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Assessment of nutritional and microbial quality of Jamun-Bael blended fruit cheese during storage

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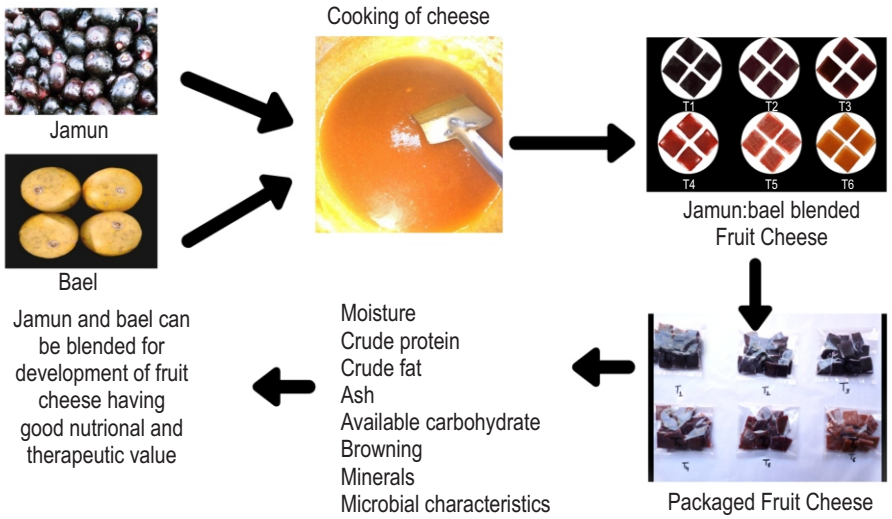
Abstract

Aim: To standardize appropriate blends of jamun and bael for developing fruit cheese and its nutritional and microbial analysis during 90 days of storage.

Methodology: Fruit cheese was prepared by blending jamun and bael fruit in different ratios of pulp in each treatment. The blended product was monitored regularly for 90 days of storage period at ambient conditions at an interval of 30 days. The data obtained was analysed statistically using Factorial Completely Randomized Design (CRD) at 5 % level of significance.



Results: With the advancement of storage period moisture content, crude protein, ash and crude fat decreased from 16.94 to 15.90 %, 2.15 to1.72%, 0.63 to 0.52 % and 5.98 to 5.54 %, respectively. Available carbohydrates and browning showed increasing trend from 74.30 to 76.35 % and 0.483 to 0.610 (OD), respectively, during storage with highest mean available carbohydrate of 76.25 % in treatment containing 100 % jamun.

Interpretation: Jamun and bael fruits can be blended to formulate fruit cheese with improved nutritional quality viz., crude protein, ash and minerals. The microbiological characteristics of prepared fruit cheese were within safe limits. The blended fruit cheese can be stored at room temperature for more than 90 days without much loss in nutritional and eating quality.

Key words: Bael, Fruit cheese, Jamun, Microbial, Nutritional analysis

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Introduction

Fruits form an important part of our nutritional requirement by supplementing our diet with both micronutrients and macronutrients such as vitamins, minerals and many bioactive components. Therefore, it is necessary that fruits should be available in fresh or processed form for human consumption throughout the year. Unfortunately, a big proportion (30-40%) of these perishable commodities, as seasonal surplus or glut, goes waste due to improper post harvest handling, transport, storage, distribution and marketing (Negi and Anand, 2016). Several efforts are being made to preserve fruits due to their seasonal nature and limitations of growing regions. Preservation methods are main contributor to broaden the range of forms and textures of fruits and associated fruit products, such as preserves, jams and jellies, fruit leathers, soft dried fruit, etc. (Mongia, 2014). Confectionery items are considered as broad segment of our market. Most of the confectionery products are prepared from artificial flavour and concentrate of fruits, not directly from pulp that can be harmful for health, but fruit cheese is a product prepared from pulp or puree of sound ripe fruits, whether in fresh form, frozen or previously preserved, by cooking with nutritive sweeteners and salt to obtain a thick consistency so that it sets on cooling. It can be prepared from a single fruit or with mixed fruits (Kumar *et al.,* 2019a).

Fruit cheese is a chewable confectionary product which is relatively new to fruit processors. Fruits like pineapple, apple, papaya, banana, pear and plum have been used for preparing fruit cheese yet there are many fruits like jamun and bael which are unexploited by the food processing industries (Sucheta et al., 2017). Jamun (*Syzygium cumini* L.) belongs to *Myrtaceae* family. It is commonly known as black plum, jambhul, java plum, Indian blackberry, jamb lag, jambu and jamboola in various regions of India. Jamun pulp contains protein (0.13-0.7 g), fat (0.15-0.3 g), crude fiber (0.3-0.9 g), carbohydrates (14.0 g), vitamin A (80 I.U. 100 g^{-1}) and calcium (8.3-15 mg 100 g^{-1}). Besides, jamun is rich in anthocyanins which are intensely coloured water soluble pigments that impart colour to the fruit (Yadav and Singh, 2020). Bael (*Aegle marmelos* Corr.) on the other hand, is an indigenous fruit of India which belongs to family *Rutaceae* and it is commonly known as bengal quince, stone apple, Indian quince, golden apple in english and holy fruit, bel, belwa, sriphal in hindi. It contains 28-39 % total soluble solids, 19-21 % carbohydrates, 11-17 % sugar, 0.2 % fat and 7-21 mg $100g^{-1}$ vitamin C (Singh *et al.,* 2014).

Minerals found in bael pulp are phosphorus (51.60 mg $100g^{-1}$), potassium (603 mg $100g^{-1}$), calcium (78.00 mg $100g^{-1}$) and magnesium (4.00 mg $100g^{-1}$) (Kaur and Kalia, 2017). Jamun fruit being a highly perishable and short term crop is lost either through rainfall or in sorting and grading. The surplus fruits can, therefore, be processed into excellent quality new value added products. Blending of jamun with therapeutic fruit like bael could yield a highly nutritious and functional product. The bael fruit has a strong and tempting aroma which is not destroyed even during processing, however, due to outer hard shell, mucilaginous texture and numerous seeds embedded in pulp is not popular. Being excellent in flavour, nutritive and therapeutic values, the fruit shows potential for processing into functional food products. Further bael fruit flavour is entirely unknown in internal and export markets (Ullikashi *et al.,* 2017). Therefore, the value added products from bael might possess higher scope in future. Considerable research efforts have been made in the past for developing fruit cheese from different fruits. These include preparation of guava cheese with varying concentrations of pectin (0, 0.5, 1 and 1.5 %) by Patel *et al.* (2016). Rahul *et al.* (2019) studied sensory qualities of guava-jamun cheese and observed that cheese prepared with 20 per cent guava and 80 per cent jamun pulp blends was found most acceptable with respect to colour and appearance (8.20), flavour (8.10), texture (8.10), taste (8.10) and overall acceptability (8.12). Kumar *et al.* (2019a) blended aonla-papaya pulp to form cheese blends (100:0, 80:20, 60:40, 40:60, 20:80 and 0:100) as per standard procedure.

In an another study Kumar *et al.* (2019b) studied storability of aonla-papaya cheese and observed gradual increase in total sugars (55.96-61.55%) whereas ascorbic acid (19-93%), total carotenoids (011-1.77%), total phenols (77-94%) and overall acceptability (7.7-8.1) decreased significantly in aonla-papaya cheese during storage of three months but an effective and reliable process has not been developed. However, fewer efforts have been made for utilizing these less exploited fruit crops, i.e., jamun and bael for developing value added products. Thus, developing new products by using blended fruit pulp from these lesser exploited fruit crops will increase the utility of these fruits along with providing gainful employment opportunities. Keeping this in view, the present investigation was carried out to develop a blended fruit cheese product from jamun and bael along with its nutritional and microbiological evaluation.

Materials and Methods

Preparation of fruit cheese: Jamun and bael pulp were manually extracted from sorted and washed fruits. The fruit cheese was prepared from jamun and bael pulp blends *viz.,* B_1 (100:0::Jamun:Bael), B_2 (80:20::Jamun:Bael), B_3 (60:40::Jamun:Bael), B_4 (40:60::Jamun:Bael), B_5 (20:80::Jamun: Bael) and B_6 (0:100::Jamun:Bael) as per the standard procedure of Srivastava and Kumar (2012) with modifications. For preparation of fruit cheese, 1 kg of jamun: bael blended pulp (as per treatment combinations) was cooked with 750 g sugar, 70 g butter, 3 g citric acid and 3 g salt. Two percent pectin was also added for proper setting of fruit cheese. The mixture of blended pulp, sugar, butter and citric acid was cooked with constant stirring to obtain desired thick consistency. Pectin dissolved in lukewarm water was added to the cooking mass. Finally, salt was mixed with the cooked mass, when it started leaving sides of the vessel. End point was judged by sheet test and total soluble solids (72ºBrix) were measured with a hand refractometer. The product was finally spread on butter smeared trays (0.60 cm) and left for cooling and setting.

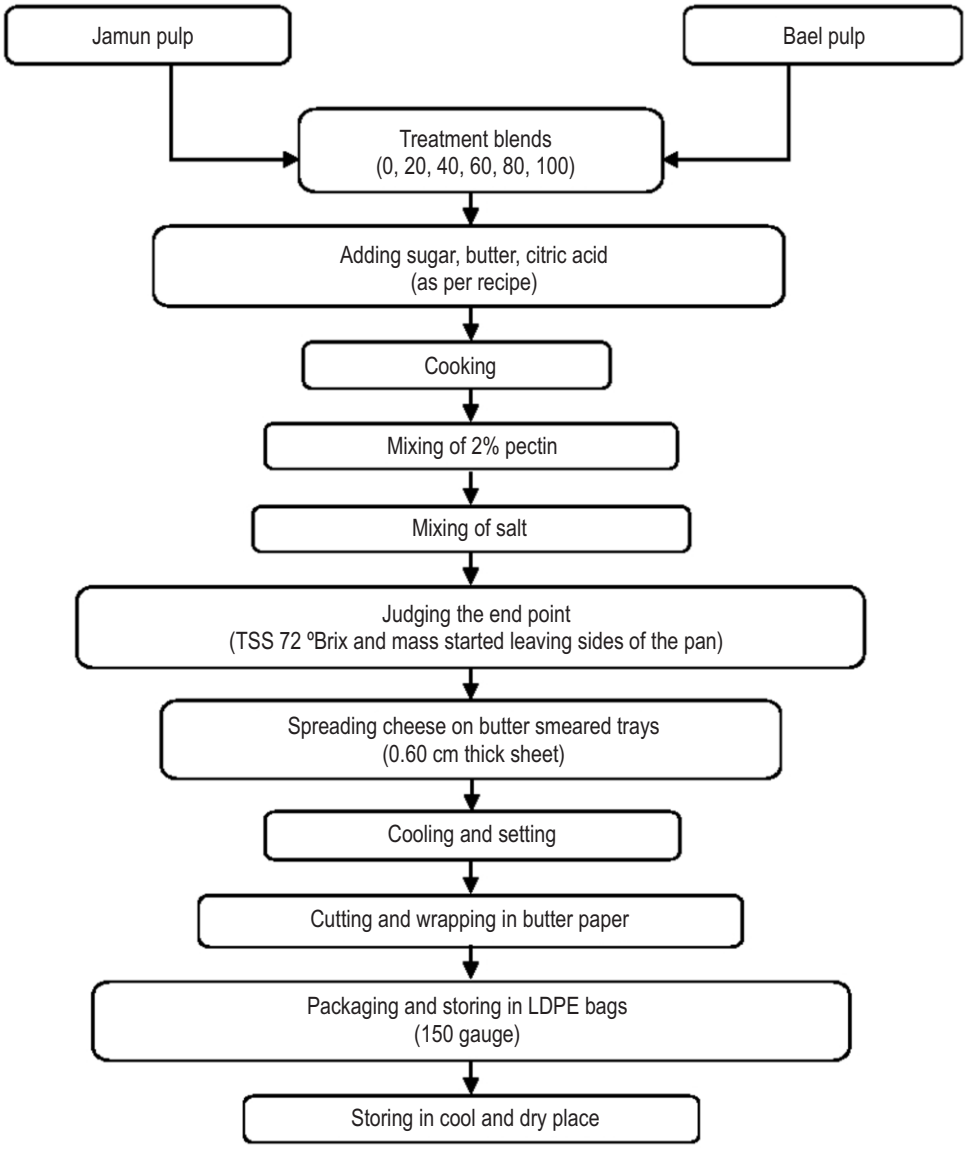

Fig 1: Flow chart for preparation of jamun-bael fruit cheese.

After setting, suitable size pieces of cheese were cut, wrapped in butter paper and packed in LDPE bags (150 gauge) (Fig 1). For each treatment combination three replications of fruit cheese were prepared. The prepared fruit cheese was stored under ambient (24.8±5.02ºC and RH 62±5 %) conditions for a period of 90 days. The sample were analysed for various chemical and microbiological parameters at an interval of 30 days.

Analysis of fruit cheese: Moisture content was determined by taking macerated sample and dried in hot-air oven at 70ºC till a constant weight was achieved (AOAC, 2012). The crude protein content was determined by micro Kjeldahl method, using the factor 6.25 for converting nitrogen content into crude protein (Sadasivam and Manickam, 2008). Ash content of sample was estimated by igniting the known sample until no charred particles remained and then placed in muffle furnace (600°C) for 5 hrs or till white ash was obtained (AOAC, 2012). Crude fat was determined by soxhlet extraction technique (AOAC, 2012). Carbohydrate content of cheese sample was estimated by difference method. It was calculated by subtracting the sum of percentage of moisture, crude fat, crude protein and ash contents from 100 (AOAC, 2012).

Calcium content in the sample was determined by titrating with standard EDTA (N/50) solution using ammonium perpurate (Mure oxide) as an indicator (Jaiswal, 2003). Phosphorous content was determined with the help of a Spectrophotometer (UV 1601) by using Vandate-molybedete reagent method (AOAC, 2012). Browning (non-enzymatic) in

jamun-bael blended cheese sample was estimated by extracting in (60 %) ethyl alcohol overnight and measuring colour at 440 nm using aqueous ethyl alcohol as a blank (Ranganna, 2014).

Microbial analyses: Serial dilution technique and pour plate methods (all the operations were done in laminar air flow chamber using sterilized glassware) were used to enumerate microbial load (Total plate count, yeast and mold count) in the cheese sample (FSSAI, 2011).

Statistical analyses: The data obtained were analyzed statistically using Factorial Completely Randomized Design (CRD) for interpretation of results through analysis of variance. The data was collected in triplicates and critical difference was taken at $p \leq 0.05$ (Gomez and Gomez, 1984).

Results and Discussion

Results showed that blend B_1 (100:0:: Jamun: Bael) recorded highest moisture content of 17.62 per cent followed by B_2 (80:20:: Jamun: Bael) with moisture content of 17.41 per cent whereas, the lowest moisture content of 16.23 per cent was recorded in B_6 (0:100:: Jamun: Bael) at the beginning of storage. However, after 90 days of storage the lowest moisture content of 15.13 per cent was recorded in B_6 (0:100:: Jamun: Bael) whereas, treatment B_1 (100:0:: Jamun: Bael) recorded the highest moisture content of 16.67 per cent. The highest mean moisture content of 17.14 per cent was recorded in treatment B_1 (100:0:: Jamun: Bael) while the lowest mean value of 15.67 per cent was recorded in case of treatment B_6 (0:100:: Jamun: Bael). Variation in moisture content of blends was observed due to difference in moisture contents of selected fruits and loss of moisture from pulp during processing. There was significant ($p \leq 0.05$) decrease in the mean moisture content from 16.94 to 15.90 % during 90 days of storage which might be due to utilization of free water in converting polysaccharides into monosaccharides and oligosaccharides (Pinandoyo and Mansar, 2020). Elbelazi (2015) also reported loss of moisture content of value added apple cheese due to evaporation of water. Higher moisture content in final product may lead to microbial growth. Sethi *et al.* (2007) prepared guava cheese fortified with soya protein isolate (SPI) and whey protein concentrate (WPC) and observed decrease in moisture content with decreasing relative humidity during 54 days of storage. Bisen and Verma (2020) also reported similar decrease in moisture percentage in guava and papaya fruit bar during storage from 17.18 ± 0.02% to 14.78 ± 0.02% after 100 days of storage at ambient temperature (25±2 ºC).

The blends and storage duration had significant effect on crude protein of fruit cheese. The highest value of 3.59 per cent crude protein was observed in B_6 (0:100:: Jamun: Bael) and lowest value of 0.60 per cent was found in B_1 (100:0::Jamun: Bael) at 0 day storage which decreased to 0.30 and 3.09 per cent after 90 days of storage, respectively (Table 1). The increase in crude protein content among blends may be due to high amount of crude protein in bael pulp. The mean value of crude protein decreased from 2.15 to1.72 % during 90 days of storage. The decrease in crude protein content with storage was attributed to denaturation and degradation of protein into amino acid. The decrease in protein content may also be due to participation of protein in maillard reaction (Anju *et al.,* 2014). Similar decrease in crude protein content from 1.62 % to 1.57 % during 3 months of storage in banana-guava cheese was reported by Singh *et al.* (2020). Vasudeva *et al.* (2011) found slight decrease in protein fortified guava cheese from 2.23±0.09 to 2.21±0.08 % in samples stored at ambient temperature conditions. Pinnandoyo and Siddiqui (2020) also reported decrease in crude protein (3.26 to 3.15 %) in fortified jam during 3 months of storage.

Blend B_6 (0:100::Jamun: Bael) recorded the highest ash content of 1.08 per cent at 0 day storage followed by B5 (20:80:: Jamun: Bael) with ash content of 0.89 per cent whereas treatment B_1 (100:0::Jamun: Bael) recorded lowest ash content of 0.21 per

Table 1: Moisture (%) and crude protein (%) content of jamun-bael blended fruit cheese

Blend (Jamun:Bael)	Moisture (%) Storage period (days)					Crude protein (%) Storage period (days)				
	0	30	60	90	Mean	0	30	60	90	Mean
B_1 (100 : 0)	17.62	17.24	16.93	16.67	17.14	0.60	0.52	0.42	0.30	0.46
B_2 (80 : 20)	17.41	16.98	16.57	16.24	16.80	1.30	1.17	1.04	0.92	1.10
B_3 (60 : 40)	17.05	16.76	16.31	15.96	16.52	1.89	1.75	1.61	1.49	1.68
B_4 (40 : 60)	16.81	16.42	16.19	15.87	16.32	2.47	2.31	2.15	2.01	2.23
B_5 (20 : 80)	16.49	16.21	15.86	15.50	16.01	3.05	2.87	2.64	2.48	2.76
B_6 (0 : 100)	16.23	15.84	15.49	15.13	15.67	3.59	3.46	3.24	3.09	3.35
Mean	16.94	16.57	16.23	15.90		2.15	2.01	1.85	1.72	
Effects		$CD_{(p\leq0.05)}$					$CD_{(p\leq0.05)}$			
Blend (B)		0.03					0.04			
Storage (S)		0.02					0.03			
BxS		0.07					0.08			

Table 2: Effect of blending and storage on ash (%) and crude fat (%) content of jamun-bael fruit cheese

Blend (Jamun:Bael)	Ash (%) Storage period (days)					Crude fat (%) Storage period (days)				
	0	30	60	90	Mean	0	30	60	90	Mean
B_1 (100 : 0)	0.21	0.18	0.16	0.13	0.17	6.21	6.07	5.92	5.81	6.00
B_2 (80 : 20)	0.36	0.33	0.28	0.25	0.30	6.11	5.98	5.85	5.73	5.92
B_3 (60 : 40)	0.54	0.51	0.47	0.43	0.49	6.02	5.85	5.72	5.58	5.79
B_4 (40 : 60)	0.72	0.68	0.66	0.62	0.67	5.90	5.74	5.60	5.49	5.68
B_5 (20 : 80)	0.89	0.84	0.80	0.76	0.82	5.86	5.69	5.48	5.31	5.57
B_6 (0 : 100)	1.08	1.02	0.98	0.95	1.01	5.79	5.60	5.39	5.20	5.49
Mean	0.63	0.59	0.56	0.52		5.98	5.82	5.66	5.54	
Effects		$CD_{(p\leq0.05)}$					$CD_{(p\leq0.05)}$			
Blend (B)		0.06					0.04			
Storage (S)		0.05					0.03			
BxS		NS					NS			

Table 3: Available carbohydrates (%) and browning (O.D. at 440 nm) of jamun-bael blended fruit cheese during storage

Blend (Jamun:Bael)	Available Carbohydrates (%) Storage period (days)					Browning (O.D.) Storage period (days)				
	0	30	60	90	Mean	0	30	60	90	Mean
B_1 (100 : 0)	75.36	75.99	76.57	77.09	76.25	0.412	0.472	0.511	0.548	0.486
B_2 (80 : 20)	74.82	75.54	76.26	76.86	75.87	0.440	0.499	0.528	0.571	0.510
B_3 (60 : 40)	74.50	75.13	75.89	76.54	75.52	0.465	0.523	0.557	0.594	0.535
B_4 (40 : 60)	74.10	74.85	75.40	76.01	75.09	0.494	0.556	0.579	0.623	0.563
B_5 (20 : 80)	73.71	74.39	75.19	75.95	74.81	0.529	0.574	0.614	0.658	0.594
B_6 (0 : 100)	73.31	74.08	74.90	75.54	74.48	0.558	0.597	0.636	0.667	0.615
Mean	74.30	74.99	75.70	76.35		0.483	0.537	0.571	0.610	
Effects		$CD_{(p\leq0.05)}$					$CD_{(p\leq0.05)}$			
Blend (B)		0.03					0.004			
Storage (S)		0.03					0.003			
BxS		0.07					0.008			

cent. After 90 days of storage, the highest ash content of 0.95 per cent was recorded in treatment B_6 (0:100:: Jamun: Bael) and the lowest ash content of 0.13 per cent was recorded in B_1 (100:0:: Jamun: Bael). The highest mean ash content of 1.01 per cent was observed in B_6 (0:100:: Jamun: Bael) while the lowest mean ash content of 0.17 per cent was recorded in B_1 (100:0::Jamun: Bael) (Table 2). Storage period had significant effect on ash content during 90 days, however, interaction between blend and storage was found to be non significant.

The mean ash content of blended cheese decreased during 90 days of storage period from 0.63 to 0.52 %. The decrease in ash content during storage might be due to interaction with other components like protein and carbohydrates (Kapoor and Ranote, 2016). The decrease in ash content of cheese might also be attributed to mineral loss due to binding of minerals by maillard reaction products during storage. Similar findings were reported in bael-apple blended jam by Asghar *et al.* (2015) where the ash content decreased from 2.67 to 2.63 % during storage. Hasanuzzaman *et al.* (2014) reported similar decrease in ash content of tomato candy during storage. The highest mean crude fat content of 6.00 % (Table 2) was recorded for B_1 (100:0::Jamun: Bael) while the lowest mean crude fat content of 5.49 % was recorded in B_6 (0:100::Jamun: Bael). The blends had significant effect on the crude fat content of cheese. Higher fat content in cheese may be due to addition of fat during processing. Shukla *et al.* (2018) reported increase in fat content in guava cheese prepared from different cultivars by addition of milk powder. Khapre and Shah (2016) also reported increase in crude fat content from 7.1 to 8.0 % in soft date toffee.

During 90 days of storage period, the mean crude fat content of blended cheese decreased from 5.98 to 5.54 % as showed by analysis of variance. The decrease in crude fat content might be attributed to increased lipolytic activity of enzymes like lipase and lipoxygenase during storage causing conversion of

Table 4: Mineral content (mg 100 g^{-1}) of jamun-bael blended fruit cheese during storage

Blend (Jamun:Bael)	Calcium (mg 100 g^{-1}) Storage period (days)					Phosphorus (mg 100 g^{-1}) Storage period (days)				
	0	30	60	90	Mean	0	30	60	90	Mean
B_1 (100 : 0)	10.35	10.31	10.27	10.19	10.28	12.32	12.28	12.22	12.14	12.24
B_2 (80 : 20)	17.62	17.57	17.51	17.47	17.54	15.98	15.93	15.87	15.79	15.89
B_3 (60 : 40)	25.89	25.83	25.76	25.69	25.79	19.61	19.54	19.46	19.37	19.50
B_4 (40 : 60)	34.81	34.77	34.70	34.62	34.73	24.13	24.07	23.99	23.87	24.01
B_5 (20 : 80)	41.97	41.93	41.87	41.80	41.89	29.08	29.01	28.92	28.80	28.95
B_6 (0 : 100)	50.25	50.19	50.11	50.02	50.14	32.90	32.83	32.75	32.64	32.78
Mean	30.15	30.10	30.04	29.97		22.34	22.28	22.20	22.10	
Effects		$CD_{(p\leq0.05)}$					$CD_{(p\leq0.05)}$			
Blend (B)		0.03					0.03			
Storage (S)		0.02					0.03			
BxS		NS					NS			

Table 5: Total plate count and yeast and mold (10^4xcfu/g) count of jamun-bael blended fruit cheese

Blend (Jamun:Bael)	Total Plate Count (10^4xcfu g^{-1}) Storage period (days)				Yeast and Mold count (10^4xcfu g^{-1}) Storage period (days)			
	0	30	60	90	0	30	60	90
B_1 (100 : 0)	ND	ND	ND	0.36	ND	ND	ND	0.21
B_2 (80 : 20)	ND	ND	ND	0.33	ND	ND	ND	0.19
B_3 (60 : 40)	ND	ND	ND	0.31	ND	ND	ND	0.17
B_4 (40 : 60)	ND	ND	ND	0.28	ND	ND	ND	0.15
B_5 (20 : 80)	ND	ND	ND	0.25	ND	ND	ND	0.13
B_6 (0 : 100)	ND	ND	ND	0.23	ND	ND	ND	0.10
Mean				0.29	Mean			0.16
Effects		$CD_{(p\leq0.05)}$	0.04			$CD_{(p\leq0.05)}$	0.01	

ND = Not Detected

fats into esters and glycerol (Zahar *et al.,* 2020). Similar decrease in crude fat content with storage was observed in bael-apple jam by Asghar *et al.* (2015) and watermelon lemon jam by Ehsan *et al.* (2002). At the beginning of storage, blend B_1 (100:0:: Jamun: Bael) recorded highest available carbohydrate of 75.36 per cent followed by B_2 (80:20::Jamun: Bael) with carbohydrate content of 74.82 per cent whereas, the lowest available carbohydrate content of 73.31 per cent was recorded in B_6 (0:100:: Jamun: Bael). After 90 days of storage the lowest available carbohydrate content of 75.54 per cent was recorded in B_6 (0:100:: Jamun: Bael) whereas, blend B_1 (100:0:: Jamun: Bael) recorded the highest available carbohydrate content of 77.09 per cent.

The highest mean available carbohydrate content of 76.25 per cent was recorded in blend B_1 (100:0:: Jamun: Bael) while the lowest mean carbohydrate content of 74.48 per cent was recorded in case of B_6 (0:100:: Jamun: Bael). The increasing proportion of bael significantly decreased the carbohydrate content in various treatments. Significant increase was observed in available carbohydrate content with respect to 90 days of storage period. The mean available carbohydrate content increased from 74.30 to 76.35 % during 90 days storage (Table 3). The increase in available carbohydrates during storage might be due to degradation of complex and structural polysaccharides into simpler sugars (Bhatt and Jha, 2015). Shahnawaz *et al.* (2009) also observed increase in available carbohydrate content from 61.43 to 67.62 % during storage in value added jamun products. Similar findings were reported in pitanga diet jam during storage by Tobal and Rodrigues (2019).

The maximum mean browning of 0.615 was recorded in blend B_6 (0:100::Jamun: Bael) and lowest of 0.486 was reported in B_1 (100:0::Jamun: Bael) (Table 3). The difference in the blends was statistically significant at $p\leq 0.05$ as shown by analysis of variance. The present study revealed that upto 90 days of storage, the mean browning of blended cheese increased significantly from 0.483 to 0.610. The increase in browning during storage period might be due to hydrolytic action of acid, which

enhanced maillard reaction and caramelization resulting in browning of the product. Heat processing and subsequent storage of fruit products is often accompanied by an unattractive discolouration perhaps due to non-enzymatic browning or oxygen effects on other compounds in the fruit (Rahul *et al.,* 2019). Kuchi *et al.* (2014) reported that degradation of ascorbic acid during storage, followed by its further degradation to 2, 3-diketogulonic acid and finally to maillard compounds such as furfural and 2 furonic acid eventually form brown pigments.

Similar findings were reported by Sucheta *et al.* (2017) during storage in guava-mango cheese storage for 90 days where browning increased from 0.25 to 0.37 during storage of 90 days. Kumar *et al.* (2019b) found similar increase in browning of aonla-papaya cheese with storage. Singh *et al.* (2020) reported similar increase of browning in fortified banana-guava cheese. Minerals like calcium and phosphorus contents of jamun-bael blended fruit cheese increased with incorporation of bael pulp. The difference in mineral content of the blends was found statistically significant ($p \leq 0.05$) as showed by analysis of variance, however, interaction between blends and storage condition was non-significant. The increase in mineral content with treatment can be attributed to the declining percentage of jamun pulp with increasing level of bael pulp which is rich in minerals. Shukla *et al.* (2018) prepared guava cheese by fortifying it with milk powder and a control cheese (without milk powder) and reported increase in calcium and phosphorous content from 1.51 (control cheese) to 2.18% and 1.50 to 1.91 %, respectively, among different varieties with fortification. The mean calcium and phosphorus content ranged from 10.28 to 50.14 mg 100 g^{-1} and 12.24 to 32.78 mg 100 g^{-1}, respectively (Table 4).

Storage evaluation of jamun-bael blended fruit cheese revealed a significant ($p \leq 0.05$) decrease in mineral contents. The mean calcium content decreased from 30.15 to 29.97 mg 100 g^{-1} whereas, phosphorus content of jamun-bael blended cheese decreased from 22.34 to 22.10 mg 100 g^{-1} during 90 days storage which might be due to its heat sensitivity even at ambient temperature which caused the destruction of minerals during storage (Attri *et al.,* 2014). Similar results have been reported in coconut based jam by Sindumathi and Amutha (2014) and in fortified toffee by Khan *et al.* (2016). Enumeration of total plate count and yeast-mold count of six blends of jamun-bael cheese was carried out at an interval of 30 days during 90 days of storage period. No microbial growth was observed in jamun-bael blended cheese during 60 days of storage period but significant increase in microbial count was observed after 90 days of storage duration.

The highest total plate count of 0.36×10^4 cfu g^{-1} in B_1 (100:0::Jamun: Bael) and lowest count of 0.23×10^4 cfu g^{-1} in B_6 (0:100::Jamun: Bael) was found after 90 days of storage (Table 5). The yeast and mold count also remained undetected during 0, 30 and 60 days of storage but after 90 days, T_1 (100:0::Jamun: Bael) recorded highest count of 0.21×10^4 cfu g^{-1} followed by T_2 (80:20::Jamun: Bael) with 0.19×10^4 cfu g^{-1} (Table 5). High TSS in blended cheese might have created high osmotic pressure and low water activity, thereby limiting microbial growth in the product (Sethi *et al.,* 2007). However, the total plate count, yeast and mold count did not exceed the standard (Moses *et al.,* 2019) acceptable limit ($\times 10^6$ cfu g^{-1}). Similar results were also reported by Chaurasiya *et al.* (2014) during storage of palm spread and toffee. The results observed for yeast and mold count in guava based papaya cheese by Meena and Raj (2017) showed increase in microbial growth with storage days.

Thus, the research could be concluded as despite of having high therapeutic and nutritional properties, bael and jamun are still being used only by unorganized sector and not given much importance for its commercialization. The present investigation has shown a way for efficient use and value addition of locally grown fruits like bael and jamun which are unexploited by the food industry. The blended fruit cheese can be stored for more than 90 days with minimum changes in nutritional and microbial quality.

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Add-on Information

Authors' contribution: G. Yadav: Execution of field / laboratory experiments and data collection; **M. Sood :** Conceptualization of research and designing of the experiments; **J.D. Bandral:** Contribution of experimental materials, designing of experiments; **N. Gupta:** Statistical analysis of data; **S. Sharma:** Contribution of experimental materials.

Research content: The research content is original and has not been published elsewhere.

Ethical approval: The procedures and protocols used in this study were designed in accordance with the Guidelines of the SKUAST-J University, Chatha, Jammu.

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