Formulation and sensory evaluation of Multigrain Khakhra by incorporating Spirulina Powder and Flax Seeds

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Abstract
Snack foods, being one of the major food categories of the global health and wellness market and becoming a major focus of new product development in the food industry. Khakhra is a popular traditional Gujarati snack prepared mainly from wheat flour. An attempt has been made to develop a healthy khakhra enriched with protein and omega-3 fatty acids (CRISSPS). Multigrain unrefined flours like, wheat flour, ragi flour, soya flour, barley flour and seeds like flax seeds and spirulina (for making value added product) were used in the development of this healthy enriched Khakhra. Ratio of different ingredients in khakhra @wheat flour (35%), ground flax seeds (5%), soya flour (15%), ragi flour (15%), barley flour (10%), peanut oil (5%), Kasuri methi (2%), spirulina (2%), turmeric powder (1%), red chilli powder (2%) and salt (4%), citric acid (1%), sugar (2%), carom seeds (2%). The sensory evaluation revealed that 78% of the panelist like very much T3 combination as compared to T1 and T2. The samples were stored at room temperature that is 23-29 degree Celsius and sensory evaluated at regular interval. It is usually eaten with coffee, tea, chutney, pickles, butter, ghee, topped vegetable, cheese or yoghurt. Khakhra can make quickly, satisfy the consumers, less perishable, more durable and more portable than prepared food. The present study was conducted to determine the sensory quality of multigrain khakhra.

Keywords: Multigrain, khakhra, spirullina, omega-3 fatty acids

Introduction
In general people have become health conscious and acknowledge the importance of healthy food when compared to the easily available junk and fast food. The Corona pandemic has also increased the demand for healthy nutrition. Therefore, there is a need to develop products which will meet the demands of this ever-growing health-conscious population. These newer products should be preservative free, natural and should also have health benefits. Multigrain foods are being increasingly considered as an approach to improve the nutritional value of products. Omega-3 fatty acids also improve cognitive functions among all age groups. There are very few vegetarian foods which provide omega-3 fatty acids. Khakhra is a popular traditional Gujarati snack prepared mainly from wheat flour. An attempt has been made to develop a healthy khakhra enriched with protein and omega-3 fatty acids (CRISSPS). Multigrain unrefined flours like, wheat flour, ragi flour, soya flour, barley flour and seeds like flax seeds and spirulina (for making value added product) were used in the development of this healthy enriched khakhra. Peanut oil was used in the preparation of the enriched khakhra. Different compositions and combinations were tried to arrive at an acceptable product.

Fig 1: Multigrain Khakhra
These trials were evaluated for their acceptability using a 9 point hedonic scale by 25 semi trained panelists. Sensory evaluation and statistical analysis revealed that khakhras (T-3) made with the following ingredients wheat flour (35%), ground flax seeds (5%), soya flour (15%), ragi flour (15%), barley flour (10%), peanut oil (5%), kasuri methi (2%), spirulina (2%), turmeric powder (1%), red chilli powder (2%) and salt (4%), citric acid (1%), sugar (2%), Carom seed (2%) was well accepted Trail T-3.

Material and Method
For preparation process of Multigrain khakhra (CRISSPS), following mixture of the Barley flour, Ragi Flour, Soya flour and the wheat flour is considered as the major ingredient and rest are Red chilli powder, turmeric powder, carom seeds, spirulina powder, Flax seed, citric acid, salt, sugar, peanut oil.

| Table 1: Followings are Formulation of different trials |
|---------------------------------|----------------|----------------|----------------|----------------|
| **Trials** | **T0** | **T1** | **T2** | **T3** |
| Wheat flour (gm) | 80 | 60 | 40 | 35 |
| Soya flour (gm) | - | 20 | 20 | 15 |
| Ragi flour (gm) | - | - | 10 | 15 |
| Barley flour (gm) | - | - | 10 | 10 |
| Red chilli powder (gm) | 2 | 2 | 2 | 2 |
| Turmeric powder (gm) | 1 | 1 | 1 | 1 |
| Kasuri methi (gm) | 2 | 2 | 2 | 2 |
| Flax seed (gm) | - | - | 3 | 3 |
| Spirulina (gm) | - | - | - | 2 |
| Sugar (gm) | - | - | - | 2 |
| Salt (gm) | 5 | 5 | 5 | 5 |
| Peanut oil (ml) | 7 | 7 | 5 | 5 |
| Citric acid (gm) | - | - | - | 1 |
| Carom seeds (gm) | 3 | 3 | 2 | 2 |

Flow diagram

1. Grind the whole grain into flour
2. Sieve the used all flour
3. Add all ingredients
4. Take mix ingredients in to a bowl and add enough water to make a soft dough
5. Knead the dough
6. Rest the dough for ½ hour
7. Divide the dough into equal balls
8. Roll out all the balls into very thin chapattis
9. Roast the chapatti on slow heat with gently cloth pressing on both sides
10. When it is crisps and light brown in colour on both sides, it is done.
11. Remove, allow it to cool & store in an air tight container

Fig 1: Flow diagram for the prepartion of multigrain khakhra (CRISSPS)
Sensory evaluation
The sensory evaluation of different organoleptic characteristics i.e., colour and appearance, taste, flavour, mouth feel, and overall acceptability were carried out by semi trained panelists on 9 point hedonic scale with “9 as Like Extremely and 1 as Dislike extremely”. The average score was calculated for individual organoleptic properties. Sensory evaluation is carried out by 10 evaluators for various quality attributes on following scale:

<table>
<thead>
<tr>
<th>Hedonic Scale</th>
<th>Dislike extremely</th>
<th>Dislike very much</th>
<th>Dislike moderately</th>
<th>Dislike slightly</th>
<th>Neither like nor dislike</th>
<th>Like slightly</th>
<th>Like moderately</th>
<th>Like very much</th>
<th>Like extremely</th>
</tr>
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<td>2</td>
<td>3</td>
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<td>5</td>
<td>6</td>
<td>7</td>
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Table 2: Hedonic scale

Results and Discussion
Multigrain khakhra prepared from different mixtures of wheat flour, ragi flour, soya flour and barley flour are subjected to sensory evaluation and scores are recorded for different parameters are presented in Table 3.

Table 3: Show the mixtures of wheat flour, ragi flour, soya flour and barley flour are subjected to sensory evaluation

Color and appearance the mean color and appearance score for different Trials of Multigrain khakhra are ranged from 6 to 8.5. The trials T3 (8) is found to be significantly superior over the rest of the trials. It was observed that by adding of Spirullina in Multigrain khakhra in T3 decreases the score of color and appearance in rest of trials.

Taste the mean score for the taste attributes of Multigrain khakhra ranges from 6 to 8. The trialsT3 (8.5) is significantly superior over the rest of the trials by adding sugar and citric acid taste like Khatta Meetha CRISP.

Flavor It is observed that the mean score for the flavor of Multigrain khakhra for trials T0, T1, T2 and T3 are 7, 7, 8, and 8.5 respectively. The trialsT3 (8) is superior over T0, T1 and T2 trials. It is observed from above findings that 35% of wheat flour mixed with 15% of Ragi flour, 15% Soya flour and 10% barley flour will give rich flavor to khakhra.

Mouth feel the highest mouth feel score is observed for trials T3 (8) followed by T2 (7.5) and T1 (6.5), by adding Citric acid and sugar mix is most acceptable (T3). Overall acceptability the mean score for trials T0, T1, T2 and T3 are 6.5, 6, 7 and 8 respectively. The trialsT3 (8), T2 (7), and T0 (6.5) ranked among like very much to like very much. The trialsT3 (8) is most accepted by the judges.

Conclusion
Many people are still unaware of the potential health benefits of spirulina powder, flaxseed, multigrain unrefined flour and food applications. Dry Spirullina powder is a potent source of nutrients that is rich in protein, vitamins, minerals, carotenoids, and antioxidants that can help protect cells from. Flaxseed enriches the potential health suitting nutritional profile in it. Flaxseeds are the richest source of ω-3 fatty acid, α-linolenic acid and lignans. It is also a considerable potential source of soluble fiber, antioxidants and high-quality protein. Millets and cereals can provided more nutrients. In addition to whole grain benefits, multigrain blend concept helps to mix different whole grains to maximize their nutritious, functional and sensory properties. The multigrain mixes developed were nutritionally superior in terms of protein, fibre, total mineral, crude fat and iron contents.

On the basis of findings, it is concluded that selected multigrain flours, flax seeds and Spirullina were found to be good sources of nutrients i.e. Energy, protein, calcium, omega 3 free fatty acid, fiber and iron. Admixture of flours can be successfully incorporated with multigrain flour, flax seeds and Spirullina powder to enhance the sensory and nutritional properties of the products made. The sensory scores of the prepared products with different flours were highly acceptable in terms of taste and flavour, color and appearance and overall acceptability when compared with control. The food products prepared from multigrain flour, flax seeds and Spirullina were rich in fiber, calcium, omega 3 free fatty acid, iron and protein content which increased significant as the incorporation level increased.

Development of the product by incorporation of the dry spirulina powder, multigrain unrefined flour and flax seeds in traditional preparations can assist to meet the daily nutritional requirements and also helps in improving the keeping quality of the end product.

On the basis of sensory evaluation revealed that 78% of the panelist like very much T3 combination as compared T1 and T2. The samples were stored at room temperature that is 23-29 degree Celsius that is performed at regular interval.

References