ISSN: 2347-467X, Vol. 06, No. (1) 2018, Pg. 142-147

Current Research in Nutrition and Food Science

Journal Website:www.foodandnutritionjournal.org

Development and Sensory Evaluation of Ragi-Wheat Composite Cake

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Abstract

Ragi (*Eleusine coracana*) is most popular and major finger millet in India. Nutritionally, Ragi is superior to Wheat and Rice because of its high Calcium (380 mg), Dietary fibre (18 g) and Phenolic compounds (0.03 g-3 g) per 100 g.The investigation was done to optimize the process for developing Ragi-Wheat composite cake with more acceptability. Calcium is highly required for children and women especially during pregnancy and lactation period. The orthogonal array design was used to optimize the level of Rag flour and refined Wheat flour. Four different levels of Ragi flour and refined Wheat flour were used during experimentation. The sensory evaluation of the optimized product was done by the panel containing 100 members, while the chemical analysis of the same was done by using standard procedures. From the results, it was observed that cake with 20% Ragi flour most acceptable followed by 10 %, 15 %, control and 25 % Wheat-Ragi Composite cake.

Article History

Received: 01 July 2017
Accepted: 20 March 2018

Keywords

Wheat-Ragi.
Orthogonal array design,
cake,
sensory.

Introduction

Finger millet is commonly known as Ragi (*Eleusine coracana*) which is having family Gramineae. Finger millet is a cereal crop and is mostly preferred as staple food by the peoples from the arid and semi arid region. However, the millets fulfil the hunger of thousands of peoples, especially those who live in the hot and humid climate[1]. Millets are also important foods in the many developing countries where adverse weather conditions like limited rainfall affects the agricultural production. The grain of ragi is similar to reddish mustered. Generally, it is harvested during December and January. Only Ragi contributes 25 % of overall food grains production. In world, India and South Africa are major ragi producing countries. Whereas, Karnataka (1630 MT), Tamil Nadu and Maharashtra (161 MT) are leading state of Ragi[2].

Ragi ball and unleavened bread/roti is a part of daily meal of low-income groups in a southern part

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To link to this article: http://dx.doi.org/10.12944/CRNFSJ.6.1.16

of India[2]. Now days, importance of finger millet has been increased due to its dietary fibre, starch pattern and high calcium-iron contents. In addition, it is nutritionally superior to Wheat and Rice because of its high Calcium (380 mg), Dietary fibre (18 g) and Phenolic compounds (0.03 g-3 g) per 100 g. The health benefits from ragi consumption are attributed to its polyphenol and dietary fibre contents. Its health beneficial effects are anti-diabetic, anti-tumorigenic, atherosclerogenic effects, antioxidants, etc.[3]. Ragi is an ideal meal for diabetics and obese because it takes long time to digest which gives the carbohydrate longer time to get absorbed[4,5]. There are three anti-nutritional factors are present in the ragi *viz*., phytic acid, tannin and trypsin inhibitor. Hence, ragi malt and fermented ragi beverage are famous traditional dishes[6]. The process of malting improves digestibility, sensory and nutritional quality of finger millet and lowers anti-nutritional factors from it. Apart from unleavened bread and ragi ball, ragi idly, pasta, ragi malt, ragi dosa, etc are the popular products available in the market.

Better utilization of finger millet through processing and value addition for enhances nutritional security[6]. The cake can be defined as a product obtained by baking a leavened and shortened batter containing flour, sugar, shortening, egg, milk or other liquids flavouring and leavening agents[2]. The cake is important delicious used all over the world for celebrating the various occasion. The globalization scenario has increased the demand for cakes, due to change in perception, changing life style, westernization, urbanization, busy life, increased women employment and increased per capita income. There are numerous benefits of malting which includes elaboration of vitamin-c, increased bioavailability of phosphorus and synthesis of lysine and tryptophan[6]. Hence an attempt was made to replace Wheat flour by Ragi flour in the preparation of cake to improve the nutritional quality of thecae.

Materials and Methods

Raw material

Basic ingredients of preparation of Ragi-Wheat composite cake are refined Wheat flour, Ragi flour, sugar, soybean hydrogenated vegetable oil, eggs, milk powder, vanilla essence and baking powder. All these ingredients were purchased from the local market of Chiplun, District-Ratnagiri (Maharashtra, India). All samples of cakes prepared from 0, 10, 15, 20, 25 % incorporation of Ragi flour in refined Wheat flour were given different code numbers. The creamy white coloured and bran free flour was selected. Sugar was used as a sweetener. Soybean oil (hydrogenated) (local brand) was used as a leavening agent. Shortening is used as a tenderizing agent and emulsifying agent. Baking powder lightens the product and makes it easy to digest and eggs acts as an emulsifier, structure builder and tenderizer[2].

Experimental Design and Statistical Analysis

The Taguchi experimental design approach was employed to design a combination of various ingredients mainly quantity of Ragi flour and Wheat flour ratio (Table 1). Taguchi design is a useful and efficient tool to optimize the process of product development[7]. In the design, every factor has given same weightage and thus allowing factors to be analysed independently over each other. There are some uncontrollable factors which cause the functional characteristics of a product to deviate from their target values. These factors are called as noise factors (e.g. human errors). The Taguchi used an orthogonal array to design an experiment for controlling the ratio of Wheat flour to Ragi flour during replacement with four different levels and hence used L16 orthogonal array i.e. 16 runs and a control. The signal-to-noise (S/N) ratio is the quality characteristic used in Taguchi to find best combination from the design. The S/N ratio characteristic has following three categories: (a) nominal is the best, (b) smaller is the better, and (c) larger is the better.

Preliminary Treatment of Raw Materials

All the raw materials required for preparation of Ragi-Wheat composite cake were weighed as mentioned in experimental design. The process of cake manufacturing is as shown in Figure 1.

Table 1: Composite Ragi Flour Levels and Treatments

Ingredients	Control	Levels			
	L_0	L_1	L_2	L_3	L_4
Refined wheat flour (g)	100	90	85	80	75
Ragi Flour (g)	0	10	15	20	25
Sugar (g)	100	100	100	100	100
Soybean hydrogenated vegetable oil (g)	30	30	30	30	30
Eggs (nos.)	02	02	02	02	02
Milk powder (g)	02	02	02	02	02
Baking powder (g)	01	01	01	01	01
Vanilla essence (ml)	03	03	03	03	03

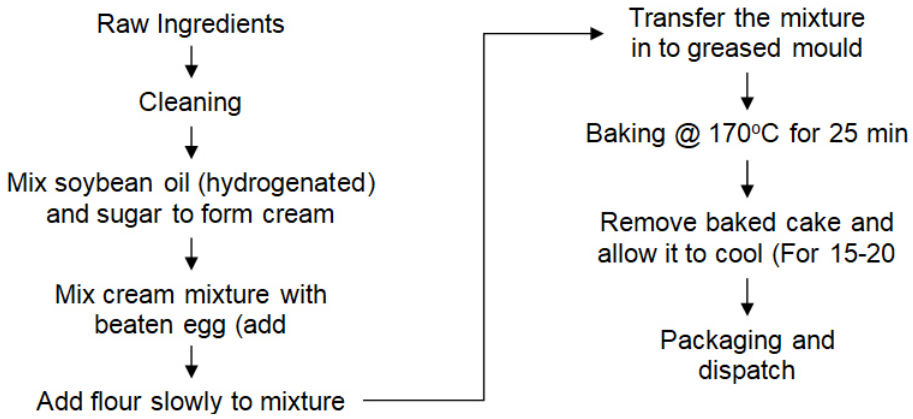

Fig. 1: Process flow chart for Ragi-Wheat Composite Cake Production Method

Refined Wheat flour, Ragi flour, sugar, milk powder and baking powder were sieved. Initially, soybean hydrogenated vegetable oil (30 g) and sugar (100 g) were mixed together to obtain a creamy texture. Two whole eggs were beaten to get foamy consistency and then essence (3 ml) was mixed with it. The mixture of egg and essence, vegetable oil and sugar, baking powder (1 g), milk powder (2 g), and flour were mixed at highest speed of blender as per experimental design so that homogeneous mix obtained. The mix was then poured into agreased pan (20×5 cm) and baked at 170 ^{0}C for 25 min in the baking oven. To ensure completion of baking, a sterilized toothpick was inserted into the centre of the cake. After commencing of baking, the cake allowed to cool for 15-20 min and then pack using PET tray and polyethene bag.

Proximate Analysis

The cake was analysed for protein (using the factor 6.25×Nitrogen (%)), fats, and ash and moisture contents using standard methods of AOAC[9]. The carbohydrate content was calculated by subtracting these values from the total weight in different cake samples were determined using standard methods of AOAC[9].

Sensory Evaluation of Developed Ragi-Wheat Composite Cake

The sensory evaluation of the Wheat- Ragi composite cake such as appearance, colour, flavour (aroma), taste, texture and overall acceptability were evaluated by a panel consisting 100 members using nine points hedonic scale[10]. The panel included the teachers, technical officers and students of S.P.

College of Food Technology, Kharawate- Dahiwali (Maharashtra). The sensory characteristics such as appearance, colour, flavour, taste, texture and overall acceptability were evaluated by assigning maximum score of 9 to each.

Results and Discussion

The study was conducted to replace wheat flour by using Ragi flour at S. P. College of Food Technology, Kharawate-Dahiwali (Maharashtra). All experiments were performed using design given in Table 1. The data obtained through sensory evaluation of cake prepared using orthogonal array design is as shown in Table 2.

Sensory evaluation of Wheat-Ragi composite cake
The sensory characteristics of ragi cake such as appearance (colour), flavour (Aroma), taste, texture and overall acceptability were evaluated by a panel. Each product sample was evaluated on a nine-point hedonic scale where 9 represented like extremely and 1 represented dislike extremely as shown in Table 2.

Table 2: Sensory Evaluation of Developed Ragi-Wheat Composite Cake

Sl. No.	Parameters	Control Levels				
		L_0	L_1	L_2	L_3	L_4
1	Colour	8.0	7.8	7.8	7.8	7.0
2	Flavour	7.7	7.8	7.8	8.0	7.5
3	Taste	7.5	7.4	7.8	8.1	7.4
4	Texture	8.0	7.8	7.6	7.6	7.0
5	Overall acceptability	7.5	7.5	7.8	8.1	7.3
6	S/N ratio	17.40	17.55	17.84	18.18	17.30

Colour

The colour is major attribute towards acceptance of any baked good. The results showed that cake prepared from 90 % wheat flour has better colour and has 7.8 scores on the hedonic scale after control which was having highest score i.e. 8 than other combinations. As a percentage of Ragi flour increases, the colour of cake changes from light brown to dark brown hence reducing the acceptance based on colour. The similar results were found by Sudha *et al.,*[10] and Zubairuddin *et al.,*[2].

Flavour

The flavour of any baking good has also an important role towards its perception. The result showed that addition of Ragi flour improved flavour initially as there was an increase in score up to 8 for 20 % addition of Ragi flour. But later, the addition of Ragi flour above 20 % decreased the sensory score on a hedonic scale to 7.5.

Taste

Acceptability of any food product is largely dependent on its taste. Addition of Ragi flour to replace wheat flour in cake improves its taste. Rating of cake with 20 % Ragi flour was higher i.e. 8.1. But more addition of Ragi flour imparts slightly bitter taste during baking hence there was a significant reduction in its score to 7.4.

Texture

The Wheat-Ragi flour composite cake had the grainy texture as reported by panellists (up to 20 % of ragi flour). The cake prepared from 25% Wheat-Ragi composition had excessive grainy appearance which caused reduction in its texture acceptability. The lower scores of appearances may be due to decrease in sponginess of cake resulting from a decrease in gluten content[10,11]. The results obtained during the study were comparable with those found for Ragi based noodles[11].

Overall Acceptability

Analysis using Taguchi orthogonal array design showed that S/N ration for 20 % incorporation of Ragi flour with 80 % wheat flour had better noise i.e. more acceptability. The highest S/N ration for that level was 18.18; however, thelower value of S/N ratio was 17.30 for 25 % inclusion of Ragi flour. Though the addition of Ragi flour increased its nutritional value, the sensory acceptability of the cake started decreasing at 25 % addition of Ragi flour. Hence, the addition of 20 % Ragi flour into Wheat flour during manufacturing of cake may be suggested.The overall acceptability was mainly based on hardness, mouth feel and taste of Ragi- wheat composite biscuit[12].

Proximate Analysis

Table 3 shows proximate analysis of optimized Wheat-Ragi Composite cake with 20 % Ragi flour inclusion level in Wheat flour. The moisture content of composite cake was less than the control. The

results were at par with other scientist[13]. The results of proximate analysis were like to those evaluated by Majumder[6], but had high ash content and less fat content. High ash content values showed that the highest amount of minerals which may be a varietal characteristic.

Table 3: Proximate Composition of Ragi-Wheat Composite Cake (20% Ragi Flour + 80 % Wheat Flour)

Sl. No.	Component	Percentage
1	Moisture content	12.40
2	Protein	7.80
3	Fat	13.20
4	Ash	1.2

Conclusion

The study on development and sensory evaluation of Wheat-Ragi Composite cake showed that incorporation of Ragi flour to replace Wheat improves its nutritional quality and palatability compared to control sample, from the results obtained in this study, it was found that the sensory panel had accepted 20 % level of Ragi flourinclusion level into Wheat flour for cake production. The Wheat-Ragi composite cake prepared will be beneficial to grow children, teenagers, pregnant women, lactating women and anaemic patients. Hence further studies on its nutritional composition especially in terms of some important micronutrients such as calcium, iron, vitamins B1, B2, B6, B9, and B12 will be required.

Acknowledgement

Authors are thankful to SP college of Food Technology, Kharawate-Dahiwali (Maharashtra) and CAEPHT (CAU), Ranipool for providing facility & guidance. Authors do not have any conflict of interest.

Funding Source

Nil

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