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Dr. B Suneetha
SMS, Department of Home Science, Krishi Vigyan Kendra, Darsi, Andhra Pradesh, India

Dr. GMV Prasada Rao
Programme Coordinator, Krishi Vigyan Kendra, Darsi, Andhra Pradesh, India

Corresponding Author:
Dr. B Suneetha
SMS, Department of Home Science, Krishi Vigyan Kendra, Darsi, Andhra Pradesh, India

Evaluation of finger millet cookies for nutritional and sensory characteristics

Dr. B Suneetha and Dr. GMV Prasada Rao

Abstract
The study was aimed and carried out to formulate calcium and iron enriched cookies with the improved ragi variety (Indravathi). The objective of this research was to prepare the nutritionally enriched cookies developed by incorporating improved ragi variety. Moisture content ranged from 1.59 to 1.63 percent. Moisture content of cookie I cookies was significantly lower as compared to local available ragi cookies and Protein content of cookie prepared from improved variety cookies were significantly higher than the other type cookies. Maximum fiber content was observed in cookie I (0.76%) followed by cookie II (0.62%) on dry weight basis. Iron content of two types of cookies varied from 3.41-3.82 mg/100g. Similarly higher Ca and Zn content was also observed in experimental cookies as compared to control, which might be due to nutrient content of improved variety. Addition of finger millet flour from the improved variety (Indravathi) increased the total mineral, fiber, calcium, iron and zinc content of cookies.

Keywords: Finger millet, improved variety, nutritional composition, sensory parameters

Introduction
In the rural areas of India, millets are considered to be the staple traditional food grains and are majorly utilized for consumption at household level (Dayakar Rao *et al*., 2007) [3]. Due to their sustainability in adverse agro-climatic conditions they are considered to be food security crops (Ushakumari *et al*., 2004) [14]. Millet sustains one third of the world's population and play a significant part of diet in developing countries, particularly India, where they are eaten by a large section of the poor community (Molt, 2006) [9]. Genetic diversity in the food basket can be broadened due to these crops as they have substantive potential and they can also ensure improved food and nutrition security (Mal *et al*., 2010) [7]. Millets help in the management of various disorders like diabetes mellitus, obesity, hyperlipidaemia, etc. due to intake of nutritional ingredients in daily diet (Veena, 2003) [15].
Finger millet (Ragi) is available in yellow, white, tan, red, brown or violet colour depending on the variety. Red coloured variety of finger millet is most common and cultivated worldwide. It is a rich source of carbohydrates and comprises of free sugars (1.04%), starch (65.5%) and non-starchy polysaccharides or dietary fibre (11.5%). Prolamins are considered as major fractions of finger millet protein. Finger millet is exceptionally rich in calcium (344 mg %), potassium (408 mg %) compared to all other cereals and millets and also contains phosphorus and iron. Finger millet the seed coat in particular, contain several phytochemicals that may have multiple health benefits. Finger millet is rich in calcium and helps in keeping the bones and teeth healthy and helps in fighting osteoporosis. It helps in controlling diabetes as its seed coat is abundant in polyphenols and dietary fibres as compared to rice, maize or wheat. It is also rich in iron which can help to fight anaemia (Gopalan *et al*., 2009) [4].
Despite the nutritional and health benefits, the consumption and cropped area under finger millet has decreased significantly due to urbanization, changing food preferences, non-exposure of these grains as well as unavailability of products suiting to the taste of rural and urban dwellers. The further promotion of finger millet requires diversification of products in terms of health food, ready to eat foods, bakery products etc. (Sinha *et al*., 2013) [12]. Despite finger millet's rich nutrient profile, recent studies indicate lower consumption of millets in general by urban Indians. Finger millet is processed by milling, malting, fermentation, popping, and decortication. Noodles, vermicelli, pasta, Indian sweet (halwa) mixes, papads, soups, and bakery products from finger millet are also emerging (Shobana *et al*, 2013) [11].
The Indian bakery Industry has been witnessing steady growth since 2004 and is expected to grow at the rate of 9.0 per cent from 2010 onwards, driven by the demand for convenience products and health food products (Mardikar, 2010) [8]. Among the bakery products, biscuit and cookies command wide popularity in rural as well as urban areas among all the age groups.

This is due to longer shelf life, prepared in local bakeries also, easy marketing, low cost, varied taste and texture. The use of millet flour is becoming more and more common in baked products especially in bread, cookies and crackers that are targeted at consumers who are gluten sensitive or diabetic (Tanwar and Dhillon, 2017) [13]. Keeping all the above points into consideration the need and demand of nutritionally enriched food products the studies have been carried out to formulate the cookies enriched with ragi flour to satisfy the calcium and iron requirement growing population.

Materials and Methods

The material required were purchased from local market. Ragi, Maida, Sugar, Butter, Corn starch Milk, Baking powder. The Butter is beaten with powdered sugar. Then the mixture of Maida, ragi flour, cocoa powder, baking powder, corn starch, is added and followed by addition of milk along with chocolate essence. A resting period of 15min at room temperature is given to the prepared dough. Then sheets are formed. It is then moulded and dropped on the baking trays. Then those trays are placed in oven for baking. After baking (140 °C for 15 min) the trays are taken out, cooled and cookies were packed (Anon, 2010) [1]. Below mentioned is the step wise flow chart for preparation process of the cookies. Data were subjected to analysis of variance (ANOVA) using complete randomized design (Panse and Sukhatme, 0.05 was estimated and used≤1961). Critical difference at P to find significant difference, if any.

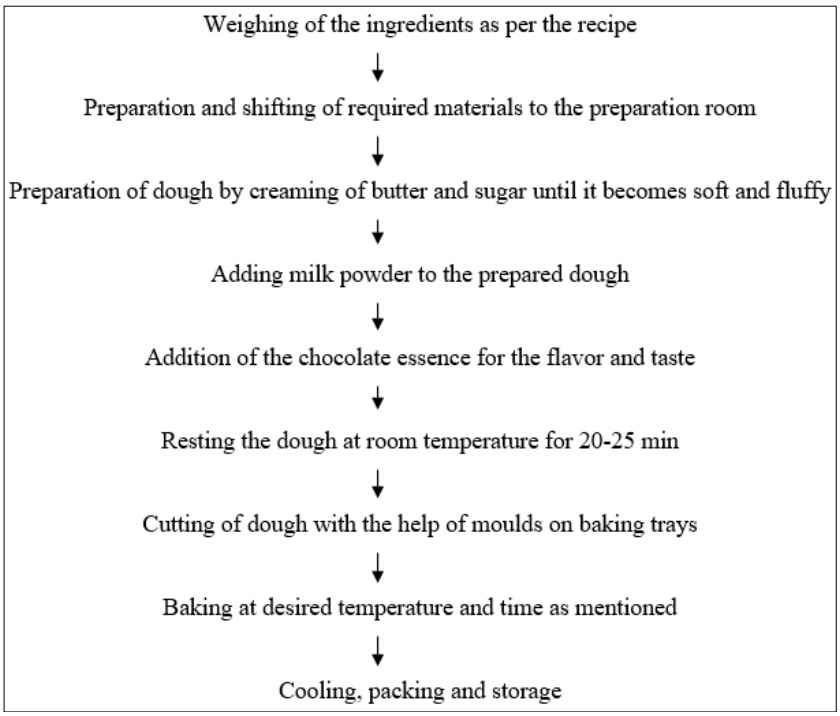

Table 1: Composition of cookies

Ingredient	Sample-I	Sample-II
Maida (g)	70	70
Ragi flour (g)	30 (Improved variety)	30 (Local variety)
Sugar (g)	52	52
Fat (g)	74	74
Baking powder (g)	02	02
Coconut powder (g)	10	10
Milk powder (g)	10	10

Fig 1: Composition of cookies

Table 2: Sensory evaluation

Evaluation of samples	Appearance	Color	Aroma	Taste	Flavor	After taste	Texture	Overall acceptability
Cookie-I	7.5±0.65	8.5±0.35	7.8±0.66	8.5±0.66	8.2±0.18	8.0±0.25	8.5±0.25	8.2±0.50
Cookie-II	7.8±0.12	7.2±0.40	7.5±0.35	8.0±0.74	7.5±0.30	7.5±0.12	8.0±0.16	7.6±0.17
F-test	NS	S	NS	S	S	S	NS	S

Sample 1: Cookies with improved variety, Sample 2: Cookies with local variety
Values are expressed as mean + standard deviation (means values of three replicates).

The recipe was finalized on the basis of sensory evaluation. The protein content was determined by using Micro-kjeldahl method, fat was estimated using soxtron fat extraction system, carbohydrate was analyzed using anthrone method. Ash content is determined in muffle furnace and moisture content is determined using hot air oven. Iron and calcium content is determined using the std. method mentioned. The sensory quality of the developed products in respect of color, appearance, aroma, texture and taste were judged by trained panelists using 9- point hedonic scale (Lawless and Klein 1991) [17]. Cookies were analyzed for moisture, total nitrogen, crude fiber, and total ash. A factor of 6.25 was used to convert

nitrogen into protein (AOAC, 2010). For determination of calcium and iron about 0.5 g of sample was digested with diacid mixture (HNO3: Hclo4:5: 1, V/V). After complete digestion, the sample was heated to near dryness and volume was made to 50 ml with double distilled water. Estimation of calcium and iron was done using atomic absorption spectrophotometer (Lindsey and Norwell, 1969) [16].

Results and Discussion

The scores for the organoleptic evaluation of ragi cookies are given in Table 1. Two types of cookies were prepared by different varieties keeping the other ingredients and preparation same. Cookies prepared only with refined flour served as control. Cookies prepared by incorporating ragi flour with improved variety was found to be acceptable. Though color and appearance of ragi incorporated cookies were significantly different from control, yet were acceptable and fell into the category of acceptable. The results showed that there were non-significant differences in the scores of aroma, texture, taste, and overall acceptability of all types of cookie.

Moisture content ranged from 1.59 to 1.63 percent (Table 3). Moisture content of cookie I cookies was significantly lower as compared to locally used variety and which might be due to lower protein content of local variety. Earlier study also reported an increase in moisture content of bakery products with increase in protein content (Anu *et al*., 2007) [2]. Protein content of cookie-I cookies were significantly higher than the other type cookies. This might be due to incorporation of developed variety with higher percentage of protein as compared to refined flour available in market. The finding of this study is in agreement with earlier study (Gopalan *et al*., 2009) [4]. Non-significant differences in fat content were observed among both the cookies. A range of 0.62 to 0.83% of mean values for ash content was observed in different types of cookies. Crude fiber content of different type of cookies varied significantly with each other. Maximum fiber content was observed in cookie I (0.76%) followed by cookie II (0.62%) on dry weight basis.

Calcium content of different types of cookies varied significantly with each other. Maximum calcium content was observed in cookie I (75.28+1.10 mg/100 g) followed by cookie II (67.34+2.20 mg/100 g) on dry weight basis (Table 3). Significantly higher calcium content observed in cookie-I as compared to cookie-II might be due to incorporation of improved ragi variety.

Iron content of two types of cookies varied from 3.41-3.82 mg/100g. Significantly higher ($p<0.05$) iron content was observed in cookie-I. Similarly higher Ca and Zn content was also observed in experimental cookies as compared to control, which might be due to nutrient content of improved variety.

Table 3: Chemical composition of cookies

Nutrient	Cookie-I	Cookie-II	p≤0.01
Moisture (%)	1.63	1.59	NS
Protein (%)	5.18	4.10	S
Fat (%)	30.24	31.56	NS
Ash (%)	0.62	0.83	S
Fiber (%)	0.76	0.62	S
Calcium (mg/100 g)	75.28	67.34	S
Iron (mg/100 g)	3.82	3.41	S
Zinc (mg/100 g)	0.65	0.40	S

Values are mean of three replications

Finger millet flour from the improved variety can be substituted for development of nutritious cookies. Substitution increased the total mineral, fiber, calcium, iron and zinc content of cookies, which have potential to be exploited for commercial venture.

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