Effect of different processing methods on the acceptability and keeping quality of burfi’s prepared from Garden cress seeds [Lepidium sativum Linn]

Shekhar Naik R, Sharada R, Prakruthi M, Devaki CS and Mahesh MS

Abstract

Garden cress seeds is one of the potential oil seeds packed with good amount of nutrition especially iron [1 mg/g]. It is the richest source of non-heme iron can be used as potential natural iron fortificant to combat iron deficiency anemia. However, the bitterness of this seed decreases the acceptability of the final product due to the presence of phenolic compounds. Further, presence of polyphenols can reduce iron bioavailability. Soaking, germination, roasting and other cooking and processing methods are known to reduce total polyphenols and can thus enhance its acceptability and iron bio-availability. To study the effect of different processing methods on the acceptability and keeping quality of burfi’s prepared from Garden cress seed flour [GCSF]. Garden cress seeds were subjected to three processing methods namely germination, roasting and soaking. Processed seeds were dried and powdered were used for product development. The developed products were tested for their sensorial attributes nutrition composition and storage stability. Further these developed burfi’s were analysed for total phenolic, antioxidant activity and total flavonoids as well. Burfi’s prepared from germinated GCSF had better acceptability compared to other processing methods when measured in a 9 point hedonic scale. Total polyphenols and flavonoids were reduced in burfi’s prepared from germinated GCSF thus reducing their bitterness and increasing its acceptability. The keeping quality was also good in germinated garden cress seeds burfi. Germination process can reduce the bitterness, polyphenol content and other anti-nutritional factors which can enhance the acceptability of the products prepared from GCSF.

Keywords: Anaemia, burfi, Garden cress seeds, Lepidium sativum, polyphenols, germination

1. Introduction

Iron deficiency Anemia (IDA), a morbid condition, is a global concern that affects people of all age groups and is significant challenge in both developed and developing countries [1]. It increases risk of premature delivery and low birth weight, retards growth, impairs cognitive and nephroprotective, and activity. Further, presence of polyphenols can reduce iron bioavailability. Enriching food or diet with simple food vehicles must be designed considering its synergistic effects with iron complexes for effective absorption and bioavailability [1]. Fortification or enrichment of iron into complex food matrix rich in fibres and polyphenols will reduce iron bioavailability. Enriching food or diet with simple food matrix with richest source of non-heme iron could be one of the effective strategy to effectively combat IDA.

Garden cress (Lepidium sativum L.) belonging to brassicacease family is a fast growing annual herb botanically related to watercress and mustard sharing their peppery, tangy flavour and aroma [3]. Also known by Chandrasur, and it is considered as an important medicinal crop in India and used in many traditional medicine [6]. Garden cress seed (GCS) possesses several of pharmacological properties like anti-anemic, antioxidant, galactogogues, etc. and has tremendous potential for the development of functional food by fortification with it [7, 8]. Garden cress seeds show many medicinal properties such as antidiabetic, hypcholesterolemic, antihypertensive, antiinflammatory, antipyretic and analgesic activities. It also has fracture healing, hepatoprotective, diuretic, and nephrocurative, and nephroprotective, potential. Garden cress seed can be used as a promising multipurpose medicinal source [9].

The seeds of the garden cress comprise good amount of protein (23 - 25%) and almost equal amount of fat. It is an important source of iron, folic acid, calcium, vitamins C, E and A. It is a rich source of iron containing 100 mg iron/100g. Minerals like calcium (317 mg),
phosphorus. Vitamins like carotene, thiamine, riboflavin, niacin are abundantly present in cress seeds [10-13]. Since the seeds are rich in macro and micro nutrients, they have been supplemented in food products. Many supplementation studies have been conducted on garden cress seeds and its products which really produced good results. For instance, laddu [11, 14], chikki [11], cookies and muffins [15], dhokla mix [16], burfi [11] and many more foods were prepared using different proportion of seeds. The products were analyzed for its nutritional value which was found to be improved with addition of seeds. But, the seeds also contain good amount of fibers (7 - 8 mg/100 g) and anti-nutritional factors like oxalates (33 mg/100 g) and phytates (1037 mg//100 g) which may interfere in the absorption of macro and micro nutrients. However, the processing reduces the anti-nutritional factors in the seeds. Despite of being rich in nutrients, the seeds are not popular. Bitterness of the seeds due to high polyphenol content is one of the factors which significantly decrease its acceptability [17, 18] and bioavailability of minerals. Burfi is one of the highly nutritious khoa based indigenous milk products with simple food matrix without anti-nutritional factors which can reduce mineral bioavailability [19, 20]. Thus, in this study the garden cress seeds were subjected to different processing techniques to examine the acceptability of the products prepared using these processed garden cress seed flour.

2. Methods and materials

2.1 Materials procurement

The raw materials such as garden cress seed, dates, desiccated coconut, jaggery and other ingredients which were required to prepare burfi was been procured from the local market of Mysuru, Karnataka.

2.2 Processing of garden cress seeds

The Garden cress seed was subjected to three methods of processing viz., Soaking, Germination and roasting.

a. Soaked: The seeds were cleaned and soaked for overnight, and then dried at ambient temperature (18-25 °C) for 4-5 days. Later, seeds were milled to produce fine texture powder.

b. Germination: The garden cress seeds were sorted and cleaned to remove impurities. The seeds were washed and drained. The seeds were spread on the muslin cloth and were kept at room temperature (18-25 °C) for 48 hours, and then dried at ambient temperature (18-25 °C) for 4-5 days. Later, seeds were milled to produce fine texture powder.

c. Roasting: The seeds were cleaned and roasted on a low flame for about 10 mins. Later, seeds were milled to produce fine texture powder.

2.3 Standardization and development of burfi [Table 1]

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Quantity [g]</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>GCSF</td>
<td>0</td>
</tr>
<tr>
<td>Milk</td>
<td>40</td>
</tr>
<tr>
<td>Ghee</td>
<td>15</td>
</tr>
<tr>
<td>Jaggery</td>
<td>10</td>
</tr>
<tr>
<td>Desiccated coconut</td>
<td>15</td>
</tr>
<tr>
<td>Dates</td>
<td>20</td>
</tr>
</tbody>
</table>

2.4 Preparation of burfi

Roast the garden cress seed powder with little amount of ghee and keep it aside

Boil the milk and reduce it into half the quantity

Add jaggery and allow it to melt

Incorporate Desiccated coconut, garden cress seed powder and chopped dry dates

Add remaining ghee with continuous stirring till the desired consistency is attained.

Pour it on a greased plate and cut into pieces.

2.5 Sensory analysis

The burfi’s were served to semi trained panellists for organoleptic evaluation on a nine point hedonic scale, with score 9 as excellent and score 1 as disliking. Sensory evaluation was carried by 25 semi trained panel members. The sensory properties such as appearance, colour, consistency, flavour, taste and overall acceptability of finished product were evaluated on the basis of 9 point hedonic scale [21].

2.6 Estimation of nutritional parameters

The chemical parameters analyzed includes proximate composition, major minerals.

2.6.1 Estimation of moisture [AOAC, 1980]

Moisture was determined by taking about 10 g of powdered sample in petri dish and dried in an oven at 60° C till the weight of the Petri dish was constant. Each time before weighing, the petri dish was cooled in desiccators. Moisture content of the sample was expressed in g/100 g of sample.

Moisture content [g/100 g] = \( \frac{\text{Initial weight [g]} - \text{final weight [g]}}{\text{Weight of sample [g]}} \times 100 \)
2.6.2. Estimation of total protein [AOAC, 1980]
The protein content of the dried samples was estimated as per cent total nitrogen by micro kjeldhal method. Protein per cent was calculated by multiplying the per cent nitrogen by the factor 6.25. [Annexure 1]

\[
\text{Protein [g/100 g]} = \frac{\text{Titre value x normality of HCl x 0.014 x 6.25}}{\text{Weight of sample (g)}} \times 100
\]

2.6.3. Estimation of fat [AOAC, 1980]
Fat content of the sample was estimated as crude ether extract using moisture free samples. The solvent was removed by evaporation and the residue of fat was weighed. [Annexure 2]

\[
\text{Fat content} = \frac{\text{Weight of ether extract}}{\text{Weight of sample}} \times 100
\]

2.6.4. Computation of carbohydrate [AOAC, 1980]
Carbohydrate content was calculated by difference method.

\[
\text{Carbohydrate [g/100 g]} = 100 - \left[ \text{protein [g]} + \text{fat [g]} + \text{fiber [g]} + \text{ash [g]} + \text{moisture [g]} \right]
\]

2.6.5. Computation of energy [AOAC, 1980]
Energy was computed as follows for all the samples.

\[
\text{Energy [kcal]} = \left[ \text{protein [g]} \times 4 \right] + \left[ \text{carbohydrate [g]} \times 4 \right] + \left[ \text{fat [g]} \times 9 \right]
\]

2.6.6. Estimation of total ash [AOAC, 1980]
The ash content of the sample was obtained by dry ashing the samples completely over a flame followed by ashing in a muffle furnace for 4 hour at 600\(^\circ\) C. this was expressed as g/100 g of the sample.

2.6.7. Preparation of mineral solution
The mineral solution was prepared by dissolving the ash obtained after ashing the samples in a muffle furnace in dilute hydrochloric acid.

2.6.8. Estimation of iron
The iron content of the sample was estimated by using atomic absorption spectrophotometer and the results were expressed in mg/100 g of the sample.

2.7. Estimation of functional compound

### Table 2: Sensorial attributes of the developed burfi

<table>
<thead>
<tr>
<th>Sensory parameters</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
<td>8.9±0.09</td>
<td>8.0±0.81*</td>
<td>8.5±0.07</td>
<td>7.6±0.66*</td>
</tr>
<tr>
<td>Color</td>
<td>8.6±0.08</td>
<td>8.0±0.90*</td>
<td>8.5±0.10</td>
<td>7.9±0.69*</td>
</tr>
<tr>
<td>Texture</td>
<td>8.7±0.03</td>
<td>8.2±0.65*</td>
<td>8.7±0.04</td>
<td>8.1±0.55*</td>
</tr>
<tr>
<td>Flavour</td>
<td>8.8±0.05</td>
<td>8.0±0.09*</td>
<td>8.6±0.04</td>
<td>8.0±0.55*</td>
</tr>
<tr>
<td>Taste</td>
<td>8.8±0.03</td>
<td>8.0±0.09*</td>
<td>8.6±0.05</td>
<td>7.9±0.63*</td>
</tr>
<tr>
<td>Overall acceptability</td>
<td>8.8±0.03</td>
<td>8.1±0.07*</td>
<td>8.6±0.04</td>
<td>7.9±0.61*</td>
</tr>
</tbody>
</table>

A. Standard burfi
B. Burfi from Soaked Garden Cress Seed flour
C. Burfi from Germinated Garden Cress Seed flour
D. Burfi from Roasted Garden Cress Seed flour

Values are mean ± SD (n=25)

Data analyzed by Holm Sidak method, \(*\ p<0.05\)

### Table 3: Nutritional evaluation of Burfi’s prepared from Garden cress seed flour from different processing methods

<table>
<thead>
<tr>
<th>Proximate [g/100 g]</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture</td>
<td>19±0.09</td>
<td>18.05±0.8</td>
<td>18.8±0.07</td>
<td>16.35±0.66*</td>
</tr>
<tr>
<td>Fat</td>
<td>31±0.08</td>
<td>34±0.90</td>
<td>32±0.10</td>
<td>38.8±0.69*</td>
</tr>
</tbody>
</table>

a. Total polyphenols
The content of total polyphenol in extracts was determined according to a modified Folin-Ciocalteu method [22]

b. Antioxidant assay
The samples were analysed for its antioxidant activity by DPPH assay [23]

c. Total flavonoid
Total flavonoid content was measured with the aluminium chloride colorimetric assay [24, 25]. Stability studies

2.8. Storage stability of the burfis
a. Free fatty acids
Acid value is the number of milligrams of KOH required to neutralize the free fatty acids present in one gram of the oil or fat [AOAC].

\[
\text{Acid value as Oleic acid} = \frac{\text{ml of alkali x N of alkali x mol.wt of NaOH}}{\text{Weight of sample}}
\]

b. Acidity
Take 1g of grated sample into conical flask and add 10ml of distilled water into it and stir it with glass rod. Add 2-3 drops of phenolphthalein indicator and titrate it against 0.1N NaOH till pale pink colour appears. Note down the burette reading.

\[
\text{Acidity} = \frac{9 \times \text{Titre value xNormality of NaOH}}{\text{Weight of the sample}}
\]

2.9. Statistical analysis
All the data were presented in the form of mean ±SD. To test the significant difference between the organoleptic scores of the product Holm Sidak method was applied.

3. Results and discussion
Results of sensory evaluation are presented in Table 2. The burfi without garden cress seeds was best accepted with overall acceptability of 8.8 out of 9. The sensory attributes of burfi’s with germinated GCSF was on par with the standard in almost all the attributes. Roasting didn’t improve the acceptability. Burfi’s prepared from GCS which were soaked had better sensory profile compared to roasting.
Nutritional composition of the burfi’s prepared from GCSF from different processing methods is presented in the table 3. There’s not much difference between the burfi prepared from GCSF of different processing methods except slightly less in roasted GCSF. Even in terms of protein, fat and energy, similar trend was evident. On contrary CHO content was reduced in the sample D.

### Table 4: Calcium and Iron content of Burfi’s prepared from Garden cress seed flour from different processing methods

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium</td>
<td>200.30±10.9</td>
<td>212.52±8.1</td>
<td>251.10±9.07*</td>
<td>210.52±10.66*</td>
</tr>
<tr>
<td>Iron</td>
<td>10.5±0.88</td>
<td>15.2±0.90*</td>
<td>16.5±1.10*</td>
<td>15.5±1.69*</td>
</tr>
</tbody>
</table>

A. Standard burfi  
B. Burfi from Soaked Garden Cress Seed flour  
C. Burfi from Germinated Garden Cress Seed flour  
D. Burfi from Roasted Garden Cress Seed flour  
Values are mean ± SD [n=3]  
Data analyzed by Holm Sidak method, * p≤0.05  

Calcium and Iron content of Burfi’s prepared from Garden cress seed flour from different processing methods is presented in the table 4. There’s not much difference in levels of calcium except in burfi from germinated GCSF which was increased by 20%. In terms of iron, addition of GCSF increased iron content of all the burfi.

### Table 5: Total polyphenols, Total Flavonoids and Antioxidant activity in the burfis prepared from Garden cress seed flour from different processing methods

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Quantity [g]</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Polyphenol</td>
<td></td>
<td>156.5±15.2</td>
<td>132±17.9</td>
<td>99±13.2*</td>
<td>132±19.3</td>
</tr>
<tr>
<td>Antioxidant activity</td>
<td></td>
<td>72±17.5</td>
<td>77.5±19.1</td>
<td>96.2±8.2*</td>
<td>43±6.5*</td>
</tr>
<tr>
<td>Total Flavonoids</td>
<td></td>
<td>671±55.8</td>
<td>519±64.4</td>
<td>447.5±38.4*</td>
<td>650±56.5</td>
</tr>
</tbody>
</table>

A. Standard burfi  
B. Burfi from Soaked Garden Cress Seed flour  
C. Burfi from Germinated Garden Cress Seed flour  
D. Burfi from Roasted Garden Cress Seed flour  
Values are mean ± SD [n=3]  
Data analyzed by Holm Sidak method, * p≤0.05  

The total polyphenol content in burfi prepared from GCSF is depicted in the table 5. It is evident that the processing methods reduced the polyphenols and total flavonoid content. However antioxidant activity was increased in germinated GCSF.

### Table 6: Storage stability [free fatty acid] studies of burfi prepared from Garden cress seed flour from different processing methods

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Days of storage</th>
<th>Free fatty acid mEq/l</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0th day</td>
<td>3.25±0.05</td>
<td>3.05±0.05</td>
<td>3.38±0.005</td>
<td>3.27±0.01</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>5th day</td>
<td>3.43±0.01</td>
<td>3.15±0.05</td>
<td>4.05±0.05*</td>
<td>3.27±0.01</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>10th day</td>
<td>3.51±0.01</td>
<td>3.43±0.005</td>
<td>4.47±0.01*</td>
<td>3.66±0.015</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>15th day</td>
<td>3.9±0.005</td>
<td>3.48±0.01</td>
<td>4.4±0.1*</td>
<td>3.87±0.01</td>
<td></td>
</tr>
</tbody>
</table>

A. Standard burfi  
B. Burfi from Soaked Garden Cress Seed flour  
C. Burfi from Germinated Garden Cress Seed flour  
D. Burfi from Roasted Garden Cress Seed flour  
Values are mean ± SD [n=3]  
Data analyzed by Holm Sidak method, * p≤0.05
It has been used as an effective tool to combat IDA. Since IDA is highly prevalent problem among the reproductive women in India (NIN, 2010) particularly adolescent girls it is appropriate to enrich energy rich snack item with Garden cress flour.

Although GCS is high in iron, it also contains lot of iron chelating polyphenols which also makes the GCSF bitter to taste [29, 30]. Several processing methods have shown to reduce the bitterness and polyphenols which can thus make them taste better. In this study it was found the processing methods does have effect on the acceptability of the product prepared. Both soaking and germination reduced the total polyphenol content there by enhancing their palatability. Further, reduction in these polyphenols may increase iron bioavailability. Processing methods did not had any significant effect on the storage stability of prepared product. Thus it can be concluded that the using different processing methods, the bitterness of the GCSF can be reduced and increase the acceptability of the product developed with them. Flour from germinated GCS can be used partially in any preparation to enhance the iron content of any product without affecting any sensorial attributes and may thus serve as an effective tool to combat IDA.

### 5. References


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**Table 7:** Storage stability [Alcoholic acidity] studies of burfi prepared from Garden cress seed flour from different processing methods

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Days of storage</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>0&lt;sup&gt;th&lt;/sup&gt; day</td>
<td>0.45±0.005</td>
<td>0.45±0.005</td>
<td>0.45±0.005</td>
<td>0.45±0.005</td>
</tr>
<tr>
<td>2.</td>
<td>5&lt;sup&gt;th&lt;/sup&gt; day</td>
<td>0.46±0.005</td>
<td>0.47±0.01</td>
<td>0.47±0.01</td>
<td>0.47±0.01</td>
</tr>
<tr>
<td>3.</td>
<td>10&lt;sup&gt;th&lt;/sup&gt; day</td>
<td>0.48±0.005</td>
<td>0.5±0.01</td>
<td>0.47±0.005</td>
<td>0.48±0.005</td>
</tr>
<tr>
<td>4.</td>
<td>15&lt;sup&gt;th&lt;/sup&gt; day</td>
<td>0.51±0.005</td>
<td>0.54±0.01</td>
<td>0.5±0.01</td>
<td>0.49±0.01</td>
</tr>
</tbody>
</table>

A. Standard burfi
B. Burfi from Soaked Garden Cress Seed flour
C. Burfi from Germinated Garden Cress Seed flour
D. Burfi from Roasted Garden Cress Seed flour

Values are mean ± SD [n=3]

Data analyzed by Holm Sidak method, * p≤0.05

**Table 8:** Microbiological analysis of burfi on studies of burfi prepared from Garden cress seed flour from different processing methods on 15<sup>th</sup> day

<table>
<thead>
<tr>
<th>Microorganisms</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yeast / mold</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
</tr>
<tr>
<td>Coliform</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
</tr>
<tr>
<td>TPC</td>
<td>1900</td>
<td>2500</td>
<td>2100</td>
<td>500</td>
</tr>
</tbody>
</table>

A. Standard burfi
B. Burfi from Soaked Garden Cress Seed flour
C. Burfi from Germinated Garden Cress Seed flour
D. Burfi from Roasted Garden Cress Seed flour


