



Comparative Study on Glucose Dynamics and Chemical Profiles of Traditional Rice Varieties at Regular Time Intervals

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ABSTRACT

This study investigated the dynamic changes in sugar content across ten traditional rice varieties during a 24-h soaking period, focusing on its impact on glycemic properties. Analysis using Anthrone and DNS methods revealed a significant decline in total, reducing, and non-reducing sugars over time, with Sample 8 showing the highest reduction of 50.67%. A strong inverse correlation was found between soaking duration and sugar content. Microbial analysis identified *Bacillus subtilis*, a bacterium with reported anti-diabetic properties, in the sample exhibiting the greatest sugar reduction. The findings suggest that optimized soaking is a simple method to lower the glycemic impact of rice, offering a practical dietary strategy for blood sugar management. Further studies in animals or humans are needed to confirm these beneficial effects *in vivo*.

Keywords: Rice soaking, Glycemic index, *Bacillus subtilis*, Sugar reduction, Traditional rice varieties.

INTRODUCTION

Rice is a staple food in South India and an essential part of both its culture and daily diet. It is the main source of carbohydrates, with different varieties offering unique flavors, textures, and nutritional benefits. Both traditional and modern rice types have distinct properties that make them suitable for various dishes. The nutritional value of rice depends on its carbohydrate, protein, fat, and mineral content. It also contains bioactive compounds such as antioxidants, phytic acid, and gamma-aminobutyric acid (GABA), which contribute to health benefits. Among its components, the sugar content-especially reducing and non-reducing sugars-plays a key role in

determining its effect on blood glucose levels. Factors such as rice variety, processing, and cooking methods influence sugar composition, which in turn affects its Glycemic Index (GI) and overall nutritional quality.

Soaking rice before cooking is known to change its sugar content and glycemic response. During soaking, water-soluble sugars leach into the liquid, reducing the sugar concentration in the rice. Enzymatic activity also breaks down starch, temporarily increasing reducing sugars, which are later washed out. As a result, extended soaking lowers the glycemic impact of rice, making it more suitable for people managing blood sugar levels. The degree of sugar reduction depends on factors like soaking time,



temperature, and rice variety. Soaking also improves texture, aids digestion, and enhances sensory qualities.

Cooking methods further influence sugar composition and glycemic behavior. Boiling, steaming, and parboiling alter starch structure and sugar availability. Parboiled rice generally has a lower GI due to starch retrogradation, while steaming reduces amylose content, slowing glucose release. Cooling cooked rice can increase resistant starch, which also lowers glycemic response. The interaction of soaking and cooking therefore has important dietary implications, particularly for individuals with diabetes or those monitoring carbohydrate intake. Understanding these processes can help balance taste, nutrition, and health benefits in everyday diets. Although many studies have examined soaking and cooking separately, little is known about their combined effects on sugar dynamics. Research has also focused mainly on white rice, leaving colored rice varieties with higher antioxidant potential underexplored. Addressing these gaps can provide better strategies for managing blood glucose through rice preparation. This study specifically investigates how soaking affects the glucose level of cooked rice, with an aim to support dietary recommendations for diabetes management and healthier food practices.

MATERIALS AND METHODS

This study examined changes in total sugar content, including reducing and non-reducing sugars, across ten rice varieties. The samples were selected to represent different genetic backgrounds, cultivation practices, and processing methods. For accurate estimation of total sugars, the Anthrone method was used because of its high sensitivity, simplicity, and cost-effectiveness. This choice was supported by a literature review and preliminary trials that confirmed its suitability for rice analysis. Soluble sugars were first extracted using ethanol, and acid hydrolysis was applied to break carbohydrates into simple sugars. Under hot acidic conditions, glucose formed hydroxymethyl furfural, which reacted with anthrone to produce a green-colored complex measurable at 630 nm.

For reducing sugar estimation, several methods were reviewed, and the DNS (3,5-dinitrosalicylic acid) method was selected for its precision, specificity, and affordability. Sugars were extracted from 100 mg of rice using hot 80%

ethanol, evaporated at 80°C, dissolved in water, and reacted with DNS reagent by boiling. The resulting red-brown complex was measured at 510 nm.

Correlation analysis using Microsoft Excel helped identify relationships between soaking, cooking, and sugar variation among rice samples.

Microbial studies were also conducted to detect bacteria and fungi. Samples were prepared and inoculated using pour and streak plate methods, then incubated at 37°C for 24–48 hours. Colonies were examined for size, shape, texture, and pigmentation. Gram and spore staining aided microscopic identification, while biochemical tests such as starch and gelatin hydrolysis, along with catalase activity, confirmed microbial identities.

RESULTS AND DISCUSSION

The analysis of total sugar concentrations across ten samples revealed a consistent declining trend over the 24-h period. Sample 8 exhibited the most pronounced reduction of 50.67%, followed by Sample 4 and Sample 5. Samples 1, 2, 3 and 6 showed moderate decreases with the range of 39.56%–41.67%, while Samples 7, 9 and 10 had milder reductions. The strong negative correlation coefficients $r = -0.6285$ to -0.9763 between time and total sugar content confirmed this trend, indicating prolonged soaking significantly reduced total sugar content. The changes in the total sugar content are shown in Table 1.1. The graphical representation of the correlation analysis between time interval and total sugar content is shown in Figure 1.

Table 1.1: Variation of amount of total sugar (in mg) at regular time intervals

Sample	Time intervals				
	0	6	12	18	24
1	2.88	4.08	2.44	2.20	2.28
2	5.36	5.00	3.36	3.32	3.24
3	4.56	4.28	3.92	2.92	2.72
4	3.92	2.72	2.44	2.20	2.08
5	3.56	2.08	2.36	NA	NA
6	3.64	3.52	2.68	2.36	2.20
7	2.16	1.96	1.56	1.48	1.44
8	3.00	2.44	1.76	1.52	1.48
9	3.84	3.56	3.44	3.20	3.16
10	3.32	3.20	2.60	2.44	2.24

Reducing sugar levels displayed notable variability in degradation rates. Sample 2 and Sample 5 demonstrated the most rapid declines of 55.83% and 49%, respectively, highlighting active

metabolic utilization. Samples 3, 4, 6, 8 and 10 also showed substantial reductions of 30.08%–49%, while Samples 1, 7 and 9 exhibited slower changes. Correlation coefficients $r = -0.5669$ to -0.9733 reinforced a strong inverse relationship between time and reducing sugar, with Samples 6, 8, 9 and 10 nearing perfect negative correlation $r \leq -0.9487$ which indicates the decrease in reducing sugar at regular time intervals. The reducing sugar content changes over time are depicted in Table 1.2. The diagrammatical representation of the correlation analysis between time interval and reducing sugar content is shown in Figure 2.

Table 1.2: Variation of amount of reducing sugar (in mg) at regular time intervals

Sample	0	6	12	18	24
1	0.80	0.93	0.93	0.80	0.67
2	1.20	1.20	0.67	0.53	0.53
3	1.20	1.20	1.07	0.80	0.80
4	1.20	1.20	0.80	0.74	0.71
5	0.53	0.53	0.27	NA	NA
6	1.33	1.07	0.80	0.80	0.74
7	1.20	1.07	0.80	0.53	0.67
8	1.33	1.20	1.07	1.07	0.93
9	0.93	0.80	0.74	0.74	0.71
10	1.11	1.07	0.93	0.80	0.80

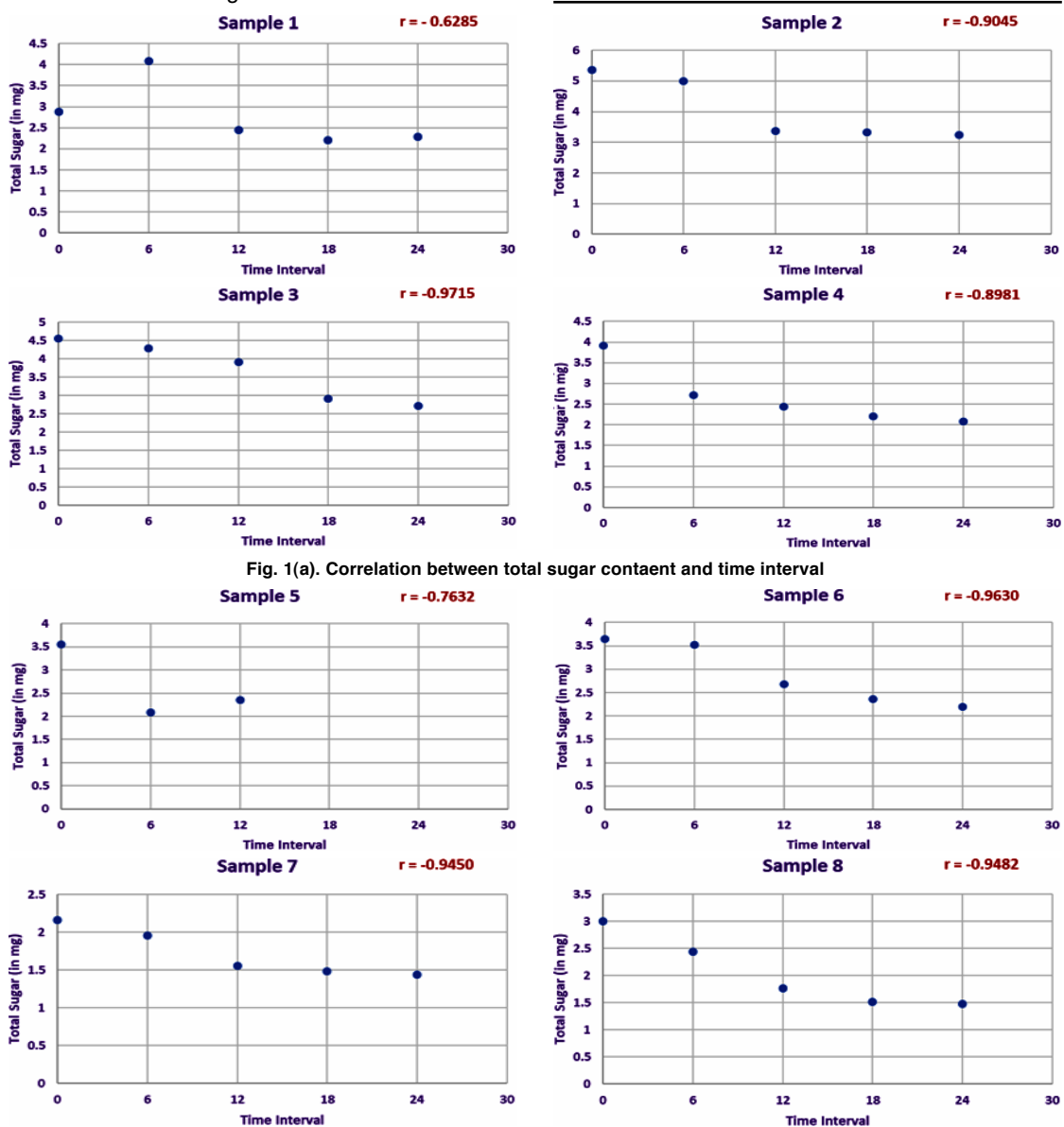


Fig. 1(b). Correlation between total sugar content and time interval

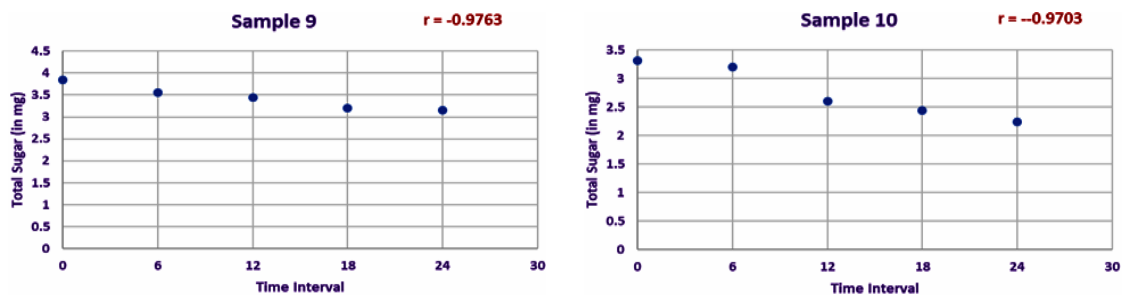


Fig. 1(c). Correlation between total sugar content and time interval

The tabular representation of changes in the non-reducing sugar content at regular time interval are shown in Table 1.3. The trends indicate that non-reducing sugar trends as same as total sugar declines in most samples. Samples 3, 4, 6 and 8 demonstrated consistent reductions, indicating balanced breakdown of sucrose or oligosaccharides into simpler sugars.

In consideration of above facts Sample 2 and Sample 8 were selected for the analysis of detection of Microbes present in the sample as it shows significant reduction in the sugar contents. The results from the cultural, morphological and biochemical tests were compiled and compared with known profiles of bacterial species. Based on the findings, Sample 8 was identified with the presence of *Bacillus subtilis*, a Gram-positive, spore-forming bacterium capable of hydrolyzing starch and gelatin. Sample 2, on the other hand, was

identified as Actinomycetes, characterized by its filamentous morphology and negative results for indole, catalase and gelatin hydrolysis tests. These identifications were consistent with the observed characteristics and biochemical profiles. In 2024, Biswapriya Chutia *et al.*, and other researchers has reported that the bacteria *Bacillus subtilis* has high anti-diabetic property.

Table 1.3: Variation of amount of non-reducing sugar (in mg) at regular time intervals

Sample	0	6	12	18	24
1	2.08	3.15	1.51	1.40	1.61
2	4.16	3.80	2.69	2.79	2.71
3	3.36	3.08	2.85	2.12	1.92
4	2.72	1.52	1.64	1.46	1.37
5	3.03	1.55	2.09	NA	NA
6	2.31	2.45	1.88	1.56	1.46
7	0.96	0.89	0.76	0.95	0.77
8	1.67	1.24	0.69	0.45	0.55
9	2.91	2.76	2.70	2.46	2.45
10	2.21	2.13	1.67	1.64	1.44

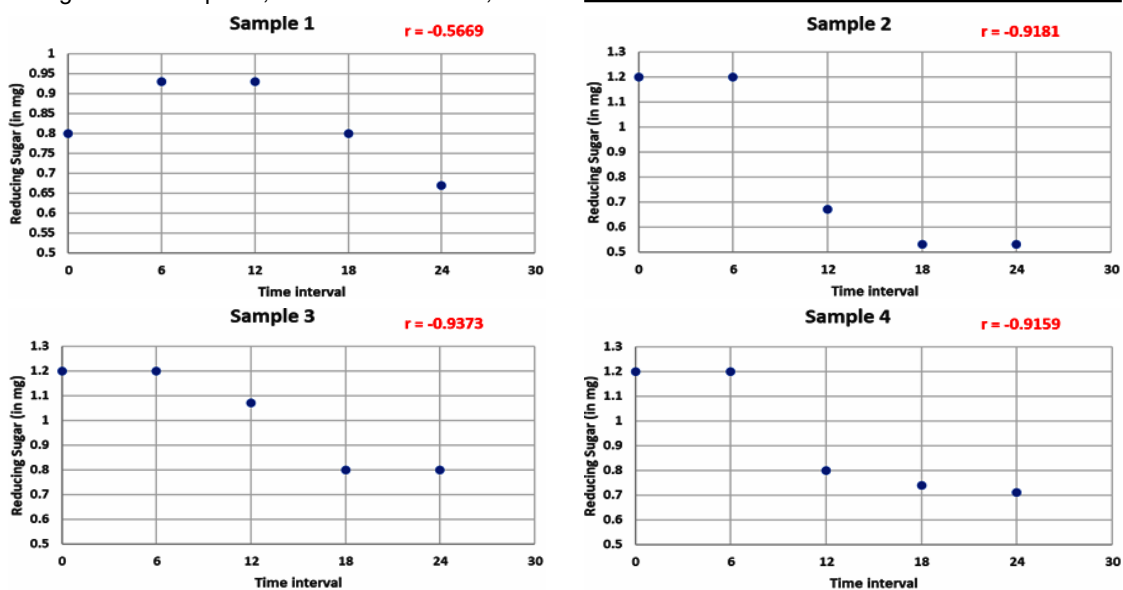


Fig. 2(a). Correlation between total sugar content and time interval

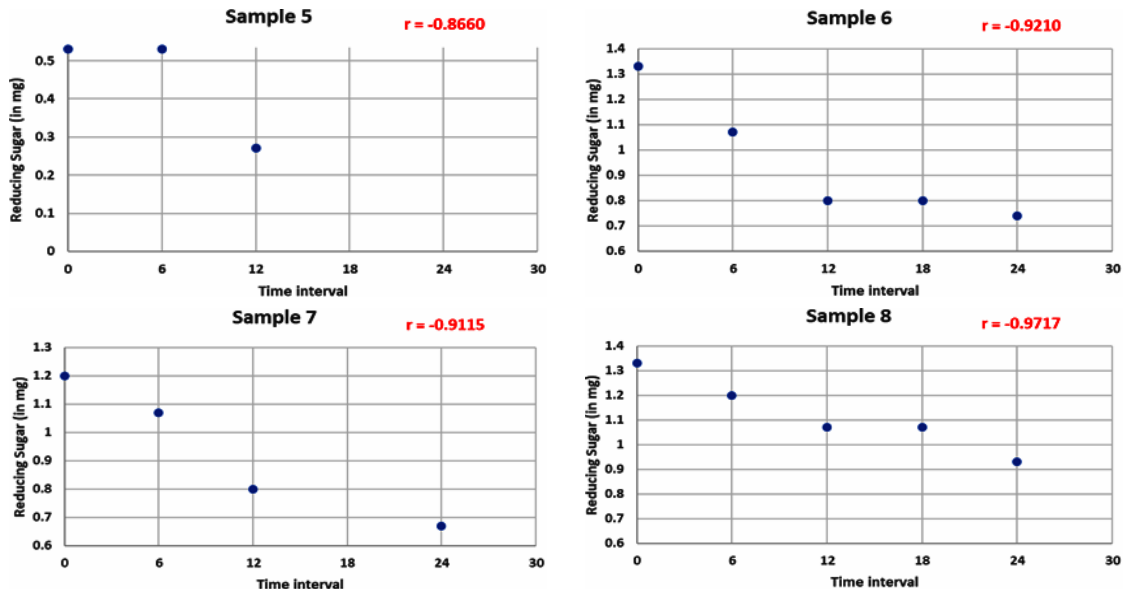


Fig. 2(b). Correlation between total sugar content and time interval

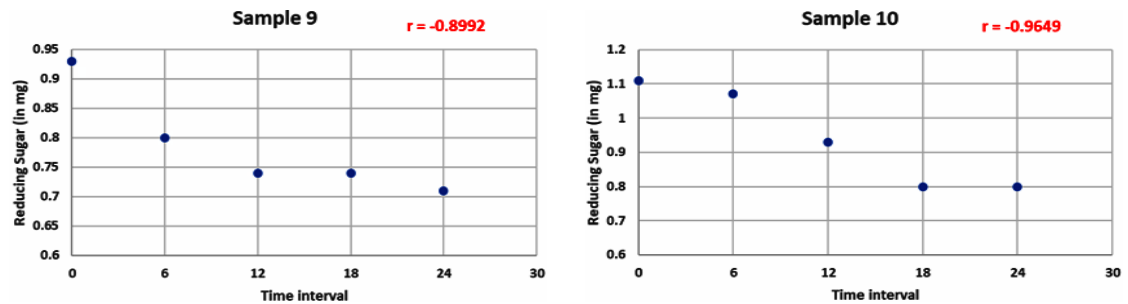


Fig. 2(c). Correlation between total sugar content and time interval

CONCLUSION

This study demonstrated that soaking rice significantly reduces its sugar content over time, with total and reducing sugars showing a consistent decline across various traditional varieties. The most substantial reduction was observed in Sample 8 which decreased by 50.67%. Microbial analysis of high-performing samples identified the presence of *Actinomyces* in Sample 2 and *Bacillus subtilis*, a bacterium noted for its anti-diabetic properties present in Sample 8. These findings confirm that prolonged soaking is a simple and effective method to lower the sugar content in rice, thereby potentially reducing its glycemic impact. Consequently, this practice offers a practical dietary strategy for individuals managing blood sugar levels. Further studies in animals or humans are needed to confirm these beneficial effects *in vivo*. Ultimately, these results

can inform public health guidelines and dietary recommendations, promoting healthier food choices for populations at risk of diabetes and related metabolic conditions.

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Conflict of interest

The author declare that we have no conflict of interest.

REFERENCES

1. S. Suman and P. Boora., *Food Sci. Res. J.*, **2016**, 7, 100.
2. E. Apriyati., IOP Conf. Ser.: *Earth Environ. Sci.*, **2024**, 1280, 012034.
3. Beenish., *Int. J. Chem. Stud.*, **2018**, 6, 45.
4. M.D.T.L. Gunathilaka and S. Ekanayake., *Ceylon Med. J.*, **2015**, 60, 63.
5. O.Rewthong.;S.Soponronnarit.;C.Taechapairoj.; P.Tungtrakul and S.Prachayawarakorn., *J. Food Eng.*, **2011**, 103, 208.
6. M. He.; C. Qiu.; Z. Liao.; Z. Sui and H. Corke., *Int. J. Biol. Macromol.*, **2018**, 111, 127.
7. H. Purwaningsih., *AIMS Agric. Food.*, **2022**, 7, 525.
8. Book Reference:
9. M. Bodanszky and A. Bodanszky, *The Practice of Peptide Synthesis*, Springer-Verlag, New York., **1984**, 78, 91.