

## Nutrient composition and physico-chemical properties of medicinal rice – *Njavara*

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■ **ABSTRACT** : *Njavara*, with two varieties *Njavara* Black (NB) and *Njavara* Yellow (NY) and *Hraswa* a non-medicinal variety, was assessed for its nutrient composition and physico-chemical characteristics. The results shows that compared to the non-medicinal rice *Hraswa*, *Njavara* has high amount of energy, protein, vitamin-B and minerals.

■ **KEY WORDS** : *Njavara*, *Hraswa*, rice, Varieties, Characteristics

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**R**ice (*Oryza sativa* L.) is one of the most important food crops of the world and India is the largest rice growing country in the world (Pandey and Anurag, 2010). According to Pandey *et al.* (2010) it is the most important food crop of India with world ranking first in area and second to China in production.

Rice has been used as a medicine by traditional healers from time immemorial. Kerala has an immense wealth of medicinal rice cultivars. Among the various medicinal rices, *Njavara* is a unique grain plant in the *Oryza* genus indigenous to Kerala, widely used in the Ayurvedic system of medicine, especially in Panchakarma treatment. Documents show that it has been under cultivation in Kerala for about 2500 years since the time of Susruta.

No other medicinal rice is used in the world as widely as *Njavara* in Ayurveda. Its importance as a health food offers opportunity to establish niche global market.

'Ashtanga Hridaya' describes two types of *Njavara*—black and white. According to the farmers and healers it is a precious gift from God to the "God's own Country" Kerala.

*Njavara* rice, with a distinct gene pool and medicinal properties, can be exploited as nutraceutical rice (Deepa *et al.*, 2009; Sulochana and Bakiyalakshmi, 2011).

Studies related to nutrient composition in *Njavara* rice

are rather limited. So, the present study is an attempt to investigate the above said indicators in comparison with a non-medicinal variety *Hraswa*.

The research was carried out at the Department of Home Science, College of Agriculture Vellayani, Thiruvananthapuram, Kerala Agricultural University.

*Njavara* rice varieties [Njavara black (NB) and Njavara yellow (NY)] were collected from Rice Research Station of Kerala Agriculture University, Moncompu and *Hraswa* was collected from Agriculture Research Station, Mannuthy, Thrissur and were processed into raw milled. The raw milled rice of the three varieties was stored in airtight containers for undertaking various laboratory analysis.

### Different quality parameters studied on the materials were:

- Physical characteristics
- Chemical/Nutritional composition

Under physical characteristics, the following characters like moisture content (A.O.A.C,1990), size (IRRI, 1996), shape (IRRI, 1996), length and width (using a screw gauge), length-breadth ratio (L/B ratio) (Pillaiyar and Mohandoss,1981).colour (by direct observation), thousand grain weight (Sindhu *et al.*, 1975) , gel consistency (Cagampang *et al.*, 1973), bulk density, gelatinization temperature (Mac Masters, 1964), chalkiness

index (Standard Evaluation System), viscography (using Brookfield Viscometer) and hardness (Rousset *et al.*, 1995) were assessed.

The major nutrients analysed in the samples were energy (Swaminathan, 1984), protein (A.O.A.C., 1970), crude fibre (Sadasivam and Manickam, 1992), soluble fibre (Raghuramalu *et al.*, 1983), total starch (Sadasivam and Manickam, 1992), amylose (Mc Cready and Hassid, 1943), amylopectin, amylose-amylopectin ratio (Mc Cready and Hassid, 1943), total ash (Raghuramalu *et al.*, 1983), calcium and phosphorus (Sadasivam and Manickam, 1992) and B-vitamins (Flurimetry method).

### Physical characteristics :

The physical characteristics are shown in Table 1, 2 and 3.

In the present study, both the *Njavara* varieties *i.e.* *Njavara* Black (NB) and *Njavara* Yellow (NY) and the control variety *Hraswa* were found to have red colour. According to Reddy (2000) *Njavara* has a wide range of colour.

Grain size and shape of rice are important characteristics, which determine the consumer preference as well as the commercial success of a variety. In the present study, all the three varieties were found medium in shape. With respect to size, NB and *Hraswa* were found to be medium, whereas, NY was found to be short. In a study done by Nandini (1995), *Hraswa* was categorized under bold and *Njavara* under medium bold.

In the present study, the mean length of NB was 5.60 mm and that of NY was 5.30 mm and the mean length of the control variety *Hraswa* was 6.48 mm. The mean value of breadth of NB, NY and *Hraswa* was 2.12 mm, 1.88 mm and 2.42 mm respectively. Reddy (2000) found that the mean grain length

and breadth of *Njavara* ranged between 7.6 mm to 9.3 mm and 2.65 mm to 3.33 mm, respectively.

Length/width ratio for NB and NY were 2.65 and 2.84, respectively, while 2.68 was the L/B ratio obtained for *Hraswa*.

According to Oghbaei and Prakash (2010) length/breadth ratio denoted the shape and size of a grain. The authors found a ratio of 2.70 for raw rice. Nandini (1995) reported an L/B of 2.31 for control variety *Hraswa* and 2.16 for *Njavara* rice varieties.

Moisture content of rice is a very important factor which markedly affected rice quality especially shelf life and milling quality. In the present study, NY was recorded high moisture percentage of 13 per cent, where as NB has 11.6 per cent and *Hraswa* has 11.90 per cent. These findings are in line with Nandini (1995).

Thousand grain weight is a major determinant in adjudging the popularity of rice varieties. In this study, thousand grain weight of the rice varieties varied significantly at 1 per cent level. The control variety *Hraswa* was found to have highest thousand grain weight (20.80 g), followed by NB (16.40 g) and NY (13.00 g). According to Elsy *et al.* (1992) *Njavara* rice varieties has a mean 1000 grain weight of 20.10 g but Reddy (2000) observed that it ranged between 18.50 g to 30.00 g. In this study, the gelatinization temperature of all the three varieties including *Hraswa* was found to be high (>74°C). NB has a mean gelatinization temperature of 85.6°C, NY has 83°C and *Hraswa* has 89.40°C. Similar results were reported by Simi and Abraham (2008).

The gelatinization of starch is influenced by many parameters such as amylose: amylopectin ratio, the degree of hydration and the size of starch granule. Gel consistency differs depending upon the source of starch and variety of grain.

The results for gel consistency for 30 and 60 minutes in

**Table 1: Physical characteristics of *Njavara* and *Hraswa***

Sr.No.	Colour	Size	Shape	Length (mm)	Breadth (mm)	L/B ratio	Moisture (%)	Thousand grain weight (g)
NB	Red	Medium	Medium	5.60	2.12	2.65	11.60	16.40
NY	Red	Short	Medium	5.30	1.88	2.84	13.00	13.00
<i>Hraswa</i>	Red	Medium	Medium	6.48	2.42	2.68	11.90	20.80
F-values				98.99**	26.78**	2.59	2.99	57.35**
CD-values				0.019	0.016	0.190	1.313	1.591

\*\* indicate significance of value at P=0.01

**Table 2 : Physical characteristics of *Njavara* and *Hraswa***

Sr. No.	Gelatinization temperature (°C)	Bulk density (g/ml)	Gel consistency (mm)	
			30 min	60 min
NB	85.60	1.00	54.40	56.60
NY	83.00	0.99	54.00	55.60
<i>Hraswa</i>	89.40	0.96	49.40	51.40
F-values	74.02**	15.84**	55.16**	33.58**
CD-values	1.153	0.016	1.152	1.467

\*\* indicate significance of value at P=0.01

**Table 3: Physical characteristics of *Njavara* and *Hraswa***

Sr. No.	Chalkiness index	Viscography (pb)	Hardness (Kg)
NB	0.05	16.80	3.72
NY	5.02	11.60	3.08
<i>Hraswa</i>	3.21	10.00	4.68

the rice varieties NB were 54.40 mm and 56.60 mm, respectively, for NY 54 mm and 55.60 mm and that of control variety *Hraswa* it was 49.40 mm and 51.40 mm. The gel consistency reported by Sarkar *et al.* (2004) ranged from 22 to 78 mm for scented and non-scented varieties and in tune with the present study.

Bulk density of any material indicates the weight volume ratio and is an important parameters from storage point of view (Oghbaei and Prakash, 2010). Bulk density of rice samples in the present study was found to be 1.00 g/ml for NB, 0.99 g/ml for NY and 0.96 g/ml for *Hraswa*. This is similar to the results reported by Oghbaei and Prakash (2010).

Results of the present study revealed that NY had the highest value of chalkiness index (5.02) while NB has the lowest chalkiness index (0.05) among the three rice varieties. In a study by Cameron and Wang (2005) found that chalkiness index of eight United States rice varieties ranged from 36.60 to 50.90.

Viscography represents the pasting property of rice. Pasting properties are reported to be influenced by granule size, amylose/amylopectin ratio, starch molecular characteristics and the condition of the thermal process employed to induce gelatinization (Zhou and Zheng, 2004). Data on viscography of rice varieties of the present study shows that NB had the highest viscography value followed by NY and *Hraswa* (control variety). Similar results were reported by Deepa *et al.* (2011) and Simi and Abraham (2008).

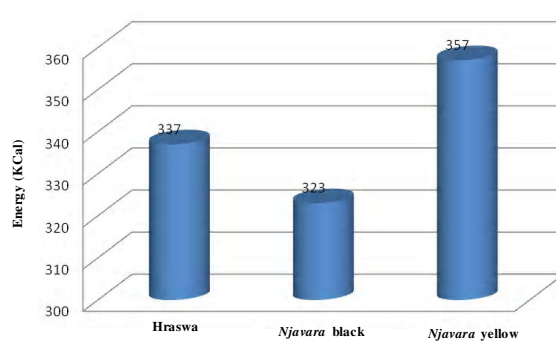
Hardness of cooked rice is one of the most important criteria which determine the rice quality. According to Pomernanz and Webb (2000) rice hardness is important to many facets of the rice industry. In the present study, among the three rice varieties control variety *Hraswa* has got the highest hardness (4.68 kg), followed by NB (3.72 kg) and NY (3.05 kg).

**Nutritional composition :**

Rice is a very widely used staple cereal and is a main source of energy for more than two-thirds of population in India (Mujoo and Ali, 2009).

In the present study, NY had the highest energy content of 357.00 Kcal/100g followed by *Hraswa* (337.00 Kcal) and NB (323 Kcal). In a study done by Deepa *et al.* (2008) reported that *Njavara* had an energy content of 388.84 Kcal/100g of rice. In another study done by Nandini (1995) had shown that *Hraswa* had an energy content of 325.00 Kcal/100g of rice.

Rai (2009) reported that among cereal proteins, rice protein is biologically the richest by virtue of its high true digestibility (88 per cent) and relatively better net protein utilization (NPU).



**Fig. 1 : Energy content of *Njavara* varieties and *Hraswa***

**Table 4 : Protein content of *Njavara* and *Hraswa***

Variety	Protein (g)	Crude fibre (g)	Soluble fibre (g)
NB	12.15	0.206	0.114
NY	11.80	0.198	0.096
<i>Hraswa</i>	8.77	0.190	0.056
F-value	82.64**	3.84*	55.08**
CD-value	0.630	0.013	0.012

\*\* indicates significance of value at P=0.01

Protein content of samples in the present study was found to be 12.15g for NB, 11.80 g for NY and 8.78g for *Hraswa*. Similar findings were reported by Reddy (2000).

The crude fibre content of the rice samples were significantly different (F=3.84\*). NB had the highest crude fibre content among the three rice varieties (0.206 g) and *Hraswa* which is the control variety had the lowest crude fibre content (0.190 g). Deepa *et al.* (2008) reported that dehusked *Njavara* rice had a fibre content of 8.08g/100g rice which is around 34.44 per cent higher than two non-medicinal varieties Jyothi and IR 64.

In the present the soluble fibre content of the three rice samples were 0.114 g, 0.096 g and 0.056g, respectively for NB, NY and *Hraswa* (control). According to Dhanvantari Ayurveda Academy, *Njavara* rice has soluble carbohydrate in the range of 1.38 to 2.93 per cent (www.dhanvantari.in). Ramulu and Udayasekhara Rao (2007) reported that the soluble dietary fibre content of rice as 0.29g/100g.

In the present investigation, the total starch percentage of NB was found to be highest (76.14 per cent), followed by

**Table 5 : Total starch and amylose content of *Njavara* and *Hraswa***

Variety	Starch (%)	Amylose (%)	Amylopectin (%)	Amylose-amylopectin ratio
NB	76.14	21.64	54.50	0.39
NY	74.45	24.37	50.08	0.49
<i>Hraswa</i>	75.81	24.81	51.00	0.49
F- values	4.24*	24.12**	16.43**	22.38**
CD values	1.340	1.077	1.771	0.033

\*\* indicates significance of value at P= 0.01

*Hraswa* (75.81 per cent) and NY (74.45 per cent).

A study done by Khatoon and Prakash (2007) revealed that raw rice had a starch content ranging from 79.90 to 83.00 per cent. Similar findings were reported by Oghbaei and Prakash (2010).

In the present study, it was noticed that all the rice varieties *viz.*, NB (21.64 per cent), NY (24.37 per cent) and *Hraswa* (24.81 per cent) were in the intermediate group, where the amylose content is found to be between 20-25 per cent. This is in agreement with the findings of Nandini (1995).

In the present study, the amylopectin content varied significantly among the rice varieties. The amylopectin content of the three rice varieties are 54.50 per cent for NB, 50.08 per cent for NY and 51.00 per cent for *Hraswa*. Sugeetha (2010) found the amylopectin content of raw rice as 59.90 per cent.

The ratio of amylose to amylopectin in starch is characteristics of the plant species and is under genetic control. In the present investigation, it was noticed that amylose to amylopectin ratio of rice varieties varied significantly with an F value of 22.38 \*\*. Similar findings were also reported by Sugeetha (2010).

**Table 6 : Total ash, Calcium and Phosphorus content of *Njavara***

Variety	Total ash (%)	Calcium (mg/100g)	Phosphorus (mg/100g)
NB	1.52	12.80	352.40
NY	1.26	12.20	351.40
<i>Hraswa</i>	1.26	10.80	135.40
F- values	12.07**	6.08*	12732.9*
CD values	0.133	1.283	3.413

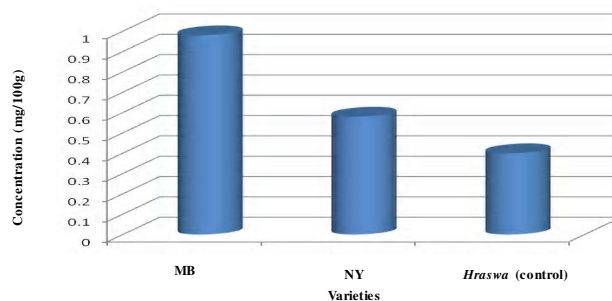
\*\* and \* indicate significance of value at P=0.01 and 0.05, respectively

The total ash content in rice samples of the present study was found to be 1.52 per cent in NB, 1.26 per cent in NY and *Hraswa*. It was also noted that there was significant difference (F=12.07 \*\*) among the varieties. Study by Deepa *et al.* (2008) reported an ash content of 1.42 per cent in *Njavara* and Nandini (1995) also observed that *Hraswa* had an ash content of 0.56 per cent.

Calcium is an important component of a healthy diet and a mineral necessary for life. In the present study NB had a calcium content of 12.80 mg/100g, NY had 12.20 mg Ca/100 g and *Hraswa* had 10.8 mg Ca/100g of rice. Deepa *et al.* (2008) reported that *Njavara* rice had 11.6 mg/100g of Ca, while Nandini (1995) reported a Ca content of 10.24 mg/100g in *Hraswa*, which is in agreement with the present study. Moldenhaver *et al.* (2008) and Oghbaei and Prakash (2010) also reported Ca similar findings.

In the present study, it was noticed that the phosphorus (P) content of *Njavara* varieties were exceptionally high when compared to the control variety *Hraswa*. The average value of phosphorus in NB was found to be 352.40 mg/100g while that of NY was 351.40 mg/100g of rice. This is in agreement

with the findings of Deepa *et al.* (2008). The phosphorus content in *Hraswa* was found to be only 135.40 mg/100 g of rice. Similar findings were observed by Nandini (1995).

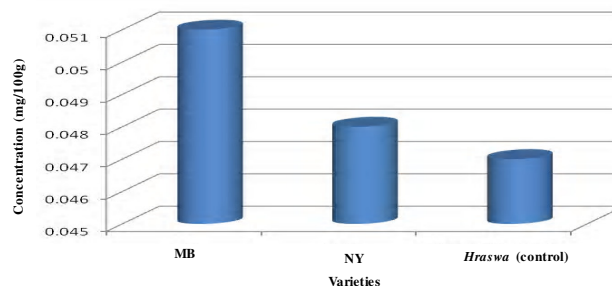


**Fig. 2 : Thiamine content of *Njavara* and *Hraswa***

Rice is a principal source of B-vitamins especially thiamine and riboflavin (Rai, 2009). In the present study, the thiamine content of NB was found to be 0.098mg/100g of rice, while that of NY was found to be 0.058mg/100g of rice. The control variety *Hraswa* was having lowest value among the three rice varieties *i.e.* 0.04mg/100g.

Deepa *et al.* (2008) reported a thiamine content of 0.52 mg in *Njavara* rice. The authors also reported that when compared to two non-medicinal varieties Jyoti and IR 64, *Njavara* had about 27-32 per cent more thiamine.

The riboflavin content of rice samples in the present investigation revealed that NB had a riboflavin content of 0.061mg/100g, while NY had 0.048 mg and *Hraswa* had 0.047 mg/100g of rice. Chang and Luh (2001) reported a riboflavin content of 0.03 mg/100g in raw rice. The variation in the vitamin content of rice reported by various authors may be due to the application of fertilizer, variation in maturity period and the degree of processing (Grewal and Sangha, 2006).



**Fig. 3 : Riboflavin content of *Njavara* and *Hraswa***

In conclusion, this study revealed that *Njavara* rice had relatively high protein, soluble fibre, minerals and B complex vitamins, compared to the non-medicinal short duration variety *Hraswa*.

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