

Development and Nutritional Assessment of Beetroot Crackers

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ABSTRACT

The study of beetroot crackers development was carried out at the Department of Food Technology, Parul Institute of Applied Sciences, Parul University, Vadodara. The main objective of the study was to develop crackers which provide enough energy, protein and nutrients such as iron and dietary fiber, which can be consumed by patients with hormonal problems like PCOD, PCOS. Beetroot crackers were developed using beetroot powder, pumpkin seed, flaxseed, sesame seed, wheat flour and olive oil. Four different formulations T1, T2, T3, T0 were prepared. T2 was found to be the best formulation after sensory evaluation with 9 Point Hedonic Scale. Further the selected formulation was nutritionally assessed on the basis of physicochemical parameters and microbiological makeup. The designed beetroot crackers was found to have the following composition: 9.03 % protein, 68.50 % carbohydrates, 8.02 % fat, 5.66 %ash, 6.16gm dietary fiber, 20.5 mg of iron, 598.9 mg of potassium, 538 mg of calcium and delivers up to 382.3 K/Cal of energy. The findings demonstrate that beetroot crackers is well regarded and excellent in terms of nutritional value due to its high protein, iron, calcium and dietary fiber content and also can be consumed as a healthier snack.

KEYWORDS: Beetroot, Pumpkin seed, Flaxseed, Sesame seed, Wheat flour

1. INTRODUCTION

Crackers are the biscuits or modified versions of the chips. They are thin, dry and crispier than biscuits. Functional foods are becoming more and more popular with consumers, which has increased their availability on the market. The market for baked goods is still comparatively underdeveloped for this trend [Siro, Kapolna, Kapolna, & Lugasi, 2008]. Because they are ready to eat, convenient, and have a long shelf life, they are becoming more and more popular as processed foods [P. Ashwitha Reddy, 2019]. Crackers containing nutritious components like protein and dietary fiber are becoming more popular as demand for health-conscious products rises [Chandra S Singh, 2015]. Grains, seeds, and millets that are high in protein, energy, vitamins, and minerals are used to make crackers. The nutritional value of crackers might vary depending on their content.

Beetroot (*Beta vulgaris*) is grown for its ability to provide sugar, food-grade organic color, food for snacking, and other essential components for humans.

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It is divided into various types, with root colors ranging from radish to white [b. hossian, 2019]. It is a great dietary supplement due to its abundance in vitamins, minerals, and other nutrients as well as its special phytoconstituents, which offer a number of therapeutic benefits [Yadav, 2016]. The beetroot contains betalians, which have strong anti-inflammatory and antioxidant properties. Blood pressure, cancer prevention, and bodily detoxification are other advantages of beetroot [J. Xiang, 2019]. Dehydration and drying are two preservation techniques that guarantee the microbiological safety of biological materials [Mathlouthi, 2001].

Sesame (*Sesamum indicum* L.) is a significant oilseed crop and a good source of gourmet edible oil (Namiki, 1995). Sesame (*Sesamum indicum* L.) is grown in a number of nations, with India, Sudan, China, and Burma being the biggest producers (accounting for 60% of global production) (Abou-Gharbia, Shehata, & Shahidi, 2000). Sesame is a wholesome food for people and is used frequently in

bread and confectionery goods (Abou-Gharbia, Shahidi, Shehata, & Youssef, 1997). According to sesame's chemical makeup, the seed is a significant source of oil (44-58%), protein (18-25%), carbohydrate (13.5%), and ash (5%); this information was found in studies by Kahyaoglu and Kaya (2006).

Flax (*Linum usitatissimum*), a member of the Lineaceae family, is an annual herb with blue flowers and small, flat seeds that range in color from golden yellow to reddish brown.

The texture and flavor of flaxseed are crisp [Morris 2007 and Rubilar et al. 2010]. Short chain polyunsaturated fatty acids, such as alpha linolenic acid, are found in flax seeds (ALA) [Parikh, 2018]. Flax seed is also a good source of minerals like calcium, iron, magnesium, phosphorus, zinc and very little sodium [Singh KK.]. Flaxseed contains bioactive compounds and functional ingredients which have beneficial effects on health like cardiovascular diseases, cancer, diabetes, obesity, bone disorder, renal and hormonal issues. Flaxseed has cholesterol lowering properties as it possesses antioxidant and hepatoprotective properties [Bhathena SJ, 2013].

Pumpkin seed belongs to the Cucurbitaceae family [M.Z. Amin, 2019 and M. Andjelkovic, 2010]. In a few areas of Mexico, Canada, the United States, China, and Europe, salted and roasted pumpkin seeds are eaten as a snack. They have a distinctive flavor and nutty taste. It contains significant amounts of protein, vitamin E, carotenoids, pigment, pyrazine, provitamins, saponins, phytosterol, triterpenoids, phenolic compounds, and derivatives of coumarin, as well as unsaturated fatty acids and flavonoids [JA Acorda, 2019 and S Dakeng, 2012]. Along with minerals including zinc, manganese, calcium, sodium, copper, and iron, pumpkin seeds are also significant providers of magnesium, phosphorus, and potassium.

Development of healthier versions of chips called crackers by adding different flours and seed powder can increase the nutritional value of the product. The idea behind adding beetroot and seed powder to the crackers is to make the cracker more wholesome and accessible to everyone. The main aim of the study is to develop nutrient rich crackers from beetroot and seeds powder (flax, sesame and pumpkin).

2. Material and Methodology

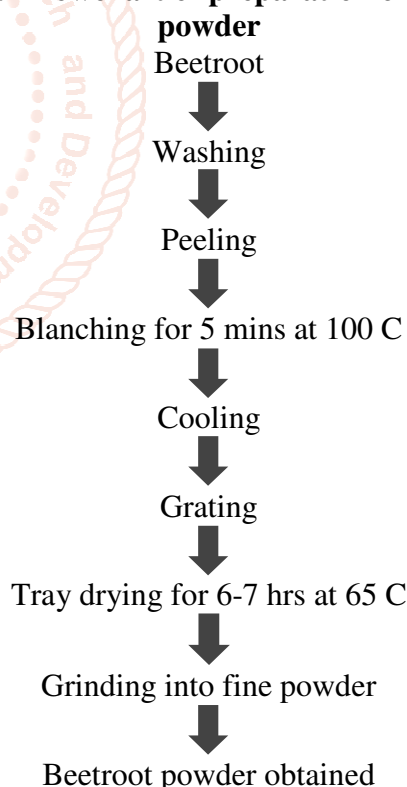
2.1. Procuring of Raw Materials

The ingredients used in the preparation of the beetroot crackers were beetroot, sesame seed flour, pumpkin seed flour, flaxseed flour, wheat flour, corn flour, olive oil, salt and spices like (peri peri and black pepper)

2.2. Beetroot powder preparation

Local markets or areas often have fresh beetroots available. One of the most important factors in beetroot selection is choosing the right size and searching for a healthy, clean beetroot. Remove all the soil, dust, and grime from the beetroot by washing it under running water. Beetroot are then peeled with a hand peeler and blanched until the water is simmering for 10 min and then immediately cooling it down. The texture of blanched beetroot is slightly soft and it retains the color and some nutrients. Then, beetroot is peeled by hand, blanched for 10 minutes until the water is simmering, and then quickly cooled down. The texture of the blanched beetroot is slightly soft, yet it still has some color and nutrients. Beetroot is grated to create fine particles so that it would dry more quickly in a dryer. The beetroot is then stored in a tray dryer for 6 to 7 hours at 65 degrees. In the tray, the beets are distributed equally. The dried beetroot is ground into a fine powder after cooling to room temperature for 6–7 hours. After 6–7 hours the dried beetroot is cooled down to room temperature and grind into fine powder so that they can be stored for a longer period of time.

Figure1:- Flowchart of preparation of beetroot



2.3. Roasting of seeds

Sesame, flaxseed and pumpkin seeds were roasted in an open pan. Sesame was roasted for about 5 min on low flame similarly, flaxseed and pumpkin seed were roasted in the same pan on low flame.

2.4. Flour preparation

After the roasting of seeds they were cooled at room temperature. The seeds were then grinded separately

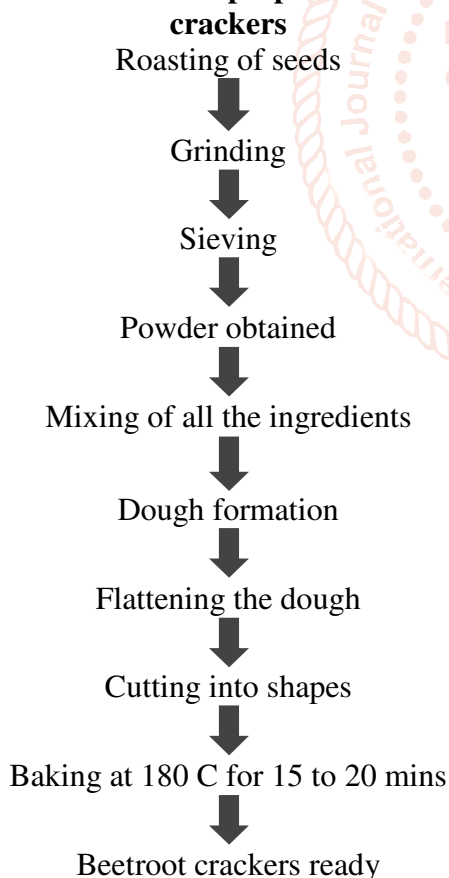
in a grinder and sieve manually to get (uniform) fine powder.

2.5. Preparation of Crackers.

The various ingredients used for the standardization of recipe for the preparation of beetroot crackers consist of 20g beetroot powder, 10g of flax seed powder, 10g of pumpkin seed powder, 10g of sesame seed powder, 50g of wheat flour, 10g of corn flour, 1 tsp of olive oil and spices.

Each of the above ingredients required for making 130 g of crackers from 100g of mixed material in total. The dry ingredients were weighed and mixed together. Spices like (pepper and peri peri), salt and oil were added. 60 ml of water was added to make the dough. The dough was then flattened by a rolling pin and cut into desired shape (square) and then transferred into the oven tray. The oven was preheated at 180 C for 10 minutes. The crackers were then baked in the oven for 15 - 20 minutes until they gave a crunchy texture. The crackers were cooled and packed in Polyp-ropylene (PP) pouches. The crackers were stored at ambient and 37 C temperature conditions for shelf life evaluation

Figure 2:-Flowchart of preparation of beetroot crackers



2.6. Formulations of beetroot crackers.

There were three formulations made for beetroot crackers and were marked as T1, T2 and T3. The composition of the formulation is mentioned in the table 1 below.

Table 1:- Formulation of Beetroot crackers

| Ingredients | T1 (gms) | T2 (gms) | T3 (gms) |
|---------------------|----------|----------|----------|
| Beetroot powder | 20 | 20 | 25 |
| Sesame seed powder | 20 | 10 | 5 |
| Flax seed powder | 20 | 10 | 5 |
| Pumpkin seed powder | 20 | 10 | 10 |
| Wheat flour | 20 | 50 | 50 |
| Corn flour | - | 10 | 5 |
| Olive oil | 1 tsp | 1 tsp | 1 tsp |
| Black pepper | 3 | 3 | 3 |
| Peri peri | 2 | 2 | 2 |

2.7. Sensory evaluation

The sensory evaluation of different sensory attributes was carried out by five panelists. Samples were placed on the tray labeled as T1, T2, T3, T0 and presented to panelists in a randomized order. Between each sensory test, panelists were given water to rinse their palate, to reduce sensory fatigue. The sensory evaluation consisted of attributes like taste, texture, color, appearance and overall appearance. All the samples were assessed with the help of a nine point hedonic scale, grading 9 as liked extremely to 1 disliked extremely.

3. Result and Discussion

Contrary to ordinary crackers (which contain refined wheat flour), this product was created by using beetroot powder, seed powder and whole wheat flour, which has a higher nutritional value than other types of plain crackers. In comparison to normal crackers the fat and butter is replaced with healthy oil. Olive oil is rich in monounsaturated fatty acid and has antioxidant properties. By creating crackers with mixed seed flour and beetroot powder, the nutritious value is often increased. The final product was analyzed for Chemical parameter, Sensory analysis, Microbial analysis and Stored at room temperature.



Figure 3:- Beetroot cracker prepared from selected formulation

3.1. Proximate Composition of Beetroot, Pumpkin seed, Flaxseed, Sesame seed and Wheat flour

Proximate composition of beetroot, pumpkin seed, flaxseed and sesame seed is mentioned in Table 2. The significant difference is observed in the nutritional parameters.

Table 2:- Proximate composition of Beetroot powder, Pumpkin seed, Flaxseed, Sesame seed and Wheat flour.

| Nutritional Parameters | Beetroot | Pumpkin seed | Flaxseed | Sesame seed | Wheat flour |
|------------------------|------------|--------------|------------|-------------|-------------|
| Protein | 1.54±0.62 | 19.94±1.64 | 22.37±0.12 | 22.41±1.25 | 12.85±2.25 |
| Carbohydrates | 21.8±0.95 | 38.77±2.86 | 24.67±0.06 | 25.2±0.07 | 77.5±0.51 |
| Total Fat | 0.20±0.06 | 26.38±2.15 | 43.55±0.06 | 41.20±0.07 | 3.55±1.25 |
| Moisture | 10.0± 0.53 | 8.46±0.45 | 4.91±0.06 | 4.53±0.3 | 7.20±1.31 |
| Total Ash | 5.26±0.51 | 6.54±0.14 | 2.86±0.06 | 4.27±0.50 | 1.70±0.80 |

[B Hossain, 2019; Singh KK, 2017; Sabiha Abbas, 2020 and Kahyaoglu T, 2006]

Table 3 shows the chemical parameter of Beetroot crackers (BC) and was compared with the wheat flour crackers (WFC). The carbohydrate content of the WF was found to be more as compared to BC. It was observed that the protein content of the beetroot crackers was found to be 9.03%, which was higher as compared to WF that ranged from 4.57 ± 2.20 . Daily requirement of protein in men and women is 55-60 gms per day which is fulfilled by diet [RDA, 2010]. The fat content of WF ranged from 0.79 ± 0.06 and BC was 8.02 ± 0.02 . The beetroot cracker contained healthier oil than that of regular wheat flour crackers. The dietary fiber was found to be more in BC 6.16 ± 0.04 as it contained seed powder (sesame seed, flaxseed and pumpkin seed) which is rich source fiber. Moisture and ash contained in WFC was 10.66 ± 0.34 and 0.49 ± 0.07 respectively as compared to BC was 8.79 ± 0.3 and 5.66 ± 0.01 .

Table 3:- Chemical Parameters of Beetroot Crackers and Wheat flour crackers

| Parameters | Beetroot crackers (BC) | Wheat flour crackers (WFC) |
|------------------------|------------------------|----------------------------|
| Carbohydrates (%) | 68.5 | 77.98 |
| Protein (%) | 9.03 | 4.57 ± 2.20 |
| Total Fat (%) | 8.02 | 10.79 ± 0.06 |
| Total Ash (%) | 5.66 | 0.49 ± 0.07 |
| Moisture(%) | 8.79 | 10.66 ± 0.34 |
| Dietary fiber (100gms) | 6.16 | 0.51 ± 0.05 |

[Sachithra Mihiranie, 2017]

3.2. Physical properties

The physical properties (thickness, weight, puffiness and baking loss) of the four types of cracker are mentioned in Table 4. There was no significant difference observed in the weight of the crackers and the control group but the ratio increased as the incorporation of seed flour. However, there was a significant difference among the beetroot crackers and control group with respect to the thickness, puffiness and baking loss. High fat content may prevent the dough from rising during the proofing process, which may have contributed to the crackers' reduced puffiness. Due to the low moisture content of seed powders (sesame, flax, and pumpkin seed) and beetroot powder, baking loss in crackers was found to be lower. Due to the low moisture level present and the extended product shelf life, baking loss is a great indicator of the quality of crackers.

Table 4:- Physical properties of Beetroot crackers

| Sample | Weight | Thickness | Puffiness | Baking loss (%) |
|--------|--------|-----------|-----------|-----------------|
| T0 | 6.3 | 0.72 | 6.43 | 2.2 |
| T1 | 6.0 | 0.41 | 2.68 | 1.0 |
| T2 | 6.2 | 0.57 | 3.22 | 1.8 |
| T3 | 6.4 | 0.66 | 3.96 | 2.0 |

3.3. Sensory Characteristics of Beetroot crackers

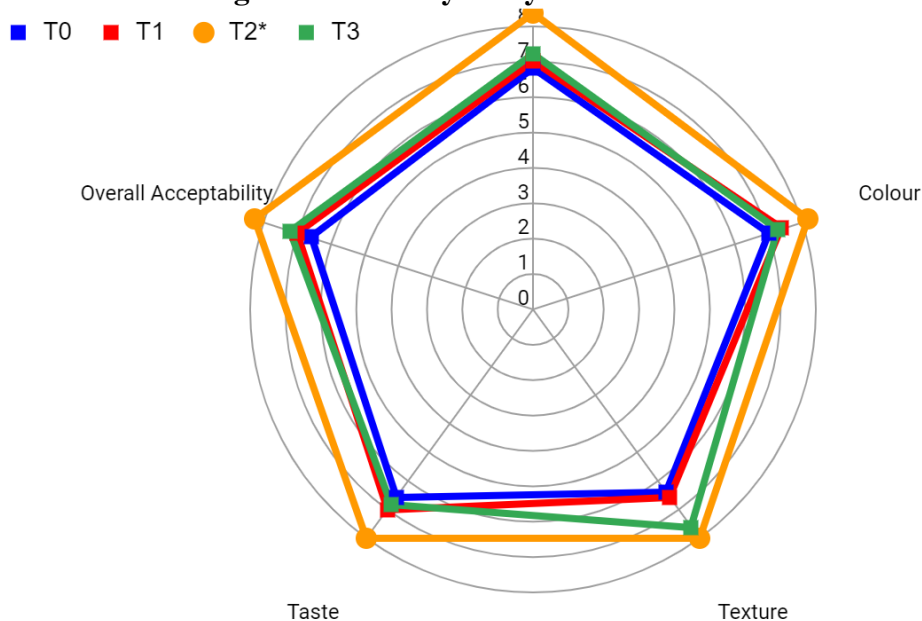
The result of the sensory analysis was based on the taste, texture, color, appearance and overall acceptability presented in Figure 3 and Table 5. It was showed, that crackers with only wheat flour (T0) had low rank for all the attributes indicating the preference was low. There was no significant difference among the T1 and T3 crackers with regard to the appearance, overall acceptability, taste and color. Hard texture was observed by the panelist with the ratio of 1:1:1:1 used in the T1 cracker. The texture of the T0 and T1 sample was almost similar

and was least preferred by the panelist. However the T3 sample showed significant difference in the terms of texture as compared to T0 and T1 sample. T2 was the highest preferred sample with all the attributes approved and ranked by the panelist. The significant difference was observed in the T2 sample and other samples. The best and most liked beetroot cracker with the highest overall acceptability was T2 with rating of 8.3.

Table 5:- Sensory Analysis of Beetroot crackers

| Sensory parameters | T0 | T1 | T2 | T3 |
|-----------------------|-----|-----|-----|-----|
| Appearance | 6.8 | 7 | 8.4 | 7.2 |
| Colour | 7 | 7.4 | 8.2 | 7.3 |
| Texture | 6.4 | 6.6 | 8 | 7.6 |
| Taste | 6.6 | 7 | 8 | 6.8 |
| Overall Acceptability | 6.6 | 7 | 8.3 | 7.2 |

Figure 4:- Sensory analysis of Beetroot crackers



3.3.1. Color analysis

The color measurement of the crackers were affected by different levels of the composition of Beetroot powder and seeds flour (pumpkin seed, flax seed and sesame seed). The red or pink color of the crackers was obtained from the addition of beetroot powder. The darkness of the crackers was observed due to the increased proportion of the beetroot powder in the crackers. The reduction in the color indicated the decreased proportion of beetroot powder in the crackers.

The protein content in the beetroot powder and the seed powder is negatively correlated with the color of the crackers.

3.3.2. Texture analysis

The texture of the beetroot crackers with addition of seeds flour (pumpkin seed, sesame seed and flaxseed) and wheat flour differ significantly in all samples. The crackers have a crispy texture but less dry because of the moisture content present in the crackers. Due to its high water content, crackers porosity is reduced while frying as a result of this, which decreases the quality of the crackers, specifically their crispness [Amirrah N I. 2018]. Since the most moisture is removed during baking, the crackers are light, crisp, and have a low moisture content. Crackers with higher fracturability break more quickly. [Jauharah M, 2014]. The decreased fracturability of crackers was seen in 1:1:1:1 ratio crackers (T1) because of more fat and moisture content and absence of corn flour. Corn starch helps to bind the crackers together. The crispy texture of the cracker was enhanced by the addition of corn flour, which was observed in T2 and T3 samples.

3.4. Mineral analysis

The iron content in the ordinary crackers is very less, which is increased by fortification or supplementation process. The Seeds are rich in iron content. The selected crackers mineral analysis are listed in the Table 6. The mixture of beetroot and the seeds flour increased the iron content to 20.5mg/100gms of product. When compared to crackers made with whole wheat flour, beetroot crackers were shown to have the highest levels of calcium (598.9mg) and potassium(538 mg) content.

Table 6:- Mineral Analysis of Beetroot crackers and Whole wheat flour crackers.

| Minerals | Beetroot crackers (T2) | Wheat flour crackers (T0) |
|-----------------------------|------------------------|---------------------------|
| Iron, Fe (mg/100 gms) | 20.5 | 3.08 |
| Calcium, Ca (mg/100 grams) | 598.9 | 50 |
| Potassium, K (mg/100 gram) | 538 | 297 |

3.5. Microbiological analysis

The microbial analysis results of the crackers are listed in the table below. According to the test results of the microbial evaluation, the data showed that the total plate count and yeast and mold were found to be <10. However, the variations were within the tolerable limits. The carbohydrate and the sugar present in the flour act as food and growing medium for the microbes. The increase in TPC may be attributed to increase in moisture content during storage [Frazier,1988]. The absence of yeast, mold and coliform bacteria is an indication of good handling of food products [Eczema, 2007].

Table 7:- Results of the Microbial properties of Beetroot crackers.

| Parameter | T0 | T1 | T2 | T3 |
|----------------|-----|-----|-----|-----|
| TPC | <10 | <10 | <10 | <10 |
| Yeast and mold | <10 | <10 | <10 | <10 |

4. Conclusion

According to the data presented by this study, the beetroot crackers were nutritionally rich as compared with normal wheat flour crackers. It could be concluded that among different formulations of beetroot powder, sesame seed, flax seed, pumpkinseed, wheat flour and corn flour the most approved formulation was T2. The T2 formulation of beetroot crackers contained 9.03 % protein, 68.50 % carbohydrates, 8.02 %fat, 20.5 mg Iron, 5.66 %ash, 6.16gm dietary fiber, 598.9 mg of potassium, 538 mg of calcium and delivers up to 382.3 K/Cal of energy. The ingredients were chosen wisely in the beetroot crackers to provide enough energy, high protein, high fiber and minerals like iron, calcium and potassium. The beetroot crackers can be consumed by normal individuals and even diabetic, weight loss and hormonal patients. The beetroot crackers can be the excellent healthier alternative and can be the best substitution for high fat crackers.

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