



Preparation and Sensory Evaluation of Arrowroot *Masala Khakhra*

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Abstract

Khakhra is a crispy version of *roti*, it is usually a cracker that is handmade and roasted to provide crunchiness. It is also a healthy snack which is a common recipe in the Rajasthani and Gujarati cuisines of western India, especially a Jain's and Gujarati's. In present investigation efforts were made to prepare *masala khakhra* by using different proportions of ingredients like whole wheat, besan, rice flour, arrowroot powder, dehydrated onion. After few trials a recipe was standardized using blends of whole wheat flour, gram flour, rice flour, arrowroot powder, dehydrated onion and spices to taste. Physico-chemical, nutritional profile and sensory analysis of final product made using standardized recipe was carried out. Sensory evaluation was done by semi trained panelists on 5 point hedonic scale. Shelf-life study of the final product was carried over a period of 14 days at room temperature it was found that product maintained the required texture for first seven days at room temperature.

Keywords: Masala *khakhra*, Sensory Evaluation, Traditional Recipe, Nutritional value, Rice flour, Arrowroot powder, Dehydrated onion

Khakhra is a traditional ready-to-eat snack or breakfast item popular in the North Western part of India. This product is very popular in the state of Gujarat. As a convenient snack it is popular during travels because it does not require any further processing at the point of consumption, need minimal packaging and has long shelf-life. *Khakhra* is a nutritious Indian diet snack. Very crispy, crunchy, mouthwatering tasty and very light in weight snack. Favorite among people of all ages from children & teenagers to adult. Available in many different flavors. It is usually relished with various kinds of chutneys, pickles, with coffee, tea, butter, ghee, topped vegetable, cheese or yoghurt. It is easy to carry and most of the people carry these as snack during travel. Since, *khakhra* is very simple to make and is enjoyed as a food item, its value addition can be done by adding many healthy ingredients in

powered form as it is to be rolled very thinly. Value addition of *khakhra* with healthy flours, and/or with seeds like garden cress seeds, linseeds etc. will provide novel health benefits and this is the gap in the market as these supplemented and enriched *khakhras* as not available as such. These enriched *khakhra's* will further provide consumers a new alternative to traditional *khakhras*. More over this research will bring a new potential to the existing *khakhra* market. Today, we find that the people are becoming more aware about their health and various problems related to it. Thus, for maintaining changing life style and stay fit one needs to eat nutritious as well as healthy food.

This study aimed to develop *masala khakhra* by using blend of whole wheat flour (*atta*), bengal gram flour (*besan*), rice flour, arrowroot powder and other spices



to add taste to the *khakhra*. Role and nutritional importance of various ingredients used in preparation of *khakhra* are discussed below:

Whole wheat flour or atta is used instead of refined wheat flour or maida as it contains complex carbohydrates, dietary fiber, and a moderate amount of proteins. Wheat germ is the heart of the kernel, is particularly rich in vitamin. It is known to be the main source of the vitamin complex in dietary structures throughout the world and includes vitamins like thiamine, folic acid, vitamin B6, and minerals like manganese, magnesium, and zinc. Fiber improves gut health. Whole wheat flour will provide the basic structure along with the bengal gram flour.

Bengal gram flour or *besan* is rich in carbohydrates, protein, and fiber. It doesn't have gluten. This flour can be used for gluten free formulations with other ingredients. It is a great source of fiber; the flour can ease your digestive system. (Clemente *et al.* 1998). It is the source of protein in present work on *khakhra* to supplement the cereal/ whole wheat flour.

Arrowroot powder is used as a binding agent and to provide crispiness to *khakhra*, apart from its other hidden nutritional benefits. Arrowroot powder is used to help with weight loss, improve immunity, help reduce the risk of birth defects due to the presence of B Vitamin folate. It plays a significant role in improving the functioning of the heart, blood pressure and people suffering from hypertension can benefit from using arrowroot.

As such, milk is a wholesome food it has various minerals like calcium, phosphorus, magnesium, and potassium, protein and vitamins. The calcium found in milk is readily absorbed by the body (Choi BS *et al.*), it is the source of calcium and other minerals in the *khakhra*.

Green chillis and onions were used to add the taste and variety. The high amounts of vitamin and capsaicin in green chillis are responsible for the health benefits that one receives from green chilli, it helps to boost metabolism and can help loose weight too. They can also fight inflammation, treat stomach illnesses, and keep your heart healthy. They're also

believed to prevent cancer and delay its progression. Onion contains phosphorus, potassium, sulphur, and copper.

Spices not just excite one's taste buds but is also composed of an impressive list of phytonutrients, essential oils, antioxidants, minerals and vitamins that are essential for overall wellness.

This study aims to develop *masala khakhra* using blends of whole wheat flour, *besan*, rice flour, arrowroot powder, dehydrated onion, milk, green chilli, red chili powder, *kasuri methi*, oil, celery, *garam masala*. Various combination of these ingredients were tried before concluding the standardized recipe. The product formulated from the standardized recipe were evaluated for product quality characteristics and shelf-life analysis. Five (5) point hedonic scale was used to evaluate the sensory characteristics of the product.

MATERIALS AND METHODS

Masala khakhra was made using blends of whole wheat, *besan*, rice flour, arrowroot powder, dehydrated onion, milk, green chilli, red chili powder, *kasuri methi*, oil, celery, *garam masala*. Following methodology was followed for developing *masala khakhra*:

(i) Raw Material Procurement

Raw materials like whole wheat flour, *besan*, rice flour, arrowroot powder, milk, edible oil, salt, and spices like red chili powder, turmeric powder, green chili, *kasturi methi*, cumin etc. were purchased from local market in Punjabi Bagh, Delhi, India.

(ii) Preparing Control Sample of *Masala Khakhra*

Control sample of *khakhra* was prepared using whole wheat flour (100 percent) with added spices, it is labelled as T₀. Dough temperature was maintained at room temperature. Both control and trial doughs were formed as per the recipe mentioned in table 1.0.

(iii) Preparing Flour Sample blend for *Masala Khakhra*

Recipe of *Masala khakhra* was standardized using different trials by doing slight variations in the

**Table 1:** Table showing methodology for various trials

Trials →	T ₀	T ₁	T ₂	T ₃	T ₄
Ingredients ↓	Amount	Amount	Amount	Amount	Amount
Wheat Flour	100g	50g	40g	30g	40g
Rice Flour	0	50g	30g	30g	30g
Besan	0	0	30g	30g	20g
Arrowroot Powder	0	0	0	10g	10g
Onion	10g	10g	10g	10g	10g
Milk	30ml	30ml	30ml	30ml	30ml
Green Chilli	1	1	1	1	1
Red Chilli Powder	2T	2T	2T	2T	2T
Kasturi Methi	2T	2T	2T	2T	2T
Oil	2T	2T	2T	2T	2T
Moringa leaves	1t	1t	1t	1t	1t
Salt	2t	2t	2t	2t	2t
Turmeric	1/4t	1/4t	1/4t	1/4t	1/4t
Cumin	1/2t	1/2t	1/2t	1/2t	1/2t
Asafoetida	1 pinch				
Garam Masala	1T	1T	1T	1T	1T

quantity of wheat flour, rice flour, arrowroot powder and dehydrated onion. Dough temperature was maintained at room temperature. The dough was formed as per the methodology given in table 1. After developing each trial sample product sensory evaluation was carried out by 10 semi trained panelist to ascertain its consumer acceptability.

Standardization of Recipe

Recipe of *Masala khakhra* was standardized by performing different trials by bringing variations in the quantity of wheat flour, rice flour, arrowroot powder and dehydrated onion.

T₀ was the control recipe in which only wheat flour was added, this was not good in protein and not even crispy so T₁ recipe was made in which 50g of wheat flour and 50g of rice flour was added to increase crispiness but still *khakhra* was lacking in protein so to increase protein content T₂ recipe was made in which 40g of wheat flour, 30g of rice flour and 30g *besan* was added but the *khakhra* became soggy and crispiness was gone completely to compensate the loss T₃ recipe was tried in which 30g of wheat flour, 30g of rice flour, 30g of *besan* and 10g of arrowroot powder was added, but it was found that there was more of *besan*

flour so another trial was done named T₄ in which 40g of wheat flour, 30g of rice flour, 20g of *besan* and 10g of arrowroot powder was added which resulted in crispy and *khakhra* with enhanced protein value. T₄ was the standardized *khakhra* recipe, the sample of which was analyzed for various physico-chemical analysis.



Fig. 1: Picture showing the developed standardized sample (T₄)



RESULTS AND DISCUSSION

Results of various trials in terms of physico-chemical analysis are discussed below.

(i) Sensory Evaluation

Organoleptic characteristics are the most important properties of *khakhra* for its consumer acceptability. Sensory evaluation of the *Masala khakhra* of sample T_0 , T_1 , T_2 , T_3 , T_4 was carried out on the basis of appearance, color, flavor, texture, taste, and overall acceptability with the help of sensory evaluation on hedonic scale by semi trained panelist of ten students of SPM college. The panelist were trained over a period of three months, the average scores given by panelist is shown in the table 2. It was observed that trial - 4 containing wheat flour, rice flour, *besan* and arrowroot powder was the most accepted recipe among all other trials.

Table 2: Table showing Sensory Evaluation of various trials

Parameter	Trial T_0	Trial T_1	Trial T_2	Trial T_3	Trial T_4
Appearance	3.5	3.0	3.0	4.0	5.0
Color	3.5	3.0	3.5	4.5	5.0
Texture	3.0	2.5	4.0	4.5	5.0
Taste & Flavor	3.5	3.0	3.5	4.0	4.5
Overall Acceptability	3.0	3.0	3.5	4.5	5.0

(ii) Physical Properties of *Khakhra*

The understanding of physical quality attributes is critical in designing end product and its use; different individual grains have different physical characteristics that may dictate end product quality and application (GM Solanke *et al.* 2018). Physical characteristics of the selected sample viz. diameter, thickness, and weight were studied. The results pertaining to physical properties of *khakhra* are presented in Table 3. It was recorded from Table 3 that the diameter of the *khakhra* was found to be 15.2 cm and the thickness was 2.65 mm. The weight of the

khakhra was found 15gm. The results were similar to control sample.

Table 3: Table showing physical properties of T_0 and T_4

Parameter	T_0 *	T_4 *
Diameter (cm)	15.5	15.2
Thickness (mm)	2.5	2.65
Weight (gm)	12	15

*Each value is a mean of three determination.

(iii) Nutritive Value

Nutritional composition represents the nutritional quality of product. The nutritional composition of ingredients adds to the nutritional quality of final product. The data pertaining to nutritional composition of *khakhra* per 100gm is depicted in Table 4. From the nutritional analysis, it was found that trial *khakhra* was nutritionally better to control *khakhra*. The product comparatively better amount of iron and protein and was low in energy value.

Table 4: Table showing nutritive value of T_0 and T_4

Parameter	T_0 *	T_4 *
Energy (KJ)	2060	1978
Fat (g)	33.46	34.17
Protein (g)	11.82	12.17
Iron (mg)	1.86	3.143
Calcium (mg)	69.34	62.29

(iv) Shelf-life Analysis

Shelf-life is an important parameter of marketability, consumer acceptance of any food by a consumer. Shelf-life study was done physically and microbiologically for 14 days at room temperature. From the results it is concluded that the product has shelf-life of 7 days at room temperature recorded in Delhi, India in the month of April.

**Table 5:** Table showing shelf-life value of T_4

Days	Sensory Analysis	Microbial Analysis
0 Day	Taste was good, appearance, texture was good	No Microbial Activity Observed
7 Day	Taste was good, texture was well maintained, color slightly reduced	No Microbial Activity Observed
14 Day	Texture was soft, and decolorized	Mold Observed

(v) Cost Analysis

The raw materials were sourced locally, the cost of ingredients and overhead costs were added to calculate the total cost of product.

Table 6: Table showing the cost of T_0 & T_4

	T_0 *	T_4 *
Cost/100g of flour taken	20.00	32.00

From cost analysis it is concluded that Total Cost of T_0 & T_4 are ₹ 20 & ₹ 32 T_4 trial sample was costly as compared to control sample as different flours were used.

(vi) Packaging and Labelling

Packaging & Labelling is an important part of a consumer's appeal for a product, especially with first time purchases. It is important to consider how consumers will view the packaging and if it will convey the product's quality goals, such as being a high-quality premium product. Primary packaging was done in polyethylene bags which will protect *khakhra* from moisture, spoilage of colour, flavour, odour, texture and will prevent from biological chemical or physical hazards, will control absorption of flavour and losses of oxygen and water vapour. Then it will be packed in an outer packet to protect its breakage and give strength during the transit. Final product was labelled properly according to FSSAI regulations in which all mandatory information like name of the product, list of ingredients, declaration regarding vegetarian food, net quantity, name

and address of manufacturer batch no., date of manufacturing and best before date is mentioned on the package.

**Fig. 2:** Picture showing the packed T_4 Sample**CONCLUSION**

Better taste and superior nutritive value of *khakhra* justifies its high consumer acceptability. On the basis of results, it could be concluded that T_4 recipe containing wheat flour, *besan*, rice flour and arrowroot is ideal for preparation of *khakhra*. After the preparation of value added *khakhra* it was packed in pouches. Then the physico-chemical properties were evaluated containing different various parameters. The shelf life study of the *khakhra* was carried out in the intervals of 0, 7, and 14 days the effect was checked during storage condition. Nutritional value of control and trial samples was checked and T_4 was found to be nutritionally better compared with control T_0 .

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