International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
www.chemijournal.com
IJCS 2020; 8(5): 1410-1416

Received: 15-06-2020
Accepted: 01-08-2020

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Evaluation of aromatic and non-aromatic rice (*Oryza sativa* L.) genotypes for physio-chemical, cooking and nutritive quality traits in Konkan Region

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DOI: https://doi.org/10.22271/chemi.2020.v8.i5t.10498

Abstract
The present study evaluated physio-chemical, cooking and nutritive qualities of 58 aromatic and non-aromatic rice genotypes. These genotypes differed significantly for hulling percentage, milling percentage, grain length, grain width, volume expansion ratio, water uptake ratio (WUR), elongation ratio, alkaline spreading value (ASV), gelatinization temperature (GT), amylose content, carbohydrate content and protein content. The hulling and milling percentage was ranged from 70.60% (Dhanaprasad)-78.35 (HMT Sona) & 60.80 (Girga)-67.88% (Karjat-2), respectively. HMT Sona (78.35%) and Karjat-2 (67.88%) was recorded significantly maximum hulling and milling percentage, respectively. Among all, Patnijira (4.23), SKL-7 (4.77) and Parag (4.12) as fine grain genotypes for L/B ratio; Phule radha (1.52), Kundlika (1.47) and Girga (1.42) for elongation ratio; Elaichi (6.63), Mamala (6.50), Patnijira (6.50), Pusasugandha (6.38) and Kundlika (6.38) for intermediate alkali value and Phule Maval (24.94%) for maximum amylose content. Among all, Kundlika (7.62%) and Basmati-107 (77.83%) was recorded maximum protein and carbohydrate content, respectively. The characteristics of the various grain types make them suitable for different food preparations and meet the preferences of majority of consumers.

Keywords: Aromatic rice, physio-chemical, qualities, cooking, nutritive, hulling and milling

Introduction

Aromatic rice (*Oryza sativa* L.) is known for its characteristic fragrance when cooked. This constitutes a small but special group of rice, which is considered best in quality. Aromatic varieties fetch higher price in rice market than the non-aromatic ones. Cultivation of aromatic rice has been gaining popularity in India over the recent years because of its huge demand both for internal consumption and export (Dutta *et al.*, 2002) [10]. It is also preferred by some consumers despite their price and yield. Hence efforts are now being made to explore the possibility of cultivating the scented rice in non-traditional area to prove its potential.

The slogan of International year (2004) of rice “Rice is life” is the most appropriate for India as this crop play a vital role in our national food security and means of livelihood for millions of rural households. In India export rice around 10.3 million metric tonnes. Total global consumption of milled rice amounted to approximately 477.77 million metric tonnes in 2016-17. China consumed around 146 million metric tonnes of milled rice per year, and was by far the world leading rice consumer in the year. In comparison U. S. consumed some 3.85 million metric tonnes (Anonymous, 2017) [3].

Rice grain quality is determined by its physical and physicochemical properties. Physical properties include kernel size, shape, milling recovery, degree of milling and grain appearance (Cruz and Khush, 2000) [9]. Physicochemical properties of rice are determined based on amylose content, alkali spreading value and gelatinization temperature (Rohilla *et al.*, 2000) [22]. In rice, eating and cooking qualities are mainly controlled by the physicochemical properties which greatly influence the consumer‘s choice (Rohilla *et al.*, 2000 and Sujatha *et al.*, 2004) [22, 27]. The consumers accept rice that possesses good cooking and eating qualities. The texture of the cooked grain influences the palatability and thus the acceptability to consumers (Kang *et al.*, 2006) [17].

Grain size and shape are usually the first criteria of rice quality that breeders consider when developing new varieties for commercial production. The longer grain types are usually associated with higher amylose content and dry fluffy cooked rice, while the typical short grain types are moist and sticky when cooked. The physical dimensions of rice kernels are of vital interest in marketing and grading, in developing new varieties and in processing. Volume expansion over cooking is another quality parameter which influences the edible volume which is the final output after cooking (Rebeira *et al.*, 2014) [21]. The gel consistency determines the softness of cooked rice. Therefore, eating and cooking quality can be considered as a vital intrinsic quality component of rice grains that have to be focused in future rice breeding programmes to meet market demands at both local and international level. In the present experiment main objective is to evaluate the aromatic and non-aromatic rice genotypes for quality parameters under konkan region.

Material and Methods

The experiment was carried out at Regional Agricultural Research Station, Karjat, Dist. Raigad (MS) during *Kharif* 2017 and 2018. It is situated at 18°91'67" North latitude and 73°33' East longitude with an altitude of 194 meters (636 ft) above the mean sea level with warm and humid conditions throughout the year. The mean annual precipitation is 3500 mm, which is generally received during the month from June to November at the location. Fifty eight aromatic and non-aromatic rice genotypes were used and cultivated in a Randomized Block Design (RBD) with two replications. All the samples were brought to laboratory, transferred in to cotton bags and stored at room temperature for analysis. Estimation of physical and chemical quality characteristics was at RARS, Karjat and Dr. BSKKV, Dapoli. The analysis was by following methods

1. Milling quality

A. **Hulling percentage:** The hulling % is calculated by the formula i.e.,

$$\text{Hulling \%} = \frac{\text{Wt. of dehusked kernel}}{\text{Wt. of paddy}} \times 100$$

Where, Wt. of paddy = 100 gm

B. **Milling percentage:** The milling % is calculated by the formula i.e.,

$$\text{Milling \%} = \frac{\text{Wt. of polished kernel}}{\text{Wt. of paddy}} \times 100$$

Where, Wt. of paddy = 100 gm

2. Quality character

A. **Grain length and width (mm):** Ten threshed grains were taken randomly and average length was recorded by using digital Vernier Calliper.

B. **L/B ratio:** The length/breadth ratio was obtained by dividing the length of a single grain by the corresponding breadth to determine the size and shape.

C. **Water Uptake Ratio:** Water uptake ratio of the milled rice samples were estimated by the method suggested by Bhattacharya and Sowbhagya (1971) [6].

D. **Volume Expansion Ratio:** Volume expansion ratio of the milled rice samples were estimated by the method suggested by Juliano (1965) [13].

E. **Elongation Ratio:** Elongation ratio of the milled rice samples were estimated by the method suggested by Azeez and Shafi (1966) [5].

F. **Alkali Spreading Value:** Alkali spreading value of the milled rice samples were estimated by the method suggested by Little (1958) [18].

G. **Estimation of Amylose:** Amylose contents of the milled rice samples were estimated by the method suggested by Juliano (1971) [14] involving the spectrophotometer.

3. Nutritive Quality

A. **Carbohydrate content:** Carbohydrate estimated by anthrone method. It is first hydrolysed into simple sugars using dilute hydrochloric acid. In acidic medium glucose is dehydrated to hydroxymethyl furfural. This compound forms with anthrone a green coloured product with an absorption maximum at 630 nm.

B. **Protein content:** The protein content in dry seed was estimated by multiplying total nitrogen content into the factor 5.95. The plant sample were analyzed for percent nitrogen content by micro kjeldahl distillation method (Jackson, 1967) [12].

Result and Discussion

1. Milling Quality Traits

Data on hulling and milling quality for aromatic and non-aromatic rice genotypes are presented in table 1. In the present investigation, significantly maximum hulling percentage was recorded in HMT Sona (78.35%) which was at par with Velchi (77.48%), Karjat-2 (77.48%) and Phule Maval (77.43%) over other rice genotypes. The minimum hulling percentage was recorded in Dhanaprasad (70.60%). Significantly maximum milling percentage was recorded in Karjat-2 (67.88%) which was at par with ACK-5 (67.75%), HMT Sona (67.75%) and Pusa Sugandha-5 (67.55%) over other rice genotypes. The minimum milling percentage was recorded in Girga (60.80%). Varietal difference for milling quality was also reported by Verma *et al* (2013) [28], Verma *et al* (2015), Saravanan Ponnappan *et al.* (2017) [25] and Subhalakshmi *et al.* (2018) [26].

Table 1: Physiological evaluation of aromatic and non-aromatic rice genotypes for milling quality of rice

S. No.	Genotypes	Hulling (%)	Milling (%)
1	Phule Maval (G_1)	77.43	67.38
2	Phuleradha (G_2)	72.38	64.50
3	SKL-7 (G_3)	73.33	63.77
4	Terana (G_4)	74.58	66.25
5	Parag (G_5)	71.06	64.40
6	ACK-5 (G_6)	77.41	67.75
7	HMT Sona (G_7)	78.35	67.75
8	Kasturi (G_8)	71.45	62.63
9	Paras Sona (G_9)	71.86	62.88

10	Lolak (G_{10})	73.98	65.85
11	Tulsi-75-14 (G_{11})	76.49	66.93
12	Basmati-63 (G_{12})	71.84	62.86
13	Pusa Sugandha-5 (G_{13})	76.81	67.55
14	Basmati-107 (G_{14})	73.90	65.32
15	Basmati-386 (G_{15})	71.63	62.91
16	Super Basmati (G_{16})	71.48	63.68
17	Antarvel (G_{17})	70.96	63.28
18	Kala Jeera (G_{18})	73.96	65.22
19	Dhanaprasad (G_{19})	70.60	62.45
20	Bishnubhog (G_{20})	71.43	63.33
21	Shrabanmasi (G_{21})	71.06	62.40
22	Pusasugandha (G_{22})	75.45	66.38
23	Kala Krishna (G_{23})	72.02	63.68
24	Belgaum Basmati (G_{24})	76.03	66.55
25	RDN-Scented (G_{25})	74.47	65.53
26	Mamla (G_{26})	72.10	62.83
27	Ghansal regional (G_{27})	71.88	62.08
28	Pakistan basmati (G_{28})	71.09	61.63
29	Pusa basmati (G_{29})	71.72	62.76
30	Kate chinoor(G_{30})	76.63	66.75
31	RDN-local (G_{31})	71.49	61.98
32	Lala (G_{32})	72.50	63.23
33	Durgabhog (G_{33})	76.98	66.15
34	Velchi (G_{34})	77.48	62.63
35	PKV-khamang (G_{35})	72.31	62.95
36	PKV-HMT (G_{36})	70.70	63.20
37	PKV-ganesh (G_{37})	70.70	62.43
38	PKV-Makrand (G_{38})	71.18	62.93
39	Ambika (G_{39})	71.47	62.02
40	Avishkar (G_{40})	71.76	61.88
41	Bhogawati (G_{41})	71.43	61.93
42	Kundalika (G_{42})	75.85	65.88
43	Pawana (G_{43})	70.75	62.15
44	Basmati-370 (G_{44})	75.90	65.98
45	Basmati-388 (G_{45})	75.88	65.83
46	Pusa sugandha-2 (G_{46})	76.56	66.80
47	Sugandha (G_{47})	72.40	63.78
48	Patnijira (G_{48})	71.95	61.93
49	Bela blue (G_{49})	72.24	62.95
50	Girga (G_{50})	70.87	60.80
51	Ambemohar (G_{51})	74.53	63.95
52	Elaichi (G_{52})	72.16	62.18
53	Badshahabhog (G_{53})	75.68	65.90
54	Karjat-3 (G_{54})	74.68	66.38
55	Karjat-2 (G_{55})	77.48	67.88
56	Karjat-7 (G_{56})	73.31	64.88
57	Karjat-8 (G_{57})	76.60	66.53
58	Karjat-9 (G_{58})	70.73	62.20
Range		70.60-78.35	60.80-67.88
S.E±		0.57	0.44
C.D at 5%		1.62	1.25

2. Quality Characters

Data on grain length, grain width, L/B ratio, elongation ratio, water uptake ratio, volume expansion ratio and alkali spreading value for aromatic and non-aromatic rice genotypes are presented in table 2.

Table 2: Physiological evaluation of aromatic and non-aromatic rice genotypes for quality characters of rice

S. No	Genotypes	Grain length (mm)	Grain width (mm)	LB ratio	ER	WUR	VER	ASV	AC (%)
1	Phule Maval (G_1)	6.66	3.43	1.94	1.06	337.50	5.11	4.88	24.94
2	Phuleradha (G_2)	5.42	1.69	3.22	1.52	356.25	4.42	4.63	23.28
3	SKL-7 (G_3)	6.33	1.33	4.77	1.20	206.25	2.95	6.13	19.43
4	Terana (G_4)	6.68	1.82	3.66	1.05	350.00	4.54	6.25	22.57
5	Parag (G_5)	6.64	1.61	4.12	1.04	275.00	4.85	6.25	22.81
6	ACK-5 (G_6)	5.29	2.73	1.94	1.27	243.75	4.28	4.88	22.91
7	HMT Sona (G_7)	6.65	1.90	3.51	1.03	143.75	5.11	1.75	23.03
8	Kasturi (G_8)	6.81	1.96	3.48	1.05	225.00	5.39	2.13	23.23
9	Paras Sona (G_9)	5.88	2.22	2.66	1.17	250.00	4.69	1.75	22.52

10	Lolak (G_{10})	7.11	2.20	3.24	1.12	237.50	4.31	2.13	22.75
11	Tulsi-75-14 (G_{11})	6.73	1.97	3.42	1.08	206.25	4.10	2.63	22.12
12	Basmati-63 (G_{12})	5.49	2.65	2.07	1.41	231.25	4.23	2.63	21.26
13	Pusa Sugandha-5 (G_{13})	6.44	1.86	3.47	1.24	243.75	4.34	6.13	21.66
14	Basmati-107 (G_{14})	6.80	1.81	3.76	1.19	281.25	3.38	2.25	19.62
15	Basmati-386 (G_{15})	7.95	1.86	4.29	1.09	268.75	4.49	4.50	22.14
16	Super Basmati (G_{16})	6.63	2.15	3.08	1.14	181.25	4.40	2.63	19.65
17	Antarvel (G_{17})	7.89	1.81	4.36	1.19	231.25	5.07	2.63	22.24
18	Kala Jeera (G_{18})	5.81	1.86	3.13	1.12	268.75	3.85	2.38	22.31
19	Dhanaprasad (G_{19})	5.96	1.68	3.57	1.15	156.25	3.68	2.25	22.52
20	Bishnubhog (G_{20})	6.72	1.84	3.65	1.13	256.25	5.12	6.13	22.17
21	Shrabanmasi (G_{21})	5.91	1.49	3.97	1.15	206.25	3.61	2.50	21.73
22	Pusasugandha (G_{22})	7.53	2.40	3.14	1.17	256.25	3.97	6.38	21.40
23	Kala Krishna (G_{23})	4.70	1.81	2.59	1.13	198.75	4.09	2.38	21.72
24	Belgaum Basmati (G_{24})	5.36	1.73	3.09	1.21	346.25	4.74	2.75	22.61
25	RDN-Scented (G_{25})	6.67	3.03	2.21	1.09	331.25	4.38	2.38	20.68
26	Mamla (G_{26})	8.25	2.22	3.73	1.23	248.75	3.69	6.50	21.01
27	Ghansal regional (G_{27})	4.56	2.31	1.98	1.25	156.25	4.28	4.50	21.39
28	Pakistan basmati (G_{28})	5.12	2.67	1.92	1.13	168.75	3.53	2.00	20.71
29	Pusa basmati (G_{29})	6.76	2.06	3.33	1.16	208.75	4.04	2.63	22.70
30	Kate chinoor(G_{30})	6.74	3.15	2.15	1.15	196.25	4.23	4.63	22.32
31	RDN-local (G_{31})	6.56	2.11	3.16	1.18	293.75	3.71	6.00	21.03
32	Lala (G_{32})	5.85	2.13	2.78	1.11	318.75	4.00	4.63	22.22
33	Durgabhog (G_{33})	5.17	1.82	2.84	1.09	156.25	4.75	2.63	21.18
34	Velchi (G_{34})	5.50	2.77	1.99	1.15	298.75	4.13	2.38	21.12
35	PKV-khamang (G_{35})	5.27	1.70	3.11	1.29	307.50	4.65	4.63	23.29
36	PKV-HMT (G_{36})	5.26	1.61	3.26	1.20	268.75	5.14	4.50	20.88
37	PKV-ganesh (G_{37})	5.58	1.89	3.01	1.06	281.25	4.81	4.63	23.41
38	PKV-Makrand (G_{38})	6.39	1.97	3.30	1.07	193.75	3.64	2.38	24.14
39	Ambika (G_{39})	6.63	1.93	3.50	1.06	256.25	3.95	2.63	21.85
40	Avishkar (G_{40})	6.71	1.64	4.08	1.06	246.25	4.75	4.63	22.09
41	Bhogawati (G_{41})	6.67	1.54	4.32	1.05	281.25	4.61	4.13	22.98
42	Kundalika (G_{42})	5.23	1.62	3.24	1.47	262.50	5.23	6.38	23.46
43	Pawana (G_{43})	6.66	2.08	3.24	1.04	346.25	4.16	4.63	21.80
44	Basmati-370 (G_{44})	6.70	2.32	2.90	1.18	206.25	4.67	2.63	21.76
45	Basmati-388 (G_{45})	7.51	2.97	2.53	1.11	256.25	4.26	2.88	20.23
46	Pusa sugandha-2 (G_{46})	8.29	2.18	3.84	1.20	156.25	4.16	4.38	19.86
47	Sugandha (G_{47})	7.30	1.59	4.59	1.15	343.75	4.47	2.63	19.49
48	Patnijira (G_{48})	6.66	1.58	4.23	1.15	231.25	4.89	6.50	21.48
49	Bela blue (G_{49})	5.79	1.53	3.78	1.15	193.75	4.38	2.63	21.81
50	Girga (G_{50})	4.14	1.91	2.17	1.42	156.25	3.79	2.25	22.11
51	Ambemohar (G_{51})	4.17	2.19	1.91	1.25	162.50	3.90	4.50	22.06
52	Elaichi (G_{52})	6.35	2.21	2.89	1.23	193.75	3.78	6.63	21.92
53	Badshahabhog (G_{53})	6.36	1.92	3.31	1.08	156.25	3.79	4.88	21.76
54	Karjat-3 (G_{54})	5.33	2.72	1.96	1.20	262.50	4.20	4.63	24.07
55	Karjat-2 (G_{55})	6.64	2.14	3.14	1.06	281.25	4.40	4.63	23.29
56	Karjat-7 (G_{56})	6.64	2.01	3.30	1.05	243.75	4.22	4.88	23.36
57	Karjat-8 (G_{57})	4.89	1.57	3.11	1.10	206.25	4.35	2.63	22.19
58	Karjat-9 (G_{58})	5.86	1.79	3.28	1.07	212.50	4.53	4.38	21.74
Range		4.14-8.29	1.33-3.43	1.91-4.77	1.03-1.52	143.75-356.25	2.95-5.29	1.75-6.63	19.43-24.94
S.E±		0.02	0.08	0.11	0.04	12.39	0.19	0.27	0.27
C.D at 5%		0.07	0.24	0.31	0.10	35.09	0.53	0.76	0.77

L/B ratio: Length Breadth ratio ER: Elongation ratio WUR: Water uptake ratio
VER: Volume expansion ratio ASV: Alkali spreading value AC: Amylose content

A. Grain length, breadth and L/B ratio

Significant differences were observed within aromatic and non-aromatic rice genotypes. The rice genotypes under study was represented all classes from short (<5.5 mm) to extra-long (>7.5 mm). Aromatic rice genotypes had grain length between 4.14-8.29 mm, grain width between 1.33-3.43 mm and grain length-width ratio 1.91-4.77. Significantly maximum grain length was recorded in Pusasugandha-2 (8.29 mm) which was at par with Mamla (8.25 mm) over other rice genotypes and minimum grain length was recorded in Girga (4.14 mm). The significantly maximum grain breadth was recorded in Phule Maval (3.43 mm) and minimum grain breadth was recorded in SYE-7 (1.33 mm). The significantly maximum L/B ratio was recorded in SYE-7 (4.77 mm) which was at par with Sugandha (4.59) over other rice genotypes and minimum L/B ratio was recorded in Ambemohar (1.91 mm). L/B ratio indicates the shape and size of rice kernel which are important quality characters of rice (Abdul Baset Mia *et al.*, 2012) [1].

B. Elongation Ratio

Elongation ratio was recorded significantly maximum in aromatic rice genotypes, Phuleradha (1.52) which was at par with Kundlika (1.47), Girga (1.42) and minimum elongation ration was recorded in HMT-Sona (1.03). Varietal difference for elongation ratio was also reported by Sanjiva *et al*. (1952) [24].

C. Water Uptake Ratio
Water uptake ratio was recorded significantly maximum in aromatic rice genotypes, Phuleradha (356.25) which was at par with Terana (350.00), Belgaum Basmati (346.25), Pawana (346.25), Sugandha (343.75), Phule Maval (337.50) and RDN-Scented (331.25) over other rice genotypes. The minimum water uptake ratio was recorded in HMT Sona (143.75). Varietal difference for elongation ratio was also reported by Verma *et al*. (2015).

D. Volume Expansion Ratio
The significantly maximum volume expansion ratio was recorded in aromatic rice genotypes, Kasturi (5.39) which was at par with Kundlika (5.23), PKV-HMT (5.14), Bishnubhog (5.12), HMT-Sona (5.11) and Phule Maval (5.11) over other rice genotypes. The minimum volume expansion ratio was recorded in SYE-7 (2.95). Similar result reported by Hossain *et al*. (2009) [11], Verma *et al*. (2015) and Subhalakshami *et al*. (2018) [26].

E. Alkali spreading value and gelatinization temperature
Evaluated different rice genotypes for alkali spreading value and found the ranges from 1.75 to 6.63. The significantly maximum alkali spreading values was recorded in aromatic rice genotypes, Elaichi (6.63) which was at par with Mamala (6.50), Patnijira (6.50), Pusasugandha (6.38) and Kundlika (6.38) over other rice genotypes. The minimum alkali spreading value was recorded in Paras Sona (1.75). The rice genotypes under present study exhibited all three ranges of GT- high (>74ºC), intermediate (70-74ºC) and low (55-69ºC). Similar result reported by Juliano (1984) [16] and Parikh *et al*. (2012) [19].

F. Amylose Content
The significant differences were observed within the aromatic and non-aromatic rice genotypes. The maximum amylose content was recorded in aromatic rice genotypes, Phule Maval (24.94 %) and minimum amylose content was recorded in SYE-7 (19.43 %). The varietal difference for amylose content was also reported by Sagar *et al*. (1988) and Asaduzzaman *et al*. (2013) [23, 4].

3. Nutritive Quality Traits
Data on carbohydrate content and protein content for aromatic and non-aromatic rice genotypes are presented in table 3.

Table 3: Physiological evaluation of aromatic and non-aromatic rice genotypes for nutritive quality of rice

S. No.	Genotypes	Carbohydrate (%)	Protein (%)
1	Phule Maval (G_1)	74.37	6.60
2	Phuleradha (G_2)	75.41	5.45
3	SKL-7(G_3)	73.36	6.89
4	Terana (G_4)	74.56	7.60
5	Parag (G_5)	73.23	7.22
6	ACK-5 (G_6)	75.30	6.05
7	HMT Sona (G_7)	73.86	7.58
8	Kasturi (G_8)	73.32	5.07
9	Paras Sona (G_9)	75.21	6.54
10	Lolak (G_{10})	74.17	6.14
11	Tulsi-75-14 (G_{11})	75.36	4.70
12	Basmati-63 (G_{12})	72.42	6.85
13	Pusa Sugandha-5 (G_{13})	73.10	7.58
14	Basmati-107 (G_{14})	77.83	7.40
15	Basmati-386 (G_{15})	75.22	5.65
16	Super Basmati (G_{16})	75.28	6.89
17	Antarvel (G_{17})	73.30	6.87
18	Kala Jeera (G_{18})	73.34	6.16
19	Dhanaprasad (G_{19})	72.51	7.22
20	Bishnubhog (G_{20})	72.82	7.60
21	Shrabanmasi (G_{21})	73.86	7.49
22	Pusasugandha (G_{22})	72.88	6.82
23	Kala Krishna (G_{23})	74.30	6.16
24	Belgaum Basmati (G_{24})	75.53	7.58
25	RDN-Scented (G_{25})	73.69	6.28
26	Mamla (G_{26})	74.77	5.51
27	Ghansal regional (G_{27})	72.90	6.41
28	Pakistan basmati (G_{28})	73.46	7.46
29	Pusa basmati (G_{29})	72.94	7.26
30	Kate chinoor(G_{30})	74.36	6.14
31	RDN-local (G_{31})	74.59	5.88
32	Lala (G_{32})	73.45	7.01
33	Durgabhog (G_{33})	72.89	7.55
34	Velchi (G_{34})	74.56	6.85
35	PKV-khamang (G_{35})	75.11	6.41
36	PKV-HMT (G_{36})	74.65	7.12
37	PKV-ganesh (G_{37})	72.89	6.53
38	PKV-Makrand (G_{38})	73.36	7.60
39	Ambika (G_{39})	72.35	7.47

40	Avishkar (G_{40})	73.22	7.58
41	Bhogawati (G_{41})	73.95	5.68
42	Kundalika (G_{42})	73.09	7.62
43	Pawana (G_{43})	74.20	7.49
44	Basmati-370 (G_{44})	74.90	7.58
45	Basmati-388 (G_{45})	77.50	6.16
46	Pusa sugandha-2 (G_{46})	73.63	7.58
47	Sugandha (G_{47})	75.05	6.93
48	Patnijira (G_{48})	72.46	6.97
49	Bela blue (G_{49})	73.32	5.41
50	Girga (G_{50})	75.10	6.85
51	Ambemohar (G_{51})	74.58	6.89
52	Elaichi (G_{52})	73.41	6.16
53	Badshahabhog (G_{53})	74.31	5.68
54	Karjat-3 (G_{54})	72.23	6.70
55	Karjat-2 (G_{55})	73.74	7.24
56	Karjat-7 (G_{56})	74.06	5.40
57	Karjat-8 (G_{57})	74.13	6.89
58	Karjat-9 (G_{58})	73.60	7.04
Range		72.23-77.83	4.70-7.62
S.E±		0.30	0.06
C.D at 5%		0.85	0.16

A. Carbohydrate Content

The significant differences were observed within aromatic and non-aromatic rice genotypes for grain carbohydrate content. The significantly maximum carbohydrate content was recorded in aromatic rice genotypes, Basmati-107 (77.83 %) which was at par with Basmati-388 (77.50 %) over other rice genotypes. The minimum carbohydrate content was recorded in Karjat-3 (72.23%). Varietal difference for carbohydrate content was also reported by Juliano (1972) [15], Asaduzzaman *et al.* (2013) [4] and Chingakham *et al.* (2016) [8].

B. Protein Content

The significantly maximum protein content was recorded in aromatic rice genotypes, Kundlika (7.62%) which was at par with Terana (7.60%), Bishnubhog (7.60%), PKV-Makrand (7.60%) and HMT-Sona (7.58%) over other rice genotypes. The minimum protein content was recorded in Tulsi 75-14 (4.70%). Varietal difference for protein content was also reported by Pederson and Eggum (1983), Ahmed *et al* (1998), Buresova *et al*. (2010) and Abdul Baset Mia *et al.* (2012) [20, 2, 7, 1].

Conclusion

In conclusion, study showed that varietal differences were evident in physio-chemical, cooking and nutritive traits of aromatic and non-aromatic rice. Among aromatic & non-aromatic rice genotypes, HMT Sona and Karjat-2 was recorded significantly maximum hulling and milling percentage, respectively. Among aromatic & non-aromatic rice genotypes, Patnijira, SYE-7 and Parag as fine grain genotypes for L/B ratio; Phule radha, Kundlika and Girga for elongation ratio; Elaichi, Mamala, Patnijira, Pusasugandha and Kundlika for intermediate alkali value and Phule Maval for maximum amylose content. Among aromatic & non-aromatic rice genotypes, Kundlika and Basmati-107 was recorded maximum protein and carbohydrate content, respectively. The gathered information can be useful towards improvement of respective traits in quality rice breeding programme.

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