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# Formulation and Nutritional Assessment of Recipes En Route for Awareness of Coarse Rice Consumption

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## Abstract

Rice is one of the oldest domestic crops being consumed by the human kind centuries back; it has been popular and a common staple food for people across the world. Rice grain has undergone various genetic evolutions for centuries. Presently, a variety of crops are grown with altered genetic nature, induced with highly toxic fertilizers and chemical insecticides. The quantity of harvest is more concerned than the quality of the grains. Being the staple food for millions of people in Asian countries, it has been portrayed as the main cause for many deadly diseases. The chapter involves in creating awareness in rice consumption through formulating healthy common recipes formulated and infused with coarse rice varieties.

**Keywords:** coarse rice, healthy food, nutrition, recipes

## 1. Introduction

Globally, the food pattern is getting worse and adversely influenced by the ostentatious behavior among the younger generations. Among the feature that manipulates healthy eating, unavailability of healthy food commodities acts as the prime fact [1]. Consumption of food in its natural state has become extinct; artificial treatments of food commodities are widespread. Food in its natural state is more nutritious and wholesome with all essential requirements; once been treated or fragmented, the food is malformed from its actual value. The food commodities are chemically treated for a long shelf life due to commercialized and industrial motives.

Rice is a staple food being commonly consumed across many countries and been portrayed as the best branded crop with good genetic map [2]. During the crop year 2016–2017, worldwide 161.1 million hectares of land was under rice cultivation, and India was the prime producer of rice to harvest 44.5 million hectares [3]. Rice varieties are categorized upon the aspects like texture, shape, length, aroma, and color.

The nutritious compilation of rice is highly influenced by the environmental facts like soil, irrigation, and climatic conditions. Rice is a composition of carbohydrate-starch (75–80%) [4]; vitamins such as thiamine, niacin, and riboflavin [5]; highly digestible protein; and water (12%). About 302 proteins are recognized in

proteome of the rice seeds that symbolize 252 gene products [6]. Besides this, rice is also rich in other micronutrients and minerals such as copper, iron, manganese, calcium, phosphorous, and zinc [7].

Rice is nutritious with low fat and sodium that prevents high blood pressure and cardiovascular diseases. It is gluten free and rich in fibers that fight against cancerous cells [8]. Rice being a staple food consumed in its natural state possesses all values of importance; being chemically treated, polished, and packed, it loses its significance.

The rice paddy undergoes a number of refining processes to turn out to be white rice; at the intermediate stage, the rice with outer bran and germ portion called brown rice is being processed, that is, removal of outer bran layer which is called the white rice. The brown rice contains five times more fiber content than the white rice [9]. The presence of outer bran layer enhances these rice varieties in its nutritional value, color, taste, texture, and flavor. Coarse rice varieties are nutty and chewy in nature; also takes an extra cooking time compared to white rice. Coarse rice is categorized upon the size of the rice and the thickness of bran layer present in the rice that determines its color [10].

Brown rice, wild rice, or coarse rice is consumed more in the rural regions of the country. These unpolished rice or brown rice accompanied with an outer covering called bran makes the rice wholesome with fibers, minerals, and vitamins [11]. At the side of the nutritious facts, consumption of these coarse rice varieties helps the farmers in developing their economic background. The farmer can recover about 7.5 kg of brown rice from 10 kg of paddy, whereas by further milling, the cost of white rice is increased by 50–60%, while the quantity is reduced to 6.5 kg [12]. Production cost of coarse rice is comparatively lesser than the white rice [13]; the demand for the white rice has reduced the production of brown rice and made it a premium product; thus, an increase in consumption of these coarse rice varieties may bring more varieties of brown rice into the market [14].

In an urge to search for healthy diet, many traditional rice varieties have been restored and brought into regular consumption beside using only for family functions and religious rituals. These rice varieties have also taken a prime role in the diet pattern of people in urban regions. All over the world, many traditional rice varieties have been recovered; these restored rice varieties can withstand climatic changes and can give a good yield with natural organic fertilizers and insecticides.

In the study area, many traditional rice varieties have been restored and brought into practice some such popular varieties used in the formulation of recipes are mapillai samba arisi (groom samba rice), karuppu kavuni arisi (black cow rice), kattu yanam arisi (wild rice), moongil arisi (bamboo rice), and red glutinous rice (sigappu kavuni arisi) [15].

These coarse rice are regaining their lost values as they are organic in nature with no additives or undergone any chemical treatments. The study enumerates some simple and common sweet recipes of these rice varieties.

## **2. Materials and methods**

The study involves formulation of recipes with the available coarse rice varieties commonly found in southern part of India. There exist no special criteria in selection of recipes; besides the only factor considered is the recipe to be common and consumable at any time with no restriction to age.

The common sweet recipes consumed in India are formulated and infused with these coarse rice varieties. The ingredients (**Table 1**) required for the study are procured from the nearby organic stores, and the recipes' formulation and preparation were done.

Ingredients	Kheer (g)	Pan cake	Puttu (g)	Kolukattai (g)	Laddoo	Kesari
Rice	200	200 g	200	200	200 g	200 g
Jaggery	200	100 g	–	100	–	–
Coconut	50	25 g	200	100	–	–
Ghee	50	50 ml	–	–	50 ml	50 ml
Cashew nut	20	10 g	–	10	25 g	20 g
Sultanas	10	–	–	–	–	20 g
Cardamom	5	5 g	5		5 g	5 g
Palm sugar	25	50 g	100	50	200 g	200 g

*Note: the table lists out the ingredients used in formulating recipes.*

**Table 1.**  
*Ingredients used in the recipes.*

The mise-en-place is done before the initiation of cooking. The rice varieties, coconut, and palm sugar are grated or blended as per the requirement for the recipes. The jaggery is made into thick syrup and filtered to remove the residues and used for cooking, which also reduces the cooking time.

**2.1 Methods of preparation**

The recipes have their own methods of cooking. The formulated recipes are preferred to be prepared with organic natural sweeteners like palm sugar or jaggery than refined white sugar. Palm sugar and jaggery are natural sugars, and enhances the recipes with their natural flavor, color, and taste. They are rich in micronutrients and vitamins [16].

The methods of preparations of the recipes are listed below:

- Mapillai samba rice kheer:
  - Cook the rice and coarsely smash and keep aside.
  - In a large pan, add ghee, roast sultanas, and cashew nut.
  - Add required amount of water and let it boil.
  - Add natural sweeteners, palm sugar and jaggery syrup, and the smashed rice.
  - Reduce the flame and then add coconut milk slowly.
  - Mix well and finally add a pinch of salt and cardamom powder.

Serve the recipe hot or refrigerated; it can be diluted with coconut milk if been thick. Garnish with roasted nuts and sultanas.

- Black kavuni rice pan cake:
  - The rice has to be soaked for 2 h at least.
  - Grind well the rice into a thick paste and dilute it with thick coconut milk for a rich taste.

- Add chopped nuts, grated coconut, and a pinch of salt and cardamom powder.
- Let the batter rest for a few minutes and then finally add the jaggery syrup and palm sugar.
- Then start making pan cakes and serve hot.
- **Wild rice puttlu (Figure 1):**
  - The wild rice is cleaned, washed, shade dried, and grinded in a blender.
  - Sieve the flour and add the cardamom powder.
  - Slightly sprinkle a small amount of salt water mix well and add grated coconut gradually and steam cook the mixture for 20 min.
  - Remove it from the heat, add finely powdered palm sugar, garnish with grated fresh coconut, and serve hot.
- **Bamboo rice kolukattai (modak):**
  - **Stuffing:**
    1. In a hard bottomed pan, add ghee and then grated coconut, and saute well for 5 min.
    2. Gradually add the jaggery syrup and palm sugar to the coconut and then the chopped cashew nuts.
    3. Mix well the mixture as the water reduces remove from flame and keep aside and let it cool.
  - **Dough:**
    1. Sieve the bamboo rice flour with salt and add hot water to it gradually and mix well to turn into soft dough. Let the dough cools.
    2. Put the soft dough in a modak die with the stuffing in the center and keep it aside.
    3. Arrange the stuffed dough in a steamer and cook the preparation for 30 min and serve hot.
- **Navara rice laddoo (Figure 2):**
  - Roast the rice into a golden brown color and grind it well.
  - Sieve the flour, add a pinch of salt and cardamom powder, and mix it well.
  - Take a thick bottomed pan heat and add ghee.
  - Gradually add the rice flour mixture and then powdered palm sugar and mix well.



- Stir well till the flour and palm sugar mixes well; add roasted cashew nut to enrich the taste; add ghee if required.
- Once the mixture blends well, remove from the fire and make small balls (lemon size) out of the mixture.
- **Rose matta rice kesari (Figure 3):**
  - Roast the rice, let it cool, and grind coarsely.
  - In a large pan, roast the sultanas and cashew nut into golden brown color then add water and let it boil.
  - Add palm sugar and boil the mixture for few minutes.
  - To the hot water mixture, add the coarsely grinded rice slowly without forming lumps. Let the mixture cook well and add ghee gradually.
  - Garnish with roasted cashew nut and sultanas. Serve hot.



**Figure 1.**  
*Wild rice puttu.*



**Figure 2.**  
*Navara rice laddoo.*



**Figure 3.**  
*Rose motta rice kesari.*

The formulations of sweet recipes are more concerned for health concepts; besides the ingredients used in recipes, the healthy cooking methods like boiling and steaming are more considered in the preparations.

The recipes formulated can also be infused with other varieties of coarse rice with same methods of preparation, while there is a small alter in cooking time depending upon the variety of coarse rice used in the recipe.

## 2.2 Assessment of nutritional composition of the recipes

The recipes were analyzed for the importance of nutritional composition; the prepared samples of rice recipes are sent to the Food Science Laboratory. The recipe samples were homogenized with electric blender and dried in electric oven. These dried rice recipe samples are blended into powder and used for the examination. The moisture content, fat, protein, and carbohydrates energy were calculated, and further analysis was carried out to exhibit the presence of minerals and micronutrients like iron, calcium, zinc, and vitamins.

Moisture content and total ash of the rice recipes were determined according to the standard methods of IS 1011 [17]. Protein was determined by IS 7219 [18], the micro-Kjeldahl method that determined the amount of nitrogen in the sample, which was subsequently multiplied by a factor of 6.25. Total fat in the sample was determined using Soxhlet extraction apparatus [Model Soxtherm Automatic by AOAC ] [19]. The remaining percentage represented carbohydrates by difference (Food and Agriculture Organization of the United Nations) [20]. Energy was calculated from fat, carbohydrate, and protein contents using Atwater's conversion factors (Food and Agriculture Organization of the United Nations) [21].

Minerals such as zinc, calcium, and iron were determined by following the method of AOAC (20th edition) 999.11:2016 [22], AOAC (20th edition) 927.02 [23], and AOAC (20th edition) 975.03 [24], respectively. Vitamins like A, E, C, B<sub>1</sub>, B<sub>2</sub>, and B<sub>3</sub> were determined by following the method AOAC. Vitamin A and E were analyzed by AOAC method of 992.06 [25]. Vitamin C was estimated by AOAC [26] method 967.21, whereas vitamin B<sub>1</sub> by AOAC [27] method of SMPR 2015.002. Vitamin B<sub>2</sub> and B<sub>3</sub> contents were estimated by AOAC [28] method of SMPR 2015.003 and AOAC [29] method of SMPR 2015.004, respectively.

### 3. Results and discussions

The study was carried out to bring out awareness about the consumption of rice in its actual state than chemically treated or polished. Being the staple food in many countries, our meal revolves around rice or rice products; consumption of rice is an unavoidable fact but the white rice can be replaced with these coarse rice varieties. Many countries have initiated creating awareness programs toward the consumption of these coarse rice varieties. They explain the positive effects of consuming coarse rice by organizing exhibitions on rice varieties, conducting cooking competitions, food festivals, posting in social media, etc.

The study enlists few common sweet recipes formulated and infused with these traditional and wholesome coarse rice varieties. The sweet recipes are too common and consumed all over the country (**Table 2**).

#### 3.1 Mapillai samba rice kheer

The kheer is a sweet dish popularly called payasam in south India, which is consumed in all parts of the country with different names [30]. Formulation of kheer with mapillai samba rice and coconut milk makes it more healthy and nutritious. The recipe is rich in iron (8.872 mg) and zinc (3.58 mg) that helps to maintain a healthy nervous system as the rice itself is rich in these micronutrients [31]. Vitamins like vitamin C (61.8 mg), niacin (2.06 mg), and riboflavin (1.48 mg) present in the recipes make the recipe nutritious.

#### 3.2 Black kavuni rice pan cake

Black kavuni rice has a high esteem value being consumed by royal peoples; the rice is energy rich a good source of protein [32] and all phyto-chemical contents [33], and the nutrients are naturally present in the plants. The rice is a good source of vitamin B12 and has a high glycemic index [34] that reduces the accumulation of hepatic fat and helps to recover liver damages [35]. The pan cake recipe is rich in calcium (340.25 mg), phosphorus (1030 mg), and vitamin B12 cobalamin (12 mg). The recipe with black rice is rich in antioxidants that help to fight cancer and cardiovascular diseases.

#### 3.3 Wild rice puttlu

Puttu is a steamed dish commonly consumed in southern part of India. It can be prepared with any rice variety or millets [36]. The recipe is rich in magnesium (385 mg) and vitamin B5 pantoic acid (9.43 mg) and a good source of fibers (12.405 g). The nutrients and fiber present in the recipe help in treatment for constipation and diabetic patients [37].

#### 3.4 Bamboo rice kolukattai (modak)

Bamboo rice is one among the staple food of the tribal peoples [38]. The recipes made out of bamboo rice are healthier and nutritive as it is recommended for the pregnant ladies to compensate diet needs [39]. The recipe is rich in calcium (232.5 mg), potassium (247 mg), and magnesium (286 mg); it helps in fighting cholesterol and maintains blood pressure.



Parameter	Composition (mean value) of nutrients in the recipes					
	Kheer	Pan cake	Puttu	Kolukattai	Laddoo	Kesari
Moisture (g)	122.93 ± 0.12	52.19 ± 0.41	40.6 ± 0.77	30.99 ± 1.01	15.075 ± 0.12	50.532 ± 0.66
Protein (g)	21.1 ± 0.19	18.48 ± 0.14	25.91 ± 0.12	20.02 ± 0.69	21.41 ± 0.94	20.35 ± 0.47
Total fat (g)	81.215 ± 0.11	66.25 ± 0.01	83.21 ± 2.1	46.84 ± 0.31	63.035 ± 1.45	60.69 ± 1.98
Minerals (g)	4.05 ± 0.45	4.335 ± 0.02	5.07 ± 0.4	3.84 ± 0.04	5.67 ± 0.17	5.55 ± 0.1
Fiber (g)	7.665 ± 0.4	8.535 ± 0.51	12.405 ± 0.94	8.53 ± 0.44	4.73 ± 0.004	17.665 ± 0.14
Carbohydrates (g)	383.54 ± 0.32	357.21 ± 0.12	280.805 ± 0.31	314.78 ± 0.11	361.08 ± 0.14	359.965 ± 7.1
Energy (kcal)	2341.4 ± 4.11	2060.55 ± 0.98	1920.45 ± 2.1	1742.1 ± 0.6	2018.45 ± 1.33	1988.65 ± 0.78
Calcium (g)	260.25 ± 0.14	340.25 ± 1.4	281.5 ± 2.39	232.5 ± 1.89	489 ± 3.95	286.5 ± 1.30
Phosphorus (mg)	579 ± 1.9	492 ± 1.77	652 ± 4.0	567 ± 7.4	528.5 ± 1.21	506 ± 2.14
Iron (mg)	8.872 ± 0.9	5.251 ± 0.12	4.83 ± 0.89	6.221 ± 0.2	3.0825 ± 0.14	1.63 ± 0.03
Note: the table exhibits the mean result of nutritional values from laboratory analysis report.						

**Table 2.**  
Nutritious assessment of the formulated recipes.

### **3.5 Navara rice laddoo**

Navara rice is a popular variety of rice used in Kerala Ayurvedic medicines, which help in treating arthritis and many neuro disorders [40]. The recipe has protein (21.41 g), vitamin C (73.1 mg), and niacin (4.201 mg). This rice variety is more helpful to reduce pain due to arthritis, strengthen bones, and promote the growth of red blood cells [41].

### **3.6 Rose matta rice kesari**

Rose matta rice is a popular coarse rice variety consumed commonly in Kerala. This variety of rice is a good source of fiber, calcium, magnesium, and vitamin A [39]. The kesari recipe formulated with this rice is enhanced by the rice's natural pink color. The recipe is nutritious with a high content of calcium (286.5 mg) and fiber (17.665 g).

The recipes formulated can be also infused and altered with other coarse rice varieties; the nutritive value is more dependent upon the coarse rice variety used. On an overall analysis, the recipes formulated with coarse rice are rich in vitamins like vitamin B and vitamin C, calcium, phosphorous, magnesium, protein, and fiber.

## **4. Conclusion**

Consumption of polished white rice has been considered as an esteemed status among the people at urban regions. The study has emphasized awareness among the common people in bringing out the importance, nutritive value, and health benefits of the available coarse rice varieties. Thus, the study suggests the inclusion of coarse rice or rice as wholesome grain and can be included in the daily recipes with innovative formulations; inclusion of this wholesome grain reduces the risk of many deadly diseases.

### **Conflict of interest**

The author declares no conflict of interest.

### **Ethical clearance**

The author declares no ethical clearance.

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