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Assessment of grain quality charactistics in the selected newly released rice varieties of central Telenagana zone

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Abstract
India is one of the world's largest producers of white rice and brown rice, accounting for 20% of the world total rice production. Rice is the most important food crop of India covering about 1/4th of the total cropped area and providing food to about half of the Indian population and it is a great source of complex carbohydrates, which is an important source of the fuel to our body needs Nutritional value of rice is mainly determined by the milled rice protein content. The present study was taken up to study the grain quality charactistics viz. milling, functional and oraganoleptic of two NRRVs (Siddi and Sheetal) of CTZ and results found significant difference($p<0.01$) in husked rice, gelatinization temperature and organoleptic properties between Sheetal and Siddi, whereas no significant difference was found in sensory properties between Sheetal and Siddi rice varieties

Keywords: rice, sheetal (wgl283), siddi(wgl44), central telangana zone (ctz), newly released rice varieties (nrrvs) milling, functional, organoleptic

Introduction
Rice is the most important food crop of India covering about 1/4th of the total cropped area and providing food to about half of the Indian population. India is one of the world's largest producers of white rice and brown rice, accounting for 20% of the world total rice production. Rice (Oryza sativa L.) is a plant belonging to the family of grasses i.e. Gramineae (Poaceae). It is one of the three major food crops of the world and forms the staple diet of about half of the world's population.

Rice contributes to about 60–70% of total calories and one-third of daily protein requirement, and is a great source of complex carbohydrates, which is an important source of the fuel to our body needs. Nutritional value of rice is mainly determined by the milled rice protein content. Therefore, quality assessment includes both the physical and chemical characteristics. The percent of brown rice removed as bran or degree of milling affects the level of recovery and influences consumer acceptance. Grain appearance is largely determined by the endosperm opacity and this is commonly classified as the amount of chalkiness. Excessive chalkiness downgrades the quality and reduces milling recovery. Cooking quality of grains directly correlates with the Gelatinization Temperature, a low GT favours fuel conservation, provided cooking quality is not adversely affected. GT also affects the molecular properties of amylopectin. Hence the present study was taken to study the grain quality characteristics of newly released rice varieties of CTZ

Review of Literature
Xinghua Lu *et al.*, (2007) [27] stated that Brown rice recovery, milled rice recovery and head milled rice recovery are the three essential parameters of milling quality.

Rice grain quality is determined by its physical and physico-chemical properties. Physical properties include kernel size, shape, milling recovery, degree of milling and grain appearance (Cruz & Khush, 2000) [7]. Physical quality has a great importance in commercial rice production as it highly influences the final output as well as the consumer demand which directly contribute to the economic profitability of the grower and miller.

Priyadarsini and Prasad (2003) [18] studied the application of various nitrogen sources on different rice varieties. It was found that grain quality characteristics like head rice recovery,

grain length and breadth, protein content and amylose content were the highest in BPT-5204 variety. The results of the integrated use of 50% nitrogen through inorganic source (urea) and organic sources (FYM+ Green manure) showed significant superiority in yield and N- uptake by NLR-145 over the other varieties studied.

Chemical properties of rice such as amylose content, alkali spreading value, gel consistency and protein content are important characteristics to determine eating quality (Shobha *et al.,* 2008, Lihong *et al.,* 2008) [21, 15].

Samina *et al.,* (2012) [20] reported that the eating and cooking properties are affected by the starch, and protein interaction. They reported that only structural changes occur rather than the change in the starch and protein interaction. An increase in gelatinization temperature has been observed with the decrease in alkali spreading value of rice starch.

The rice consuming countries like India, long grain with intermediate amylose and gelatinization temperature is preferred since it becomes soft and fluffy after cooking (Hossain *et al.,* 2009) [10].

Nandini *et al.,* (2004) [17] evaluated sixty rice cultivars for their organoleptic qualities. Divergence of samples was measured by Mahalanobis D2 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 D2 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.

Material and Methods

Two newly relased rice varities Siddi (WGL44) and Sheetal (WGL283) were selected and seed were procured from the Krishi Vigyan Kendra, Wyra, Khammam Dit. For assessment of various quality characteristics. The paddy samples collected were stored in jute bags and kept at room temperature till further analysis.

Milling quality characteristics of paddy such as husked rice percentage, head rice percentage, broken rice percentage and milling recovery percentage were analyzed as per the standard procedures of Sahay and Singh (2005) [19].

The functional properties such as pasting property [AACC (2000)] [2], gel consistency [Cagampang et al. (1973)] [6] and alkali spreading value [Little *et al.* (1958)] [16] of samples were analysed using standard procedures

Oraganoleptic properties such as cooking time, cooking weight, and cooking loss was determined by AACC, (1995) [1] method.

Sensory properties were evaluated using 5-point hedonic scale (Amerine *et al*. 1965) [4].

All the results were statistically analysed to test the significance of the results using percentages, means, standard deviations and analysis of variance (ANOVA) technique. (Snedecor and Cochran 1983) [22], correlation and student t-test.

Results and Discussion

I. Milling properties

Mean milling quality score of NRRVs

The difference in milling quality characteristics between newly released paddy varieties and check variety is given in table 1. When the mean milling quality scores of Siddi (WGL44) and Sheetal (WGL283) were compared, it was found that there was significant difference ($p<0.01$) for husked rice percentage between Siddi and Sheetal and there was no significant difference in head rice, broken rice and milling recovery percentage. While milling quality of NRRVs compared with check variety BPT5204 a significant difference ($p<0.01$) was found only for husked rice and there was no significant difference in other milling qualities like head rice, broken rice and milling recovery percentage between check variety BPT5204 and NRRVs. However, milling quality scores of Siddi and BPT5204, Sheetal and BPT5204 were compared, it found significant ($p<0.01$) difference in husked rice percentage in Siddi variety and no significant difference was found in head rice, broken rice and milling recovery percentage in Siddi and Sheetal.

Yield of head rice vary depending on several factors such as variety, grain type, chalkiness, cultural practice, drying, storing and milling conditions. (Wasserman and Calderwood, 1972; Witte, 1972; Adair *et al.*1973) [25, 26, 3].

Juliano (1990) [12] reported that milling yield and head rice recovery are the most important criteria of rice quality especially from marketing point of view. Rice contains 98 percent head rice has consistent demand in the international market.

Milling of paddy is the major operation in paddy processing. It removes husk and outer layer of bran to produce acceptable white rice with minimum breakage and impurities (Sahay *et al*., 2005) [19].

The greater the amount of chalkiness in the grain, the more it is prone to grain breakage during milling, resulting in lower head rice yield (Khush *et al*, 1979) [14]. In present study more chalkiness in the grains was observed in NRRV Sheetal (WGL283) and check variety (BPT5204).

Head rice recovery (HRR) is the proportion of whole grains in milled rice. It varies depending on the variety, grain type, cultural practices and drying conditions (Asish *et al*., 2006) [5]. More emphasis should be given to head rice recovery than to total rice yield, since it is more important commercially and it is easier to improve (Jenning *et al.,* 1979) [11]. HRR% is a heritable trait although environmental factors and postharvest handling are known to break the grain during milling (Fan *et al*., 2000) [8].

Table 1: Mean milling quality score of NRRVs

Rice varieties	Husked rice%	Head rice%	Broken rice%	Milling recovery%
NRRVs				
Siddi (WGL44)	55.00 ± 7.9	63.30 ± 13.8	36.67 ± 13.8	54.28 ± 6.4
Sheetal(WGL283)	73.57 ± 6.3	53.68 ± 9.2	46.31 ± 9.2	59.85 ± 5.9
t-value	4.86*	1.53 ^{NS}	1.53 ^{NS}	1.67 ^{NS}
Check variety				
BPT 5204	78.53 ± 6.9	53.15 ± 4.8	46.85 ± 4.8	61.69 ± 17.2
F value	21.49**	2.299 ^{NS}	2.331 ^{NS}	0.857 ^{NS}
t-value (Siddi vs BPT5204)	5.68**	1.8^{NS}	1.84 ^{NS}	1.068 ^{NS}
t-value (Sheetal vs BPT5204)	1.404 ^{NS}	0.13 ^{NS}	0.137 ^{NS}	0.26 ^{NS}

Values are expressed as mean values; *Significant ($p<0.05$); **Significant ($p<0.01$); NS- No significant

II. Functional quality characteristics

The functional quality characteristics of NRRVs is given in table 2. The mean difference in functional properties of NRRVs and check variety BPT5204 is presented in table 3.

Pasting property of newly released rice varieties

Table 2: Pasting properties of newly released rice varieties Siddi and Sheetal

Rice varieties	Pasting temperature	Peak time	Peak viscosity	Trough	Break down	Final viscosity
Siddi (WGL44)	81.20±0.11	6.84±0.01	269.56±1.52	198±2.00	62.53±0.21	455.23±1.53
Sheetal (WGL283)	83.43±0.15	6.91±0.15	276.67±0.58	201±1.00	68.20±0.10	462.33±0.58
t value	31.70**	1.23^{NS}	11.6**	3.54**	64.4**	11.48**

Values are expressed as mean values; *Significant (p<0.05); **Significant (p<0.01); NS- No significant

The pasting properties of newly released rice varieties is given in table 2. The pasting temperature, peak viscosity, through and break down properties between Siddi and Sheetal found 1% significant difference. However, no significant difference was found in peak time between Siddi and Sheetal varieties.

The pasting properties of newly released rice varieties compared with check variety is given in table3. The results indicated properties like peak temperature, peak time, peak viscosity, break down and final viscosity showed 1% level of significant difference except trough of NRRVs compared with check variety BPT5204 as well as Siddi vs BPT5204. While Sheetal vs BPT5204 showed significant difference (p<0.01) in all pasting properties.

Table 3: Pasting properties of NRRVs with check variety BPT5204

Rice varieties	Pasting temp	Peak time	Peak viscosity	Trough	Break down	Final viscosity
Siddi (WGL44)	81.20±0.11	6.84±0.01	269.56±1.52	198.00±2.00	62.53±0.21	455.23±1.53
Sheetal (WGL283)	83.43±0.15	6.91±0.15	276.67±0.58	201±1.00	68.20±0.10	462.33±0.58
BPT5204	80.15±0.16	5.99±0.05	279±0.32	199±1.00	65.37±0.25	459±1.32
Fvalue	29.07**	56.73**	80.25**	3.5 ^{NS}	27.05**	25.69**
t-value (Siddi.vs. BPT5204)	14.3**	44.1**	16.07**	0.94^{NS}	23.0**	5.23**
t-value (Sheetal vs BPT5204)	39.2**	15.3**	11.9**	3.74**	28.4**	5.5**

Values are expressed as mean values; *Significant (p<0.05); **Significant (p<0.01); NS- No significant

Gel consistency, gelatinization temperature and alkali spreading value of newly released rice varieties

The mean difference in functional properties of gel consistency, gelatinization temperature and alkali spreading value of newly released rice varieties of NRRVs and check variety BPT5204 is presented in table 4 and 5

Table 4: Gel consistency, gelatinization temperature and alkali spreading of Siddi and Sheetal rice varieties with check variety BPT5204

Rice varieties	Gel consistency (mm)	Gelatinization Temperature	Alkali Spreading Value
BPT5204	5.9	High >74° C	1-2 Low
Siddi (WGL44)	9.8	Low (55° C-69° C)	5 All grains dispersed & inter mingled
Sheetal (WGL283)	5.8	High >74° C	6 Kernel chalky, collar powdery
f ratio	116.67**	88**	66.67**
t-value (Siddi vs BPT5204)	3.87**	2.07*	0.879^{NS}
t-value (Sheetal vs BPT5204)	0.926 ^{NS}	0 ^{NS}	0.32 ^{NS}

Values are expressed as mean values; *Significant (p<0.05); **Significant (p<0.01); NS- No significant

The gel consistency and alkali spreading value of NRRVs i.e. Siddi and Sheetal compared with check variety BPT5204 found 1% level of significant difference. Gelatinization temperature between NRRVs and check variety BPT5204 rice varieties were showed 1% significant difference. The Sheetal variety had maximum gelatinization temperature and Siddi variety had minimum gelatinization temperature. Significant difference (p<0.01) in gel consistency and gelatinization temperature (p<0.05) was found in Siddi vs BPT5204 and there was no significant difference was found in gel consistency and GT of Sheetal compared with BPT5204.

According to the classification given by Little *et al.* (1958) [16] alkali spreading value in relation to the gelatinization temperature was high i.e. > 74 ° C for Siddi and BPT 5204 rice varieties.

Gelatinization temperature (GT) is a physical property of the rice starch and refers to the range of temperature within which starch granules start swelling irreversibly in hot water. In other words, GT determines the time taken to cook the rice. The quality and quantity of starch in rice endosperm together with GT strongly influence the cooking quality of rice (Ghosh and Govindswamy, 1997) [9] such as water uptake, volume expansion and linear kernel elongation (Tomar and Nanda, 1985) [24].

If water absorption into the kernels is insufficient, the starch located in the central part of the kernel may not become fully gelatinized during cooking, resulting in hard texture (Kainuma and Seki 1982) [13].

The results of the present investigation are also in accordance with the results reported in the above study for Siddi and BPT5204 rice varieties.

Table 5: Gel consistency and Alkali Spreading value of Siddi and Sheetal rice varieties

Rice varieties	Gel consistency (mm)	Gelatinization Temperature	Alkali Spreading Value
Siddi (WGL44)	9.8	Low (55° C-69° C)	5 All grains dispersed & inter mingled
Sheetal (WGL283)	5.8	High >74° C	6 Kernel chalky, collar powdery
t-value	14.76**	21.68**	19.03**

Values are expressed as mean values; *Significant (p<0.05); **Significant (p<0.01); NS- No significant

The functional properties of NRRVs are compared in table 5. The functional properties like gel consistency, gelatinization temperature and alkali spreading value between the Siddi and Sheetal varieties found 1% significant difference.

III. Organoleptic and sensory quality characteristics

The mean scores of organoleptic quality characteristics of NRRVs and BPT5204 variety is presented in table 6 and 7.

Organoleptic quality characteristics of newly released rice varieties

The table 6. represents the mean difference in organoleptic properties of the NRRVs and check variety BPT5204. The results revealed that there was no difference in weight of raw rice, rice to water quantity ratio and cooking time between the NRRVs and check variety BPT5204. A significant difference at 1 %level was found between NRRVs and check variety BPT5204 in weight of cooked rice. The cooked weight was higher in Sheetal (214gms) when compared to Siddi (195gms) and check variety BPT5204 (207gms). The cooking loss was more in Sheetal (0.69gms) than Siddi(0.64gms) and BPT5204(0.61gms), showing a significant difference ($p<0.01$). Whereas no significant difference was found in mean elongation ratio between NRRVs compared to Check variety. While there was no significant difference was found in all organoleptic properties of Siddi and Sheetal varieties compared with BPT5204.

Table 6: Organoleptic properties of newly released rice varieties Siddi and Sheetal with check variety BPT5204

Rice varieties	Weight of raw rice (gms)	Water Quantity (ratio)	Cooking time (min)	Cooking weight (g)	Cooking loss (g)	Elongation ratio (mm)
Siddi(WGL44)	64	1:2	5	195	0.64	1.15
Sheetal(WGL283)	64	1:2	5	214	0.69	1.16
t-value	0^{NS}	0^{NS}	0^{NS}	0.35^{NS}	0.13^{NS}	0.10^{NS}
BPT5204	64	1:2	7	207	0.61	1.12
f-value	1.34^{NS}	0.98^{NS}	0.74^{NS}	49.05**	24.5**	0.64^{NS}
t- value (Siddi vs BPT5204)	0^{NS}	0^{NS}	0.32^{NS}	0.45^{NS}	0.27^{NS}	0.03^{NS}
t-value (Sheetal vs BPT5204)	0^{NS}	0^{NS}	0.33^{NS}	0.57^{NS}	0.02^{NS}	0.06^{NS}

Values are expressed as mean values; *Significant ($p<0.05$); **Significant ($p<0.01$); NS- No significant

Sensory quality characteristics of newly released rice varieties

The table 7. represents mean sensory characteristics difference in Siddi and Sheetal varieties. From the table it was found that there was no significant difference in all sensory characteristics like color, appearance, flavor, taste, texture and overall quality between these two varieties.

Table 7: Mean sensory evaluation scores of newly released rice varieties Siddi and Sheetal

Rice varieties	Color	Appearance	Flavor	Taste	Texture	Overall quality
Siddi (WGL44)	3.67±0.82	3.73±0.80	3.33±0.62	3.27±0.70	3.20±0.77	3.60±0.91
Sheetal (WGL283)	3.80±0.56	3.33±0.72	3.13±0.74	3.13±0.74	2.8±0.86	3.47±0.52
t-value	0.34^{NS}	0.98^{NS}	0.54^{NS}	0.36^{NS}	0.91^{NS}	0.32^{NS}
BPT5204	4.13±0.74	3.8±0.68	3.67±0.72	3.77±0.78	3.53±0.83	4.07±0.70
f-value	1.043^{NS}	1.35^{NS}	1.54^{NS}	2.06^{NS}	1.98^{NS}	1.928^{NS}
t-vale (Siddi vs BPT5204)	1.31^{NS}	0.21^{NS}	1.31^{NS}	1.5^{NS}	0.92^{NS}	1.31^{NS}
t-value (Sheetal vs BPT5204)	1.12^{NS}	1.59^{NS}	1.65^{NS}	1.88^{NS}	1.93^{NS}	2.17*

Values are expressed as mean values; *Significant ($p<0.05$); **Significant ($p<0.01$); NS- No significant

Srinadh (2014) [23] studied sensory properties of normal rice and flood effected rice and found the mean sensory scores for all the attributes was higher for normal rice (color 4.7, appearance 4.7, flavor 4.3, taste 4.2, texture 4.6 & overall quality 4.4) compared to flood affected rice. In present study the results with the sensory attributes of NRRVs are similar with the normal rice.

Conclusion

It can be concluded that Significant difference was not observed for all the milling quality characteristics like percentage of head rice, broken rice and milling recovery except for husked rice which was significantly higher ($p<0.01$) in control compared to both the NRRVs and in Sheetal compared to Siddi. Significant difference ($p<0.01$) was found in gel consistency and alkali spreading values of NRRVs when compared to control, while Significantly ($p<0.01$) higher gelatinization temperature was observed between NRRVs and control (>74° C) and also between Siddi and Sheetal, in which Sheetal had higher (>74ºC) GT than Siddi (55-69 ºC). Oraganoleptic properties such as cooking time and cooking loss alos showed significan difference ($p<0.01$) between Siddi and Sheetal. Whereas there was no significant difference was observed in the mean sensory evaluation scores between Sheetal and Siddi and also between control and both the NRRVs.

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