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Manoj Kumar Pal
P. G. Student, Warner College of Dairy Technology, SHUATS, Naini, Allahabad, UP-211007, India

Thejus Jacob
Assistant Professor (Food Engineering), Warner College of Dairy Technology, SHUATS, Naini, Allahabad, UP-211007, India

Veer Pal
P. G. Student, Warner College of Dairy Technology, SHUATS, Naini, Allahabad, UP-211007, India

Prachi Wasnik
PhD Research Scholar, Warner College of Dairy Technology, SHUATS, Naini, Allahabad, UP-211007, India

Correspondence
Manoj Kumar Pal
P. G. Student, Warner College of Dairy Technology, SHUATS, Naini, Allahabad, UP-211007, India

Development and quality evaluation of burfi prepared by using bottle gourd (*Lagenaria sicereria*) and carrot (*Daucus carota* L *sub sp. Sativus*)

Manoj Kumar Pal, Thejus Jacob, Veer Pal and Prachi Wasnik

Abstract
The present study was undertaken with the objective of developing burfi with enhanced nutritional properties and acceptable sensory attributes. The product was prepared by using khoa (6% Fat), bottle gourd (*Lagenaria sicereria)* along with carrot (*Daucus carota* L *sub sp. Sativus*) in the ratio of T_0 (100:00:00), T_1 (80:12:08), T_2 (80:08:12), T_3 (80:04:16). Sugar was incorporated @ 20%. The burfi thus prepared was analyzed for physico-chemical properties (Percent Ash, Acidity, Carbohydrate, Fat, Moisture, Protein). Sensory evaluation was done on 9point Hedonic scale. The increasing trend for percent protein from T_0 to T_3 may be attributed to increasing levels of carrot and amount of bottle gourd present (from 0 to 16%) in the treatment samples. Treatment combination T_2 was recorded highest for its mineral content. Treatment T_2 (8% bottle gourd and 12% carrot) received highest scores (8.60) for colour and appearance, body and texture (8.40), flavor (8.80) and overall acceptability (8.565) on 9 point Hedonic Scale. Standard Plate Count (cfu/gm) for 10^3 dilutions was highest (17.20) for treatment sample T_1.Coliform counts observed were nil. Cost of production (Rs. Per kilogram of finished product) for experimental samples were T_1 (187.4), T_2 (187.6), T_3 (188) and that for control was T_0 (224).

Keywords: Bottle gourd, burfi, carrot, *Daucus carota*, khoa, *Lagenaria sicereria*

1. Introduction
Availability of liquid milk and preparation of milk based delicacies has been a practice from time immemorial (Bankar *et al.*, 2013) [2]. As far as traditional milk products are concerned, it has been estimated that 6.5 percent of total milk produced in India is converted into khoa and other condensed milk products (Shete *et al.*, 2012) [20]. The value of khoa manufactured annually in India becomes almost double on its conversion into variety of popular indigenous khoa based sweets particularly burfi, peda, gulabjamun, kalakand etc. (Kadam *et al.*, 2010) [15]. Khoa prepared from buffalo milk can be adapted for preparing wide varieties of traditional sweets because of its appealing flavor, body and texture. Khoa bases sweets bear high commercial significance because of their popularity throughout the country and longer shelf life. In India, these milk sweets have been an indispensable part of the socio-cultural life (Kumar, 2013) [16].
Burfi is most popular khoa based sweet all over India. Khoa is responsible for desired texture of burfi (Dharmadhikari, 2002) [5]. It is also expected to retain most of the fat soluble vitamins A and D and also fairly large quantities of water soluble B complex vitamins contained in the original milk (De, 1991) [4]. There are many varieties of burfi, depending on the ingredients mixed with it, *viz*., besan burfi (made with gram flour), kaju barfi (made with cashew nuts), pista burfi (made with pistachio) etc., and fruits/ spices added to it, viz., mango burfi, coconut burfi, and cardamom burfi etc. (Navale *et al.*, 2014) [17].
Bottle gourd is delicately flavoured and botanically belongs to the broader Cucurbitaceae (gourd) family of plants, in the genus *Lagenaria*. Its scientific name is *Lagenaria sicereria*. Some of the common names are white-flower gourd, long-squash, etc., in the west and doodhi or lauki in the Indian subcontinent. Telangana region in India is endowed with a rich variability of bottle gourd, especially with regard to fruit characteristics (Sivaraj and Pandravada, 2005) [21]. It is grown in rainy season as well as in summer season and very much appreciated by both rich and poor people. Bottle gourd contains about 92 to 93 % (wb) water and the remaining is easily digestible fiber. So it is the easily digestible food. The glucose and sugar related compounds are nearly nil in the bottle gourd. So, it is one of the best food options for the diabetic patients. The bottle gourd is one of the body heat control food and it keeps

your body temperature at normal level. Bottle gourd juice is widely used for weight loss therapy. It also helps to reduce the inflammations in the liver and kidneys. The bottle gourd juice is also helpful in treating diarrhea and for those who are suffering with the constipation. Hair oil prepared from bottle gourd with sesame oil helps for the good sleep. It is one of the remedy for the insomnia. Bottle gourd helps to treat the urinary tract infection as well (Ram *et al*, 2006) [18].

The consumption of carrot and its products have increased steadily due to their recognition as an important source of natural antioxidants besides, anticancer activity of β-carotene being a precursor of vitamin A (Dreosti, 1993; Speizer *et al*., 1999) [7, 22]. Carrot (*Daucus carota* L *sub* sp. *Sativus* (Hoffm Arcang) is a significant source of vitamins (A, B, C). Further it contains vitamins

E, H, folic acid and pantothenic acid. Carrot is an important source of trace elements (K, Na, Ca, Mg, P, S, Mn, Fe, Cu and Zn). Consumption of carrot improves eyesight, lowers cholesterol and improves digestion (Bystricka *et al.*, 2015) [3]. Carotenoids, polyphenols and vitamins present in it act as anti-diabetic, antioxidants, anti-carcinogens, and immune-enhancers, lowers cholesterol and cardiovascular diseases. Anti-hypertensive, hepato-protective and wound healing benefits of carrot have also been reported. The cardio- and hepato-protective, anti-bacterial, anti-fungal, anti-inflammatory and analgesic effects of carrot seed extracts are also noteworthy (Dias, 2014) [6]. Significance of burfi, bottle gourd and carrot lead to the idea of development of acceptable product which contained combined benefits of all three of them.

2. Materials and methods

Milk, bottle gourd, carrot and sugar were collected from the local market of Indranagar, Lucknow whereas the required analytical grade chemicals and compounds were obtained from the research lab of "CytoGene Research & Development" B- Block Chauraha, Indranagar, Lucknow, UP. Four treatment samples were studied and each treatment was replicated five times. In all 20 samples were studied. Average values for physico-chemical, microbial and sensory analysis were recorded for the final product. The final products were analyzed for percent ash, acidity, carbohydrate, fat, moisture, protein and total solid. Microbiological analysis involved estimation of Coliform count, Standard plate count, Yeast & Mould count. Sensory analysis was carried out on 9 point Hedonic scale to judge for body & texture, colour & appearance, flavour and over all acceptability.

2.1 Treatment combinations

Table 1: Treatment combinations for bottle gourd and carrot burfi.

Treatment	**Khoa (%)**	**Bottle gourd (%)**	**Carrot (%)**
T_0 (Control)	100	0	0
T_1	80	12	08
T_2	80	08	12
T_3	80	04	16

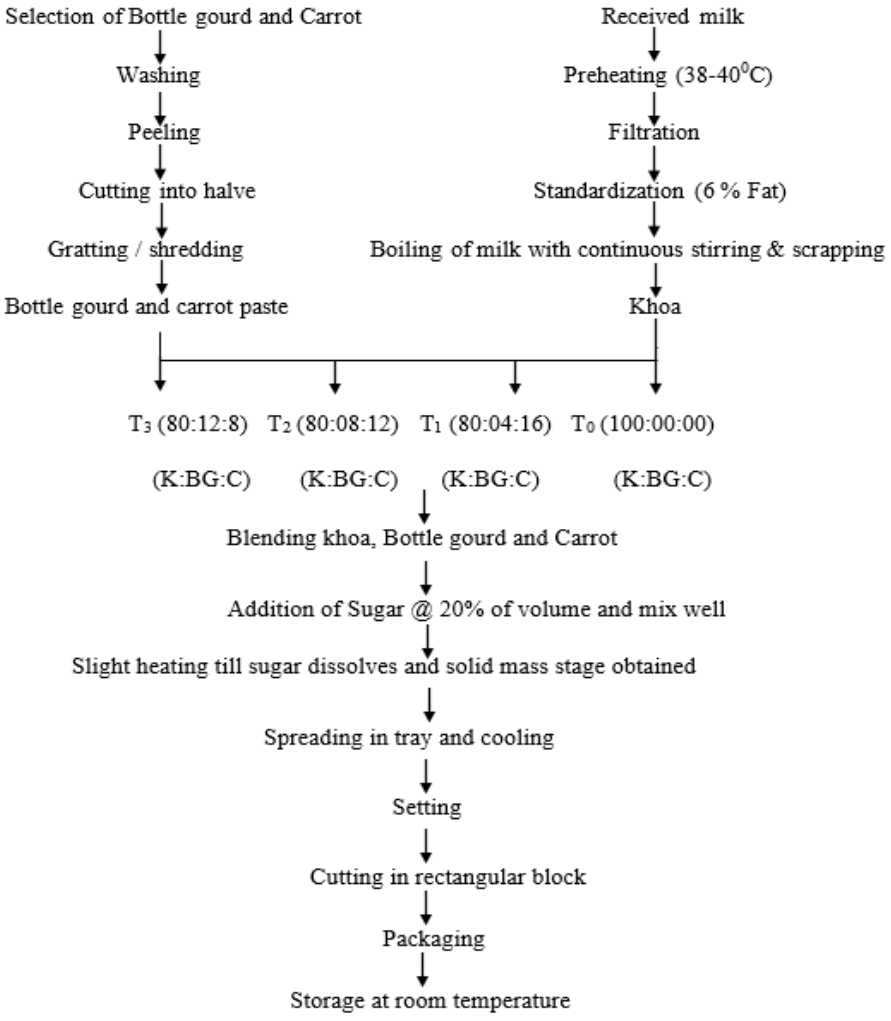

Fig 1: Flow diagram for preparation of bottle gourd and carrot burfi

2.2 Preparation of bottle gourd and carrot burfi

Fresh and acceptable quality of milk was received, preheated (38-40 ^{0}C), filtered and standardized to 6% fat. It was boiled with continuous stirring and scrapping for preparation of khoa. Simultaneously, Good quality of bottle gourd and carrot were procured from the market, properly washed in running tap water to remove dirt. This was followed by peeling and cutting of bottle gourd and carrot in to two halves. These halves were gratted and shredded for the ease of making paste. Definite combinations of khoa, bottle gourd and carrot paste were obtained as per the treatments. Sugar @ 20% was added. All the ingredients were blended properly. This blend was heated till sugar was dissolved and a solid homogenous mass was obtained. This solid mass was properly spread over sterilized stainless steel tray and allowed to set and cool. After setting the mass was carefully cut in to rectangular shape (approximately 4cm x 2cm) with the help of sterilized stainless steel knife. The final product was packed in cardboard boxes and stored at room temperature for further analysis.

2.3 Physico- chemical analysis

The moisture of treatment samples was determined by procedure described in IS: 1010 (1968) [8]. Fat extraction of burfi were determined as per the procedure described in IS: 2311 (1963) [13]. In this method, the sample is treated with ammonia to dissolve the proteins and ethyl alcohol to help precipitate the proteins. Thereafter, the fat is extracted with diethyl ether and petroleum ether. The mixed ethers are then evaporated and the residue weighed. Total nitrogen/protein of burfi was determined by Semi Micro Kjeldahl method (IS:1479 Part II, 1961) [11]. Ash content of all the samples was determined by procedure described in IS:1547 (1985) [12]. The acidity of burfi was obtained by method described in BIS (IS: 1166 1968) [10] for condensed milk. Carbohydrate content was calculated by differential method (AOAC, 1980) [1].

2.4 Sensory analysis

The samples were subjected to sensory evaluation as described in using a 9 point hedonic scale score card as suggested by Stone and Sidel (2004) [23].

2.5 Microbiological analysis

All the burfi samples were analyzed for the Standard Plate Count (SPC), Coliform count and Yeast and Mold count (YMC) by the methods as described in IS:5550 (2005) [14].

3. Results and discussion

3.1 Carbohydrate

The data regarding carbohydrate percentage in Burfi prepared by using Bottle gourd and Carrot of different treatment are presented in Table 2.

Table 2: Carbohydrate percentage in control and experimental Burfi.

Treatments	Replication					Mean	F-test	S. Ed. (±)	C.D. (P=0.05)
	R1	R2	R3	R4	R5				
T0	45.87	45.48	45.84	42.97	44.36	44.90	S	0.56	1.22
T1	39.25	39.78	39.60	39.72	39.52	39.57			
T2	38.95	38.09	39.78	39.66	38.88	39.07			
T3	38.74	40.21	40.29	39.66	41.01	39.98			

3.2. Protein

The data regarding protein percentage in Burfi prepared by using Bottle gourd and Carrot of different treatment are presented in Table 3.

Table 3: Protein percentage in control and experimental Burfi.

Treatments	Replication					Mean	F-test	S. Ed. (±)	C.D. (P=0.05)
	R1	R2	R3	R4	R5				
T0	13.15	13.47	13.27	13.56	13.22	13.33			
T1	14.89	13.95	14.56	14.73	14.39	14.50	S	0.27	0.59
T2	15.63	15.85	14.79	14.46	15.52	15.25			
T3	15.83	15.39	15.25	15.76	14.96	15.43			

3.3. Fat content.

The data regarding fat percentage in Burfi prepared by using Bottle gourd and Carrot of different treatment are presented in Table 4.

Table 4: Fat percentage in control and experimental Burfi

Treatments	Replication					Mean	F-test	S. Ed. (±)	C.D. (P=0.05)
	R1	R2	R3	R4	R5				
T0	17.78	17.56	17.44	17.76	17.26	17.56			
T1	19.56	19.38	19.11	19.40	19.25	19.64	S	0.11	0.24
T2	19.05	18.89	18.29	18.70	18.44	18.67			
T3	18.87	18.29	18.75	18.57	18.49	18.59			

3.4. Ash Content.

The data regarding Ash percentage in Burfi prepared by using Bottle gourd and Carrot of different treatment are presented in Table 5.

Table 5: Ash percentage in control and experimental Burfi.

Treatments	Replication					Mean	F-test	S. Ed. (±)	C.D. (P=0.05)
	R1	R2	R3	R4	R5				
T0	2.64	3.02	2.73	2.87	2.57	2.77			
T1	2.39	2.85	2.57	2.43	2.73	2.59	S	0.12	0.25
T2	3.43	3.78	3.36	3.63	3.54	3.59			
T3	3.60	3.55	3.82	3.45	3.15	3.51			

3.5. Moisture Content

The data regarding moisture percentage in Burfi prepared by using Bottle gourd and Carrot of different treatment are presented in Table 6.

Table 6: Moisture percentage in control and experimental Burfi

Treatments	Replication					Mean	F-test	S. Ed. (±)	C.D. (P=0.05)
	R1	R2	R3	R4	R5				
T0	20.56	20.47	20.72	22.84	22.59	21.41			
T1	23.91	24.04	24.16	23.72	24.11	23.99	S	0.41	0.89
T2	22.94	23.39	23.78	23.55	23.63	23.46			
T3	22.96	22.56	22.89	22.56	22.39	22.67			

3.6. Percent Acidity

The data regarding Acidity percentage in Burfi prepared by using Bottle gourd and Carrot of different treatment are presented in Table 7.

Table 7: Acidity percentage in control and experimental Burfi

Treatments	Replication					Mean	F-test	S. Ed. (±)	C.D. (P=0.05)
	R1	R2	R3	R4	R5				
T0	0.76	0.82	0.80	0.78	0.81	0.79			
T1	0.82	0.88	0.84	0.85	0.87	0.85	S	0.01	0.03
T2	0.85	0.90	0.87	0.87	0.91	0.88			
T3	0.89	0.88	0.93	0.95	0.92	0.91			

3.7. Colour &appearance.

The data regarding colour & appearance score in Burfi sample of different treatments are presented in Table 8.

Table 8: Average score of colour and appearance of control and experimental Burfi

Treatments	Replication					Mean	F-test	S. Ed. (±)	C.D. (P=0.05)
	R1	R2	R3	R4	R5				
T0	8	9	7	8	8	8.00	S	0.42	0.92
T1	8	8	8	9	8	8.20			
T2	9	8	8	9	9	8.60			
T3	9	7	6	7	7	7.20			

3.8 Body & texture

The data regarding Body & texture score in burfi sample of different treatments are presented in Table 9.

Table 9: Average score of Body and texture of control and experimental burfi.

Treatments	Replication					Mean	F-test	S. Ed. (±)	C.D. (P=0.05)
	R1	R2	R3	R4	R5				
T0	9	9	8	8	7	8.20			
T1	8	7	9	7	8	7.80	S	0.45	0.97
T2	8	8	9	9	8	8.40			
T3	7	7	8	6	7	7.00			

3.9 Flavour

Table 10: Average score of Flavour of control and experimental burfi.

Treatments	Replication					Mean	F-test	S. Ed. (±)	C.D. (P=0.05)
	R1	R2	R3	R4	R5				
T0	9	9	9	8	8	8.60			
T1	8	8	9	9	9	8.60	S	0.37	0.77
T2	9	9	9	9	8	8.80			
T3	7	7	8	6	7	7.00			

3.10 Overall Acceptability

The data regarding Overall acceptability score in burfi sample of different treatments are presented in Table 11.

Table 11: Average score of Overall acceptability of control and experimental burfi.

Treatments	Replication					Mean	F-test	S. Ed. (±)	C.D. (P=0.05)
	R1	R2	R3	R4	R5				
T0	8.6	9	8	8	7.6	8.24			
T1	8	7.6	8.6	8.3	8.3	8.16	S	0.30	0.64
T2	8.6	8.3	8.6	9	8.3	8.56			
T3	7.6	7.0	7.0	6.3	7.0	6.98			

3.11. Standard plate count
The data regarding SPC in burfi sample of different treatments are presented in Table 12.

Table 12: Average of SPC ($x10^3$cfu/gm) in sample of control and experimental burfi

Treatments	Replication					Mean	F-test	S. Ed. (±)	C.D. (P=0.05)
	R1	R2	R3	R4	R5				
T0	12	18	16	12	14	14.40	S	1.29	2.80
T1	14	17	20	16	19	17.20			
T2	14	14	13	12	12	13.00			
T3	16	13	14	15	17	15.00			

3.12. Yeast and mold count
The data regarding Yeast and mould in Burfi sample of different treatments are presented in Table 13.

Table 13: Average of Yeast & Mold ($x10^3$cfu/gm) in sample of control and experimental burfi.

Treatments	Replication					Mean	F-test	S. Ed. (±)	C.D. (P=0.05)
	R1	R2	R3	R4	R5				
T0	7	6	7	8	6	6.80	S	0.69	1.50
T1	6	6	8	5	6	6.20			
T2	3	5	3	5	5	4.20			
T3	6	4	5	5	4	4.80			

3.13 Coliform count
The coliform test of control and experimental burfi is found to be nil in each replication.

3.14 Cost of production

S. No.	Treatments	Cost (Rs./Kg)
1	T0	224.0
2	T1	187.4
3	T2	187.6
4	T3	188.0

It is evident from the tables that carbohydrate percent was highest for control sample whereas the protein percent was lowest for the same. The increasing trend for protein from T_0 to T_3 may be attributed to increasing levels of carrot (from 0 to 16%) in the treatment samples. Fat percent calculated was highest for T_1 which may be due to the highest percent bottle gourd present in it. As the percent of bottle gourd decreases from T_1 to T_3 the percent fat also goes on decreasing. Ash percent was lowest for control but was highest for T_2 containing 12% carrot and 8% bottle gourd. Treatment combination T_2 was recorded highest for its mineral content. Moisture percent was mainly dependent upon percent bottle gourd present in treatment samples. As it was present in highest amount in Treatment T_1 hence its moisture percent was highest (23.99%). Treatment T_3 recorded highest percent acidity as compared to all other samples which showed a decreasing trend from T_3 to T_0.Treatment T_2 (8% bottle gourd and 12% carrot) received highest scores (8.60) for colour and appearance, body and texture (8.40), flavor (8.80) and overall acceptability (8.565) on 9 point Hedonic Scale. Standard Plate Count (cfu/gm) for 10^3 dilution was highest (17.20) for treatment sample T_1 may be due to highest moisture percent present providing favourable environment for growth and proliferation of microbes. Yeast and mould count in 10^3 dilution was highest in control samples. Lesser count of Yeast and Mould were observed in other treatment samples which may be attributed to the antimicrobial components present in their ingredients as is evident from the literature. Coliform counts observed were nil which demonstrate no post packaging contamination. Cost of production (Rs. Per kilogram of finished product) for experimental samples were T_1 (65.28), T_2 (65.76), T_3 (66.24) and that for control was T_0 (59.52).

4. Conclusion
All the treatment samples showed more protein and ash percent present in them when compared to the control samples. Treatment T_2 reported highest scores in sensory evaluation on 9 point Hedonic scale in terms of colour and appearance, body and texture, Flavour and overall acceptability. Hence it can be concluded that more qualitative finished product of Burfi can be developed using 08% bottle gourd and 12% carrot. Cost of production increased from T_0 to T_3.

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