Multigrain Beetroot Crisps: A Healthy Snacking Option

Nikita Singh1* and Rupali Sengupta1

1Department of Clinical Nutrition and Dietetics, Dr. BMN College of Home Science, SNDT Women’s University, R. A. Kidwai Road, Matunga (E), Mumbai, 400019, Maharashtra, India.

Authors’ contributions

This work was carried out in collaboration between both authors. Author NS designed the study, performed the statistical analysis, wrote the protocol, managed literature searches and wrote the first draft of the manuscript. Author RS managed the analyses of overall study. Both authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AJMAH/2020/v18i330189

Editor(s):
(1) Dr. Janvier Gasana, Kuwait University, Kuwait.

Reviewer(s):
(1) Faiza Nouh, University of Benghazi, Libya.
(2) E. G. Moke, Delta State University, Nigeria.
(3) Maria Cristina Gonzalez-Torres, Universidad Autonoma Metropolitana-Iztapalapa, Mexico.

Complete Peer review History: http://www.sdiarticle4.com/review-history/56263

ABSTRACT

Aim: With the rise of metabolic disorders like obesity in developed countries, maintenance of healthy lifestyle has become very challenging. Food plays a very important role in this process. Consumption of healthy foods with proper portion control can help in controlling excess weight gain and can prevent metabolic disorders like obesity. Obesity is characterized by excess accumulation of fat. This further leads to complications like dyslipidemia, hypertension, diabetes mellitus and cardiovascular diseases. Increased consumption of calorie dense fatty snacks or high sugar processed foods between meals is one of the causes of obesity. Consumption of low fat high fiber snacks has shown to help in weight reduction. Therefore development of a healthy snacking option was considered. The aim of the study was to develop and standardize a healthy snack for obese as well as healthy population.

Place and Duration of Study: Department of Clinical Nutrition and Dietetics, Dr. BMN College of Home Science, between November 2019 and February 2020.

Methodology: A healthy snacking option in the form of Multigrain Beetroot Crisps was prepared by using a mixture of cereals and millets flours. The snack was baked instead of frying to reduce the...
calorific and fat content. Standardization was done by testing for sensory evaluation using 5 point hedonic scale for four weeks. Shelf life study was carried out to find stability of developed product.

**Results:** Sensory evaluation studies showed the product was well accepted by the target population. On comparison with the commercially available product, Multigrain Beetroot Crisps was high in fiber, calcium and iron. Shelf life study showed, the product was stable for four weeks at room temperature when kept in an airtight container.

**Conclusion:** A healthy snacking option in the form of Multigrain Beetroot Crisps was developed for obese as well as healthy population which is nutritionally better as compared to commercially available beet chips owing to its fiber, calcium and iron content which are beneficial in obesity related complications.

**Keywords:** Health; obesity; snack; multigrain; beetroot; fiber; calcium.

### 1. INTRODUCTION

Healthy population plays a key role in the development of any country. With the advancement of technology and changing lifestyle, maintenance of health has become very challenging. Increased stress, lack of adequate sleep, improper eating habits in the form of untimely consumption of deep fried fast foods which are low in nutrients and lack of sufficient physical activity has led to increased weight gain among individuals which, if not managed, can lead to metabolic complications like obesity.

Obesity is a medical condition that is described by excess accumulation of fat that leads to reduced life expectancy and increased adverse health effects [1]. Central obesity (obesity around the abdomen) leads to hypertension, dyslipidemia and increased risk of type 2 diabetes mellitus [2]. Excess metabolic fat leads to increased risk of cardiovascular diseases and other metabolic and inflammatory diseases. Due to lack of physical activity and increased intake of energy dense food, excess of energy deposition in the form of increased visceral fats around the abdomen occurs. Hypertrophy of adipocytes leads to impaired cytokine secretion profiles with decreased Adiponectins, increased Tumor Necrosis Factor-α and Interleukin 6, all these being inflammatory markers that cause increased C - reactive protein (CRP) levels in blood. Interleukin 6 that activates liver to secrete CRP. Intercellular adhesion molecule 1 and heat shock proteins are also released leading to endothelial injury [3].

Decreased intake of coarse cereals, pulses, fruits and vegetables combined with increased intake of salt and meat products has led to increased prevalence of obesity in urban India [4]. High fiber diets are beneficial in obesity management.

A key factor in weight management is reduction of intake of energy dense foods, portion control and quality of nutrients consumed [5,6]. Low to moderate fat supplementation of good quality with energy restriction and management of sugars is important in weight management [7]. Thus, food plays an important role in maintaining a healthy lifestyle so that the risk of metabolic disorders like obesity can be prevented.

Multigrain beetroot crisps is made from a mixture of millets and cereal flours like Bajra, Jowar, Ragi Maize, Wheat And Rice flour along with Beetroot, Sesame Seeds And Spices. Literature survey has shown that consumption of steamed beetroot increases bile binding capacity of beets [8] which has shown to reduce serum cholesterol and triacylglycerol levels in dyslipidemic rats [9]. Beetroot is a rich source of dietary nitrate that provides in vivo Nitric Oxide to strengthen endothelial function. It is also a rich source of phytochemical compounds like carotenoids, ascorbic acid, flavonoids and various bioactive phenolics like rutin, epicatechin and caffeic acid that perform antioxidant function [10]. Beetroot contain Betalain which is an antioxidant compound that scavenges free radical species [11]. These antioxidants are important to reduce inflammation in the body.

Ragi helps in lowering cholesterol [4]. Finger Millet (*Eleusine coracana*) is a good source of protein (7.7g/100g), crude fiber (3.6g/100g) and minerals like calcium (344mg/100g) and iron (6.3mg/100g). The bulkiness of fiber provides satiety for longer period of time and thus helps prevent excess calorie intake [12,13]. Ragi provides antioxidants, phytochemicals which makes it easily available and slow for digestion [14].
Bajra contains ω3 fatty acids which cause reduction in triglycerides level in blood [15]. Pearl millet (Pennisetum glaucum) has less starch, low glycemic index and 8-15 times higher α amylase activity as compared to wheat. [14] It is a rich source of fiber (Dietary fiber 17g/100g) due to which it delays gastric emptying and helps in lowering overall consumption of food [16].

Jowar is a rich source of resistant starch. Resistant starch passes undigested in the small intestine and arrives intact in large intestine where it is fermented by microorganisms to produce Short chain Fatty acids. Sorghum starch helps manage blood lipid levels because of its high resistant starch content. It helps prevent obesity [17].

Sesame seeds have hypocholesterolemic activity that shows significant reduction in serum Total cholesterol and LDL-C [18,19]. Sesame (Sesamum indicum L.) is mainly composed of fats and considered main source of antioxidants such as tocopherols, phenolic acids and lignans like sesamin, sesamolin and sesamol that helps in dyslipidemic patients [20].

Spices are known to play a role in obesity and non alcoholic fatty liver disease owing to their antimicrobial and antioxidant properties which help reduce inflammation. Curcumin from turmeric and Pepper are known to inhibit amyloid beta aggregation by activation of adipose tissue-liver interaction [21].

Being baked not fried Multigrain Beetroot Crisps is a low calorie, low fat healthy snack option for obese as well as healthy population. Its high fiber content provides satiety and could curb the need for constant eating between meals.

2. METHODOLOGY

2.1 Selection of Ingredients

Healthy flours used in the form of a mixture of cereals and millets as they are rich in carbohydrates, vitamins and minerals. Cereals provide fiber which helps induce satiety, delay gastric emptying and reduce the need of frequent snacking. High calcium sources such as sesame seeds and Ragi were used. Ragi is rich in iron. Calcium supplementation can help with bone disorders induced by overweight and obesity. Beetroot is a rich source of antioxidants and dietary nitrates that help alleviate inflammation. Baking was preferred over frying to reduce the fat content and formulate a healthy snacking option.

2.2 Method of Preparation

1. Wash the Beetroot with water
2. Steam it in steamer for 20 min until it becomes tender.
3. Cool it. Peel out the skin. Grate it using grater.
4. Mix all the ingredients mentioned above and add grated beetroot to it.
5. Knead into soft dough.
6. Roll the dough into thin sheets.
7. Cut the dough using a flower shaped cutter.
8. Grease an oven tray using oil.
9. Preheat oven at 180°C. Place the crisps in oven and bake at 180°C for 15min.
10. Cool and serve with a tangy dip.

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beetroot</td>
<td>25 g</td>
</tr>
<tr>
<td>Multigrain flour (Ragi, Bajra, Jowar, Maize, Whole wheat, Rice)</td>
<td>Each flour 5 g</td>
</tr>
<tr>
<td>Sesame seeds</td>
<td>2.5 g</td>
</tr>
<tr>
<td>Oil</td>
<td>2.5 ml</td>
</tr>
<tr>
<td>Spices (Turmeric, Red chili powder, Black pepper, Salt)</td>
<td>A pinch of each</td>
</tr>
</tbody>
</table>
Table 2. Nutritive value of multigrain beetroot crisps: per serving (30 g)

<table>
<thead>
<tr>
<th>Sr. no.</th>
<th>Ingredients</th>
<th>Amount (g)</th>
<th>Energy (Kcal)</th>
<th>Carbohydrates (g)</th>
<th>Proteins (g)</th>
<th>Fats (g)</th>
<th>Total fiber (g)</th>
<th>Calcium (mg)</th>
<th>Iron (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Beetroot</td>
<td>25</td>
<td>8.90</td>
<td>1.50</td>
<td>0.48</td>
<td>0.35</td>
<td>0.81</td>
<td>4.32</td>
<td>0.19</td>
</tr>
<tr>
<td>2</td>
<td>Ragi flour</td>
<td>5</td>
<td>16.03</td>
<td>3.30</td>
<td>0.35</td>
<td>0.05</td>
<td>0.55</td>
<td>18.20</td>
<td>0.23</td>
</tr>
<tr>
<td>3</td>
<td>Bajra Flour</td>
<td>5</td>
<td>17.39</td>
<td>3.05</td>
<td>0.50</td>
<td>0.25</td>
<td>0.55</td>
<td>1.36</td>
<td>0.32</td>
</tr>
<tr>
<td>4</td>
<td>Jowar flour</td>
<td>5</td>
<td>16.70</td>
<td>3.35</td>
<td>0.45</td>
<td>0.05</td>
<td>0.50</td>
<td>1.38</td>
<td>0.19</td>
</tr>
<tr>
<td>5</td>
<td>Maize flour</td>
<td>5</td>
<td>16.70</td>
<td>3.20</td>
<td>0.40</td>
<td>0.15</td>
<td>0.60</td>
<td>0.53</td>
<td>0.12</td>
</tr>
<tr>
<td>6</td>
<td>Wheat flour</td>
<td>5</td>
<td>16.01</td>
<td>3.20</td>
<td>0.50</td>
<td>0.05</td>
<td>0.55</td>
<td>1.54</td>
<td>0.20</td>
</tr>
<tr>
<td>7</td>
<td>Rice flour</td>
<td>5</td>
<td>17.81</td>
<td>3.90</td>
<td>0.35</td>
<td>0.02</td>
<td>0.10</td>
<td>0.37</td>
<td>0.03</td>
</tr>
<tr>
<td>8</td>
<td>Sesame seeds</td>
<td>2.5</td>
<td>12.98</td>
<td>0.27</td>
<td>0.54</td>
<td>1.07</td>
<td>0.42</td>
<td>32.07</td>
<td>0.37</td>
</tr>
<tr>
<td>9</td>
<td>Oil</td>
<td>2.5</td>
<td>22.50</td>
<td>0</td>
<td>0</td>
<td>2.5</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>145</strong></td>
<td><strong>21.7</strong></td>
<td><strong>3.57</strong></td>
<td><strong>4.49</strong></td>
<td><strong>4.08</strong></td>
<td><strong>60.0</strong></td>
<td><strong>1.65</strong></td>
<td></td>
</tr>
</tbody>
</table>
3. RESULTS AND DISCUSSION

3.1 Nutritive Value Calculation and Comparison with Commercially Available Product [22]

It can be seen from Tables 2 and 3 that Multigrain Beetroot Crisps is nutritionally better than commercially available product. It has comparatively high amount of fiber, protein, Calcium and Iron and also low sodium content which is beneficial in management of weight and preventing further complications.

3.2 Sensory Evaluation of the Product

After standardization of product sensory evaluation was done for four weeks by using scoring test with 5 points scale where, 1=poor, 2=fair, 3=good, 4=very good, 5=excellent. 10 semi trained panelists were asked to score the product on the following characteristics:

Table 3. Comparison of nutritive values of commercially available beet chips and multigrain beetroot crisps

<table>
<thead>
<tr>
<th>Nutrients</th>
<th>Commercially available beet chips</th>
<th>Multigrain beetroot crisps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy</td>
<td>134 Kcal</td>
<td>145 Kcal</td>
</tr>
<tr>
<td>Carbohydrates</td>
<td>22.4g</td>
<td>21.7g</td>
</tr>
<tr>
<td>Proteins</td>
<td>1.3 g</td>
<td>3.57 g</td>
</tr>
<tr>
<td>Fats</td>
<td>4.2 g</td>
<td>4.49 g</td>
</tr>
<tr>
<td>Total Fiber</td>
<td>0.4 g</td>
<td>4.08 g</td>
</tr>
<tr>
<td>Calcium</td>
<td>20.0 mg</td>
<td>60.0 mg</td>
</tr>
<tr>
<td>Iron</td>
<td>0.8 mg</td>
<td>1.65 mg</td>
</tr>
</tbody>
</table>

Fig. 1. Results of sensory evaluation of product done for 4 weeks
Appearance, Texture, Aroma, Taste, Color and Overall Acceptability. The graph showed linear increase in overall sensory attributes from the 1st week towards fourth week. Initially during the 1st week the product was served without a dip which affected its sensory evaluation. On addition of dip its sensory attributes increased and remained linear all throughout the four weeks.

3.3 Shelf Life Study

To test for shelf life of the product, a shelf life study of four weeks was carried out. The product was kept in an airtight glass container for four weeks at normal room temperature conditions. Glass container was preferred over plastic container to avoid any chemical changes that plastic material would attribute to the product. At the end of each week, the product was checked for changes in its sensory attributes like color, texture, aroma, taste and crispiness. The product was found to be stable for 4 weeks retaining its sensory attributes (Fig. 1).

4. CONCLUSION

A healthy snacking option was developed in the form of Multigrain Beetroot Crisps. It is nutritionally enriched as compared to commercially available beetroot chips. It is low in energy, rich in fiber which is beneficial for maintaining health as it leads to feeling of fullness for longer time thus avoiding the need of frequent eating. Calcium and iron enrichment helps with osteoporosis complications of obesity. The product is palatable and tasty and overall positively accepted not only by obese people but also by healthy individuals.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES


