

EVALUATION OF THE EFFECTIVENESS OF SELECTED PRESERVATIVES IN ENHANCING THE SHELF LIFE OF FRUIT BEVERAGES

Shital Sahebrao Deosarkar and P.S. Prajapati

*MAFSU, College of Dairy Technology, Warud, Pusad 445204

Deptt. of Dairy Technology, SMC College of Dairy Science, Gujarat Agri. University, Anand-388 110

Abstract: The present investigation was undertaken to evaluate the effectiveness of selected chemical preservatives in extending the shelf life of fruit beverages. A mango-based fruit beverage was prepared and treated with potassium metabisulphite (KMS), sodium benzoate, and a combination of both preservatives at permissible levels. The beverages were stored under refrigerated ($4\pm 1^\circ\text{C}$) and ambient ($28\pm 2^\circ\text{C}$) conditions for 90 days and evaluated periodically for physicochemical, microbiological, and sensory characteristics. Significant ($P < 0.05$) changes were observed in total soluble solids, pH, titratable acidity, ascorbic acid content, microbial load, and sensory attributes during storage. The combined application of potassium metabisulphite (350 ppm) and sodium benzoate (300 ppm) was most effective in controlling microbial growth and preserving sensory quality. The optimized beverage remained microbiologically safe and organoleptically acceptable for 90 days under refrigerated storage and 60 days under ambient conditions. The findings suggest that judicious use of permitted preservatives can significantly enhance the shelf life and marketability of fruit beverages.

Keywords: Fruit beverage, potassium metabisulphite, sodium benzoate, shelf life, preservatives, mango beverage, storage stability

Introduction

Fruit beverages are widely consumed owing to their refreshing taste, nutritional value, and convenience. However, their high moisture content, favorable pH, and abundance of fermentable sugars make them highly susceptible to microbial spoilage and quality deterioration during storage. Preservation of fruit beverages remains a major challenge for the food processing industry. Deterioration during storage is often manifested by microbial growth, enzymatic reactions, browning, flavor loss, sedimentation, and nutrient degradation. Consequently, extension of shelf life without compromising product quality has become an important research priority. Chemical preservatives continue to play a significant role in beverage preservation owing to their effectiveness, ease of application, and cost efficiency. Potassium metabisulphite (KMS) and sodium benzoate are among the most widely used preservatives in fruit beverages because of their broad-spectrum antimicrobial activity.

Potassium metabisulphite releases sulphur dioxide, which inhibits the growth of yeasts, molds, and bacteria while minimizing oxidative changes. Sodium benzoate is particularly effective against yeasts and molds in acidic food systems. Although these preservatives are widely used individually, information regarding their comparative effectiveness and synergistic action in fruit beverages under different storage

conditions remains limited. Therefore, the present study was undertaken to evaluate the effectiveness of selected preservatives in enhancing the shelf life of fruit beverages.

Materials and Methods

Procurement of Raw Materials: Fully ripe Alphonso mangoes were procured from local markets. Granulated sugar, citric acid, potassium metabisulphite (KMS), and sodium benzoate of food-grade quality were obtained from authorized suppliers.

Preparation of Fruit Beverage: Mango fruits were washed, peeled, and pulped using a stainless-steel pulper. The beverage was standardized to contain Mango pulp: 20%, Total soluble solids: 15°Brix and Acidity: 0.30% (as citric acid). The beverage base was pasteurized at 85°C for 15 s and cooled to room temperature before addition of preservatives.

Experimental Design

Table 1. Treatment Details

Treatment	Preservative	Concentration (ppm)
T ₀	Control (without preservative)	0
T ₁	Potassium metabisulphite (KMS)	700
T ₂	Sodium benzoate	600
T ₃	KMS + Sodium benzoate	350 + 300

The preservative levels were selected according to permissible limits under Indian food regulations. The beverages were filled into sterilized glass bottles, sealed, and stored under Refrigerated conditions ($4\pm 1^\circ\text{C}$) and at Ambient conditions ($28\pm 2^\circ\text{C}$)

Analytical Methods: Samples were analyzed initially and at 15-day intervals for Total soluble solids (°Brix), pH, Titratable acidity (%), Ascorbic acid (mg/100 mL), Reducing sugars (%) and Non-reducing sugars (%). Standard AOAC (2005) methods were followed.

Microbiological Analysis: Microbial quality was assessed by determining Standard plate count (SPC), Yeast and mold count and Coliform count. Results were expressed as log cfu/mL.

Sensory Evaluation

A panel of ten semi-trained judges evaluated the beverages using a 9-point hedonic scale for Color and appearance, Flavor, Taste, Mouthfeel and Overall acceptability

Statistical Analysis: The experiment was conducted using a Completely Randomized Design (CRD) with factorial arrangement. Data were analyzed by ANOVA, and significant differences among treatments were determined at $P < 0.05$.

Results and Discussion

Physicochemical Changes During Storage

Table 2. Changes in Total Soluble Solids (°Brix) During Storage at Refrigerated Conditions

Storage Period (Days)	T ₀	T ₁	T ₂	T ₃
0	15.0±0.1	15.0±0.1	15.0±0.1	15.0±0.1
30	15.4±0.1	15.2±0.1	15.2±0.1	15.1±0.1
60	16.2±0.2	15.4±0.1	15.5±0.1	15.3±0.1
90	Spoiled	15.8±0.1	15.9±0.1	15.5±0.1

An increase in TSS was observed during storage, which may be attributed to hydrolysis of polysaccharides and conversion of complex carbohydrates into soluble sugars.

Changes in pH and Acidity

Table 3. Changes in pH and Titratable Acidity

Treatment	Initial pH	Final pH	Initial Acidity (%)	Final Acidity (%)
T ₁	3.82±0.02	3.64±0.03	0.30±0.01	0.38±0.01
T ₂	3.81±0.03	3.60±0.03	0.30±0.01	0.39±0.01
T ₃	3.82±0.02	3.72±0.02	0.30±0.01	0.35±0.01

The decrease in pH and corresponding increase in acidity during storage may be attributed to degradation of sugars and formation of organic acids.

Retention of Ascorbic Acid

Table 4. Ascorbic Acid Retention (mg/100 mL)

Storage Period (Days)	T ₁	T ₂	T ₃
0	24.8±0.4	24.8±0.4	24.8±0.4
30	22.6±0.4	22.2±0.5	23.4±0.4
60	20.4±0.5	19.8±0.4	21.8±0.5
90	18.8±0.4	18.2±0.5	20.6±0.4

The combined preservative treatment demonstrated superior retention of ascorbic acid by minimizing oxidative degradation.

Microbiological Quality

Table 5. Standard Plate Count (log cfu/mL) During Storage

Storage Period (Days)	T ₀	T ₁	T ₂	T ₃
0	1.42±0.04	1.40±0.04	1.40±0.04	1.38±0.03
30	3.28±0.08	2.14±0.06	2.24±0.06	1.86±0.05
60	Spoiled	2.82±0.08	2.94±0.08	2.24±0.06
90	—	3.48±0.10	3.64±0.10	2.86±0.08

No coliform organisms were detected in preserved beverages throughout storage.

The combination treatment (T₃) effectively suppressed microbial growth compared with individual preservatives.

Sensory Evaluation

Table 6. Overall Acceptability Scores During Storage

Storage Period (Days)	T ₁	T ₂	T ₃
0	8.62±0.08	8.58±0.10	8.68±0.08
30	8.42±0.10	8.36±0.12	8.56±0.10
60	8.14±0.12	8.06±0.14	8.38±0.10
90	7.84±0.14	7.76±0.16	8.12±0.12

The combined preservative treatment maintained superior sensory characteristics throughout storage. The results clearly demonstrated that preservative addition significantly influenced the storage stability of fruit beverages. The synergistic effect of potassium metabisulphite and sodium benzoate effectively inhibited microbial growth and reduced oxidative deterioration. Sulphur dioxide released from KMS acts as an antimicrobial and antioxidant agent, whereas sodium benzoate exerts greater efficacy against yeasts and molds in acidic environments.

The enhanced retention of ascorbic acid and improved sensory characteristics observed in the combined treatment may be attributed to reduced oxidative reactions and lower microbial activity. The increase in acidity and reduction in pH during storage are consistent with changes commonly reported in fruit beverages and may result from degradation of carbohydrates and formation of acidic compounds.

Industrial Significance: The use of appropriate preservative combinations can extend the shelf life of fruit beverages, reduce p and minimize refrigeration costs

Conclusion

The present investigation demonstrated that the combined application of potassium metabisulphite (350 ppm) and sodium benzoate (300 ppm) was more effective than individual preservatives in extending the shelf life of fruit beverages. The optimized formulation remained microbiologically safe and organoleptically acceptable for 90 days under refrigerated conditions and 60 days under ambient storage.

The findings provide a practical strategy for improving the commercial viability of fruit beverages while ensuring product quality and safety.

References

1. AOAC (2005). *Official Methods of Analysis*. 18th edn. Association of Official Analytical Chemists, Washington DC, USA.
2. Amerine MA, Pangborn RM and Roessler EB (1980). *Principles of Sensory Evaluation of Food*. Academic Press, New York.
3. De S (2001). *Outlines of Dairy Technology*. Oxford University Press, New Delhi.
4. Frazier WC and Westhoff DC (2004). *Food Microbiology*. 4th edn. Tata McGraw-Hill Publishing Co., New Delhi.
5. Ranganna S (2008). *Handbook of Analysis and Quality Control for Fruit and Vegetable Products*. 2nd edn. Tata McGraw-Hill Publishing Co., New Delhi.
6. Srivastava RP and Kumar S (2002). *Fruit and Vegetable Preservation: Principles and Practices*. 3rd edn. International Book Distributing Co., Lucknow.
7. Srilakshmi B (2007). *Food Science*. 4th edn. New Age International Publishers, New Delhi.
8. Thakur BR, Singh RK and Handa AK (1997). Chemistry and uses of pectin: A review. *Critical Reviews in Food Science and Nutrition* 37: 47–73.