



Divergence in rice cultivars based on organoleptic qualities

P.V. Nandini^{1,*}, P. Saraswathy² and L. Prema¹

Departments of ¹Home Science and ²Agricultural Statistics, College of Agriculture, Vellayani, Thiruvananthapuram 695 522, Kerala

Received 30 January 2001; received in revised form 12 November 2004; accepted 15 November 2004

Abstract

Sixty rice cultivars were evaluated for their organoleptic qualities. Divergence of samples was measured by Mahalanobis D^2 statistic and clustering done by Tocher's method. For raw rice, the varieties formed six clusters while for the parboiled samples, 10 clusters could be recognized. Results of the D^2 analysis revealed that among the 60 rice varieties, as much as 35 were homogeneous with respect to quality attributes such as appearance, colour, flavour, texture and taste for the preparation of boiled rice either in the raw or parboiled forms.

Key words: cluster analysis, Mahalanobis D^2 , raw rice, parboiled rice

Introduction

Rice is a vital food for more than half the world's population; and among the cereals, it is considered more nutritious than wheat. Although a primary source of carbohydrates, rice supplements the protein requirements for millions of Asians. Genetic diversity, however, abounds in this crop, and it reflects the nutritional quality, besides, the organoleptic qualities. Furthermore, in Kerala where rice is a staple food crop, the plant breeders over the last three to four decades have evolved a large number of improved varieties with disparate grain qualities and the farmers also use a vast number of traditional varieties. No previous studies, however, have analyzed the clustering pattern of the traditional and the improved rice cultivars of the state. Hence, a study was undertaken to collect preliminary information regarding the extent of variability in the organoleptic qualities among the predominant rice cultivars of the state and also to group them based on the homogeneity in group distance measured by D^2 values.

Materials and methods

Sixty varieties of rice (Table 1) were collected from the

progressive farmers and the research stations at Pattambi, Kayamkulam, Moncompu and Vyttila under the Kerala Agricultural University. The collected grains were processed into raw and parboiled milled samples and cooked to evaluate their optimum cooking time and organoleptic qualities viz., appearance, colour, flavour, texture and taste. The samples were scored using a scorecard by a panel of judges selected through a triangle test. Mahalanobis D^2 analysis was used to measure the divergence of the cooked samples based on organoleptic qualities and clustering was done by the Tocher's method (Rao, 1952). For estimating the intra-cluster distance, the formula used was

$$\sum \frac{D^2 l}{N}$$

where $\sum D^2 l$ is the sum of the distance between all possible combinations (N) of the varieties forming a cluster. For assessing the average inter cluster distance, the distance between all possible combinations of the clusters and the sum of the distance between varieties in a pair of clusters at a time were worked out. The sum of D^2 values divided by the product of the number of varieties in each cluster gave the inter cluster distance for a particular pair of clusters.

*Author for correspondence: Phone: 91-471-2575163; E-mail: nandininambissan@yahoo.co.in

Table 1. Rice varieties selected for the study

High yielding varieties	Traditional/local varieties	Other selections/ varieties
'Annapoorna'	'Aruvakkari'	Co-25
'Aruna'	'Aryankali'	'Mashuri'
'Asha'	'Aryan'	
'Bhadra'	'Aranmula local'	
'Bharathy'	'Chenkayama'	
'Bhagya'	'Cheriya Aryan'	
CSRC collection	'Chettivirippu'	
'Dhanya'	'Chitteni'	
'Hraswa'	'Chuvannamodan'	
'Jaya'	'Chuvannari - Thavalakannan'	
'Jayathi'	'Elappapoochemban'	
'Jyothi'	'Kattamodan'	
'Kanakom'	'Kutticheradi'	
'Karthika'	'Kuruwa'	
'Lakshmi'	'Kavunginpoothala'	
'Makom'	'Navara'	
'Neeraja'	'Pavizhachembavu'	
'Nila'	'Thrissur local-1'	
'Onam'	'Thrissur local-2'	
'Pavizham'	'Ponnaryan'	
'Matta Triveni'	'Sinduram'	
'Remya'	'Thekken'	
'Reshmi'	'Thekkencheera'	
'Sabari'	'Teena'	
'Sagara'	'Vadakken chitteni'	
'Swarnaprabha'	'Vellari'	
'Swarnamodan'	'Veluthavattan'	
'Triveni'	'Veluthari Thavalakannan'	
'Vyttila-1'		
'Vyttila-3'		

Results and discussion

The 60 rice varieties presently evaluated based on the organoleptic qualities in raw rice formed six clusters (Table 2), whereas for parboiled rice, the varieties constituted ten clusters (Table 3). Tables 4 and 5 present the cluster means of the raw and parboiled rice respectively. Considerable differences in cluster means were noticed for all quality attributes. For instance, in raw rice, cluster I showed the highest mean value for appearance (3.41), while cluster V was superior for other characters like colour (4.00), flavour (3.80), and taste

Table 2. Clustering pattern for raw rice

Clusters	Varieties	Count
I	'Sabari', 'Aranmula local', 'Jaya', 'Jyothi', 'Kuruwa', 'Matta Triveni', 'Onam', 'Bhadra', 'Asha', 'Pavizham', 'Aruna', 'Makom', 'Kanakom', 'Dhanya', 'Lakshmi', 'Bhagya', 'Sagara', 'Chitteni', 'Pavizhachembavu', 'Vellari', 'Kavunginpoothala', 'Veluthavattan', 'Kattamodan', 'Swarnaprabha', 'Swarnamodan', 'Bharathy', 'Aryan', 'Vadakken chitteni', 'Chenkayama', 'Chuvannamodan', 'Elappapoochemban', 'Co-25', 'Jayathi', 'Neeraja', 'Navara', 'Ponnaryan', 'Thrissur local-1', 'Thrissur local-2', 'Veluthari- Thavalakannan', 'Thekkencheera', 'Cheriya Aryan', 'Aruvakkari', 'Mashuri', 'Annapoorna', 'Triveni', 'Reshmi', 'Hraswa', 'Kutticheradi', 'Sinduram', 'Vyttila-1' and 'Vyttila-3'	51
II	'Teena', CSRC collection, 'Nila'	3
III	'Chettivirippu', 'Karthika'	2
IV	'Remya', 'Chuvannari Thavalakannan'	2
V	'Thekken'	1
VI	'Aryankali'	1

(3.50). The varieties grouped under cluster II were, however, intermediate in this respect. Likewise, for parboiled rice, cluster V showed the highest mean scores for appearance (4.30) and colour (4.35), while cluster II exhibited the highest scores for texture (3.73) and taste (3.71) implying that clusters V and II were superior to the rest. Furthermore, clusters X and VIII recorded the lowest scores for flavour (1.50) and texture (2.40) respectively.

Average intra- and inter-cluster distances for raw and parboiled rice are presented in Table 6 and 7 respectively. For raw rice, the maximum intra cluster distance was observed in cluster I (4.34) followed by clusters III (1.20), II (1.16) and IV (1.03). Minimum divergence in raw rice was observed for clusters II with IV (1.19), followed by clusters I with V, II with I, III with I, VI with III and II. For parboiled rice varieties also, the intra cluster distance was maximum for cluster I (3.47) followed by clusters II (1.24) and VI (1.07).

Table 3. Clustering pattern for parboiled rice

Clusters	Varieties	Count
I	'Chettivirippu', 'Aranmula local', 'Jyothi', 'Matta Triveni', 'Asha', 'Bhadra', 'Karthika', 'Kanakom', 'Aryankali', 'Dhanya', 'Lakshmi', 'Bhagya', 'Teena', 'Pavizhachembavu', 'Chitteni', 'Kattamodan', 'Swarnaprabha', 'Swarnamodan', 'Nila', 'Aryan', 'Vadakken chitteni', 'Thekken', 'Chenkayama', 'Co-25', 'Jayathi', 'Neeraja', 'Thrissur local-1', 'Thrissur local 2', 'Ponnaryan', 'Cheriyar Aryan', 'Aruvakkari', 'Mashuri', 'Annappooran', 'Triveni', 'Reshmi', 'Hraswa', 'Kutticheradi', 'Sinduram', 'Veluthari Thavalakannan', 'Chuvannari Thavalakannan', 'Thekkencheera'	41
II	'Chuvannamodan', 'Elappapoochemban', 'Aruna', 'Remya', 'Vyttila-1', 'Pavizham', 'Vyttila-3'	7
III	'Navara', 'Makom'	2
IV	'Sabari', 'Jaya'	2
V	'Veluthavattan', 'Onam'	2
VI	'Kuruwa', 'Kavunginpoothala'	2
VII	'Vellari'	1
VIII	'Bharathy'	1
IX	'Sagara'	1
X	CSRC collection	1

Table 4. Cluster means of quality attributes of raw rice (scores)

Quality attributes	Clusters					
	I	II	III	IV	V	VI
Appearance	3.41	2.63	3.40	1.95	3.00	2.10
Colour	3.42	2.50	3.35	2.00	4.00	2.00
Flavour	3.19	3.17	2.40	2.75	3.80	1.40
Texture	3.18	2.77	3.75	2.15	3.75	2.60
Taste	3.36	2.93	3.05	2.30	3.50	2.00

Table 6. Average intra-inter cluster distance for raw rice

	I	II	III	IV	V	VI
I	4.34	1.59	1.63	2.13	1.58	2.33
II		1.16	2.16	1.19	1.70	2.05
III			1.20	2.57	2.06	1.73
IV				1.03	2.35	1.91
V					0.00	2.77
VI						0.00

Diagonal values are intra cluster distances

Table 5. Cluster means of quality attributes of parboiled rice (scores)

Quality attributes	Clusters									
	I	II	III	IV	V	VI	VII	VIII	IX	X
Appearance	3.33	4.24	2.65	3.00	4.30	2.50	3.00	2.50	2.50	2.80
Colour	3.55	3.99	2.70	2.90	4.35	2.75	2.80	2.80	3.20	2.80
Flavour	3.52	3.79	3.40	2.80	3.60	2.60	3.80	2.60	3.10	1.50
Texture	3.23	3.73	2.95	3.50	2.85	2.40	2.50	2.40	3.50	2.90
Taste	3.30	3.71	3.15	2.70	3.45	2.05	3.10	3.00	3.50	2.10

Table 7. Average intra-inter cluster distances for parboiled rice

Quality attributes	I	II	III	IV	V	VI	VII	VIII	IX	X
I	3.47	1.34	1.21	1.46	1.73	1.68	1.36	1.37	1.30	2.28
II		1.24	1.86	1.71	1.40	2.19	1.81	2.11	1.99	2.55
III			0.39	1.52	2.21	1.57	1.09	1.24	1.30	2.40
IV				0.57	2.38	1.35	1.99	1.73	1.46	1.42
V					1.04	2.26	1.92	2.08	2.43	2.79
VI						1.07	1.75	1.38	1.75	1.63
VII							0.00	1.49	1.93	2.87
VIII								0.00	1.24	1.95
IX									0.00	2.13
X										0.00

Diagonal values are intra cluster distances

High intra cluster distance for a cluster suggests a high degree of variability for quality attributes. In the present study, for both raw and parboiled rice, cluster I showed the maximum intra cluster distance demonstrating such an effect. Obviously, cluster I, which had 41 to 51 different entries, had the highest variability for all quality parameters. In conclusion, the results of D^2 analysis based on organoleptic qualities revealed that among the 60 varieties tested, thirty-five varieties were homogeneous with respect to quality attributes such as appearance, colour, flavour, texture and taste for the preparation of cooked rice. Furthermore, there was no distinctive pattern separating

the improved and the traditional cultivars in this respect.

Acknowledgements

This paper forms part of the PhD thesis submitted by the first author to the Kerala Agricultural University, Thrissur, India.

Reference

Rao, C.R. 1952. *Advanced Statistical Methods in Biometric Research*. John Wiley Sons, New York, 390p