Cost Analysis of Prepared Synbiotic Banana Lassi Enriched with Honey and *L. rhamnosus* GG

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Abstract

With rising consumer interest in health and nutrition, there is increasing demand for functional foods that combine high nutritional value with desirable sensory characteristics. The study was carried out in the year of 2019 at the Department of Dairy Microbiology, College of Dairy Science and Food Technology, Chhattisgarh Kamdhenu Vishwavidyalaya, (Chhattisgarh), study aimed to develop a synbiotic lassi product using locally available ingredients—*Grand Nain* variety banana, honey and the probiotic strain *L. rhamnosus* GG—to enhance both health benefits and consumer acceptability. Five formulations were prepared with varying banana pulp concentrations: T_0 (0%), T_1 (5%), T_2 (10%), T_3 (15%), and T_4 (20%), with honey used as a natural sweetener and prebiotic enhancer. Among these, the T_2 sample (10% banana pulp and 70% dahi) was found to be most acceptable in sensory evaluation and was further tested for storage stability and microbiological quality. The T_2 formulation maintained probiotic viability (7.2 log cfu/g) and showed no microbial spoilage up to 10 days under refrigeration. For cost analysis, local sourcing of ingredients (banana from Chhattisgarh, honey, and dahi) contributed significantly to reducing production costs. The use of banana pulp, a readily available and low-cost fruit in the region, provides a viable option for value addition in dairy products. The cost per 200 ml of the optimized lassi (T_2) was calculated to be economically feasible when compared to similar commercially available functional beverages. Additionally, the integration of probiotics and prebiotics adds market value and justifies a premium pricing strategy. This study concludes that synbiotic banana lassi not only holds nutritional and sensory appeal but also presents a cost-effective solution for small-scale dairy processors aiming to diversify product offerings with functional health benefits.

Keywords:
Synbiotic lassi, *L. rhamnosus* GG, Banana pulp, Honey, Probiotics, Prebiotics, Fermented milk product.

Introduction

Scientific advancements in the understanding of the intricate relationship between nutrition and health have driven the global interest in functional foods those offering specific health benefits beyond basic nutrition (Bhat and Bhat, 2011). Functional foods such as probiotics, prebiotics,

and synbiotics are gaining popularity due to their positive impact on gut health, immunity and overall well-being (FAO *et al*., 2007). In particular, the probiotic dairy sector has witnessed steady market growth, fueled by consumer preference for natural, health-promoting alternatives (Bastani *et al.,* 2016).

In the Indian context, fermented dairy products like dahi, lassi and buttermilk are deeply embedded in traditional dietary patterns. Among these, lassi stands out as a widely accepted and regionally diverse beverage known for its refreshing taste and digestive benefits. Its appeal is further enhanced when fortified with health-enhancing ingredients such as fruits and natural sweeteners.

Banana (*Musa spp.*) an extensively cultivated fruit in India, particularly in states like Chhattisgarh, is a cost-effective and nutrient-dense food. It is rich in dietary fibre, potassium and prebiotic compounds, making it an ideal ingredient for functional food formulation. Similarly, honey serves not only as a natural sweetener but also as a valuable prebiotic source. These locally available ingredients have the potential to reduce input costs while enhancing the nutritional and sensory value of the final product. The integration of these ingredients into a synbiotic formulation-combining probiotic strains like *L. rhamnosus* GG with prebiotics from banana and honey-creates a high-value, functional lassi-style beverage. However, for such innovations to be commercially viable, cost analysis is essential. This includes evaluating raw material costs, processing, packaging, shelf-life stability and consumer acceptability. Therefore, the present study is not only aimed at developing a synbiotic banana lassi with improved sensory and nutritional quality, but also focuses on assessing its economic feasibility. The analysis emphasizes utilizing locally sourced ingredients and existing dairy processing infrastructure to minimize production costs and promote rural entrepreneurship. By aligning health benefits with affordability, this product has the potential to cater to health-conscious consumers while supporting sustainable and value-added dairy production.

Storage Study of Synbiotic Banana Lassi

The shelf life refers to the edible qualities of food product after production. Lassi has higher kept quality than dahi or yoghurt. The quality of lassi largely depends on the method of preparation and initial micro flora like yeast, mold and other contaminates. The product also undergoes acidification during storage which may lead to off flavour. The treatment and control samples of Lassi were stored in refrigerated conditions and analyzed for organoleptic, chemical and microbiological parameters at an interval of 2 days. Based on sensory analysis product was analyzed till it becomes unacceptable. Organoleptic parameters included colour and appearance, consistency, flavour and overall acceptability was recorded. The chemical parameters included titratable acidity and pH. Finally, the microbiological parameters included probiotic count, coliform count and yeast and mold count.

Chemical and Sensory Properties of Synbiotic Banana Lassi During Storage

Titratable Acidity and pH

The titratable acidity and pH were evaluated for controls and T_2 sample on 0, 2, 4, 6, 8 and 10 days of storage. The titratable acidity (Fig.1) was observed to be increasing with the days of storage in control and test samples. This is mainly due to partial growth of starter culture during

the storage. Although there was no significant difference between the pH values (Fig.2) of the samples during the storage period

Concentration treatments	Days					
	0	2	4	6	8	10
T_0	7.12	6.8	6.82	6.64	6.5	6.5
T_2	8.04	8.12	7.82	7.76	7.92	8.12

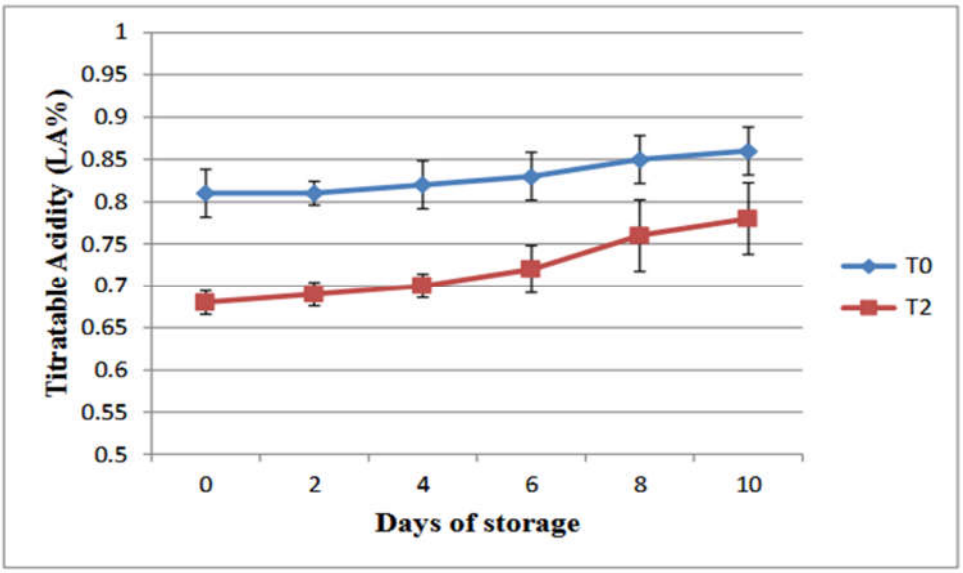

Fig.1. Acidity for T_0 and T_2 during storage period

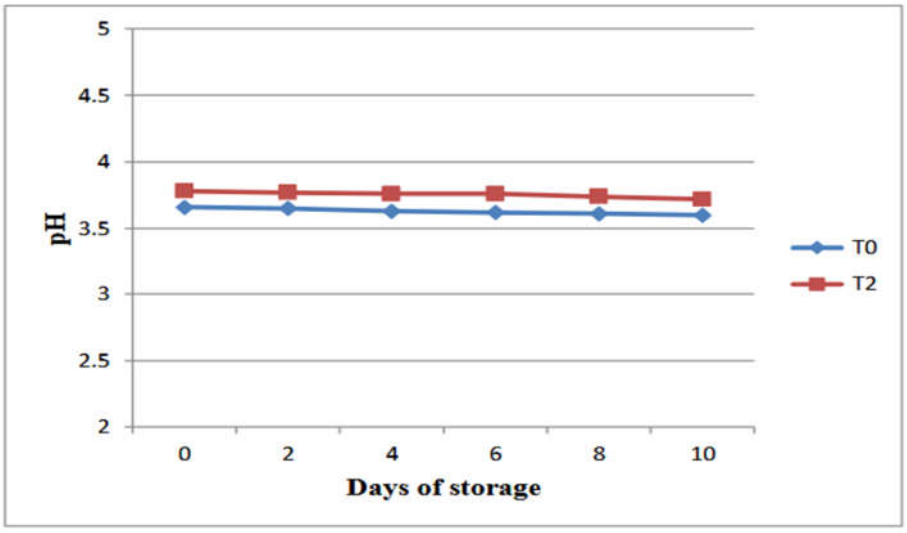

Fig.2 pH for T_0 and T_2 during storage period.

Sensory Evaluation

In any product development process, organoleptic attributes play a vital role deciding acceptability of the product. The sensory parameters chosen to assess the quality of Synbiotic Lassi prepared using banana pulp viz. Colour and appearance, consistency, sweetness, flavour and overall acceptability. The consumption of the product was stopped on 6th day and the product was assessed only for overall acceptability thereafter.

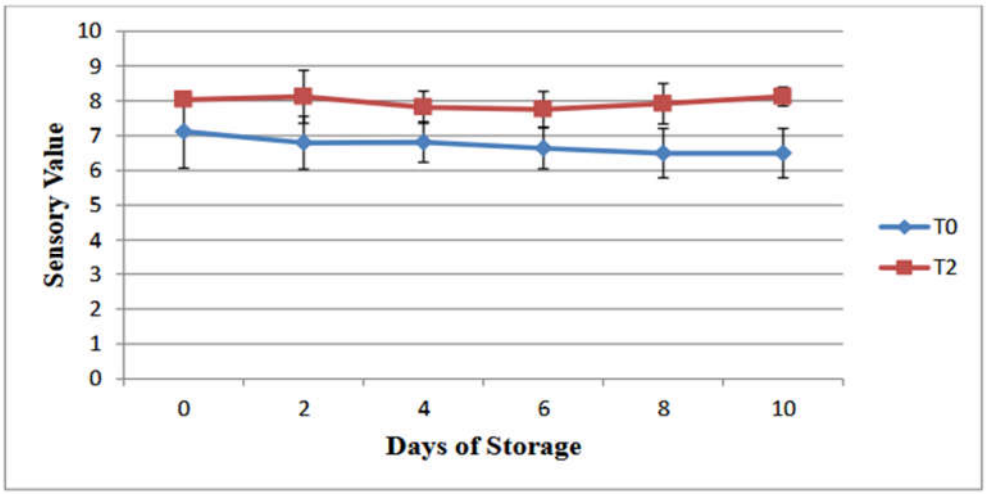

Fig.3 Overall acceptability of T_0 and T_2 during storage period

COST ANALYSIS

Synbiotic Banana Lassi (per 100 g) requires 70 g Dahi, 10 g Honey, 10 g Water, and 10 g Pulp

1. 1 kg Milk – 44.70 g milk (Fermented to dahi) - ₹3.08
2. 1 kg Honey - 380 10 g honey - ₹3.8
3. 100 g Banana Pulp - 14 10 g banana pulp - ₹1.4
4. 1 Kg Water - Nil 10 g water - Nil

Cost of per 100 g of synbiotic lassi = (3.08 + 3.8 + 1.4) = ₹8.28
After adding 10 per cent processing cost (including Probiotic cultures cost) = 8.28 + 1.51= ₹9.79
So, cost of per 100 g of banana synbiotic lassi = ₹9.79

Conclusion

The present study successfully developed a synbiotic banana lassi enriched with *L. rhamnosus GG*, using locally available ingredients such as Grand Nain banana, honey and dahi. Among the five formulations, the T_2 variant (10% banana pulp) emerged as the most acceptable in terms of sensory properties, while also maintaining probiotic viability and microbiological safety for up to 10 days under refrigeration. Cost analysis revealed that the use of regionally sourced ingredients significantly reduces production costs, making the product economically feasible for small-scale dairy entrepreneurs. The final cost of the optimized formulation was calculated to be ₹9.79 per 100 g, which supports a sustainable and value-added business model. This synbiotic banana lassi not only meets consumer demand for functional and nutritious beverages but also offers a promising avenue for rural innovation, health promotion and local economic development.

References

Aneja, R. P., Mathur, B. N., Chandan, R. C. and Banerjee, A. K. (2002). Technology of Indian milk products: handbook on process technology. modernization for professionals, entrepreneurs and scientists, pp: 465

Bastani, P., Akbarzadeh, F., Homayouni, A., Javadi, M. and Khalili, L. (2016). Health benefits of probiotic consumption. In Microbes in food and health, pp: 163-183.

Bhat,Z.and Bhat,H. (2011). Milk and dairy Products as Functional Foods: A review. International Journal of Dairy Science, 6 (1):1-12.

De Langhe, C., Vrydaghs, L., De Maret, P., Perrier, X. and Denham, T. (2009). Why bananas matter: an introduction to the history of banana domestication. Ethnobotany Research and Applications, 7: 165-177. Gorbach,

FAO, F., and Organisation, A. (2007). FAO technical meeting on prebiotics. Food Quality and Standards Services (AGNIS), 15-16.

Jiang, Y., Joyce, D. C. and Macnish, A. J. (1999). Extension of the shelf life of banana fruit by 1-methylcyclopropene in combination with polyethylene bags. Postharvest Biology and Technology, 16(2): 187-193.

Lilly, D. M. and Stillwell, R. H. (1965). Probiotics: growth promoting factor produced by microorganisms. Science, 147: 747-748.

Patel, R.S. and Ranz-Scheuen, A.C. (1997). Lactic acid bacteria, yoghurt, and benefits Indian Dairy Man, 49(9):9-14.

Roberfroid, M., Gibson, G. R., Hoyles, L., McCartney, A. L., Rastall, R., Rowland, I., & Guarner, F. (2010). Prebiotic effects: metabolic and health benefits. British Journalof Nutrition, 104(S2): S1-S63.

Obi, V. I., Barriuso, J. J., and Gogorcena, Y. (2018). Effects of pH and titratable acidity on the growth and development of Monilinia laxa (Aderh. and Ruhl.) in vitro and in vivo. European Journal of Plant Pathology, 151(3): 781-790.