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Comparative Analysis on Chemical Properties of Selected Varieties of Paddy

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ABSTRACT

The present study aimed to compare the proximate composition, functional and chemical characteristics of Chhattisgarh Madhuraj, Hanthipanjra and Mahamaya paddy varieties. The proximate composition namely protein content, fat content, total ash, crude fiber and chemical & functional properties namely starch, amylose, amylopectin, water absorption index (WAI), water solubility index (WSI) and swelling power at moisture contents ranging from 11.23 to 12.17 % w.b. for Madhuraj paddy, 10.93 to 11.63 % w.b. for Hanthipanjra paddy and from 10.83 to 11.23 % w.b. for Mahamaya paddy were determined using standard techniques. The proximate composition of Madhuraj, Hanthipanjra and Mahamaya paddy were found to be 4.27 %, 3.18 % and 3.25 % for fat content, 3.14 , 2.65, and 3.39 (g/100g) for crude fiber , 4.28, 3.68 and 3.74 (g/100gm) for protein content, 1.54 %, 1.15 % and 1.00 % for ash content respectively. The chemical and functional properties of Madhuraj, Hanthipanjra and Mahamaya paddy were found to be 2.25, 2.1, and 2.49 (g/g) for WAI, 4.24 %, 2.95 % and 3.20 % for WSI respectively.

Key word: *proximate, functional, chemical characteristics, Varieties- Madhuraj, Hanthipanjra, Mahamaya*

INTRODUCTION

Paddy (*Oryza sativa* L.) is a semi aquatic, annual grass which can be grown under a broad range of climatic conditions. The contribution of India towards world paddy production is one fifth with a consolidated production figures of 22.69±1.79% and 20.71±1.64% for Asia and World, respectively[13]. India has the largest area under paddy in the world and ranks second in the production after China. Country has also emerged as a major rice consumer. Rice is primarily a high energy calorie food. The major part of rice consists of carbohydrate in the form of starch, which is about 72- 75 percent of the total grain composition and the protein content of rice is around 7 percent. Ali *et al.*[3] reported that starch is the major dietary source of carbohydrates and is the most abundant storage polysaccharide in plants.

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Amylose and amylopectin are two macromolecular components of starch granules. Isolated starch is used in the food industry to impart functional properties, modify food texture, consistency and so on. Not only is the amount of starch important for the texture of a given product, but also the type of starch is critical. Starch from rice is non-allergenic, because of the hypoallergenicity of the associated protein. Rice starch granule being very small in size provides a texture perception similar to that of fat. Recent uses of starch include their use as delivery vehicles that protect pharmaceutically active proteins from digestion such as microencapsules for small molecules and biodegradable films.

MATERIAL AND METHODS

The determination of various chemical, functional and proximate properties of paddy varieties was done using standard techniques.

Raw Material Procurement

The Chhattisgarh Madhuraj Paddy-55 (Chaptigurmatiya), Hanthipanjra, and Mahamaya paddy grains were selected for the present research work. The samples of paddy varieties was procured from Department of Plant Molecular Biology and Biotechnology, Department of Plant Breeding and Genetics and National Seed Project, IGKVV, Raipur (Chhattisgarh). The sample materials were properly cleaned and graded to have a uniform sample.

Chemical and functional properties

The Water absorption index (WAI) and water solubility index (WSI) of rice flour samples were determined following the method described by Kadan . One gram of dried flour sample was accurately weighed and suspended in 10 ml of distilled water and shaken in water bath at 80°C for 30 min. The content was centrifuged at 3,000 rpm for 25 min. The supernatant was carefully poured into an petri dish (of known weight) before drying at 105°C for 4 hr in oven and weighing. The sediment was collected and weighed. The WAI and WSI were calculated from given equation,

$$\text{WAI (g/g)} = \frac{\text{Weight of wet sediment}}{\text{Dry weight of sample}} \quad (1)$$

$$\text{WSI (\%)} = \frac{\text{Weight of dried solids in supernatant}}{\text{Dry weight of sample}} \times 100 \quad (2)$$

The Swelling power (SP) of rice flour samples was determined by measuring water uptake of the samples (Schoch, 1964).

$$\text{SP, (g/g)} = \frac{W_{ws}}{W_f - W_t} \quad (3)$$

Where,

W_{ws} = Weight of wet sediment (g),

W_f = Weight of rice flour (g)

and Wt = Weight of dry solid in supernatant (g)

Starch content of rice was determined by the anthrone reagent.

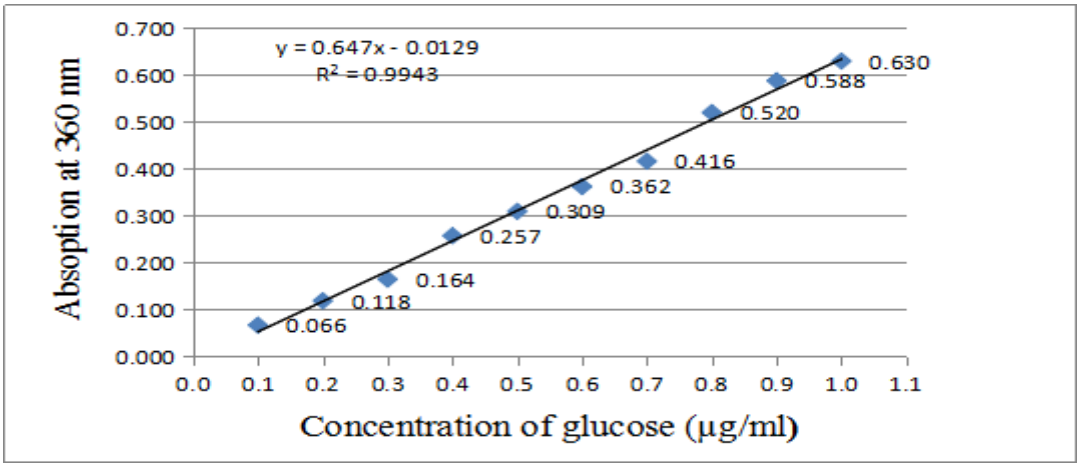

Fig. 1: Standard graph of glucose solution using anthrone reagent

Starch is composed of two components, namely amylose and amylopectin. Amylose is a linear or non-branched polymer of glucose. The glucose units are joined by α-1-4

glucosidic linkages. Amylose exist in coiled form and each coil contains six glucose residues. The amylose content of starches usually ranges from 15 to 35 %. High amylose content rice shows high volume expansion (not necessarily elongation) and high degree of flakiness.

The amylose content of paddy varieties was determined by iodine reagent (IKI solution) method. A standard graph of amylose content was developed by taking the colour of standard amylose solution at different concentration 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, and 1 ml at 590 nm.

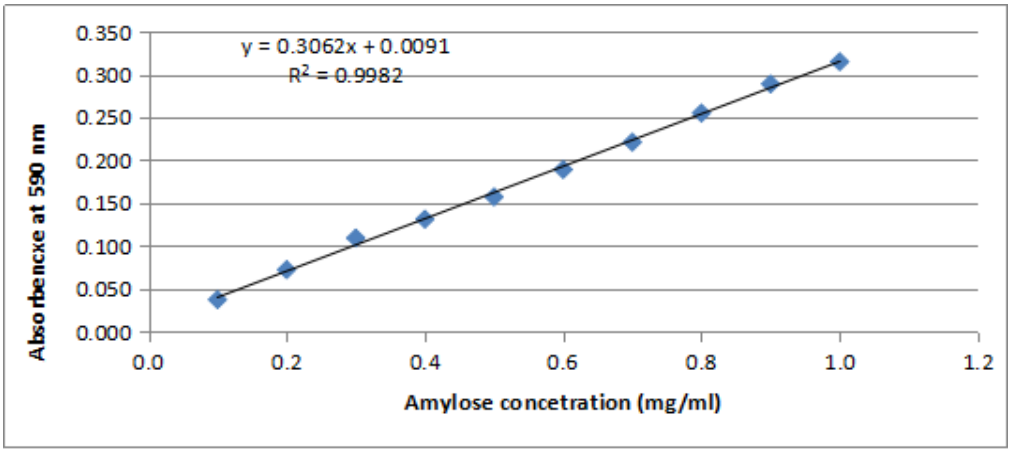

Fig. 2: Standard graph of amylose solution using antrone reagent

The amount of amylopectin is obtained by subtracting the amyolse content from that of total starch content present in the sample.

Proximate analysis

The moisture content of the sample was determined by standard air-oven method.

Moisture Content, % (wb) = $\frac{W1-W2}{W1}\times 100$ (4)

Where, W_1 and W_2 = Initial weight of wet material sample and final weight of dried sample in gram.

Crude fat was determined by using the Soxhlet apparatus[2] .

$$\text{Fat Content (\%)} = \frac{W_2 - W_1}{W}\times 100 \quad (5)$$

Where, W_1 = Weight of empty beaker (g),
W_2 = Weight of beaker containing oil (g) and
W = Initial weight of sample (g)

The Protein content was determined by measuring nitrogen (N_2, %) of rice samples by using auto Kjeldahl equipment (Kel Plus, Pelican System, India). The percentage of N_2 of rice samples was calculated using following equation.

$$N_2(\%) = \frac{14.01\times(SR - BR)\times 0.1\times 100}{1000\times \text{Weight of sample}} \quad (6)$$

Where, 14.01 is atomic weight of nitrogen,SR = titrate reading of the sample(ml),BR = titrate reading of the blank sample (ml) and W_s = weight of the sample (g)

Then, protein content was estimated by using the following expression.

Protein content = $N_2 \times 6.25$ (7)

Crude fiber was determined by using the fibra plus apparatus.

Fiber content (%) = $\frac{W1 - W2}{W}\times 100$ (8)

Where,

W1 = Weight after oven drying (g)
W2 = Weight after ashing (g)
W = Initial weight of sample (g)

Ash content was determined according to AOAC[1] procedure. 1 g of sample was taken in silica and weighed. It was made to ash in a muffle furnace at 600°C for 4 hours. The crucible was cooled in the desiccators and weighed, and the value for ash content was calculated by using the following expression:

$$\text{Ash Content} = \frac{W_2 - W_1}{W}\times 100 \quad (9)$$

Where,

W1 = Weight of empty crucible (g)
W2 = Weight of crucible and ash (g)
W = Initial weight of sample (g)

RESULTS AND DISCUSSION

The effect of various chemical, functional and proximate properties, important observations, outcome of adopted methodology and above all analysis are presented in compiled and tabulated form.

Proximate analysis of paddy varieties

The initial moisture content of the paddy varieties namely Madhuraj, Hanthipanjra and Mahamaya at the time of experiment was 11.81 ± 0.39 % (w.b), 11.23 ± 0.26 % (w.b), and 11.05 ± 0.16 % (w.b) respectively. The value of fat content for Madhuraj, Hanthipanjra and Mahamaya paddy varieties was varies between 4.22 to 4.34 %, 3.15 to 3.21 % and 3.04 to 3.38 % with mean value 4.27 ± 0.06 %, 3.18 ± 0.03 % and 3.25 ± 0.18 % respectively. The fat content was highest in Madhuraj variety, nearly same in remaining two varieties and not shown a big difference through statistical analysis. The fiber content of Madhuraj rice, Hanthipanjra and Mahamaya paddy varieties lies between 2.36 to 4.25 %, 1.62 to 4.28 % and 2.24 to 4.21 % with mean value 3.14 ± 0.99 %, 2.65 ± 1.43 % and 3.39 ± 1.03 % respectively. The fiber content was higher in Mahamaya paddy variety and the lower value of fiber content in Hanthipanjra paddy variety. The protein content of Madhuraj, Hanthipanjra and Mahamaya paddy varieties lies between 3.88 to 4.74 %, 3.26 to 4.17 % and 3.49 to 3.86 % with mean value 4.28 ± 0.44 %, 3.68 ± 0.46 % and 3.74 ± 0.21 % respectively. The protein content was higher in Madhuraj paddy variety and the lower value of protein content in Hanthipanjra paddy variety. The ash content of Madhuraj, Hanthipanjra and Mahamaya paddy varieties lies between 1.28 to 1.68 %, 1.08 to 1.19 % and 0.95 to 1.05 % with mean value 1.54 ± 0.23 %, 1.15 ± 0.06 % and 1.00 ± 0.05 % respectively. The ash content was higher in Madhuraj paddy variety and the lower value of ash content in Mahamaya paddy variety.

Table 1: Proximate composition of different varieties of paddy

Parameters	Madhuraj	Hanthipanjra	Mahamaya
Moisture content (%)	11.81 ± 0.39	11.23 ± 0.26	11.05 ± 0.16
Fat content (%)	4.27 ± 0.06	3.18 ± 0.03	3.25 ± 0.18
Fiber content (%)	3.14 ± 0.99	2.65 ± 1.43	3.39 ± 1.03
Protein content (%)	4.28 ± 0.44	3.68 ± 0.46	3.74 ± 0.21
Ash content (%)	1.54 ± 0.23	1.15 ± 0.06	1.00 ± 0.05

Mean ± Standard deviation values

Chemical and functional properties of paddy varieties

The starch content of Madhuraj, Hanthipanjra and Mahamaya rice varieties lies between 73.99 to 74.89 %, 75.19 % to 79.29 % and 75.49 % to 77.69 % with mean value 74.25 ± 0.56 %, 77.19 ± 2.05 % and 76.46 ± 1.12 % respectively. The value of starch content was found higher in Hanthipanjra and the lower value was found in Mahamaya rice variety. The amylose content of Madhuraj, Hanthipanjra and Mahamaya rice varieties lies between 17.93 to 20.47 %, 18.58 to 21.20 % and 24.13 to 25.44 % with mean value 19.45 ± 1.47 %, 20.11 ± 1.36 % and 24.68 ± 0.68 % respectively. The value of amylose content was found higher in Mahamaya and the lower in Madhuraj rice variety. The values of amylopectin content in Madhuraj, Hanthipanjra and Mahamaya rice varieties lies between 75.20 to 76.85 %, 78.80 to 81.09 % and 74.56 to 75.87 % with mean value 76.08 ± 0.82 %, 79.89 ± 1.15 % and 75.32 ± 0.68 % respectively. The value of amylopectin was higher in Hanthipanjra rice variety and the lower in Mahamaya rice variety. The water absorbing index (WAI) of Madhuraj, Hanthipanjra and Mahamaya rice varieties lies between 2.22 to 2.29 g/g, 2.09 to 2.12 g/g and 2.35 to 2.63 g/g with mean value 2.25 ± 0.04 g/g, 2.10 ± 0.02 g/g and 2.49 ± 0.14 g/g respectively. The water absorbing index (WAI) was higher in Mahamaya variety rice and the lower in Hanthipanjra. The water solubility index (WSI) of Madhuraj, Hanthipanjra and Mahamaya rice varieties lies between 4.22 to 4.27 %, 2.55 to 3.17 % and 2.98 to 3.37 % with mean value 4.24 ± 0.03 %,

2.95 ± 0.34 % and 3.20 ± 0.20 % respectively. The water solubility index (WSI) was higher in Madhuraj and the lower value in Hanthipanjra rice variety. The water swelling power (SP) of Madhuraj, Hanthipanjra and Mahamaya paddy varieties lies between 6.12 to 6.70 %, 6.41 to 6.47. % and 6.12 to 6.17 % with mean value 6.40 ± 0.29 %, 6.44 ± 0.03 % and 6.15 ± 0.03 % respectively. The swelling power (SP) was higher in Hanthipanjra paddy variety and the lower value of swelling power (SP) in Mahamaya and Madhuraj paddy variety.

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

Parameters	Madhuraj	Hanthipanjra	Mahamaya
Starch content (%)	74.25 ± 0.56	77.19 ± 2.05	75.46 ± 1.12
Amylose content (%)	19.45 ± 1.47	20.11 ± 1.15	24.68 ± 0.68
Amylopectin (%)	80.55 ± 1.47	79.89 ± 1.36	75.32 ± 0.68
Water absorbing index (g/g)	2.25 ± 0.04	2.10 ± 0.02	2.49 ± 0.14
Water solubility index (%)	4.24 ± 0.03	2.95 ± 0.34	3.20 ± 0.20
Swelling power (%)	6.40 ± 0.29	6.44 ± 0.03	6.15 ± 0.03

Mean ± Standard deviation values

CONCLUSIONS

Current experiments and investigation concludes that soaking time and roaster temperature of paddy affects the flaking yield or total flaked rice percentage and recovery of flaked rice. With more increase in roaster temperature it decreases flaking yield but at low roaster temperature also it decreases flaking yield, so it is important to determine optimum soaking time and temperature for any paddy variety used for flaking. The physico-chemical varieties of Madhuraj are very similar to Mahamaya variety, and after pressing its flaking yield also gives good results, which shows Madhuraj variety is good and adoptable for industrial and all purposes. The Hanthipanjra variety has good result of physical properties and almost similar result of chemical properties compare to Madhuraj and Mahamaya but its flaking yield and recovery of flaked rice is less compare to other. It has been also observed that all the proximate analysis (moisture content, fat content, fiber content, protein content) of flaked rice for thick and thin size among all varieties were significant difference but for ash content, significant difference was not observed. Overall acceptability of these established varieties through experiments is good and its properties are very similar to Mahamaya variety, which creates a good flaking market for this variety in future.

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