Processing and sensory evaluation of Khakhra fortification with Spinach and Aonla

Kamble PS, Sonwane CG and Khandekar SA

Abstract
Khakhra is a thin cracker common in the Gujarati and Rajasthan cuisines of western India. It is traditionally made from wheat flour and oil. Khakhra are individually hand-made and roasted to provide a crunchy and healthy snack. This can be enjoyed with a selection of spicy pickles and sweet chutneys. The traditional Khakhra is enriched with protein by adding kidney bean flour. The nutritional and medicinal value of Kidney beans makes it suitable diet for asthma and diabetes patients, boosting their immune system. Such enriched Khakhra are great source of vitamin, minerals, proteins, dietary fibers and iron.

Spinach (Spinacia oleracea) is an annual herb belongs to the family Chenopodiaceae. It is native to Southwest Asia and widely distributed and cultivated through the world including Iran as vegetables for its high nutritious value. Spinach is a good source of minerals (iron, copper, phosphorius, zinc, selenium), vitamin B complex (niacin and folic acid), ascorbic acid, carotenoids (ß-carotene, lutein, zeaxanthin) and phenols (flavonoids, p-coumaric acid), apocynin and Omega-3-fatty acids. It is a relatively quick-growing vegetable and easy to maintain and distinguishable by its green color as well as smooth, oblong shaped leaves that can be either crinkled or smooth. Also, the whole plants is medicinally important and are used in traditional medicine for numerous therapeutic effects because of the presence of biological actives such as tannins and phenolic active phytochemicals as alkaloids, flavonoids, coumarins and terpenoids. It is used to treat diabetes, leprosy, asthma, urinary diseases, lung inflammation, joint pains, thirst, scabies, vomiting, ringworm, sore eye, cold, sneezing, fever and the diseases related to brain and heart(Afra, R. and Seied, M. M) [1].

Aonla (Emblica officinalis) is native of tropical India and Southeast Asia, commonly named as ‘Indian gooseberry’ (Barthakar and Arnold, 1991) [2]. Aonla fruits are fleshy, yellowish green in colour which having six vague perpendicular furrows enclosing seeds. Aonla fruit makes it popular all over the world due to its, commercial and medicinal significance of (Goyal et al., 2007) [3]. Aonla is an excellent source of ascorbic acid (300-900 mg/100 g), amino acid and minerals. It also has phytochemicals such as polyphenols, tannins, emblicol, linoleic acid, corilagin, phyllemblin and rutin (Ghorai and Sethi, 1996) [4].

Aonla fruit is useful in the treatment of haemorrhage, dysentery, diarrhoea, gastric disorders, constipation, headache, jaundice and enlargement of liver (Parrotta, 2001; Goyal et al., 2007) [8, 3]. Various research studies show that aonla has prominent antibiotic, antiulcerogenic, diuretic, laxative, adaptogenic, antitumor, antiscorbutic, hepatoprotective, cardio tonic, antiviral and hypoglycemic properties (Rege et al., 1999). Aonla have good effect on Hypolipidaemic (Mathur et al., 1996) [6]. Aonla is also effective on anti-pyretic and analgesic activity in ethanolic and aqueous extract of Emblica officinalis (Periamayagam et al. 2004) [9]. Banarasi, Chakaiya, Krishna, Francis (Hathijholu), Kanchan (NA-4), NA-6, NA-7, Anand-1, 2, 3 are some of the commercially cultivated varieties of aonla in India (Goyal, 2008; Singh, 2009) [4, 10].

Keywords: Fortified Khakhra, Traditional Recipe, Nutritional value, Sensory Evaluation

1. Introduction
Khakhra is handmade or made by machines and roasted to obtain crispiness. It is also a crispy version of roti. This is a healthy snack common recipe in the Rajasthan and Gujarati cuisines. Khakhra when prepared by using Aonla in the form of dried powdered provides a much more nutrition in terms of protein, carbohydrates, minerals and dietary fibers in comparison with the traditional khakhra that is made of only wheat flour. Since over consumption of wheat or its products are known for improper health condition such as celiac disorder may overcome by minimizing its proportion with adding Spinach as it is rich in iron with many health benefits and aonla in powder form which is rich vitamin C helps to cure or precautions to the Scurvy disease. Finally obtained product is kept for evaluation sensory parameters.

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Owing to its excellent nutritional profile and physico-chemical properties, aonla is processed into different types of product. Aonla fruit having sour and astringent taste, generally utilised raw, cooked or in the form of pickle. Murrabas, juice, jam, cheese, candy, powder, beverage, chutney are the different types of aonla products available in the market and preferred by the consumer being the rich source of vitamin C and antioxidants. Aonla is one of the main constituent of many ayurvedic preparations like Triphla and Chyawanprash (Pant et al., 2004; Goyal et al., 2007)[7, 3].

2. Materials and Methods
2.1 Flow chart- Manufacturing Process of Aonla and Spinach Fortified Khakhra

Selection of raw material

Weighing

Washing

Cutting

Grinding

Mixing of all ingredients

Addition of hot oil and water

Preparation of dough

Preparation of small balls

Shaping

Roasting

Cooling

Applying chat masala

Packaging

Storage

Considered as the major ingredient,  
T0 100% wheat flour by weight (control)  
T1 10% Spinach juice+ 2% Aonla Powder+ 90% wheat flour by weight  
T2 15% Spinach juice + 4% Aonla Powder+ 85% wheat flour by weight  
T3 20% Spinach juice +3% Aonla Powder+ 80% wheat flour by weight  
Khakhra is safer and less prone to microbial spoilage.  
• It has low moisture content in the product.  
• Also possess a longer shelf life.

3. Result and Discussion
Aonla and Spinach fortified khakhra prepared from different mixtures of wheat flour and aonla powder and spinach juice is subjected to sensory evaluation and scores are recorded for different parameters are presented in Table 1.

Table 1: To sensory evaluation and scores are recorded for different parameters

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Color and appearance</th>
<th>Flavor</th>
<th>Consistency</th>
<th>Mouth Feel</th>
<th>Acceptability</th>
</tr>
</thead>
<tbody>
<tr>
<td>T0</td>
<td>8.02</td>
<td>8.15</td>
<td>8.35</td>
<td>8.01</td>
<td>8.12</td>
</tr>
<tr>
<td>T1</td>
<td>8.2</td>
<td>8.23</td>
<td>8.66</td>
<td>8.12</td>
<td>8.14</td>
</tr>
<tr>
<td>T2</td>
<td>8.12</td>
<td>8.32</td>
<td>8.28</td>
<td>8.23</td>
<td>8.20</td>
</tr>
<tr>
<td>T3</td>
<td>8.10</td>
<td>8.12</td>
<td>8.20</td>
<td>8.01</td>
<td>8.0</td>
</tr>
</tbody>
</table>

3.1 Color and appearance
The mean color and appearance score for different treatments of spinach aonla khakhra are ranged from 8.02 to 8.12. The treatment T1 (8.12) is found to be significantly superior over the rest of the treatments. It was observed that decrease in the level of spinach and aonla in khakhra decreases the score of color and appearance slightly.

3.2 Flavor
It is observed that the mean score for the flavor of spinach aonla khakhra for treatments T0, T1, T2 and T3 are 8.15, 8.23, 8.32, and 8.12 respectively. The treatment T2 is superior over T0 and T3 treatments. It is observed from above findings that 90% of wheat flour mixed with 15% of spinach juice and 4% aonla powder will give rich flavor to khakhra.

3.3 Consistency
The mean score for the consistency attributes of Spinach aonla khakhra ranges from 7.20 to 8.66. The treatment T1 (8.66) is significantly superior over the rest of the treatments.

3.4 Mouth feel
The highest mouth feel score is observed for treatment T1 (8.12) followed by T2 (8.23), T0 (8.01) and T3 (8.0). 15% of spinach juice and 4% aonla powder mix is most acceptable (T2).

3.5 Overall acceptability
The mean score for treatment T0, T1, T2 and T3 are 8.12, 8.14, 8.20 and 8.0 respectively. The treatment T2 (8.20) is most accepted by the judges. So use of 15% of spinach juice and 4% aonla powder is more acceptable than the other treatment combinations.

4. Conclusion
Addition of Spinach juice and Aonla Powder into traditional khakhra makes it more nutritious and also helps in improving the keeping quality of the end product. The optimum amount of Spinach juice and Aonla Powder that can be used in the process of preparation of khakhra is up to 15% & 4%.

5. References
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10. Singh D. Aonla (Cultivation and Processing), 2009, 47-56. India: Agriculture and Biological Sciences.