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Monika Sood
Division of Food Science and Technology, Faculty of Agriculture, SK University of Agricultural Sciences and Technology of Jammu, Chatha, Jammu, Kashmir, India

Julie D Bandral
Division of Food Science and Technology, Faculty of Agriculture, SK University of Agricultural Sciences and Technology of Jammu, Chatha, Jammu, Kashmir, India

Neeraj Gupta
Division of Food Science and Technology, Faculty of Agriculture, SK University of Agricultural Sciences and Technology of Jammu, Chatha, Jammu, Kashmir, India

Correspondence
Monika Sood
Division of Food Science and Technology, Faculty of Agriculture, SK University of Agricultural Sciences and Technology of Jammu, Chatha, Jammu, Kashmir, India

Effect of incorporation of jamun pulp on the quality characteristics of crackers

Monika Sood, Julie D Bandral and Neeraj Gupta

Abstract
The demand for designer food products having specific nutritional/functional attributes is on the increase worldwide. The objective of this study was to explore the suitability of incorporating different amount of jamun pulp powder (0, 5, 10, 15, 20 and 25 per cent) in crackers to enhance dietary fiber content. Physicochemical and sensory properties of samples containing jamun pulp were examined and compared with control crackers. The mean width (4.00 cm) and thickness (0.40 cm) were observed highest in treatment T_1 (control). Incorporation of jamun pulp powder led to increase in crude fibre (2.51 to 2.81 %), ash (2.41 to 2.70%) and carbohydrate (64.94 to 66.24%) content of crackers. Sensory evaluation of crackers revealed that 15% jamun pulp powder recorded highest mean score for overall acceptability (8.11). Overall results suggest that jamun pulp is a potential functional food ingredient high in fiber content that may be processed into powder and used in food applications, such as baked goods.

Keywords: Jamun, crackers, protein, fat, fibre, overall acceptability

Introduction
Jamun (*Syzygium cumini* L.) is an evergreen tropical tree in the flowering plant family Myrtaceae, native to India and Indonesia. Jamun (*Syzygium cumini* L.) also known as Indian blackberry has long been used as a traditional medicine to cure various lifestyle diseases such as diabetes, cardiovascular diseases, age related macular degeneration and others (Sagrawat *et al*., 2006) [1]. It is minor fruit enriched with flavanoids, essential oils, anthocyanins, phenolic compounds and other antioxidants. Jamun pulp contains 19.7 per cent carbohydrates, 0.7 per cent proteins, 0.1 per cent fat, 0.9 per cent fibre, 0.02 per cent calcium, 0.01 per cent phosphorous and 0.1 per cent iron (Benherlal and Arumughan, 2007) [2].
The upcoming trends in the food industry focus on the theme of health and wellness, thus, there is a need to explore the opportunities to combine various food sources and develop a wholesome healthy product. Incorporation of fruit in cereal products creates excellent opportunities for new product development. The era of combination of cereal-fruits and vegetable is rising in view to enhance the antioxidant status of cereal based products. Cereal products are high in protein content compared to fruits and vegetables whereas fruits and vegetables are high in bioactive compounds such as carotenoids, ascorbic acid and phenolic acids (anthocyanins, tannins). Therefore, combination of the two can serve the dual purpose in a diet making the diet rich in proteins as well as phytochemicals in the finished product (Francis and Phelps, 2003) [3]. Cracker is one of the most popular ready-to-eat snack foods that are readily available throughout the year. Crackers contain little sugar, moderate levels of fat and relatively low levels of salt (Han *et al*., 2010) [4]. Consequently, crackers can be used as a good substitute for sweeter snacks. Along with, crackers can be utilized as a source of incorporation of different nutritionally rich ingredients for the diversification (Sudha *et al.*, 2007) [5]. The jamun fruits possess very good processing qualities and are used for the preparation of different value added products such as squashes, jellies, wine, vinegar, juice, etc. (Nawaz, 2010) [6].
Incorporation of jamun pulp in the whole wheat flour can help improve the nutritional status of crackers. Therefore, the present investigation has been carried out to study the utilization of *jamun* (*Syzygium cumini* L.) pulp in whole wheat flour and to assess the physical, proximate and sensory characteristics of j*amun* pulp supplemented crackers. However, report on utilization of jamun fruit or its fraction for development of functional foods is scanty.

Material and Methods

Raw materials

Jamun (*S. cumini* L.) fruit and wheat flour was obtained from local market.

Fresh and fully ripe jamun fruits were washed thoroughly under running tap water. *Jamun* fruits were gently heated in its own juice on hot plate maintained at 60 °C for 10 min. Seeds were removed manually and uniform pulp was collected by passing the seedless material through fruit strainer. The pulp was spread as a thin layer on trays of dimension 40 × 80 cm and dried in cabinet hot air at 40 ± 5 °C for 8 h. The position of trays was interchanged periodically and the material was dried till constant weight was attained. The dried pulp was then powdered and stored in airtight containers for further use.

Development of jamun blended crackers

Crackers were prepared from blends of wheat-jamun powder (in various ratios of 5, 10, 15, 20 and 25%) and other ingredients (water, baking powder, shortening, cheese, salt and sugar) according to formulation described by Kohajdova *et al.* (2013) [7]. Wheat flour was used for preparation of control crackers. Preparation of crackers included these operations: mixing of dry and liquid ingredients, 10 minutes resting of dough, sheeting and cutting into square shape. The crackers were baked in three deck oven at 210 °C for 8 to 10 minutes and cooled to room temperature. The prepared crackers were packed in aluminium laminate (150 gauge) and then stored for a period of 90 days at room temperature. The stored products were analyzed for physico-chemical and sensory characteristics at a regular interval of 30 days.

Physical parameters and proximate composition of blended crackers

Thickness and width of crackers was measured by using vernier caliper. Spread ratio was calculated by dividing width with thickness. All the samples of jamun blended crackers were analysed for moisture (AOAC, 1995) [8], crude protein (N × 6.25, Micro Kjeldhal method of AOAC, 1995) [8], crude fat (AOAC, 1995) [8], ash (AOAC, 1995) [8], fibre (AOAC, 1995) [8] and carbohydrates (AOAC, 1995) [8].

Sensory evaluation

Sensory evaluation depends upon the responses given by different sense organs. The samples were evaluated on the basis of colour, texture, taste, crispness and overall acceptability by semi-trained panel of 7-8 judges by using 9 point hedonic scale assigning scores 9- like extremely to 1- dislike extremely

Statistical analysis

The data obtained were statistically analyzed using CRD factorial for interpretation of results through analysis of variance. Data was compared at 5 per cent level of significance.

Results and discussion

Effect of storage on proximate composition of jamun blended crackers

A general increase in moisture content (Table 2) took place during the storage period and it was found that moisture content increased from its initial value 3.80 to 4.23% after 90 days of storage. The maximum moisture content of 4.31% was recorded in treatment T_1 (control) and minimum of 3.76% was observed in treatment T_6 (25% Jamun pulp powder). Similar results regarding moisture content were reported by Owusu *et al*. (2011) [9] in commercial crackers. The increase in moisture content of crackers might be due to hygroscopic nature of wheat flour and jamun powder. This might also be due to increase in physical parameters such as width and thickness exposing more area of crackers, thus increasing the moisture content. The moisture content of crackers fell within the maximum limit (6%) given by BIS for moisture content of crackers. Increase in moisture content with storage period was also reported by Nagi *et al*. (2012) [10] in cereal bran biscuits.

Crude protein content (Table 2) of different treatments decreased during storage period of 90 days from the initial mean value of 15.42 to 15.16%. Maximum crude protein content of 15.59% was found in treatment T_1 (control) and minimum of 15.00% in treatment T_6 (25% jamun pulp powder). The decrease in protein content during storage might be due to hydrolysis of peptide bonds by the help of protease enzyme that cause splitting of protein molecules during storage. Similar decrease of protein content with storage period was reported by Kanchana *et al*. (2008) [11] in value added single cell protein biscuits and Nwabueze and Atuonwu (2007) [12] in African bread fruit seeds incorporated biscuits.

With the advancement of the storage period the mean ash content (Table 3) decreased from the initial level of 2.63 to 2.51% during 90 days of storage. Treatment T_6 (25% jamun pulp powder) recorded highest mean ash content of 2.68% and lowest (2.41%) was recorded by treatment T_1 (control). Similar results were reported by Kulkarni and Joshi (2013) [13] in pumpkin powder blended biscuits. With the progression of storage period, the crude fat content (Table 3) decreased from its initial value of 9.96 to 9.67%. The decrease in crude fat content might be due to increase in the activity of lipase enzyme (lipolytic oxidation). The lowest mean crude fat content of 9.49% was reported in treatment T_6 (25% jamun pulp powder) and the highest of 10.24% was recorded in treatment T_1 (control). These findings are in accordance with the findings of Singh *et al*. (2008) [14] who reported that crude fat decreased with storage in biscuits.

The mean crude fibre (Table 4) content during 90 days of storage declined significantly from the initial level of 2.73 to 2.58%. The decrease in crude fibre might be due to the degradation of hemicelluloses and other structural polysaccharides during storage. Further Sharon and Usha, (2006) [15] reported that heat and moisture solubilizers degrade pectic substances leading to the decrease in the fibre content. However, with the incorporation of jamun powder the crude fibre content increased and highest crude fibre content was observed by treatment T_6 (25% jamun pulp powder) whereas, lowest crude fibre content (2.51%) was recorded in treatment T_1 (control). It was observed that with the advancement of storage period, the mean carbohydrate content (Table 4) increased from its initial level of 65.46 to 65.84%. Treatment T1 (control) recorded lowest mean carbohydrate content of 64.94% and highest (66.24%) was recorded by treatment T6 (25% jamun pulp powder).

A decrease in overall acceptability score (Fig 1) was observed in all the treatments with the advancement of storage period. Among the treatments, treatment T_4 (15% jamun pulp powder) obtained maximum score of 8.11 followed by T_3 (10% jamun pulp powder) and lowest score of 7.29 was observed in treatment T_6 (25% jamun pulp powder). Similar results have been reported by Kapoor *et al*. (2015) [16] in jamun supplemented unleavened flat bread.

Table 1: Physical parameters of jamun pulp blended crackers

Treatment	Width (cm)	Thickness (cm)	Spread ratio
T_1 (Control)	4.00	0.40	10.00
T_2 (5% JPP)	3.95	0.43	9.19
T_3 (10% JPP)	3.90	0.46	8.48
T_4 (15% JPP)	3.84	0.49	7.84
T_5 (20% JPP)	3.80	0.51	7.45
T_6 (25% JPP)	3.75	0.54	6.94
Mean	3.87	0.48	8.32
$CD_{0.05}$	0.11	0.07	0.13

Table 2: Effect of treatment and storage on Moisture (%) and Crude protein (%) of jamun pulp blended crackers

Treatment	Moisture (%)					Crude protein (%)				
	Storage period (days)					Storage period (days)				
	0	30	60	90	Mean	0	30	60	90	Mean
T_1 (Control)	3.95	4.20	4.48	4.60	4.31	15.74	15.63	15.52	15.45	15.58
T_2 (5% JPP)	3.87	4.10	4.30	4.48	4.19	15.56	15.43	15.34	15.26	15.40
T_3 (10% JPP)	3.83	3.97	4.13	4.25	4.05	15.47	15.40	15.29	15.21	15.34
T_4 (15% JPP)	3.77	3.89	3.96	4.11	3.93	15.35	15.27	15.18	15.13	15.23
T_5 (20% JPP)	3.71	3.80	3.92	4.06	3.87	15.24	15.16	15.10	15.03	15.13
T_6 (25% JPP)	3.65	3.68	3.81	3.90	3.76	15.17	15.04	14.93	14.86	15.00
Mean	3.80	3.94	4.10	4.23		15.42	15.32	15.23	15.16	

Effect	**$CD_{0.05}$**	**$CD_{0.05}$**
Treatment0.05	0.06	
Storage	0.04	0.05
Treatment x Storage	0.10	0.11

JPP Jamun Pulp Powder

Table 3: Effect of treatment and storage on Ash (%) and Crude fat (%) of jamun pulp blended crackers

Treatment	Ash (%)					Crude fat (%)				
	Storage period (days)					Storage period (days)				
	0	30	60	90	Mean	0	30	60	90	Mean
T_1 (Control)	2.48	2.44	2.39	2.35	2.41	10.40	10.31	10.19	10.05	10.24
T_2 (5% JPP)	2.56	2.52	2.49	2.45	2.50	10.13	10.07	9.96	9.88	10.01
T_3 (10% JPP)	2.61	2.59	2.54	2.51	2.56	9.99	9.90	9.83	9.74	9.86
T_4 (15% JPP)	2.66	2.62	2.59	2.54	2.60	9.85	9.77	9.65	9.56	9.71
T_5 (20% JPP)	2.70	2.67	2.64	2.60	2.65	9.76	9.68	9.59	9.47	9.62
T_6 (25% JPP)	2.75	2.72	2.68	2.64	2.70	9.65	9.56	9.44	9.32	9.49
Mean	2.63	2.59	2.55	2.52		9.96	9.88	9.78	9.67	

Effect	**$CD_{0.05}$**	**$CD_{0.05}$**
Treatment	0.03	0.04
Storage	0.03	0.03
Treatment x Storage	0.07	0.08

JPP Jamun Pulp Powder

Table 4: Effect of treatment and storage on Crude fibre (%) and Carbohydrates (%) of jamun pulp blended crackers

Treatment	Crude fibre (%)					Carbohydrates (%)				
	Storage period (days)					Storage period (days)				
	0	30	60	90	Mean	0	30	60	90	Mean
T_1 (Control)	2.57	2.53	2.50	2.46	2.51	64.86	64.89	64.92	65.09	64.94
T_2 (5% JPP)	2.63	2.59	2.55	2.50	2.57	65.25	65.29	65.36	65.43	65.33
T_3 (10% JPP)	2.69	2.65	2.60	2.57	2.63	65.41	65.49	65.61	65.72	65.56
T_4 (15% JPP)	2.75	2.70	2.66	2.61	2.68	65.62	65.75	65.96	66.05	65.84
T_5 (20% JPP)	2.82	2.78	2.72	2.67	2.75	65.77	65.91	66.03	66.17	65.97
T_6 (25% JPP)	2.90	2.85	2.78	2.70	2.81	65.88	66.15	66.36	66.58	66.24
Mean	2.73	2.68	2.63	2.58		65.46	65.58	65.71	65.84	

Effect	**$CD_{0.05}$**	**$CD_{0.05}$**
Treatment	0.05	0.06
Storage	0.04	0.05
Treatment x Storage	0.07	0.12

JPP Jamun Pulp Powder

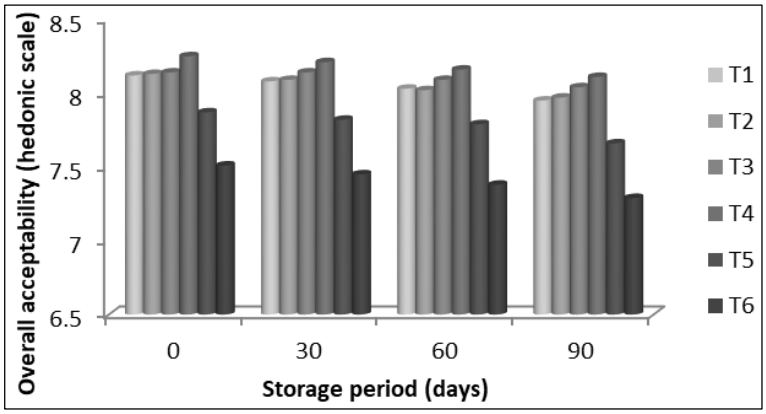

Fig 1: Overall acceptability of jamun pulp powder blended crackers

Conclusion

From the present studies, it is, therefore, concluded that incorporation of jamun powder in wheat flour crackers could be used as a nutritional ingredient to partially substitute crackers. The level of 15 per cent was the optimum proportion to produce the acceptable ready to eat products. Hence, the jamun powder incorporation has potential as an ingredient in novel products targeting health conscious consumers.

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