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# Development of finger millet and flaxseed crackers

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Finger millet oftenly known as Ragi which is one of the most nutritious crop among the major cereal crops. Ragi is a coarse grain which is rich in fiber (3.6g/100g) and calcium (350 mg/ 100 g). It has low Glycemic index which makes it a boon for people suffering from diabetes and obesity. It takes longer time to get digested and hence keeps check on the blood sugar levels and gives a feeling of fullness in the stomach whereas flax seeds are nutritionally high in alpha linoleic acid (ALA), an omega-3 fatty acid that is heart healthy and also a source of anti-inflammatory precursor molecules. They contain soluble and insoluble fibre, which helps to maintain normal cholesterol levels and promotes optimal bowel function. Different trials were done by combining finger millet and flaxseed with refined wheat flour to make nutritious product *i.e.*, "Crackers", to finalize the formulation. Finalized product contained 11.04 per cent Poly-unsaturated fat fatty acid, 46.7 per cent dietary fibreand 70.3 mg/100g calcium.

**Key Words :** Crackers, Calcium, Finger millet, Flaxseed, Omega-3 fatty acid, Wheat flour

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## INTRODUCTION

Bakery products are becoming increasingly popular in India due to their convenience, unique taste and easy availability at reasonable cost. Among bakery products, biscuits/cookies and crackers are the most popular and versatile snack foods and widely consumed to satisfy the occasional 'pangs' of hunger and are an integral part of the society.

'Cracker' is a generic term used throughout the world and refers to products with very low sugar and fat content. The term cracker can be used when the baked product has a cereal base, e.g. wheat, oat or barley, of at least 60 per cent and a low moisture content of 1–5 per cent, which is the distinguishing factor. Crackers are usually flat, crisp, and small in size and made in various shapes commonly round or square. Crackers are generally considered as ready to eat snack food.

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### Finger millet :

Finger millet (*EleusineCoracana*) is an important staple food in the eastern and central Africa as well as some parts of India (Majumder *et al*., 2006). Finger millet oftenly known as Ragi, is versatile source of carbohydrate, protein and mineral that is comparable to other common cereal grains (Supriya and Chandra, 1989). It is grown in foothills of Himalaya, Zarkhand, Maharashtra, Rajasthan, Karnataka and Tamil Nadu. The crop yields around 5 quintals per hectare and seed can be stored for decades, and hence it is highly valued as a reserve against famines (Supriya and Chandra, 1989). It contains protein ranging from 6-14 per cent, fat 1-1.4 per cent, dietary fibre 11.5 g/100g, carbohydrates 72 g/ 100g and energy around 1350 to 1450 kJ (Anonymous, 1996). The calcium content is higher than all cereals (370

mg/100 g). Ragi is considered to be ideal food for diabetic individuals due to its low sugar content and slow release of glucose/sugar in the body (Kang *et al.*, 2008).

**Flaxseed :**

Flaxseed, or Linseed (*LinumUsitatissimmum*), popularly known as Alsi, Jawas, Aksebija in Indian languages, is a blue flowering *Rabi* crop and a member of family Linaceae.Flaxseed is one of the richest vegetarian source of α- linolenic acid (omega 3 fatty acid). An analysis of flax averaged 41 per cent fat, 20 per cent protein, 28 per cent total dietary fibre, carbohydrate 29 per cent, 23 per cent omega-3 fatty acid, 7.7 per cent moisture and 3.4 per cent ash (Morris, 2003). Flaxseed protein is effective in lowering plasma cholesterol and triglycerides (TAG) compared to soy protein and casein protein (Bhathena *et al.*, 2002). Flaxseed is the richest source of plant lignans (Thompson *et al.*, 1991). Secoisolariciresinoldiglucoside (SDG) is the predominant lignan in flaxseed. Lignans have antioxidant activity and thus they contribute to the anticancer activity of flaxseed (Yuan *et al.*, 1999). Flaxseed is also rich in dietary fibre and may help to reduce the risk of heart disease, diabetes, colorectal cancer, obesity and inflammation (Morris, 2003).

Today's consumer is becoming more concerned about the health benefits of reduced calories and consuming additional proteins and dietary fibre in the diet. Low calorie products rely on the addition of high bulking agent that has high moisture absorption resulting in reducing calories by one third. Diabetes, blood pressure and malnutrition are the major health problems of the majority of the Indian population and those suffering from them need high protein, high fibre and low calorie diet. So the aim behind making these crackers was to make a combination of healthy ingredients in a consumable form and to make a healthy product with an affordable cost.

## METHODOLOGY

Refined wheat flour, Flaxseed and Ragi were used for the preparation of Crackers. The refined wheat flour, flaxseed and ragi were procured from Hadapsar market, Pune. Vegetable oil, spices, baking soda and salt were also bought from Hadapsar market, Pune. The whole processing was carried out in Rajbaug Bakery, Loni-Kalbhor, Pune.

Initially ragi and flaxseed were roasted at 90º C for 10 minutes individuallyfollowed by cooling at room temperature and coarse grinding. Roasting gave good aroma to the product and gave good grinding effect (as it didn't ooze off the oil). Bookwalter *et al.* (1987) reported inactivation of lipase in millet flours when roasted at 90 ºC. Inactivation of lipase led to minimization of fat hydrolysis. These flours were sieved from a sieve of mesh size No. 30-40. Thisuniform size particle flour was mixed with refined wheat flour and Spices (Red chilli powder, Ajowan powder, Black pepper powder, Cumin seed powder). Trials with different combinations were taken with a ratio like refined wheat flour: flaxseed flour: finger millet flour, $T_1$ (3:1:1); $T_2$ (3:2:1); $T_3$ (3:1:2). Protocol for preparation of crackers was same for all the trials as shown in Fig. A.

All the ingredients were mixed and dough was prepared in a dough kneader (Make: Mangal engineers),

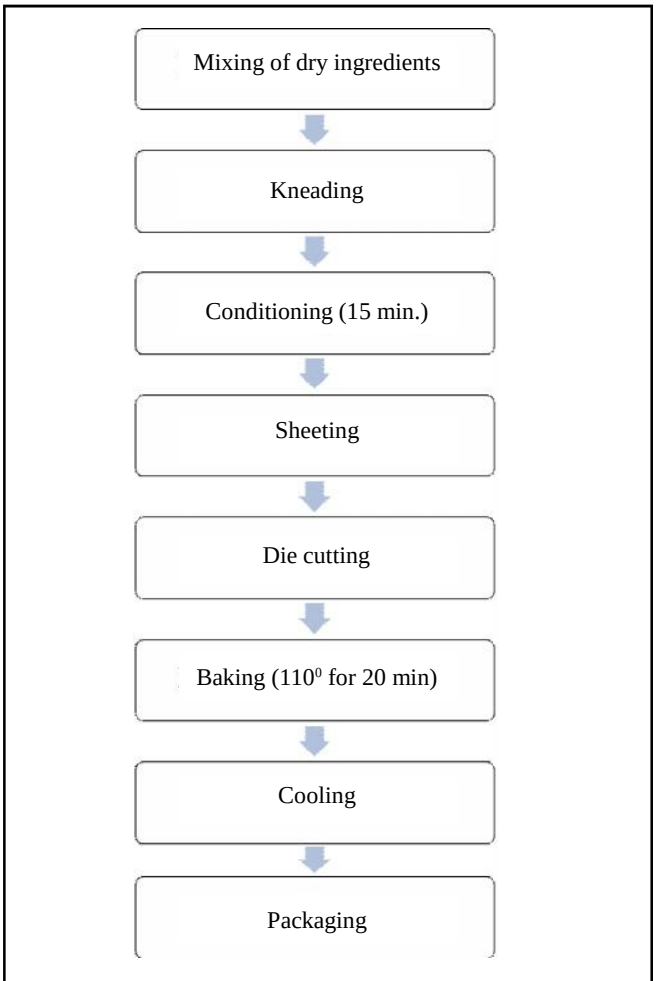


**Fig. A : Flow sheet for production of crackers**

kneading was continued tillvisco-elastic rheology of dough has been formed. These visco-elastic dough was kept for conditioning (15 minutes) at room temperature 26 °C. Conditioned dough was transferred to the sheeting machine (Shiva engineers) to make a uniform thickness sheet (0.2 cm). Further die cutting was carried out manually using a die of diameter 4 cm. Die cut pieces were transferred into the bakery trays where baking was done at 110 ºC for 20 min in the baking oven (Make: Sigma engineers) as shown in Fig. A. After baking the crackers were cooled at room temperature for 20 minutes and then packaging was done in HDPE and LDPE bag.

Physico-chemical, microbiological and sensory analysis of these baked crackers was done further where moisture was determined by using standard oven method. Fat by Soxhlet method, Protein by Kjeldhal method, energy by using bomb calorimeter, carbohydrate by difference method, ash was determined by using muffle furnace method (Ranganna, 2007). Total sugars as sucrose by AOAC 923.09. Dietary fibre was estimated by IS 11062-2010, Saturated fat, monounsaturated fat and polyunsaturated fat by AOAC 996.01 and calcium was estimated by ICP- OES. Under physical analysis of cracker, diameter and thickness of cracker were measured by using vernier caliper. Microbial analysis was carried out for Total plate count and fungus growth. For sensory analysis semi-trained members were selected and it was done based on 9 point hedonic scale (Ranganna, 2007).

## OBSERVATIONS AND ASSESSMENT

Crackers prepared using refined wheat flour, flaxseed flour and ragi flour with different combination ratios like refined wheat flour: flaxseed flour: finger millet flour, $T_1$ (3:1:1); $T_2$ (3:2:1); $T_3$ (3:1:2). Protocol for preparation of crackers was same for all the trials as mentioned in Fig. A.

Out of these trials, 3:1:1 ratio was having most acceptable texture and flavour. While the crackers with 3:2:1 ratio of refined wheat flour, flaxseed flour and ragi flour showed good texture but the colour was unacceptable and the taste found was bitter which may be due to more quantity of flaxseed. The third formulation of crackers *i.e.* 3:1:2 of refined wheat flour, flaxseed flour and ragi flour was having good taste but unacceptable texture. Thus crackers prepared using the first formulation *viz.*, 3:1:1 was having overall good consumer acceptance.

Sensory analysis was done based on the 9 point hedonic scale (Ranganna, 2007). Sensory tests included appearance, colour, texture, taste and flavour. Sensory test was carried out among 10 semi-trained persons. The average score obtained is mentioned in Fig. 1.

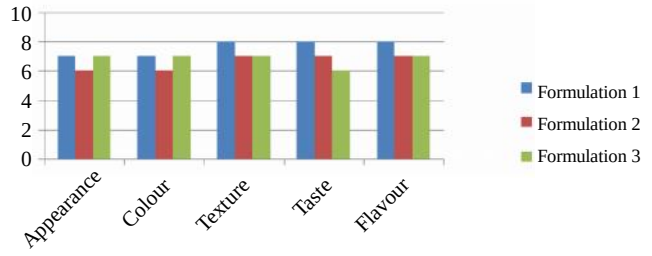


**Fig. 1 : Sensory analysis of different formulation**

The finalized formulation of crackers was kept for a storage study of 3 months using LDPE and HDPE (200 gauge) as the packaging material. Where the comparison of this packaging material was done based on moisture content readings obtained for 3 months storage period. During 3 months storage period it was found that there was 1 per cent moisture rise in its initial moisture content in case of HDPE type of packaging material, where as in case of LDPE, 4 per cent moisture rise in the initial moisture content of crackers was observed.Storage was found to have a noteworthy effect on the moisture content of crackers. The above observations indicated that moisture was absorbed during three months of storage by the crackers. The gain in moisture content might be due to hygroscopic nature of dried product, storage environment (temperature and relative humidity) as well as the nature of packaging material.Moisture uptake in the polyethylene pouches might be due to their permeability to moisture and air. Due to this problem laminated pouches will be the suggested material to overcome this problem.

Proximate analysis of finalized formulation *i.e.*, trial 1 obtained wasenergy value 442 kcal/100g; protein, carbohydrate, fat was 11.3 g/100g, 61.5g/100g, 16.7g/100g, respectively. Total sugars as sucrose was 10.2 g/100g. Dietary fibre and Calcium were 46.7 g/100g and 70.3 mg/100g, respectively. Saturated fat, monounsaturated fat and polyunsaturated fat were 2.7g/100g, 4.6g/100g and 11.04g/100g, respectively.

Microbial populations like bacteria and fungus were estimated by serial dilution followed by solidification in petriplate using nutrient agar and rose Bengal agar, respectively for HDPE packed material. After

solidification both bacteria and fungus colony containing plates were incubated at room temperature for 24 to 48 hours. The formed colonies were counted and converted as number of colony forming units (CFU) per gram of sample. Microbial load estimation for the crackerwas carried out for fresh as well as 30, 60 and 90 days old samples.

Microbial load obtained were under the acceptable limits for a period of 3 months from the date of manufacture. Bacterial count for the crackers was lower than the acceptable limit of $1\times10^5$ CFU/g of sample. The bacterial count for the fresh, 30 days 60 days and 90 days obtained were $1\times10^2$ CFU/g, $2.51\times10^3$ CFU/g, $7.5\times10^3$CFU/g and $6.4\times10^4$CFU/g. Fungus growth was not observed in all the cases.

After 3 months off flavour started developing in the cracker which was due to rancidity developed due to the presence of flaxseed.The oxidative rancidity is a major cause of development of bad odour and flavour in the foods containing higher oil contents. Free radical formation is responsible for that process. The instability of flaxseed oil to oxidation is the restraining factor for its incorporation in food products. (Kolodziejczyk and Fedec, 1995) reported that the stability of oil can be extended by suitable storage which is vital for improving the oxidative stability of flaxseed oils. ALA in remote form or as a part of an extracted oil is generally considered susceptible to oxidation as it is highly unsaturated and oxidation in oils is encouraged by both heat (auto-oxidation) and light (photo-oxidation). However, ALA in the intact seed of flax has proven particularly resistant to oxidation. Both the whole and coarsely ground flaxseed showed long-term storage stability at room temperature (Ratnayake *et al.*, 1992).

**Conclusion:**

A novel product, fortified with flax seed and finger millet was successfully produced. Flax seed increased the protein, ash, fat, fibre and dark colour of the crackerwhereas finger millet gave good amount of calcium and colour. Use of finger millet flour and flaxseed flour gave the low cost but nutritious product in terms of Calcium (70.3 mg/100g), Dietary fibre (46.7 g/100 g) and Polyunsaturated fat (11.04 g/100 g) which should be stored at room temperature and consumed before 90 days.

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