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## Development of *burfi* with incorporation of kodo millet

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### Abstract

Burfi, prepared from khoa, is a popular sweet confectionery of Indian subcontinent. The present study was undertaken to develop value added burfi with khoa and kodo millet for better nutritional profile. Value added burfi was prepared by incorporating popped kodo millet flour at 10% (KBK1), 15% (KBK2) and 20% (KBK3) based on the weight of khoa. Sensory evaluation study revealed that KBK1 was best accepted among the variations and obtained an overall acceptability score of 8.55. The value added burfi KBK1 had a moisture content of 17.4%, 21.02g fat, 9.89g protein, 2.38g ash, 0.59g crude fibre, 80.19µg vitamin A, 355.5mg calcium and 0.69 mg iron per 100g. Though the rheological attributes showed a decreasing trend with incorporation of kodo millet, the native texture of burfi was retained. Millet incorporated burfi (KBK1) had a shelf life of 5 days at room temperature and 10 days at refrigeration temperature. Kodo millet can successfully be incorporated to khoa based burfi with highly acceptable sensory attributes.

**Keywords:** Burfi, kodo millet, sensory evaluation, texture analysis, shelf life study

### 1. Introduction

In the current millennium, the dairy market is experiencing a transition from bulk commodities to delightfully tasty and novel value-added goods, with a distinctive niche segment in taste, colour, and appearance. Value added food items have taken on significant importance nowadays.

Burfi, prepared from khoa with an appropriate content of sugar, is a popular sweet confectionery of Indian subcontinent<sup>[1, 2]</sup>. The simplest burfi consists only of milk solids and sugar, and its preparation involves evaporating milk in a wide mouthed open pan to obtain a thick pasty mass known as khoa and then blend khoa with sufficient quantity of sugar. During the repeated heat treatments, burfi acquires its aroma and taste characteristics<sup>[3]</sup>. There are several varieties of burfi made from different nutmeats and flavourings with a base of milk solids that also contributes to texture, taste and flavour.

Kodo millet (*Paspalum scrobiculatum*), known as cow grass, rice grass, native Paspalum, ditch millet, or Indian crown grass, is widely spread throughout the world's tropics and subtropics in humid habitats. The seeds produced are very small and ellipsoidal, ranging in color from light brown to dark gray<sup>[4]</sup>. It is one of the major food sources in India's Deccan plateau, some regions of Maharashtra, Uttar Pradesh, Odisha, Rajasthan and West Bengal, and is traditionally consumed as food for health and vitality in rural India<sup>[5]</sup>.

A combination of milk product (burfi) and millet (kodo) in the present scenario has synergistic effect, where, deficiency of lysine in kodo millet and deficiency of dietary fibre and iron in milk product are being complemented by each other. Thus, the present study was undertaken to develop value added burfi with khoa and kodo millet for better nutritional profile.

### 2 Material and methods:

The study was carried out in the Department of Food Science and Nutrition, University of Agricultural Sciences, Bangalore, during the year 2019-2020.

**2.1 Procurement of raw ingredients:** Ingredients like full cream milk, millets, sugar and ghee were procured from local markets of Bengaluru.

## 2.2. Development of product

Kodo millet was processed into *hurihittu* in order to avoid raw flavour in the final product. Kodo millet was sprinkled with a small quantity of curd and was kept undisturbed for 20-25 minutes. It was then popped in a wide mouthed pan, allowed to cool and was ground.

*Khoa* was prepared from pasteurized full cream milk (6% fat and 9% SNF). It employed heating milk in an open pan with constant manual stirring-cum-scraping, till it reached a semi solid consistency. Fresh *khoa* was broken into bits and was spread uniformly in a *karahi*. Ground sugar was added at 30% based on the weight of *khoa* and mixed well. Kodo millet *hurihittu* was then added at 10%, 15% and 20% rate replacing *khoa*. The millet *hurihittu* was previously boiled in four times its quantity of water and gelatinized to a thick paste consistency in order to ensure uniform blending with *khoa*. The mixture was then worked thoroughly using a flattened ladle to avoid any lumps and uniform distribution was ensured. The homogenous mass was heated using a wide mouthed *karahi* in low flame till the desired consistency was obtained. The hot mass was then transferred to a stainless steel plate smeared with ghee, spread evenly and cut into pieces. The product was kept in a cool dry place (26- 28 °C) for 8-12 h for setting.

**Table 1:** Formulation of *khoa* based *burfi*

Particulars	BRF1	KBK1	KBK2	KBK3
<i>Khoa</i> (g)	100	90	85	80
Kodo millet (g)	0	10	15	20
Sugar (g)	30	30	30	30

## 2.3. Sensory evaluation

Sensory evaluation was carried out using nine-point hedonic scale. The score card was based mainly on appearance, colour, texture/consistency, taste and overall acceptability. Twenty-two semi trained judges having good health status and interested in sensory evaluation were selected from Department of Food Science and Nutrition, UAS, Bangalore.

## 2.4. Nutritional analysis

Moisture, protein, fat, ash and crude fibre content of best accepted *burfi* along with control *burfi* (BRF1) was analyzed using standard methods specified by AOAC.

Carbohydrate content of the same was calculated using difference method. Titrimetric method for calcium [6], atomic absorption spectrophotometry for iron and liquid chromatography for vitamin A estimation was employed.

## 2.5 Texture analysis

Texture profile analysis (TPA) was done using Stable Micro System TAXDi Texture Analyzer fitted with 100kg load cell. A P36R cylindrical probe was used with 5mm/s of pre-test, 0.5mm of test and post-test speeds. Representative graphs for the texture of products displayed in the computer attached to the instrument was studied to compute parameters such as hardness, cohesiveness, adhesiveness, springiness, gumminess and chewiness.

## 2.6 Shelf life study

The product best accepted by the sensory panel along with control *burfi* was considered for shelf life studies and the changes in sensory characteristics, moisture and microbial load were studied for a period of 15 days. The products were stored in air tight polypropylene containers and studied at room and refrigerated temperature

## 2.7 Data analysis

The data was analyzed using one-way analysis of variance (ANOVA) (F-test) and in randomized complete block design to determine the level of significance control product. However, among the variations, KBK1 with 10% incorporation levels was found to be best accepted and KBK3 with 20% incorporation levels had the lowest score. The difference in all the sensory characteristics among different variations was found to be statistically significant at 5% level.

## 3. Result and discussion

The scores for *khoa* based *burfi* incorporated with kodo millet ranged from 7.98 to 8.84 for appearance, 7.76 to 8.90 for colour, 7.82 to 8.68 for texture/consistency, 7.97 to 8.68 for taste and 7.97 to 8.77 for overall acceptability. Sensory scores were observed to decrease with increasing incorporation levels. Highest score in all of the sensory characteristics was observed for the (7 °C). The containers were dipped in 0.5 per cent H<sub>2</sub>O<sub>2</sub> solution and dried in an oven maintained at 60-65 °C for 30 min.

**Table 2:** Mean scores for sensory attributes of kodo millet incorporated *khoa* based *burfi*

Sample	Appearance	Colour	Texture/ Consistency	Taste	Overall acceptability
BRF1	8.84	8.90	8.68	8.68	8.77
KBK1	8.55	8.60	8.55	8.59	8.55
KBK2	8.32	8.08	8.05	8.30	8.32
KBK3	7.98	7.76	7.82	7.97	7.97
CD at 5%	0.281	0.297	0.268	0.305	0.206
SE.m ±	0.099	0.105	0.094	0.108	0.073
F value	*	*	*	*	*

\*- Significant at 5% level, BRF1-Control *burfi*, KBK1-Kodo millet incorporated *khoa* based *burfi* (10%), KBK2-Kodo millet incorporated *khoa* based *burfi* (15%), KBK3-Kodo millet incorporated *khoa* based *burfi* (20%)

Kodo millet incorporated *burfi* seemed to hold in more moisture and an attempt to continued desiccation yielded a product that was dry and crumbly in appearance and had hard body and coarse texture. Owing to the addition of kodo millet, moisture, crude fiber and iron content significantly increased from 14.54 to 17.4, 0 to 0.59 and 0.60 to 0.69 respectively.

However, a significant decrease in fat, protein, ash and the energy values were observed, as, per gram availability of these nutrients are higher in *khoa* than the millets.

Narwade [7] (2017) analyzed the nutritional composition of *burfi* incorporated with finger millet and the results so obtained were in line with the present study.

**Table 3:** Nutritional composition of best accepted *khoa* based *burfi*

Nutrients per 100g	BRF1	KBK1	F value	SE m ±	CD at 5%
Moisture (%)	14.54	17.4	*	0.043	0.172
Fat (g)	23.95	21.02	*	0.046	0.185
Protein (g)	12.49	9.89	*	0.034	0.139
Total ash (g)	2.78	2.38	*	0.038	0.151
Crude fibre (g)	0	0.59	*	0.012	0.048
Carbohydrate (g)	46.23	48.72	*	0.123	0.494
Energy (Kcal)	450.43	423.62	*	0.321	1.293
Calcium (mg)	475	355.5	*	0.049	0.321
Iron (mg)	0.60	0.69	*	0.003	0.021
Vitamin A as Retinol acetate (µg)	93.10	80.19	*	0.051	0.334

\*- Significant at 5% level, BRF1-Control *burfi*, KBK1-Kodo millet incorporated *khoa* based *burfi* (10%)

It was observed that all the rheological attributes such as hardness, cohesiveness, springiness, adhesiveness, gumminess and chewiness were lower for the kodo millet incorporated *burfi* compared to control *burfi*. All of the attributes showed statistically significant difference at 5% level. It was evident from the above table that the addition of millet had an undesirable effect on texture of the product and could be attributed to the retention of higher moisture in the product. Gupta <sup>[8]</sup> *et al.*, (1990) in their texture studies on *khoa*, as influenced by its composition, reported high levels of correlations between moisture content and various textural descriptors for *khoa*.

**Table 4:** Textural profile of best accepted *khoa* based *burfi* variations

Sample	BRF1	KBK1	F value	SE.m ±	CD at 5%
Hardness	25.091	16.096	*	0.295	0.978
Cohesiveness	0.1027	0.0891	*	0.002	0.008
Springiness	1.2914	0.554	*	0.007	0.022
Adhesiveness	2.2815	1.5883	*	0.005	0.016
Gumminess	2.5782	1.4342	*	0.051	0.17
Chewiness	3.3287	0.7939	*	0.051	0.168

\*- Significant at 5% level, BRF1-Control *burfi*, KBK1-Kodo millet incorporated *khoa* based *burfi* (10%)

**Table 5:** Effect of storage on sensory scores of *khoa* based *burfi* at room temperature

Sample	Duration	Appearance	Colour	Texture/ Consistency	Taste	Overall acceptability
BRF1	0th day	8.84	8.90	8.68	8.68	8.77
	5th day	8.14	8.15	8.23	8.02	7.98
	10th day	7.89	7.74	7.91	7.82	7.45
	F value	*	*	*	*	*
	SE.m ±	0.080	0.079	0.111	0.079	0.074
	CD at 5%	0.229	0.112	0.318	0.112	0.213
KBK1	0th day	8.55	8.60	8.55	8.59	8.77
	5th day	7.99	7.95	8.09	7.68	7.64
	10th day	7.32	7.43	7.45	7.32	7.18
	F value	*	*	*	*	*
	SE.m ±	0.079	0.108	0.081	0.092	0.096
	CD at 5%	0.111	0.308	0.233	0.262	0.274

\*- Significant at 5% level, BRF1-Control *burfi*, KBK1-Kodo millet incorporated *khoa* based *burfi* (10%)

**Table 6:** Effect of storage on sensory scores of *khoa* based *burfi* at refrigeration temperature

Sample	Duration	Appearance	Colour	Texture/ Consistency	Taste	Overall acceptability
BRF1	0th day	8.84	8.90	8.68	8.68	8.77
	5th day	8.30	8.28	8.34	8.16	8.11
	10th day	8.07	7.97	8.09	8.05	7.73
	15th day	7.93	7.88	8.00	7.91	7.59
	F value	*	*	*	*	*
	SE.m ±	0.071	0.074	0.101	0.072	0.082
	CD at 5%	0.202	0.209	0.285	0.204	0.234
KBK1	0th day	8.55	8.60	8.55	8.59	8.77
	5th day	8.13	8.09	8.09	7.82	7.77
	10th day	7.55	7.64	7.82	7.61	7.45
	15th day	7.48	7.57	7.61	7.52	7.32
	F value	*	*	*	*	*
	SE.m ±	0.095	0.095	0.083	0.102	0.098
CD at 5%	0.268	0.270	0.234	0.289	0.277	

\*- Significant at 5% level, BRF1-Control *burfi*, KBK1-Kodo millet incorporated *khoa* based *burfi* (10%)

Sensory scores for both control *burfi* and kodo millet incorporated *burfi* significantly decreased on storage. Samples had acceptable sensory scores between 'like moderately' to 'like very much' till 10<sup>th</sup> day when stored at

room temperature and till 15<sup>th</sup> day at refrigeration temperature. During storage, the samples turned dry and lost the original greasy appearance, which resulted in a steady decrease in colour and appearance scores. In the present

study, evaporation of moisture during storage might have aggregated the appearance of burfi as presence of moisture enlivens the appearance of product by reflecting incident light. The texture and consistency scores decreased during storage period, the stored samples progressively became brittle because of reduced cohesiveness. At refrigerated temperature the product became dry, hard, sandy and brittle which might be ascribed to the loss of moisture and possible due to crystallization of added sugar. In fresh product, the compounds formed during browning reactions are responsible for the typical flavour of the product, but as storage period progressed, the chemical reactions disturbed the delicate balance of the compounds.

**Table 7:** Effect of storage on moisture content of *khoa* based burfi at room temperature

Duration	Moisture Content (%)	
	BRF1	KBK1
0th day	14.55	17.4
5th day	13.54	16.99
10th day	12.75	16.51
F value	*	*
SE ±	0.17	0.119
CD Value	0.685	0.481

\*- Significant at 5% level, BRF1-Control burfi, KBK1-Kodo millet incorporated *khoa* based burfi (10%)

**Table 8:** Effect of storage on moisture content of *khoa* based burfi at refrigeration temperature

Duration	Moisture Content (%)	
	BRF1	KBK1
0th day	14.55	17.4
5th day	13.49	16.86
10th day	12.52	16.27
15th day	12.03	15.44
F value	*	*
SE ±	0.19	0.094
CD Value	0.671	0.331

\*- Significant at 5% level, BRF1-Control burfi, KBK1-Kodo millet incorporated *khoa* based burfi (10%)

Moisture content of burfi samples decreased with increasing storage period. Control product showed a decrease in moisture content from 14.55 to 12.75 at room temperature at the end of 10th day and to 12.03 at refrigeration temperature over a period of 15 days. Burfi incorporated with kodo millet had a decrease in moisture from 17.4 to 16.51 at room temperature on 10th day and to 15.44 at refrigeration temperature on 15th day.

Similarly, Shrivastava *et al.*, [9] (2018) reported a decreasing trend in moisture content of rava burfi during storage, packed in composite polyethylene terephthalate (PET)/low density polyethylene (LDPE) film.

**Table 9:** Effect of storage on microbial population of *khoa* based burfi at room temperature

Organisms		Duration			
		0th day	5th day	10th day	Mean
TBC (× 102 CFU/g)	BRF1	11.33 (3.439)	79.33 (8.935)	234.67 (15.629)	9.334
	KBK1	16.67 (4.143)	86.67 (9.336)	250.00 (15.827)	9.768
	Mean	3.791	9.1355	15.728	
		F-value	SEm ±	CD at 5%	
	Treatment	*	0.071	0.213	
	Duration	*	0.071	0.213	
	T x D	NS	-	0.123	
Fungi (CFU/g)	BRF1	0.00 (0.707)	3.3 (1.949)	6.6 (2.665)	1.774
	KBK1	0.00 (0.707)	6.6 (2.665)	13.3 (3.715)	2.362
	Mean	0.707	2.307	3.19	
		F-value	SEm ±	CD at 5%	
	Treatment	NS	0.074	-	
	Duration	*	0.074	0.221	
	T x D	NS	0.128	-	
Coliforms (× 102 CFU/g)	BRF1	0.00 (0.707)	0.00 (0.707)	0.00 (0.707)	0.707
	KBK1	0.00 (0.707)	0.00 (0.707)	0.00 (0.707)	0.707
	Mean	0.707	0.707	0.707	
		F-value	SEm ±	CD at 5%	
	Treatment	NS	0.00	-	
	Duration	NS	0.00	-	
	T x D	NS	0.00	-	

NS- Non significant, \*- Significant at 5% level, BRF1-Control burfi, KBK1-Kodo millet incorporated *khoa* based burfi (10%). Values in parenthesis indicate  $\sqrt{(x + 0.5)}$

**Table 10:** Effect of storage on microbial population of *khoa* based burfi at refrigeration temperature

Organisms		Duration				
		0th day	5th day	10th day	15th day	Mean
TBC (× 102 CFU/g)	BRF1	11.33 (3.439)	19 (4.416)	53.33 (7.337)	169.67 (13.045)	7.059
	KBK1	16.67 (4.143)	21.67 (4.709)	63.33 (7.989)	186.67 (13.681)	7.631
	Mean	3.791	4.5625	7.663	13.363	
		F-value	SEm ±	CD at 5%		
	Treatment	*	0.082	0.240		
	Duration	*	0.094	0.277		
	T x D	NS	0.164	-		

Fungi (CFU/g)	BRF1	0.00 (0.707)	0.00 (0.707)	3.3 (1.949)	13.3 (3.715)	1.769	
	KBK1	0.00 (0.707)	0.00 (0.707)	6.6 (2.665)	16.6 (4.135)	2.054	
	Mean	0.707	0.707	2.307	3.925		
		F-value		SEm ±	CD at 5%		
	Treatment	NS		0.058	NA		
	Duration	*		0.095	0.197		
	T x D	NS		0.116	NA		
Coliforms (× 10 <sup>2</sup> CFU/g)	BRF1	0.00 (0.707)	0.00 (0.707)	0.00 (0.707)	0.00 (0.707)	0.707	
	KBK1	0.00 (0.707)	0.00 (0.707)	0.00 (0.707)	0.00 (0.707)	0.707	
	Mean	0.707	0.707	0.707	0.707		
			F-value		SEm ±	CD at 5%	
	Treatment	NS		0.00	-		
	Duration	NS		0.00	-		
	T x D	NS		0.00	-		

NS- Non significant, \*- Significant at 5% level, BRF1-Control burfi, KBK1-Kodo millet incorporated khoa based burfi (10%). Values in parenthesis indicate  $\sqrt{(x + 0.5)}$

The total bacterial count of *burfi* during storage study was well within the limits laid down by BIS (30,000 cfu/g). KBK1 developed visible mold growth on 11<sup>th</sup> day of storage at room temperature and control product had visible mold growth on 12<sup>th</sup> day. However, a maximum of 10 cfu/g is specified for fungal colonies and millet incorporated *burfi* (KBK1) samples exceeded the standard limits by 10<sup>th</sup> day of storage at room temperature and by 15<sup>th</sup> day of storage at refrigeration temperature.

Therefore, kodo millet incorporated *burfi* (KBK1) was acceptable up to 5 days at room temperature and up to 10 days at refrigerated storage.

#### 4. Conclusion

Milk and dairy products are considered as 'nearly complete' foods as they contain a wide array of nutrients. However, it is well known that milk is not a good source of iron and fibre. Millets, in contrast, are deficient in essential amino acids like lysine, compromising the protein quality. An effort was therefore made in the present study to formulate food products from milk-millet combination. Results revealed that the kodo millet could successfully be incorporated to a dairy product like *burfi*, with highly acceptable sensory attributes. Thus, development and consumption of such products from milk-millet combination can be encouraged among all healthy sectors of population and the enhanced nutritional profile can be exploited.

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