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Research Article

Studies on the Development of High Nutritional Biscuits from Composite Flour

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Abstract

The present project was done on study on development of nutritional biscuits from composite flour in which quinoa, wheat gram, and semolina, garden cress seeds opium seeds were used as main ingredients and Bengal gram and Green gram used as composite flour. Protein content of biscuits increased as the level of the pulse flours increased. Protein supplements are popular nutritional supplements consumed primarily by physically active individuals with increased protein demands.

The high protein biscuit is evaluated by test, colour, odour, texture, taste and identification test for protein. The nutritionally enrich biscuit was prepared from various ingredient and evaluation test such as sensory evaluation of Biscuits The sensory evaluation were carried out of high protein biscuits data with respect to colour, appearance, taste, texture, moisture content, soaking time. Biscuits are made from a number of ingredients. Flour is the most basic and important. Different types give a range of textures and crispness. Whole meal wheat flour is used in the "digestive," "sweet meal," or "wheat-meal" type of biscuits

Keywords: Nutritional Biscuits; Quinoa; Wheat Flour; Semolina; Garden Cress Seeds; Chia Seed; Evaluation; Protein Rich

Introduction

The globalization scenario in new millennium year has increased the demand for bakery products along with ready to eat (RTE) foods due to change in economic consideration, Westernization, Urbanization, busy life and increased women employment. Today consumers have requested convenient, Ready-to-eat foods that fulfill their dietary needs and accommodate their busy schedules. Many people who are on special diet, either as result of a medical condition, or because they have elected to live a healthier lifestyle, spend a lot of time in meal planning and trying to locate foods they can eat. Multinational food industries, especially baking industries have responded well to the increased interest in nutrition and so they are developing products that meet the nutritional requirement and recommendation of the consumer. Consumption of bakery products per capita per annum in our country is has seen demand rise during the pandemic. Simona., *et al*. 2014 [1].

Biscuits are made from a number of ingredients. Flour is the most basic and important. Different types give a range of textures and crispness. Whole meal wheat flour is used in the "digestive," "sweet meal," or "wheat-meal" type of biscuits. Oatmeal forms the basis of oatmeal biscuits. Rice flour and corn flour add flavor. Fats give the biscuits their "shortness." Butter and lard are the main fats, though these are augmented by vegetable and other refined fats. For fancy biscuits, sugar is an important ingredient, and introduces

a range of tastes. It is added in several forms: processed as caster and Demerara sugars, syrups, honey, and malt extract. Long shelf-life of biscuits makes large scale production and distribution possible. Good eating quality makes biscuits attractive for protein fortification and other nutritional improvements. Development of fortified biscuits or other composite flour bakery products is the latest trend in bakery industry. The growing interest in these types of bakery products is due to their better nutritional properties and possibility of their use in feeding programs and in catastrophic situations such as starvation or earthquakes. Biscuits have a high energy content, ranging from 420 to 510 kcal per 100 g. The present work deals with Protein Enriched Biscuits here we introduce quinoa and pulses which make biscuits more nutritious and impart health benefits. Baljeet., *et al*. 2016 [2].

Quinoa belongs to the class Dicotyledoneae, family Chenopodiaceae, genus Chenopodium, and species the quinoa. Chenopodium quinoa Wild is a native to Andean region of South America. It belongs to the group of crops known as pseudo-cereals. The quinoa grains are considered as potentially gluten-free, has high protein content with abundance of essential amino acids such as lysine, threonine and methionine. This is a valuable source of protein for vegans, as its protein levels are similar to those found in milk and higher than those present in wheat, rice and maize. Nisar., *et al*. 2017 [3].

Semolina, also known as durum wheat semolina, is sometimes used in high-protein biscuit formulations for a few reasons: Why Semolina is Used:

- **High Protein Content:** Semolina has a relatively high protein content compared to regular wheat flour (around 12–14%), contributing to the overall protein content of the biscuit.
- **Texture and Crunch:** It gives a desirable coarse texture and a crisp bite, which is often preferred in high-protein or health-focused biscuits.
- **Binding and Structure:** The gluten-forming proteins in semolina help in binding and maintaining the structure of the biscuits, especially when combined with other high-protein ingredients like soy flour, whey protein, or chickpea flour. Semolina is utilized in high-protein biscuit formulations to enhance protein content and improve texture due to its high gluten content and coarse grain structure. Shukla, R. N., and Srivastava, S., *et al*. 2020 [7].

It does not contain gluten, so it can be eaten by people suffering from celiac disease. Furthermore, it is a good source of dietary fibre. The Incas credited quinoa with medicinal properties including lowering of blood cholesterol, improving glucose tolerance and reducing insulin requirements. Due to its excellent nutritional profile, it is considered as one of the most nutritious and super food. It is also rich in unsaturated fatty acids (linoleic and linolenic acids), in vitamins (folate and tocopherol), minerals (iron, copper, manganese, potassium) and other phytochemicals, phenolic acids, flavonoids with possible nutraceutical benefits (isoflavons and lipids). Besides nutrient compounds, it also contain anti nutrients (phytic acid, saponin and tannin) which mainly concentrated in the outer layer of the grai. Kavali., *et al*. 2020 [4].

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Garden cress seeds (*Lepidium sativum* L.) are loaded with nutrition. It is an important source of iron, folic acid, calcium, vitamins C, E and A. It is a rich source of iron 'containing 100 mg iron/100g. They are high in calories. It has about 454 kcal and 33 gram of carbohydrate per 100 gram with a protein content of 25.3 grams. It is often given postpartum to lactating mothers. It has low fat of 24.5 g, when compared with other nuts and oilseeds. It contain minerals like calcium, phosphorus. Talpade., *et al*. 2018 [5].

Bengal gram which is also known as chickpea (*Cicer arietinum*) is an annual legume of the family Fabaceae, subfamily Aboideau. Bengal gram is a protein-rich supplement, it is considered a popular alternative for animal or meat protein. Regular consumption of bengal gram helps in reducing protein malnutrition. It also helps

in lowering the cholesterol level in the bloodstream. Bengal gram is good for diabetic patients as it has a low glycemic index. The mung bean (*Vigna radiata*), alternatively known as the green gram is a plant species in the legume family. It is rich in high quality proteins and other essential nutrients. A 100 g serving of cooked moong dal can provide you with about 6 g protein. It also contains some amounts of vitamin E, C, and K. An integral part of the Indian diet; it is incredibly light and easy to digest. Bhosale., *et al*. 2021 [6].

Chia seeds are increasingly used in high-protein biscuit formulations due to their rich nutritional profile. Here's a breakdown of why they're included, followed by a sample reference-style statement: Why Chia Seeds Are Used in High-Protein Biscuits:

- **High Protein Content:** Chia seeds contain about 16–20% protein.
- **Rich in Omega-3 and Fiber:** They also add nutritional value through healthy fats and fiber, making the biscuits more functional.
- **Binding Properties:** When soaked, chia seeds form a gel-like consistency due to soluble fiber, helping in binding the dough without the need for eggs or synthetic binders.
- **Texture and Shelf Life:** They add a nutty flavor and slightly crunchy texture, and their antioxidant content may help improve shelf life. Sreeraj, R., and Leelavathi, K., *et al*. 2017 [8].

Sr. No	Ingredient	Protein (Per 200 gm)	Fat (Per 200 gm)	Carbohydrate es (Per 200 gm)	Fiber (Per 200 gm)	Minerals (Per 200 gm)
1.	Quinoa flour	8.2	6	39	4	Ca- 100 mg, Mg- 590 mg
2.	Wheat flour	12	2	140	6	Ca- 40 - 50 ml Iron- 5.4 mg
3.	Semolina	12	2.4	140	4	Zn- 2.2 - 2.8 ml Co- 0.28 mh
4.	Bengal gram	3	16	48	12	Fe- 8 - 99 mg Na-20 - 25 mg
5.	Green gram	20	6	60	10	Fe-13 - 14 mg Mg- 280 - 300 mg
6.	Opium seeds	14	2	40	12	Cu- 2 - 2.2 mg Na-20 - 25 ml
7.	Garden cress seed	24	40	60	24	Zn- 5 - 6 mg Cu- 0.9 - 1 mg
8.	Chia seed	20	40	88	34	Fe- 13 - 15 mg Cu-1.6 - 1.8 mg
9.	Sugar	-	-	-	199.8	Ca- 2 - 4 mg k- 2 - 3 ml
10.	Salt					Na-80000 mg Mg- 0.1 mg
11.	Butter	2	2	2	0	Cl-60-80 mg

Table 1: Nutritional value of ingredients.

Aim

Study on the development of high Protein nutritional biscuits from composite flour.

Objectives

- To formulate composite flour blends by combining wheat flour with protein-rich sources such as legumes (e.g., soy, chickpea), cereals (e.g., millet, quinoa), or seeds.
- To develop biscuit samples using varying proportions of composite flour blends.
- To analyse the nutritional composition of the developed biscuits, including protein, fat, carbohydrate, fibre, and moisture content.
- To evaluate the sensory attributes (taste, texture, colour, aroma, and overall acceptability) of the high-protein biscuits using a trained panel.
- To assess the functional properties of the composite flours such as water absorption capacity, bulk density, and dough handling characteristics.
- To compare the developed high-protein biscuits with conventional wheat-based biscuits in terms of nutritional and sensory quality.

Materials and Equipment

- Literature review on composite flour and high nutritional biscuits development.
- Selection of ingredient. (Wheat Flour, semolina, Green gram, Bengal gram, Quinoa, Garden cress seeds, Butter, Baking powder)
- Preparation of composite flour blends.
- Biscuits formulation and standardization (Recipe development.)
- Preparation of biscuits samples
- Provisional evaluation of prepared biscuits
- Taste

Sr. No	Ingredients	Address	Use
1	Quinoa flour	Siddheshwar Kirana store, Dharashiv	Anti- inflammatory
2	Refined Wheat flour	Siddheshwar Kirana store, Dharashiv	Source of nutrients
3	Semolina	Siddheshwar Kirana store, Dharashiv	Heart Health, Digestion
4	Bengal gram flour	Siddheshwar Kirana store, Dharashiv	Treating digestive problem
5	Green gram flour	Siddheshwar Kirana store, Dharashiv	Source of vitamin, Protein
6	Gaeden cress seeds	Siddheshwar Kirana store, Dharashiv	Functional food development
7	Opium seeds	Siddheshwar Kirana store, Dharashiv	Analgesic, Hypotonic
8	Chia seeds	Siddheshwar Kirana store, Dharashiv	Digestive health, Heart health
9	Sugar + Salt	Siddheshwar Kirana store, Dharashiv	Sweater
10	Butter	Siddheshwar Kirana store, Dharashiv	Flavor, Texture, Moisture
11	Baking soda + Baking Powder	Siddheshwar Kirana store, Dharashiv	Leavening agents

Table 2: List of raw Materials for biscuits preparation.

Sr. No	Equipment	Purpose
1	Dish	For combining
2	Weighing balance	For measure accurate quantity
3	Mixer grinder	For grinding the ingredients
4	Oven	For baking biscuits
5	Spoon	For taking ingredients

Table 3: List of instruments/equipment used for biscuit preparation.

Ingredients

Sr. No.	Ingredients
1	Quinoa flour
2	Wheat flour
3	Semolina
4	Bengal gram flour
5	Green gram flour
6	Garden cress seeds
7	Opium seeds
8	Chia seeds
9	Sugar Powder + Salt
10	Butter
11	Baking soda and Baking Powder

Table 4: Formulation of Biscuits.

Preparation of methods

Sr. No.	Ingredients	T1(gm)	T2(gm)	T3(gm)
1.	Quinoa	25	25	30
2.	Refined Wheat Flour	40	45	35
3.	Semolina	5	10	10
4.	Bengal gram	4	4	3
5.	Green gram	4	4	3
6.	Garden cress seeds	2	2	2
7.	Sugar + Salt	15+2	20+3	30 + 1
8.	Opium seeds	1	1	1
9.	Chia seeds	1	1	1
10.	Butter	95	86	82
11.	Baking powder and Baking soda	1	1	2

Table 5: Formula for nutritional biscuits.

By the third trial (T3), we finally managed to get the nutritional biscuits just right. Everything seemed to come together perfectly. the taste was well-balanced and enjoyable, and the appearance matched exactly what we had envisioned from the start. The bars had a nice, uniform shape with a clean finish, making them look much more appealing compared to the earlier versions. Texture-wise, they were neither too hard nor too dense, and they offered a pleasant bite with a satisfying mouthfeel. It was clear that the adjustments we made—whether in the ingredient proportions, mixing method, or baking time—had paid off. This trial felt like a real breakthrough, and the results were much more in line with what we were aiming for in terms of both flavor and overall quality.

Preparation

For preparation of High Protein biscuits, Quinoa, Bengal gram and green gram were grinded into a fine powder. Garden cress were roasted at 120 °C for 5 mins and then then grinded into fine powder. All these ingredients were then added with refined wheat flour, butter, sugar, salt, baking powder and baking soda and dough was prepared. These dough was then sheeted to desired height and biscuits were given shapes with the help of moulder which were then baked in an air circulation oven at 180 °C for 10 mins. The biscuits were cooled for 10 mins at room temperature and stored in low density plastic container.

Method

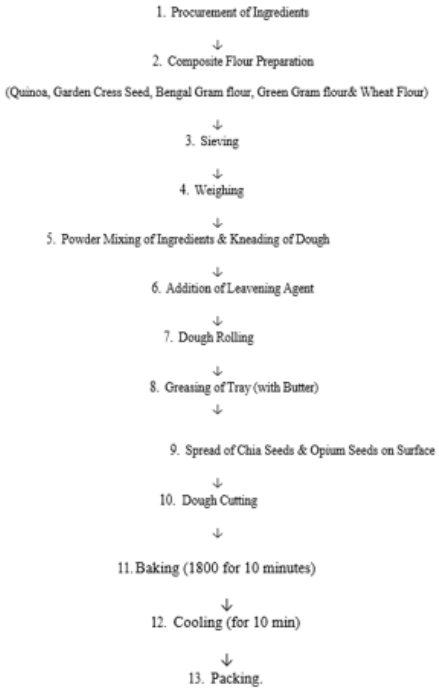

Figure 1: Nutritional Biscuits.

Evaluation test

Organoleptic evaluation of biscuits

Ten semi-trained panellists carried out a sensory evaluation of high nutritional biscuits and compared with the control samples. At the start the subjects described two very different biscuits (control and High protein biscuit) and mainly focused on the texture change. Then, the most frequently cited attributes were selected, and their definitions and the protocols scoring them were developed. Next, the panellists were given a score sheet to evaluate sensory attributes, namely, colour, taste, texture, flavour and overall acceptability.

Physical evaluation test

Physical parameters such as colour, appearance and consistency were checked.

- Appearance – Fresh Appealing
- Colour - Brownish
- Odour – Fresh Buttery
- Aroma Taste – Balance Slightly sweet
- Texture – Crispy, Slightly chewy

Soaking test

To determine the soaking time of biscuits in water 30-35 Seconds: For harder nutritional biscuits.

Moisture content test

Moisture Content: 8.2% Moisture content indicates the amount of water present in the bar. A value of 8.2% is relatively low, suggesting good shelf stability and less likelihood of microbial spoilage. Lower moisture also aids in maintaining the product's crispness and prevents sogginess.

Identification test for Proteins

Sample preparation

- Crush or grind the biscuit into a fine powder.
- Take about 2–5 grams of the powder and mix with distilled water or dilute NaOH solution.
- Heat gently to help dissolve the proteins and filter the mixture to get a clear filtrate for testing.

Common Identification Test for protein

Xanthoproteic Test (for aromatic amino acids) Reagents: Concentrated nitric acid and NaOH.

Procedure: 1. Add a few drops of conc. HNO□ to the extract and heat gently.

Cool and add NaOH.

Result: Yellow to orange colour indicates aromatic amino acids (e.g., tyrosine, tryptophan).

Ninhydrin Test (for free amino acids or protein hydrolysates) Reagent: Ninhydrin solution.

Procedure: Add a few drops and heat.

Result: Blue or purple colour indicates free amino acids or peptides.

Result

The nutritionally enrich biscuit was prepared from various ingredient and evaluation test such as sensory evaluation of Biscuits The sensory evaluation were carried out of high protein biscuits data with respect to colour, appearance, taste, texture, moisture content, soaking time.

Figure 2: Nutritional Biscuit.

Sr. No.	Evaluation Test	Result Obtained
1	Colour	Brownish
2	Appearance	Fresh Buttery Aroma
3	Taste	Balance Slightly sweet
4	Texture	Crispy, Slightly chewy
5	Moisture Content	8.2 %
6	Soaking Time	30-35 Seconds
7	Xanthoproteic Test	Present
8	Ninhydrin Test	Present

Table 6: Result of total evaluation of protein biscuits.

Discussion

Nutritional biscuits are becoming increasingly popular, especially among fitness enthusiasts, athletes, and people looking to increase their protein intake without sacrificing taste. Here's a breakdown for a good discussion on them.

Benefits

- **Muscle Maintenance and Growth:** Ideal for post-workout snacks or as part of a high-protein diet.
- **Satiety:** Protein increases feelings of fullness, which can aid in weight management.

Nutritional considerations

- **Calories:** While high in protein, some may also be high in calories due to added fats or sugars.
- **Sugar Content:** Some brands compensate for taste by adding sugars, which may reduce health benefits.
- **Fiber:** Many include whole grains or added fiber for digestive health.

Summary

The study focused on developing nutritional biscuits using composite flour, which combined wheat flour with protein-rich ingredients such as quinoa, refined wheat flour, bengal gram green gram. The objective was to enhance the nutritional value of traditional biscuits without compromising on taste, texture, and consumer acceptability.

Different formulations were tested to determine the optimal ratio of composite ingredients that would yield a desirable balance between protein content, sensory attributes, and physical properties of the biscuits. Key parameters evaluated included protein content, moisture content, spread ratio, texture (crispness and hardness), colour, and sensory evaluation (taste, aroma, appearance, and overall acceptability.

Conclusion

The development of nutritional biscuits using composite flour is a feasible and effective strategy to improve the nutritional profile of a popular snack item. By carefully optimizing the blend of flours, it is possible to produce biscuits that are not only rich in protein but also acceptable in terms of taste and texture.

The study concludes that composite flours can successfully be used in biscuit production to address protein-energy malnutrition, particularly in populations where protein intake is low. Further research could explore fortification with vitamins and minerals and investigate shelf- life stability under different storage conditions [9-27].

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