Designer Ragi Based Food Products for Elderly

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Abstract

Ragi is rich in protein, fat, fiber, calcium, and iron. It has a hypoglycemic effect and antinutritional factors that help in reducing starch digestibility and absorption. Ragi based food products like ragi laddu, biscuits, thepla, thor, halvasan, mohanthal, choco balls were developed and evaluated as per the hedonic test score card for its sensory qualities and acceptability by consumer and semi-trained panel members of Vadodara. The developed products were found to be most acceptable without any digestive problems among the elderly consumer panel, with an average hedonic score of 7.6/9 which fulfilled almost one-third requirements of Recommended Dietary Allowances (RDA) for energy, protein, calcium, iron, and fiber for elderly. Ragi based products were found soft, easy to chew, digest, and very much liked and accepted. Thus this paper depicts the potential of ragi based products for elderly palate with poor nutritional status in different living arrangements.

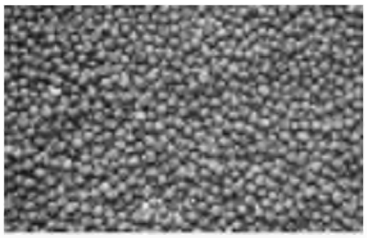
Keywords: Food Product, Ragi, Hedonic Test Score Card

Introduction

According to the population census 2011 there are nearly 104 million elderly persons (aged 60 years or above) in India, 53 million females and 51 million males [1]. Health risks for older people are malnutrition, micronutrition deficiency, physical inactivity, and adverse drug reaction [2]. Besides physical illness, they are more likely to be affected by poor mental health [3]. Department of Foods and Nutrition of The Maharaja Sayajirao University of Baroda studies have shown consistent gross nutritional deficiencies concerning energy, protein, beta-carotene, iron, vitamin-C (50-75% deficiency as compared to RDA) in the diet of the elderly [4]. India has an alarmingly high burden of VMDs (Vitamin and Mineral Deficiencies) which are iron, iodine, vitamin, zinc, and folic acid [5, 6, 7, 8].

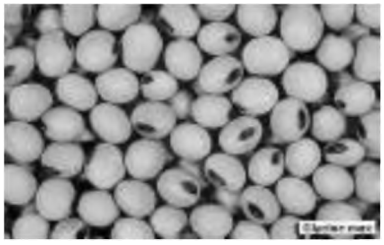
The food-based approach is one of the most cost-beneficial strategies involving multi-sectoral help from various departments to correct nutritional deficiencies in vulnerable groups. Thus in this context ragi, soybean, Niger seeds (black sesame seeds) were used to develop food products that were obtained from the Department of Gujarat State Forest Development Corporation Limited, Vadodara.

Ragi (Finger millet)



Ragi is rich in protein, fat, fiber, calcium and iron as compared to other cereals. Consumption of ragi based diets also found to have hypoglycemic effect which might be due to its higher fiber content or presence of anti-nutritional factors in whole finger millet which are known to reduce starch digestibility and absorption [9].

Soybean



The heart-protective mechanisms of soy phytoestrogens have been reported by researchers, such as improved lipid profiles, arterial compliance, prevention of LDL oxidation and lowering blood pressure and also have shown to improve bone health by preventing bone resorption and by enhancing bone formation [10]. Soy phytoestrogen appears to lower low-density lipoprotein concentrations while increasing plasma concentrations of the high-density lipoproteins. Particularly noteworthy to the high-density lipoprotein effects are the increases in apolipoprotein A-1 [11, 12].

Black sesame seeds/ Niger seeds



Black sesame seeds (niger seeds) are an extremely good source of calcium. They have high amounts of protein, phosphorous, iron, and magnesium and as a rich source of iron, are valuable in iron deficiency anemia too. After soaking one teaspoon of the seeds in warm water for a couple of hours, they should be ground and strained, and then mixed with a cup of milk and sweetened with jaggery or sugar. This emulsion should be given to patients suffering from anemia. Whole grains add fiber to the diet. Raw sprouted grains, nuts and seeds add enzymes that can speed potential healing. The black sesame seed is widely demanded in the market due to the

rich nutty taste and aroma.

Objectives of the study:

To develop different food products for the elderly out of ragi as base ingredient with soybean flour and niger seeds incorporation in the products as functional agents with the following objectives.

1. To formulate and develop micronutrient-rich recipes from millet, incorporating soybean and niger seeds.
2. To carry out organoleptic trials for the developed products.
3. To assess the nutritive value of the developed products by calculation.

Methodology

Both male and female elderly subjects aged 60 years and above belonging to the middle-income group from old age homes of Vadodara were selected and consent was taken. Two groups of 20 subjects each was taken as control and experimental group. The period for intervention was of 5 weeks. The socio-demographic profile, baseline data of elderly subjects shows 40 percent males and 60 percent females in old age homes out of which 50 percent each falls under 60-79 years and 80 years and above age group, 30 percent were married, 50 percent unmarried and 20 percent were widows. 95 percent belong to the Hindu religion and 35 percent were graduates, while 25 percent each have completed primary and high school education. 80 percent of subjects were unoccupied/ retired and 55 percent use their savings as a source of income followed by 30 percent through family and 10 percent through children and only 5 percent through their pension. 85 percent have a nuclear family background. Time spent in hours for daily activity patterns was maximum for sleep followed by daily activities. Nearly no time was spent in any religious or social activities. Anthropometric assessment like Height, Weight, BMI, Demispan, Demiquet, Mindex of subjects were studied. Dietary pattern was studied using 24-hour diet recall.

For the formulation of recipes, ragi was used as a base ingredient along with soy flour and niger seeds. All the ingredients were procured from the Gujarat State Forest Development Corporation Limited, Vadodara. Seven recipes were developed out of ragi namely laddu, biscuits, thepla, thor, halvasan, Mohan thal, choco balls following the traditional method of their preparation. Once the products were developed in the food laboratory, they were evaluated for their sensory characteristics through a nine point hedonic test scorecard by semi-trained and consumer panels of Vadodara. Hedonic rating test is judgment of whole food or its attributes from liked extremely to dislike extremely. Semi trained panelists were the group of individuals from the Department of Foods and Nutrition who have scientific knowledge of sensory evaluation whereas consumer panels were the group of elderly individuals for whom the products were formulated to be consumed. The nutritive value of the products was calculated from the Nutritive Value of Indian Foods [13].

Results & Discussion

Ragi a very good source of calcium, fiber, iron, and protein, was considered as a base substitute of recipes with the incorporation of soybean flour and niger seeds. Designer ragi based traditional recipes of Gujarat along with choco rolls were formulated [14]. Table 1 depicts standardized recipe composition substituted with ragi base and functional foods. The quantity of ragi flour used varied from 50 grams to 30 grams for the product to be standardized. Soy flour varied from 15 grams to 50 grams whereas niger seeds varied from 10 grams to 5 grams as per the requirement of the recipe to be standardized. Since the recipes were standardized as per their traditional methods so other ingredients were taken into account as per their requirements. To the recipes, the desired taste was obtained by adding required flavoring agents/ herbs/condiments, etc. as per the demand of the item. In most of the recipes, ragi was able to form a good substitute except mohan thal where more amount of bengal gram flour was used to meet the proper outcome of the product in proportion to ragi flour.

Table 2 depicts the nutrient composition of the ragi based developed products for the elderly. This shows that ragi laddu, biscuits, thepla, and halvasan met on average 25 percent of RDAs [15, 16] for energy whereas ragi thor, mohanthal met on average 17 percent, and choco rolls met 10 percent of RDAs of energy for elderly. The requirement of protein as per RDAs for elderly was met maximum by thepla 17 percent, on average 13 percent by laddu, biscuits and halvasan, and between 7 to 5 percent from mohanthal and choco rolls. Availability of iron as per elderly RDAs was met on average maximum by 15 percent through laddu, biscuits, and thepla, and between 2 to 4 percent by thor, halvasan, mohanthal and choco rolls. Calcium as per RDAs for the elderly was met 40 percent from choco rolls, followed by 35 percent from halvasan. On average 16 percent calcium was met from laddu, biscuits and thepla, and between 7 to 4 percent from thor and mohanthal.

All the food items were subjected to sensory evaluation by the semi-trained and consumer panel for understanding the acceptability. The hedonic rating test is a nine-point scale [17, 18]. The mean score of the panelist is shown in Figure 1. Ragi laddu scored 7.9 out of 9 which showed that most of the panels liked food attributes such as taste, flavor, texture, color, and overall appearance of the laddu. Ragi thepla scored 7.8/9 which showed that again its taste, appearance, texture was accepted by our panels. Ragi thor scored 7.7/9 which indicates that it was accepted for its texture, flavor, taste, and appearance. Ragi mohanthal scored 7.6/9 showed that inculcation of ragi flour with bengal gram flour was liked by our panels concerning its flavor, taste, and texture. Ragi halvasan scored 7.5/9 indicates that it was accepted for flavor, texture, and taste. Ragi biscuits scored 7.3/9 which was quite acceptable in terms of texture, taste specifically because of

chocolate flavor and appearance by our panels. Ragi choco rolls scored 7.4/9 which showed that it was preferred for its flavor, taste, and texture. Thus it was observed that ragi laddu on a nine point scale scored maximum followed by ragi thepla, ragi thor, ragi mohanthal, ragi halvasan, ragi choco balls, and ragi biscuits respectively. The scores indicate that all the products were liked moderately by the panels.

Intervention of ragi based products show no change in the percent of underweight, normal, overweight, and obese male and female subjects before and after intervention. With biochemical parameters, the systolic and diastolic pressure was normal after intervention. Hemoglobin levels improved in both males and females whereas severity in anemia was decreased showing 7.6 percent subjects shifted from severe category to mild category after intervention. Mean lipid profile values show no adverse effect after the intervention of developed ragi products. In the experimental group after intervention overall decrease was seen in LDL, total cholesterol, and triglyceride levels in the blood. Fasting blood glucose levels were decreased because of the hypoglycaemic activity of ragi and soy flour in the products but were not much significant. Nutrient intake for energy, protein, calcium, fiber, iron, vitamin-C, Beta-carotene was improved after intervention. Disease profile covering the severity of minor illness in elderly subjects was reduced on average of 15 percent. Problems of gastrointestinal tract like lack of appetite, acidity, constipation, and general body aches was reduced. 40 percent improvement in the mental health status of the subjects as per MMSE scores was found after the intervention. For physical strength improvement in the grip strength of male subjects was 25 percent and 12 percent in female subjects after intervention. The mean time taken by the elderly for five rises from chair improved after intervention for both genders.

Conclusion

The developed ragi based products on average met almost one-third requirements of Recommended Dietary Allowances (RDA) for energy, protein, calcium, iron, and fiber for the elderly. The ragi laddu satisfied one third RDA requirements of the elderly. Two biscuits, two theplas, ten pieces of ragi thor, ten pieces of mohanthal, four pieces of ragi halvasan and two choco rolls provided good nutrition options. The Ragi based food products were found to be most acceptable without any digestive problems among the institutionalized elderly. Developed designer Ragi products were soft, easy to chew, and digest and very much liked and accepted depicting the potential of large scale supplementation to elderly with poor nutritional status for improving quality of life.

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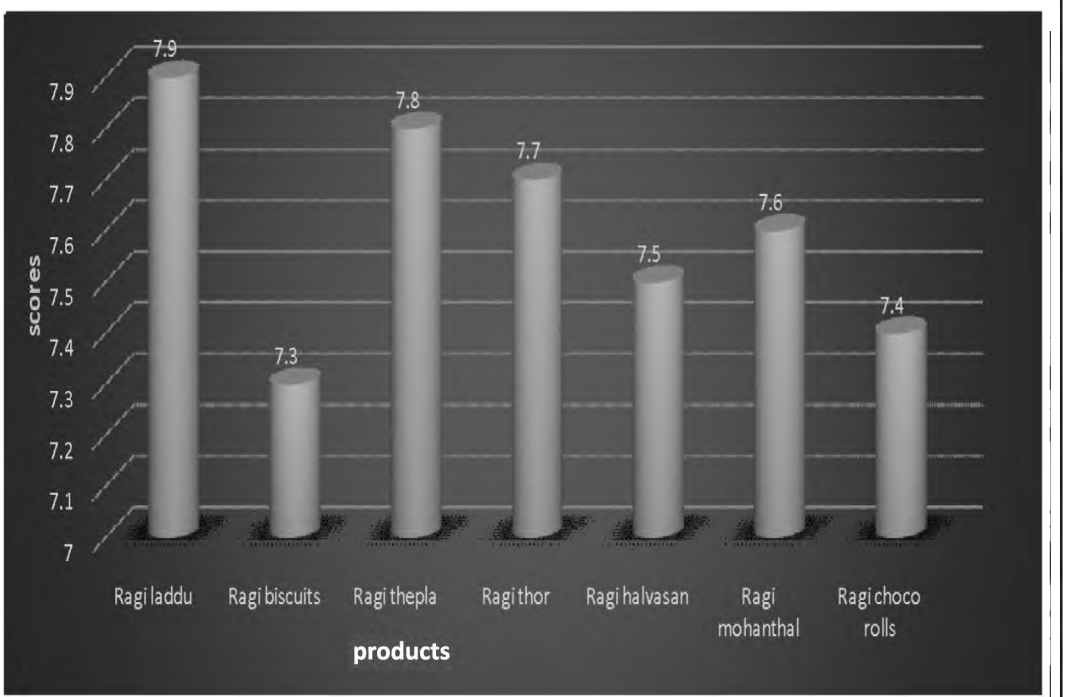


Figure-1: Mean scores of developed products by 9 point hedonic rating scale

Table -1: Formulation of Ragi based food products

Sr. No	Developed Product	Ragi flour	Soya bean flour	Rice flour	Maida	Niger seeds	Jaggery	Ghee	Curd	Oil	Salt	Sugar	Milk	Gunder powder	Bengal gram dhal flour	Drinking chocolate powder		Cocoa powder	Khoa
1.	Ragi laddu	50g	15g	-	-	10g	37g	20g	-	-	-	-	-	-	-	-	-	-	-
2.	Ragi biscuit	50g	15g	-	-	10g	20g	37g	-	-	-	-	-	-	-	-	-	-	-
3.	Ragi thepla	30g	15g	-	-	5g	15g	-	10g	10ml	To taste	-	-	-	-	-	-	-	-
4.	Ragi thor	40g	50g	5g	40g	-	-	40g	-	For frying	-	100g	-	-	-	-	-	-	-
5.	Ragi halvasan	30 g	-	-	-	-	-	5g	15g	-	-	150g	150ml	5g	-	-	-	-	-
6.	Ragi mohanthal	25g	-	-	-	-	-	75g	-	-	-	75g	10 ml	-	75g	-	-	-	-
7.	Ragi choco rolls	20g	-	-	-	-	-	10g	-	-	-	25g	20 ml	-	-	5g	10 g	1.25g	20 g

Sr. No	Developed product	Energy (Kcal)	Protein (g)	Iron (mg)	Calcium (mg)
1.	Ragi laddu	370.00	7.24	5.47	143.00
2.	Ragi biscuits	370.00	7.24	5.47	143.00
3.	Ragi thepla	326.00	9.51	4.27	172.10
4.	Ragi thor	202.80	5.44	1.75	59.90
5.	Ragi halvasan	310.50	7.18	0.39	301.50
6.	Ragi mohanthal	269.20	3.59	1.02	31.60
7.	Ragi choco rolls	163.20	2.80	0.70	351.46

Table-2: Nutritive value of developed products (Gopalan.C et.al, 2010)