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Correlation Studies on Grain Physicochemical Characteristics of Aromatic Rice

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Abstract: Simple correlation was worked out based on the mean values obtained from tested 16 aromatic rice varieties to determine the extent and strength of the possible pairs of 13 quality characters. Correlation studies revealed that kernel length had highly significant positive correlation with length/breadth ratio and kernel length after cooking and significant positive correlation with gel consistency. Length/breadth ratio showed significant to highly significant positive correlation with gel consistency, protein content, water uptake ratio and kernel length after cooking. Head rice showed significant positive correlation with milled rice, kernel breadth and gel consistency. Gel consistency showed highly significant positive correlation with gelatinization temperature while it showed highly significant negative correlation with amylose content. Expanded volume showed highly significant positive correlation with amylose content, elongation ratio and water uptake ratio. The strong and significant positive correlation of kernel length, length/breadth ratio, head rice, gel consistency and expanded volume with different quality characters indicated that these are prime grain quality characters for improvement of genotypes.

Key words: Aromatic rice, physicochemical characteristics, correlation

Introduction

Grain quality, along with crop yield and resistance to pest and diseases, is an important criteria in most rice breeding programs. It has always been an important consideration in rice variety selection and development (Singh *et al*., 2000). The physicochemical characteristics of rice grains are important indicators of grain quality. It is mainly determined by the combinations of many physical as well as chemical characters. The physical quality characters include kernel size, shape, hulling, milling and head rice recovery. The chemical quality is mainly determined by amylose content, gelatinization temperature, gel consistency and cooking behaviour.

Cooking quality is an important character that determines consumers preference. These properties determine the cooked rice texture. Surveys show that consumer acceptance of a variety depends primarily on its cooking and eating quality (Juliano *et al*., 1964). High volume expansion and length-wise expansion of kernel during cooking are more desirable traits of good quality rice like Basmati rice. These rices fetch at high prices in the domestic and international markets. Rices with soft to medium gel consistency, intermediate amylose content and intermediate gelatinization temperature is a preferred level for the consumers (Khush *et al*., 1979).

In the development of improved breeding lines having superior quality, the correlation between the grain quality characters is useful in the choice of parents, screening and selection procedures for the segregation populations. Hence, an attempt was made to unravel the correlation of quality characters of the aromatic rice varieties from germplasm collection.

Materials and Methods

The experimental materials consisted of sixteen aromatic rice varieties from the Central Luzon State University germplasm collection. The varieties were: Azucena, Milagrosa, Sigadis Milagrosa, Milfor 6, GRB 1570, IR 841, Thailand aromatic, Dinorado, Basmati 370, Kasturi, Sabarmati, Basmati 385, Super Basmati, Della, KDML 105 and Lawangin. All the materials were grown at the experimental field of the Research, Extension and Training, Central Luzon State University, Philippines during the wet season of 2001. Twenty five day old seedlings of each variety were transplanted using 2-3 seedlings/hill in 2-row plots, 5 m long, at a spacing of 25 cm between rows and 20 cm between plants. Plots were assigned a randomized complete block design. Normal cultural and manurial practices were followed. The grains harvested from each plot were cleaned, processed and dried. These grains were utilized for recording quality characteristics viz., kernel length, kernel breadth, length/breadth ratio, milled rice, head rice, amylose content, gelatinization temperature, gel consistency, protein content, water uptake ratio, expanded volume, kernel length after cooking and elongation ratio. The measurement of quality characters such as kernel length, kernel breadth, length/breadth ratio, milled rice, head rice, amylose

content, gelatinization temperature, gel consistency and protein content were taken as per the method described by Anonymous (1999). Water uptake ratio and expanded volume were determined following the Batcher's method as outlined by Ohtsubo (1995). Kernel length after cooking and elongation ratio were determined using the procedure described by Cruz and Khush (2000). Correlation coefficient analysis was computed following the standard statistical procedures using IRRISTAT program Version 3.1.

Results and Discussion

Physical and milling characteristics: Kernel length exhibited a highly significant positive correlation with length/breadth ratio (r= 0.79). This was similar to the result reported by Chauhan *et al.* (1987) Deosarkar and Nerkar (1994) and Christopher *et al.* (1999). On the other hand, kernel breadth showed highly significant but negative association with length/breadth ratio (r= - 0.76). Similar association was reported by Sood and Siddiq (1980), Deosarkar and Nerkar (1994) and Christopher *et al.* (1999). Head rice showed highly significant positive association with milled rice (r= 0.72).

Chemical characteristics: Result indicated that there was highly significant and negative correlation between amylose content and gel consistency (r= -0.90). The close and negative correlation found between amylose content and gel consistency agreed with the results of Chang and Li (1981), Zhang and Tang (1981), Hsieh and Kuo (1982) and Tang *et al.* (1989). Result also showed highly significant negative correlation between amylose content and gelatinization temperature (r= -0.60) which was also supported by Tang *et al.* (1989) and Singh *et al.* (1997). The highly significant negative correlation between AC and GC indicated that simultaneous improvement of these two quality traits can be made with the selection of either one but not both of them. Similarly also with AC and GT. A highly significant positive association was observed between GC and GT (r= 0.47). On the other hand, protein content failed to disclose any significant association with amylose content, gelatinization temperature and gel consistency.

Cooking characteristics: There was highly significant and positive correlation between water uptake ratio and expanded volume (r= 0.87) (Table 1). This result is in confirmation with the findings of Tomar and Nanda (1982) and Deosarkar and Nerkar (1994). On the other hand, water uptake ratio (r= 0.52) and expanded volume (r= 0.61) had highly significant and positive association with elongation ratio. Sood and Siddiq (1986) also reported that water uptake ratio showed positive and significant correlation with kernel elongation.

Inter correlation among all quality characteristics: Elongation ratio showed highly significant positive association with amylose content (r= 0.53) while significant to highly significant negative association with gelatinization temperature (r = -0.33), milled rice (r= - 0.35) and gel consistency (r= -0.52), respectively.

Kernel length after cooking had highly significant positive association with kernel length (r= 0.85) and length/breadth ratio (r = 0.78) while it showed significant to highly significant negative association with kernel breadth, milled rice and head rice respectively (Table 1). However, it had no significant association with amylose content, gelatinization temperature, gel consistency, protein content, water uptake ratio, expanded volume and elongation ratio.

Amylose content directly affected the volume expansion during cooking (Juliano, 1979) that was supported by this study. Correlation studies showed that there was highly significant positive association between amylose content and expanded volume (r= 0.45). This indicated that as amylose content increases, the volume of expansion likewise increases. On the other hand, expanded volume had significant to highly significant negative association with head rice (r= - 0.32), gelatinization temperature (r= - 0.46) and milled rice (r= - 0.51).

Water uptake ratio was found to correlate with length/breadth ratio in positive direction while that of gelatinization temperature, milled rice and kernel breadth, in negative direction (Table 1).

Protein content showed strong correlation with length/breadth ratio (r= 0.34) while it showed strong negative association with head rice (r= -0.42), kernel breadth (r= -0.47) and milled rice (r= -0.54). On the other hand, kernel length had no association with protein content.

Gel consistency showed significant positive association with kernel length (r= 0.34), length/breadth ratio (r= 0.29) and head rice (r= 0.35) while gelatinization temperature showed no significant correlation among the physical and milling characteristics. Although amylose content showed significant to highly significant negative correlation with kernel length (r= -0.31) and head rice (r= -0.42), but it failed in any significant correlation with kernel breadth, length/breadth ratio and milled rice.

Head rice showed highly significant positive correlation with kernel breadth (r= 0.54) while it had significant to highly significant negative correlation with kernel length (r= - 0.31) and length/breadth ratio (r = - 0.55). The

Table 1: Correlation coefficients between pairs of 13 grain physicochemical characteristics of aromatic rices

Item	KB (mm)	L/B ratio	MR (%)	HR (%)	AC (%)	GT	GC (mm)	PC (%)	WUR	EV	KLAC (mm)	ER
KL (mm)	−0.21NS	0.79**	0.17NS	−0.31*	−0.31*	0.26NS	0.34*	0.07NS	−0.18NS	−0.13NS	0.85**	−0.28NS
KB (mm)		−0.76**	0.69**	0.54**	0.08NS**	0.0.8NS	−0.13NS	−0.47**	−0.76**	−0.56**	−0.31*	−0.18NS
L/B ratio			−0.54**	−0.55**	0.23NS	0.10NS	0.29*	0.34*	0.36*	0.27NS	0.78**	−0.05NS
MR (%)				0.72**	−0.18NS	0.04NS	0.10NS	−0.54**	−0.53**	−0.51**	−0.36*	−0.35*
HR (%)					−0.42**	0.07NS	0.35*	−0.42**	−0.28NS	−0.32*	−0.47**	−0.27NS
AC (%)						0.60**	−0.90**	−0.04NS	0.21NS	0.45**	−0.02NS	0.53**
GT							0.47**	0.09NS	−0.30*	−0.46**	0.09NS	−0.33*
GC (mm)								−0.02NS	−0.09NS	−0.27NS	0.06NS	−0.52**
PC(%)									0.15NS	0.05NS	0.13NS	0.10NS
WUR										0.87**	0.11NS	0.52**
EV											0.19NS	0.61**
KLAC (mm)												0.26NS

KB = Kernel length, KB = Kernel breadth, L/B = Length/ breadth ratio, MR = Milled rice, HR=Head rice, AC = Amylase content, GT = Gelatinization temperature, GC = Gel consistency, PC = Protein content, WUR = Water uptake ratio, EV = Expanded volume, KLAC = Kernel length after cooking, ER = Elongation ratio, ** = Significant at 1% level, * = Significant at 5% level, NS = Not significant

significant negative association between head rice and kernel length is supported the result of Wenchao *et al.* (1992).

Milled rice showed highly significant positive correlation with kernel breadth (r= 0.69) and highly significant negative correlation with length/breadth ratio (r= −0.54). Head rice also showed significant to highly significant negative association with kernel length (r= − 0.55) and length/breadth ratio (r= − 0.55) while positive correlation with kernel breadth.

Based on the strong and positive correlation between all possible pairs of 13 quality characters, it was concluded that the characters such as kernel length, length/breadth ratio, head rice, gel consistency and expanded volume can be used as selection indices for the improvement in grain quality characteristics of aromatic rices.

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