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# Development of value added product with ragi and analyze the mineral content

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Finger millet or ragi is one of the ancient millets in India (2300 BC). Of all the cereals and millets, finger millet has the highest amount of calcium (344 mg %) and potassium (408 mg %). It has higher dietary fibre, minerals and sulfur containing amino acids compared to white rice, the current major staple in India. The present study was carried out with objective to develop fortified mathri using non-germinated and germinated ragi flour and assess the organoleptic acceptability and analyze the mineral content (calcium, phosphorus and iron) of developed products. Ragi provides highest level of calcium, antioxidants properties, phytochemicals, which makes it easily and slowly digestible. Hence, it helps to control blood glucose levels in diabetic patients very efficiently. The recipe was standardized and subjected to organoleptic evaluation by a panel of semi-trained judges using 9-point hedonic scale. The overall organoleptic acceptability of the control mathri was 7.0 ± 1 and the mean score of developed mathri 20 per cent and 30 per cent fortified with ragi flour and germinated ragi flour sample were 6.2±1.30, 6±0.70, 7±0.70 and 7.4±0.54, respectively. It was observed that mathris prepared with fortification of 30 per cent germinated ragi flour were the most acceptable and liked by the panel of members. The results of the analysis indicated that Ca content was 198.9, Fe was 2.19 and P was 92 mg/100g in the control mathris. On the other hand, mathri fortified with 20 per cent and 30 per cent germinated ragi flour contained high content of Ca (329.0 and 394.1 mg/100g, respectively). This shows that the germination increases the calcium content in ragi. Regarding the level of iron, fortification of mathris with non-germinated ragi flour at 20 per cent and 30 per cent levels increased the iron content. Iron was found to be 2.68 and 4.06 mg/100g in the non-germinated ragi flour fortified mathris. While, in the mathris that were fortified with germinated ragi flour at 20 per cent and 30 per cent levels had comparably higher iron content. Level of phosphorus in non-germinated ragi flour fortified mathris (20% and 30% levels) had 96 and 148 mg/ 100g and germinated ragi flour had phosphorus 172 and 256 mg/100g.

**Key Words :** Ragi, Germinated ragi flour, Fortified mathri, Organoleptic evaluation, Mineral content

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## INTRODUCTION

Finger millet or ragi is one of the ancient millets in India (2300 BC) and this review focuses on its antiquity, consumption, nutrient composition, processing and health benefits. Of all the cereals and millets, finger millet has the highest amount of calcium (344 mg %) and potassium (408 mg %). It has higher dietary fibre, minerals and sulfur containing amino acids compared to white rice, the current major staple in India. 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,

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popping and decortication. Noodles, vermicilli, pasta, Indian sweet (*Halwa*) mixes, papads, soups and bakery products from finger millet are also emerging (Shobana *et al*., 2013).

Finger millet (Ragi, *Eleusine coracana*) is an important staple food in the eastern and central Africa as well as some parts of India (Majumder *et al.*, 2006). It is rich in protein, iron, calcium, phosphorus, fibre and vitamin content. The calcium content is higher than all cereals and iodine content is said to be highest among all the food grains. Ragi has best quality protein along with the presence of essential amino acids, vitamin A, vitamin B and phosphorus (Gopalan *et al*., 2004). Thus, ragi is a good source of diet for growing children, expecting women's, old age people and patients.

Ragi provides highest level of calcium, antioxidants properties, phytochemicals, which makes it easily and slowly digestible. Hence, it helps to control blood glucose levels in diabetic patients very efficiently. The bulkiness of the fibres and the slower digestion rate makes us feel fuller on, fewer calories and therefore may help to prevent us from eating excess calories. Therefore, 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 and Lakshmi and Sumathi, 2002). The finger millet contains important amino acids *viz.*, isoleucine (4.4 g), leucine (9.5 g), mthionine (3.1 g) and phenylalanine (5.2 g) which are deficient in other starchy meals. Finger millet is normally consumed in the form of flour-based foods such as *Roti* (unleavened pancake), *Mudde* (stiff porridge/dumpling) and *Ambli* (thin porridge) and each of these foods have their characteristics features. The detail preparation methods have been reported by (Malleshi, 2007).

Traditionally ragi is processed either by malting or fermentation (Rao and Muralikrishna, 2001). There are various benefits of malting such as vitamin-C is elaborated, phosphorus availability is increased and lysine and tryptophan are synthesized (Desai *et al.*, 2010). The malted and fermented ragi flour are extensively used in preparation of weaning food, instant mixes, beverages and pharmaceutical products (Rao and Muralikrishna, 2001). Food uses of millets have, however, been confined only to traditional consumers; limited especially to areas of their cultivation and still have remained underutilized. Processing them using traditional as well as contemporary methods for preparation of value added and convenience products would certainly diversify their food uses. Their exploitation for preparation of ready-to-use or ready-to-cook products would help in increasing the consumption of millets among non-millet consumers and thereby nutritional security.

**Objectives:**

Considering the above facts, the study was aimed to develop fortified mathri using non-germinated and germinated ragi flour and assess the organoleptic acceptability and analyze the mineral content (calcium, phosphorus and iron) of developed products.

## METHODOLOGY

**Locale of the study:**

The present study was carried out in the Department of Food Science and Nutrition, College of Community and Applied Sciences, MPUAT, Udaipur.

**Plan of the study:**

Preparation of sample, sensory evaluation and mineral content analysis of the products prepared from non-germinated and germinated ragi flour, as well as their control products.

The materials used and method adopted in the experiments conducted for attainment of various objectives has been elaborated in this section, under the following heads:

**Selection of recipes:**

Today, the incidence of different public health diseases as protein energy malnutrition, cardio-vascular disease, diabetes, osteoporosis and other bone diseases, celiac diseases etc. is increasing day by day. It is very important to maintain health through diet with medicine in various diseases. Keeping in view the nutritional benefits of ragi, it was selected for product development in the present project.

**Standardization of recipes:**

*Planning of recipes*:

One recipe was selected *i.e.* mathri- made by refine, non-germinated and germinated ragi flour the recipe was standardized.

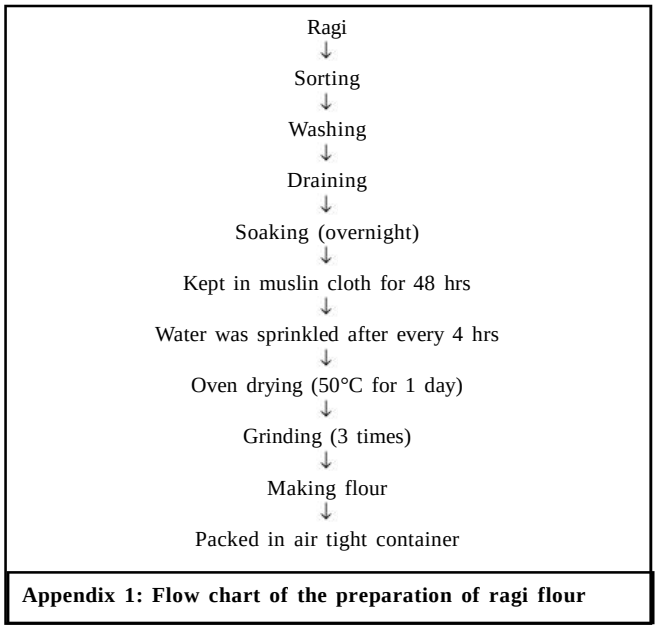
*Procurement of raw materials*:

Ragi was made available by the foods lab of

department of Foods and Nutrition, College of Home Science, MPUAT, Udaipur.

*Preparation of sample*:

The ragi was first sorted and cleaned and then washed with water for 5 times and soaked in water for 8 hours. Excess water was drained, seeds were tied in a muslin cloth. These seeds were germinated at room temperature for 48 hours and oven- dried. The germinated ragi seeds were grounded into flour by using the electric grinder (Appendix 1).




**Appendix 1: Flow chart of the preparation of ragi flour**

## Equipments:

The following equipments were used in the preparation of sample and products:

– Kadhai – Stirrer-stainless steel ladle
– Grinder – Weighing balance
– Microwave oven – Measuring spoon/cups

*Development of products*:

Recipe of mathri was standardized
Preparation time: 10-15 minute,
Cooking time: 10 minute, Amount: 4

## Method:

– Sift the flour, add salt and *Ajwain* and rub in the oil with finger tips.
– Make a stiff dough using water.
– Cover it and leave for 20-30 min.
– Divide the dough into 4 portions and make balls.
– Roll it to thick rounds.
– Insert a whole black pepper in the center and prick with fork.
– Heat oil and fry mathris on slow fire till golden brown on the both sides.
– Drain on brown paper (Appendix 2).

## Sensory evaluation of developed products:

The acceptability of ragi fortified mathri and germinated ragi fortified mathri were evaluated by a panel of 10 judges using 9-point Hedonic Scale (Ranganna, 1986) to test the liking or disliking of products. Semi-trained panel did the evaluation. The panelist asked to record the level of liking or disliking by giving marks for various characteristics of the products. The samples were rated on 9 point Hedonic scale for quality attributes according to following grade descriptions and scoring.

## Analyze the mineral content (Calcium, phosphorus and iron) of developed products:

Phosphorus was determined colorimetrically by the

**Appendix 2 : Recipe for mathri**

| Ingredients | Amount (in g) | | | | |
|---|---|---|---|---|---|
| | Control | 20% fortification with ragi flour | 30% fortification with ragi flour | 20% fortification with germinated ragi flour | 30% fortification with germinated ragi flour |
| Refined flour | 25 | 20 | 17.5 | 20 | 17.5 |
| Ragi flour | - | 5 | 7.5 | - | - |
| Germinated ragi flour | - | - | - | 5 | 7.5 |
| Oil | 2 tbsp | 2 tbsp | 2 tbsp | 2 tbsp | 2 tbsp |
| *Ajwain* seeds | 1/8 tsp | 1/8 tsp | 1/8 tsp | 1/8 tsp | 1/8 tsp |
| Whole black pepper | 4 corn | 4 corn | 4 corn | 4 corn | 4 corn |
| Water | Acc.to need | Acc. to need | Acc. to need | Acc. to need | Acc. to need |
| Salt | Acc. to taste | Acc. to taste | Acc. to taste | Acc. to taste | Acc. to taste |

method given in USDA Hand Book No. 60 (1954). Calcium and iron in acid digested samples were determined by Atomic Absorption Spectrophotometer according to the method of Lindsey and Norwell (1969).

## OBSERVATIONS AND ASSESSMENT

The present study was undertaken to develop and analyse the ragi fortified mathris for their mineral content. The findings of the study are presented in the following tables:

**Sensory evaluation / Organoleptic acceptability:**

Mathris were served to the panel members for sensory evaluation and the results obtained were presented here. Table 2 shows the mean score of overall acceptability obtained by organoleptic evaluation between control and developed sample. The table shows that the overall organoleptic acceptability of the control mathri was 7.0 ± 1 and the mean score of developed mathri 20 per cent and 30 per cent fortified with ragi flour and 20 per cent and 30 per cent fortified with germinated ragi flour sample were 6.2±1.30, 6±0.70, 7±0.70 and 7.4±0.54, respectively.

It was observed from the Table 1 that mathris prepared with fortification of 30 per cent germinated ragi flour were the most acceptable and liked by the panel of members, followed by mathris prepared with fortification of 20 per cent germinated ragi flour, control and mathris fortified with ragi flour 20 per cent and 30 per cent, respectively.

**Mineral content**

The total mineral content of prepared mathris are summarized in Table 2. The Ca, Fe and P level were analyzed. The results of the analysis indicated that Ca content was 198.9, Fe was 2.19 and P was 92 mg/100g in the control mathris. On the other hand, mathri fortified with 20 per cent and 30 per cent germinated ragi flour contained high content of Ca (329.0 and 394.1 mg/100g, respectively). This shows that the germination increases the calcium content in ragi. Since ragi is calcium rich, its fortification (non-germinated ragi flour) at 20 per cent and 30 per cent levels increased the calcium content in the mathris as compared to the control mathris, *i.e.* 268.0 and 300.6 mg Ca/ 100g, respectively.

Regarding the level of iron, it was observed that, fortification of mathris with non-germinated ragi flour at 20 per cent and 30 per cent levels increased the iron content. Iron was found to be 2.68 and 4.06 mg/100g in the non-germinated ragi flour fortified mathris. While, in the mathris that were fortified with germinated ragi flour at 20 and 30 per cent levels had comparably higher iron content.

Level of phosphorus in the control mathris was found to be 92 mg/100g. Non-germinated ragi flour fortified mathris (20% and 30% levels) had 96 and 148 mg P/ 100g. The mathris that were fortified with germinated

**Table 1 : Mean score of organoleptic acceptability of developed mathri**

| Sr. No. | Parameters | Study group products | | | | |
|---|---|---|---|---|---|---|
| | | Control | 20% fortification with ragi flour | 30% fortification with ragi flour | 20% fortification with germinated ragi flour | 30% fortification with germinated ragi flour |
| 1. | Colour | 7.6±0.89 | 6.6± 1.34 | 6±1.41 | 6.8±1.30 | 6.8±1.30 |
| 2. | Flavour | 7.2± 0.44 | 6.2± 0.83 | 6.4±0.89 | 7±0.70 | 7.2±0.44 |
| 3. | Appearance | 7± 0.70 | 5.8± 0.83 | 6.2±0.83 | 6.6±0.54 | 6.8±0.44 |
| 4. | Texture | 7.4± 0.54 | 6.4± 1.14 | 6.2±1.09 | 6.8±0.83 | 6.8±0.83 |
| 5. | Mouth feel or taste | 7.6±0.89 | 6.4± 1.14 | 6.8±1.09 | 6.6±1.34 | 7±0 |
| 6. | Overall acceptability | 7±1 | 6.2±1.30 | 6±0.70 | 7±0.70 | 7.4±0.54 |

**Table 2: Total calcium, iron and phosphorus in developed mathri (mg/100g, on dry matter basis)**

| Sr. No. | Mineral composition | Study group products | | | | |
|---|---|---|---|---|---|---|
| | | Control | 20% fortification with ragi flour | 30% fortification with ragi flour | 20% fortification with germinated ragi flour | 30% fortification with germinated ragi flour |
| 1. | Calcium | 198.9 | 268.0 | 300.6 | 329.0 | 394.1 |
| 2. | Iron | 2.19 | 2.68 | 4.06 | 4.75 | 5.44 |
| 3. | Phosphorus | 92 | 96 | 148 | 172 | 256 |

ragi flour had phosphorus 172 and 256 mg/100g.

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