

**EVALUATE THE EFFECT OF PROCESSING OF CHHATTISGARH
LOCAL PADDY VARIETY TO FLAKED RICE (*POHA*) ON
PROXIMATE, CHEMICAL AND FUNCTIONAL CHARACTERISTICS**

ABSTRACT

The present study was undertaken to study the evaluate the effect of processing of Chhattisgarh local paddy variety to flaked rice (*Poha*) on proximate, functional and chemical characteristics. In the proximate analysis, change in crude fat content from paddy 3.20% to 0.96% for thick and 1.00% for thin flaked rice. The change in Crude fiber content from paddy to flaked rice was found to be 2.00% to 1.85% for thick and 1.79 for thin flaked rice. Similarly, change in crude protein content from paddy to flaked rice was found to be 4.23% to 4.04% for thick and 3.76 for thin flaked rice and change in ash content from paddy to flaked rice was found to be 1.00% to 1.35% for thick and 1.24% for thin flaked rice. Chemical properties, show that amylose content from paddy to flaked rice 19.27% to 18.19% for thick and 18.26% for thin flaked rice. Similarly, change in starch content from paddy to flaked rice 74.15% to 73.89% for thick and 73.47% for thin flaked rice. Functional properties, show that Water absorbing index (WAI) from paddy to flaked rice 2.19 g/g to 5.18 g/g for thick and 5.05 g/g for thin flaked rice. Similarly, water solubility index (WSI) from paddy to flaked rice 3.25% to 4.86 for thick and 5.09% for thin flaked rice

Keywords – Paddy, Raw rice, chemical and functional properties of flaked rice.

1. INTRODUCTION

The grain, called rice (*Oryza sativa* L.) for more than 8000 years, has been the companion of humankind. 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 (*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 different varieties of rice depending upon the climate, cultivation situation, rainfall and socio-economic factors. 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 depend mainly on the variety of paddy as well as the parboiling characteristics of paddy (Dahare *et al.*, 2019).

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). A significant variation in physical, milling and cooking quality has been shown among rice varieties produced in different parts of the world due to diverse genetic and environmental factors (Singh *et al.*, 2005; Izawa, 2008).

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 the 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).

The paddy grain is made up of hull or husk (18 - 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%) (Lantin, 1999). 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 rice (Kumar *et al.*, 2016; Bhattacharya, 2011). It also contains valuable nutrients including dietary fiber and phytochemicals, which have been linked to minimizing the risk of various diseases (Maisont and Narkrugsa, 2009). It

is utilized mostly at the household level where it is consumed as boiled, fried or ground rice with stew or soup (Osaretin and Abosede, 2007). 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 the 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 the present study was to “Evaluate the effect of processing of Chhattisgarh local paddy variety to flaked rice on proximate, chemical and functional characteristics”.

2. MATERIALS AND METHODS

2.1 Raw material procurements

Three varieties of paddy Dokra-Dokri grown in *kharif* season 2016 were selected for the present investigation. The material was properly cleaned and graded to have a uniform sample. The sample of paddy varieties were procured from the Department of Genetics and Plant Breeding, Department of Plant Molecular Biology and Biotechnology and National Seed Project (NSP), Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh.

2.2 Preparation of thick and thin sized flaked rice

Flaked rice in two different sizes (thick and thin) was prepared at Agro-Industry situated at a Village Mundihpar, District Gondia, Maharashtra. In this process, first raw paddy was soaked in the water for 24 to 30 hours at a room temperature to increases its moisture content from 11-12% to 30-32%. After soaking excess water is removed and put the paddy for conditioning in a gunny bags for 2-3 hours. After soaking-conditioning process paddy was roasted with the help of roaster at a temperature about 172 - 175°C for a period of about 2 to 3 min. After roasting the moisture content of paddy was reduced then the roasted paddy that conveyed to the rice flaked machine which was operated at 200 rpm. The retention time of paddy in a rice flaking machine was 45 to 55 sec for thick size flaked rice (*poha*) and about 60 to 70 sec for thin flaked rice (*poha*), with further cleaning to separate broken and husk from flaked rice.

2.3 Proximate analysis

2.3.1 Moisture content

The moisture content of the sample was determined by standard air-oven method (AOAC, 2000). A test sample of 5 g was dried for 24 hours in hot air electric oven (mild steel digital laboratory oven) maintained at 105°C after 24 hours the sample drawn from the oven and placed in desiccators for cooling to ambient temperature. After cooling, the weight of the sample was taken precisely. The loss in weight was determined and moisture content was calculated by using equation (1):

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

Where,

W_1 = Initial weight of wet material sample (g)

W_2 = Final weight of dried material sample (g)

2.3.2 Crude protein content

Nitrogen (N_2 %) of brown rice samples was estimated by using auto Kjeldahl equipment (KEL PLUS apparatus, pelican system, India). According to the method describe in (AOAC, 2000), digestion of brown rice (0.5 g sample) was carried out in the equipment at 420°C 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 equation (2):

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

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

Where,

SR= Sample reading after titration

BR= Blank reading after titration

W_s = Initial weight of sample (g)

2.3.3 Crude fat content

Crude fat was determined by using the Soxhlet apparatus (AOAC, 2000). Oven dry beaker and sample at 100°C for 30 min. Keep them in desiccators to avoid moisture content gain from the atmospheres. Weighted the beakers and note the reading as initial weighted. Carefully weight five (5) g of sample flour and keep in cellulose thimble. The thimble was then placed in a beaker and beaker is filled with petroleum ether (boiling point 40-60°C) about 80 ml of the beaker. Then beaker is now placed in soxhlet apparatus with a thimble for 2 h at 90°C. The petroleum ether was then removed by evaporation and the beaker with residue in an oven at 105°C for 30 min. Cooled in desiccators and weighted. The percentage of oil was calculated by using the equation (4):

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

Where,

W_1 = Weight of empty beaker (g)

W_2 = Weight of beaker containing oil (g)

W = initial weight of sample (g)

2.3.4 Ash content

Ash content was determined according to (AOAC, 2000) procedure. One (1) g of the sample was taken in a silica crucible and weighted. It was made to ash in a muffle furnace at 600°C for 4 hours. The crucible was cooled in the desiccators and weighted, and the value of ash content was calculated by using the equation (5):

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

Where,

W_1 = Weight of empty crucible (g)

W_2 = Weight of crucible and ash (g)

W = initial weight of sample (g)

2.3.5 Crude fiber content

The crude fiber was determined by using the fibra plus apparatus (Sadasivam and Manickam, 2005). Oven dry crucible and sample at 100°C for 30 min. 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 two (2) g of sample grind flour and keep in the crucible. The crucible was then placed in a fibra plus apparatus. And after that, the 1.25 % sulfuric acid (H₂SO₄) is filled from the top of the apparatus up to the 150 ml of the crucible. And the sample is boiled in apparatus at 400°C for 40 min. After completion, the acid wash drains the acid and wash the sample twice and thrice with distilled water. During drainage ensure that the knob is in vacuum mode. After acid wash, a similar process is done. The 1.25 % NaOH (sodium hydroxide) is filled from the top of the apparatus up to the 150 ml of the crucible. And the sample is boiled in apparatus at again 400°C for 40 min. After completion, the acid wash drains the acid and wash the sample twice and thrice with distilled water. During drainage ensure that the knob is in vacuum mode. After alkali wash takes out crucibles and dries them in a hot air oven until the crucible is free from moisture. Cooled in the desiccators. Weight the crucible and record the reading as W₁. Place all the crucibles in a muffle furnace at 600°C 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 the sample is calculated using the equation (6):

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

Where,

W₁ = Weight after oven drying (g)

W₂ = Weight after ashing (g)

W = initial weight of sample (g)

2.4 Chemical properties

2.4.1 Starch content determination

A 0.5 g sample of grind powder of each grain variety was weighted and kept in a centrifuge tube and homogenized the sample in hot 80% ethanol to remove sugar. Centrifuged

at 600 rpm for 5 min at 25°C and retained residue. (Sadasivam and Manickam, 2005). Washing the residue repeatedly with hot 80% ethanol until the washing did not give the colour 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 min at 0°C and supernatant was saved for further procedure. The centrifuge of the sample was repeated with perchloric acid and distilled water with saved supernatant 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 colour at 630 nm.

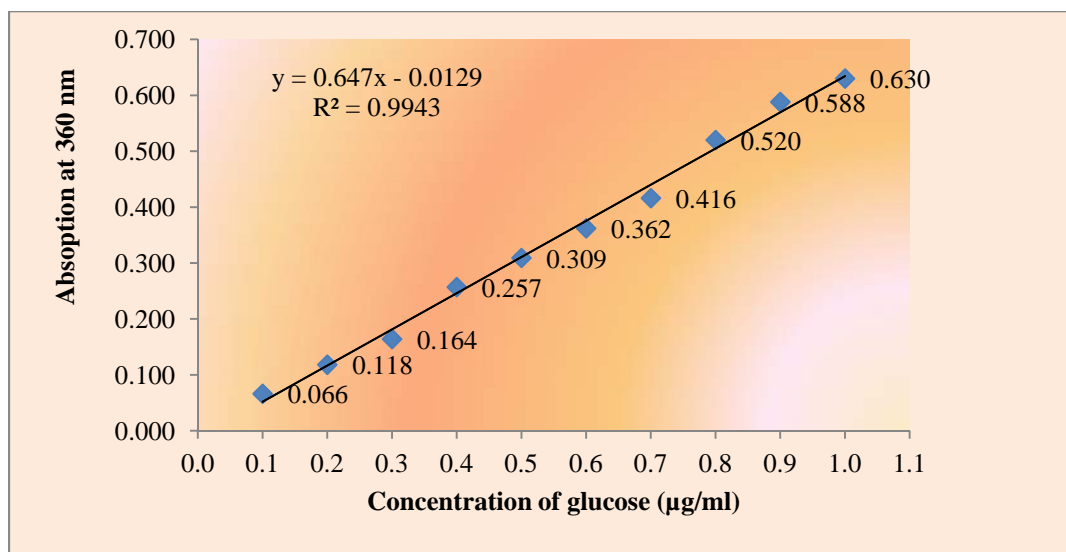


Fig. 2.1: Standard graph of glucose solution using anthrone reagent

2.4.2 Amylose content determination

A 0.1 g 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). Then the sample was heated in a boiling water bath at 100°C for 10 min. 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 colour was 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

colour of the 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 colour at 590 nm.

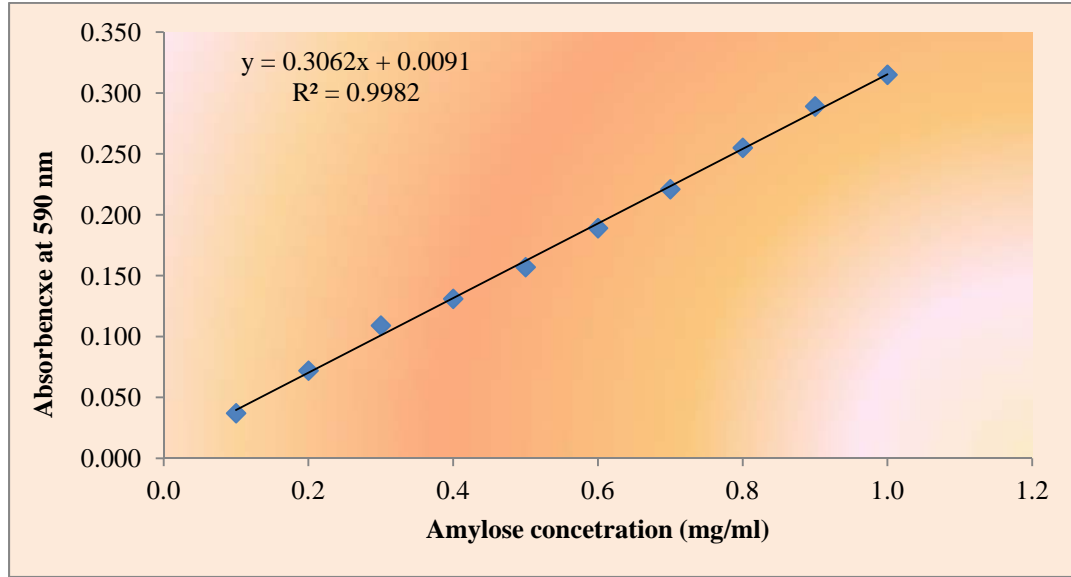


Fig. 2.2: Standard graph of amylose using iodine reagent

2.5 Determination of functional properties

2.5.1 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. WAI was calculated by using Equation (7). 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°C was recorded and used in the calculation of WSI by using Equation (8) (Stojceska *et al.*, 2008; Kumar *et al.*, 2016).

$$\text{WAI (g/g)} = \frac{\text{Weight of gel}}{\text{The dry weight of the sample}} \quad \dots\dots 7$$

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

2.5.2 Swelling power

The swelling power of rice flour sample was determined by measuring the water uptake of the sample (Thumrongchote, 2012). The 0.5 g of rice flour was weighted into a centrifuge tube and 15 ml of distilled water was added. The suspension was heated in a water bath at 80°C for 30 min. and then centrifuged at 4000 rpm for 20 min. the supernatant was carefully poured into the aluminum dish (of known weight) before drying at 105°C to constant weight and weighing. The sediment was collected and weighed. The swelling power was calculated by using the following equation

$$\text{Swelling Power (g/g)} = \frac{W_{ws}}{W_f - W_t} \quad \dots 9$$

Where,

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

W_f = Weight of rice flour (g)

W_t = Weight of dry solid in supernatant (g)

3. RESULT AND DISCUSSION

3.1 Proximate composition

The result of proximate composition of Chhattisgarh local paddy variety (Dokra-Dokri) is presented in Table 1. The initial moisture content of the Chhattisgarh local paddy variety (Dokra-Dokri) and their value-added product thick and thin flaked rice were found to be 11.31%, 13.89% and 13.79%, respectively. Moisture content was higher in thick and thin flaked rice as compared to brown rice, due to the soaking process, the paddy kernel absorbs water resulting in its increased moisture content. Their values were below 14% optimal values for bag storage of grains (Juliano and Villarreal, 1993). Low moisture content is known to enhance keeping the quality of rice under storage.

Crude fat content of Chhattisgarh local paddy variety (Dokra-Dokri) is presented in Table 1. Crude fat content of the Chhattisgarh local paddy variety (Dokra-Dokri) and their value-added product thick and thin flaked rice were found to be 3.20%, 0.96% and 1.00%, respectively. The fat content was nearly same for thick and thin flaked rice of selected varieties and not shown a big difference, but the fat content of raw rice is higher than their

value-added product. Since, crude fat content 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). Higher crude fat contents expose the grains to spoilage during storage due to oxidation.

Crude fibre and protien content of Chhattisgarh local paddy variety (Dokra-Dokri) is presented in Table 1. Crude fiber content of Chhattisgarh local paddy variety (Dokra-Dokri) and their value-added product thick and thin flaked rice were found to be 2.00%, 1.85%, and 1.79%, respectively. Crude protein content of Chhattisgarh local paddy variety (Dokra-Dokri) and their value-added product thick and thin flaked rice were found to be 4.23%, 4.04%, and 3.76%, respectively. The nutritional value of rice depends on the total quantity and quality of crude protein. On the basis of crude protein content, all the varieties contained sufficient amount which was slightly lower the reported values of 7% (Dipti *et al.*, 2002; Dutta *et al.*, 1998). Crude fiber content and crude protein content of brown rice, thick and thin flaked rice were almost similar.

Ash content of Chhattisgarh local paddy variety (Dokra-Dokri) is presented in Table 1. Ash content of Chhattisgarh local paddy variety (Dokra-Dokri) and their value-added product thick and thin flaked rice were found to be 1.00%, 1.35% and 1.24%, respectively. 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).

3.2 Chemical properties of rice

The starch content of Chhattisgarh local paddy variety (Dokra-Dokri) and their value-added product thick and thin flaked rice were found to be 74.15%, 73.89% and 73.47%, respectively. Similarly, the values of Amylose content of Chhattisgarh local paddy variety (Dokra-Dokri) and their value-added product thick and thin flaked rice were found to be 19.27%, 18.91% and 18.26%, respectively. Processing of paddy into flaked rice at higher temperature results in starch gelatinization with a portion of amylose getting converted into resistant starch yielding flaked rice with higher resistant starch content in the process of rice parboiling (Chitra *et al.*, 2010; Mahanta and Bhattacharya, 2010; Ibukun, 2008). The Amylopectin content in Chhattisgarh local paddy variety (Dokra-Dokri) and their value-added product thick and thin flaked rice, was found to be 79.78%, 78.80% and 80.76%, respectively.

Table 1: Proximate composition of Brown rice and flaked rice

Parameter	Chhattisgarh local paddy variety (Dokra-Dokri)		
	Brown rice	Thick flaked rice	Thin flaked rice
Moisture content (%)	11.31 \pm 0.38	13.89 \pm 0.17	13.79 \pm 0.15
Crude fat content (%)	3.20 \pm 0.12	0.96 \pm 0.08	1.00 \pm 0.06
Crude fiber content (%)	2.00 \pm 0.49	1.85 \pm 1.53	1.79 \pm 1.00
Crude protein content (%)	4.23 \pm 0.52	4.04 \pm 0.38	3.76 \pm 0.46
Ash content (%)	1.00 \pm 0.10	1.35 \pm 0.35	1.24 \pm 0.15
Mean \pm Standard deviation values			

3.3 Functional properties of rice

The WAI and WSI of brown, thick and thin flaked rice are shown in Table 2. The water absorbing index (WAI) of Chhattisgarh local paddy variety (Dokra-Dokri) and their value-added product thick and thin flaked rice were found to be 2.19 g/g, 5.18 g/g and 5.05 g/g, respectively. The water solubility index (WSI) of Chhattisgarh local paddy variety (Dokra-Dokri) and their value-added product thick and thin flaked rice were found to be 3.25%, 4.86%, and 5.09%, respectively. WAI of thick and thin flaked rice were found to be greater than the brown rice. Processing of paddy to flaked rice resulted in physicochemical changes of grains. Roasting at high temperature resulted in decreasing moisture content of grains that led to the dry heat gelatinization. Both roasting and flaking resulted in the damage of some starch granules leading to their enhanced water absorption capacity (Kumar *et al.* 2016). The swelling power of brown, thick and thin flaked rice are shown in Table 2. Swelling power (SP) of Chhattisgarh local paddy variety (Dokra-Dokri) and their value-added product thick and thin flaked rice were found to be 6.11%, 6.51% and 6.29%, respectively.

Table 2: Chemicals and functional properties of Brown rice and flaked rice

Parameter	Chhattisgarh local paddy variety (Dokra-Dokri)		
	Brown rice	Thick flaked rice	Thin flaked rice
Starch content (%)	74.15 \pm 1.20	73.89 \pm 0.96	73.47 \pm 1.37
Amylose content (%)	19.27 \pm 0.22	18.91 \pm 0.16	18.26 \pm 0.25

Amylopectin (%)	79.78 ± 0.20	78.80 ± 0.16	80.76 ± 0.25
Water absorbing index (g/g)	2.19 ± 0.24	5.18 ± 0.29	5.05 ± 0.15
Water solubility index (%)	3.25 ± 1.03	4.86 ± 1.11	5.09 ± 0.75
Swelling power (%)	6.11 ± 0.07	6.51 ± 0.04	6.29 ± 0.8
Mean ± Standard deviation values			

CONCLUSION

Their proximate chemical and functional were all within acceptable levels. Therefore, the Chhattisgarh local paddy variety (Dora-Dokri) is good quality. 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, fiber content, protein content, starch content, water absorbing/solubility index and swelling power, etc. In this investigation we found in the case of proximate analysis, the Chhattisgarh local paddy variety (Dora-Dokri) gives good result in terms of fat content and moisture content. Similarly, investigation of chemical and functional properties we found that Chhattisgarh local paddy variety (Dora-Dokri) gives good result in terms of starch content and Amylose content. In functional properties, Chhattisgarh local paddy variety (Dora-Dokri) gives good result of flaked rice with increase in water absorption index (WAI) and water solubility index (WSI). It is recommended that, Chhattisgarh local paddy variety (Dora-Dokri) show good result all attributes and it is used for making flaked rice (*Poha*) instead of Mahamaya Paddy variety in industrial level.

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