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Preparation and characterization of beetroot fortified cheese crackers to enhance nutritional benefits

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Abstract
The beetroot cheese crackers were prepared to enhance the nutritional benefits. Crackers were incorporated with beetroot (Beta vulgaris) which is a good source of protein, dietary fibre, vitamins and minerals. Betalains are water-soluble nitrogen-containing pigments, found in high concentrations in beetroot. Betalain exhibits anti-inflammatory, antiradical and antioxidant activity (Gentile *et al*., 2004). Beetroot has been advocated as a material with cancer preventive properties and providing way to booster immune system (Rasic *et al*. 1984). Different cracker formulations with varying levels of beetroot were produced & subjected to sensory evaluation using attributes such as taste, texture, flavour, and overall acceptability on a 9 point hedonic scale. Formulation with sample E, scored high with a mean score of 7.5, 7.5, 7.4, and 7.5 was obtained correspondingly for taste, texture, flavour, and overall acceptability. Scores for these attributes indicated that the crackers were acceptable. Proximate analysis for moisture, fat, protein, carbohydrate, ash content was carried out.

Keywords: cheese, crackers**,** beetroot, sensory evaluation

Introduction
Bakery products such as bread, cookies, cakes, biscuits, crackers have long history of development. The global market for Bakery products is projected to exceed US$570 billion by 2024, driven by the surging popularity of healthy and all natural baked goods by extending the consumption of it. (Global Bakery Stastical Report 2017) Bakery industry in India is considered as one of the major food processing industry with an annual demand of over 2758 MT.

Crackers are thin, crisp biscuits or wafers made from unleavened and unsweetened dough. These are hard baked products made from flour and a small amount of moisture. These are versatile convenience foods. Crackers are usually served as snacks, light meal accompaniments, appetizers. Now day consumers are more interested in food products that are made from healthier ingredients. Crackers are often branded as nutritious and convenient way to consume a staple food or cereal grain. A precedent for the modern crackers can be found in nautical ship biscuit, military hardtack and sacramental bread. Ancestors of the crackers can be found in ancient flatbreads, such as lavash, pita, matzo, flatbread, and crisp bread. Asian analogues include papadum and senbei.

Efforts for enhancing nutritional value of cheese crackers as an introduction of vegetable i.e. beetroot in cracker recipe will continue to receive significant attention. Beetroot is a good source of dietary fibre, important vitamins and minerals. It is rich in carbohydrates and betalaine (Kanner *et al*. 2001) [8]. Beetroot has been advocated as a material with cancer preventative properties and providing a way to booster immune system (Rasic *et al*. 1984) [13]. Specific anti-carcinogens are bound to the red coloring matter of beetroot, helping in fighting against cancer (Edenharder *et al*. 1994; Kapadia *et al*. 1996) [9]. Beetroot juice contains a high level of biologically accessible antioxidants (Wootton-Beard *et al*. 2011) [14, 15] as well as many other health promoting compounds such as potassium, magnesium, folic acid, iron, zinc, calcium and phosphorus. It is also rich source of a number of polyphenolic compounds (Kaur and Kapoor 2002; Pitalua *et al*. 2010) [10, 12].

Betalains are reported to have some antioxidant activity and are found to be effective in inhibiting lipid peroxidation. Thus it is suggested that red beet products consumed regularly in the diet may provide protection against certain oxidative stress-related disorders in humans and also improve digestion and blood quality (Kanner *et al*. 2001 [8]; Butera *et al*. 2002; Herbach *et al*. 2004; Azeredo. 2009) [6, 1]. The characteristic color of beetroot is due to pigment called betalain, a class of betalamic acid derivatives which are composed of betacyanins and betaxanthins (Pitalua *et al*. 2010) [12]. The consumption of beetroot which are rich source in anti-oxidants can contribute to protection from age-related diseases. Anti-oxidant activity in beetroot also helps in scavenging of free radicals and consequently in the prevention of diseases like cancer, cardiovascular diseases etc. (Delgado-Vargas *et al*. 2000) [2]. According to Gentile *et al*. (2004) [3] betalain exhibits anti-inflammatory, antiradical and antioxidant activity. Kujala *et al*. (2002) [11], in addition to betalains, both the roots and the peels of beetroot contain phenolic compounds, such as ferulic acid, phenolic amides, and flavonoids.

Materials and Methods
The refined wheat flour, cheese, grated beetroot pulp were the major ingredients required for the preparation of beetroot cheese crackers and other ingredients used included vegetable oil, sugar, salt, yeast, black pepper, chat masala obtained from the local market of Pune city.

The various instruments and chemicals required are obtained from the Department of Food Science and Technology, MIT College of Food Technology, Pune. Different formulations with beetroot pulp variations were prepared as shown in table 2.

Table 1: Formulation for Beetroot cheese cracker

Sr. No	Material	Control (%)	Sample A (%)	Sample B (%)	Sample C (%)	Sample D (%)	Sample E (%)
1	Refined wheat flour	70	70	70	70	70	70
2	Beetroot pulp	0	15	20	25	30	35
3	Vegetable oil	25	25	25	25	25	25
4	Cheese	5	5	5	5	5	5
5	Sugar	2	2	2	2	2	2
6	Salt	2	2	2	2	2	2
7	Yeast	2	2	2	2	2	2
8	Black Pepper	1	1	1	1	1	1
9	Chat masala seasoning	2	2	2	2	2	2

Procedure for Preparation of Beetroot Cheese Crackers

All the ingredients were weighed according to the formulation. Mix refined wheat flour, oil, dissolved yeast & other ingredients to form a dough of firm consistency. The dough is rest for 60 min in refrigerator. After resting period dough is rolled to uniform thickness of 1.5 – 2.0 mm and crackers were cut through round cutter. Then crackers were baked at 180°C for 10 to 15 minutes, cooled to room temperature and packed in high density polyethylene bags.

Take good quality of refined wheat flour, sugar.
↓
Weighing and sieving
↓
Addition of vegetable oil, yeast dissolved in water
↓
Addition of Beetroot pulp, cheese, salt, black pepper powder
↓
Mixing and Kneading
↓
Resting time for 45-60 minute in refrigerator.
↓
Rolling and Cutting
↓
Preheating of oven
↓
Baking at 150-180 ◦C for 10-15 min.
↓
Cooling
↓
Packaging and Labelling
↓
Storage

Fig 1: Process Flow chart of Preparation of Beetroot Cheese Crackers

Proximate Analysis

Chemical constituents like moisture, protein, fat, and ash content of beetroot cheese cracker were determined by AOAC, (2003).

Sensory Evaluation

Sensory evaluation of crackers for color, taste, flavor, texture, appearance, and overall acceptability were carried out using 9-point hedonic scale with semi-trained panelists. Sensory attributes were rated on a scale of 1 (dislike extremely) – 9 (like extremely)

Results and Discussion

Proximate Analysis

The proximate analysis of beetroot cheese crackers are listed in table 3. The beetroot cracker was analyzed for physicochemical properties viz., moisture, fat, protein, carbohydrate and ash content were determined and the results are summarized in Table 3. The data revealed that addition of beetroot pulp in crackers resulted in decrease in various parameters, the percent moisture, carbohydrate, ash, fat & protein.

Table 2: Proximate analysis of Beetroot Cheese Crackers Samples

Sr. No	Parameters	Control	Sample A (%)	Sample B (%)	Sample C (%)	Sample D (%)	Sample E (%)
1	Moisture Content	4.1	4.3	4.2	3.9	3.5	3.0
2	Carbohydrate	48.6	49.3	50.1	51.6	52.7	52.9
3	Fat	31.1	32.1	31.4	27.6	25.7	23.2
4	Protein	6.8	6.9	7.1	8.2	8.9	9.3
5	Ash	0.50	0.53	0.49	0.43	0.40	0.37
6	Crude Fibre	0.5	0.6	0.8	1.3	1.7	2.3

Sensory Evaluation

Table 3 presents the mean ratings for the attributes assessed in the sensory evaluation. The results show variations in the formulations as far as these attributes are concerned.

Taste

It is clearly observed that the taste of beetroot cheese cracker was significantly affected by addition of beetroot pulp. The sample E obtained highest sensory score (7.3) among all the samples whereas the sample A,B,C and D showed more score than control sample.

Flavor

The flavour of beetroot cheese cracker was at par with control sample up to 15% beetroot pulp addition level. Higher level of beetroot pulp increases the flavor of cracker.

Texture

The texture of product was greatly improved with progressive increase in beetroot pulp. The sample showed maximum at 15% beetroot pulp addition level. However higher level of beetroot pulp had no adverse effect on the texture. The improvement in textural qualities of cracker can be attributed

to fibre & starch molecule interaction providing firmness to the matrix. (Karad V.A *et al.* 2016) [16].

Table 3: Average score for Beetroot cheese cracker samples

Sensory attributes of samples	Colour	Taste	Flavour	Texture	Appearance	Overall acceptability
Control	6.9	7.0	6.0	**7.5**	**7.0**	**7.0**
Sample A	7.1	7.3	6.0	7.5	7.1	7.2
Sample B	7.1	7.3	6.5	7.5	7.0	7.1
Sample C	7.2	7.3	7.1	7.5	7.3	7.3
Sample D	7.3	7.4	7.2	7.5	7.4	7.4
Sample E	7.4	7.5	7.4	7.5	7.5	7.5
GM	7.12	7.28	6.68	7.47	7.18	7.22
S.E.	0.040	0.033	0.033	0.030	0.033	0.033
C.D. @ 5%	0.12	0.10	0.10	NS	0.10	0.10
C.D.@1%	0.17	0.14	0.14	NS	0.14	0.14
CV (%)	0.99	0.79	0.86	0.70	0.80	0.80

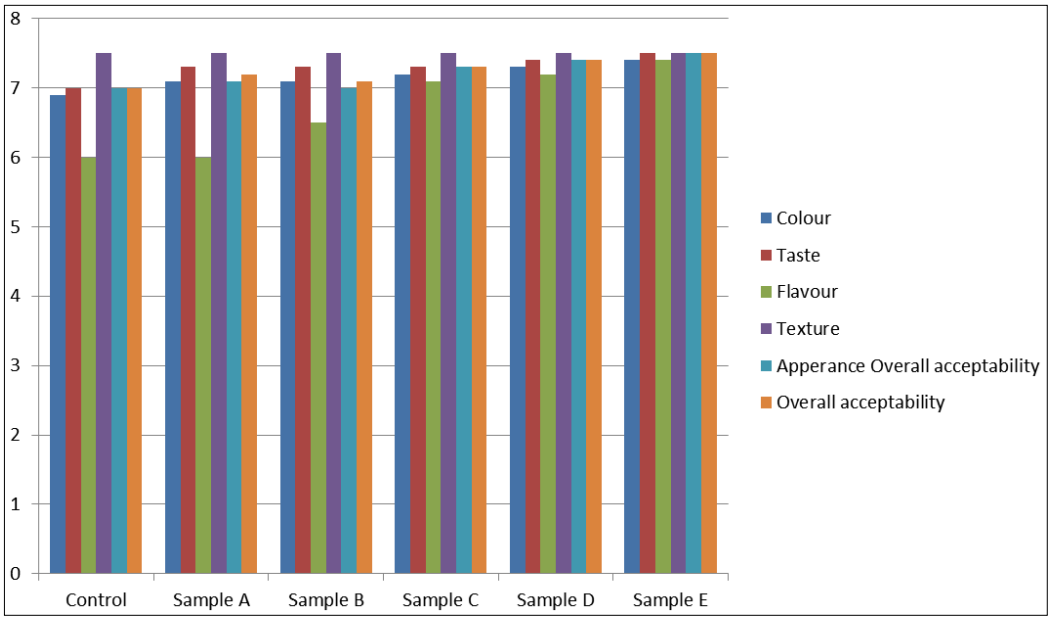

Fig 1: Sensory evaluation parameters for Beetroot cheese cracker samples

Conclusion

It may be concluded that good quality cheese crackers with beetroot pulp incorporation can be prepared by addition of refined flour: Beetroot pulp in proportion of 70:20. Overall acceptance of sample A in all the parameters. was highest among In the present study, our aim is concerned Beetroot due to its taste, consumed less frequently. So by incorporating it into cheese crackers make it a healthier snack. Beetroot is a good source of protein, dietary fibre, important vitamins and minerals. It is rich in carbohydrates and betalaine which exhibit exhibits anti-inflammatory, antiradical and antioxidant activity. Thus, beetroot crackers find new avenue for consumption of healthy snacks.

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