Type of article : Original article

Formulation and evaluation of nutritional and sensory properties of porridge from Bangladeshi high-yielding rice varieties

Abstract

Rice provides a vast portion of the daily nutrient requirements of Bangladeshi people as their daily rice intake is high. So, Rice is relatively a better source of vitamins, minerals, protein and starch among cereals for them. Porridge is packed with nutrients that the body needs. When eaten as a breakfast meal, it provides sufficient nutrients and energy for morning activities without causing stomach pain, fatigue, or hunger throughout the day.

The present study was undertaken to formulate porridge added with chicken, fish and vegetables from Bangladeshi four high-yielding rice varieties (BRRI dhan29, BRRI dhan34, BRRI dhan50 and BRRI dhan84) and evaluate nutritional (calorie, protein, fat, fiber, calcium, magnesium, iron copper, phosphorus, potassium and sodium) and sensory properties (color and appearance, consistency, taste and flavor and overall acceptability). BRRI dhan34 is aromatic rice and BRRI dhan84 is iron and zinc enriched rice. After the formulation of porridge, nutritional and sensory properties were evaluated. Overall sensory scores were good enough except for fish with rice recipes. The formulated porridge recipes in this study contains more than two folds higher calorie and other nutrients than porridge nutritional facts in USDA food and nutrient database. Calorie, protein, zinc, iron and other nutrients in the formulated porridge can have a significant effect in fulfilling Recommended Daily Allowance (RDA) of the nation. Significant study on porridge formulation and nutritional facts lack in Bangladesh. But number of studies are available outside the country. But most of the studies have a time-consuming recipe (as those recipes contains multigrain or fermented products) although having higher nutrient content. In some cases, recipes are not possible in traditional houses in Bangladesh. In this study, we formulated recipes that can be easily prepared within a short time. It can be the initial step to make rice porridge a popular breakfast as well as other meal items in Bangladesh.

Keywords: Chicken, Fish, Nutritional value, Rice porridge, Sensory evaluation.

Introduction

Nowadays, consumers are expressing a heightened demand for food products that are more healthy, accessible, and natural, without sacrificing health objectives, flavors, or components. Above all else, these food items need to make it easier for customers to manage their busy lives. Porridge is well known for being a nutritious dish that is simple to prepare, easy to digest, and great for feeding the sick and toothless, such as infants and the elderly. Regardless, starchy porridge isn't exactly packed with nutrients. Instead of just eating plain porridge, one may up the nutritional content by adding various beans, grains, and veggies as functional components (Noor *et al.*, 2023). As a semi-fluid food, porridge's viscous texture facilitates chewing, swallowing, and digestion (Gaikward *et al.*, 2019). A variety of congee attributes, such as water-to-rice ratio, rice softness, and congee consistency, differ by region. Because congee was simple to prepare and digest in ancient times, poor people or those who were ill ate it (Toleno, 2017). The rise in the number of people who live alone and lack of time to prepare meals resulted in an increase in demand for foods which is timesaving and easy to prepare (Mahgoub, Mohammed, & Mobarak, 2020).

Compared to other cereals, rice has more beneficial nutrients, including protein, starch, vitamins, and minerals (Shozib *et al.*, 2018). As a result of the absence of gluten, rice is hypoallergenic (Koo and Lasekan, 2007) and can be used to develop gluten-free hypoallergenic food. Besides, rice-based foods can be the best solution to treat lactose intolerance. Aside from being hypoallergenic, the caryopsis-derived protein from rice has better digestibility and biological value than other grains like corn, wheat, and barley, but lower than proteins from oil crops, legumes, and animals (Day, 2013). In 2023, Bangladesh occupies the position of being the third-largest producer of rice worldwide (Mahmud, 2013). Rice is cultivated in three seasons in Bangladesh: aman, aus, and boro. With a heavy reliance on irrigation and fertilizers, boro is the major paddy producing crop. Aman and aus follow closely after. The high per capita consumption of rice in Bangladesh is a reflection of the fact that the country's population relies on this crop as a mainstay diet. The nutritional demand of the majority of people is met with rice (Ishrat *et al.*, 2016). Bangladeshi people consume rice three times a day. So, rice has a great contribution on their daily calorie intake and overall nutrition. Not only does it make up 97% of

all grain output, but it is also vital to the nation's nutrition because adults get half of their daily protein and calories from it (Biswash *et al.*, 2022).

Porridge, being cooked till soft and mushy with a fine texture, is more easily digestible for the bo dy than conventional hard rice. Consuming readily digestible foods such as porridge mitigates bloating, indigestion, and prevents excessive overburden on the stomach. In addition, porridge is a great source of essential nutrients, including rice's carbohydrates, meat's protein, eggs' or oil's fat, veggies' vitamins and minerals, and herbs like ginger. When consumed as a breakfast, it gives you enough energy and nutrition for your daily activities without making you feel bloated, hungry, or nauseous all day. One benefit of porridge is that it can be made in a number of ways to suit individual tastes. It is a versatile dish that may be consumed either plain or completely garnished, appropriate for individuals of all genders and ages, from youngsters to the elderly. Mild porridge recipes are easy to eat. In Bangladesh, Rice porridge is not too much popular as a breakfast cereal. Most of the people consider it as a child food item. But as a rice-producing country, porridge formulation with chicken/fish/vegetables might add dietary diversity besides nutrition in the diet. Porridge is packed with nutrients that the body needs, such as carbohydrates from rice, protein from meat, fat from oil, vitamins and minerals from vegetables, various seasonings, and herbs like ginger, which helps relieve flatulence, bloating, and aids digestion. When eaten as a breakfast meal, it provides sufficient nutrients and energy for morning activities without causing stomach pain, fatigue, or hunger throughout the day. Porridge is gentle on the stomach, making it suitable for those with digestive issues or recovering from illness. The porridge is often cooked with a lot of water, helping to keep you hydrated. It can be a low-calorie meal option, which is beneficial for weight management.

The objective of the study is to formulate rice porridge recipes modified with chicken, fish and vegetable as a source of nutrient of Bangladeshi people.

Materials and methods

Collection of ingredients: A total of four Bangladeshi rice varieties (BRRI dhan29, BRRI dhan34, BRRI dhan50, BRRI dhan84) were used for 3 porridge recipe (Chicken with rice, fish with rice and vegetable with rice) formulation. BRRI dhan29 is a widely cultivated variety in Bangladesh. BRRI dhan34 and BRRI dhan50 both are aromatic rice variety released by Bangladesh Rice Research Institute (BRRI). BRRI dhan50 is locally known as “Banglamati”. BRRI dhan84 is a high zing (27.6 mg/kg) and high protein (10.1 mg/kg) containing BRRI variety. All the ingredients except rice were collected from local market (Joydebpur, Gazipur city, Gazipur) at stored at -20□ until use. All the rice varieties used for the porridge formulation were cultivated in BRRI field and after harvesting, dried appropriately and milled (10% polish) in Grain Quality and Nutrition (GQN) Division. Rice samples were dehusked by Satake Rice mill, followed polishing in a Grainman rice polisher.

Preparation of porridge

After collecting all of the ingredients, porridge preparation was started. Ingredients were refrigerated only for a short time needed to collect all of the ingredients. Ingredients needed for porridge formulation are listed in table 1.

Chicken with rice recipe: Chicken was cut into small pieces and 0.5 teaspoon of soy sauce was added and kept for about 20 minutes. At the time onion, ginger and garlic were peeled and cut into small pieces. Chicken pieces were fried with onion, ginger and garlic for better flavor and color, and partially blended to mix properly with the rice. 50 grams of 10% polished rice was taken in a saucepan and washed. About 900 ml of water was added to the saucepan and started to cook. After 15 minutes, previously fried and partially blended chicken was added to the rice. After 25 minutes, coking was completed. Throughout the cooking time, porridge was stirred with a stirrer to increase the texture and to prevent setting down to the saucepan.

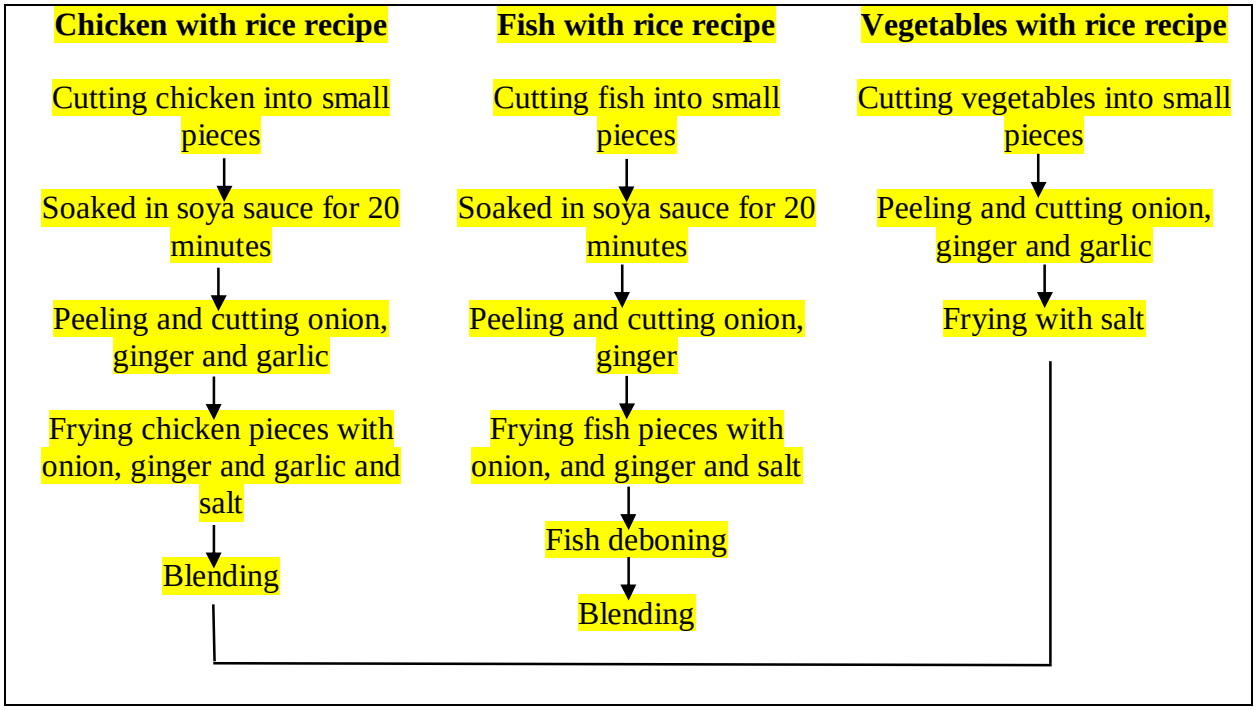
Table 1: List of ingredients for porridge preparation.

Ingredients	**Rice + chicken**	**Rice + fish**	**Rice + vegetables**	**Control**
Rice (10% polished) (g)	50	50	50	50
Chicken (g)	15	-	-	-
Fish (Rui) (g)	-	15	-	-
Carrot (g)	-	-	5	-
Red amaranth (g)	-	-	5	-
Sweet pumpkin (g)	-	-	5	-
Lentils (g)	-	-	5	-
Tomato	-	5	-	-
Coriander leaves	-	3	-	-
Green pepper (g)	-	-	2	-
Onion (g)	2	2	2	-
Ginger (g)	2	2	-	-
Garlic (g)	2	-	-	-
Soy sauce (teaspoon)	0.5	0.5	-	-
Soybean oil (ml)	2	3	3	-
Salt	As per need	As per need	As per need	As per need

Fish with rice recipe: For fish recipe, same cooking method was followed except addition of coriander leaves and tomatoes. These were added to the rice after 20 minutes of cooking. The fishbone was separated manually before blending. After 25 minutes, cooking was completed.

Vegetable with rice recipe: Vegetables were fried in soybean oil and added to the rice and lentils after 15 minutes of cooking and followed the same cooking method as for Chicken and fish recipe.

Control: 50 grams of 10% polished rice was taken in a saucepan and washed properly and cooked for about 25 minutes with continuous stirring (mainly after 10 minutes).



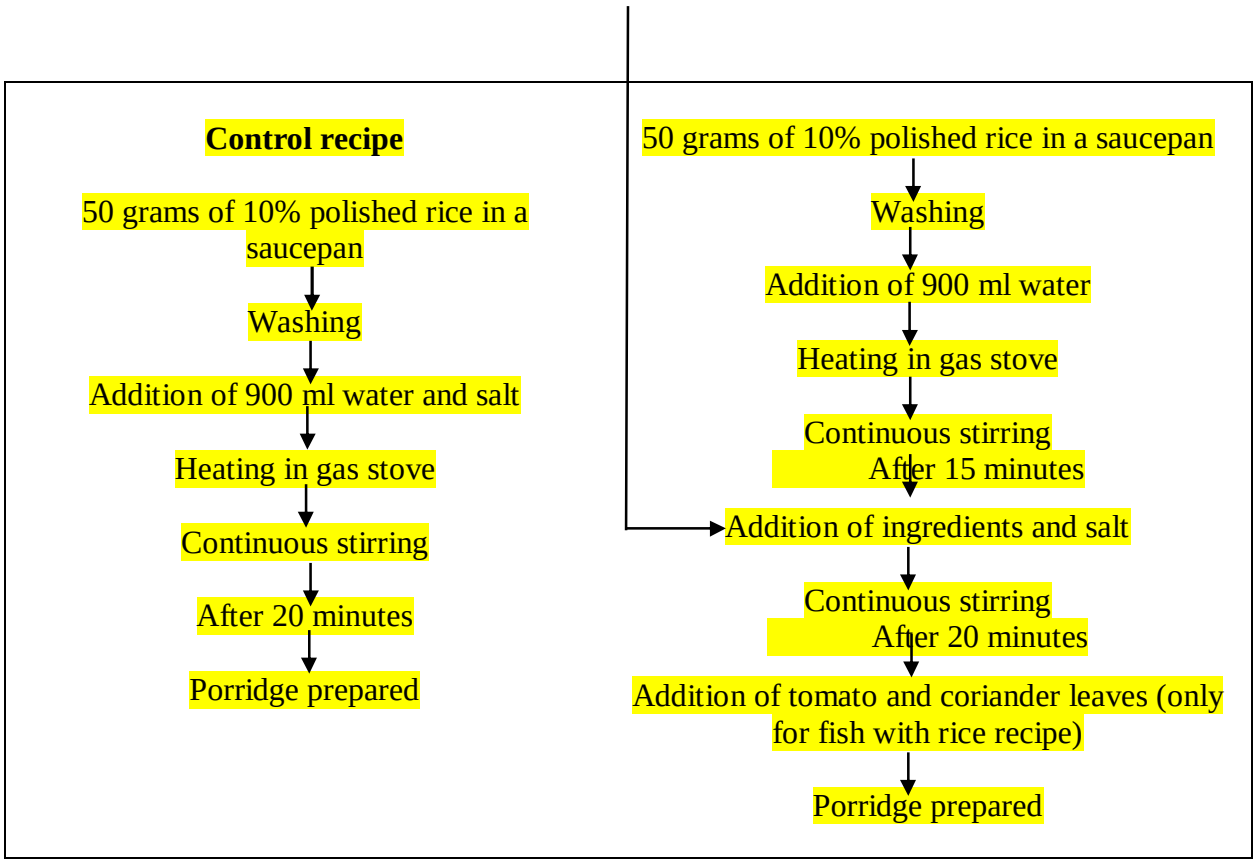


Fig 1: Flowchart of Different recipes for porridge preparation

Determination of nutritional value of porridge

Standard protocol was used to test the chemical composition of the porridge. Fat (Soxhlet method) and carbohydrate were analyzed by following the AOAC method (2005).

Crude fiber was obtained gravimetrically after sample digestion with diluted acid, alkali and alcohol (Holst,1982; AOAC 1984). Crude fiber is determined gravimetrically after chemical digestion and solubilization of other materials present. The fiber residue weight is then corrected for ash content after ignition.

About 2 g of sample was weighed and transferred to a Whatman Folded Filter Paper No. 597. And extracted with three 25 mL portions of ether. The extracted portion was applied vacuum until sample was dry. After transferring the sample in 600 ml beaker, 20 mL of well-mixed ceramic fiber suspension, 200 mL of boiling 1.25% sulfuric acid solution, and 1 drop of diluted antifoam were added. The beaker was placed on digestion apparatus with preadjusted heater and boiled exactly 30 minutes, totaling beaker periodically to keep solids from adhering to sides.

Removing the beaker, contents was filtered through California Buchner funnel precoated with about 0.75 g of ceramic fiber. The beaker was rinsed with 50-75 mL of boiling water. The steps were repeated with three 50 mL portions of water. Fiber mat was returned with residue to beaker by blowing back through funnel. 200 mL of boiling 1.25% sodium hydroxide solution was added and returned to heater and boil exactly 30 minutes. Beaker was removed and filtered as before and washed with 25 mL of boiling 1.25% sulfuric acid solution, three 50 mL portions of water, and 25 mL of alcohol. Fiber mat and residue were dried at 130°C for 2 hours and cooled in a desiccator. After being cooled, weight was taken. Then fiber mat and residue were ignited at 600°C to constant weight and cooled in desiccator and weighed.

$$\% \text{ Crude Fiber} = \frac{(\text{Dry residue wt (g)} - \text{Ignited residue wt.(g)} - \text{Blank wt loss (g)})}{\text{Sample wt (g)}} * 100$$

Moisture was determined from sample weight loss after drying at 105° C until constant weight. The moisture free samples were charred and heated to 600□ until a constant weight was achieved and the residue being quantified as ash (AOAC 2000).

$$\text{Moisture (\%)} = \frac{\text{Loss in weight}}{\text{Weight (g) of sample}} * 100$$

Protein content was determined by Micro Kjeldahl method**.** 0.2 gram of sample was taken in digestion tube and 5ml H_2SO_4 and catalyst were added. This sample was heated in a block digestion chamber at 300□ for 60 minutes and 350□ for 90 minutes. Appearance of greenish color indicated the completeness of digestion. Titration was done with 0.1N HCL solution. Total nitrogen content was calculated by the following equation and total protein content was calculated from nitrogen content.

$$\text{Nitrogen (\%)} = \frac{(b-a)*N*14}{w*1000} * 100$$

$$\text{Protein (\%)} = \text{Nitrogen (\%)} * 5.95$$

Where, a= volume of the acid required to titrate for blank (ml), b= volume the acid required to titrate sample (ml), N= normality of the HCL, w= weight of the sample taken (g).

Carbohydrates were calculated by difference method. Available carbohydrates by difference: 100 - (water + protein + fat + ash + fiber).

Mineral profiling: 0.2 g sample with 7 ml HNO_3 and 1 ml H_2O_2 was digested in a microwave digester. After digestion, final volume was made 50 ml with deionized water and estimation was done by ICPOES (ICPE-9020, Shimadzu, Japan) (Erik *et al.*, 2017).

Sensory evaluation

A panel of five seasoned individuals were presented with prepared foods for organoleptic evaluation. Five scientists (disease free individuals having no habit of smoking, alcohol and betel

leaves) from Grain Quality and Nutrition (GQN) Division of Bangladesh rice Research Institute (BRRI) were selected for sensory evaluation. Their age rage was 25 to 55 years. Using a hedonic scale-based scorecard of nine points, the panel members evaluated the product (Srilakshmi, 2007; Hussain, 2018; Singh, Verma and Bala, 2017). Color and appearance, consistency, taste and flavor and overall acceptability of the formulated porridge were evaluated.

Statistical analysis

All the statistical analysis was done using SPSS (version 26). Duncan Multiple Range Test (DMRT) was performed to compare means where statistically significant level was 0.05.

Results and discussion

Nutritional properties

A total of thirteen porridge recipes (with control) were prepared. Among the chicken with rice recipe, porridge prepared with BRRI dhan84 was found to have the highest protein (2.37±0.10 g/100g) and zinc (0.73±0.05 g/100g) content followed by BRRI dhan34 (protein: 2.16±0.04 g/100g; zinc:0.56±0.03 g/100g). BRRI dhan84 is a high-protein and high-zinc-containing variety. Among the fish with rice recipes, porridge from BRRI dhan84 had the highest protein content (2.43±0.12g/100 g) followed by BRRI dhan34 (2.28±0.07 g/100g). All of the vegetable-with-rice recipes had comparatively lower protein content. This is due to the absence of any animal protein source(s) in those recipes. But all the vegetable with rice recipes were found to have higher fat (12.08±0.10 to 12.71±0.12 g/100g) and higher fiber (0.22±0.01 to 0.52±0.05 g/100g) than the other two recipes. The chicken with rice recipe had the lowest fiber content (0.05±0.00 to 0.11±0.01 g/100g) than other recipes whereas the control recipe had only 0.07±0.00g fiber content.

Iron (Fe) is an essential micronutrient for all organisms. Enzymes that synthesize collagen and certain neurotransmitters contain it, and it is an integral part of proteins that are necessary for respiration and energy metabolism (Kulaszynska *et al.*, 2024). The effective functioning of the immune system also requires iron. The correct operation of all living things depends on microelements such as iron, copper (Cu), and zinc (Zn). These elements are involved in protein synthesis, affect gene expression, impact enzyme function, and contribute to cellular metabolism, antioxidant and anti-inflammatory defenses, and many more processes (Weyh et al., 2022; Munoz *et al.*, 2007)

The Chicken with BRRI dhan84 recipe had the highest iron content (0.47±0.02 mg/100g). All chicken-based recipes were found to have high iron levels. Interestingly, vegetable-based rice recipes contained higher iron than fish-based recipes, likely due to the addition of iron-rich vegetables, although their bioavailability is lower compared to animal sources. BRRI dhan84 can be an excellent source of both iron and zinc for Bangladeshi people, given their average daily

rice consumption of 328.92g (HIES 2022). The calcium and magnesium contents were higher in vegetable-based rice recipes, as vegetables are known to be rich in magnesium. The highest magnesium content was found in the Vegetable with BRRI dhan29 recipe (7.05±0.06 mg/100g), followed by BRRI dhan34 (6.99±0.03 mg/100g).

Magnesium is essential for proper brain function and mood regulation; insufficient levels have b een associated with an elevated risk of major depressive disorder. Research suggests that magnesium deficiency, experienced by over half of all type 2 diabetics, may hinder the body's capacity to control blood sugar levels (Veronese, 2021). Phosphorus was higher in chicken with rice recipes than in others (9.21±0.02 to 9.51±0.43 mg/100g). In addition to helping the bones grow stronger and more dense, phosphorus also helps the muscles contract and recuperate from activity, and it filters and eliminates waste from the kidneys. Higher potassium content was found in vegetables with rice recipes followed by fish with rice and chicken with rice recipes (28.33±0.33 to 28.64±0.08 vs 25.28±1.44 to 26.95±1.00 vs 22.11±0.10 to 22.41±0.24 mg/100g). On the other hand, zinc content was higher for all Recipes with BRRI dhan84 as it is a high zinc variety. The control (BRRI dhan29) recipe was found to have much less amount of all parameters except total energy and carbohydrates (Table 2 and Table 3). . The formulated porridge recipes in this study contains more than two folds higher calorie and other nutrients than porridge nutritional facts in USDA food and nutrient database. The control recipe had almost same calorie value although rest of the nutrient contents were much lower than the other recipes formulated in this study.

Table 2: Nutritional properties of formulated porridge (per 100g formulated porridge).

Recipe	Rice variety	Energy (Kcal)	Protein (g)	Fat (g)	Carbohydrates (g)	Crude Fiber (g)
Chicken-rice	BRRI dhan29	66.11±1.24^{a}	1.89±0.15^{b}	1.26±0.05^{g}	11.87±0.05b^{c}	0.11±0.01^{b}
	BRRI dhan34	63.48±0.56^{bcd}	2.16±0.04^{cd}	1.23±0.01^{ef}	11.94±0.22^{bc}	0.06±0.01^{a}
	BRRI dhan50	67.97±0.75^{cd}	1.99±0.11^{c}	1.22±0.01^{e}	11.74±0.09^{ab}	0.05±0.00^{a}
	BRRI dhan84	70.43±0.54^{ef}	2.37±0.10^{e}	1.26±0.02^{fg}	11.98±0.08^{bc}	0.06±0.01^{a}
Fish-rice	BRRI dhan29	64.61±1.01^{b}	2.05±0.08^{c}	1.08±0.02^{c}	11.92±0.09^{bc}	0.27±0.01^{d}
	BRRI dhan34	62.57±1.27^{bcd}	2.28±0.07^{de}	1.10±0.01^{cd}	11.73±0.22^{ab}	0.24±0.04^{cd}
	BRRI dhan50	64.81±0.70^{de}	2.07±0.08^{c}	1.08±0.01^{c}	11.58±0.16^{a}	0.22±0.01^{c}

	BRRI dhan84	66.21±1.21f^{g}	2.43±0.12^{e}	1.08±0.03^{c}	11.96±0.15^{bc}	0.21±0.00^{c}
Vegetable-rice	BRRI dhan29	68.51±0.77^{bc}	1.79±0.05^{e}	1.12±0.00^{d}	12.08±0.10^{c}	0.22±0.01^{c}
	BRRI dhan34	63.99±2.24^{cd}	1.71±0.11^{b}	1.00±0.02^{b}	12.33±0.07^{d}	0.52±0.05^{e}
	BRRI dhan50	65.25±1.49^{de}	1.78±0.08^{b}	1.01±0.01^{b}	12.62±0.20^{e}	0.49±0.01^{e}
	BRRI dhan84	69.36±1.30^{fg}	1.99±0.06^{c}	1.00±0.02^{b}	12.71±0.12^{e}	0.50±0.01^{e}
Control (BRRI dhan29)		56.77±2.67^{g}	1.19±0.03^{a}	0.16±0.00^{a}	11.78±1.68^{abc}	0.07±0.00^{ab}

NB: All the data are average of triplicate results ± Standard deviation. Different letters in the same column are significantly different ($p<0.05$).

Table 3: Mineral profile of formulated porridge recipes (per 100g formulated porridge).

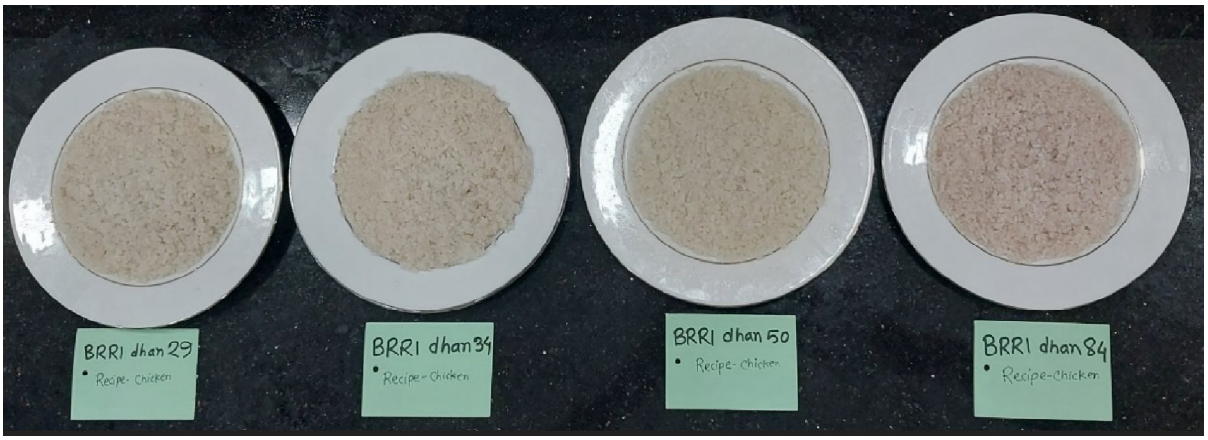
Recipe		Ca (mg)	Fe (mg)	Mg (mg)	P (mg)	K (mg)	Na (mg)	Zn (mg)	Cu (mg)
Chicken-rice	BRRI dhan29	1.80±0.02^{bc}	0.39±0.00^{b}	4.06±0.05^{c}	9.51±0.43^{e}	22.11±0.10^{a}	34.68±0.16^{a}	0.54±0.01^{d}	0.01±0.00^{a}
	BRRI dhan34	1.93±0.02^{c}	0.38±0.01^{b}	4.01±0.03^{c}	9.25±0.05^{d}	22.41±0.24^{a}	34.63±0.09^{a}	0.56±0.03^{d}	0.01±0.00^{a}
	BRRI dhan50	1.79±0.04^{b}	0.34±0.02^{b}	2.29±0.05^{a}	9.21±0.02^{d}	22.15±0.15^{c}	34.09±0.60^{bc}	0.53±0.02^{d}	0.02±0.00^{a}
	BRRI dhan84	1.77±0.08^{b}	0.47±0.02^{c}	2.23±0.03^{a}	9.32±0.08d^{e}	22.31±0.18^{d}	35.58±1.24^{bcd}	0.73±0.05^{f}	0.01±0.00^{a}
Fish-rice	BRRI dhan29	5.90±0.10^{d}	0.23±0.01^{cd}	5.56±0.06^{e}	8.53±0.06^{c}	26.61±0.54^{a}	33.67±0.59^{a}	0.45±0.01^{c}	0.02±0.00^{a}
	BRRI dhan34	6.04±0.06^{d}	0.23±0.01^{cd}	5.54±0.05^{e}	8.58±0.11^{c}	26.83±0.76^{b}	34.66±1.06^{b}	0.45±0.03^{c}	0.01±0.00^{a}
	BRRI dhan50	5.98±0.04^{d}	0.25±0.02^{d}	3.82±0.04^{b}	8.54±0.06^{c}	25.28±1.44^{c}	34.37±0.55^{bcd}	0.42±0.03^{c}	0.01±0.00^{a}
	BRRI dhan84	5.97±0.03^{d}	0.31±0.03^{e}	3.82±0.02^{b}	8.54±0.05^{c}	26.95±1.00^{d}	35.70±1.47^{cd}	0.630.04^{f}	0.01±0.01^{a}
Vegetable-rice	BRRI dhan29	8.09±0.16^{e}	0.36±0.02^{f}	7.05±0.06^{f}	2.71±0.02^{b}	28.33±0.33^{a}	2.59±0.28^{a}	0.33±0.05^{b}	0.01±0.00^{a}
	BRRI dhan34	8.47±0.12^{g}	0.36±0.02^{f}	6.99±0.03^{f}	2.74±0.03^{b}	28.53±0.11^{c}	2.57±0.09^{b}	0.27±0.03^{a}	0.03±0.01^{b}
	BRRI dhan50	8.29±0.08^{f}	0.36±0.01^{f}	5.23±0.01^{d}	2.72±0.02^{b}	28.590.08^{d}	2.55±0.05^{bcd}	0.27±0.02^{a}	0.03±0.00^{a}
	BRRI dhan84	8.39±0.09^{fg}	0.42±0.02^{g}	5.20±0.03^{d}	2.67±0.11^{b}	28.64±0.08^{d}	2.60±0.01^{d}	0.47±0.02^{c}	0.03±0.00^{b}
Control (BRRI dhan29)		0.52±0.03^{a}	0.09±0.00^{a}	2.20±0.17^{a}	0.03±0.00^{a}	-	-	0.26±0.02^{a}	-

NB: All the data are average of triplicate results ± Standard deviation. Different letters in the same column are significantly different ($p<0.05$).

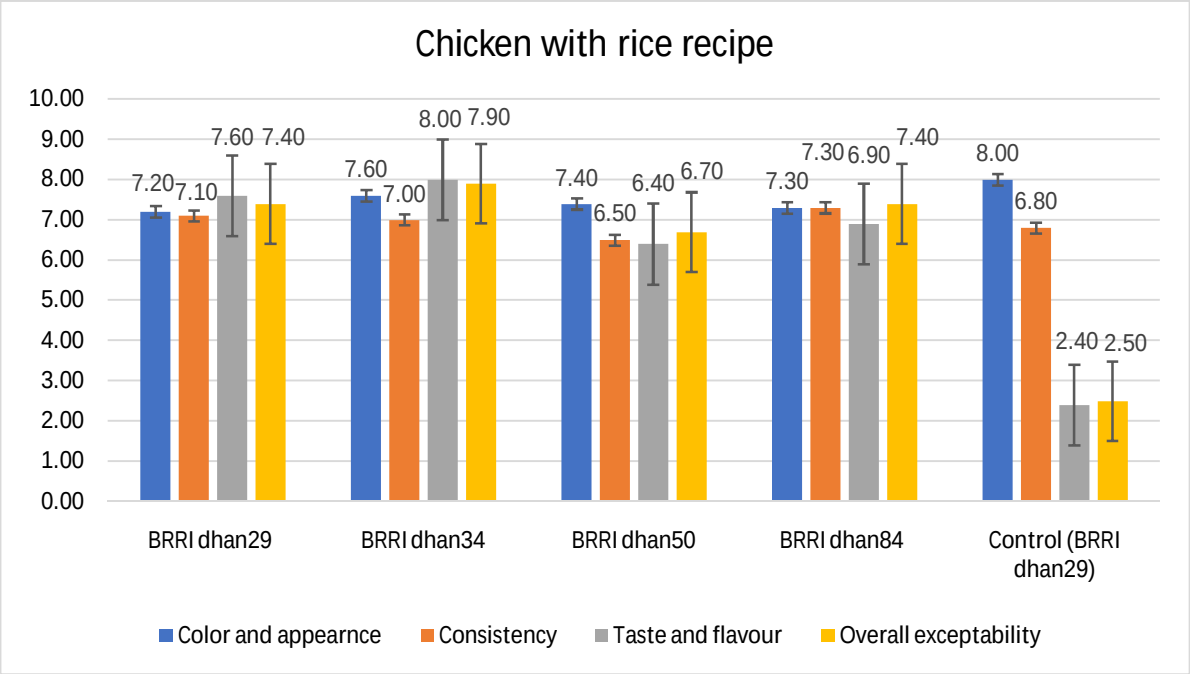
Sensory evaluation

Color is a key aesthetic attribute of food quality, especially when combined with other characteristics. It not only provides an indication of freshness and taste but also plays a significant role in influencing consumer decisions and satisfaction. The sensory experience of eating, including taste, aroma, color, and texture, is crucial in food consumption, as it enhances enjoyment and can lead to feeling satisfied with smaller portions. In the food processing industry, aromas and flavors are essential. While some foods may have strong, off-putting odors, the addition of appealing flavors and fragrances can mask these scents, improving the overall taste and making the dish more attractive to consumers.

A porridge's sensory quality was determined by how it tasted, looked, felt, and was generally acc epted. Among chicken recipes, porridge prepared from BRRI dhan34 has the highest overall acceptability score followed by BRRI dhan84 and BRRI dhan29. BRRI dhan34 is a popular rice variety in Bangladesh because of its aroma and small pericarp. The aroma of BRRI dhan34 is the factor that affects the overall acceptability in sensory evaluation. The aroma of rice added extra attractive flavor to the porridge. Besides it affects the overall texture of the porridge. All the fish-rice recipes have obtained lower sensory scores. This may be due to disfavor the fish smell or coriander leaves. Coriander leaves are popularly used in vegetable and fish recipes due to its flavor. It is not uncommon finding people disfavoring coriander leaves as they can’t tolerate/ dislike it. In this case, we recommend avoiding this item in porridge. BRRI dhan84 has red-colored pericarp and its appearance score was good enough. All of the vegetable recipes have a better sensory parameter score. Lentils in this recipe has added extra texture as well as color and made porridge overlook the deficiency of amino acid lysine. The addition of chicken and fish sources was to provide some animal sources of nutrients to make the porridge more nutritious. Besides chicken and fish also contributed to the color, taste and texture of the porridge to make it more acceptable to the consumer.


BRRI dhan 29
• Recipe- Chicken
BRRI dhan 34
• Recipe- Chicken
BRRI dhan 50
• Recipe- Chicken
BRRI dhan 84
• Recipe-Chicken

(a)

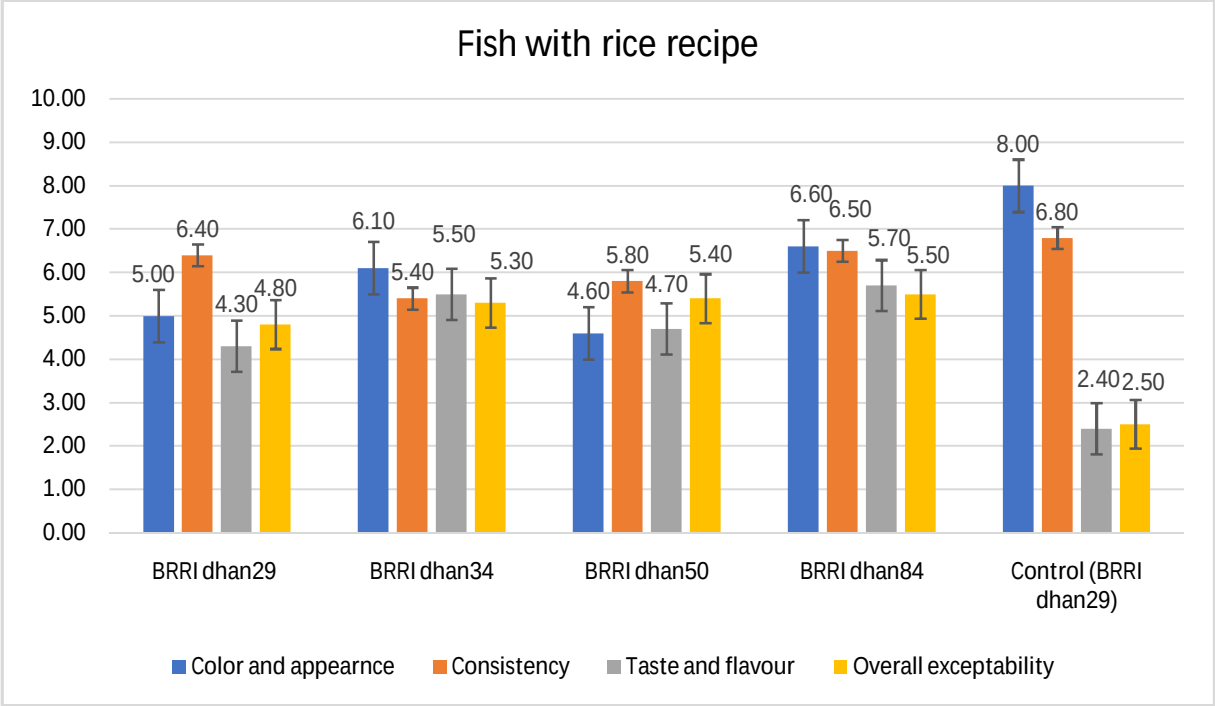


(b)

Figure 2: (a) Chicken with rice porridge; (b) Sensory scores of chicken with rice porridge.

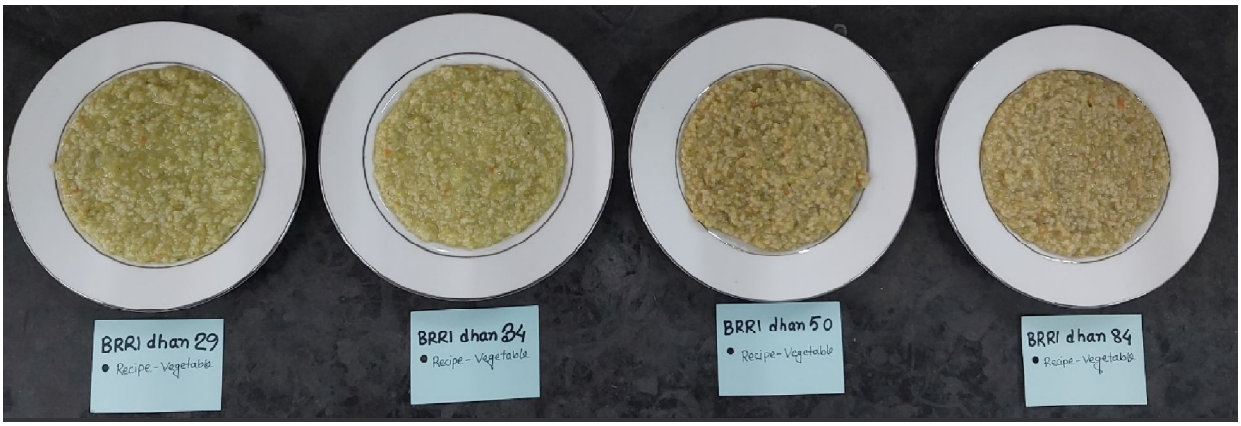

BRRI dhan 29
Recipe- Fish
BRRI dhan34
Recipe- Fish
BRRI dhan 50
Recipe- Fish
BRRI dhan84
Recipe- Fish

(a)

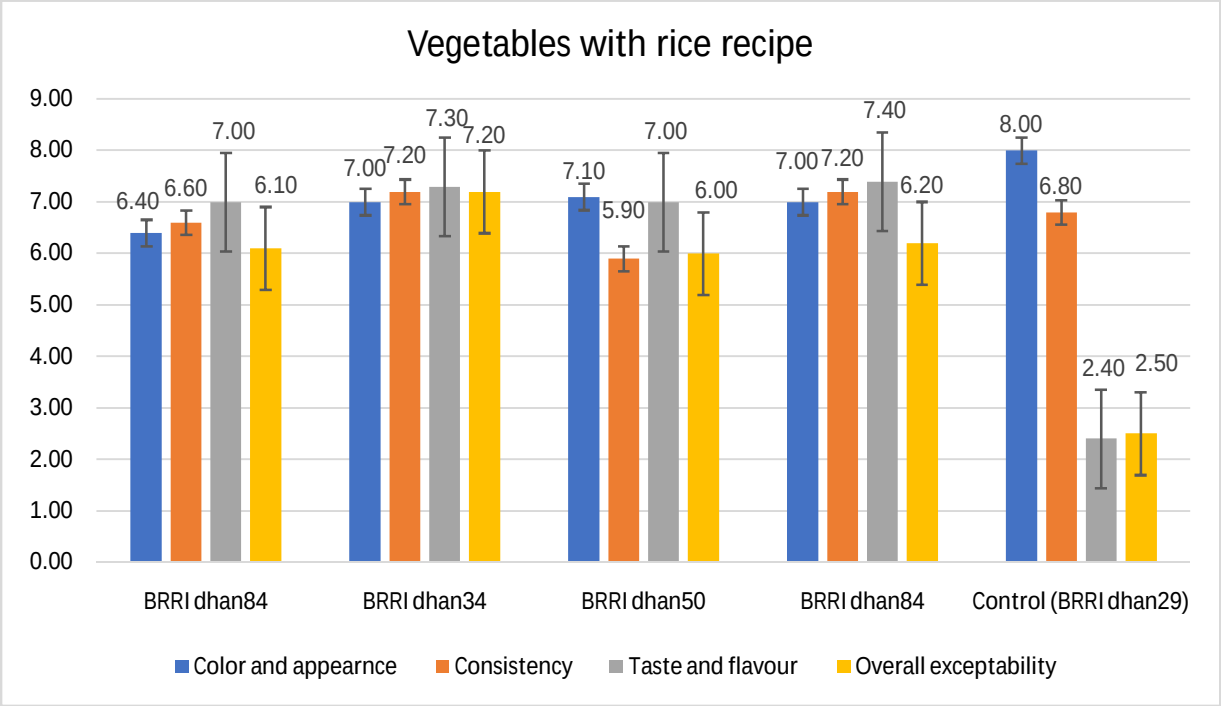


(b)

Figure 3: (a) Fish with rice porridge; (b) Sensory scores of fish with rice porridge.


BRRI dhan 29
• Recipe - Vegetable
BRRI dhan 34
• Recipe - Vegetable
BRRI dhan 50
• Recipe - Vegetable
BRRI dhan 84
• Recipe - Vegetable

(a)



(b)

Figure 4: (a) Vegetables with rice porridge; (b) Sensory scores of vegetables with rice porridge.

Conclusion

This study successfully formulated rice porridge using four high-yielding Bangladeshi rice varieties (BRRI dhan29, BRRI dhan34, BRRI dhan50, and BRRI dhan84), enriched with chicken, fish, and vegetables, to significantly boost its nutritional value. The porridge recipes provided higher levels of calories, protein, and essential minerals like zinc and iron, surpassing standard nutritional values and offering a practical means of meeting the Recommended Daily Allowance (RDA). While the sensory evaluation showed good overall acceptability, minor adjustments to flavors, such as avoiding coriander leaves, were suggested to enhance preferences. These porridges are not only nutritious but also easy to prepare, making them an ideal and convenient meal option for Bangladeshis, especially as a nutritious breakfast or alternative meal.

Disclaimer (Artificial intelligence)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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