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## Nutritional gluten-free multigrain Khakhra using red rice, buckwheat and flaxseed: A review

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### Abstract

Nowadays snack food is playing a major priority in the food industry for new product growth, becoming one of the main food categories on the global health and wellness market. Snacks are of different types that can make the meal easily, attract buyers, less perishable, more durable and more versatile than the meal prepared. The current research was carried out to determine the sensory consistency and Khakhra nutrient material prepared with buckwheat and red rice inlaid. Khakhra is crunchy in nature, Khakhra cracker is something that is basically made in home. Khakhra is healthy snack, It is a common recipe in the Gujarat. Khakhra is prepared by using Buckwheat, Flaxseed and as it consist Red rice as a major provides a much more nutrition benefits in terms of protein, minerals, dietary fibers and carbohydrates in comparison with the commonly it is made up of wheat flour. Over consumption of wheat or its products are known for improper health condition such as celiac disorder may overcome by substituting it with buckwheat and red rice which is rich in several minerals and vitamin.

**Keywords:** Health, perishable, sensory, consistency, celiac

### 1. Introduction

Snack foods are playing an important role in the development in food industry as one of the major food groups on the world health and goodness merchandise. In general, a snack is a smaller portion of the food consume in between meals. Snacks are of various varieties that can make the food quickly, please buyers, less perishable, more durable and more versatile than the food prepared. Khakhra is one of the snack food that is very thin, crispy, crunchy, nutritious and flavoured snack usually served as a breakfast dish mostly in Gujrat and Rajasthan. It is a thin cracker popular in western India's Gujarati and Rajasthan cuisines, especially among the Jain community. Generally, snack foods is considered unhealthy and should be avoided but same can be made nutritious if enriched with addition of fruits, vegetables, pulses or cereals into it which not only solve health problems related to gluten allergy, obesity but at the same time provides sufficient energy and adds variety to the diet.

### 2. Importance of Multigrain Food Products

Multigrain food products are enriched with vitamins, minerals (sahoo *et al.*, 2010) <sup>[34]</sup> and fibers (Topping, 2007) <sup>[19]</sup>. Because of their optimal dietary fiber quality, they are often correlated with medicinal safety benefits such as maintaining gut wellbeing, bowel transferring, lower rate in plasma glucose and lower cholesterol level. Dietary fibers in multigrain goods help boost heart patients' safety because of their improved the binding nature of lipid belongs to a grain goods (Angioloni and Collar, 2011) <sup>[2]</sup>. Among participants who ate mixed cereal items relative to others, Odes *et al.* (1993) <sup>[35]</sup> and Dubois *et al.* (1993) <sup>[36]</sup> recorded a decrease among lipid rates.

Improving peoples diets and in effect their well-being is at the fore front of the political agenda in many countries around the world. This is seen as a means of solving the growing issues of overweight and obesity portrayed as an "obesity epidemic", and reducing the cost of health insurance (Patterson and Johnston, 2012) <sup>[37]</sup>. Extant research has been done to do this by rendering well-being the duty of the person (Petersen and Lupton, 1996; De Souza, 2011) <sup>[41, 39]</sup>. Today, this is considered "the modern age of public safety" (Petersen and Lupton, 1996). By following a personal care routine (Schneider and Davis, 2010; O' Neil and Silver, 2017) <sup>[43, 42]</sup> and by sticking into a socially healthy livelihood, health is what individuals gain

(Crawford, 2006) [38]. The growing emphasis on health has generated demand for products that have been advertised as healthy or associated with some form of well-being (Hudson, 2012) [44]. Today, in many sections of the world, the most rising nutritional trend is what is sold as “clean and nourishing food” (Griffith, 2018) [40]. Extruded foods are also called “Junk foods”, since they are usually fried with poor consistency. But their consumption, particularly in developed countries can lead to various metabolic problems by eating these fatty foods (Espinoza-Moreno *et al.*, 2016) [21]. Thus, the latest trend in the snack sector is to raise of healthy foods (Tumuluro, 2016) [46] using the introduction of active compounds such as proteins, dietary fibers and antioxidant compounds (Cortes *et al.*, 2014; Espinoza-Moreno *et al.*, 2016 [48, 21] and Chavez *et al.*, 2017) [47].

The vast majority of the cases multigrain items like snacks things are set up with or without wheat flour alongside different grains just as oilseeds, red rice and buckwheat are most consistently used grains in multigrain items to upgrade structure, flavour, texture, dietary assortment and purchaser worthiness over this time, the production of rice, wheat and maize has evolved continuously, and that of rice is the most notable follows with wheat. Conversely, the creation of different grains, Sorghum, millets, little millet, and coarse oats, for examples, are all either stable or deteriorated. Its grain production, as seen in Table 1.

**Table 1:** showing the production of grains in India from 2012 to 2017 (in MT)

Crop	2012-13	2013-14	2014-15	2015-16	2016-17
Rice	105.24	106.65	105.48	104.41	109.15
Wheat	93.51	95.85	86.53	92.29	97.44
Sorghum	5.28	5.54	5.45	4.24	4.74
Pearl millet	8.74	9.25	9.18	8.07	9.86
Maize	22.26	24.26	24.17	22.57	26.14
Finger millet	1.57	1.98	2.06	1.82	1.43
Small millets	0.44	0.43	0.39	0.39	0.44
Barley	1.75	1.83	1.61	1.44	1.79
Coarse cereals	40.04	43.29	42.86	38.52	44.39
Total	238.79	245.79	234.87	235.22	250.98

(Source: Agricultural Statistics Division, 2016-17)

### 3. Demand of Gluten-Free Products

The existence of gluten is important for preserving the gases released while cooking in order to achieve optimum growth / texture and volume in the material produced (Alvarez-Jubete *et al.*, 2009) [1]. Therefore gluten is responsible for the formation of crumbs and the appearance of cereal-dependent products. Given recent advances in the development of gluten-free goods with similar value, Total removal of gluten from cereal-based products such as pie, cereals for tea, noodles, cake and biscuits remains a major issue. At around 1% of the world inhabitants suffers from gluten allergy, demand for gluten-free goods is rising (Demirkesen *et al.*, 2010) [4]. Some people who struggle with gluten intolerance tend to limit foods involving gluten for their entire life. Though most gluten-free foods is created with gluten-free refined starches or flours, rice flour is a common cereal ingredient for producing gluten-free products, despite having a bland taste. Although rice typically includes a small amount of prolamin, appropriate substances including such gums, emulsifiers, and dairy products may be used to enhance the consistency or density of the plant.

### 3.1 Red rice

Rice is a notable crop consume as a main food by maximum portion of the total populace. Consumption of rice is exceptionally great in nations and Asian countries. About 94% of rice cultivation is done in Asian nations and about portion of the total populace expends it. Besides, India is probably the biggest nation as far as vitality utilization from horticulture and rice includes a significant piece of it as mentioned in Table 2 (Kennedy *et al.*, 2019) [31]. *Oryza sativa*, the most used rice species, is an individual from the *Poaceae* family. Generally, rice was developed mainly in the stream areas of South and Southeast Asia 10,000 years back (Gnanamanickam, 2009) [7] and its initial consumption was known to have started likely in India. Rice is a principal food in numerous social cooking styles far and wide. In view of the worldwide market situation regarding rice, the creation has expanded somewhat with years, utilization of rice as food stays prevalent contrasted with feed and different employments. The paddy (likewise, harsh rice or rice grain) comprises of the frame, an external defensive covering, and the natural product or rice caryopsis (earthy colored or dehusked rice) (Juliano and Bechtel, 1985) [10]. Rice fundamentally comprises of starches, proteins and little amounts of fat, debris, fiber and dampness. Nutrients and minerals are to a great extent limited to the grain and germ (Tangpinijkul, 2019) [32].

**Table 2:** Global Rice Production and Utilization (in MT) (FAO, 2017)

	2014-2015	2015-2016	2016-2017	2017-2018
Production	490.9	491.9	501.2	502.2
Supply	709.2	703.8	712.0	718.4
Utilization	494.3	492.5	497.9	503.5
Food use	397.2	395.6	400.9	406.7
Feed use	18	18.2	17.8	17.5
Other uses	79.2	78.7	79.2	79.4

The only two main species among 40,000 varieties of rice cultivated worldwide are cultivated widely - *Oryza sativa* or the Asian rice and *Oryza glaberrima* or the African rice. The varieties of colored rice are either semi-polished or unpolished as shown in Table 3. Red-shaded rice assortments are known to be rich in iron and zinc, while dark rice assortments are particularly high in protein, fat and unrefined fiber as mentioned in Table 4. Red and dark rice get their shading from anthocyanin colors, which are known to have free radical searching and cancer prevention agent limits, as well as other medical advantages (Rathna *et al.*, 2019) [27]. Phytochemicals found in rice are compound-containing carbohydrates, phenolics, alkaloids, phosphorus, and organosulphur. The textured cereal crops such as red and purple / black rice contain larger levels of pharmacological activities than non-pigmented forms. Anthocyanins are a main additive blamed for black and red rice color, they are a type of flavonoids. This color rice bran contains anthocyanins which have reductase enzyme inhibition and antidiabetic activity (Yawadia, 2007) [45]. Maapillai Samba, a kind of Tamil Nadu red rice, does have the highest average phenolic compounds and anthocyanin content than those of the Sri Lankan, Chinese red rice and north - east India black rice types as shown in Table 5.

**Table 3:** Nutrient content of rice varieties (FAO, 2004)

Type of Rice	Protein (g/100g)	Iron (mg/100g)	Zinc (mg/100g)	Fibre (g/100g)
White - polished	6.8	1.2	0.5	0.6
Brown	7.9	2.2	0.5	2.8
Red	7.0	5.5	3.3	2.0
Purple	8.3	3.9	2.2	1.4
Black	8.5	3.5	-	4.9

Red rice contains magnesium which prevents cardiac arrest risks. It has a high magnesium component compared to white rice which plays a crucial role in reducing blood pressure and body sodium control. This also has the capacity to promote balanced bowel development and aerobic activity. Anthocyanins found in red rice have properties which can help control weight by reducing allergies.

**Table 4:** Proximate composition of Red rice (Rathna *et al.*, 2019) [27]

Proximate composition	Value
Moisture	9.3 – 13.1
Protein	7.16 – 10.85 g
Fat	1.15 – 3.19 g
Crude fibre	0.28 – 0.61 g
Crude ash	0.82 ± 1.5 g
Carbohydrates	70.75 – 81.29 g

**Table 5:** Varieties of Red rice

Varieties	Total phenolic content (mg/100g)	Total anthocyanin content (mg cyanidin-3 glucoside Equivalent/100g)	Reference
Sri Lanka Red rice	118.47 ± 11.52	0.35 ± 0.02	(Sompong <i>et al.</i> , 2011) [29]
China Red rice	253.34 ± 5.14	1.00 ± 0.01	
Chak-hao amubi (Manipur black rice)	579	1.81	(Saikia <i>et al.</i> , 2012)
Maapillai Samba (Tamil Nadu red rice)	294.71 ± 33.9	6.52 ± 2.73	(Rathna <i>et al.</i> , 2019) [27]

### 3.2 Buckwheat

The Natural Fauna Qiao, otherwise known Tartary buckwheat, has a place with the class Fagopyrum of yearly dicotyledonous plants of the family *Polygonaceae* and is accessible at some rugged locales of Asia (Janes *et al.*, 2009) [9]. The protein content in Buckwheat contains a high dietary benefit attributable to its amazing amino corrosive piece. Buckwheat is wealthy in fats and contains extensively more unsaturated than immersed unsaturated fats, particularly oleic and linoleic acids. Linoleic and oleic acids advance development and improvement of kids and forestall coronary illness (Tavcar *et al.*, 2014) [49]. In this manner, buckwheat gives a wide scope of uses in various types of food. Buckwheat is for the most part expended as noodles, rolls, grains, heating food, and diet treatment food. It used to be consumed as flour or as a fixing blend with rice flour. Buckwheat is a food fixing with a decent potential especially in the useful and wellbeing food enterprises (Liu Wang *et al.*, 2016) [12]. The buckwheat covers a rich starch, carbohydrate, and fat content, and a limited percentage of minerals and polyphenols. Sugar is the core component of buckwheat which forms 70% of the whole substance and more than half of it is fructose (Gao *et al.*, 2016) [6]. Protein content is stronger than in other grains (wheat, corn, and maize), which constitutes 9.61% of the entire item. Buckwheat is rich in lysine, which constitutes 6% of the whole methyl-corrosive material (Zhou *et al.*, 2016) [18]. The protein substance of buckwheat has even amino corrosive creation and useful properties (Nam *et al.*, 2015) [13]. These incorporate high water limit, better emulsification, frothing, and chewiness, hindrance of muscle versus fat collection and gallstone arrangement, decrease of blood cholesterol, diminished clogging, and deferred maturing (Tomotake *et al.*, 2002) [33]. It has been accounted for that buckwheat protein has a low absorbability, which is chiefly because of the nearness of proteinase inhibitors and a low affectability of protein parts to the assimilation procedure (Ikeda, 2002) [8].

### 3.3 Flaxseed

Flaxseed (*Linum usitatissimum*) is one of the most essential robotic oilseed crops, even for food and feed use. Flaxseed is used to represent flax while consumed by humans while linens are used to depict flax as used for practical applications. Both parts of the vegetable oil seedling are used commercially, either legally or just in the wake of exploitation. The cell provides fabric of great quality, of high quality and robustness. The seed provides essential fatty acids rich fat, absorbable protein, and lignans. Flaxseed is one of a kind of oilseeds, despite its exceptionally strong corrosive  $\alpha$ -linolenic content (ALA, 18:3n-3) and lignans Flaxseed contains 35-45% crude, 45-52% of it is ALA (Bhatty, 1995) [3]. Flaxseed develops in the practical food sector as one of the main outgrowths of phytochemicals. Besides being perhaps the most expensive source of  $\alpha$ -linolenic toxic oil and lignans, flaxseed is indeed an essential source of high-grade protein and solvent fiber, and also has an outstanding ability as a wellspring of phenolic mixes (Oomah, 2001) [14]. The composition of flaxseed as described by varied processes is stated at in Table A. Flaxseed comprises 35 to 45% fat. Uninhabited species are the major oil stockpiling tissues, comprising 75 percent of the leaf extracts (Bhatty, 1995) [3]. The undeveloped organism hub's oil content is 44.9% and that of the impending species is 51.0%. What's more, the combined check includes 22.9 per cent oil. Flaxseed products are stable despite their high ALA quality. Significant sections of flaxseed making it useful in human and creature feeding, an incredibly high corrosive alpha linolenic material (omega-3 unsaturated fat) essential to humans; a moderate amount of solvent and insoluble dietary fiber, and the lowest level of "lignans" of all plant nutrients used by human using Lignans give off an impression of being against cancer-causing mixes (Lay and Dybing, 1989) [23, 24]. The National Cancer Institute (United States) has assessed flaxseed alongside various major potential consumable food fixings, as a part of "creator nourishments" (Stitt, 1990) [16].

#### 4. Development of Multi-Nutritional Khakhra

Khakhra is a conventional prepared to-have bite or breakfast thing well known in the North Western piece of India. This item is well known in the territory of Gujarat. As a helpful nibble it is well known during movements since it doesn't require any further preparing at the purpose of utilization, need negligible bundling and has long timeframe of realistic usability. A nutritious Indian eating routine. Extremely firm,

crunchy, divine delicious nutritious and exceptionally light in weight nibble. Top pick among kids and young people. Accessible in a wide range of flavors. It is normally eaten with espresso, tea, chutney, pickles, spread, ghee, beat vegetable, cheddar or yogurt. Simple to convey and the vast majority of the individuals of Gujarat convey these as nibble during movement. Varieties of multi-nutritional Khakhra is mentioned in Table 6.

**Table 6:** Development of Multi-nutritional Khakhra

Product	Nutritional content	Reference
Composition & Sensory assessment of Finger Millet Khakhra		(Giridhar, 2019) <sup>[50]</sup>
Development and quality evaluation of value-added Khakhra using different variety and proportion of flour	11.07% crude protein, 1.83% crude fat, 69.57% carbohydrates, 12.75% Iron.	(Solanke <i>et al.</i> , 2018) <sup>[51]</sup>
Development of Nutritionally Enriched Khakhra prepared from rajma flour	5.2g protein, 195.9Kcal energy, 42.2g carbohydrates, 0.7g fat, 4.9 mg iron, 3.0mg calcium	(Kulkarni, 2019) <sup>[34]</sup>

#### 5. Conclusion

Snack food is a smaller amount of food than daily meals, which can be consumed between meals. It is convenient, simple, crispy, crunchy, mouth-watering tasty nutritious, light weight and fast eating everyday snack. It is a traditional ready-to-eat snack or breakfast item popular in the North Western part of India. It is normally eaten with espresso, tea, chutney, pickles, spread, ghee, beat vegetable, cheddar or yogurt. The benefits of multigrain Khakhra is that it is more nutritive as compared to the common Khakhra. Khakhra made up from Buckwheat, Flaxseed and Red rice have some positive effects. Buckwheat and Red rice both are gluten-free and rich in minerals and fiber. Flaxseed is rice in omega-3 fatty acid ALA, lignans and fiber all of which have been shown to have many potential health benefits. The multigrain Khakhra is good source of protein, minerals because of addition of different type of flour. Buckwheat is good substitute for wheat because it can help with a variety of ailments as it is packed with food, calcium, antioxidants and aromatic compounds. Buckwheat can improve heart health, foster weight loss and help with diabetes management. Buckwheat is an outstanding source of protein, fiber and red rice antioxidant help in fighting free radicals, which protect our skin from premature ageing.

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