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Process optimization for preparation of sprouted mung (*Vigna radiata*) burfi

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Abstract

The studies on “Process optimization for preparation of sprouted mung (*Vigna radiata*) burfi” was undertaken with a view to optimize the forms, levels of sprouted mung powder and sugar in the burfi and its effect on physical properties.

Initially, on the basis of sensory evaluation levels of sprouted mung powder in the burfi was optimized. The burfi samples were prepared with 3, 5, 7, 11, 13, 15, 17, 19 and 21 percent sprouted mung powder and 24, 26, 28, 30 and 32 percent sugar of khoa. Experiment was laid out in Completely Randomized Design (CRD). Four levels of powder of sprouted mung treated with boiled water treatment before drying (11, 13, 15 and 17 percent) and 28 percent sugar were chosen for experimental trials.

The experimental treatments comprised, without powder of sprouted mung treated with boiled water treatment before drying (T₀), powder of sprouted mung treated with boiled water treatment before drying @ 11 percent (T₁), 13 percent (T₂), 15 percent (T₃) and 17 percent (T₄).

It was observed that the burfi prepared using 13 percent powder of sprouted mung treated with boiled water before drying and 28 percent sugar was found most acceptable in respect of sensory attributes and the product rated as ‘excellent’ by 55.83% consumers.

Keywords: Burfi, sprouted mung powder, khoa

Introduction

Burfi is one of the most popular khoa based sweet meat of India. The product while still hot and possessing a semisolid consistency is poured into previously prepared molds and then cooled. After cooling, the mass is cut into pieces of required size and shape (FSSAI 2011) [3]. The colour should be uniform off white to slightly yellowish or light caramel depending on the type of the milk used and the extend of heat desiccation during preparation (Pal and Raju, 2006) [7]. Incorporation of fruit seeds, cereals and legume grains powder in burfi is gaining popularity amongst consumers due to typical, attractive colour, flavour and enriched nutritional value. Traditionally burfi is served as an item for ceremonial celebrations in Indian society. There are many varieties of burfi available in market viz., besan burfi (Sharma et al., 1992) [14], cashew nut burfi (Satyanarayanrao et al., 1993) [13], moong daal burfi (Sharma et al., 2003) [15].

Mung bean (*Vigna radiata*) is one of the important legume crops widely cultivated in Asia. It has bioactive compounds with many beneficial physiological benefits such as antioxidant, antidiabetic, anticholesteromic and anticancer effect in controlling and preventing various metabolic disorders. Previous study shown that processing alters the nutritional and functional properties of food (Boateng et al., 2008) [1]. Mung bean can be treated with various processes such as sprouting, cooking and boiling before consumption. Ground mung bean sprouts are dehydrated and subsequently ground and dry blended with a mix. The mix is used to produce mung burger mix, mung instant soup and mung protein drink.

Materials

Milk

The fresh crossbred cow’s milk samples were procured from Research-Cum-Development Project (RCDP) on Cattle, MPKV, Rahuri, Dist. Ahmednagar (Maharashtra) for preparation of burfi samples.

Mung bean grains

Good quality Mung bean grains were procured from local market.

Sugar

Good quality clean crystalline cane sugar was obtained from local market.

Karahi

Iron *Karahi* with 31 cm diameter and 8.5 cm depth with capacity to hold four liters of milk was used for preparation of *burfi*.

Long handled stirrer with flattened end made up of mild steel was used for stirring-cum scraping the milk during preparation of *burfi*, Rectangular stainless steel tray (size 28 x 23 x 3.5 cm) was used for spreading and cooling of *burfi* samples.

Cutting knife

Stainless steel cutting knife was used to cut the *burfi* samples of desirable size.

Cream separator

The 'Alfa Felix' Kolhapur. (Maharashtra), make hand operated cream separator was used for cream separation.

Glassware

Borosil and Corning brand glasswares were used for analytical purpose.

***Khoa* machine prototype**

Khoa samples were prepared in a prototype of *khoa* making machine manufactured by Madhur *khoa* machinery, kanheri, Dist.-Kolhapur. (Maharashtra), India.

Colour Scanning Machine

The colour scanning machine manufactured by premier colourscan, Thane was used for measuring colour characteristics of sprouted mung *burfi*.

Universal testing machine

Ag-X Universal testing machine made by Shimadzu, Japan was used to determine the rheological properties i.e. hardness, cohesiveness, springiness, adhesiveness, chewiness of sprouted mung *burfi*.

Methods**Pre-experimental trials****Preparation of sprouted mung powder**

The sprouting of mung and powder preparation was done by the method suggested by Lal *et al.*, (1963) [11], with suitable modifications.

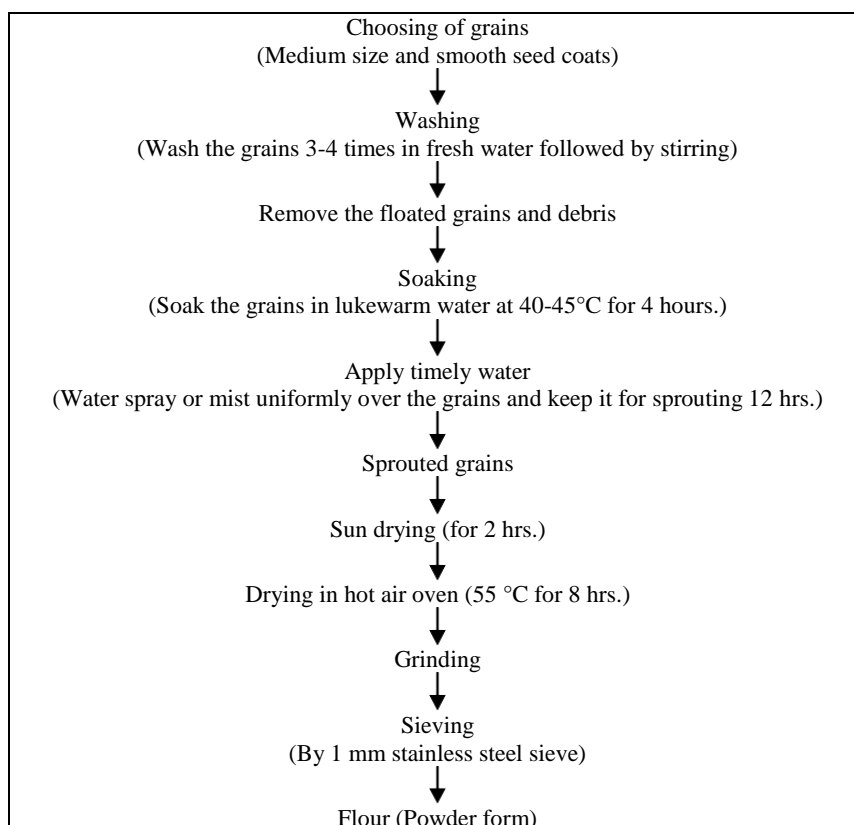


Fig 1: Flow diagram for preparation of sprouted mung flour

Optimization of form of sprouted mung

Following forms were selected to conduct pre-experimental trials

- Control (without sprouted mung powder).
- Sprouted mung powder as such.
- Roasted mung powder.
- Sprouted mung powder roasted with ghee.
- Boiled water treatment to sprouted mung before drying.

Optimization of levels of ingredients

The pre-experiment trials were carried out using 3-factor Response Surface Methodology to finalize the levels of sprouted mung powder, sugar and fat for experimental trials.

- Sprouted mung powder levels: 3%, 5%, 7%, 9%, 11%, 13%, 15%, 17%, 19%, 21%
- Sugar levels: 24%, 26%, 28%, 30%, and 32%
- Milk fat levels: 3%, 4%, and 5%

Table 1: Level of variables used for SRM design

Variable	Code	Levels tested		
		-1	0	+1
Fat levels (%) in buffalo milk	X ₁	3	4	5
sprouted mung powder (SMP) (% of <i>khoa</i>)	X ₂	3	13	21
Sugar (% of <i>khoa</i>)	X ₃	24	28	32

Optimization of levels of Sprouted Mung

The sprouted mung powder levels 3%, 5%, 7%, 9%, 11%, 13%, 15%, 17%, 19% and 21% per of the *khoa* and sugar level @ 30 percent.

The combinations were as follows

- E₀: Control, without addition of sprouted mung powder.
- E₁: *khoa* + 3 percent sprouted mung powder by weight of *khoa*.
- E₂: *khoa* + 5 percent sprouted mung powder by weight of *khoa*.
- E₃: *khoa* + 7 percent sprouted mung powder by weight of *khoa*.
- E₄: *khoa* + 9percent sprouted mung powder by weight of *khoa*.
- E₅: *khoa* + 11percent sprouted mung powder by weight of *khoa*.
- E₆: *khoa* + 13 percent sprouted mung powder by weight of *khoa*.
- E₇: *khoa* + 15 percent sprouted mung powder by weight of *khoa*.
- E₈: *khoa* + 17 percent sprouted mung powder by weight of *khoa*.
- E₉: *khoa* + 19 percent sprouted mung powder by weight of *khoa*.

E₁₀: *khoa* + 21 percent sprouted mung powder by weight of *khoa*.

Optimization of sugar level

The suitable sugar level was worked out using SRM (Surface Response Method) Software. The *burfi* samples were subjected to sensory evaluation by five semi-trained judges. On the basis of the results of sensory evaluation, the most acceptable level *viz.*, 28 percent was chosen for experimental trials.

Optimization of fat level

The most acceptable fat level i.e. 4 percent was kept constant in the milk.

Optimization of stage of addition of ingredients

All ingredients were added at pat formation stage during preparation of *burfi* samples.

Experimental trials

The *burfi* samples were prepared as per method described by De (1980) [2] with suitable modifications.

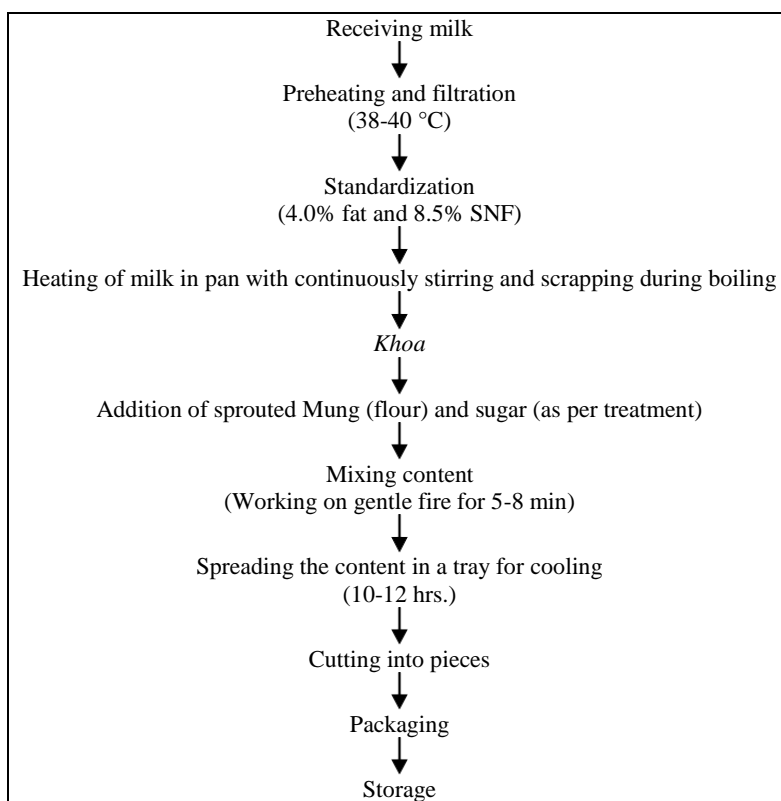


Fig 2: Flow diagram for preparation of sprouted mung *burfi*

Treatments details for experimental trials

T ₀ (Control)	<i>khoa</i> + 0% Sprouted mung powder + 28% Sugar
T ₁	<i>khoa</i> + 11% Sprouted mung powder + 28% Sugar
T ₂	<i>khoa</i> + 13% Sprouted mung powder + 28% Sugar
T ₃	<i>khoa</i> + 15% Sprouted mung powder + 28% Sugar
T ₄	<i>khoa</i> + 17% Sprouted mung powder + 28% Sugar

Sensory evaluation of *burfi*

Sensory evaluation of pre-experimental and experimental samples of Sprouted Mung *burfi* was carried out using 9-point Hedonic scale given in IS: 6273, Part - I and II (1971) for various sensory attributes. A panel of six trained judges was

formulated for this purpose. The samples were coded and concealed their identity and offered to the judges for evaluation.

Physical properties of sprouted mung *burfi*

Textural properties

Test mode	:	Compression
Pre-test mode	:	1 mm/sec
Test speed	:	1 mm/sec
Post-test speed	:	5 mm/ sec
Target mode	:	Distance
Distance	:	5 mm
Count	:	2 count

Universal testing machine was used to study the rheological properties of sprouted mung *burfi*.

The textural properties were evaluated using the TA.XT plus texture analyzer of stable Micro system equipped with 50 kg load cell. The analyzer is linked to a computer a computer that recorded the data via a software programme. The *burfi* sample of length 1 cm³ was cut from the central portion of tofu cake with a stainless steel cutter. A stainless steel probe of 5 mm diameter with a flat end was used to determine the textural properties with following settings.

Hardness

It is defined as the value of the peak force of the first compression of the product.

Hardness, g (H) = maximum force of first compression.

Cohesiveness

Extent to which a material can be deformed before it ruptures depending on the strength of internal bonds (Ratio of the positive force areas under first and second compressions).

$$\text{Cohesiveness} = \frac{\text{Area under the 2}^{\text{nd}} \text{ compression (A}_2\text{)}}{\text{Area under the 1}^{\text{st}} \text{ compression (A}_1\text{)}}$$

Adhesiveness

The energy required to overcome attractive force between the food and any surface it is in contact.

Adhesiveness, g, mm (A₃) = Negative area in the graph.

Springiness

The elastic recovery that occurs when the compressive force is removed. Springiness = D₁.

Colour Characteristics

Colour characteristics of sprouted mung *burfi* samples were measured by colour scanning machine.

Statistical design

The experiment was laid out in Completely Randomized Design (CRD) with four replications for pre-experimental trials and five replications for experimental trials. The data was tabulated and statistically analyzed as per the method of snedecor and Cochran (1994) [16].

Results and Discussion

The present study "Process optimization for preparation of sprouted mung *burfi*" was undertaken in the laboratories. The results obtained during study are presented under following headings.

Chemical composition of milk

The results obtained were presented in Table 2.

Table 2: Chemical composition of milk

Parameter	values
Fat (%)	4.00
Protein (%)	3.66
Lactose (%)	4.39
Water (%)	86.52
Ash (%)	0.68
Lactic Acidity (% LA)	0.13
pH	6.62

The milk had an average 4.00 percent fat, 3.66 percent protein, 4.39 percent lactose, 0.68 percent ash, 12.52 percent total solids, 0.13 percent acidity (%LA) and 6.62 pH values.

Chemical composition of *khoa*

Table 3: Chemical composition of *khoa*

Constituent	Value
Fat (%)	21.12
Protein (%)	20.16
Lactose (%)	17.78
Moisture (%)	20.78
Ash (%)	3.12
Lactic acidity (% LA)	0.66

The results presented in the Table 3 show the chemical composition of *khoa* used for preparation of *burfi*. The values were 21.12 percent fat, 20.16 percent protein, 17.78 percent lactose, 20.78 percent moisture, 3.12 percent ash, 0.66% LA lactic acidity.

Chemical composition of mung powder

Table 4: Chemical composition of sprouted mung powder

Constituents	Sprouted mung powder	Boiled water treated sprouted mung powder
Fat (%)	1.45	1.22
Protein (%)	30.00	26.00
Total fiber (%)	4.40	4.15
Ash (%)	2.55	2.15
Carbohydrate (%)	58.07	58.06
Moisture (%)	5.10	5.13

The chemical composition of sprouted mung powder and boiled water treated sprouted mung powder used for *burfi* preparation during pre-experimental and experimental trials is depicted in Table 4. The sprouted mung powder had an average 1.45% fat, 30.0% protein, 4.40% total fibre, 2.55% ash, 58.07% carbohydrate and 5.10% moisture, respectively. Whereas boiled water treated sprouted mung powder had 1.22% fat, 26.0% protein, 4.15% total fibre, 2.15% ash, 58.06% carbohydrate and 5.13% moisture, respectively.

Pre-experimental trials

Optimization of levels of ingredients

The pre-experimental trials were conducted to finalize the form of sprouted mung to be used, levels of sprouted mung powder, sugar level, stage of addition of sprouted mung powder and fat in the *burfi*.

Optimization of form of sprouted mung

Table 5: Sensory profile of *burfi* influenced by different forms of sprouted mung

Treatment	Colour and appearance	Body and texture	Flavour	Overall Acceptability
A	8.23 ^a	8.27 ^a	8.23 ^a	8.22 ^a
B	6.05 ^e	7.61 ^e	5.95 ^e	6.02 ^e
C	7.10 ^d	7.31 ^d	7.35 ^d	7.12 ^d
D	7.62 ^c	7.33 ^c	7.71 ^c	7.72 ^c
E	8.36 ^b	7.89 ^b	8.32 ^b	8.31 ^b
SE±	0.011	0.013	0.021	0.019
CD at 5%	0.047	0.051	0.043	0.038

- A: Control (without sprouted mung powder).

- B: Powder of Sprouted mung as such @ 10 percent and 30 percent sugar of *khoa*.
- C: Powder of Sprouted mung roasted before drying @ 10 percent and 30 percent sugar of *khoa*.
- D: Sprouted mung powder roasted with ghee @ 10 percent and 30 percent sugar of *khoa*.
- E: Powder of sprouted mung treated with boil water before drying @ 10 percent and 30 percent sugar of *khoa*.

Colour and appearance

The colour and appearance score of *burfi* prepared using different forms of sprouted mung powder is presented in Table 5.

From above Table it is seen that the mean sensory score for colour and appearance for *burfi* samples A, B, C, D and E were 8.23, 6.02, 7.10, 7.63 and 8.36, respectively. The *burfi* prepared with 10% sprouted mung treated with boiled water before drying of sprouted mung found better as compare to the other forms used in the study. It might be due to boiling water treatment to sprouted mung before drying eliminated the odd flavour perceived to the judges of mung bean. The score of colour and appearance of the *burfi* significantly ($p<0.05$) influenced due to addition of different forms of sprouted mung powder in the *burfi*. The *burfi* prepared with powder of sprouted mung treated with boiled water before drying (E) showed much more acceptable as compare to other forms of mung. The treatment E significantly ($p<0.05$) scored highest for colour and appearance among the rest of *burfi* samples.

The forms of sprouted mung B, C and D were not found much acceptable in respect of colour and appearance. The addition of different form of sprouted mung powder in *burfi* changes colour accordingly. It became darker in treatment B due to mung seed coat colour. The *burfi* prepared with powder of sprouted mung routed before drying (C) and sprouted mung powder roasted using ghee (D) occurred tiny blackish spot on *burfi* surface.

Body and texture

The body and texture score of *burfi* prepared using different forms of sprouted mung powder was illustrated in Table 5.

The *burfi* prepared with 10% sprouted mung treated with boiled water before drying had most acceptable body and texture as compare to other forms used in study. The *burfi* prepared with 10% sprouted mung treated with boiled water before drying (E) had body and texture score 7.89 followed by sprouted mung powder roasted with ghee D (7.33), sprouted mung powder roasted before drying C (7.61), use of sprouted mung powder as such B (7.31).

The mean sensory score for body and texture ranged from 7.31 to 8.27. The score of body and texture of *burfi* was significantly ($p<0.05$) differed due to addition of different forms of sprouted mung powder.

The other forms of sprouted mung were not found much acceptable in respect of body and texture. The addition of different form of sprouted mung powder in *burfi* changes texture accordingly. It became oily texture in treatment B due to mung seed powder roasted with ghee, in treatment C and D occur hard surface due to roasting of mung reduced moisture of powder. Treatment E showed maximum score because it posses uniform texture.

Flavour

The flavour score of *burfi* prepared using different forms of sprouted mung powder is presented in Table 5.

The flavour score for the treatments A, B, C, D and E were 8.23, 5.95, 7.35, 7.71 and 8.32, respectively. The flavour of *burfi* samples significantly ($p<0.05$) changed due to addition of different forms of sprouted mung. It was observed that *burfi* prepared with 10% sprouted mung powder treated with boil water before drying had maximum flavour score (8.32) as compare to other form of sprouted mung powder used in the study.

The other forms of sprouted mung were not found much acceptable in respect of flavour. The addition of different form of sprouted mung powder in *burfi* changed flavour accordingly.

Overall acceptability

The sensory score for overall acceptability of *burfi* prepared using different forms of sprouted mung powder is depicted in Table 5.

The Overall acceptability score for the treatments A, B, C, D and E were 8.22, 6.02, 7.12, 7.72, and 8.31, respectively. The Overall acceptability of sprouted mung *burfi* samples was significantly ($p<0.05$) influenced due to addition of different forms of sprouted mung. The *burfi* sample prepared with 10% sprouted mung powder treated with boil water before drying had maximum overall acceptability score (8.31). The *burfi* prepared with sprouted mung treated with boiled water treatment (E) scored higher overall acceptability and ranked in between 'like moderately to 'like very much'.

Optimization of levels of sprouted mung powder

On the basis of sensory evaluation most acceptable form of sprouted mung i.e. powder of sprouted mung treated with boiled water before drying (E) was selected to conduct experimental trials and sugar level was kept constant i.e. 30 percent of *khoa*.

Treatment details

E₀: burfi prepared without Sprouted mung powder.

E₁: Sprouted mung powder 3% of *khoa*.

E₂: Sprouted mung powder 5% of *khoa*.

E₃: Sprouted mung powder 7% of *khoa*.

E₄: Sprouted mung powder 9% of *khoa*.

E₅: Sprouted mung powder 11%.of *khoa*.

E₆: Sprouted mung powder 13% of *khoa*.

E₇: Sprouted mung powder. 15% of *khoa*.

E₈: Sprouted mung powder 17% of *khoa*.

E₉: Sprouted mung powder 19% of *khoa*.

E₁₀: Sprouted mung powder 21% of *khoa*.

Table 6: Sensory profile of *burfi* influenced by different levels of sprouted mung powder (boiled water treated)

Treatment	Colour and Appearance	Body and Texture	Flavour	Overall Acceptability
E0	8.21cd	8.41b	8.32bc	8.32cd
E1	7.71ef	7.71f	7.82de	7.52fg
E2	7.41hi	7.51gh	7.52ef	7.41gh
E3	7.41hi	7.52gh	7.51fg	7.47gh
E4	7.48g	7.6g	7.50ef	7.51fg
E5	8.21cd	7.95d	8.21de	8.22b
E6	8.61a	8.45a	8.50a	8.53a
E7	8.32b	8.21c	8.30bc	8.32cd
E8	7.71ef	7.32i	7.53fg	7.72e
E9	6.43h	6.35j	6.71h	6.52i
E10	6.06j	6.18k	6.12i	6.12j
SE±	0.009	0.018	0.028	0.017
CD at 5%	0.071	0.33	0.049	0.068

Colour and appearance

The colour and appearance score of *burfi* prepared using different levels of sprouted mung powder is depicted in Table 6. The colour and appearance score for the *burfi* samples E₀, E₁, E₂, E₃, E₄, E₅, E₆, E₇, E₈, E₉ and E₁₀ 8.21, 7.71, 7.41, 7.41, 7.48, 8.21, 8.86, 8.32, 7.71, 6.43 and 6.06, respectively. The colour and appearance of *burfi* samples prepared with different levels of sprouted mung (boiled water treated) powder significantly ($p < 0.05$) affected due to addition of different levels of sprouted mung powder. The *burfi* samples prepared with sprouted mung powder using 11%, 13%, 15% and 17% had significantly more acceptable colour and appearance as compare to other levels of sprouted mung powder (E₁, E₂, E₃, E₄, E₉ and E₁₀). The *burfi* sample prepared without sprouted mung powder had 8.21 colour and appearance score. The *burfi* sample E₁ (3%) and E₈ (17%), E₂, E₃ and E₉ were at par and E₀ and E₅ were at par.

Body and texture

The sensory score for body and texture of *burfi* prepared using different levels of sprouted mung powder is summarized in Table 6.

The body and texture score for the *burfi* samples (E₀, E₁, E₂, E₃, E₄, E₅, E₆, E₇, E₈, E₉ and E₁₀) were 8.41, 7.71, 7.51, 7.52, 7.60, 7.95, 8.45, 8.21, 7.32, 6.35 and 6.18, respectively. The body and texture score of *burfi* samples prepared with different levels of sprouted (boiled water treated) mung powder significantly ($p < 0.05$) affected due addition of different levels of sprouted mung powder. The sensory score for the *burfi* samples E₅, E₆, E₇ and E₈ had significantly better body and texture as compare to other levels of sprouted mung powder in the study.

Flavour

The organoleptic score for flavour of *burfi* prepared using different levels of sprouted mung powder was depicted in Table 6.

The flavour score for treatment E₀, E₁, E₂, E₃, E₄, E₅, E₆, E₇, E₈, E₉ and E₁₀ were 8.32, 7.82, 7.52, 7.51, 7.50, 8.21, 8.50, 8.30, 7.53, 6.71 and 6.12, respectively. The sensory score of *burfi* samples significantly ($p < 0.05$) affected due to addition of different levels of sprouted mung powder. It was seen that *burfi* samples prepared with 11%, 13%, 15% and 17% had significantly maximum acceptable flavour score as compare to other levels of sprouted mung powder in the study. The flavour of all levels of *burfi* samples significant among themselves.

Overall acceptability

The sensory score for overall acceptability of *burfi* prepared using different levels of sprouted mung powder was illustrated in Table 6.

The sensory score for overall acceptability of *burfi* samples E₀, E₁, E₂, E₃, E₄, E₅, E₆, E₇, E₈, E₉ and E₁₀ prepared using different levels of sprouted mung powder were 8.32, 7.52, 7.41, 7.47, 7.51, 8.22, 8.53, 8.32, 7.72, 6.52 and 6.12, respectively. The overall acceptability score of *burfi* samples significantly ($p < 0.05$) affected due to use of different levels of sprouted mung powder. The *burfi* samples prepared with 11, 13, 15 and 17% were significantly more acceptable as compare to other levels of sprouted mung powder used in the study.

Optimization of sugar level

The optimization of sugar level in *burfi* was done on the basis of sensory evaluation. Best levels of sprouted mung powder

added during preparation. The sugar was tried at 5 levels i.e. 24, 26, 28, 30 and 32 percent of *khoa*. The appropriate rang of sugar level was decided using SRM software and most acceptable levels of SMP (sprouted mung powder) and sugar combinations were used to decide the sugar level for experimental trials.

E₁: Sprouted mung powder 11% of *khoa*.

E₂: Sprouted mung powder 13% of *khoa*.

E₃: Sprouted mung powder 15% of *khoa*.

E₄: Sprouted mung powder. 17% of *khoa*.

S₁ - Sugar 24% of *khoa*.

S₂ - Sugar 26% of *khoa*.

S₃ - Sugar 28% of *khoa*.

S₄ - Sugar 30% of *khoa*.

S₅ - Sugar 32% of *khoa*.

Table 7: Sensory profile of *burfi* influenced by different combinations of sugar and sprouted mung powder

Treatment	Colour and Appearance	Body and Texture	Flavour	Overall Acceptability
E ₁ S ₁	7.05 ^{kl}	6.81 ^{kl}	6.10 ^{pq}	7.09 ^k
E ₁ S ₂	7.10 ^{ij}	7.51 ^f	6.52 ^{lm}	6.80 ^m
E ₁ S ₃	7.72 ^{ab}	7.62 ^d	7.20 ^{fg}	7.52 ^d
E ₁ S ₄	7.13 ^{hi}	7.20 ^{gh}	7.13 ^{hi}	7.12 ^h
E ₁ S ₅	6.42 ^{qr}	6.71 ^{mn}	6.33 ^o	6.71 ^{mn}
E ₂ S ₁	7.09 ^{ih}	7.10 ^{hi}	6.64 ^k	7.06 ⁱ
E ₂ S ₂	7.12 ^{hi}	7.16 ^{gh}	7.46 ^d	7.31 ^f
E ₂ S ₃	7.71 ^{ab}	8.10 ^a	8.12 ^{ab}	8.10 ^a
E ₂ S ₄	7.33 ^d	7.81 ^b	7.76 ^c	7.71 ^c
E ₂ S ₅	6.82 ^{no}	6.26 ^q	6.45 ⁿ	6.33 ^{pq}
E ₃ S ₁	7.25 ^f	6.57 ^{no}	7.20 ^{fg}	6.61 ^o
E ₃ S ₂	7.10 ^{ij}	6.38 ^p	6.51 ^{lm}	6.72 ^{mn}
E ₃ S ₃	6.81 ^{no}	7.76 ^b	8.10 ^{ab}	7.81 ^b
E ₃ S ₄	7.20 ^h	7.12 ^{hi}	7.36 ^c	7.21 ^g
E ₃ S ₅	6.42 ^{qr}	6.81 ^{kl}	7.23 ^{fg}	7.06 ^{ij}
E ₄ S ₁	7.22 ^g	6.10 ^{rs}	6.10 ^{pq}	6.12 ^{rs}
E ₄ S ₂	7.06 ^{kl}	6.06 st	6.02 ^{rs}	6.33 ^{pq}
E ₄ S ₃	7.41 ^c	7.03 ^j	7.10 ^{hi}	7.52 ^d
E ₄ S ₄	7.01 ^m	6.61 ^{mn}	6.8 ^{ij}	7.02 ^l
E ₄ S ₅	6.51 ^p	6.12 ^{rs}	6.05 ^{rs}	6.12 ^{rs}
SE±	0.009	0.018	0.028	0.017
CD at 5%	0.71	0.33	0.049	0.068

The 20 combinations were formed. It evaluated for sensory evolution and the sensory evaluation data analyzed using SRM Software.

1.3.1 Colour and appearance

The colour and appearance score of *burfi* prepared using different treatment combinations of sprouted mung powder and sugar is presented in Table 7.

From above Table it was revealed that the mean colour and appearance score of *burfi* samples was significant ($p < 0.05$) among themselves due to addition of different levels of sugar. The mean score of colour and appearance of *burfi* samples ranged from 6.42 to 7.72. The *burfi* sample prepared with 28 percent sugar and 11%, 13%, 15% and 17% SMP found most acceptable as compare to other treatment combinations in the study.

Body and Texture

The body and texture score of *burfi* prepared using different treatment combinations of sugar and 4 levels of sprouted mung powder is illustrated in Table 7.

From the above Table it was concluded that the mean body and texture score of *burfi* samples significantly ($p < 0.05$) influenced due to addition of different levels of sugar. The

mean score of body and texture varied from 6.06 to 8.10. The burfi sample prepared with 28 percent sugar and 11%, 13%, 15% and 17% SMP found most acceptable as compare to other treatment combinations in the study.

Flavour

The flavour score of *burfi* prepared by using different combinations of sugar and sprouted mung powder is summarized in Table 7.

From above Table it was revealed that the mean flavour score of *burfi* samples was significant ($p < 0.05$) among themselves due to addition of different levels of sugar. The mean score of flavour of *burfi* samples ranged from 6.05 to 8.12. The *burfi* sample prepared with 28 percent sugar and 11%, 13%, 15% and 17% SMP found most acceptable as compare to other treatment combinations in the study.

Overall acceptability

The overall acceptability score of *burfi* prepared by using different combinations of sprouted mung powder and sugar is depicted in Table 7.

From the above Table it was observed that the mean overall acceptability score of *burfi* prepared using different combinations was significantly ($p < 0.05$) influenced. The *burfi* sample prepared with 28 percent sugar and 11%, 13%, 15% and 17% SMP found most acceptable as compare to other treatment combinations in the study.

Experimental Trials

As per the results of pre-experimental trials conducted using different forms of sprouted mung, sugar level, following levels were finalized to conduct experimental trials. I) Levels of sprouted mung: powder of sprouted mung treated with boil water before drying @ 11, 13, 15, and 17 percent of *khoa*, II) Level of sugar: 28 percent.

Table 8: Treatment details

Treatment	Details
T ₀ (Control)	Without powder of sprouted mung treated with boiled water before drying and 30 percent sugar of <i>khoa</i>
T ₁	11% powder of sprouted mung treated with boiled water before drying and 28% sugar of <i>khoa</i>
T ₂	13% powder of sprouted mung treated with boiled water before drying and 28% sugar of <i>khoa</i>
T ₃	15% powder of sprouted mung treated with boiled water before drying and 28% sugar of <i>khoa</i>
T ₄	17% powder of sprouted mung treated with boiled water before drying and 28% sugar of <i>khoa</i>

Sensory profile of fresh sprouted mung *burfi*

Table 9: Sensory profile of fresh sprouted mung *burfi*

Treatment	Sensory score (out of 9)			
	Colour and Appearance	Body and Texture	Flavour	Overall Acceptability
T ₀	8.35 ^b	8.27 ^a	8.20 ^b	8.32 ^a
T ₁	8.07 ^c	7.82 ^c	7.82 ^c	7.95 ^c
T ₂	8.40 ^a	8.12 ^b	8.30 ^a	8.27 ^b
T ₃	7.85 ^d	7.56 ^d	7.65 ^d	7.65 ^d
T ₄	7.50 ^f	7.27 ^e	7.25 ^e	7.35 ^e
SE±	0.052	0.055	0.048	0.042
CD at 5%	0.150	0.165	0.147	0.129

Colour and appearance

The colour and appearance of any product is considered as the first indication of perception. It is one of the important sensory property of any food product and gives to consumer

an almost immediate impression about freshness of the product. The colour and appearance of the products affects the consumer's decision to purchase or select the product.

The organoleptic score for colour and appearance of fresh *burfi* samples prepared using different levels of sprouted mung powder is depicted in Table 9.

From the Table 4.7 it is seen that the colour and appearance of the *burfi* samples significantly ($p < 0.05$) influenced due to addition of different levels of sprouted mung powder in the *burfi*. The colour and appearance score for the *burfi* samples T₀, T₁, T₂, T₃ and T₄ were 8.35, 8.07, 8.40, 7.85 and 7.50, respectively. The *burfi* sample (T₂) had highest colour and appearance score (8.40) followed by T₀, T₁, T₃ and T₄. The *burfi* sample T₂ was significantly superior in respect of colour and appearance with glossiness over the other treatments in the study. As the level of sprouted mung powder increased the colour of the product become amber yellow to light brown with mid values corrosion to brownish tint. The treatment T₂ had most attractive colour and appearance as compared to other treatments.

The results of the present investigation are at par with the findings of Jadhav (2015) ^[8] who observed that as level of addition of *besan* increased the *burfi* imparted the dark colour and appearance. Kamble *et al.*, (2019) ^[10] also observed increased level of green chickpea in *burfi*. The colour became darker and dull light greenish colour which was not liked by the judges.

Body and Texture

It is one of the important attribute of any food product. In general sense, the word texture refers to surface characteristics and appearance of object given by size, shape, density, arrangement, and proportion of its elementary parts. Texture property of food product is associated with the sense of feel or touch experienced by fingers or mouth. The body and texture of the product helps in its marketing value. It also represents product's inner makeup. The body and texture score of the fresh *burfi* samples prepared using different levels of sprouted mung powder is presented in Table 9.

It is revealed that the addition of sprouted mung powder in the *burfi* significantly ($p < 0.05$) influenced the body and texture of *burfi*. The body and texture score of the *burfi* samples T₀, T₁, T₂, T₃ and T₄ was 8.27, 7.82, 8.12, 7.56 and 7.27, respectively. The treatment T₀ had highest score (8.27) with smooth body and texture followed by T₂, T₁, T₃ and T₄. The granularity and firmness of the *burfi* samples decreased as the level of sprouted mung powder increased. All *burfi* samples significantly differed among themselves. The body and texture of *burfi* samples became harder with increased level of sprouted mung powder. It might be due to increased level of total solids in the samples.

The present results are correlated with the results of Golande *et al.* (2012) ^[5] who reported that the incorporation of increased level of sweet orange juice, in the *burfi* resulted in decrease in the body and texture score. Jadhav (2015) ^[8] reported that increase in the level of *besan* in the *burfi* the stickiness in the product increased and ultimately sensory score decreased. Kamble *et al.*, (2019) ^[10] observed that body and texture score decreased with increase in green chickpea level, due to the moist, sticky, loose body and grainy texture.

Flavour

The flavour is one of the most important sensory attributes of any food products. It is combination of smell and taste and it plays a significant role in product acceptance by consumers.

The flavour score of the fresh sprouted mung *burfi* samples is summarized in Table 9. It is seen that the flavour score of *burfi* samples was significantly ($p < 0.05$) influenced due to addition of different levels of sprouted mung powder. The flavour score of the *burfi* samples T₀, T₁, T₂, T₃ and T₄ was 8.20, 7.82, 8.30, 7.65 and 7.25, respectively. The *burfi* sample T₄ had least score (7.25). The *burfi* sample T₂ was significantly superior over *burfi* samples T₀, T₁, T₃ and T₄. From the above results it was observed that the product prepared using 13 percent sprouted mung powder and 28 percent sugar was superior in the flavour attribute as compared to other treatments in the study.

The *burfi* prepared with the addition of 13% sprouted mung powder (T₂) had most acceptable caramelized, nutty pleasant flavor as compared to the other treatments in the study. The *burfi* prepared with 17% sprouted mung powder had least acceptable flavour with increased caramelized favour as compare to other *burfi* samples in study.

The results of the present investigation are comparable with the findings of Jadhav (2015)^[8] who observed that doughy flavour increased with level of *besan* in the *khoa burfi*. Kamble *et al.*, (2019)^[10] observed that addition of 4 percent chickpea paste in *burfi* was the most acceptable level and received the highest sensory score.

Overall Acceptability

The overall acceptability of food products depends on colour and appearance, body and texture and flavour of the product.

The overall acceptability of the fresh sprouted mung *burfi* samples prepared using different levels of sprouted mung powder was significantly ($p < 0.05$) influenced due to addition of sprouted mung powder. The overall acceptability score for fresh sprouted mung *burfi* is highlighted in the Table 9.

The overall acceptability score for the treatments T₀, T₁, T₂, T₃ and T₄ were 8.32, 7.95, 8.22, 7.65 and 7.35, respectively. The *burfi* sample prepared without SMP (T₀) had highest overall acceptability score followed by *burfi* sample prepared with 13% SMP T₂ (8.27). The *burfi* samples T₀ and T₂ ranked in between 'liked very much' to 'like extremely' on the basis of 9 point hedonic scale. Whereas the other *burfi* samples T₁ (11%), T₃ (13%) and T₄ (17%) ranked 'like moderately' to 'liked very much'.

Hence, it is inferred that the addition of 13 percent sprouted mung powder and 28 percent sugar in *khoa* was observed the most acceptable product as compare to other *burfi* samples.

The results obtained in respect overall acceptability of *burfi* are at par with the results of Nikam (1996)^[12] and Kadam (2008)^[9] and Kamble *et al.*, (2019)^[10].

Conclusions

The study optimized the levels of sprouted mung powder and sugar in *burfi*, determining that a combination of 13% sprouted mung powder treated with boiled water before drying and 28% sugar resulted in the most acceptable sensory attributes, rated as 'excellent' by 55.83% of consumers.

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