 months.

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