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## Studies on thermo-chemical evaluation of branded and unbranded varieties/genotypes of rice (*Oryza sativa*)

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**Abstract**

The present study was conducted to evaluate twenty advance branded and unbranded varieties of rice for quality parameters. The samples were collected from market/mandis and University farm as well after grading of the sample the quality analysis in the laboratory was conducted as per standard procedures in the laboratories of the Department of Agricultural Biochemistry. A significant variation was detected in all traits studied. There was considerable variability among varieties. Data on the Gel consistency varied from 56-81mm. The water uptake value was significant and ranged from 357-396ml, respectively. The Volume expansion on cooking was significantly ranged from 9.38-14.60mm, respectively. The Kernel elongation was ranged from 9.04-15.08mm, respectively. The kernel elongation ratio was significant and ranged from 1.61-2.26mm, respectively. Protein content ranged from 7.03-8.12 per cent. Amylose content varied from 19.72-25.32 per cent. Starch content varied from 76.00-85.85 per cent.

**Keywords:** Quality rice, gel consistency, the water uptake value, volume expansion on cooking, kernel elongation, kernel elongation ratio, protein content, amylose content, starch content

**Introduction**

The physicochemical characteristics include grain length (L), grain breadth (B), L/B ratio, hulling and milling percentage. The cooking qualities are amylose content, alkali spreading value, water uptake, volume expansion ratio and kernel elongation ratio. Grain quality is a very wide area encompassing diverse characters that are directly or indirectly related to exhibit one quality type (Siddiqui *et al.*, 2007) [16]. It also has been reported that a diet containing Black rice extracts which had anthocyanin (31.3g/100 g) decreased cholesterol, LDL-cholesterol and concentration of triacylglycerol in plasma of rats (Yodmanee *et al.*, 2011) [21]. Rice is one of the oldest cultivated crops, first mentioned in history as far back as 2800 BC in China. Rice is a staple crop and forms the foundation of the diet for many of the world's population, especially those living in Southern and Eastern Asia. There are a huge number of rice varieties –such as long-grain, basmati and Arborio – but only a few are grown widely. Grain quality is a very wide area encompassing diverse characters that are directly or indirectly related to exhibit one quality type (Siddiqui *et al.*, 2007) [16]. The physico-chemical characteristics of rice grain include grain length, breadth, L/B ratio, hulling and milling percentage and thermal and the cooking characteristics include alkali spreading value, water uptake, volume expansion ratio and kernel elongation ratio.

**Materials and Methods**

The present research work was carried out during summer season of year twenty advance branded and unbranded varieties of rice. Some variety of rice grown at Students Instructional Farm of Chandra Shekhar Azad University of Agriculture & Technology, Kanpur (U.P.) Some variety of rice buy from market in CRD design with three replications and after harvesting the grains were processed for different quality parameters. Gel consistency was estimated by the method as described by Cagampang *et al.*, 1973 [2]. Water uptake capacity was determined by Hogan and Plank (1958) method. 100 g rice was taken and added 10 ml of water at 77°C. Kernel length after cooking was determined by with the help of thread Vernier Calliper's scale and measured in mm. The expansion of rice after cooking expressed in terms of original volume is called volume expansion which determined as described by Halick and Kelly (1959) [5]. Elongation ratio was determined on the basis of ratio of kernel length after and before cooking of rice. The kernel elongation ratio was computed as follows:

$$\text{K.E.R.} = \frac{\text{Kernel elongation of cooked rice (mm)}}{\text{Kernel length (mm)}}$$

Protein content was determinations by Jayapraguam *et al.* (1988)<sup>[8]</sup>. Amylose content of rice grains was determined by the method of Juliano (1979)<sup>[9]</sup>. The starch content was estimated by the method as described by (Hodge & Hofreiter, 1962 and Thayumanavan, 1987)<sup>[6, 19]</sup>.

### Statistical analysis

All sample extracts were prepared and analysis done using a complete randomized design at 5% level of critical difference. Analysis of variance (ANOVA) for the design was carried out to determine the significance of differences among different treatments.

### Results and Discussion

Data recorded on Gel consistency varied from 56-81mm. The variety Hydrabadi Biryani showed the maximum Gel consistency (81mm) followed by variety- Sakkar Chine (78.50mm), CSR-10 (75.33mm), Regular Basmati (75mm). The minimum Gel consistency was found in variety-Kala Namak (56mm). The variety NDR-359 which was significant and higher over the rest varieties. These results are in

agreement to Oko *et al.*, (2012)<sup>[13]</sup>, Bhonsle *et al.*, (2010)<sup>[11]</sup> and Cagampang *et al.*, (1973)<sup>[2]</sup>. Data recorded on water uptake value ranged from 357-396ml. The maximum water uptake value was obtained in variety CSR-10 (396 ml), followed by Azad Basmati (395.50 ml), NDR-359 (394.50), Raj Rani (393.16).

While minimum water uptake values were recorded in variety Hydrabadi Biryani (357 ml). The variety CSR-10 which was significant and superior over the rest of varieties. Similar results were reported by Verma and Srivastava (1993)<sup>[17]</sup>, Sarkar *et al.* (1994)<sup>[15]</sup>, Malik *et al.* (1994)<sup>[12]</sup>, and Mahendra Kumar (1995)<sup>[11]</sup>. Data recorded on Volume expansion on cooking ranged from 9.38-14.60mm. The maximum Volume expansion on cooking was obtained in variety Regular Basmati (14.60mm), followed by Azad Basmati (14.50mm), Hydrabadi Biryani (14.20mm), IPB-1 Scented (14.10mm). While minimum Volume expansion on cooking were recorded in variety Jaya (9.38mm). The variety Regular Basmati which was statistically significant and superior over the rest of varieties. Sarkar *et al.* (1994)<sup>[15]</sup>, Malik *et al.* (1994)<sup>[12]</sup>, Govindaswami *et al.* (1969)<sup>[4]</sup>.

**Table 1:** Thermal and Cooking Characteristic of branded and unbranded rice varieties

S.N.	Varieties	Gel consistency (mm)		Pooled mean value	Water Uptake Value (ml)		Pooled mean value	Volume expansion on Cooking (mm)		Pooled mean value
		2019	2020		2019	2020		2019	2020	
1	Hydrabadi Biryani	79	83	81	356	358	357	13.30	15.10	14.20
2	Regular Basmati	74	76	75	377	382	379.50	13.15	16.05	14.60
3	Raj Rani	71	74	72.5	393.33	393	393.16	11.01	13.05	12.03
4	Pulav Rice	60	64	62	389	394	391.50	13.20	14.05	13.62
5	Everyday Basmati	56	57	56.5	368	368.66	368.33	12.84	15.05	13.94
6	Prmal S ehlla	62	56	59	363.66	365	364.33	13.09	14.40	13.74
7	Hybrid 6444	63	68	65.5	382	384	383	12.45	10.05	11.25
8	Azad Basmati	59	63	61	394	397	395.50	13.50	15.50	14.50
9	IPB-1 Scented	57	60	58.5	381	378	379.50	12.95	15.26	14.10
10	Dehradun Basmati	70	73	71.5	365	362	363.50	12.75	14.91	13.83
11	PR- 13	69	72	70.5	369	366	367.50	10.05	10.50	10.27
12	Endrasan	66.66	69.05	67.85	379	383	381	10.20	11.05	10.62
13	Jaya	67	65	66	390	395	392.50	8.52	10.24	9.38
14	Sakkar Chine	80	77	78.5	396	394	395	9.50	10.83	10.16
15	Kanki	76.33	72.8	74.56	388	390	389	9.25	11.04	10.14
16	NDR 359	76	71	73.5	392	397	394.50	10.85	12.40	11.62
17	CSR 10	75.66	75	75.33	394	398	396	9.85	12.03	10.94
18	CSR 27	73	69	71	365	368.33	366.66	9.97	10.45	10.21
19	Ram Raj	68	60	64	375	380	377.50	10.4	11.40	10.90
20	Kala Namak	54	58	56	374	370	372	9.57	10.95	10.26
	mean	67.83	68.14	67.98	379.54	381.14	380.34	11.32	12.71	12.01
	S.E. (d)	1.53	4.46	1.51	2.68	3.20	0.93	0.039	0.22	0.029
	C.D. (5%)	3.12	9.04	3.07	5.43	6.50	1.88	0.07	0.45	0.060

Data recorded on Kernel elongation ranged from 9.04-15.08mm. The maximum Kernel elongation was obtained in variety Hydrabadi Biryani (15.08mm), followed by Regular Basmati (14.78mm), Pulav Rice (14.29mm), Dehradun Basmati (13.94mm). While minimum Kernel elongation were recorded in variety Kala Namak (9.04mm). The variety Hydrabadi Biryani which was significant and superior over the rest of varieties. Similar results were reported by Bhonsle (2010)<sup>[11]</sup>, Govindaswami *et al.* (1969)<sup>[4]</sup> and Husaini *et al.*

(2009)<sup>[7]</sup>. Data recorded kernel elongation ratio ranged from 1.61-2.26mm. The maximum kernel elongation ratio was obtained in variety Raj Rani (2.26mm), followed by PR-13 (2.16mm), Azad Basmati (2.10mm), Dehradun Basmati (2.09mm). While minimum kernel elongation ratio were recorded in variety Hybrid 6444 (1.61mm). The variety Raj Rani which was significant and superior than varieties. This result was supported by Bhonsle and Krishnan (2010)<sup>[11]</sup>, Husaini *et al.* (2009)<sup>[7]</sup>.

**Table 2:** Thermal and Cooking Characteristic of branded and unbranded rice varieties

S.N.	Varieties	Kernel elongation (mm)		Pooled mean value	K/E Ratio		Pooled mean value
		2019	2020		2019	2020	
1	Hydrabadi Briyani	14.12	16.05	15.08	1.85	2.09	1.97
2	Regular Basmati	14.51	15.05	14.78	1.90	1.97	1.93
3	Raj Rani	11.20	11.95	11.57	2.19	2.33	2.26
4	Pulav Rice	14.50	14.08	14.29	1.94	1.88	1.91
5	Everyday Basmati	13.18	12.94	13.06	1.98	1.95	1.96
6	Prmal Sehlla	12.06	13.15	12.60	1.69	1.87	1.78
7	Hybrid 6444	10.15	10.45	10.30	1.60	1.62	1.61
8	Azad Basmati	12.90	14.50	13.70	1.98	2.22	2.1
9	IPB-1 Scented	12.23	14.80	13.51	1.81	2.18	1.99
10	Dehradun Basmati	13.25	14.59	13.92	1.99	2.19	2.09
11	PR- 13	10.70	11.55	11.12	2.10	2.23	2.16
12	Endrasan	10.90	12.45	11.67	1.93	2.17	2.05
13	Jaya	9.10	9.15	9.12	1.75	1.66	1.70
14	Sakkar Chine	9.85	8.93	9.39	1.79	1.72	1.75
15	Kanki	9.50	9.58	9.54	1.74	1.69	1.71
16	NDR 359	9.20	10.15	9.67	1.60	1.70	1.65
17	CSR 10	10.64	10.77	10.70	1.83	1.78	1.80
18	CSR 27	9.65	9.45	9.55	1.70	1.59	1.64
19	Ram Raj	10.50	9.86	10.18	1.92	1.74	1.83
20	Kala Namak	8.50	9.59	9.04	1.62	1.82	1.72
	mean	11.33	11.95	11.63	1.84	1.92	1.88
	S.E. (d)	0.11	0.077	0.026	0.03	0.035	0.028
	C.D. (5%)	0.22	0.15	0.053	0.06	0.071	0.056

Data on protein content varied from 7.03-8.12% of various cultivars of some branded and unbranded rice varieties/genotypes. The variety Kala Namak showed the maximum protein content (8.12%) followed by variety-Hybrid 6444 (7.89%), Hydrabadi Biryani (7.87%), Jaya (7.77%). The minimum protein content was found in variety-IPB-1 Scented (7.03%). The variety Kala Namak which was significant and superior over the rest of varieties. These results on protein content changed are closely supported by Reddy *et al.* (1986) [14], Singh (1993) [18]. Data on amylose content range from 19.72-25.32%. The variety Kala Namak showed the maximum amylose content (25.32%) followed by variety- Endrasan (24.57%), Regular Basmati (24.55%), PR-

13 (24.52%). The minimum amylose content was found in variety-Raj Rani (19.72%).

The variety Kala Namak which was significant and superior than other varieties. The results range have been supported by Thenammai *et al.* (1975) [20], Chikkalingaiah *et al.* (1997) [3], Singh and Srivastava. (1997) [17]. Data on starch content range from 76.00-85.85%. The variety PR-13 showed the maximum starch content (85.85%) followed by variety- CSR-10 (85.26%), Ram Raj (85.08%), Sakkar Chine (84.28%). The minimum starch content was found in variety-Raj Rani (76.00%). The variety PR-13 which was significant and superior than other varieties. This result was in agreement with Karzan *et al.* (2016) [10].

**Table 3:** Nutritional characteristics of branded and unbranded rice varieties

S.N.	Varieties	Protein (%)		Pooled mean value	Amylose (%)		Pooled mean value	Starch (%)		Pooled mean value
		2019	2020		2019	2020		2019	2020	
1	Hydrabadi Briyani	7.85	7.89	7.87	21.33	21.49	21.41	82.05	80.10	81.07
2	Regular Basmati	7.17	7.21	7.19	24.49	24.61	24.55	81.12	80.13	80.62
3	Raj Rani	7.20	7.25	7.22	19.60	19.84	19.72	81.23	70.77	76
4	Pulav Rice	7.66	7.79	7.72	21.41	21.29	21.35	81.50	83.56	82.53
5	EverydayBasmati	7.63	7.50	7.56	21.72	21.64	21.68	82.06	86.09	84.07
6	Prmal Sehlla	7.33	7.40	7.36	22.44	22.73	22.58	81.24	83.70	82.47
7	Hybrid 6444	7.83	7.95	7.89	21.74	21.88	21.81	78.23	77.07	77.65
8	Azad Basmati	7.27	7.29	7.28	22.87	22.67	22.77	79.36	76.42	77.89
9	IPB-1 Scented	7.10	6.96	7.03	23.50	23.58	23.54	82.14	84.91	83.52
10	Dehradun Basmati	7.30	7.35	7.32	20.14	20.273	20.20	83.05	85.70	84.37
11	PR- 13	7.03	7.26	7.14	24.42	24.62	24.52	86.33	85.37	85.85
12	Endrasan	7.50	7.70	7.60	24.59	24.55	24.57	83.45	85.49	84.47
13	Jaya	7.66	7.89	7.77	24.05	24.16	24.10	84.42	82.45	83.43
14	Sakkar Chine	7.09	7.12	7.10	23.86	23.97	23.91	84.70	85.06	84.88
15	Kanki	7.15	7.20	7.17	20.79	20.69	20.74	85.50	82.84	84.17
16	NDR 359	7.36	7.46	7.41	23.27	23.43	23.35	83.11	80.14	81.62
17	CSR 10	7.60	7.80	7.70	23.44	23.51	23.47	87.25	83.28	85.26
18	CSR 27	7.51	7.55	7.53	22.63	22.66	22.64	85.23	82.26	83.74
19	Ram Raj	7.06	7.35	7.20	21.10	21.19	21.14	86.57	83.59	85.08
20	Kala Namak	8.09	8.15	8.12	25.26	25.39	25.32	84.85	82.88	83.86
	mean	7.41	7.50	7.45	22.63	22.70	22.66	83.16	82.09	82.62

S.E. (d)	0.14	0.13	0.026	0.21	0.10	0.027	1.05	1.00	0.72
C.D. (5%)	0.30	0.28	0.053	0.43	0.21	0.055	2.14	2.03	1.48

## Conclusion

On the basis of above results Gel consistency were obtained in rice varieties, Hydrabadi Biryani, Sakkar Chine, CSR-10, Regular Basmati, 81mm, 78.50mm, 75.33mm and 75mm respectively. The minimum Gel consistency was found in variety-Kala Namak, 56mm. The maximum water uptake value were obtained in CSR-10, Azad Basmati, NDR-359 and Raj Rani, of range from 396ml, 395.50ml, 394.50ml and 393.16ml respectively. While minimum water uptake values were recorded in variety Hydrabadi Biryani, 357 ml. The maximum volume expansion on cooking was recorded in rice varieties, Regular Basmati, Azad Basmati, Hydrabadi Biryani, IPB-1 Scented range from, 14.60mm, 14.50mm, 14.20mm, 14.10mm. While minimum Volume expansion on cooking were recorded in variety Jaya, 9.38mm. The variety Hydrabadi Biryani, Regular Basmati, Pulav Rice and Dehradun Basmati show maximum kernel elongation range, 15.08mm, 14.78mm, 14.29mm and 13.94mm. While minimum Kernel elongation were recorded in variety Kala Namak, 9.04mm. The maximum kernel elongation ratio were obtained in rice varieties Raj Rani, PR-13, Azad Basmati and Dehradun Basmati in range from, 2.26mm, 2.16mm, 2.10mm and 2.09mm. While minimum kernel elongation ratio were recorded in variety Hybrid 6444, 1.61mm. Highest protein content in various varieties of rice Kala Namak, Hybrid 6444, Hydrabadi Biryani and Jaya range from, 8.12%, 7.89%, 7.87% and 7.77%. The minimum protein content was found in variety-IPB-1 Scented, 7.03%. The amylose content was ranged from in rice varieties Kala Namak, Endrasan, Regular Basmati and PR-13, 25.32%, 24.57%, 24.55% and 24.52%. The minimum amylose content was found in variety-Raj Rani (19.72%). In the present investigation rice varieties PR-13, CSR-10, Ram Raj and Sakkar showed the maximum starch content, 85.85%, 85.26%, 85.08% and 84.28% respectively. The minimum starch content was found in variety-Raj Rani, 76.00%.

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