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Screening Of Prominent Rice Varieties of North India For Making Quality Wine

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ABSTRACT
Rice production is surplus in north India and rice grains are wasted due to poor storage infrastructure. We hypothesized that wasted rice grains could be used for alcoholic beverages. With this objective, seven prominent rice varieties of north India were evaluated for their suitability for quality wine. The wine produced from different rice varieties differed for chemical analysis. The highest percentage of phenol was found in wines made from PR-114, while the lowest was found in Punjab Basmati-7 indicating increased antioxidant activity of PR-114 compared with other varieties. Wine made from PR-114 had lower pH and total titrable acidity compared with Punjab Basmati 7 indicated wine of PR-114 had a tart and crisp properties. Lower pH of PR-114 wine may protect it from microbial attack. The alcohol content of PR-114 was also found better than Punjab Basmati 7.A significant difference was observed for total soluble solids of wines prepared from the PR-114 variety. These results suggest that rice variety PR-114 is highly suitable for making quality wine.
Keywords: *Alcohol, Antioxidant, Phenolic content, Phytochemical, Rice,*

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I. INTRODUCTION

In Punjab (India), rice is grown in an area 31.5 lakh hectares, with a production of 139.9 lakh tons (Anonymous 2022). In Punjab, wheat is a staple food, while in the major parts of India, rice is the staple food. Therefore, much of the rice from Punjab is delivered to other states of India. Punjab is considered as the food bowl of India as it contributes around 29% of rice to the central pool of India.

A large quantity of rice grains is wasted in Punjab because of aberrant weather conditions and inadequate storage facilities. An estimate by the Food Corporation of India revealed that about 1,94502 metric tonnes of food grains were wasted in India from 2005 to 2013. This damage stock was around 84% for rice and 14% for wheat. Punjab with a total damage stock of 98,200 metric tonnes recorded about 50% of the total damage. These wasted rice grains could be used for alcoholic beverages and this value addition could help in strengthening the distillery industry and generate employment opportunities in Punjab (Anonymous 2020).Indian Punjab is also famous for basmati rice and currently, it is grown in an about 20% of the total area of rice. Farmers geta premier price for basmati rice as much of the basmati is exported to other countries. However, when the area under basmati rice increases, farmers do not get premium prices due to a surplus production and therefore a glut in the market. Therefore, products related to the value addition of basmati rice are required so that farmers may get a premium price for basmati rice when the production of basmati rice increases beyond a certain level. It is worth mentioning here that basmati rice consumes less water than non-basmati rice, however, the productivity of basmati is lower than non basmati rice. In the scenario of dwindling water resources in Punjab, the increased area under basmati rice in this region could save water and improve the livelihood of farmers if some products of basmati rice are to be developed. This will reduce the risk of farmers of getting lower returns when the production of basmati rice is surplus.

In Industry, rice is gaining importance for beer, fermented products, and wine (Jaheo et.al., 2003). Most of the wine industries are related to making wine from grapes and other fruits and the procedure is well standardized. However, the possibility of good quality wine from rice grains is still under investigation. To make rice wine, rice starch is fermented and converted to sugar. Rice wine uses the amylolytic process by the action of the enzyme amylase (Subhasree, 2010). Conversion of starch into alcoholic beverages involves three steps, starch liquefaction, enzymatic saccharification, and fermentation (Suresh et al., 1990). Fermented rice drinks in liquid form are rice beer, rice wine, and rice vinegar.

Rice wine is different from beer as beer production employs a mashing process to convert starch to sugars, whereas rice wine uses the amylolytic process by the action of acids or enzymes like amylase for its conversion to alcoholic beverages. Rice wine is popular in various parts of the world including India since ancient times. Thai rice wine and Korean beverages yakju and takju are very famous beverages that are also

made from rice (Park et al., 1977). Chinese rice wine is a traditional alcoholic beverage and having a history of 14000 years. Rice wine is popular since ancient times because it has many health-promoting benefits such as antioxidants, anti- diabetes. anti- cancer, and anti- hypertensive activities (Bamforth, 2004; Blandino et al., 2003; Lotong, 1998; Ekundayo, 1969; Bagchi et al., 2016; Karki,1986). In addition to that, rice wine also contains vitamins, minerals, proteins, organic acids, and other nutritional components. The wine is composed of organic and inorganic substances such as proteins, carbohydrates, ethyl alcohol amino acids, organic acids, inorganic acids, and micronutrients, etc. Biochemical composition of rice may influence the quality of wine and the quality of wine may differ with rice varieties. Therefore, the present study was taken up with seven rice varieties that are popular in Punjab, India for assessing the quality of wine production. We chose basmati and non basmati varieties as we hypothesized that aroma and phenolic compounds in basmati varieties may alter the alcohol content and fermented rice beverages. The objective of this study was to compare the nutritional, physicochemical, and phytochemical analysis of rice wine using different rice varieties. The data generated from this research may help in identifying rice varieties that may benefit the wine industry by making quality wine from rice.

II. MATERIALANDMETHODS

The rice varieties selected for study viz.PR-128, PR-114, PR-131, Pusa Basmati 1718, Punjab Basmati 7, Pusa Basmati 1509, and PR-130 were purchased from Punjab Agricultural University, Ludhiana, India. Varieties were chosen on the basis of different quality parameters and popularity in Punjab, India.

The enzyme Diastase a-amylase was purchased from Hi Media Laboratories, Mumbai. Each variety of rice in known quantity was cooked separately. After cooking each variety of rice was mashed and treated with Diastase alpha-amylase at a specified temperature and time for saccharification to obtain maximum reducing sugars.

The reducing sugar of each variety was then subjected to fermentation by inoculating the standard yeast strain *Saccharomyces cerevisiae* var ellipsoideus 101. After fermentation, the wine of each variety was siphoned-off and clarified using bentonite clay and stored at a low temperature.

The wine samples in three replicates were analysed for residual reducing sugars using 3, 5, dinitrosalicylic acid method (Miller, 1959), pH using the pH meter of Analog model (Corion Research, USA), protein by modified Microkjeldhal method (Jackson, 1973), TSS using the ERMYand refractometer, ethanol by colorimetric method (Caputi et al., 1968). Titrable acidity by titrating against 0-1 N NaOH solution, colour, and brightness using the spectrophotometer (Onkarayya, 1985). The total phenolic content was by following standard protocol (Ragaee et al. 2006).

All the Chemical analysis was done by FARELABS, Gurugram, Haryana. (TC-5503, ISO 9001:2015, ISO 14001:2015,

ISO 45001:2018, ISO/IEC 27001:2013.)

Statistical Analyses

The data were subjected to an analysis of variance (ANOVA) in a completely randomized design using the software CPCS1, verified with GENSTAT 19th edition (VSN International, Hemel Hempstead, UK). Treatment means were compared at the 5% level of significance using Fisher's protected least significant difference (LSD). Data were also validated to meet the assumptions of normality and variance before analyzing.

III. RESULTSAND DISCUSSIONS

Total phenols and antioxidants

The quantity of total phenols in rice wine was prepared from several varieties of rice. Total phenols were found to vary between 84.70 and 91.30 mg/L. The highest percentage was found in wines made from PR-114, while the lowest was found in Punjab Basmati 7. Pusa Basmati 1718 rice wine, on the other hand, measured 88.8 mg/L total phenols, which was determined to be statistically equivalent to PR-130, PR-131, and PR-128 wines. In the instance of Pusa Basmati 1509 wine, the value was 86.1 mg/L. Wine development resulted in a significant increase in phenolics, resulting in increased antioxidant activity.Total antioxidant content was highest in a wine of PR-131 (90.2%) and lowest in a wine of PR-114 (82.3%). Wines of all other varieties had higher antioxidants than PR-114. The antioxidant content in a wine of PR-128, PR-114, Pusa Basmati 1718, Punjab Basmati 7, Pusa Basmati 1509, and PR-130 decreased by 3.9, 8.7, 5.5, 4.1, 3.5, and 3.9%, respectively, compared with the wine of PR-131. Previous studies revealed that antioxidantsin Korean rice wine was in the range of 35-66% (Jeong et al. 2011). A higher amount of antioxidants in PR-131 could be due to higher antioxidant content in PR-131 compared with other varieties. (Refer Table – 1)

pH and titratable acidity

The chemical analysis of wine made from different rice varieties revealed that there was a significant difference in the rice varieties in terms of pH and titratable acidity (Table). When rice wine made from Punjab Basmati 7 was compared to other wines, it had the highest pH (3.24), as well as the highest total titratable

acidity (1.15 g/mL). In general, the pH of wines is determined by their acid and sugar levels. Wines with a low pH are often tart and crisp, whilst wines with a higher pH are weak and flabby in flavor. In addition, the low pH protects wine from spoiling due to microbial development. Kim et al., 2013 got a pH value of 4.4 for rice wine, which is somewhat higher than the current study. The findings were also consistent with the findings of Bhatt et al. (2022) in fermented beverages made from *Maurrayakonengii*.(Refer Table – 1)

Alcohol content

Alcohol is a significant factor in determining wine quality. The wine made from PR-130 had the greatest alcohol concentration in this trial (4.94 percent). These findings are consistent with Dung's (2013) claim that the alcohol concentration of rice wine can reach up to 15% depending on fermentation performance. Punjab Basmati 7 wine has the lowest alcohol concentration (4.15 percent). This might be because the amount of alcohol generated is affected by variations in fermentable sugar, yeast fermentation efficiency, sugar absorption capacity, and alcohol tolerance limit. Thus, the alcohol concentration is one of the parameters that influence rice wine quality and may be used to determine the degree of fermentation throughout the fermentation process.(Refer Table – 1)

Total protein

Total protein content in wines of PR-128, PR-114, Pusa Basmati 1718, Punjab Basmati 7, and Pusa Basmati 1509 was lower than PR130. The protein content in wines of PR-130 and PR-131 was similar. In general, good wines have no protein or very low level of protein. Protein in wine forms the haze, therefore, not considered a good characteristic of quality wine. Our results suggest that protein content in rice wines is not too high. Protein in wine is a source of nitrogen for yeast growth. Previous studies reported that protein content in wines prepared from different rice varieties ranged between 0.03 to 0.04% (Sanchez et al. 1987)(Refer Table – 1)

TSS and Reducing sugars

A significant difference was observed for total soluble solids of wines prepared from the PR-114 variety which had maximum total soluble solids (3.77 %) and least total soluble solids (3.02 %) observed with the wine from the PR-128 variety. This might be due to the difference in reducing sugar content in the rice varieties and reducing sugars constitute a major part of soluble solids present in the must. Similar work was done by (Kyalakond, unpublished results) who reported that rice wine prepared from the different rice varieties had TSS of 3.0 to 3.9 °Brix where most of the study results fall in the range. This significant difference ($p < .05$) in reducing sugar is due to the breakdown of sugars into alcohol along with the generation of carbon dioxide. The pH of wine is extremely important in its production and stability. Low pH aids in the solubilization of tartrate salts, ascorbic acid, and proteins, as well as the stabilization of different oxidative and browning events.(Refer Table – 1)

Color, brightness, and turbidity

Color reading was highest in PR-128 wine and it was similar to PR-114. Pusa Basmati 1509 wine had the lowest color reading, and the color of Pusa Basmati wine 1509 was similar to PR-130.

The brightness reading was highest for PR-131 wine and wine of all other varieties had lower brightness than PR-131. The brightness reading was lowest in Pusa Basmati 1509 wine. Punjab Basmati-7 wine had a higher reading of brightness than PR-128, PR-114, Pusa Basmati-1718, Pusa Basmati 1509, and PR-130.

Turbidity reading was highest in Pusa Basmati-1718 wine. Wine of all other varieties had lower turbidity than Pusa Basmati-1718. Wine of PR-128, PR-114, PR-131, Pusa Basmati 1509 and PR-130 had similar turbidity. The lowest turbidity was found in the wine of Punjab Basmati 7.(Refer Table – 1)

IV. CONCLUSIONS

Conclusively, the results of the present study provide an effective way of delivering the health advantages of rice in the form of nutritious and palatable alcoholic beverages. The study revealed that rice wine brewed from the PR-131 variety was found to be richer with more total antioxidants (90.2 %) as compared to other wines. The amount of total phenols were significantly higher in PR-114 wine (91.3 mg/L) than in PR-131 wine (87.8 mg/L) and total antioxidants were noted as 82.3 %. However, on the basis of quality parameters, rice wine made from PR-114 variety recorded maximum TSS (3.77 %). The color (0.57), brightness (1.13) and turbidity (61.0 NTU) were also acceptable. Considering total antioxidants, phenols, and other quality factors, wine made from the PR-114 rice cultivar might been visioned as a health supplement drink. Furthermore, their market availability will undoubtedly serve as an essential source of nutrients and help health-conscious individuals.(Refer Table – 1)

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TABLE 1: CHEMICAL ANALYSIS OF RICE WINE FROM DIFFERENT VARIETIES

Variety	Total phenol	Total antioxidants		Total protein	Reducing sugar	pH	Color	Brightness	Turbidity	Acidity (tartaric acid)	Alcohol	TSS
	mg/L	%		% by weight	g/100g				NTU	g/100 ml	% by weight	% by weight
PB-128	88.7	86.7		0.14	2.27	3.13	0.61	1.10	62.6	1.05	4.78	3.02
PR-114	91.3	82.3		0.14	2.13	3.17	0.57	1.13	61.0	1.05	4.86	3.77
PR-131	87.8	90.2		0.15	2.29	3.18	0.36	1.51	59.4	1.07	4.86	3.71
Pusa Basmati 1718	88.8	85.2		0.13	2.44	3.23	0.43	1.07	68.8	1.03	4.75	3.64
Punjab Basmati 7	84.7	86.5		0.13	2.35	3.24	0.55	1.37	57.3	1.15	4.15	3.51
Pusa Basmati 1509	86.1	87.0		0.14	2.14	3.13	0.31	1.06	58.4	1.09	4.76	3.70
PR130	88.6	86.7		0.16	2.28	3.12	0.33	1.27	59.3	1.07	4.94	3.65
LSD (0.05)	0.8	0.4		0.01	0.06	0.06	0.04	0.03	4.1	0.03	0.05	0.03

LSD : Least significant differences at 5% level of significance
Statistical analysis was done in a completely randomized design with three replicates


Rice Wine
Variety PB-1509
Rice Wine
Variety PB-128
Rice Wine
Variety PR- 114


Rice Wine
Variety PR- 130
Rice Wine
Variety PB- 7
Rice Wine
Variety PR- 131
Rice Wine
Variety PB- 1718