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Compositional Analysis of Four Varieties of Rice-Chevally, Njavara, D1 and Bhadra

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ABSTRACT

Background: Rice is the most important and extensively grown food crop in the world in terms of food, area and production. It is a staple food which serves for nearly half of the world's seven billion people (IRRI, 2013). Rice constitutes high percentage of carbs with substantial amount of proteins, fat, fibre, mineral and vitamins.

Methods: Composition and nutritional content of rice varies with varieties and especially processing method. The objective of the present investigation titled "Compositional Analysis of Four Varieties of Rice-Cheruvally, Njavara, D1 and Bhadra" was to compare the proximate composition and total amylose-amylopectin content of rice cultivars selected. Total Amylose content, amylopectin content and amylose-amylopectin ratio was estimated spectrophotometrically at 620 nm. Among the proximate composition analysis, percentage of carbohydrate, crude protein, ash, moisture and fat were determined using AOAC standard method.

Result: In the present investigation the results of the proximate composition and the amylose content of all the four rice varieties indicated significant difference in all the parameters assessed. It is understood that the rice samples selected for the study belongs to high amylose variety with amylose-amylopectin ratio falling between 0.35-0.45. In summary, the study on the proximate composition and amylose content of rice cultivars has revealed some vital information and these generated results will find their way in determining their suitability in food and other relevant industries.

Key words: Proximate composition, Rice, Total amylose content.

INTRODUCTION

Rice (*Oryza sativa* L.) is one of the most important cereals in human nutrition and is consumed by two third of global population (Kennedy *et al*., 2003). Usually, it is consumed as whole grain after cooking and in regular Asian diet it contributes for 40-80% of total calorie intake (Paramita *et al*., 2002). In South India, nearly half of daily energy intake come from refined grains and white polished rice constitutes >75% of refined grain intake (Kumar *et al*., 2011). The brown rice is rarely consumed in China and considering the Asian populations, white rice makes large contributions to dietary glycemic load, an index reflecting the acute blood glucose-raising potential of foods or diets (Mohan *et al*., 2010).

Rice is a source of carbohydrate and contains adequate amounts of crude protein and fat and is also considered to be a source of B-complex vitamins including thiamin, riboflavin and niacin (Fresco, 2005). The rice grain consists of starch (75-80%), water (12%) and protein (7%) with full complement of amino acids. The crude protein present in rice is highly digestible (93%) with excellent biological value (BV) and protein efficiency ratio (2.02%-2.04%) owing to the presence of high concentration of lysine (about 4%) (Juliano, 1993 and Oko *et al*., 2012). Macro minerals like calcium (Ca), magnesium (Mg) and phosphorus (P) are present along with some traces of micronutrient including iron (Fe), copper (Cu), Zinc (Zn) and manganese (Mn) (Anjum *et al*., 2007). The nutritional content of rice varies with different varieties, soil fertility, fertilizer application and other environmental conditions. Due to its nutritional quality and higher digestibility, rice is considered as the queen among cereals (Sajilata *et al*., 2006). Freshly reaped rice grains have about 80% carbohydrate which includes starch, glucose, sucrose and dextrin.

The main carbohydrate present in rice is starch which is composed generally of amylose and amylopectin molecules which in turn determines the quality of rice during cooking. The differences in starch composition influences physicochemical and metabolic properties of rice which in turn is caused by the variation in the ratio of its two macromolecules-amylose and amylopectin. Amylose is a linear and relatively short polymer of glucose units linked by α (1→4) bonds while Amylopectin is a branched and longer polymer where glucose units are arranged linearly through α (1→4), with branches emerging *via* α (1→6) bonds occurring every twenty-four to thirty glucose units (Hu *et al*., 2004).

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It is well known that starches with a higher amount of amylose are more resistant to digestion (Dong, 2007). A study conducted by Frei *et al*., (2003) reported that great variations in the amylose: Amylopectin ratio in rice grains of different varieties allow their classification as waxy (1-2% amylose), very low amylose content (2-12%), low amylose content (12-20%), intermediate amylose content (20-25%) and high amylose content (25-33%).

Being a major cereal grain, evaluating the nutritional composition of rice has been given highest priority (Joy, 2016). Providing adequate information about the quality of rice consumed by local population is important for those customers who are health conscious. Variety with best grain properties remain the most important determinant of market grading and end use qualities. However, studies have not been carried out comprehensively on nutritional composition of the traditional rice varieties in Kerala, India. To boost traditional rice agronomy in India, there is need for a systematic study that would reveal nutritional qualities from traditional rice varieties and would stand the world market competitiveness. Thus, keeping in view of above facts, the present research work was undertaken to analyze proximate composition and total amylose content of four different varieties of rice selected-Cheruvally, Njavara, D1 and Bhadra.

MATERIALS AND METHODS

Four rice varieties-"Cheruvally, D1, Njavara and Bhadra" were procured from Rice Research Station, Moncompu, Alappuzha District, Kerala. The paddy varieties collected for the study were cleaned for removing any debris and milled for subsequent chemical analysis. Determination of moisture, crude protein, fat and ash were done based on AOAC standard method. Carbohydrate content was determined by difference.

Carbohydrate (%) =

100% - (% moisture + fat + protein + ash)

Amylose content in rice samples were determined based on the Iodine-binding procedure. In brief, for 100 mg of rice flour, 1 ml of ethanol (95%) and 9 mL of 1 N NaOH were added in a volumetric flask (100 ml) followed by thorough mixing. Further, samples were heated on a boiling water bath for 10 min to gelatinize the starch and later on cooled to room temperature. 5 ml of gelatinized starch solution was then transferred to a 100 ml volumetric flask followed by addition of 1 mL of 1N acetic acid and 2 ml of iodine solution, with the volume adjusted to 100 mL with distilled water. All the contents were thoroughly vortex mixed and allowed to stand for 20 min. The absorbance was measured at 620 nm using a UV-Spectrophotometer.

RESULTS AND DISCUSSION

Proximate composition

A comparative proximate composition was studied among the samples and approximate chemical nutrient composition of these selected rice cultivars obtained from the study is shown in Table 1. The moisture content is considered as an important parameter in determining the shelf-life and lowest value gives better shelf life (Alaka *et al*., 2011) and enhanced keeping quality during storage (Eshun, 2009). The moisture content recorded, vary between 4.6% - 11.95%, with the highest value observed in D1 and the lowest in Njavara. These values closely correspond to the results of 11.65% to 13.43% reported by (Abbey *et al*., 2001) and 12% (Deviga *et al*.,2001). The values obtained were less than 14% which is ideal for the safe storage of rice (Hofman, 2002). The differences in genetic makeup and the climatic conditions in which they are cultivated determine the moisture content in rice varieties.

The ash content is generally recognized as a measure of quality assessment of functional properties of foods (Mbatchou *et al*., 2012) and its amount indicates the level of essential minerals (Heineman *et al*., 2005). In this study the percentage of ash content obtained for all rice varieties fell below 1.6%. The proximate profile of different Brazilian rice depicted the contents of ash varies in the range of 0.91-1.46% (Lawal *et al*., 2011). The differences in ash content may be due to genetic factors or the mineral content of the soils (Oko, 2021).

Analysis of carbohydrate content revealed that Njavara variety possesses highest content (81%) and Bhadra with lowest value (73.49%) and these values are slightly similar to those reported by Oko (2021). In his study the rice samples selected contained high quantities of carbohydrates ranging from 76.92 to 86.03%. All the rice varieties similarly had higher values for percentage carbohydrate and this observed high carbohydrate content among the varieties is not surprising as rice is a well-known carbohydrate food source. The fat present in rice is a good source of linoleic acid and other essential fatty acids and it does not contain cholesterol (Oko *et al*., 2012). The lipids are mainly confined to the rice bran and occurs as lipid bodies in the aleurone layer and bran. Starch lipids present in rice is composed of monoacyl lipids (fatty acids and lysophosphatides)

Table 1: Proximate composition of rice varieties.

Proximate composition	Cheruvally	D1	Bhadra	Njavara
Moisture content (%)	11.68	11.94	10.8	4.6
Carbohydrate content (%)	76.82	77.12	73.49	81
Crude protein content (%)	8.36	7.93	12.56	11.16
Fat (%)	1.69	1.58	2.4	1.8
Ash (%)	1.45	1.43	0.75	1

Table 2: Total amylose and amylopectin content and Amylose-Amylopectin ratio.

Name of rice variety	Total amylose (%)	Amylopectin (%)	Amylose-Amylopectin ratio (%)
Cheruvally	26.1	73.9	0.35
D1	26.8	73.2	0.37
Bhadra	31.21	68.79	0.45
Njavara	29.78	70.22	0.42

complexed with amylose. In the present study the percentage of lipid content was found to be high in Bhadra variety (2.4%) and lowest in D1 (1.58%). The values obtained in the present study was somewhat comparable to the lipid content stated in the local rice varieties of Ghana (Kennedy *et al*., 2019). The crude fat values obtained from local and imported rice samples of Ghana ranged between 0.49-2.57% with the imported brands having lower values compared to local ones.

In India, the dietary supply of rice per person per day is 207.9 g, this provides about 24.1% of the required dietary protein (Gopika *et al*., 2020). Rice has a well-balanced amino acid profile due to the presence of lysine, in superior content to wheat, corn, millet and sorghum and thus makes the rice protein superior to other cereal grains. The lysine content of rice protein is between 3.5 and 4.0%, making it the highest among cereal proteins. From the percentage of protein calculated highest value was found in Bhadra (12.56%) followed by Njavara (11.16%), Cheruvally (8.36%) and D1 accounts for lowest protein content (7.93%). However, the values showed in the present study were within the range (Bhattacharya, 2011). In her study, chemical and nutritional composition of traditional rice varieties of Karnataka, among all the rice varieties tested, Malgudi sanna (12.35) recorded highest protein content followed by Gandhasaale (11.23) and Rjakaime (10.49) and least was observed in Rajmudi (7.63).

Total amylose content

Amylose content is a key factor which determines the cooking and processing attributes of rice (Jittnapa *et al*., 2019) and also affects the physical properties of starch such as gelatinization, retrogradation, viscosity and viscoelasticity. It is also common to estimate the amylose content and infer amylopectin content by difference. Starch is the major constituent of rice and the amylose content of rice differ among the varieties depending on geographical location and seasonal changes. Bhadra contains high amylose content (31.21%) followed by Njavara (29.78%), D1 (26.8%) and Cheruvally (26.1%). The present results are slightly similar with the study of (Jittnapa *et al*., 2019) in which the amylose content for the low, medium and high amylose groups varies in the range of 18.42-20.80%, 20.58-21.96% and 29.92-36.77%, respectively given in Table 2.

The amylopectin content of rice varieties varied from 68.79% to 73.9% and ratio of amylose to amylopectin was found to be in the range of 0.35 to 0.45. According to the food classification based on amylose content all the four rice cultivars selected contains high amylose content. The amylose to amylopectin ratio reported by Gopika and Usha, 2020 ranged from 0.18 to 0.54. The amylose-amylopectin ratio of present study falls within this range.

The results of the proximate composition and the amylose content of all the four rice varieties indicated significant difference in all the parameters assessed. Percentage of Moisture content ranged from 4.6-11.94 with D1 variety bearing highest value and Njavara with lowest. Low moisture signifies storage capability of the food material and this could lead to more shelf life of the product. The ash content of the rice cultivars was in the range of 0.75 to 1.45 and ash content creates an insight of the element of minerals available in the food product. The lipid content was high for Bhadra (2.4) followed by Njavara (1.8), Cheruvally (1.61) and least for D1 (1.58). Maximum stability of food product can only be guaranteed for low fat foods. Crude protein analysis was also conducted and recorded results ranged from 7.93 to 12.56. Results of carbohydrate content falls within the range of 73.49 to 81%, with Njavara being the highest one.

CONCLUSION

From the present investigation it is understood that the rice samples selected for the study belongs to high amylose variety with amylose-amylopectin ratio falling between 0.35-0.45. In summary, the study on the proximate composition and amylose content of rice cultivaters has revealed some vital information and these generated results will find their way in determining their suitability in food and other relevant industries.

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