Original Research Article

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

ABSTRACT

The present study was undertaken to study the effect of some proximate, functional and chemical characteristics during the transformation of Chhattisgarh local paddy variety to flaked rice (*Poha*). In the proximate analysis, change in Fat content was found to be significant (P>0.05) and it was ranged from paddy 3.20% to 0.96% for thick and 1.00% for thin flaked rice. and the change in 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 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. During the investigation of chemical properties, it was found that the change in Amylose content from paddy to flaked rice was found to be significant (P>0.05) and it was ranged from paddy 19.27% to 18.19% for thick and 18.26% for thin flaked rice. Similarly, change in Starch content from paddy to flaked rice was found to be 74.15% to 73.89% for thick and 73.47% for thin flaked rice. While the investigation on functional properties, it was found to be significant (P>0.05) result in Water absorbing (WAI) and Water solubility index (WSI). Change in Water absorbing index (WAI) from paddy to flaked rice was found to be 2.19 g/g to 5.18 g/g for thick and 5.05 g/g for thin flaked rice. similarly, change in Water solubility index (WSI) from paddy to flaked rice was found to be 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 varieties of rice depending upon the climate, cultivation situation, rainfall and socio-economic factors and such as numerous varieties of paddy are produced in 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 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 significants 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 (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). 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). 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 evaluation "effect on some proximate, chemical and functional characteristics during the transformation of Chhattisgarh local paddy variety to flaked rice

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). A test sample of 5 g was kept for 24 hours in hot air electric oven maintained at 105ºC 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 the following expression:

$$MC_{wb}(\%) = \frac{W1 - W2}{W1} \times 100 \quad ...1$$

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 420ºC 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).

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

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

2.1.3 Fat content

Crude fat was determined by using the Soxhlet apparatus (AOAC, 2000). Oven dry beaker and sample at 100ºC 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 placed in a beaker and beaker is filled with petroleum ether (boiling point 40-60ºC) about 80 ml of the beaker. Then beaker is now placed in soxhlet apparatus with a thimble for 2 h at 90ºC. the petroleum ether was then removed by evaporation and the beaker with residue in an oven at 105ºC for 30 min., cooled in desiccators and weight. The percentage of oil was calculated by using the following equation

$$\text{Fat content (\%)} = \frac{\text{W2} - \text{W1}}{\text{W}} \times 100 \qquad \ldots..4$$

2.1.4 Ash content

Ash content was determined according to (AOAC, 2000) procedure. 1 g of the sample was taken in a silica crucible and weighted. It was made to ash in a muffle furnace at 600ºC 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.

$$\text{Ash content (\%)} = \frac{W2 - W1}{W} \times 100 \quad \text{.....5}$$

2.1.5 Fiber content

The crude fiber was determined by using the fibra plus apparatus (Sadasivam and Manickam, 2005). Oven dry crucible and sample at 100ºC 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 the crucible. The crucible was then placed in a fibra plus apparatus. And after that, the 1.25 % sulfuric acid (H_2SO_4) is filled from the top of the apparatus up to the 150 ml of the crucible. And the sample is boiled in apparatus at 400ºC for 40 minutes. 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 400ºC for 40 minutes. 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 desiccators. Weight the crucible and record the reading as W1. Place all the crucibles in a muffle furnace at 600ºC 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 following equation.

$$\text{Fiber content (\%)} = \frac{W1 - W2}{W} \times 100 \quad \text{.....6}$$

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 homogenized the sample in hot 80% ethanol to remove sugar. Centrifuged at 600 rpm for 5 minutes at 25ºC and retained residue. (Sadasivam and Manickam, 2005). Washing the residue repeatedly with hot 80% ethanol until 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 0ºC 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.

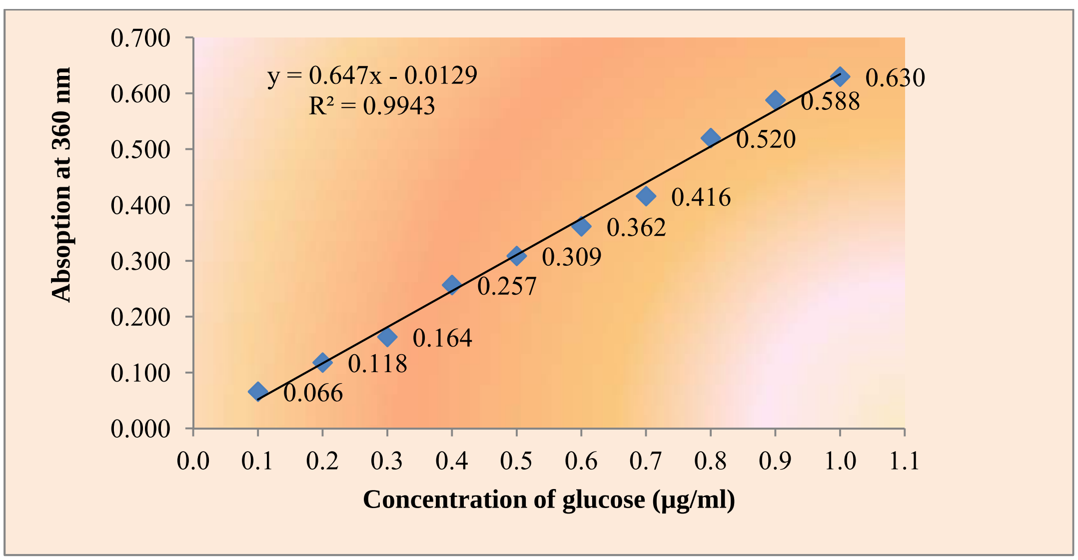

Fig. 2.2: Standard graph of glucose solution using anthrone reagent

2.2.2 Amylose content

Starch is composed of two compounds, 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). Then the sample was heated in a boiling water bath at 100ºC 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 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 color at 590 nm.

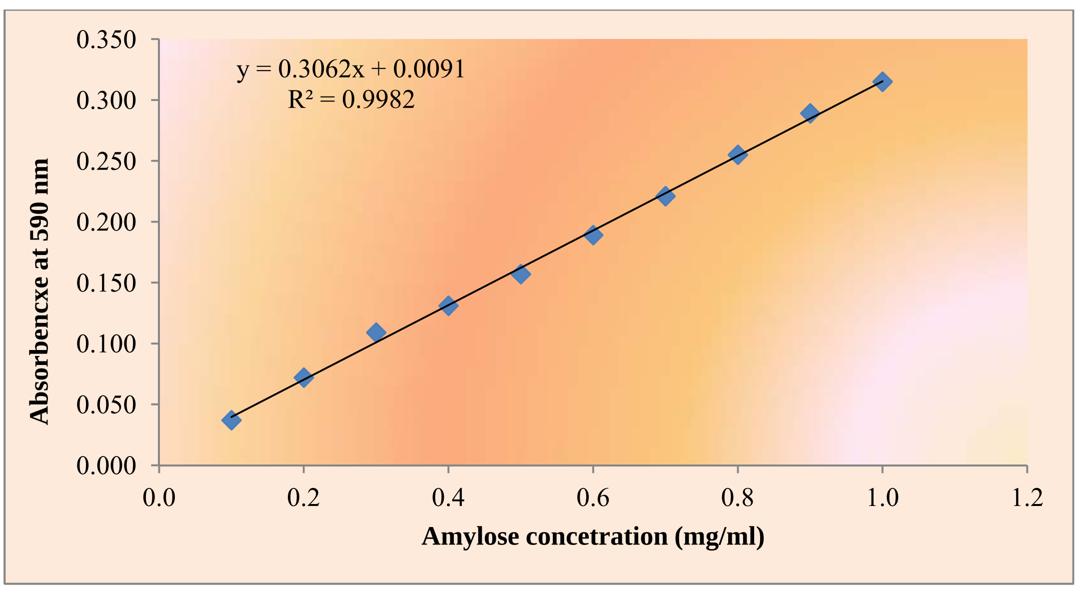

Fig. 2.3: Standard graph of amylose using iodine reagent

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 the 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 103ºC was recorded and used in the calculation of WSI by using Eq. (9) (Stojceska *et al.,* 2008; Kumar *et. al.,* 2016).

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

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

2.3.2 Swelling power

The swelling power of rice flour sample was determined by measuring the water uptake of the sample (Duangrutai Thumrongchote, 2012). The 500 mg 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 80ºC 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 105ºC to constant weight and weighing. The sediment was collected and weighed. The swelling power was calculated by using the following equation

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

3. RESULT AND DISCUSSION

3.1 Proximate analysis

At the time of the experiment, the initial moisture content of the Chhattisgarh local paddy variety (Dokra-Dokri) and their value-added product thick and thin flaked rice, was found to be 11.31%, 13.89 % and 13.79% (wet basis) respectively. The moisture content of the rice varieties differed significantly ($p>0.05$). 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 (Table 1).

The value of fat content for Chhattisgarh local paddy variety (Dokra-Dokri) and their value-added product thick and thin flaked rice, was 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 and showing the significant result ($p>0.05$). 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). Higher the fat contents expose the grains to spoilage during storage due to oxidation (Table 1).

The fiber content of Chhattisgarh local paddy variety (Dokra-Dokri) and their value-added product thick and thin flaked rice, was found to be 2.00%, 1.85%, and 1.79% respectively. The protein content of Chhattisgarh local paddy variety (Dokra-Dokri) and their value-added product thick and thin flaked rice, was found to be 4.23%, 4.04%, and 3.76% respectively. 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). Fiber content and Protein content of brown rice, thick and thin flaked rice were almost similar and did not differ significantly ($p<0.05$) (Table 1).

The ash content of Chhattisgarh local paddy variety (Dokra-Dokri) and their value-added product thick and thin flaked rice, was 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). 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).

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, was 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, was found to be

19.27%, 18.91%, and 18.26% respectively. Amylose content in brown rice was significantly (P>0.05) higher than thick flaked rice. Processing of paddy into flaked rice at high-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 2).

Table 1: Proximate composition of different varieties of rice.

Parameter	Chhattisgarh local paddy variety (Dokra-Dokri)		
	Brown rice	Thick flaked rice	Thin flaked rice
Moisture content (%)	11.31 ± 0.38	13.89 ± 0.17	13.79 ± 0.15
Fat content (%)	3.20 ± 0.12	0.96 ± 0.08	1.00 ± 0.06
Fiber content (%)	2.00 ± 0.49	1.85 ± 1.53	1.79 ± 1.00
Protein content (%)	4.23 ± 0.52	4.04 ± 0.38	3.76 ± 0.46
Ash content (%)	1.00 ± 0.10	1.35 ± 0.35	1.24 ± 0.15

Mean ± 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, was 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, was found to be 3.25%, 4.86, and 5.09% respectively. The WAI and WSI of flaked rice increased significantly (p > 0.05) during the processing of paddy. WAI of thick and thin flaked rice was 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 (SP) of Chhattisgarh local paddy variety (Dokra-Dokri) and their value-added product thick and thin flaked rice, was found to be 6.11%, 6.51% and 6.29% respectively (Table 2).

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

Parameter	Chhattisgarh local paddy variety (Dokra-Dokri)		
	Brown rice	Thick flaked rice	Thin flaked rice
Starch content (%)	74.15 ± 1.20	73.89 ± 0.96	73.47 ± 1.37
Amylose content (%)	19.27 ± 0.22	18.91 ± 0.16	18.26 ± 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 ± 0.04s	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) 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 Chhattisgarh local paddy variety (Dora-Dokri) which may be useful for developing much more better 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, 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 or significant ($p>0.05\%$) 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 or significant ($p>0.05\%$) result in terms of starch content and Amylose content. Significant ($p>0.05\%$) difference was observed in functional properties of flaked rice with increase in water absorption index (WAI) and water solubility index (WSI).

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