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Evaluation of some proximate, chemical and functional properties of Chhattisgarh popular paddy varieties for suitability of flaked rice (*Poha*)

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Abstract

For preparation of value added product like puffed, popped and flaked rice of agriculture product requires information about their all the chemical and functional properties. The objective of this work was to determine some of the chemical and functional properties of three different type of rice variety which may influence the rice processing operation from raw rice to value added product. In this study, various chemical and functional properties of raw rice variety were determined at a moisture content of about 11.45%, 12.15% and 11.33% on (wet basis) for Rajeshwari, Durgeshwari and Mahamaya paddy variety respectively. In the case of Rajeshwari rice variety, the fat, fiber, protein an ash content were 3.62%, 3.74%, 6.73% and 1.05% respectively. The corresponding values were 4.27%, 3.14%, 6.29% and 1.13% for Durgeshwari rice variety and 3.45%, 3.39%, 6.51% and 1.39% for Mahamaya rice variety. The starch, Amylose and Amylopectin were determined as its chemical properties and water absorbing index, water solubility index and swelling power were determined as functional properties. The starch, Amylose and Amylopectin were observed 74.60%, 24.43% and 75.57% for Rajeshwari raw rice, 74.88%, 24.55% and 75.45% for Durgeshwari raw rice, 75.53%, 24.80% and 75.20% for Mahamaya raw rice variety. And for functional properties of rice it were observed between 2.46 g/g, 3.98% and 6.20 for Rajeshwari raw rice, 2.25 g/g, 4.24% and 6.40% for Durgeshwari raw rice, 2.49 g/g, 3.20% and 6.15% for Mahamaya raw rice variety taken as water absorbing index, water solubility index and swelling power.

Keywords: Paddy, raw rice, chemical properties of paddy, functional properties of paddy

1. Introduction

The grain, called rice (*Oryza sativa* L.) for more than 8000 years, has been the companion of human kind. It is the most important food commodity in Asia, particularly in South and South-East Asia, where more than 90% of rice is produced and consumed. Paddy is a mahor food (*Oryza sativa L.*) is a major food grain in India. It is grown under wide agro-climatic conditions. Several varieties of paddy are being grown in the world. India produces varieties of rice depending upon the climate, cultivation situation, rainfall and socio-economic factors and such as numerous varieties of paddy are produced India. However, there are over 7,000 varieties of rice around the world. Before the rice grain is consumed, paddy undergoes several post harvest operations. The maximum recovery of head rice, yield and the quality of rice depends mainly on the variety of paddy as well as the parboiling characteristics of paddy.

Rice is a regular component of the African diet, usually consumed as a whole grain; which contributes more to the total calorie intake. In the major rice consuming countries, rice quality dictates the market value of the commodity and plays an important role in the development and adoption of new varieties (Juliano and Villarreal, 1993; Fitzgerald *et al.*, 2009) [10, 9]. A significants variation in physical, milling and cooking quality has been shown among rice varieties produced in different parts of world due to diverse genetic and environmental factors (Singh *et al.*, 2005; Izawa, 2008) [19, 11].

Paddy (*Oryza sativa L.*) is one of the most important staple food crops which is a major source of nutrients in many parts of the world. Paddy is second largest major cereal crop a member of grass family (Graminaceae), which produces starchy seeds. Rice is used as an important staple food by the people in many parts of the world after wheat. Rice is used as a source of nourishment for more than half of the world's population (Dahare *et al.*, 2017) [4].

The paddy grain is made up of hull or husk (l8 - 28%) and the caryopsis or the brown rice (72 - 83%). The brown rice consists of a brownish outer layer (pericarp, tegmen and aleurone layers) called the bran (5 - 8%), the germ or embryo (2 - 3%) connected on the ventral side of the grain, and the edible portion endosperm, (89 - 94%) (Ray Lantin, 1999) [17].

Apart from production the success of rice industries depends on the milling quality of rice. According to the qualities of rice, it is used for different industrial purpose. Chalky, medium, bold rice is more preferred by *"Poha"* Industries, than translucent for rice grain varieties having translucent character fine, slender, with better Head Rice Recovery (HRR) are preferred. HRR is an important trait of rice makes the variety important for industrial purpose. If in any variety HRR is more it has better economic importance, but this trait varied within the varieties if grown in different seasons.

The whole rice is a good source of carbohydrate as well as other ingredients such as vitamins, minerals and oryzanol as compared to with rice (Kumar *et al.*, 2016; Bhattacharya, 2011) [12, 2]. It also contains valuable nutrients including dietary fiber and phytochemicals, which have been linked to minimize risk of various diseases (Maisont and Narkrugsa, 2009) [13]. It is utilized mostly at the house hold level where it is consumed as boiled, fried or ground rice with stew or soup (Osaretin and Abosede, 2007) [15]. Consumer demand for good quality rice is high due to their patronage for imported rice. Since rice production is the major occupation of most farmers In India, and to ensure that locally processed rice varieties remain vital and relevant to rural economy and agricultural production, there is the need to evaluate their quality so as to compare them with their imported counterparts. Therefore, the objective of present study was to evaluation of some proximate, chemical and functional properties of Chhattisgarh popular paddy varieties for suitability of flaked rice (*poha*).

2. Material and Method

2.1 Proximate analysis

2.1.1 Moisture content

The moisture content of the sample was determined by standard air-oven method (Ranganna, 1995) [16]. A test sample of 5 g was kept for 24 hours in hot air electric oven maintained at 105 ºC after 24 hours the sample drawn from the oven and placed in desiccators for cooling to ambient temperature. After cooling, the weight of sample was taken precisely. The loss in weight was determined and moisture content was calculated by using the following expression:

$$MC_{wb}(\%) = \frac{W_1 - W_2}{W_1} \times 100 \quad \text{.... 1}$$

2.1.2 Protein content

Nitrogen (N_2%) of brown rice samples was estimated by using auto Kjeldahl equipment (Kel plus, pelican system, India). Digestion of brown rice (0.5 g sample) was carried out in the auto Kjeldahl equipment at 420 ºC for 2.30 hours. The digested sample obtained was distilled with 40% NaOH (sodium hydroxide) and 4% boric acid. The vapor of ammonia obtained after distillation was collected in boric acid (distillation time approximately 7 min.) and then titrated against 0.1 N HCL (hydrochloric acid). The percentage OF N_2 of brown rice sample was calculated by using the following equation (Ranganna, 1995) [16]

$$\text{Nitrogen } (\%) = \frac{14.01 \times (SR - BR) \times 0.1 \times 100}{1000 \times Ws} \quad \text{.... 2}$$

$$\text{Protein } (\%) = N \times 6.25 \quad \text{.... 3}$$

2.1.3 Fat content

Crude fat was determined by using the soxlet apparatus (AOAC, 2000) [1]. Oven dry beaker and sample at 100 ºC for half hours. Keep them in desiccators to avoid moisture content gain from the atmospheres. Weight the beakers and note the reading as initial weight. Carefully weight 5 gm of sample flour and keep in cellulose thimble. The thimble was then place in a beaker and beaker is filled with petroleum ether (boiling point 40-60 ºC) about 80 ml of beaker. Then beaker is now place in soxlet apparatus with thimble for 2 h at 90 ºC. the petroleum ether was then removed by evaporation and the beaker with residue in an oven at 105 ºC for 30 min., cooled in desiccators and weight. The percentage of oil was calculated by using following equation

$$\text{Fat content } (\%) = \frac{W_2 - W_1}{W} \times 100 \quad \text{.... 4}$$

2.1.4 Ash content

Ash content was determined according to (AOAC, 2000) [1] procedure. 1 g of sample was taken in a silica crucible and weighted. It was made to ash in a muffle furnace at 600 ºC for 4 hours. The crucible was cooled in the desiccators and weighted, and the value of ash content was calculated by using the following equation

$$\text{Ash content } (\%) = \frac{W_2 - W_1}{W} \times 100 \quad \text{.... 5}$$

2.1.5 Fiber content

Crude fiber was determined by using the fibra plus apparatus (Sadasivam and Manickam, 2005) [18]**.** Oven dry crucible and sample at 100 ºC for half hours. Keep them in desiccators to avoid moisture content gain from the atmospheres. Weight the crucibles and note the reading as initial weight W. Carefully weight 2 gm of sample grind flour and keep in crucible. The crucible was then place in a fibra plus apparatus. And after that, the 1.25% sulfuric acid (H_2SO_4) is filled from top of the apparatus up to the 150 ml of crucible. And sample is boiled in apparatus at 400 ºC for 40 minutes. After completion the acid wash drain the acid and wash the sample twice and thrice with distilled water. During drainage ensure that the knob is in vaccume mode. After acid wash similar process is done. The 1.25% NaOH (sodium hydroxide) is filled from top of the apparatus up to the 150 ml of crucible. And sample is boiled in apparatus at again 400 ºC for 40 minutes. After completion the acid wash drain the acid and wash the sample twice and thrice with distilled water. During drainage ensure that the knob is in vaccume mode. After alkali wash take out crucibles and dry them in a hot air oven until the crucible are free from moisture. cooled in desiccators. Weight the crucible and record the reading as W1. Place all the crucibles in muffle furnace at 600 ºC for ashing. Cool down the hot crucible after ashing to room temperature using a desiccator. Now weight the crucible and record the reading as W2. The fiber content of sample is calculated by using following equation

$$\text{Fiber content } (\%) = \frac{W_1 - W_2}{W} \times 100 \quad \text{.... 6}$$

2.2 Chemical properties

2.2.1 Starch content

Starch is an important polysaccharide. Starch, which is composed of several glucose molecules, is a mixture of two types of component namely Amylose and Amylopectin. Starch is hydrolyzed into simple sugar by dilute acid and the quantity of sample sugar is measured colorimetrically.

A 500 mg sample of grind powder of each grain variety was weighted and kept in a centrifuge tube and homogenised the sample in hot 80% ethanol to remove sugar. Centrifuged at

600 rpm for 5 minutes at 25 ºC and retained residue. (Sadasivam and Manickam, 2005) [18]. Washing the residue repeatedly with hot 80% ethanol till the washing did not give the color with anthrone reagent. In dried sample of residue 5.0 ml of distilled water and 6.5 ml of perchloric acid were added and centrifuged at 6000 rpm for 20 minutes at 0 ºC and supernatant was saved, the centrifuge of the sample was repeated with perchloric acid and distilled water and supernatant were saved and diluted sample with volume makeup with 100 ml distilled water. After that, pipette out 0.2 ml of supernatant and make up the volume to 1 ml with distilled water in each tube 4 ml of anthrone reagent was added carefully and also 4 ml anthrone reagent was added in standard solution prepared by taking 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9 and 1.0 ml of working standard of glucose with makeup 1 ml distilled water solution. Heated up 8 minute in boiling water bath and cooled down rapidly and read the intensity of green to dark color at 630 nm.

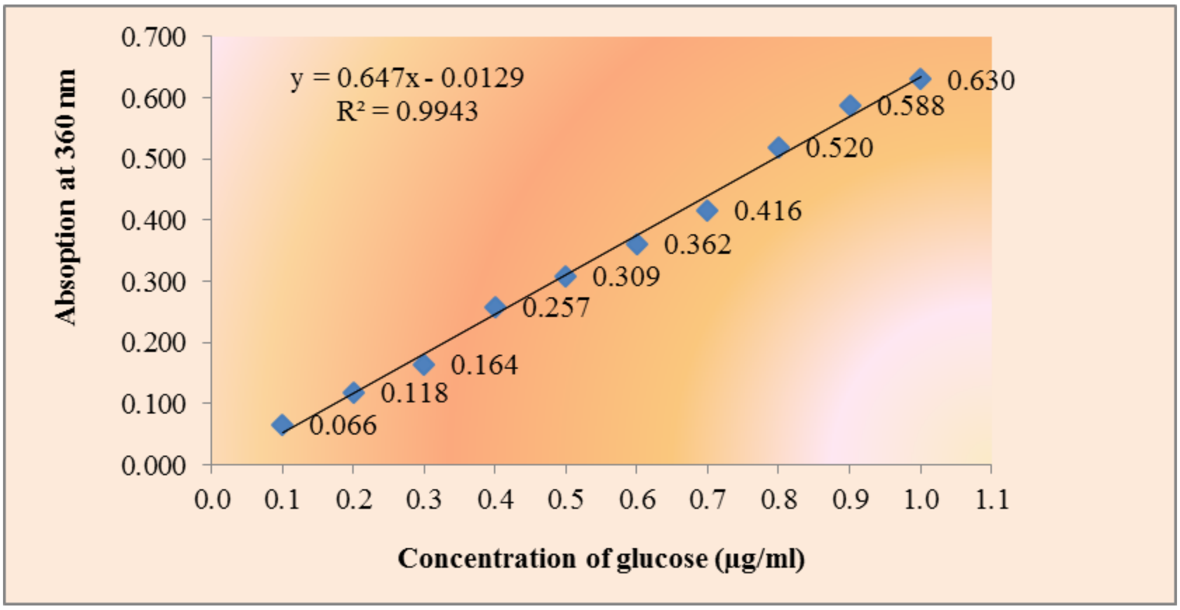

Fig 1: Standard graph of glucose solution using anthrone reagent

2.2.2 Amylose content

Starch is composed of two compound, namely Amylose and Amylopectin. Amylose is a linear or non branched polymer of glucose. The glucose units are joined by α-1-4 glucosidic linkage.

A 100 mg of grind powdered sample of each grain variety was weighted and put into a conical flask and 1 ml of distilled ethanol and 10 ml of 1N NaOH were added. (Sadasivam and Manickam, 2005) [18]. Then the sample was heated in boiling water bath at 100 ºC for 10 minutes. 100 ml volume was made up by adding distilled water. 2.5 ml of the extract was taken then 20 ml distilled water and 3 drops of 0.1% phenolphthalein were added. 0.1 N HCL solution was added drop by drop until the pink color is disappeared. After that 1 ml of iodine reagent (KI solution) was added and 50 ml volume was made up by adding distilled water then the color of solution was read at 590 nm. The blank solution was prepared by diluting 1 ml iodine reagent into 50 ml distilled water. A standard graph of Amylose content was developed by taking the color of standard amylose solution at 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9 and 1 ml concentration and read the intensity of color at 590 nm.

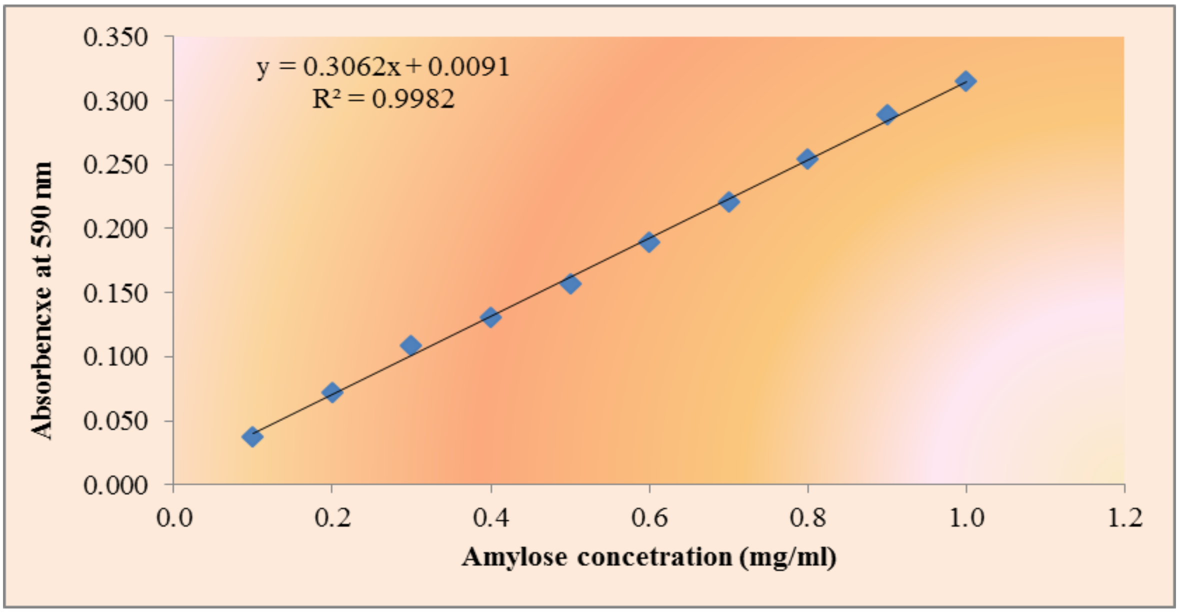

Fig 2: Standard graph of amylose using iodine reagent

2.3 Functional properties

2.3.1 Water absorbing index (WAI) and water solubility index (WSI)

One gram sample taken in centrifuge tube was added with 10 ml distilled water and agitated for 30 min followed by its centrifugation at 3000 rpm for 25 min. The decanted centrifuged tube with settled gel at the base was weighed and used in calculation of WAI (Eq. (8)). The supernatant obtained during WAI estimation was used to determine WSI by decanting it into a pre weighed evaporating dish whose final weight after oven drying at 103 ºC was recorded and used in the calculation of WSI by using Eq. (9) (Stojceska *et al.*, 2008; Kumar *et. al.*, 2016) [12].

$$\text{WAI (g/g)} = \frac{\text{Weight of gel}}{\text{Dry weight of sample}} \quad \text{.... 7}$$

$$\text{WSI (\%)} = \frac{\text{Weight of dry solid in supernatant}}{\text{Dry weight of sample}} \quad \text{.... 8}$$

2.3.2 Swelling power

The swelling power of rice flour sample was determined by measuring water uptake of sample (Duangrutai Thumrongchote, 2012) [8]. The 500 mg of rice flour was weighted into centrifuge tube and 15 ml of distilled water was added. The suspension was heated in water bath at 80 ºC for 30 min. and then centrifuge at 4000 rpm for 20 min. the supernatant was carefully poured into aluminum dish (of known weight) before drying at 105 ºC to constant weight and weighing. The sediment was collected and weighed. The swelling power was calculated by using following equation

$$\text{Swelling Power (g/g)} = \frac{\text{Wws}}{\text{Wf}-\text{Wt}} \quad \text{.... 9}$$

3. Result and Discussion

3.1 Proximate analysis

The initial moisture content of the paddy varieties namely Rajeshwari, Durgeshwari and Mahamaya at the time of experiment was 11.45 ± 0.03% (wb), 12.15 ± 0.06% (wb), and 11.33 ± 0.06% (wb). The moisture content of the rice varieties ranged between 11.33 to 12.15% and they differed significantly (P<0.05). Their values were below 14% optimal values for bag storage of grains (Juliano and Villarreal, 1993) [10]. Low moisture content are known to enhance keeping quality of rice under storage (Table 1).

The value of fat content for Rajeshwari, Durgeshwari and Mahamaya paddy varieties was varies between 3.62 ± 0.17%, 4.27 ± 0.17% and 3.45 ± 0.18% respectively. The fat content was nearly same in all the selected varieties and not shown a big difference. The fat content ranged from 3.45 to 4.27%. The results were much higher than the values of 1.10- 1.50% for some milled rice varieties earlier reported by Juliano and Villareal (1993) [10]. Since fat is more on the bran layer and the more this layer is removed during milling the less the fat content of the milled rice (Okaka, 2005) [14]. Higher fat contents, exposes the grains to spoilage during storage due to oxidationThe fiber content Rajeshwari, Durgeshwari and Mahamaya paddy varieties lies between 3.74 ± 0.49%, 3.14 ± 0.99% and 3.39 ± 1.03% respectively. The fiber content was higher in Rajeshwari paddy variety and the lower value of fiber content in Durgeshwari paddy variety (Table 1).

The protein content of Rajeshwari, Durgeshwari and Mahamaya paddy varieties lies between 6.73 ± 0.17%, 6.29 ± 0.09% and 6.51 ± 0.11% respectively. The protein content was higher in Rajeshwari paddy variety and the lower value of protein content in Durgeshwari paddy variety. The nutritional value of rice depends on the total quantity and quality of protein. On the basis of protein content, all the varieties contained sufficient amount which is slightly lower the reported values of 7% (Dipti *et al.*, 2002; Dutta *et al.*, 1998) [5, 7] (Table 1).

The ash content of Rajeshwari, Durgeshwari and Mahamaya paddy varieties lies between 1.05 ± 0.10%, 1.13 ± 0.15% and 1.39 ± 0.07% respectively. The ash content was higher in Mahamaya paddy variety and the lower value of ash content in Rajeshwari paddy variety. Ash residual is generally taken to be a measure of the mineral content of materials. High ash content in milled rice is an indication of a good quality of minerals in the rice sample (Dipti *et al.*, 2003) [6]. All the tested varieties showed high ash content which ranged from 1.05 to 1.39%. The ash content of all the tested varieties did not differ significantly (p<0.05) (Table 1).

Table 1: Proximate composition of different varieties of rice.

Parameters	Rajeshwari	Durgehwari	Mahamaya
Moisture content (%)	11.45 ± 0.03	12.15 ± 0.06	11.33 ± 0.06
Fat content (%)	3.62 ± 0.17	4.27 ± 0.17	3.45 ± 0.18
Fiber content (%)	3.74 ± 0.49	3.14 ± 0.99	3.39 ± 1.03
Protein content (%)	6.73 ± 0.17	6.29 ± 0.09	6.51 ± 0.11
Ash content (%)	1.05 ± 0.10	1.13 ± 0.15	1.39 ± 0.07

Mean ± Standard deviation values

3.2 Chemical properties of rice

The starch content of Rajeshwari, Durgeshwari and Mahamaya rice varieties lies between 74.60 ± 0.18%, 74.88 ± 0.31% and 75.53 ± 0.15% respectively. The value of starch content was found higher in Mahamaya and the lower value was found in Durgeshwari rice variety. the values of Amylose content of Rajeshwari, Durgeshwari and Mahamaya rice varieties lies between 24.43 ± 0.58%, 24.55 ± 0.42% and 24.80 ± 1.11% respectively. The values of Amylose content was found higher in Mahamaya and the lower in Rajeshwari rice variety. The Amylopectin content in Rajeshwari, Durgeshwari and Mahamaya rice varieties lies between 75.57 ± 1.21%, 75.45 ± 1.40% and 75.20 ± 1.11% respectively. The value of Amylopectin was higher in Rajeshwari rice variety and lower in Mahamaya rice variety (Table 2).

3.3 Functional properties of rice

The water absorbing index (WAI) of Rajeshwari, Durgeshwari and Mahamaya rice varieties lies between 2.46 ± 0.27 g/g, 2.25 ± 0.22 g/g and 2.49 ± 0.14 g/g respectively. The water absorbing index (WAI) was higher in Mahamaya rice variety and the lower in Durgeshwari rice variety. the water solubility index (WSI) of Rajeshwari, Durgeshwari and Mahamaya rice varieties lies between 3.98 ± 0.15%, 4.24 ± 0.09% and 3.20 ± 0.20% respectively. The water solubility index (WSI) was higher in Durgeshwari and the lower value in Rajeshwari rice variety. The swelling power (SP) of Rajeshwari, Durgeshwari and Mahamaya paddy varieties lies between 6.20 ± 0.04%, 6.40 ± 0.10% and 6.15 ± 0.03% respectively. The swelling power (SP) was higher in Durgeshwari paddy variety and the lower value of swelling power (SP) in Mahamaya rice variety (Table 2).

Table 2: Chemicals and functional properties of different varieties of paddy

Parameters	Rajeshwari	Durgehwari	Mahamaya
Starch content (%)	74.60 ± 0.18	74.88 ± 0.31	75.53 ± 0.15
Amylose content (%)	24.43 ± 0.58	24.55 ± 0.42	24.80 ± 1.11
Amylopectin (%)	75.57 ± 1.21	75.45 ± 1.40	75.20 ± 1.11
Water absorbing index (g/g)	2.46 ± 0.27	2.25 ± 0.22	2.49 ± 0.14
Water solubility index (%)	3.98 ± 0.15	4.24 ± 0.09	3.20 ± 0.20
Swelling power (%)	6.20 ± 0.04	6.40 ± 0.10	6.15 ± 0.03

Mean ± Standard deviation values

4. Conclusion

Their proximate chemical and functional were all within acceptable levels. Therefore, the varieties are of good quality. This investigation into the properties of grains gives rise to a number of conclusions. This study concludes with information on proximate, chemical and functional properties of Rajeshwari, Durgeshwari and Mahamaya paddy variety which may be useful for developing much more batter quality of flaked rice (*poha*). For developing of flaked rice it has been necessary that the flaked rice show higher or good result is some quality parameter like fat content, fibre content, protein content, starch content, water absorbing/solubility index and swelling power etc. In this investigation we found in case of proximate analysis the Rajeshwari rice variety and Mahamaya rice variety paddy varieties gives good or higher result in terms of fiber content and protein content at almost same moisture content but it has been also observed in all three variety of rice higher value of fat content in Durgeshwari rice variety followed by Rajeshwari and Mahamaya. Similarly, investigation on chemical and functional properties we found that Durgeshwari and Mahamaya paddy varieties gives good or higher result in terms of starch content, Amylose content, water solubility index and swelling power as compare with Rajeshwari paddy variety.

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