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Studies of formulation and quality evaluation of chia sedds, flax seeds incorporated with quinoa crackers

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Abstract
Recently Consumer demand has increased for healthy snacks. Crackers include high potential to enhance the nutritional value by incorporating natural ingredients. The natural ingredients in cludes finger millets due to rich source of calcium, flax seeds rich source of carbohydrates, chia seeds and quinoa rich in protein. The formulation of quinoa crackers were made by varying levels of ingredients by 3 trials T1, T2 and T3. Among the trials T2 was selected by highest score with following proportion of refined wheat flour, finger millet, quinoa, chia seeds, and flax seeds as 15:35:15:03:22. The Process for Quinoa Crackers begins by grinding Quinoa Seeds, Finger millet. After roasting Chia Seeds and Flax Seeds are grinded. All the flour mixed by adding salt and required spices. After mixing dough was prepared and rolled into thin sheet by cutting with molder and baked at 150^0c for 20 min. Proximate composition of Incorporated Quinoa Crackers were Moisture content (4%), Ash (6.2%), Fat (7.66%), Protein (30.62%), Carbohydrate (55.52%) and Energy value (413.5Kcal) were best among all the levels Incorporated Quinoa Crackers prepared recorded highest score in all the quality attributes with highest source of protein. It was concluded that the Incorporated Quinoa Crackers can be stored in HDPE for 2 months at room temperature. So the Incorporated Quinoa Crackers can be satisfy the consumer in accepts and quality.

Keywords: Quinoa, chia, Formulation, Crackers, Proximate analysis, HDPE, Storage study

Introduction
A cracker is a baked food typically made from flour. Flavoring or seasoning, such as salt, herbs, seeds or cheese, may be added to the dough or sprinkled on top before baking. Crackers are often branded as a nutritious as a nutritious and convenient way to staple food or cereal grain. Crackers can be eaten on their own but can also accompany other food items, such as cheese or meat slices; dips slices; or soft spreads such as jam, butter or peanut butter. Bland or mild crackers are sometimes used as a palate cleanser in food product testing or flavor testing, between samples. A precedent for the modern cracker can be found in nautical ship biscuits, military hardtack and sacramental bread. The holes in crackers are called “docking” holes. The holes are placed in dough to stop overly large air pockets from forming in the crackers while baking. Crackers come in size, shapes and sizes – round, square, and triangles. In American English, the name “crackers” is most often applied to flat biscuits with a savory, salty flavor in distinction from “cookie”, which may be similar to a “crackers” in appearance manner in which they are made. Crackers may be further distinguished from cookies by the manner in which they are made. Crackers are merely made by layering dough and cookies may be made in many of the same manners a cake would be prepared. Crackers sometimes have cheese or spices as ingredients or even chicken stock. Crackers are typically salted flour products.

Finger millet is commonly known as Ragi (*Eleusine Corcana*). It is annual herbaceous plant. It originated from East Africa. It belongs to *Poaceae* family. It grows in tropical and arid climate. It has polygonal rhombic shape. It is small in size, varying diameter (1-2mm). Its colour shades ranging from red to almost black. Finger millet contains moisture (12%), protein (4.9-11.3%), fat (1.3-1.8%), carbohydrates (72%). It also contains Vitamins like thymine (0.42mg), riboflavin (0.19mg), niacin (1.1mg), minerals (2.7gm). (Shobana *et.al.* 2013) [16].

The interest in finger millet due to its health benefits namely, hypoglycemic characteristics and also antimicrobial and antioxidant activities of its polyphenols have been growing. Evidence has long shown that patients with diabetes tolerate finger millet better than rice and that there blood sugar levels are lower. Ragi is an ideal food for the obese because its digestion is slow due to which the carbohydrates take a longer time to get absorbed. By eating preparations made from Ragi, the constant desired to eat is curbed, thus reducing calorie intake. At the same time it supplies and abundant quantity of calcium, phosphorus, iron, vitamin B1 and B2 and prevents malnutrition in restricted food intake. Phytochemicals found in Finger millets are trypsin inhibitor, hemagglutinin, goitrogenic agents, cyanogronic glycosides, alkaloids, tannins, phytates and saponins. (Patel *et al.*, 2016) [14].

Flax seed is commonly known as Linseed (*Linumusitatissimmum*), popularly known as Alsi, Jawas in india. It is a blue flowering Rabi crop and member of family *Linaceae*. The Sphercial fruit capsules contain two seeds in each of five compartments. The seed is flat and oval with a pointed tip. It has smooth glossy surface. It varies in colour dark brown to yellow. Texture of flax seed is crispy and

chewy possessing a pleasant nutty taste. Flax seeds is rich in fat, protein, dietary fibre. It contains moisture (7.7%), fat (41%), protein (20%), and total dietary fibre (28%). (Ganorkar and Jain, 2013) [4].

Phytochemicals found in flax seed are steroids, terpenoids, tannin, saponin, phenols, flavonoids, glycosides and emodins. (Hanna *et al*., 2017) [5].

The antioxidant activity of the flax seed has been shown to reduce total cholesterol as well as platelet aggregation. (Soni*et. al.*, 2016)

Flax seed encompasses the potential health suiting nutritional profile in it. However, many people are still unaware of the potential health benefits of flax seeds and food applications. Omega-3-fatty acids, dietary fibre and lignin content attract food technologists to explore its abilities at fullest extent in commercial food processing sector. Flax seed is emerging as one of the nutritive and functional ingredient in food products. Scientific findings are growing in support of flax seed consumption. (Ganorkar and jain, 2013) [4].

Quinoa (*Chenopodium quinoa Willd*) has been reported to be a potential crop for food and nutrition security. It is an ancient and native food crop for the Andeans people in South Africa. Quinoa is a pseudocereal belonging to the *Chenopodiceae* family. Based on colour unprocessed quinoa seed colour varies from white, black to red. It hasbeen referred to as mother crop due to nutritional potential.Quinoa is rich in carbohydrates and protein. It contains carbohydrates (66-78%), protein (16.5%), fat (10%), fibre (3.8%), ash (3.5%). It also contains calcium, magnesium, potassium, iron, copper and zinc. (Zikankuba and James, 2017) [23].

Phytochemicals such as phenolic compounds, terpenoids, betanins, carotenoids. Bioactive phytochemicals of quinoa are found mainly in the outer layers of seeds. (Tang and Tsao, 2017) [20].

Chia (*Salvia hispanica*) seed is an annual herbaceous plant belonging to the*lamaceae* family. It was one of the basic foods of several Central American civilizations. Seeds are mainly consumed in mexicoand the south western United States. The chia seed contains protein (15-25%), fats (30-33%), carbohydrates (26-41%), dietaryfibres (18-30%) and ash (4-5%). (Maira *et al*.,2014) [11]. Chia seeds are also a source of vitamin B, calcium, phosphorous, potassium, zinc and copper. It contains natural antioxidants such as chlorogenic acid, caffeic acid and flavanol glycoside. (Jean *et al.*, 2009) [7].

Snack food consumption has increased as a result of urbanization and modernization. However, most of the snacks contain high amount of fats, sugar, salt and least amount of dietary fibre which can cause health problems. Due to this, the consumer demand of healthy snacks is increasing. Therefore, snack crackers can be considered as one of the most desirable snacks due to their good eating quality and superior nutritional properties. (Mihiranie *et al.*, 2017) [13].

Recently consumer demand has increased for healthy snacks. Snack crackers are popular as healthy snacks and there is a high potential to enhance the nutritional value by incorporating natural ingredient. In the present study, the nutritional content of the snack crackers was improved by using quinoa seeds, finger millet, flax seeds.

Material & Methods

Procurement of Raw Material

Raw materials required during present investigation were procured from local market of Saralgaon such as finger millet, flax seeds, chia seeds, quinoa etc.

Physical Properties of Crackers incorporated with quinoa Seed

The colour of Crackers incorporated with quinoa Seed was determined by visual observations, the length, breadth and width of Crackers incorporated with quinoa Seed was measured by vernier caliper. The weight of Crackers incorporated with quinoa Seed was measured on analytical weighing balance.

Chemical Properties of ingredients and Incorporated Quinoa crackers

Proximate composition such as moisture, ash, crude fat, crude protein and crude fiber of all the Ingredients and Crackers incorporated with quinoa Seed was determined according to the procedures given in AOAC (2000). For moisture determination samples were dried in oven at 130ºC for 60 minutes. For ash determination samples were placed in muffled furnace at 550ºC to burn out all carbon compounds leaving in organic part (ash). Fat was determined by fat extraction unit by using n. Hexane. For fiber determination, samples were treated with 1.25% Sulphuric acid and Sodium Hydroxide solution. After filtration of digested material it was washed with hot water and then ignited. By calculating loss of weight after ignition, crude fiber contents were determined. Protein contents were determined by using Kjeldahls unit.

Sensory Evaluation Incorporated Quinoa crackers

Prepared product were evaluated for sensory characteristics in terms of appearance, color, flavor, aftertaste, texture and overall acceptability by 10 semi-trained panel members comprised of academic staff members using 9- point Hedonic scale. Judgments were made through rating the product on a 9 point Hedonic scale with corresponding descriptive terms ranging from 9 ‘like extremely’ to 1 ‘dislike extremely’. The obtained results were recorded in sensory score card.

Statistical Analysis

The analysis of variance of the data obtained was done by using completely randomized design (CRD) for different treatments as per the method given by Panse and Sukhatme (1967). The analysis of variance revealed at significance of $p<0.005$ level S.E and C.D. at 5 percent level is mentioned wherever required.

Formulation of Incorporated Quinoa crackers

Crackers prepared with incorporation varying levels of quinoa seeds, chia seeds, flax seeds and finger millet powder were investigated. The formulation was made by varying levels of refined wheat flour, quinoa seeds, flax seeds and finger millet *viz.*, 90:00:00:00, 10:25:15:33, 15:15:22:35 and 20:10:20:39 percent respectively and data given are illustrated in table. Sample T2 of crackers were organoleptic ally acceptable and used for further study

Table 1: Formulation for preparation of Incorporated Quinoa Crackers

Ingredients	Treatments			
	T0	T1	T2	T3
Refined Wheat Flour Finger Millet Flour	90 g 00 g	10 g 33 g	15 g 35 g	19 g 39 g
Quinoa Seed Flour	00 g	25 g	15 g	10 g
Chia Seed Flour	00 g	7 g	3 g	2 g
Flax Seed Flour	00 g	15 g	22 g	20 g
Edible common salt	2 g	2 g	2 g	2 g
Edible oil	2 g	2 g	2 g	2 g
Spices	6 g	6 g	6 g	6 g
Water	60 ml	60 ml	60 ml	60 ml

Where**,**
T0-90 g Refined wheat flour+00 g Quinoa flour + 00 g Flax seed flour + 00 g Finger millet flour.
T1-10 g Refined wheat flour + 25 g Quinoa flour + 15 g Flax seed flour + 33 g Finger millet flour
T2-15 g refined wheat flour + 15 g Quinoa flour + 22 g Flax seed flour + 35 g Finger millet flour.
T3-20 g refined wheat flour + 10 g Quinoa flour + 20 g Flax seed flour + 39 g Finger millet flour

Preparation of crackers
Quinoa seeds, chia seeds, flax seeds and finger millet flours were mixed with different variation as per table 1 with other ingredients such as chilli powder, edible common salt, ginger and garlic paste and edible oil. Then dough is kneaded with addition of water and rolled into thin shit with giving its shape. The detail procedure used for preparation of crackers is presented below in flow sheet 3 as per method given by Murtuza *et al.,* (2016)

Flow sheet for Preparation of Crackers

Collect the flour
(Finger millet flour, Chia seeds flour, Flaxseeds flour, Quinoa flour)
↓
Mixing
↓
Addition of spices (2-3gm)
↓
Preparation of dough
↓
Rolling into thin sheet
↓
Moulding
↓
Baking (150^0 C for 20 min)
↓
Cooling
↓
Storage

Result and Discussion

Physical Properties of Quinoa Crackers

Table 2: Physical Properties of Quinoa Crackers

Sr. no.	Parameter	Observation
1	Colour	Brown
2	Shape	Square
3	Length	2.5cm
4	Breadth	2.5 cm
5	Width	0.2 cm
6	Weight	2.02 gm

Colour of quinoa crackers was Brown which was determined by visual Observation. The shape was square with length and breadth of crackers 2.5cm with width 0.2 cm. The weight of 1 cracker was 2.02 gm.

Chemical Properties of Quinoa Crackers

Table 3: Chemical Properties of Quinoa Crackers

Parameters	Sample T2 (%)
Ash	6.2%
Moisture	4%
Fat	7.66%
Protein	30.62%
Carbohydrate	55.52%
Energy Value	413.5Kcal

It concludes that Ash value of Quinoa Crackers was found to be 6.2%, Moisture content 4%, Fat content 7.66 %, Protein content 30.62%, Carbohydrate content 55.52% and Energy value 413.5Kcal.respectively.it concluded that crackers rich in Protein.

Sensory Evaluation

Table 4: Sensory Evaluation of Quinoa Crackers

Sample	Colour	Flavour	Texture	Appearance	Taste	Overall Acceptability
Control	9	9	8.5	8	9	9
T1	7	8	7	7	7	7
T2	9	9	9	8	9	9
T3	7	7	7	8	7	7

It was concluded that sample T2 has highest score as compared to other samples. The color of T2 sample as per graph is 9 point while sample T0 (9), T1 (7), T3 (7). The flavour of sample T2 was acceptable with 9 point while samples T0 (9), T1 (8), T3 (7). The texture of sample T2 was selected by 9 points while other samples points are T0 (8.5), T1 (7), T3 (7). The appearance of sample T2 was selected by 8 points while other samples points are T0 (8), T1 (7), T3 (8). The taste of sample T2 was selected by 9 points while other samples T0 (9), T1 (7), T3 (7). The overall acceptability of sample T2 was selected by 9 points while other samples points are T0 (9), T1 (7), T3 (7).

Conclusion

It was evidenced that the formulation and standardization of recipe for Quinoa Crackers was carried out successfully prepared by using quinoa and other ingredients. The health benefit of quinoa and other ingredient are well known so the

product is having enrichment. Hence, the product can satisfy the consumer in accepts and quality.

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