International Journal of Agricultural Sciences
Volume **17** | AAEBSSD | 2021 | 133-137
ISSN : 0973-130X
DOI:10.15740/HAS/IJAS/17-AAEBSSD/133-137
Visit us : *www.researchjournal.co.in*

Research Paper

Glycemic index studies in rice (*Oryza sativa* L.) varieties developed by ANGRAU

S. Divya Prasanna Kumari[1], G. Nirmala Devi* **and** N. Chamundeswari[2]
Department of Food Science and Nutrition, College of Community Science, ANGRAU, Lam, Guntur (A.P.) India
(Email: nirmalalaxman2002@gmail.com)

Abstract : Twenty popular rice varieties developed by ANGRAU obtained from Regional Agricultural Research Station (RARS), Maruteru during *Kharif* – 2019, were screened for chemical quality traits *viz.*, gel consistency, gelatinization temperature, amylose along with glycemic index.In our study, significant variation was observed among all the varieties for chemical traits but no significant variation was observed in case of glycemic index.The amylose content observed over the varieties ranged from 21.7 per cent to 24.73 per cent. All the varieties have intermediate amylose content. Gel consistency ranged from 37.67 (hard gel) to 75 (soft gel) with the mean of 52.57. The alkali spreading value was noticed to be low, intermediate and high among all rice varieties.Glycemic index rangedfrom 56.72 -66.43 with a general mean of 60.67. Furthermore, all the varieties were categorized as medium GI varieties (56-69). Among all the varieties, Pushyami has shown the least value (56.72) for glycemic index.From the present investigation, it is concluded that, Rice varieties such as Chandra, Indra, Sri Dhruthi, Swarna, Samba Mahsuri, Sujatha, Maruteru Samba, MaruteruMahsuri recorded intermediate amylose, alkali spreading value and medium GI, which are desirable for rice consumers while counting for better rice with the best quality and glycemic index.

Key Words : Rice, Gel consistency, Gelatinization temperature, Amylose along with glycemic index

View Point Article : Divya Prasanna Kumari, S., Nirmala Devi, G. and Chamundeswari, N. (2021). Glycemic index studies in rice (*Oryza sativa* L.) varieties developed by ANGRAU.*Internat. J. agric. Sci.*, **17** (AAEBSSD) : 133-137, **DOI:10.15740/HAS/IJAS/17-AAEBSSD/133-137.** Copyright@2021: Hind Agri-Horticultural Society.

Article History : Received : 15.07.2021; **Revised :** 18.07.2021; **Accepted :** 23.07.2021

Introduction

Rice (*Oryza sativa* L.) has a unique position being a staple food crop for half of the world and Asia accounts for over 90 per cent of the world's production of rice, mainly in China, India and Indonesia. Among all the Asian countries, India is the prominent rice growing country accounting for about 20 per cent of all world rice production. In India, rice is grown in 44.7 per cent of the total cropped land and accounts for 70.3 per cent of the total food grain production in India (Madhubabu *et al.* 2020). Now-a-days, consumers are becoming extra conscious regarding the quality of the rice varieties they use. So, it is essential to focus on the quality characteristics along with the production of rice. The FAO/WHO report on carbohydrates in human nutrition provides the glycemic index (GI) idea for preferring the most suitable carbohydrate-containing foods for health maintenance, treatment and elimination of several disease states.

*** Author for correspondence :**
[1]Department of Food Science and Nutrition, APGC, ANGRAU, Lam, Guntur (A.P.) India (Email: dd1782811@gmail.com)
[2]Maize Research Centre, Agricultural Research Station, Vijayarai, West Godavari (A.P.) India (Email: narne_chamundeswari@rediffmail.com)

In contrast to the other cereal grains, rice possess higher glycemic index ranging from 54-121. Recognition of low GI (55 or less) rice varieties would be research studies priority due to the rice consumer's potential health advantages. Hence rice with a lower GI and improved nutritional quality might help avoid diet-related diseases. Despite being a higher glycemic index (GI), ranging from 54 to 121, rice is still used as staple food compared to other starchy food. Thus, rice with low GI should help avoid diet-related diseases (Wang *et al.,* 2017). Determining low glycemic index rice genotypes of high nutritional value from existing germplasm collection may be an efficient and reliable way to deliver benefits to farmers and society (Fitzgerald *et al.* 2011 and Jain *et al.*, 2012). Hence the present study was conducted to estimate the chemical quality traits and glycemic index of popular rice varieties developed by ANGR Agricultural University, Andhra Pradesh.

MATERIAL AND METHODS

The experiment material used for the study was 20 popular rice varieties which were collected from Regional Agricultural Research Station (RARS), Maruteru and West Godavari District. The salient features of genotypes are mentioned in Table A. After threshing and cleaning, the seed from individual varieties were dried under shade until moisture content reaches to 14%. A random sample

Table A : List of rice varieties

Sr.No.	Name of the variety	Grain yype
1.	Amara (MTU1064)	MS
2.	Badava Mahsuri (PLA 1100)	MS
3.	Bhavapuri Sannalu (BPT 2270)	MS
4.	Chandra (MTU 1153)	LS
5.	Cottondora Sannalu (MTU 1010)	LS
6.	Indra (MTU1061)	MS
7.	Ksheera (MTU 1172)	MS
8.	MaruteruMahsuri(MTU 1262)	MS
9.	Maruteru Samba (MTU 1224)	MS
10.	Nellore Mahsuri (NLR34449)	MS
11.	Pushyami (MTU1075)	LS
12.	Samba Mahsuri (BPT 5204)	MS
13.	Sravani (MTU 1239)	MS
14.	Sri Dhruthi (MTU 1121)	MS
15.	Srikakulam Sannalu (RGL2537)	LB
16.	Sujatha (MTU 1210)	MS
17.	Swarna (MTU 7029)	MS
18.	Tarangini (MTU 1156)	LB
19.	Varam (MTU 1190)	MS
20.	Vijetha (MTU 1001)	MS

Categorization of rice according to gel consistency

Gel length (mm)	Type of gel consistency
26 – 40	Hard
41 – 60	Medium
61 – 100	Soft

Alkali spreading scale

ASV score	Kernel spreading
1	Kernel not affected
2	Kernel swollen
3	Kernel swollen, collar incomplete and narrow
4	Kernel swollen, collar complete and wide
5	Kernel split or segmented, collar complete wide
6	Kernel dispersed, merging with collar
7	Kernel completely dispersed and intermingled

of 250 g paddy was subjected to dehusking using 'Satake' laboratory huller (Type THU 35A) followed by polishing the dehusked brown rice (0% polishing) at two levels *i.e* 5% and 10% polishing. A sample of 150 g of dehusked brown rice was subjected to polishing using 'Satake' rice polisher (Type TM05) for a period of 60 sec to get 5% polishing and 1min 25 sec for 10% polishing. The milled rice samples (0%, 5% and 10% polished samples) were ground to 100 mesh with a cyclotech grinder.Chemical quality traits viz., gel consistency (mm), alkali spreading value (gelatinization temperature) and amylose content (%) were estimated, The gel consistency test is based on the consistency of the rice paste and estimated as per Jennings *et al.* (1979). The alkali spreading of kernels noted on a 7 point scale following the protocol of Little *et al.,* (1958).

GI was performed following Goni *et al.* (1996) method and a detailed protocol is mentioned below.All the polished rice samples were dried in oven at 50°C till the weight became constant and were subjected to *in-vitro* GI analysis. Two grams of rice sample was taken into a 50 ml tube and 6ml of water was added. The sample was cooked for 20 minutes in boiling water bath after soaking for 10 minutes. The weight of cooked rice was determined by subtracting the weight of empty tube from weight of tube cooked rice.

Calculation:

$$\textbf{Hydrolysis index (HI) of the sample} = \frac{\textbf{Absorbance of test}}{\textbf{Absorbance of standard}} \textbf{x100}$$

Absorbance of standard= 0.934

The equation reported by Goni *et al.* (1997). It corrects the variation between *in vitro* and *in vivo* GI analysis.

Glycemic index (GI) = 39.71 + (0.549 × HI of the sample).

Classification of glycemic index	
Classification	GI range
Low	0-55
Medium	56-69
High	>70

RESULTS AND DISCUSSION

Analysis of variance has revealed a significant difference for all the attributes studied and among the varieties except for glycemic index. The mean performance of genotypes for the characters studied are presented in Table 1.

Amylose (%) :

Amylose determines the starch content of rice and this influences the physical appearance after cooking. The amylose content observed over the varieties ranged from 21.7 per cent to 24.73 per cent. In our study, all the varieties have intermediate amylose content. Grain amylose content significantly varied from 23 to 31per cent among varieties in the study conducted by Abeysekera *et al.* (2016). Shahidullah *et al.* (2009) reported that the amylose content in all rice grades ranged between 20.7 - 21.4 per cent. Due to low amylose content rice becomes moist and sticky when cooked. Amylose and amylopectin in kernels determine the texture of cooked rice and consumers prefer rice with intermediate amylose content.

Gel consistency (mm):

Gel consistency measures the tendency of the

Table 1: Mean performances of rice varieties for chemical quality traits and Glycemic index

Sr. No.	Name of the variety	Chemical traits			GI value
		AC (%)	GC (mm)	ASV	
1.	Amara (MTU1064)	21.93	68.33	6.07	59.97
2.	BhadavaMahsuri (PLA 1100)	22.43	65.00	5.70	59.87
3.	BadavapuriSannalu (BPT 2270)	23.10	75.00	7.00	60.56
4.	Chandra (MTU 1153)	22.97	68.67	4.13	60.46
5.	CottondoraSannalu (MTU 1010)	24.07	43.33	3.03	61.40
6.	Indra (MTU1061)	24.60	58.33	3.20	60.60
7.	Ksheera (MTU 1172)	23.47	37.67	5.03	58.68
8.	Nellore Mahsuri (NLR34449)	23.33	55.67	2.60	60.36
9.	Pushyami (MTU1075)	21.70	64.33	5.67	56.72
10.	Samba Mahsuri (BPT 5204)	24.73	48.00	4.17	56.78
11.	Sri Dhruthi (MTU 1121)	22.20	43.00	2.97	60.73
12.	Srikakulam Sannalu (RGL 2537)	23.17	56.00	5.60	66.43
13.	Swarna (MTU 7029)	23.53	46.33	2.90	60.93
14.	Tarangini (MTU 1156)	22.87	60.67	4.23	60.17
15.	Varam (MTU 1190)	22.33	38.33	4.70	60.93
16.	Vijetha (MTU 1001)	23.77	40.00	6.13	61.40
17.	Sujatha (MTU 1210)	23.93	45.00	4.03	60.52
18.	Maruteru Samba (MTU 1224)	23.90	40.67	4.97	60.30
19.	Sravani (MTU 1239)	24.17	42.67	5.10	62.30
20.	MaruteruMahsuri(MTU 1262)	22.67	54.33	4.93	64.34
	Mean	23.24	52.57	4.61	60.67
	SD	0.86	11.57	1.24	0.49
	SE	0.19	2.59	0.28	3.53
	CV	3.70	22.00	26.90	4.88
	Lowest Range	21.70	37.67	2.60	56.72
	Highest Range	24.73	75.00	7.00	66.43

cooked rice to harden on cooling. The gel consistency is related to the eating quality of rice. The higher the gel, the harder the rice (Kanlayakrit and Maweang, 2013). The gel consistency (GC) was measured into soft, medium and hard.

The rice samples GC ranged from 37.67 – 75 mm and was categorized as soft (75 mm); this means the tendency of cooked rice to be soft on cooling. This trait showed a significant variation and ranged from 37.67 (hard gel) to 75 (soft gel) with the mean in 52.57. The highest gel consistency was depicted by Bhavapuri Sannalu (BPT 2270) (75mm), while the lower GC was observed in Ksheera (37.67 mm), followed by Varam (MTU 1190) (38.33) and Vijetha (MTU 1001) (40 mm). All the pre-released varieties were considered as medium gel consistency (41-60mm) varieties and eight released varieties, Cottondora Sannalu (MTU 1010) (48.33mm), Indra (MTU 1061) (58.33mm), Nellore Mahsuri (NLR 34449) (55.67mm), Samba Mahsuri (BPT 5204) (48mm), Sri Dhruthi (MTU 1121) (43mm), Srikakulam Sannalu (RGL 2537) (56mm), Swarna (MTU 7029) and Vijetha (MTU 1001) were classified as medium gel consistency varieties.

Alkali spreading value (ASV):

The alkali spreading value was noticed to be low, intermediate to high among all rice varieties. The overall mean was 4.61, with a variation of 2.6 to 7. The highest ASV value of 7 was observed in BhavapuriSannalu, followed by Vijetha with 6.13, whereas the lowest value was observed in Nellore Mahsuri (2.6). The intermediate ASV indicated medium disintegration and classified as intermediate gelatinization temperature, which is highly desirable for quality grain (Bansal *et al.,*2006; Madhubabu *et al.,* 2017).

Glycemic index:

The range of glycemic index was 56.72-66.43 with a general mean of 60.67 for all the 20 rice varieties as shown in Table 1. The highest mean value was observed in released variety Srikakulam Sannalu (66.43), followed by Vijetha and CottondoraSannalu (61.4) and the least was recorded in Pushyami (56.72) followed by Samba Mahsuri (56.78). Among pre-released varieties, MTU 1262 variety showed a higher GI (64.34) value and the least was noted in MTU 1224 (60.3). Categorization of glycemic index as given by Goni*et al.* (1997), all varieties analyzed were classified as medium GI (56-69), which was identical to the report of Lai *et al.* (2016), where most of the varieties were categorized as medium GI varieties. In the study of Fernandes *et al.* (2019), three different Carolino rice varieties were subjected to *in vitro* digestion protocol to evaluate starch hydrolysis and subsequent glycemic index (GI) determination starch granules morphological study. In terms of GI, all samples can be categorized as medium GI foods since they exhibit a GI between 55 and 70.

The results obtained in the investigation of Dutt *et al.* (2019) presented the highest GI in the sample PSi and HBPS (GI ~ 46 ± 0.35 and 45.7 ± 1.1 respectively), whereas the lowest in samples NB (41.6 ± 0.28), WSD (41.9 ± 0.64), GS (41.6 ± 0.35) and PSA (41 ± 0.49). Nevertheless, all rice varieties studied fell under the low GI category. The expected *in vitro*glycemic index (GI)

Table 2 : Analysis of variance for chemical quality traits

Source	Chemical traits				
	SS	Df	MSS	F	P-Value
Variety	2603.28	19	137.01	32.56	<0.05
Chemical traits	70142.46	2	35071.23	8334.97	<0.05
Variety * Chemical traits	5156.68	38	135.70	32.25	<0.05
Error	504.93	120	4.21		
Corrected Total	78407.34	179			

Table 3 : Analysis of variance for glycemic index

Source of variation	SS	Df	MS	F	P-value	F crit
Treatments	260.96	19	13.73	1.57	0.11	1.85
Error	349.32	40	13.73			
Total	610.28	59				

MSS – Mean sum of squares, SS- Sum of squres, df – Degrees of freedom of all analysed six high amylose rice varieties differing in length/width ratio was similar (88.2–92.4) and the varieties are grouped as high glycemic index in the study of Gunaratne *et al.* (2020). According to the variance analysis results, there is no significant difference (p = 0.11) as shown in Table 3 between all the varieties regarding glycemic index.

From the present investigation, it is concluded that, Rice varieties such as Chandra, Indra, Sri Dhruthi, Swarna, Samba Mahsuri, Sujatha, Maruteru Samba, MaruteruMahsuri recorded intermediate amylose, alkali spreading value and medium GI, which are desirable for rice consumers while counting for better rice with the best quality and glycemic index.

REFERENCES

Abeysekera, W. K. S. M., Premakumara, G. A. S., Bentota, A. P., Abeysiriwardena, D. S. and de, Z. (2016). Grain amylose Content and its Stability over Seasons in a Selected Set of Rice Varieties Grown in Sri Lanka. *The Journal of Agricultural Sciences*, **12** : 43-50.

Bansal, U. K., Kaur, H. and Saini R. G. (2006). Donors for quality characteristics in aromatic rice. *Oryza*, **43**(3):197-202.

Dutt, P., Hasan, M., Shaquzzaman, M. and Panda, B. P. (2019). Quality assessment of Indian rice varieties, evaluation of its relationship with their Glycemic index, *Food Measure.* **13** : 2389–2397.

Fernandes, J. M., Madalena, D. A., Pinheiro, A. C and Vicente, A. A. (2019). Rice in vitro digestion: application of INFOGEST harmonized protocol for glycemic index determination and starch morphological study. *Journal of Food Science and Technology*,1-12.

Fitzgerald, M. A., Rahman, S., Resurreccion, A. P., Concepcion, J., Daygon, V. D., Dipti, S. S., Kabir, K. A., Klingner, B., Morell, M. K and Bird, A. R. (2011). Identification of a Major Genetic Determinant of Glycaemic Index in Rice, *Rice*, **4** : 66–74.

Goñi, I., Garcia-Alonso, A and Saura-Calixto, F. (1997). A starch hydrolysis procedure to estimate glycemic index. *Nutrition Research,* **17** (3): 427–437.

Goñi, I., García-Diz, L., Mañas, E and Saura-Calixto, F. (1996). Analysis of resistant starch: a method for foods and food products. *Food Chemistry*, **56** (4): 445–449.

Gunaratne, A., Wu, K., Kong, X., Gan, R.Y., Sui, Z., Kumara, K., Ratnayake, U.K., Senarathne, K., Kasapis, S. and Corke, H. (2020). Physicochemical properties, digestibility and expected glycaemic index of high amylose rice differing in lengthwidth ratio in Sri Lanka. *International Journal of Food Science and Technology,* **55**: 74-81.

Jain, A., Rao, S. M and Sethi, S. (2012). Effect of cooking on amylose content of rice. *European Journal of Experimental Biology*, **2** : 385-388.

Jennings, P. R., Coffman, W. R and Kauffman, H. E. (1979). Amylose Gel Consistency. *Rice Improvement*, **6** : 111-112.

Kanlayakrit, W and Maweang, M. (2013). Postharvest of paddy and milled rice affected physicochemical properties using different storage conditions. *International Food Research Journal,* **20** (3): 1359-1366.

Lai, M. H., Liu, K. L., Chen, P. Y., Ke, N. J., Chen, J. J., Sung, J. M., Wu, Y. L and Lin, S. D. (2016). Predicted Glycemic Index and Glycemic Index of Rice Varieties Grown in Taiwan. *Cereal Chemistry,* **93** (2): 150–155.

Little, R. R., Hilder, G. B and Dawson, E. H. (1958). Differential effect of dilute alkali on 25 varieties of milled white rice. *Cereal Chemistry,* **35**: 111-126.

Madhubabu, P., Surendra, R., Suman, K., Chiranjeevi, M., Abdul Fiyaz, R., Sanjeeva Rao, D., Chaitanya, U., Subba Rao, L. V., Ravindra Babu, V and Neeraja, C. N. (2020). Assessment of genetic variability for micronutrient content and agromorphological traits in rice (*Oryza sativa* L.). *Indian Journal of Genetics,* **80** (2) 130-139.

Madhubabu, P., Suman, K., Rathod, R. R., Abdul-Fiyaz, D., Sanjeeva Rao, Sudhakar, P., Satya, A. K., Babu, V. R and Neeraja, C. N. (2017). Evaluation of Grain Yield, Quality and Nutrients Content in Four Rice (*Oryza sativa* L.) Genotypes. *Current Journal of Applied Science and Technology,* **22** (1): 1-12.

Shahidullah, S. M., Hanafi, M. M., Ashrafuzzaman, M., Ismail, M. R and Khair, A. (2009). Genetic diversity in grain quality and nutrition of aromatic rices. *African Journal of Biotechnology*, **8** (7): 1238-1246.

Wang, S., Li, P., Zhang, T., Yu, J., Wang, S and Copeland, L. (2017). *In vitro* starch digestibility of rice flour is not affected by method of cooking. *LWT- Food Science and Technology*, **84** : 536–543.

17th Year
★ ★ ★ ★ ★ of Excellence ★ ★ ★ ★ ★