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Histochemical and Organolyptic Analysis of Major Aroma Compound (2-acetyl-1-pyrroline) in Kalanamak Rice Landraces and Some Basmati Rice Varieties

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Abstract

In the present paper, the histochemical analysis was carried out to localize the presence of aroma compound i.e 2-acetyl-1-pyrroline in the rice caryopsis of the kalanamak rice landraces. For the localization of 2-AP, reagent 2, 4-Dinitrophenyl hydrazine was used. Presence of the aroma was confirmed by organolyptic analysis of the Kalanamak rice accessions, Type-3, Pusa Basmati-1 and PantDhan-18.The sensory test appeared to be a simple and reliable method for rapid identification of aromatic rice. This study may help in better understanding the biology of rice grain and improvement of rice quality.

Introduction

Rice (Oryza sativa L.) is the staple food for more than two billion people in Asia. The cultivation of high-quality rice has significantly increased in recent years, and consequently, the aromatic rice cultivars grown in Asian countries are attracting attention [1]. Small variations in sensory properties can change the perception of the consumers, whether highly desired by or unacceptable to consumers [2]. Consequently, aroma and flavor have been rated as the major criteria for preference among consumers [3]. To increase the production of aromatic rice and satisfy the diversification of the demand from current rice consumers worldwide, it is necessary to develop the suitable breeding methods of aromatic rice.

Materials and Methods

The evaluation of rice aroma is not easy, and classical smelling or chewing methods are not supposed to be totally reliable because of their subjective nature [4]. For the sensory evaluation, seeds of all the genotypes of Kalanamak, Type-3 and Pusa basmati-1 and non-scented Pantdhan-18 were collected from Norman E. Boralog Crop Research Centre of GBPUA & T, Pantnagar (U.K.), India. All the genotypes of Kalanamak, Pantdhan-18, Type-3 and Pusa Basmati-1 were manually dehusked. For the test using seeds, 10 seeds of each genotype were taken in Stoppard test tubes. About 10ml 1.7% KOH solution was added to each Stoppard test tube and left at room temperature for 30 min. After 30 minutes, each

Stoppard test tube was opened and the degree of aroma was evaluated by sniffing and was scored on the 1-4 scale with 1, 2, 3 and 4 corresponding to the absence of aroma, slight aroma, moderate aroma and strong aroma. The score for each sample was recorded by a panel of 5 experts according. All measurements were recorded in triplicates and these were expressed as mean ± SE.

For histochemical studies, Seeds of all the varieties were soaked overnight to soften the seed-coat and were manually dehusked and hand-cut transverse sections were obtained using a razor blade. Theses thin sections were transferred through 60% alcohol grade. Afterward, Sections were transferred to 2, 4-dinitrophenyl hydrazine reagent in a beaker and incubated in hot air oven at 60°C for 30 min. Later sections were mounted by Canada balsam and observed under bright field microscope [5].

Results and Discussion

The presence or absence of aroma in the rice seeds was assessed for 70 Kalanamak rice accessions, Type-3, Pusa Basmati-1 and PantDhan-18 from Uttrakhand region. Table 1 lists the aroma responses of the rice cultivars. The result showed that most of the Kalanamak Genotypes were found give moderate to the slight aroma. Out of 70 Genotypes, 4 genotypes had the strong aroma, 38 genotypes had the slight aroma and 26 genotypes had the moderate aroma.

Genotype	Accession No	Weight/ Seeds (gm)	Aroma
Pant Dhan 18	-	0.21	1
Pusa Bas.-1	-	0.17	3
Type-3	-	0.16	2
Kalanamak 1	3089-P	0.10	2
Kalanamak 2	3089-SN	0.10	2
Kalanamak 3	3144-SN	0.11	2
Kalanamak 4	3114-1-P	0.09	2
Kalanamak 5	3114-1-SN	0.11	3
Kalanamak 6	3114-2-P	0.12	2
Kalanamak 7	3117-P	0.12	4
Kalanamak 8	3117-SN	0.11	2
Kalanamak 9	3119-P	0.12	3
Kalanamak 10	3119-SN	0.10	3
Kalanamak 11	3119-1-SN	0.12	2
Kalanamak 12	3119-2-P	0.12	2
Kalanamak 13	3119-2-SN	0.11	4
Kalanamak 14	3120-P	0.12	3
Kalanamak 15	3120-SN	0.13	2
Kalanamak 16	3120-1-P	0.12	2
Kalanamak 17	3120-1-SN	0.13	3
Kalanamak 18	3120-2-P	0.12	3
Kalanamak 19	3120-2-SN	0.12	3
Kalanamak 20	3121-P	0.10	3
Kalanamak 21	3121-SN	0.11	2
Kalanamak 22	3121-1-SN	0.16	2
Kalanamak 23	3122-P	0.17	4
Kalanamak 24	3122-SN	0.18	2
Kalanamak 25	3124-P	0.17	2
Kalanamak 26	3124-SN	0.18	2
Kalanamak 27	3125-SN	0.17	3
Kalanamak 28	3126-P	0.17	2
Kalanamak 29	3126-SN	0.16	2
Kalanamak 30	3128-P	0.20	3

Kalanamak 31	3128-SN	0.14	3
Kalanamak 32	3129-P	0.12	2
Kalanamak 33	3129-SN	0.14	2
Kalanamak 34	3130-P	0.13	3
Kalanamak 35	3130-SN-CH	0.19	3
Kalanamak 36	3131-SN-CH	0.17	2
Kalanamak 37	3131-SN	0.11	2
Kalanamak 38	3131-P	0.10	3
Kalanamak 39	3131-2-P	0.12	3
Kalanamak 40	3131-2-SN	0.11	1
Kalanamak 41	3212-P	0.13	3
Kalanamak 42	3212-CH-SN	0.10	2
Kalanamak 43	3213-SN	0.11	3
Kalanamak 44	3214-N	0.10	3
Kalanamak 45	3214-SN	0.13	2
Kalanamak 46	3215-P	0.16	2
Kalanamak 47	3215-SN	0.16	3
Kalanamak 48	3215-1-P	0.14	3
Kalanamak 49	3216-P	0.15	3
Kalanamak 51	3216-SN	0.14	2
Kalanamak 52	3216-1-P	0.17	3
Kalanamak 53	3219-P	0.15	2
Kalanamak 54	3219-SN	0.17	2
Kalanamak 55	3221-SN	0.15	2
Kalanamak 56	3222-P	0.17	2
Kalanamak 58	3224-P	0.13	2
Kalanamak 59	3229-SN	0.15	2
Kalanamak 60	3256-P	0.16	2
Kalanamak 61	3256-CH-SN	0.14	2
Kalanamak 63	3257-P	0.12	2
Kalanamak 64	3257-CH-P	0.12	3
Kalanamak 65	3253-SN	0.13	3
Kalanamak 66	3266-P	0.12	2
Kalanamak 67	3266-1-P	0.11	2
Kalanamak 68	3266-SN	0.11	4
Kalanamak 69	3266-4-P	0.13	2
Kalanamak 70	3278-P	0.13	3
Mean – 2.485			
Range – 1-4			
STD - 0.651			

Table 1: Organolyptic analysis of Kalanamak rice accessions, Type-3, Pusa Basmati-1 and PantDhan-18.

From the earlier studies, it was concluded the 2-AP was present in the aleurone layer than the endosperm [6,7]. Histochemical studies revealed that aromatic compound i.e. 2-acetyl-1-pyrroline was present in the aleurone layer. 2, 4- dinitrophenyl hydrazine reacts with methyl ketones to give an orange-red color.

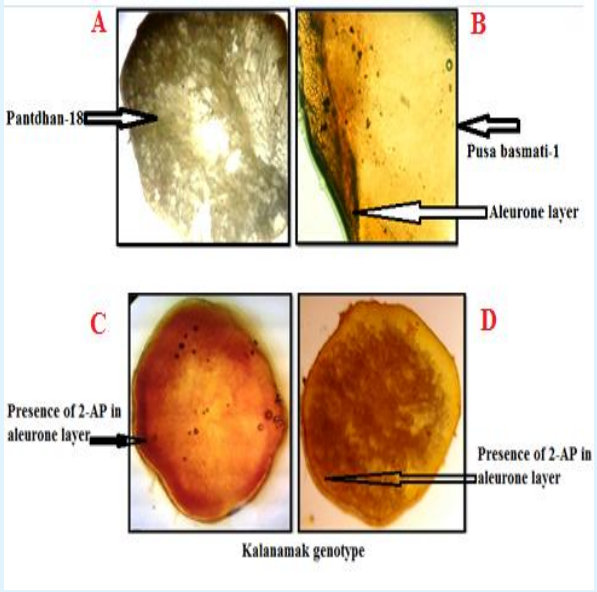

Figure 1: Histochemical analysis of rice genotype: A) Pantdhan-18 showing no reaction with 2, 4-Dinitrophenyl hydrazine in the aleurone layer. B) Pusa Basmati-1: showing a reaction with 2, 4-Dinitrophenyl hydrazine in the aleurone layer. C and D) Kalanamak 7 & 13 accessions showing reaction with 2,4-Dinitrophenyl hydrazine in the aleurone layer.

2-acetyl-1-pyrroline + 2,4-dinitrophenylhydrazine → 2-acetyl-phenyl hydrazone (orange-red colour)

Organoleptic test with consumer preferences of different rice accessions provides information for improvement of valuable grain quality traits. So it is important to identify the aromatic substances determining the aroma in rice. In addition, further studies should be carried out to confirm the precursors and pathways of 2-AP formation in aromatic rice cultivars to elucidate the nature and expression of the aroma trait in rice.

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