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Studies on Functional Enrichment of Burfi and Khoa with Beetroot and Tomato Peel Powder

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Abstract

The effect of beetroot and tomato peel powder incorporation at 1%, 2%, 3%, 4%, and 5% and their combinations in burfi with khoa as a base (control) were studied. The quality parameters studied were nutritive, physicochemical, functional, sensory, and shelf life of the burfi at the different concentrations of beetroot and tomato peel powder incorporation. A significant decrease has been observed in the protein content from 15.6 in BPP1 to 10.0 in BPP5 and 15.0 in TPP1 to 10.0 in TPP5. The fat content of burfi is also decreased significantly from 18.4 in BPP1 to 14.9 in BPP5 and 19.1 in TPP1 to 15.2 in TPP5 with an increase in moisture and ash content as the concentration of the beetroot and tomato powder increased. A significant increase in the Flavonoid content was also observed from 1% to 5% of beetroot (4.64 mg to 28.59 mg) and tomato (6.66 mg to 14.38 mg) peel powder incorporation. On the contrary, the antioxidant activity including the free radical scavenging activity significantly increased as the beetroot and tomato peel concentration increased from 13.89 ± 0.21 in BPP1 to 16.75 ± 0.17 in BPP5 and 10.95 ± 0.29 in TPP1 to 13.42 ± 0.19 in TPP5. The antioxidant activity FRAP is also increasing significantly from 0.53 ± 0.17 in BPP1 to 2.56 ± 0.31 in BPP5 and 0.96 ± 0.11 in TPP1 to 4.05 ± 0.19 in TPP5 with having control 0.42 ± 0.1 and the combination 1.48 ± 0.1. Sensory evaluation revealed that the most acceptable burfi was the one with 3%beetroot and 4% tomato peel powder incorporation in the base khoa. The combination that have been made from 5% of beetroot peel powder and 5% of tomato peel powder in the khoa as base (control). Shelf life analysis was done on 3% and 4% of the beetroot and tomato peel burfi.

Keywords: Tomato peel burfi • Shelf life analysis • Tomato peel powder

Introduction

India is the world's largest producer of milk. Approximately India produces about 127.85 million tonnes of milk per annum. It is 15% of the world's milk production. About 50%-55% of the total milk produced in India is converted into different types of traditional milk products such as paneer, dahi, khoa, etc. and 7% of milk is used to make khoa and khoa based products. Burfi is a khoa based product which is very popular in India. Burfi is prepared by boiling milk to obtain a semi-solid product called khoa to which sugar is added in crystalline, powder, or syrup form.

There are different types of burfi available in the market like kaju burfi, chocolate burfi, mawa burfi, fruit burfi, etc. The main principle of Khoa making is to reduce the moisture content and increase total solids which will results in a longer shelf of the product than the milk. The longer shelf life of a product indicates healthy profits over a longer period. To overcome this problem, value additions of traditional products with good nutritive and functional properties are developed. The addition of a different type of fruit and vegetable to the burfi is to improve its functional properties, nutritive value, and sensory attributes, and aroma characteristics. The flavored burfi is one of the most popular sweet in India. The preparation of different types of flavored burfi using different types of fruit and vegetable makes it more acceptable in the market. In today's society, in which there is a great demand for appropriate nutritional standards. These are characterized by high costs and also less availability of raw materials. Consequently, there is a considerable emphasis on the recovery, recycling, and upgrading of wastes. This is valid for the food and food processing industry in which wastes, residues, and by-products can be recovered and can often be upgraded to higher value and useful products. The food industry produces large volumes of wastes, both solids, and liquids, resulting from the production, preparation, and consumption of food. Therefore, the waste from beetroot and tomato peel has been used for the preparation of khoa based milk product [1-10].

Tomato is one of the most important horticulture crops. Tomato belongs to species *Solanum lycopersicum*. The worldwide production of tomatoes is 126 million tonnes. Tomato is an excellent source of many nutrients such as vitamin C and E, mineral matter, β-carotene, lycopene, flavonoids, organic acids, phenolic compounds, and chlorophyll. Tomato also provides a good number of total Antioxidants and is consumed in diverse ways, raw or cooked, in many dishes, sauces, salads, and drinks. Tomato peels contain a high level of lycopene (2.5 times) as compare to pulp and seed. Lycopene and β-carotene are plant pigments which are also known as natural food colorants. Albanese, et al. stated that lycopene plays an important role in human health due to its high antioxidant activity. It helps to prevent or treating cancer. Tomato peel and seed also have essential amino acids and a good amount of minerals (Fe, Cu, Zn, and Mn). Tomato peels also have monounsaturated fatty acids such as oleic acid and linoleic acid. The majority of the flavonoids in tomatoes are present in the skin. Tomatoes contain a high level of lycopene which is very good for the skin, prevents several types of cancer; they contain a good amount of calcium and vitamin K. Although the protective effect against cancer is thought to be due to antioxidant activity synthesis vitamin E, vitamin C and b-carotene are not effective. The tomato skin is a rich source of lycopene and polyphenol compounds.

Beetroot is a good source of water soluble nitrogenous pigments, which belongs to the species Beta vulgaris and is also known as betalains. These are characterized into two categories, the red betacyanins and the yellow betaxanthins. Betanin makes up 75%-95% of the total coloring matter found in the beetroot. Although the color of the beetroot is more stable at pH of range 3-7. These are free radical scavengers and prevent the oxidation of biological molecules. The beetroot contains a good amount of total phenolic content in the order of peel (50%), the crown (37%), and flesh (13%). The beetroot peel having the main portion of betalains (54%). Approximately 15%-30% of beetroot by-product is being utilized as feed and for the preparation of dietary fiber and biofuel. The antioxidant property of beetroot peel can help to prevent oxidative damage in the human body system by scavenging oxygen free radicals. Beetroot contains bioactive compounds that have anti-inflammatory, anti-hypertensive, anti-oxidant, antipyretic, antibacterial, antiemetic, and diuretic and DE toxicant properties. Beetroot contains betalains which plays important role in chemoprevention against skin cancer. It also

possesses hepatic-protective properties. The flavonoids exhibit ant proliferative activity on cancer cells. Beetroot is a nitric oxide (NO generator having the potential to improve cerebrovascular flow. It has been reported that dietary Nitrate (NO_3), supplementation affects cerebral hemodynamic [11-15].

Materials and Methods

Procurement of raw material

Tomato and beetroot were purchased from the local vendors Phagwara, Punjab, India, under sterile conditions. These were washed with distilled water and peeled off with the help of a hand peeler. The peels were dried for 2 days in a tray drier at a temperature of 60°C. Once the peels were dried, they were grounded using an electrical mixture grinder. The power was collected and sieved at the particle size of 6 mm and stirred in the air tight pouches at room temperature. The extract was then stored in sterile airtight bags at room temperature. Khoa and sugar were taken in a ratio of 2:1 and in these different concentrations of tomato and beetroot peel powder were added and the process flow chart is shown in Figure 1. The different concentrations were 1%, 2%, 3%, 4%, 5%, combination (5% of tomato peel powder: 5% of beetroot peel powder) which was compared with control sample (100%). As shown in Table 1. Different experiments have been conducted based on chemical properties, functional properties, bioactive properties, sensory analysis, and shelf life analysis (Figures 2 and 3).

Table 1. Ferent concentration for the burfi preparation.

Treatments. Dif	Composition	Khoa (gm)	Sugar (gm)	Tomato/Beetroot peel powder (gm)
Control		100	25	0
BPP1/TPP1	1%	99	25	1
BPP2/TPP2	2%	98	25	2
BPP3/TPP3	3%	97	25	3
BPP4/TPP4	4%	96	25	4
BPP5/TPP5	5%	95	25	5
Combination	5%,5%	90	25	5,5

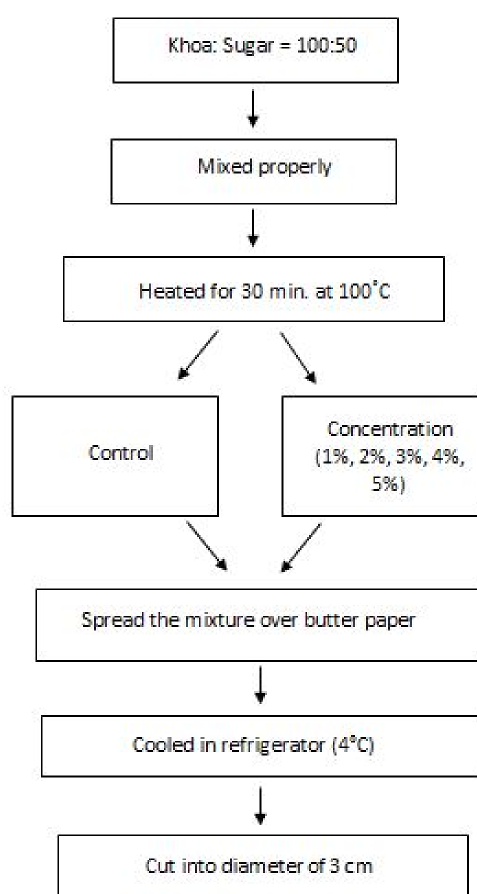

Figure 1. Combination of beetroot and tomato peel burfi.

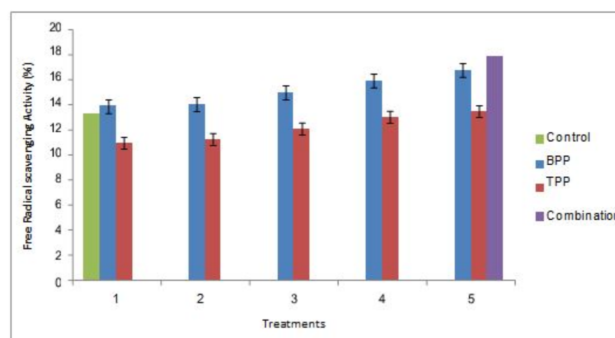

Figure 2. Graphical representation of free radical scavenging activity of burfi.

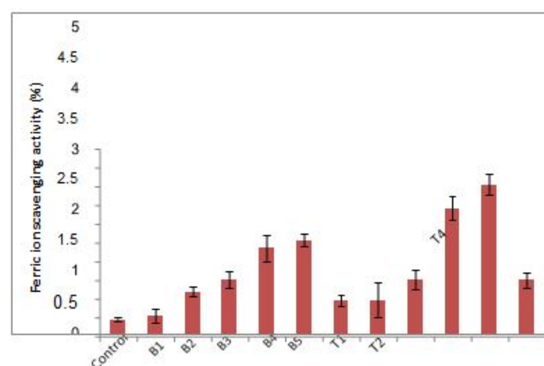

Figure 3. Graphical representation of Ferric ion reducing antioxidant power of burfi.

Proximate analysis

The moisture content was determined by taking a 5 gm sample in petridish and heated in a hot air oven at 105°C for 3

hours. After that three same consecutive readings were noted. The petridish was taken out and cooled. The moisture content was calculated using the following formula:

$$\text{Moisture content} = \frac{w1-w2}{w1-w} \times 100$$

Where,

W=Weight of dish with sample.

W1=Weight of dish without sample .

W2=Final weight of dish (gm).

Ash content: Ash content has also been determined by taking sample 5 gm in the crucible and kept for charring for 2 hours. After that, the sample was kept in a muffle furnace for 6 hours.

$$\text{Ash content} = \frac{w2-w1}{s} \times 100$$

Where,

W1=Weight of empty silica crucible (gm)

W2=Weight of silica crucible and ash (gm)

S=Weight of sample (gm).

Protein content: Protein content was determined by the Kjeldahl method and the Soxhlet apparatus was used for determining fat content.

Titratable acidity: Titratable acidity was determined by taking a known volume of sample was titrated against 0.1 N NaOH standard solutions by using phenolphthalein as an indicator up to the endpoint (Pink color).

pH: The pH was measured using a portable electric pH meter (Model EZDO PL -600, HTA Instrumentation, Banglore, India)

Chemical analysis

Ascorbic acid: Weight 1 gm sample and add 5 ml of 3% Meta phosphoric acid. Centrifuge at 6000 rpm for 20 min. After that take, 5 ml of supernatant and add 10 ml 3% Meta-phosphoric acid. Add 2-3 drops of phenolphthalein indicator and titrate it with dye. Put the values in the formula,

$$\text{Ascorbic acid}=\frac{dye\ factor * v2 * 100 * 100}{5 * weight\ of\ sample}.$$

Total phenols: Take 0.1 gm of sample to measure the total phenols and add 5 ml, 80% ethanol centrifuge it at 6000 rpm. Took the supernatant and boiled it to evaporation. Add 5 ml distilled water to the residue and mix. Took 0.2 ml in another test tube and volume was made up to 3 ml with water. Added 0.5 ml folin ciolcalteau reagent left for 3 minute and added 2 ml 20% sodium carbonate and boiled for 1 minute. OD was taken at 650 nm. Gallic acid was taken as standard and results were expressed as mg GAE/100 gm.

Flavonoids: Flavonoids were measured by taking sample 0.1 gm was mixed with 5 ml 80% ethanol and was filtered. 0.25 ml extract was taken in a test tube and added 1.25 ml distilled water and 0.75 ml of 3% sodium nitrate, left for 6 min and added 0.275 ml distilled water and took OD at 510 nm.

Anthocyanin: 1 g of sample was mixed with 10 ml ethanolic HCl and was left undisturbed overnight at 4°C. The sample was filtered and the volume was made up to 10 ml with ethanolic HCl. The absorbance was recorded at 535 nm. The anthocyanin content was calculated using the formula:

$$\text{Total anthocyanin content}=\frac{absorbance * voloume\ made\ upto * total\ voloume * 100}{ml\ of\ extract * weight\ of\ sample}$$

Antioxidant analysis: DPPH free radical scavenging assay was measured by taking a powdered sample (0.1 g) extracted with methanol and was then filtered. An aliquot of 5 µl was taken from the filtrate and was mixed with 3.995 ml of DPPH solution. The sample was then incubated in dark for 30 minutes. The absorbance was recorded at 515 nm [16-19].

$$\text{DPPH (\%)=(O.D. of DPPH)–[(O.D. of sample+DPPH)/(O.D. of DPPH)]} \times 100$$

To check the Ferric Reducing Antioxidant Power (FRAP) Acetate buffer (300 mM), TPTZ (10 ml in 40 mM HCl), and $FeCl_3$ (20 mM) were mixed in 10:1:1 to form FRAP reagent. Sample (0.1 g) was extracted with 80% ethanol. Filtrate (5 µl) was mixed with 3.995 ml FRAP reagent and was incubated for 30 min. at room temperature. O.D. was taken at 593 nm. The results were expressed as mgTE/g using Trolox as a standard.

Staling test

Free Fatty Acid (FFA) was performed by taking 0.5 gm of a sample into a 60 ml of a stopper test tube. Extraction with 10 ml of ISO proposal and mix thoroughly. Follow this by adding 6 ml of petroleum ether and 4 ml of distilled water. Stopper AMD temper the test tube was 40℃ for 10 min. Shake the content vigorously for 20 sec. separate the 2 layers for 10-15 min and take an aliquot of the upper layer (5-8) which was withdrawn and titrated against 0.02 N Methanolic KOH solution using 1%phenolphthalein as an indicator. A blank, in which the sample was replaced with distilled water, was used to obtain the background titration.

$$\text{FFA} = 56.1 \times N \times V/N$$

Where,

N=Normality

V=Volume

M=Weight of a sample

Similarly, Hydroxyl Methyl Furfural (HMF) content in the burfi sample was determined by the method of Keenly and Basset (with slight modification. (0.5 g) samples were mixed with 9.5 ml distilled water, 0.5 ml of 3 N oxalic acid and the tubes were kept in a boiling water bath for 60 min. After cooling the contest add 5 ml of 40% Trichloroacetic Acid (TCA) solution. A precipitate was formed and this precipitate mixture was filtered through Whitman no. 42 filter paper. 0.5 ml of the filtrate was pipette out into a 5 ml test tube followed by 3.5 ml of distilled water and 1 ml of 0.05 m TBA solution and was mixed well. Tubes were kept in a water bath at 40℃ for 50 min. A blank was run in the same manner with distilled water and was measured at 443 nm.

Total HFM (π moles/100 gm)=(A absorbance−0.055) × 87.5 × 0.4.

For Thiobarbituric Acid (TBA) value determination about 2 gm of the sample was taken and blended with 50 ml of 20% of TCA AMD 50 ml of distilled water and left undisturbed for 10 min. Then the contents were filtered through what man no. 1 filter paper. The filtrate (5 ml) was pipette out in the test tube and added with 5 ml of 0.01 m 2-Thiobarbtituric acid. Colour was developed by incubating tubes in a boiling water bath for 30 min. at 100°C. The content was cooled to room temperature and absorbance was determined 532 no. The blank determination was made using distilled water in place of the sample. TBA value was expressed as absorbance at 532 nm.

TBA=7.8 × D (mg Malenaldehyde/kg)(D=Absorbance)

Microbial analysis was done by enumeration of Mesophilic Aerobic Bacteria (MAB), coliforms and yeast/molds, and detection of *Salmonella*, *E. coli*, and *Staphylococcus aureus* was done on freshly procured, freshly processed and stored coconut burfi during periodic withdrawals using standard methods of APHA (2001): (1) Total plate count agar (pour plate technique) for total mesophilic bacteria.

Sensory analysis

Sensory analysis was done using nine-point hedonic scales. The sensory panel members comprise of 20 semi-trained individuals from the premises of lovely professional university, Phagwara, Punjab, India. All the different concentration of Burfi samples was evaluated for color and appearance, body and texture, flavor and sweetness, mouthfeel, and overall acceptability.

Statistical analysis

Statistical analysis was done by collecting the data that were obtained in triplicate and presented in mean ± standard deviation. One Way Analysis of Variance (ANOVA) followed by Duncan's Multiple Range Test and the Post hoc tests was used to analyze the data using the SPSS 22.0 software (SPSS Italia, Bologna, Italy) at the error level of 5%.

Results and Discussion

The proximate value of the Burfi incorporated by beetroot and tomato peel is given in the following Table 2. In the above table, the moisture content of the control is 15.61% and the Burfi containing beetroot peel powder is significantly increased ($p<0.05$) from 21% to 30.8%, and the value for the tomato peel powder is incorporation increased from 21.78%to 29.03%, as the amount of the peel powder significantly increased ($p<0.05$). The study of Ingle et al. showed that during the preparation of beetroot cookies, the moisture content significantly increased ($p<0.05$) from 2.57% to 5.26% as the amount of beetroot peel powder increased. The difference in moisture content between samples might be due to the high fiber content in beetroot. More hydroxyl groups of cellulose in fiber were able to bind with free water molecules through hydrogen bonding and thus resulting in greater water holding capacity. The ash content of the control is 5.03%. As the amount of beetroot and tomato peel powder significantly increased ($p<0.05$) the ash content is also significantly increased ($p<0.05$) from 2.53% to 8.03% and from 0.46 to 6.53%. Sahni, et al. reported that the ash content of cookies made from beetroot pomace powder has significantly increased ($p<0.05$) as the concentration of powder increased. The protein content of the beetroot and tomato peel powder is decreasing as the amount of the powder concentration increased in both the samples and the protein content of control and the combination is 14.87% and 15%. Ingle, et al. stated that as the amount of the peel powder concentration is increased, the amount of protein content is decreased. The fat content of the burfi is decreased as the concentration of the peel powder is increased. The study of Wasnik, et al. showed that fat content decreased as the amount of orange pulp is increased from 20.0%to 16.0%. The reduction in protein, fat, and ash contents was due to the replacement of milk solids with beetroot and tomato peel powder. The pH of the tomato and beetroot powder significantly increased ($p<0.05$) as we increased the concentration. The study of Arora, et al. stated that the pH of the control was 6.45 and the pH of Aspartame Burfi was 6.43. The Titratable acidity of the burfi is significantly increased ($p<0.05$) as the amount of beetroot and tomato peel concentration is increased. The acidity content of Burfi is significantly increased ($p<0.05$) as the amount of orange pulp is significantly increased ($p<0.05$) from 0.36% to 0.81%. The increase in acidity was due to the fact that the beetroot and tomato had a lower pH and higher acidic content Wasnik, et al.

Table 2. The proximate value of the Burfi.

Treatments	Moisture content%	Ash %	Fat %	Protein %	pH	Titratable acidity
Control	15.61 ± 0.68	5.03 ± 0.51	14.87 ± 0.11	20.1 ± 1.81	6.4	0.36 ± 0.19
BPP1	21 ± 0.19	2.53 ± 0.55	15.6 ± 0.13	18.4 ± 1.21	3.4	0.51 ± 0.11
BPP2	21.79 ± 0.56	2.96 ± 0.52	12.68 ± 0.19	17.5 ± 0.69	3.9	0.59 ± 0.21
BPP3	22.04 ± 0.82	4.03 ± 0.49	12.25 ± 0.21	16.2 ± 0.26	4.2	0.65 ± 0.17
BPP4	27.01 ± 0.91	5.53 ± 0.68	11.81 ± 0.26	15.8 ± 0.64	5.1	0.78 ± 0.31
BPP5	30.08 ± 0.16	8.03 ± 0.57	10.0 ± 0.29	14.9 ± 0.74	5.8	0.88 ± 0.14
TPP1	21.78 ± 0.19	0.46 ± 0.46	15.0 ± 0.31	19.1 ± 1.84	4.4	0.45 ± 0.22
TPP2	24.14 ± 0.27	4.03 ± 0.39	13.5 ± 0.17	18.2 ± 0.73	4.6	0.54 ± 0.19
TPP3	26.04 ± 0.18	4.96 ± 0.41	13.5 ± 0.21	17.4 ± 0.26	5.1	0.63 ± 0.36
TPP4	26.79 ± 0.14	5.46 ± 0.51	12.0 ± 0.29	16.7 ± 0.36	5.4	0.72 ± 0.17
TPP5	29.03 ± 0.51	6.53 ± 0.61	10.0 ± 0.33	15.2 ± 0.59	5.6	0.81 ± 0.21
Combination	28.01 ± 0.41	6.5 ± 0.19	15.0 ± 0.26	12.14 ± 0.34	6.5	0.91 ± 0.21

Chemical analysis

Chemical analysis is represented in Table 3. Vitamin C is also known as ascorbic acid. It is mainly found in the pulp of citrus fruits but in some amount, it is also present in the peel of tomato and beetroot. The vitamin C content in the burfi is decreased as the amount of corporation of peel powder is increased of beetroot and tomato peel burfi. The value for the control and the combination is 100 and 125. The study of Thakur et al. stated that vitamin C content decreased as the amount of bottle guard and tomato pulp concentration increased. The phenolic content of beetroot and tomato peel Burfi is significantly increased ($p<0.05$) as the amount of beetroot peel powder and tomato peel powder increased. The phenolic content for beetroot peel Burfi significantly increased ($p<0.05$) from 27.86 to 186.94 and the phenolic content for tomato peel Burfi is significantly increased ($p<0.05$) from 53.50 to 237.69. The values for control and the combination are 198.03 and 144.95 respectively. Flavonoids are natural polyphenols of plant origin. They have antioxidant, anti-inflammatory, and anticarcinogenic properties. The flavonoid content of beetroot peel burfi observed is significantly increased ($p<0.05$) as the amount of incorporation of beetroot peel powder increased. The same is observed in the case of the tomato peel powder. As the amount of the tomato peel powder is increased, the value of the flavonoid content is also significantly increased ($p<0.05$). The flavonoid value for the control and combination is 7.54 and 14.56. The test for anthocyanin content was conducted at the optical density of 535 nm. The values for the beetroot peel powder burfi is significantly increased ($p<0.05$) as the amount of the incorporation of peel powder increased and the anthocyanin content for the tomato peel burfi is also significantly increased

(p<0.05) as the powder concentration increased. The value for control and combination is 12.96 and 15.96.

Table 3. The chemical values for the prepared burfi.

Treatments	Vitamin C mg/100 gm	Total phenols	Flavonoids	Anthocyanins
Control	100	26.96	7.54	12.96
BPP1	101	27.86	8.04	8.41
BPP2	105	40.38	12.18	17.58
BPP3	106	146.98	15.28	21.82
BPP4	109	169.42	19.78	26.95
BPP5	110	186.94	27.98	30.1
TPP1	125	53.5	7.86	10.45
TPP2	126	59.2	8.09	15.75
TPP3	128	97.91	8.15	18.56
TPP4	129	219.06	9.27	20.8
TPP5	135	237.69	13.36	39.4
Combination	138	144.95	14.56	15.1

Antioxidant activity

The total antioxidants are the one that quantifies the ability of a complex biological sample to quench free radicals. The antioxidant activity is increasing as the concentration of beetroot and tomato peel powder significantly increased (p<0.05) from 13.89 ± 0.1 to 16.75 ± 0.1 and 10.95 ± 0.2 to 13.42 ± 0.1. The study of Olumese, et al. showed that the antioxidant activities of the processed beetroot and tomato were significantly increased (p<0.05) at a higher temperature. Vullic, et al. stated that the value for the beetroot pomace extract is significantly increased (p<0.05) as the concentration of pomace is significantly increased. The FRAP test is conducted for the burfi samples at the optical density of 593 nm. The values for the FRAP is significantly increased (p<0.05) as the amount of the peel powder increased in both beetroot and tomato peel burfi. The value of the FRAP control is 0.42 and 1.49

Shelf life

Hydroxymethyl Furfural (HMF) content (μ moles/100 g) is an index of browning in dairy products. It plays an important role in the case of burfi, as the product has a characteristic brown color. During heating of milk, lactose present in milk undergoes some reactions which will lead to the Formation of C compounds also includes some quantities of hydroxymethylfurfural *i.e.* HMF. The HMF content of the burfi is given in Table 4. The HMF content of the burfi is significantly increased (p<0.05) as the days are passed in both of the packaging materials.

In cardboard packaging, the HMF content was 0.96 μ moles on the very first day and it significantly increased (p<0.05) up to 2.07 μ moles till the 9th day. The same has happened in the case of LDP packaging material. The study of Verma shows that the HMF content significantly increased (p<0.05) from 16.36 (initial day) to 18.68 (12th day). The Thiobutyric Acid (TBA) content for the fresh sample is ranged from 2.17 to 2.34 in all type of packaging material and at both of the temperatures. According to the study of Verma, the TBA content is significantly increased (p<0.05) from the initial day to the final day. As per that, the TBA value of control, beetroot and tomato peel burfi and the combination of both is also significantly increased (p<0.05) from 1st day to 12th day in both the packaging materials. The TBA content for the samples is given in Table 5. The free fatty acid content (μ equivalent/g) of control burfi, peel powder fortified Burfi, and the combination of tomato and beetroot peel powder were analyzed for free fatty acid content. The FFA content for the entire sample is shown in Table 6. During the storage at the initial day of burfi, the FFA content in the control sample at the temperature of 4℃ is 33.67 μ equivalent/g (cardboard) and at 27℃ is 67.34 μ equivalent/g (LDP). The FFA content was analyzed till the 9th day and we observed that the FFA content of the burfi is significantly increased (p<0.05). The study of Chawla, et al. showed that the FFA significantly increased (p<0.05) as the days of storage increased.

Table 4. Effect of storage conditions on HMF (Hydroxymethyl furfural) content of Burfi and samples stored at two different temperatures.

Temperature (4℃)							
Sample	**Packaging**	**Day 0**	**Day 3**	**Day 6**	**Day 9**	**Day 12**	**Day 15**
Control	Cardboard LDP	0.96 ± 0.12	1.06 ± 0.69	1.27 ± 0.1	2.07 ± 0.6	2.31 ± 0.4	2.84 ± 0.4
		1.24 ± 0.21	1.63 ± 0.56	1.63 ± 0.9	2.46 ± 0.8	3.05 ± 0.5	3.85 ± 0.6
TPP	Cardboard LDP	1.63 ± 0.25	1.77 ± 0.46	2.12 ± 0.7	2.82 ± 0.6	3.45 ± 0.3	4.15 ± 0.1
		1.78 ± 0.16	2.17 ± 0.15	2.57 ± 0.2	3.27 ± 0.9	4.12 ± 0.6	5.05 ± 0.3
BPP	Cardboard LDP	1.70 ± 0.26	2.57 ± 0.45	3.24 ± 0.4	3.26 ± 0.8	3.98 ±0 .4	4.85 ± 0.1

		1.66 ± 0.36	2.68 ± 0.26	3.34 ± 0.5	3.37 ± 0.5	3.99 ± 0.7	4.95 ± 0.2
Combination	Cardboard LDP	1.84 ± 0.48	2.76 ± 0.28	3.47 ± 0.8	3.66 ± 0.5	4.09 ± 0.8	5.12 ± 0.2
		1.94 ± 0.56	3.16 ± 0.39	3.60 ± 0.5	3.86 ± 0.6	4.35 ± 0.9	5.18 ± 0.2
Temperature (27℃)							
Sample	**Packaging**	**Day 0**	**Day 3**	**Day 6**	**Day 9**	**Day 12**	**Day 15**
Control	Cardboard LDP	1.37 ± 0.2	2.34 ± 0.6	2.34 ± 0.4	2.54 ± 0.6	2.95 ± 0.4	3.65 ± 0.3
		1.66 ± 0.6	1.66 ± 0.1	1.75 ± 0.8	2.80 ± 0.4	3.45 ± 0.8	4.25 ± 0.1
TPP	Cardboard LDP	2.33 ± 0.8	3.06 ± 0.7	3.17 ± 0.3	3.17 ± 0.5	3.84 ± 0.8	4.74 ± 0.9
		2.46 ± 0.5	3.54 ± 0.4	3.73 ± 0.9	3.73 ± 0.7	4.19 ± 0.4	4.98 ± 0.4
BPP	Cardboard LDP	2.67 ± 0.4	2.80 ± 0.7	3.17 ± 0.4	3.17 ± 0.4	3.81 ± 0.6	4.55 ± 0.7
		2.96 ± 0.4	3.20 ± 0.5	3.63 ± 0.7	3.63 ± 0.5	3.89 ± 0.2	4.47 ± 0.6
Combination	Cardboard LDP	3.03 ± 0.5	3.66 ± 0.4	3.73 ± 0.2	3.73 ± 0.2	3.81 ± 0.5	3.88 ± 0.6
		3.24 ± 0.2	3.68 ± 0.7	3.94 ± 0.1	3.94 ± 0.1	3.99 ± 0.1	4.05 ± 0.7

Table 5. Effect of storage conditions on TBA (Thio butyric acid) content of Burfi and samples stored at two different temperatures.

Temperature (4℃)							
Sample	**Packaging**	**Day 0**	**Day 3**	**Day 6**	**Day 9**	**Day 12**	**Day 15**
Control	Cardboard LDP	2.55 ± 0.5	2.70 ± 0.5	2.57 ± 0.9	2.66 ± 0.2	2.85 ± 0.8	3.05 ± 0.9
		2.77 ± 0.9	2.86 ± 0.5	2.75 ± 0.5	2.94 ± 0.3	3.19 ± 0.1	3.48 ± 0.8
TPP	Cardboard LDP	2.87 ± 0.4	2.79 ± 0.6	2.94 ± 0.4	3.26 ± 0.3	3.15 ± 0.6	3.65 ± 0.4
		3.02 ± 0.8	3.06 ± 0.8	2.86 ± 0.8	3.14 ± 0.2	3.11 ± 0.4	3.52 ± 0.7
BPP	Cardboard LDP	2.17 ± 0.7	1.90 ± 0.7	1.48 ± 0.8	1.26 ± 0.3	2.42 ± 0.4	3.74 ± 0.6
		2.86 ± 0.6	2.26 ± 0.9	1.57 ± 0.6	1.33 ± 0.2	2.99 ± 0.6	3.23 ± 0.5
Combination	Cardboard LDP	2.80 ± 0.6	2.56 ± 0.5	1.73 ± 0.2	1.41 ± 0.6	3.05 ± 0.7	3.73 ± 0.4
		3.06 ± 0.9	2.36 ± 0.8	1.66 ± 0.9	1.45 ± 0.7	3.77 ± 0.8	4.25 ± 0.2
Temperature (27℃)							
Sample	**Packaging**	**Day 0**	**Day 3**	**Day 6**	**Day 9**	**Day 12**	**Day 15**
Control	Cardboard LDP	2.20 ± 0.6	1.97 ± 0.6	2.47±0.6	1.57±0.5	2.48±0.6	2.81±0.9
		2.34 ± 0.7	2.16 ± 0.5	2.56±0.7	1.68±0.1	2.84±0.5	3.14±0.3
TPP	Cardboard LDP	2.46 ± 0.4	2.27 ± 0.5	2.75±0.4	1.88±0.1	2.95±0.4	3.35±0.1
		2.51 ± 0.5	2.35 ± 0.5	2.86 ± 0.5	2.10 ± 0.7	3.16 ± 0.6	3.66 ± 0.3
BPP	Cardboard LDP	2.92 ± 0.6	2.13 ± 0.6	1.43 ± 0.4	0.40 ± 0.3	3.40 ± 0.4	3.92 ± 0.3
		2.98 ± 0.2	2.20 ± 0.6	1.51 ± 0.8	0.57 ± 0.8	3.65 ± 0.9	4.05 ± 0.1
Combination	Cardboard LDP	3.14 ± 0.4	2.37 ± 0.5	1.57 ± 0.5	0.79 ± 0.7	3.78 ± 0.8	4.21 ± 0.2
		3.24 ± 0.6	2.47 ± 0.5	1.63 ± 0.4	0.38 ± 0.4	3.65 ± 0.4	3.89 ± 0.4

Table 6. Effect of storage conditions on FFA (Free fatty acid) content of Burfi and samples stored at two different temperatures.

Temperature (4℃)							
Sample	**Packaging**	**Day 0**	**Day 3**	**Day 6**	**Day 9**	**Day 12**	**Day 15**
Control	Cardboard LDP	33.67 ± 0.6	33.67 ± 0.7	67.34 ± 0.6	134.7 ± 0.8	185.4 ± 0.6	245.6 ± 0.6
		67.35 ± 0.6	67.35 ± 0.3	100.7 ± 0.5	168.4 ± 0.6	198.7 ± 0.4	265.4 ± 0.9
TPP	Cardboard LDP	134.7 ± 0.5	134.7 ± 0.3	168.4 ± 0.4	201.7 ± 0.8	275.8 ± 0.8	325.7 ± 0.7
		134.7 ± 0.9	168.4 ± 0.1	201.7 ± 0.4	201.7 ± 0.9	233.4 ± 0.2	298.7 ± 0.8
BPP	Cardboard LDP	100.7 ± 0.7	134.7 ± 0.8	168.2 ± 0.4	168.2 ± 0.9	185.2 ± 0.5	219.4 ± 0.5
		134.7 ± 0.6	168.2 ± 0.2	201.7 ± 0.7	201.7 ± 0.6	283.4 ± 0.6	312.5 ± 0.4
Combination	Cardboard LDP	168.2 ± 0.6	168.2 ± 0.4	201.7 ± 0.8	235.4 ± 0.8	275.6 ± 0.1	301.3 ± 0.6
		168.2 ± 0.7	201.7 ± 0.2	201.7 ± 0.6	269.4 ± 0.4	336.4 ± 0.8	379.6 ± 0.3
Temperature (27℃)							
Sample	**Packaging**	**Day 0**	**Day 3**	**Day 6**	**Day 9**	**Day 12**	**Day 15**
Control	Cardboard LDP	33.67 ± 0.9	67.34 ± 0.2	100.2 ± 0.4	134.7 ± 0.4	175.7 ± 0.4	231.6 ± 0.4
		67.34 ± 0.3	134.7 ± 0.8	134.7 ± 0.8	168.4 ± 0.4	185.4 ± 0.1	215.5 ± 0.8
TPP	Cardboard LDP	100.7 ± 0.3	134.7 ± 0.1	168.4 ± 0.9	201.7 ± 0.1	229.5 ± 0.6	285.6 ± 0.9
		168.4 ± 0.1	168.4 ± 0.9	201.7 ± 0.3	232.4 ± 0.3	262.6 ± 0.9	298.8 ± 0.8
BPP	Cardboard LDP	33.67 ± 0.2	67.34 ± 0.4	67.34 ± 0.6	100.7 ± 0.5	162.4 ± 0.5	212.6 ± 0.4
		67.34 ± 0.7	100.7 ± 0.5	100.7 ± 0.4	134.7 ± 0.7	164.6 ± 0.4	195.5 ± 0.5
Combination	Cardboard	134.7 ± 0.1	168.1 ± 0.4	201.7 ± 0.5	235.0 ± 0.7	275.7 ± 0.4	313.6 ± 0.6

Sensory evaluation

The burfi prepared were just subjected to sensory evaluation by a panel of 20 people from different disciplines. Out of the sum, 10 panelists were belonging to the field of food, while 04 were students of the same field and the remaining 06 came from different walks of life. The panelist was asked to rate the product through their sensory abilities and record their results on evaluation which had a hedonic scale for references. The results showed that the BPP3 *i.e.* 3% treatment of beetroot peel powder and TPP4 *i.e.* 4% of tomato peel powder were the most acceptable followed by control and the combination we have made of BPP3 and TPP4 was not that accepted by most of the panelists.

Conclusion

The study was done to incorporate beetroot and tomato peel in burfi, a sweet product traditionally prepared from khoa. The incorporation was done in base of khoa. Eleven different treatments were made with beetroot and tomato peel powder at different concentrations (1%, 2%, 3%, 4%, and 5%) along with base khoa as control. Various quality parameters for burfi were conducted which included physiochemical, proximate, functional, and sensory. We have observed that, as the concentration of the beetroot and tomato peel increased, there was a significant increase in the flavonoid content. Also, the antioxidant activity related to the FRAP and DPPH test or free radical scavenging activity of burfi increased significantly with an increase in beetroot and tomato peel powder. The sensory evaluation has resulted in 3% of beetroot and 4% of tomato was the most acceptable product and then shelf life analysis was done. Beetroot and tomato peel powder incorporation in khoa burfi is an innovation itself with added to health benefits due to its antioxidant properties and bioactive compounds. Overall, this incorporation brings variety to the traditional method of preparing burfi from khoa and thus, is unique in its nature.

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