



ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2021; 10(4): 510-513
© 2021 TPI
www.thepharmajournal.com
Received: 15-02-2021
Accepted: 28-03-2021

Banshidhar
Department of Genetics and
Plant Breeding, G. B. Pant
University of Agriculture and
Technology (GBPUAT),
Pantnagar, UK, India

Priyanka Jaiswal
Department of Genetics and
Plant Breeding, Banaras Hindu
University (BHU), Varanasi,
UP, India

Mithilesh Kumar Singh
Department of Genetics and
Plant Breeding, G. B. Pant
University of Agriculture and
Technology (GBPUAT),
Pantnagar, UK, India

Indra Deo
Department of Genetics and
Plant Breeding, G. B. Pant
University of Agriculture and
Technology (GBPUAT),
Pantnagar, UK, India

Corresponding Author:
Priyanka Jaiswal
Department of Genetics and
Plant Breeding, Banaras Hindu
University (BHU), Varanasi,
UP, India

Biochemical evaluation and correlation studies for grain characteristics in Kalanamak advanced recombinant lines

Banshidhar, Priyanka Jaiswal, Mithilesh Kumar Singh and Indra Deo

DOI: <https://doi.org/10.22271/tpi.2021.v10.i4h.5998>

Abstract

The present investigation was undertaken with the objective of evaluation of grain characteristics in Kalanamak Advanced Recombinant Lines (KARL). Trials were conducted for two consecutive wet seasons during Kharif 2016 and 2017 at Norman E. Borlaug Crop Research Centre (NEBCRC), G. B. Pant University of Agriculture and Technology (GBPUAT), Pantnagar, Uttarakhand in a Randomized Complete Block Design in three replications with the spacing of 20 cm × 15 cm and the harvested kernels were used for biochemical analysis. KARL 2 (21.33%), KARL5 (22.13%), KARL6 (21.33%) and KARL 10 (21.67%) showed intermediate amylose content. KARL 5 has highest endosperm amylose content while KARL 8 (19.47%) shows minimum amylose content. These lines have high to intermediate alkali spread value while intermediate to low Gelatinization temperature. Gel consistency value was recorded highest for KARL 8 (73 mm) and minimum for PSD -17 (54 mm). High value of Hulling (%), Milling (%) and Head rice recovery (%) was reported for all KARL genotypes over the check variety PSD -17. Based on the result of this study it can be inferred that these Kalanamak lines are good source of quality rice intermediate amylose content, soft gel consistency and intermediate gelatinization temperature. These genotypes can be further utilized in improving the biochemical quality traits in rice.

Keywords: Kalanamak rice, amylose content, gelatinization temperature, gel consistency, grain aroma

Introduction

Rice a semi-aquatic annual grass native to tropical Asia. In India it has the largest area under cultivation and highest production among grain crop. India possesses an immense wealth of aromatic rice germplasm and land races exhibiting a wide variability with respect to their grain and cooking characteristics (Singh *et al.*, 2013) [18]. Through its basmati and scented rice genetic resources India has ruled the world rice market. The scented and basmati rice has also played a significant role in boosting rice economy through foreign exchange. Among the scented varieties Kalanamak is one of the finest quality aromatic rice cultivated in India. It derives its name from black husk of kernel (Kala) and ability for successful adaption in usar soils characterised by higher salt concentration and high pH and/or having a distinct salty taste (Namak). This variety is designated as the scented black pearl or Buddha's gift. Since this variety is under cultivation even during the early Buddhist period (600 BC). It has a characteristic aroma in the grains because of which in 2012 this rice has been granted the Geographical Indication (GI) Tag by the Government of India. On account of its flavour and palatability aromatic rice are preferred by consumers all over the world. In Indian subcontinent people are highly conscious about quality of food. Hence, grain quality is second only to yield as the major breeding objective in rice (Juliano and Duff, 1991; Bajpai and Singh, 2010) [14]. The production area of Basmati rice is specially demarcated hence it can't be grown all over the world to meet the ever-increasing demand for quality Basmati rice. Thus, there is an urgent need to exploit possibilities in non-basmati aromatic rice for superior qualities in the form preferred by consumers *viz.* intermediate amylose content, soft and fluffy texture, strong aroma etc. In this regard Kalanamak rice qualifies as a better alternative. Except for grain length, Kalanamak rice had outshined even the most demanded basmati rice in all other quality parameters. It is a non-basmati aromatic rice with strong aroma, even more than some basmati rices. Its grain length varies between short to medium having high elongation after cooking. Cooked Kalanamak rice (amylose content of about 20%) is fluffy and softer than other rice varieties. On account of its superior qualities, it was also featured in the book 'Specialty rices

Of the world' by Food and Agriculture Organization of the United Nations. Keeping this in view, present investigation was undertaken for Biochemical Evaluation of Kalanamak Advanced Recombinant Lines for grain characteristics. The inferences from the results of this study will be helpful in further utilization of these genotypes in improving the biochemical quality traits in rice.

Materials and Methods

Experimental materials

The experimental material consists of 11 Kalanamak Advanced Recombinant Lines and PSD -17 grown with the spacing of 20 cm × 15 cm following standard crop production and crop protection practices. The kernels were harvested at physiological maturity and used for biochemical analysis. Rice grains were dehusked to facilitate the alkali digestion test and further grounded into flour for gel consistency test and amylose estimation.

Methods

Amylose content of rice flour of different genotypes was determined following the modified method of Juliano (1972) [5]. The presence or absence of amylose in the kernels was measured by single observation of a group of grains at hard caryopsis stage. Absorbance of the solution was recorded at wavelength of 620 nanometers with a spectrophotometer and amylose content was calculated by using a standard curve and the results were expressed on the dry weight basis.



Fig 1: Test of amylose content in endosperm

Gelatinization temperature (GT) was determined indirectly as the alkali spreading value (ASV) of hulled kernels, as per modified procedure of Little *et al.*, 1958 [6]. Six whole grains, were dipped in Petri-dishes containing 1.7% KOH and incubated at room temperature for 24 hr. The alkali

spreading value was scored visually by the appearance of the grains and the degree of grain disintegration on a 1-7 linear scale (Standard Evaluation System, IRRI, 1996) [3]. Decorticated grain Aroma was evaluated by smelling the cooked rice (5 g of rice in 15 ml of distilled water). Cooked rice was transferred into a petri-plates and cooled for 20 min in refrigerator. Then these petri-plates were opened and the contents were smelled. The cooked rice possessing the scent, as one could easily feel, produced a sharp and readily recognizable aroma. Gel Consistency (GC) The gel consistency test was performed following the method of Cagampang *et al.*, 1973) [2]. Rice flour (0.1 g) are treated with 95% Ethanol (0.2 mL) and 0.2 N potassium hydroxide (2 mL) followed by heating in boiling water bath (10 min) and t subsequent cooling in ice water bath (20 min). The treated samples were held horizontally on graph paper and after 30 min Gel consistency was measured as the distance moved by the gel in the test tubes. Hulling percentage is calculated as percentage ratio of the weight of brown rice to weight of rough rice. Milling percentage is calculated as percentage ratio of the weight of white or milled rice to weight of rough rice. Head rice percentage is calculated as percentage ratio of weight of head grain or whole kernels to weight of rough rice. Head rice normally includes broken kernels that are 75-80% of the whole kernel. L/B ratio is calculated by dividing average length of grain by its average breadth.

Results and Discussion

Physicochemical characteristics

The various results on amylose content, alkali spread value, gelatinization temperature and gel consistency value are presented in Table 1. The cooked grain quality in rice is largely dependent on the physicochemical properties of the rice starch (Pushpa *et al.*, 2018) [7]. On the basis of starch content, the studied lines were classified into low and intermediate categories which ranges from 19.47 in KARL 8 to 22.13 in KARL 5. On the basis of Alkali spread value the studied lines were classified into high value group with mean ASV of 6 (KARL1, KARL5, KARL6 and KARL10 and PSD 17) and intermediate group with mean ASV of 5 (KARL2, KARL4, KARL7, KARL 8 and KARL11) and 4 (KARL3 and KARL9). Alkali spread value and the gelatinization temperature have inverse relation, thus the lines with low alkali spread value will have a high gelatinization temperature (Waters *et al.*, 2006) [9]. The studied lines were classified in two categories based on gelatinization temperature (GT) (as an estimate of ASV) namely intermediate GT 70-74°C and low GT 55-69 °C. Gel consistency test is used for screening of cooked rice for its hardness or softness. In present study, lines were classified into the medium (KARL 5, KARL 10 and PSD 17) and soft group (rest) based on the gel consistency values. The relationship between AC, ASV and GC is shown in graph (Fig 2).

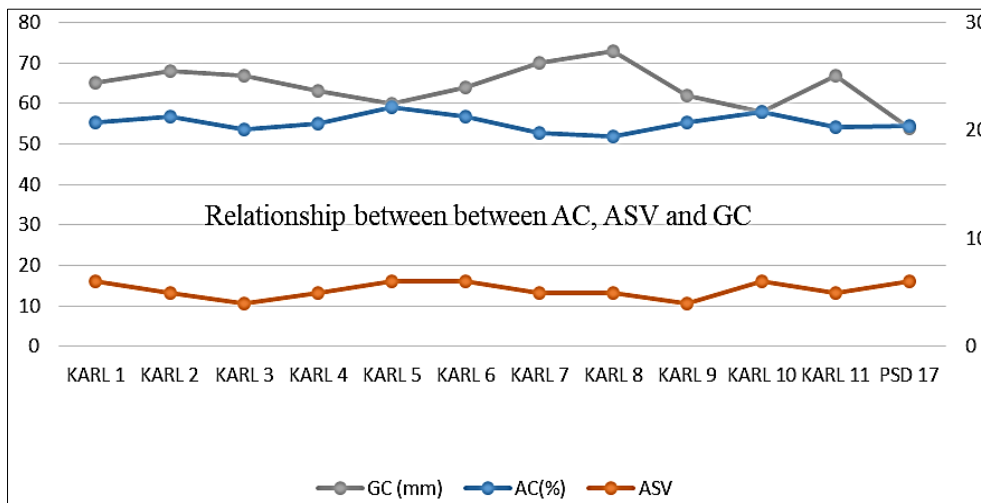


Fig 2: Graphical representation of relationship between between AC, ASV and GC

Table 1: Mean value and range for amylose content, alkali spread value, gelatinisation temperature and gel consistency for Karl genotypes over the year

| Genotype | AC (%) | AC group | ASV | ASV group | GT | GC (mm) | GC range |
|----------|--------|----------|-----|-----------|-----|---------|----------|
| KARL 1 | 20.73 | Im | 6 | High | Low | 65 | S |
| KARL 2 | 21.33 | Im | 5 | Im | Im | 68 | S |
| KARL 3 | 20.13 | Im | 4 | Im | Im | 67 | S |
| KARL 4 | 20.67 | Im | 5 | Im | Im | 63 | S |
| KARL 5 | 22.13 | Im | 6 | High | Low | 60 | M |
| KARL 6 | 21.33 | Im | 6 | High | Low | 64 | S |
| KARL 7 | 19.73 | Low | 5 | Im | Im | 70 | S |
| KARL 8 | 19.47 | Low | 5 | Im | Im | 73 | S |
| KARL 9 | 20.73 | Im | 4 | Im | Im | 62 | S |
| KARL 10 | 21.67 | Im | 6 | High | Low | 58 | M |
| KARL 11 | 20.27 | Im | 5 | Im | Im | 67 | S |
| PSD 17 | 20.47 | Im | 6 | High | Im | 54 | M |

Where, AC: Amylose content; ASV: Alkali spread value; GT: Gelatinisation temperature; GC: Gel consistency; Im: Intermediate; Soft; M: Medium

Physical characteristics

The mean value and descriptive statistics for various physical characteristics is shown in Table 2 and Table 3 respectively. In rice aroma is considered as most important grain quality parameter. In present investigation all the Kalanamak lines are reported to be strongly scented while the check variety PSD -17 was medium scented. Grain size and shape (length/breadth ratio) is a varietal property. PSD -17 has highest L/B ratio (5.44) while KARL 5 has lowest

L/B ratio (3.18). KARL 9 has highest value for hulling (83.8) and milling percentage (73.2) while KARL 5 has highest value for head rice percentage (54.1) while the check variety PSD-17 has lowest value for hulling (77.8), milling (65.35) and head rice percentage (44.6). Long slender grains normally have greater breakage than short, bold grains and consequently have a lower milled rice recovery. This relationship can be easily seen in the graph (Fig 3).

Table 2: Mean value for hulling (%), milling (%), head rice recovery (%) and L/B ratio for KARL genotypes over the year

| Genotype | Aroma | Hulling (%) | Milling (%) | Head rice recovery (%) | L/B ratio |
|----------|-------|-------------|-------------|------------------------|-----------|
| KARL 1 | SS | 80.75 | 71.1 | 51.2 | 3.79 |
| KARL 2 | SS | 79.2 | 68.9 | 48.8 | 4.26 |
| KARL 3 | SS | 78 | 65 | 46.25 | 3.72 |
| KARL 4 | SS | 82.9 | 71.5 | 51.4 | 3.49 |
| KARL 5 | SS | 82.13 | 72.8 | 54.1 | 3.18 |
| KARL 6 | SS | 79 | 67.9 | 49 | 3.81 |
| KARL 7 | SS | 78.5 | 68.7 | 50.3 | 3.43 |
| KARL 8 | SS | 79.25 | 71.4 | 52.6 | 3.95 |
| KARL 9 | SS | 83.8 | 73.2 | 52 | 3.45 |
| KARL 10 | SS | 81.3 | 72.6 | 52.9 | 3.49 |
| KARL 11 | SS | 79.6 | 67.3 | 49.4 | 4.06 |
| PSD 17 | MS | 77.8 | 65.35 | 44.6 | 5.44 |

Where, SS: Strongly scented; MS: Medium scented

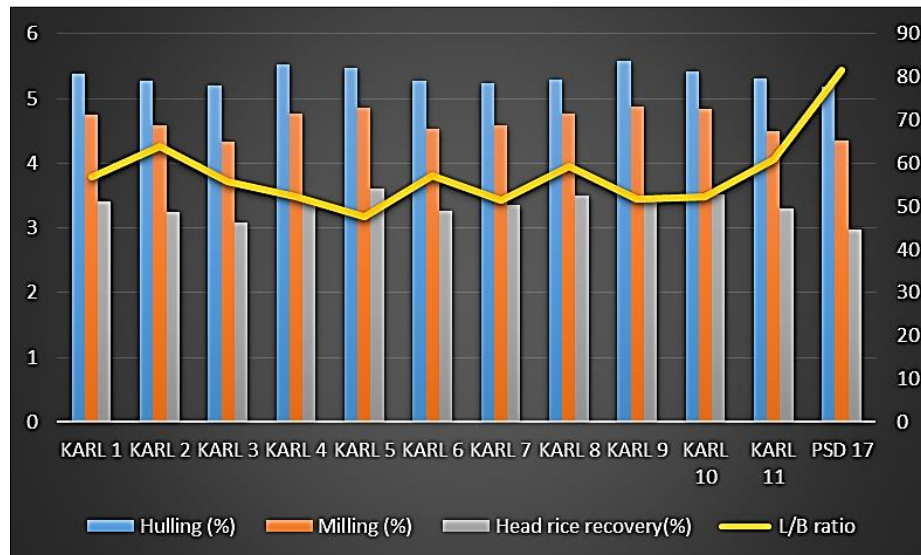


Fig 3: Graphical representation for hulling (%), milling (%), head rice recovery (%) and L/B for KARL genotypes

Table 3: Descriptive statistics for hulling (%), milling (%), head rice recovery (%) and L/B for KARL genotypes over the year

| Descriptive statistics | Hulling (%) | Milling (%) | Head rice recovery (%) | L/B |
|---------------------------|-------------|-------------|------------------------|-------|
| Range | 6 | 8.2 | 9.5 | 2.26 |
| Average | 80.19 | 69.65 | 50.21 | 3.84 |
| Standard Deviation | 1.97 | 2.86 | 2.78 | 0.59 |
| Variance | 3.88 | 8.18 | 7.72 | 0.35 |
| Standard Error of Mean | 0.57 | 0.83 | 0.80 | 0.17 |
| Co-efficient of Variation | 2.46 | 4.11 | 5.53 | 15.34 |

Correlation matrix

The Pearson correlation matrix between amylose content, alkali spread value and gel consistency value showed positive and significant correlation (at both 1% and 5% level of significance) between AC and ASV. Thus, this may helpful in indirect selection of traits simultaneously, while negative and significant correlation (at 5% level of significance) between AC and GC. Results showed a direct relationship between AC and ASV.

Table 3: Pearson correlation matrix for amylose content (AC), alkali spread value (ASV) and gel consistency (GC)

| | AC | ASV | GC |
|-----|---------|----------------------|----------------------|
| AC | 1.000 | 0.461** | -0.405* |
| ASV | 0.461** | 1.000 | -0.313 ^{NS} |
| GC | -0.405* | -0.313 ^{NS} | 1.000 |

Conclusion

The amylose content, alkali spread value, gelatinization temperature and gel consistency value are some of the important parameters that determine the grain quality in rice, thus directing their use in quality improvement programmes. On the basis of experimental studies KARL5 with intermediate amylose content (22.13), low GT, medium gel consistency (60 mm), strong aroma and highest head rice recovery percentage (54.1) was reported to be best genotypes in respect of desired grain quality characteristics and could be used as a potential source for deriving improved lines through selection.

Authors' contribution

This work was carried out in collaboration among all the authors. Authors Banshidhar and ID designed and executed the experiment and prepared the original draft of the manuscript. Author MKS performed the statistical analysis and provided technical support in interpretation of results. Author PJ proof read the manuscript and prepared the final

draft. All authors read and approved the final draft of the manuscript.

Competing interests

Authors have declared that no competing interests exist.

References

- Bajpai A, Singh Y. Study of quality characteristics of some small and medium grained aromatic rices of Uttar Pradesh and Uttarakhand. *Agric. Sci. Digest* 2010;30(4):241–245.
- Cagampang GB, Perez CM, Juliano BO. A gel consistency test for eating quality in rice. *J Sci Food Agric* 1973;24:1589–159.
- IRRI. Standard Evaluation System for rice, Los Banos, Philippines 1996, P56-60.
- Juliano BO, Duff B. In rice grain marketing and quality issues. IRRI, Los Banos, Philippines 1991, 55-64.
- Juliano BO. Physicochemical properties of starch and protein and their relation to grain quality and nutritional value of rice. In: *Rice breeding*, International Rice Research Institute, Los Banos, Philippines 1972, P389-405.
- Little RR, Hilder GB, Dawson EH. *Cereal Chem* 1958;35:111-126.
- Pushpa R, Suresh R, Iyyanar K, Mannimaran R, Sankumar D. Study on the Gelatinization properties and amylose content in rice germplasm. *Journal of Pharmacognosy and Phytochemistry*. SP1 2018, P2934-2942.
- Singh Y, Bajpai A, Singh US. Biochemical characterization and grain quality evaluation of some aromatic rice varieties/lines for food security. *Internat. J agric. Sci* 2013;9(2):736-742.
- Waters DL, Henry RJ, Reinke RF, Fitzgerald MA. Gelatinization temperature of rice explained by poly morphisms in starch synthase. *Plant Biotechnology Journal* 2006;4:115-122.