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Evaluation of Grain Quality of Kalanamak varieties/lines cultivated in Uttar Pradesh

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Abstract- India possesses an immense wealth of Basmati and non Basmati aromatic rice varieties and land races exhibiting a wide variability in their grain quality and cooking characteristics. Among non basmati aromatic rices, Kalanamak is an important and popular scented rice variety grown in Eastern Uttar Pradesh. This variety is famous for its taste and aroma. In eastern India it is cooked in honour of guest or given as gift. Although Kalanamak is fast going out of cultivation, it is one indigenous aromatic rice variety if it is promoted properly, offers a great promise not only in domestic market but also as an export commodity. It can be boon for farmers of Eastern Uttar Pradesh and Tarai area of Bihar. In present study 40 lines/varieties of Kalanamak, collected from different parts of Eastern Uttar Pradesh were evaluated on the basis of grain quality for pure line selections and further improvement to attract more and more farmers for its cultivation again.

In our study aroma ranged from very low to strong. Three variety/lines showed very low aroma, while low aroma was shown by 11 variety/lines, Moderate aroma was reported for 12 variety/lines & the remaining 14 variety/lines showed strong aroma. The gelatinizing temperature of most of varieties/ lines under study was low (33), remaining were grouped in intermediate (06) and High (01) gelatinizing temperature Category. This was decided by Alkali Digestion Score which ranged from 2.0 (Kalanamak 3120 SN) to 7.0 (Kalanamak 3259 SN, 3131 CH, 3219 SN,3214 CH,3216 N,3222 N,3216-1 SN, 3125 CH, 3128 N,3129 CH, 3121 N, 3329 N, 3256 CH,3089 CH, 3129 CH,3121-1 SN, 3122 CH, 3278 SN &3131-1 SN). Cooked kernel length was recorded from 8.3 (3257 CH) to 10.90 mm (3214 CH), while cooked kernel breadth ranged between 2.4 mm (3219 N, 3214 CH, 3216 N, 3222 N, 3216-1 SN, 3128 N, 3256 CH,3119-2 SN & 3114-1 N) to 3.0 mm (3278 SN). Elongation ratio was recorded from 1.60 (Kalanamak 3257 CH) to 2.33 (Kalanamak 3319-2 SN). Most of the parameters of these varieties/lines were compared to premium Dehradun basmati 3020. Based on this study it was revealed that besides Basmati rice other non Basmati aromatic rice varieties like Kalanamak should also promoted by scientists and adopted by more and more farmers & traders so the consumers can get better aromatic rice at lower cost and simultaneously we can maintain our traditional non basmati aromatic rice germ plasm.

Index Terms- Kalanamak, Grain quality, Non Basmati rice, Amylose content, Gelatinizing temperature, Aroma

I. INTRODUCTION

More than 90% of the world's rice is grown and consumed in Asia, where 60% of the calories are consumed by 3 billion Asians **(Khush, 1997)**. India is one of the world's largest producers of white rice, accounting for 20 % of all world rice production. India stands first in area, second in production, followed and preceded by China on these two aspects. The other major rice growing countries are Indonesia, Vietnam, Bangladesh, Thailand, Myanmar and Philippines among Asian countries. Now these days rice is excessively produced in whole of the world. Rice grain quality is a major factor from consumer as well as marketing point of view. Aromatic rice, which has stronger aroma and kernel elongation than ordinary rice, has more in demand in different countries of the world. India is one of the largest exporter of basmati rice in world **(Husaini et al, 2009)** The consumer demand has increased markedly to pay a premium price for fragrance **(Louis et al, 2005)**

Scented rices grow best and produce finest quality grains under cool, humid conditions, which are common in Himalayan Tarai of U.P and Uttarakhand and foot hills of Vindhya Hills. Hence Himalayan Tarai of Uttar Pradesh (U.P) and Uttarakhand is probably the place of origin of aromatic rices **(Khush, 2000).** Among non basmati aromatic rices, Kalanamak is the most popular scented rice variety grown in Uttar Pradesh. It is among one of the most important scented rice varieties of India. This variety is famous for its taste and aroma. It is cooking at marriages is considered auspicious and it's smoke is believed to be purifying the atmosphere.It derives its name from its black husk. It is grown widely in Tarai area of Uttar Pradesh adjoining Nepal particularly in the districts of Siddharthnagar, Santkabirnagar and Basti and in small pockets in districts Gorakhpur, Mahrajganj, Balrampur, Gonda, Bahraich, Shrawasti, Deoria and Padrauna (North Eastern Plain Zone of eastern UP). According to **H.N. Singh *et. al.*, (2006)** there is no official record, but extensive discussion with farmers of its native area of cultivation revealed that Kalanamak used to be the most popular variety in this area until the 1970s. Even during the 1990s, statistics show that Kalanamak was grown on more than 8 % of the rice area in Siddhartha Nagar alone.

Grain quality has always been an important consideration in rice variety selection and development. Based on the survey of 11 major rice growing countries **Juliano & Duff (1991)** concluded that grain quality is second only to yield as the major breeding objective. In the future grain quality will be even more important as once the very poor , many of whom depend largely on rice for their staple food become better off and begin to

demand higher quality rice **(Juliano & Villarreal , 1993).** Grain quality in rice is very difficult to define with precision as preferences for quality vary from country to country. The cooking quality preferences vary in different countries (**Azeez and Shafi, 1966).**The concept of quality varies according to the preparations for which grains are to be used. Rice is one cereal that is consumed mainly as whole milled and as boiled grain. The desired properties may vary from one ethnic group or geographical region to another and may vary from country to country **(Juliano et al, 1964)**. Grain quality characters are reported to play important role in genetic divergence too **(Singh, *et. al,* 2008).** Besides grain quality characters , agro-morphological character like plant height ,weight of panicle , 1000 grain weight, panicle length also contribute towards genetic divergence (**Singh and Singh , 2008**). Further both grain quality and agro-morphological characters followed by molecular marker study may be utilized to explore the variability and relatedness among different Basmati and non basmati scented rice lines not only at morpho-physiological and grain quality level but also at molecular level, which can be a positive step towards documentation of our scattered knowledge about germ plasm available in India. **(Singh, Yogendra 2006).**

Basmati rice costs 2-3 times more to pocket of consumers than non Basmati rice. It is not possible for each and every person to expend more money for procurement of Basmati rice for their kitchen. On other hand it is not possible to farmers / traders to provide Basmati for each person as production of most of Basmati rice in India is limited to specific area i.e. The Himalayan Tarai region. Hence there is need to explore potential of other non Basmati aromatic rices particularly Kalanamak as substitute of Basmati rice. Keeping in mind these facts present study was done to generate comparative data of various grain quality characteristics of Kalanamak varieties/lines for further improvement to attract more and more farmers for its cultivation again.

II. Material and Method

Total 40 varieties/ lines of Kalanamak collected from Uttar Pradesh were taken for present study. All the lines were grown at seed Production Center (SPC), Pantnagar under G.B. Pant University of Ag. & Tech, Pantnagar under organic field conditions during period of 2005-06 to 2007-08. Most of the parameters of these varieties/lines were compared to premium Dehradun basmati 3020. Some field observations like plant height and panicle size **(Fig 01)** were also taken. Grain samples of all lines were analyzed for different quality characteristics viz. hulling per cent, milling per cent and head rice recovery as described by **Ghosh *et. al,*. (1971)**, alkali value following the method of **Little *et. al.* (1958)**, amylose content **(Juliano, 1972)** aroma, gel consistency and kernel elongation ratio by method adopted by **Azeez and Shafi, 1966** were followed.

III. Results and Discussion

The mean values of grain quality characters of different aromatic rice varieties/ lines in present study are summarized in T**able no. 01**. Among all quality characteristics aroma is considered as most important quality parameter of high quality rice. Aroma development is influenced by both genetic factors and environment. The major aromatic compound responsible for aroma is considered is 2-acetyl-1- pyrroline **(Buttery *et .al,* 1983, 1986).** In our study aroma ranged from very low to strong. Three variety/lines i.e 3229 N, 3117 CH, & 3120 SN showed very low aroma , while low aroma was shown by 11 variety/lines i.e Kalanamak 3215 CH, 3259 SN, 3131 CH, 3125 CH, 3126 CH, 3229 SN, 3256 CH, 3278 SN, 3124 CH, 3120-1 SN, & 3114-1 SN. Moderate aroma was reported for 12 variety/lines i.e 3219 N, 3222 N, 3319 CH, 3215 CH, 3121 N, 3213 CH, 3257 CH, 3089 CH, 3121-1 SN, 3131-1 SN, 3120-2 SN & 3114-2 SN. The remaining 14 variety/lines showed strong aroma. According to **Lefebvre *et. al.,* 2010**, the training and recruiting the sensory expert panel are important in the process of sensory analysis and organoleptic tests

Many cooking and eating characteristics of milled rice are influenced by the ratio of two kinds of starches i.e amylose and amylopectin, in rice grain. **(Sanjiva Rao et.al.,1952).** Amylose content correlates negatively with taste panel scores for cohesiveness, tenderness, colour and gloss of boiled rice. Among all varieties the amylose concentration ranged from High (02), High-Intermediate (15) to Intermediate (23) category and it ranged from 20.80 % (Kalanamak 3131 N) to 30.80 % (Kalanamak 3229 SN & 3131-2 SN). Consumers generally prefer intermediate amylose conc. (20-25 %). The rice varieties are grouped on the basis of their amylose content in to waxy (0-2 %) very low (3-9 %), low (10-19 %), intermediate (20-25 %) and high (>25 %) **(Dela Cruz and Khush, 2000).** Gel consistency **(Fig.04)** generally correlates negatively with amylose conc. Gel consistency decides the either rice is soft (gel consistency > 60 mm gel length), flaky (gel consistency 41-60 mm gel length) or hard (gel consistency ≤ 40 mm gel length). Amylose and amyl pectin in kernel determines the texture of cooked rice and consumers prefer rice with intermediate Amylose content. Amylose content, starch, gel consistency and non reducing sugars content decreases with elevated temperature **(Pandey et al. 2007).** In our study it ranged from 30.0 mm (Kalanamak 3256 CH) to 90.0 mm (3222 N, 3119 CH, 3213 CH,3117 CH, 3089 CH, 3129 CH, 3256-1 SN, 3131-1 SN, 3119-2 SN 3120 SN, 3114-2 SN & 3131-2 SN). All varieties were grouped in three category i.e soft (29), medium (06) and hard (05) .The gelatinizing temperature of most of varieties/ lines under study was low (33), remaining were grouped in intermediate (06) and High (01) gelatinizing temperature Category. This was decided by Alkali Digestion Score **(Fig. 03)** which ranged from 2.0 (Kalanamak 3120 SN) to 7.0 (Kalanamak 3259 SN, 3131 CH, 3219 SN,3214 CH,3216 N,3222 N,3216-1 SN, 3125 CH, 3128 N,3129 CH, 3121 N, 3329 N, 3256 CH,3089 CH, 3129 CH,3121-1 SN, 3122 CH, 3278 SN &3131-1 SN). Grain quality evaluation of aromatic rice has been reported by **S.J. Bhonsle, (2010)**

The length wise elongation **(Fig.02)** upon cooking increase in girth is considered most desirable in high quality rice. During cooking rice grains absorb water and increase in length, breadth and volume (**Sood, 1978).** In present study the kernel length ranged from 4.20 mm (3124 CH) to 5.60 mm (3120 SN) and kernel breadth ranged from 1.80 mm (3216 N, 3125 CH, 3319 CH, 3121 N, 3213 CH, 3126 CH, 3229 SN, 3256 CH, 3089

CH,3121-1 SN, 3122 CH, 3278 SN, &3124 CH) to 2.10 mm (3121 CH &3120 SN). The L/B ratio of kernel ranged from 2.20 (3215 CH) to 2.88 (3126 CH, 3089 CH, 3121-1 SN & 3278 SN). According to **Dela Cruz and Khus (2000).** The L/B ratio decides the shape and category size of rice grain i.e. L/B ratio > 3.0 is for Slender shape, 2.1 to 3.0 is for Medium shape while ≤ 2.0 is called as Bold grain. Cooked kernel length was recorded from 8.3 (3257 CH) to 10.90 mm (3214 CH), while cooked kernel breadth ranged between 2.4 mm (3219 N, 3214 CH, 3216 N, 3222 N, 3216-1 SN, 3128 N, 3256 CH,3119-2 SN & 3114-1 N) to 3.0 mm (3278 SN). Elongation ratio was recorded from 1.60 (Kalanamak 3257 CH) to 2.33 (Kalanamak 3319-2 SN). The quality characterization of newly developed basmati and non basmati rice cultivars from cereal chemistry approach and to find correlation between important properties has been recently reported from different parts of India by **Bhonsele and Sellappan (2010) , S.J. Bhonsle, (2010) , and Kaur *et. al.*, (2011)**

Cultivation and selection by farmers for centuries under varied growing conditions has resulted in a myriad of rice varieties. Rice varieties differ from each other in growth duration, photoperiod sensitivity, grain size, shape and colour, and endosperm properties. The small and medium grain aromatic rices are regarded as separate class **non Basmati aromatic rices**. The non-basmati aromatic rices also share one or more of the basmati characteristics, but not all of them. Generally they have small to medium kernel length but may have similar L/B ratio and kernel elongation rate as that of Basmati types. Many non basmati aromatic rices may surpass basmati types in all other quality characteristics except kernel length.Uttar Pradesh has been the home of some of the finest quality scented rices. While the long-grained Basmati rice is grown in Western U.P. and Uttranchal, the small and medium grained scented rices are distributed all over U.P. Due to the quest for high yielding varieties, beginning in the mid-sixties, a large number of small and medium grained scented rice varieties, slowly vanished from the farmers' fields. For example, only a few years back, U .P. had as many as 40 well-known scented rice varieties, but today, one finds not more than 3 or 4. In the absence of any systematic breeding work and seed production program, most varieties found on the farmers' fields show a high degree of admixture, so much so that the varieties are on the verge of losing their identity **(Singh et. al. 2003).** Among non basmati aromatic rices, Kalanamak is the most popular scented rice variety grown in U.P. it is one of the most important scented varieties of India. It derives its name from its black husk. It is grown widely in Tarai area adjoining Nepal. This variety is famous for its taste and aroma. In eastern India it is cooked in honour of guest or given as gift. It is cooking at marriages is considered auspicious and it's smoke is believed to be purifying the atmosphere. Although Kalanamak is fast going out of cultivation, it is one indigenous aromatic rice variety if it is promoted properly, offers a great promise not only in domestic market but also as an export commodity. It can be boon for farmers of Eastern Uttar Pradesh and Tarai area of Bihar. However there is need to offer strong research policy and marketing support to promote this cultivar.

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Table No.01: Physicochemical properties of different Kalanamak varieties/Lines

S. No.	Kalanamak Variety/Line	KL (mm)	KB (mm)	L/B	CKL (mm)	CKB (mm)	ER	Aroma	GC		A C.		GT	
									Gel Length (mm)	Cat	%	Cat	AS	Cat
1	3215CH	4.4	2.0	2.20	10.1	2.6	2.29	Low	65	S	26.5	H-I	6.5	L
7	3259SN	4.6	2.0	2.3.	10.0	2.8	2.17	Low	65	S	23.6	I	7.0	L
2	3131CH	5.0	2.1	2.38	10.6	2.6	2.12	Low	40	H	29.7	H-I	7.0	L
3	3219N	5.0	2.0	2.50	9.3	2.4	1.86	Moderate	60	M	23.3	I	7.0	L
4	3214CH	5.4	2.0	2.70	10.9	2.4	2.01	Strong	60	M	23.6	I	7.0	L
5	3216N	4.8	1.8	2.66	10.6	2.4	2.20	Strong	65	S	24.8	I	7.0	L
6	3222N	5.4	1.9	2.84	8.8	2.4	1.63	Moderate	90	S	22.7	I	7.0	L
8	3216-1SN	5.0	2.0	2.50	10.6	2.4	2.12	Strong	35	H	24.2	I	7.0	L
9	3125CH	4.6	1.8	2.55	9.8	2.6	2.13	Low	40	H	25.5	H-I	7.0	L
10	3128N	5.4	2.0	2.70	11.2	2.4	2.07	Strong	70	S	22.5	I	7.0	L
11	3319CH	4.8	1.8	2.66	8.4	2.7	1.75	Moderate	90	S	28.3	H-I	7.0	L
12	3215CH	5.4	2.0	2.70	11.0	2.6	2.04	Moderate	60	M	26.5	H-I	6.5	L
13	3121N	5.0	1.8	2.77	8.2	2.5	1.64	Moderate	70	S	20.8	I	7.0	L
14	3213CH	5.0	1.8	2.77	9.4	2.6	1.88	Moderate	90	S	22.6	I	6.5	L
15	3126CH	5.2	1.8	2.88	11.2	2.6	2.15	Low	60	S	29.4	H-I	6.5	L
16	3329N	5.0	1.9	2.63	9.2	2.6	1.84	Very Low	65	S	25.9	H-I	7.0	L
17	3257CH	5.2	1.9	2.73	8.3	2.6	1.60	Moderate	45	M	25.7	H-I	6.5	L
18	3229SN	4.8	1.8	2.66	9.2	2.5	1.92	Low	40	H	30.8	H	6.0	L
19	3266SN	5.4	1.9	2.84	8.9	2.6	1.65	Strong	70	S	23.3	I	6.5	L
20	3117CH	4.8	1.9	2.52	10.2	2.5	2.13	Very Low	90	S	23.2	I	6.0	L
21	3256CH	5.0	1.8	2.77	9.8	2.4	1.96	Low	30	H	24.5	I	7.0	L
22	3089CH	5.2	1.8	2.88	10.2	2.6	1.96	Moderate	90	S	21.9	I	7.0	L
23	3327SN	4.8	2.0	2.4	9.4	2.7	1.96	Strong	85	S	25.5	H-I	6.9	L
24	3129CH	5.0	1.9	2.63	9.7	2.8	1.94	Strong	90	S	23.3	I	7.0	L
25	3121-1SN	5.2	1.8	2.88	10.5	2.6	2.02	Moderate	60	M	22.3	I	7.0	L
26	3122CH	5.1	1.8	2.83	9.9	2.7	1.94	Strong	60	M	23.1	I	7.0	L
27	3278SN	5.2	1.8	2.88	10.3	3	1.98	Low	75	S	21.9	I	7.0	L
28	3256-1SN	5.4	2.0	2.7	8.9	2.6	1.65	Strong	90	S	24.1	I	5.2	L
29	3124CH	4.2	1.8	2.33	10.1	2.6	2.4	Low	65	S	21.8	I	6.5	L
30	3212CH	5.3	2.0	2.65	10.0	2.7	1.89	Strong	70	S	21.2	I	5.5	I
31	3131-1SN	4.8	2.0	2.40	9.4	2.6	1.96	Moderate	80	S	23.5	I	7.0	L

32	3119-2SN	4.9	1.9	2.57	11.4	2.4	2.33	Strong	90	S	26.0	H-I	5.0	I
33	3120SN	5.6	2.1	2.66	10.8	2.6	1.93	Very Low	90	S	26.8	H-I	2.0	H
34	3120-1SN	5.4	1.9	2.84	10.9	2.5	2.02	Low	85	S	26.5	H-I	6.0	L
35	3120-2SN	5.3	1.9	2.78	11.0	2.5	2.08	Moderate	70	S	25.9	H-I	6.5	L
36	3114-1N	4.9	1.9	2.57	10.6	2.4	2.16	Low	85	S	21.7	I	4.5	I
37	3114-2SN	4.8	1.9	2.52	10.2	2.5	2.13	Moderate	90	S	23.1	I	4.5	I
38	3131-2SN	5.0	2.0	2.50	9.4	2.7	1.88	Strong	90	S	30.8	H	5.0	I
39	3119N	4.8	1.9	2.52	9.7	2.6	2.02	Strong	85	S	25.4	H-I	6.0	L
40	3119-1SN	4.8	2.0	2.40	9.8	2.6	2.04	Strong	80	S	27.5	H-I	4.5	I
41	Dehradun Basmati 3020	7.0	1.8	3.9	13.1	2.2	1.9	Strong	80	S	25.5	H-I	2.3	H

PL=paddy length, PB=paddy breadth, HR=hulling recovery, MR=milling recovery, KL=kernel length, KB=kernel breadth, L/B= kernel length/kernel breadth, CKL=cooked kernel length, CKB=cooked kernel breadth, ER=elongation ratio (after cooking), AS=alkali score, GT=gelatinization temperature, GC=gel consistency, GL=gel length, AC= Amylose content, cat. =category; L=low; I=intermediate; H-I=high-intermediate; H=high , Amylose content codes: I=intermediate (20-25%), H-I=High-Intermediate (25-30%), H=High (>30%)

Aroma codes: Strong (S), Moderate (M), Low (L), Very Low (VL)

Alkali score codes:	Gelatinizing temperature
1	H=High
2	H=High
3	H-I=High-Intermediate
4	I=Intermediate
5	I=Intermediate
6	L=Low
7	L=Low

Gel consistency:

Gel length (mm)	Category
0-40	H=hard
41-60	M=Medium
61-100	S=Soft

Fig.01: Panicle size

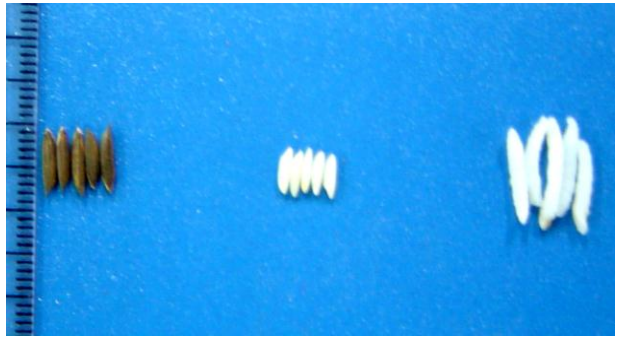

Fig.02: Cooked Kernel Elongation

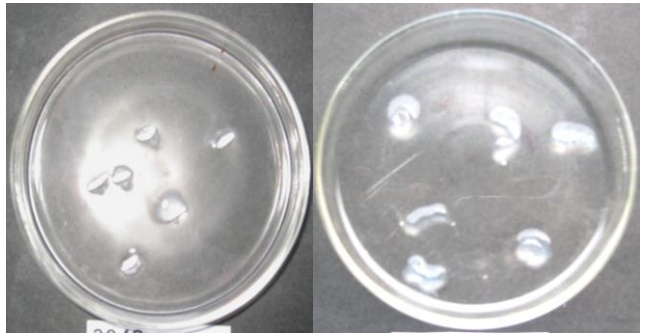

Fig.03: Alkali digestion Score Analysis

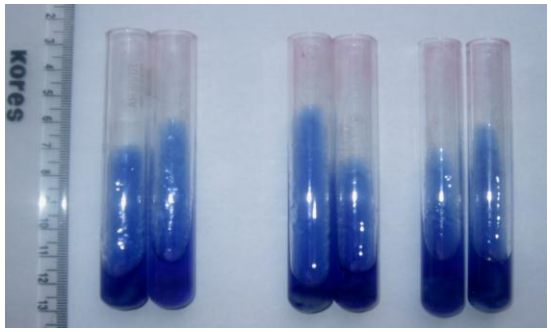

Fig.04: Gel Consistency