AATCC Review

27 August 2023: Received
18 October 2023: Revised
04 January 2024: Accepted
23 January 2024: Available Online

www.aatcc.peerjournals.net

Research Article Open Access

Milling and sensory characteristics of Indian indica subset of 3k Rice germplasm

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ABSTRACT

The world's most significant cereal grain is rice (Oryza sativa L.). Nearly half of the population of the globe consumes it as a staple. It is a typical Asian cuisine that makes up between 40 and 80 percent of the total calories consumed after being cooked. The accuracy and efficiency of the milling machine, coupled with the behavior of the grain during milling, greatly influence the market value of the grain. Milling is a crucial unit operation in the processing of rice. Getting an edible, properly milled, white rice kernel that is impurity-free is the major goal of milling. Plenty of researchers have investigated the relationships between physicochemical properties and sensory quality. A general trend among the accessions with good eating quality is towards low protein, low amylose, high viscosity, low gelatinization temperature (GT), low hardness (HD), high stickiness, and high adhesiveness. Therefore, in the present study milling and sensory characteristics were evaluated to understand the marketability and palatability of the Indian indica sub-set of 3k rice germ plasm. Overall, the milling recovery % for 250 3K lines ranged from 49.71 % to 86.31 %. Concerning overall acceptability, 93 lines fell under the dis like very much category, 124 lines fell under dis like moderate category, and 33 lines fell under neither like nor dislike category.

Keywords: *3K rice germ plasm, Milling efficiency, Indian indica, sensory quality.*

Introduction

The world's most significant cereal grain is rice (Oryza sativa L.). Nearly half of the population of the globe consumes it as a staple. It is a typical Asian cuisine that makes up between 40 and 80 percent of the total calories consumed after being cooked [1]. At the household level, it is typically eaten as boiled or fried rice. Varied civilizations have varied preferences for particular rice kinds' of flavor, appearance, and stickiness. The Oryza sativa and Oryza glaberriumn species of rice are the two most significant cultivars. While Oryza glaberrium is grown only in Africa, Oryza sativa is grown in the majority of Asian and American regions. Japonica (round grain), Indica (long grain), and Jayanica (middle grain) are three types of subspecies of rice grown in the world. The majority of the carbohydrates in rice are in the form of starch, which accounts for 72–75% of the grain's overall makeup. In rice, 7% of the protein content is made up primarily of glutelin. The term "oryzenin" refers to the glutelin found in rice [2].

The accuracy and efficiency of the milling machine, coupled with the behavior of the grain during milling, greatly influence the market value of the grain. Milling is a crucial unit operation in the processing of rice. Getting an edible, properly milled, white rice kernel that is impurity-free is the major goal of milling [3].

Plenty of researchers have investigated the relationships between physicochemical properties and sensory quality [4]. A general trend among the accessions with good eating quality is towards low protein, low amylose, high viscosity, low gelatinization temperature (GT), low hardness (HD), high stickiness, and high adhesiveness [5]. Bhat and Riar reported that there is a substantial association between cooking and textural properties and physicochemical properties including GT, gel consistency, amylose, and amylopectin [6]. Additionally, there is a strong positive link between instrumental and sensory hardness [7].

Therefore, in the present study milling and sensory characteristics were evaluated to understand the marketability and palatability of the Indian indica sub-set of 3k rice germ plasm.

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DOI: https://doi.org/10.58321/AATCCReview.2024.12.01.102

Materials and Methods

The milling quality characteristics of 250 Indian *indica* subsets of 3K Rice germplasm along with 15 University fine grain varieties were determined using standard methods (Sahay and Singh 2005). A minimum hundred grams of paddy were weighed and subjected to de-husking in a standard de-husker/sheller. After cleaning, the de-husked kernels were weighed using an analytical balance. The rice kernels were then passed through a rice grader having different (mm) grooves. Then the whole grains were separated from the broken grains to quantify the head rice recovery. Full grains and 3/4th size grains are weighed and considered as head rice recovery [8].

$$\text{Milling recovery \%} = \frac{\text{Weight of total rice}}{\text{Total weight of paddy}} \times 100$$

Sensory quality: Sensory evaluation was carried out by using a point hedonic scale by semi-trained panelists [9].

Results and Discussion

Milling Characteristics

The degree of milling is a measure of the percent bran removed from the brown rice kernel. Milling degree affects milling recovery and influences consumer acceptance. Apart from the amount of white rice recovered, the milling degree influences the color and the cooking behavior of rice. Unmilled brown rice absorbs water poorly and does not cook as quickly as milled rice. The water absorption rate improves progressively up to about 25% milling degree after which, there is very little effect [10]. The milling quality characteristics of 250 Indian *indica* subsets of 3K Rice germplasm were calculated. Overall, the milling recovery % for 250 3K lines ranged from 49.71 % to 86.31 %. Out of these 250 3K lines, 29 lines had a milling recovery % of > 80 % (Figure 1). While, 192 3K lines had a milling recovery of 70.07% (3K-130) to 79.97% (3K-169) (Figure. 2). Further, 27 3K lines had a milling recovery % between 49.71% (3K-24) to 69.76 % (3K-134) (Figure 3).

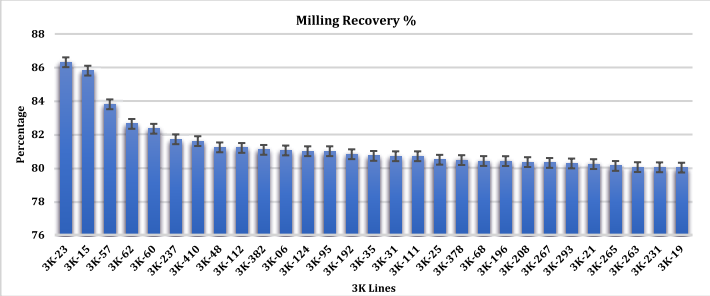

Figure 1. 3K line with > 80 % of milling recovery

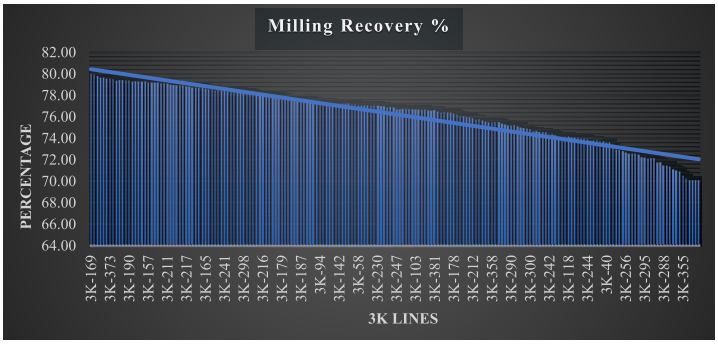

Figure 2 One ninety-two 3K lines with milling recovery between 70 to 80 percent

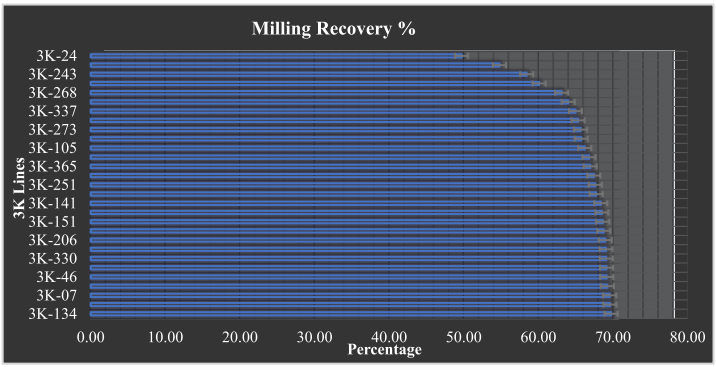

Figure 3. Twenty-nine 3K lines with milling recovery < 70 percent

Table 1: Sensory scores of 250 Indian indica subset of 3K rice germplasm

S.No	Sample name	Appearance	Cohesiveness	Tenderness on touching	Tenderness on chewing	Taste	Aroma	Elongation	Overall acceptability
1.	3k-297	2	5	4	3	2	5	3	2
2.	3k-273	1	3	3	2	1	3	2	1
3.	3k-25	2	3	2	4	1	4	2	2
4.	3k-152	4	2	3	3	3	1	3	3
5.	3k-31	4	1	2	2	1	3	1	2
6.	3k-32	4	1	5	3	3	4	2	1
7.	3k-337	4	4	3	2	2	3	3	1
8.	3k-124	2	2	3	5	2	3	3	2
9.	3k-306	1	2	1	3	1	4	2	1
10.	3k-327	3	4	2	3	3	4	2	2
11.	3k-121	4	3	1	1	2	1	3	1
12.	3k-242	1	2	4	2	1	5	1	2
13.	3k-125	4	1	3	4	3	3	2	3
14.	3k-192	2	1	3	3	3	2	2	1
15.	3k-48	2	2	2	3	3	3	1	1
16.	3k-202	3	3	3	2	2	4	3	2
17.	3k-290	2	4	4	3	2	3	2	2
18.	3K-01	1	4	3	4	1	4	3	3
19.	3K-02	1	5	3	3	1	3	2	2
20.	3K-06	3	3	5	3	3	2	2	1
21.	3K-07	2	4	4	5	2	5	1	2
22.	3K-08	3	3	3	4	3	3	2	1
23.	3K-100	2	2	3	3	1	4	3	1
24.	3K-103	1	3	4	3	2	1	3	2
25.	3K-104	4	2	5	4	2	3	2	3
26.	3K-105	3	3	4	5	3	2	2	2
27.	3K-106	4	4	3	4	2	4	3	2

28.	3K-107	4	4	3	3	1	3	2	1
29.	3K-180	2	5	2	3	3	5	1	1
30.	3K-181	3	3	3	2	1	3	2	2
31.	3K-184	2	4	4	3	2	3	3	1
32.	3K-185	3	3	5	4	3	4	3	2
33.	3K-187	2	2	4	5	2	3	2	2
34.	3K-188	4	3	3	4	2	5	2	3
35.	3K-19	4	4	2	3	1	3	3	2
36.	3K-190	3	4	4	2	1	2	2	1
37.	3K-193	2	3	4	4	3	3	1	2
38.	3K-194	1	2	3	4	1	5	2	2
39.	3K-272	1	2	3	3	3	5	3	2
40.	3K-275	5	1	5	3	2	4	3	1
41.	3K-277	3	4	5	5	2	3	2	2
42.	3K-278	3	5	4	5	1	2	3	3
43.	3K-280	2	2	3	4	3	5	2	2
44.	3K-281	4	3	3	3	2	3	3	1
45.	3K-282	2	2	4	3	1	4	2	1
46.	3K-283	3	5	5	4	3	1	2	2
47.	3K-284	5	2	4	5	3	3	3	1
48.	3K-285	3	3	3	4	3	4	1	2
49.	3K-38	3	5	3	3	2	3	2	1
50.	3K-380	2	5	2	3	2	3	3	2
51.	3K-381	4	4	3	2	1	4	3	3
52.	3K-382	2	3	4	3	1	4	2	1
53.	3K-383	5	2	5	4	3	1	2	1
54.	3K-385	4	4	4	4	2	5	3	2
55.	3K-391	1	1	3	3	3	3	1	2
56.	3K-392	3	3	2	3	1	2	2	3
57.	3K-393	2	2	4	2	2	3	2	2
58.	3K-396	1	2	4	3	2	4	1	1
59.	3K-40	3	3	3	4	3	3	3	2
60.	3K-108	5	2	3	3	2	4	2	1
61.	3K-109	4	3	5	3	1	3	3	1
62.	3K-11	3	4	5	5	3	2	2	2
63.	3K-111	2	5	4	4	1	5	2	3
64.	3K-112	1	2	3	3	2	3	1	2
65.	3K-115	5	1	3	3	3	4	2	2
66.	3K-118	4	3	4	4	2	1	3	1
67.	3K-119	2	2	5	5	2	3	3	1
68.	3K-12	1	3	4	4	1	2	2	2
69.	3K-120	3	2	3	3	1	4	2	1
70.	3K-122	4	2	3	3	3	3	3	2
71.	3K-127	3	1	2	2	1	5	2	2
72.	3K-129	2	3	3	3	3	3	1	3
73.	3K-13	3	5	4	4	2	3	2	2
74.	3K-130	4	2	5	5	2	4	3	1
75.	3K-132	4	1	4	4	1	3	3	2
76.	3K-133	5	4	3	3	3	5	2	2
77.	3K-134	1	3	2	2	2	3	2	2
78.	3K-136	3	5	4	4	1	2	3	1
79.	3K-137	4	2	4	4	3	3	2	2
80.	3K-14	3	1	3	3	3	5	1	3
81.	3K-140	4	3	3	3	3	5	2	2
82.	3K-141	2	2	5	5	2	4	3	1
83.	3K-142	1	3	5	5	2	3	3	1
84.	3K-145	3	2	4	4	1	2	2	2
85.	3K-146	4	2	3	3	1	5	3	1
86.	3K-148	1	1	3	3	3	3	2	2

87.	3K-149	4	3	4	4	2	4	3	1
88.	3K-15	2	5	5	5	3	1	2	2
89.	3K-150	2	2	4	4	1	3	2	3
90.	3K-151	3	1	3	3	2	4	3	1
91.	3K-153	1	4	3	3	2	3	1	1
92.	3K-154	3	3	2	2	3	3	2	2
93.	3K-156	4	5	3	3	2	4	3	2
94.	3K-157	1	2	4	4	1	4	3	3
95.	3K-158	4	1	5	4	3	1	2	2
96.	3K-160	2	3	4	3	1	5	2	1
97.	3K-162	2	2	3	3	2	3	3	2
98.	3K-165	3	3	2	2	3	2	1	1
99.	3K-167	2	2	4	3	2	3	2	1
100.	3K-169	1	2	4	4	2	4	2	2
101.	3K-170	1	1	3	3	1	3	1	3
102.	3K-171	3	3	3	3	1	4	3	2
103.	3K-176	2	5	5	5	3	3	2	2
104.	3K-177	3	2	5	4	1	2	3	1
105.	3K-178	2	1	4	3	3	5	2	1
106.	3K-179	1	4	3	3	2	3	2	2
107.	3K-18	4	3	3	4	2	4	1	1
108.	3K-196	3	2	4	5	1	1	2	2
109.	3K-198	4	1	5	4	3	3	3	2
110.	3K-20	4	3	4	3	2	2	3	3
111.	3K-201	2	5	3	3	1	4	2	2
112.	3K-203	3	2	3	2	3	3	2	1
113.	3K-205	2	1	2	3	3	5	3	2
114.	3K-206	3	4	3	4	3	3	2	2
115.	3K-207	2	3	4	5	2	3	1	2
116.	3K-208	4	5	5	4	2	4	2	1
117.	3K-209	4	3	4	3	1	3	3	2
118.	3K-21	3	3	3	2	1	5	3	3
119.	3K-210	2	2	2	4	3	3	2	2
120.	3K-211	1	1	4	4	2	2	2	1
121.	3K-212	1	1	4	3	3	3	3	1
122.	3K-213	3	4	3	3	1	5	2	2
123.	3K-215	4	2	3	5	2	5	1	1
124.	3K-216	2	2	5	5	2	4	2	2
125.	3K-217	1	4	5	4	3	3	3	1
126.	3K-22	3	3	4	3	2	2	3	2
127.	3K-220	4	2	3	3	1	5	2	3
128.	3K-223	1	1	3	4	3	3	3	1
129.	3K-226	4	1	4	5	1	4	2	1
130.	3K-227	2	2	5	4	2	1	3	2
131.	3K-23	2	3	4	3	3	3	2	2
132.	3K-230	3	4	3	3	2	4	2	3
133.	3K-231	2	4	3	2	2	3	3	2
134.	3K-234	1	5	2	3	1	3	1	1
135.	3K-237	1	3	3	4	1	4	2	2
136.	3K-24	3	4	4	4	3	4	3	1
137.	3K-241	2	3	5	3	1	1	3	1
138.	3K-243	3	2	4	3	3	5	2	2
139.	3K-244	2	3	3	2	2	3	2	3
140.	3K-245	1	2	2	3	2	2	3	2
141.	3K-247	3	3	4	4	1	3	1	2
142.	3K-249	2	4	4	3	3	4	2	1
143.	3K-250	3	5	3	3	2	3	2	1
144.	3K-251	1	3	3	5	1	4	1	2
145.	3K-252	4	3	5	4	3	3	3	1

146.	3K-255	2	2	5	3	3	2	2	2
147.	3K-256	2	1	4	3	3	5	3	2
148.	3K-257	3	1	3	4	2	3	2	3
149.	3K-26	4	4	3	5	2	4	2	2
150.	3K-263	2	2	4	4	1	1	1	1
151.	3K-264	1	2	5	3	1	3	2	2
152.	3K-265	3	4	4	3	3	2	3	2
153.	3K-266	4	3	3	2	2	4	3	2
154.	3K-267	1	2	3	3	3	3	2	1
155.	3K-268	4	1	2	4	1	5	2	2
156.	3K-269	2	1	3	5	2	3	3	3
157.	3K-286	2	2	4	4	2	3	2	2
158.	3K-287	3	3	5	3	3	4	1	1
159.	3K-288	2	4	4	2	2	3	2	1
160.	3K-289	1	4	3	4	1	5	3	2
161.	3K-29	1	5	2	4	3	3	3	1
162.	3K-292	3	3	4	3	1	2	2	2
163.	3K-293	2	4	4	3	2	3	2	1
164.	3K-295	3	3	3	5	3	5	3	2
165.	3K-296	2	2	3	5	2	5	2	3
166.	3K-298	1	3	5	4	2	4	1	1
167.	3K-300	4	2	5	3	1	3	2	1
168.	3K-303	3	3	4	3	1	2	3	2
169.	3K-305	4	4	3	4	3	5	3	2
170.	3K-309	4	5	3	5	1	3	2	3
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172.	3K-312	3	3	5	3	2	1	2	1
173.	3K-314	2	2	4	3	2	3	3	2
174.	3K-317	3	1	3	2	1	4	2	1
175.	3K-322	2	1	3	3	3	3	2	1
176.	3K-323	4	4	2	4	2	3	3	2
177.	3K-325	4	2	3	4	1	4	1	3
178.	3K-326	3	2	4	3	3	4	2	2
179.	3K-330	2	4	5	3	3	1	3	2
180.	3K-334	1	3	4	2	3	5	3	1
181.	3K-335	1	2	3	3	2	3	2	1
182.	3K-339	1	1	2	4	2	2	2	2
183.	3K-340	4	1	4	3	1	3	3	1
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185.	3K-347	2	3	3	5	3	3	2	2
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193.	3K-36	1	3	3	3	1	3	1	2
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195.	3K-365	4	3	5	3	1	4	3	2
196.	3K-367	2	4	3	4	2	3	3	1
197.	3K-369	2	5	3	5	3	5	2	1
198.	3K-373	3	3	2	4	2	3	2	2
199.	3K-374	2	3	4	3	2	3	3	1
200.	3K-378	1	2	3	2	1	4	2	2
201.	3K-379	5	1	2	4	1	3	1	1
202.	3K-400	1	1	3	4	3	5	2	2
203.	3K-401	4	4	2	3	1	3	3	3
204.	3K-404	2	2	3	3	3	2	3	1

205.	3K-407	3	2	4	5	2	3	2	1
206.	3K-408	1	4	5	5	2	5	2	2
207.	3K-409	5	3	3	4	1	5	3	2
208.	3K-41	1	2	3	3	3	4	2	3
209.	3K-410	4	1	2	3	2	3	1	2
210.	3K-414	2	1	4	4	1	2	2	1
211.	3K-417	2	2	3	5	3	5	3	2
212.	3K-42	3	3	2	4	3	3	3	1
213.	3K-43	2	4	4	3	3	4	2	1
214.	3K-45	1	4	4	3	2	1	3	2
215.	3K-46	5	5	3	2	2	3	2	3
216.	3K-47	4	3	3	3	1	4	3	2
217.	3K-49	5	4	5	4	1	3	2	2
218.	3K-50	4	3	4	4	3	3	2	1
219.	3K-51	1	2	3	3	2	4	3	1
220.	3K-53	3	3	2	3	3	4	1	2
221.	3K-54	2	2	3	2	1	1	2	1
222.	3K-56	3	3	2	3	2	5	3	2
223.	3K-57	4	4	3	4	2	3	3	2
224.	3K-58	4	5	4	3	3	2	2	3
225.	3K-59	3	3	5	3	2	3	2	2
226.	3K-60	2	3	3	5	1	4	3	1
227.	3K-61	1	2	3	4	3	3	1	2
228.	3K-62	5	1	2	3	1	4	2	2
229.	3K-63	4	1	4	3	2	3	2	2
230.	3K-65	1	4	4	4	3	2	1	1
231.	3K-66	4	2	3	5	2	5	3	2
232.	3K-68	5	2	2	4	2	3	2	3
233.	3K-69	4	4	4	3	1	4	3	2
234.	3K-71	2	3	4	3	1	1	2	1
235.	3K-72	3	2	3	2	3	3	2	1
236.	3K-74	3	1	3	3	1	2	1	2
237.	3K-76	4	1	5	4	3	4	2	1
238.	3K-77	2	2	4	5	2	3	3	2
239.	3K-78	1	3	3	4	2	5	3	1
240.	3K-79	3	4	2	3	1	3	2	2
241.	3K-80	4	4	3	2	3	3	2	3
242.	3K-81	1	5	2	4	2	4	3	1
243.	3K-82	4	3	3	4	1	3	2	1
244.	3K-83	2	4	4	3	3	5	1	2
245.	3K-84	2	3	5	3	3	3	2	2
246.	3K-85	3	2	3	5	3	2	3	3
247.	3K-93	2	3	3	5	2	3	3	2
248.	3K-94	1	2	2	4	2	5	2	1
249.	3K-95	1	3	4	3	1	5	2	2
250.	3K-99	2	4	3	3	1	4	3	1
	F Ratio	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	CD	0.000	1.40	0.000	0.77	0.000	0.000	0.000	0.000
	P value	1.000^{NS}	0.00**	1.000^{NS}	0.00**	1.000^{NS}	1.000^{NS}	1.000^{NS}	1.000^{NS}

From the sensory scores (Table 1) of 3k rice germ plasm it is evident that among 250 3k lines concerning the appearance, 51 lines fell under dis like very much category, 69 lines fell under dis like moderate category, 58 lines fell under the neither like nor dislike category, 58 lines fell under like moderately category and 14 lines fell under like very much category. Concerning cohesiveness, 37 lines fell under the dis like very much category, 69 lines fell under dis like category, 72 lines fell under neither like nor dislike category, 48 lines fell under the like moderately category and 24 lines fell under like very much category. Concerning tenderness on touch, 2 lines fell under dis like very much category, 34 lines fell under dis like moderately category, 100 lines fell under neither like nor dislike category, 75 lines fell under like moderately category and 39 lines fell under like very much category. Concerning tenderness on chewing, 1 lines fell under dis like very much category, 27 lines fell under dis like moderate category, 110 lines fell under neither like nor dislike category, 76 lines fell under the like moderately category and 36 lines fell under the like very much category. Concerning taste, 77 lines fell under dis like very much category, 90 lines fell under the dis like moderate category, and 83 lines fell under the neither like nor dislike category. Concerning aroma, 18 lines fell under dis like very much category, 29 lines fell under dis like

moderate category, 101 lines fell under neither like nor dislike category, 60 lines fell under like moderately category and 42 lines fell under the like very much category. Concerning elongation, 35 lines fell under the dis like very much category, 122 lines fell under the dis like moderate category, and 93 lines fell under neither like nor dislike category. Concerning overall acceptability, 93 lines fell under the dis like very much category, 124 lines fell under the dis like moderately category, and 33 lines fell under neither like nor dislike category.

Conclusion: Thus, it can be concluded that 29 Indian *indica* subset of 3k rice germ plasm
Lines had good milling recovery and 93 lines were found to have very good overall acceptability.

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