|| Volume 1 || Issue 5 || January 2016 || ISSN (Online) 2456-0774
INTERNATIONAL JOURNAL OF ADVANCE SCIENTIFIC RESEARCH
AND ENGINEERING TRENDS

EVALUATION OF THE EFFECTIVENESS OF SELECTED STABILIZERS IN IMPROVING THE QUALITY OF WHEY-BASED 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 stabilizers in improving the quality and storage stability of a whey-based fruit beverage. Clarified paneer whey blended with mango pulp was used as the beverage base, and four stabilizers, namely pectin, carboxymethyl cellulose (CMC), guar gum, and xanthan gum, were incorporated at optimized concentrations. The beverages were evaluated for physicochemical properties, serum separation, viscosity, sensory characteristics, and microbiological quality during refrigerated storage (4±1°C) for 21 days. Significant (P<0.05) differences were observed among treatments for viscosity, sedimentation index, cloud stability, and sensory scores. The beverage containing pectin at 0.20% exhibited the lowest serum separation (2.14%), highest cloud stability (97.86%), and superior overall acceptability score (8.72±0.08). The results demonstrated that appropriate stabilizer selection significantly enhances the quality and shelf life of whey-based fruit beverages.***

Keywords: *Stabilizers, whey beverage, pectin, carboxymethyl cellulose, guar gum, xanthan gum, cloud stability, sensory quality*

Introduction

Whey is a nutrient-rich by-product generated during the manufacture of paneer, cheese, chhena, and casein. Approximately 85–90% of milk volume is converted into whey, which contains lactose, whey proteins, minerals, and water-soluble vitamins (Kosikowski, 1979; Zadow, 1992). Disposal of untreated whey poses environmental concerns owing to its high biological oxygen demand and chemical oxygen demand (Mawson, 1994). Development of whey-based fruit beverages offers an attractive strategy for sustainable utilization of dairy by-products while creating functional beverages with enhanced nutritional value. However, instability arising from phase separation, sedimentation, protein aggregation, and serum separation remains a major challenge in the commercialization of such beverages.

Hydrocolloid stabilizers are widely used in beverage systems to improve viscosity, suspend insoluble particles, reduce serum separation, and enhance mouthfeel. Pectin, carboxymethyl cellulose (CMC), guar gum, and xanthan gum are commonly used stabilizers in dairy and fruit beverages because of their ability to interact with proteins and modify rheological properties (Walstra et al., 2006). The effectiveness of stabilizers depends on beverage composition, pH, protein concentration, and processing conditions. Therefore, systematic evaluation of stabilizer performance is essential for developing stable and consumer-acceptable whey-based beverages. The present investigation was undertaken to compare the effectiveness of selected stabilizers in improving the quality attributes of whey-based fruit beverages.

Materials and Methods

Procurement of Raw Materials: Fresh paneer whey was obtained from the university dairy plant. Fully ripe Alphonso mangoes were procured from local markets. Food-grade pectin, carboxymethyl cellulose (CMC), guar gum, and xanthan gum were obtained from certified suppliers.

Preparation of Whey Beverage Base: Paneer whey was clarified by filtration through muslin cloth followed by centrifugation at 4,000 rpm for 15 min. The beverage base was standardized to contain whey: 70%, Mango pulp: 20%, Sugar: 10%, Citric acid: 0.15%. The ingredients were blended and homogenized at 150 bar.

Experimental Design

Table 1. Treatment Details

Treatment	Stabilizer	Concentration (%)
T_0	Control (without stabilizer)	0.00
T_1	Pectin	0.20
T_2	CMC	0.15
T_3	Guar gum	0.10
T_4	Xanthan gum	0.08

The concentrations were selected based on preliminary optimization trials. The beverages were pasteurized at 85°C for 15 s, bottled in sterilized glass bottles, and stored at 4±1°C.

Analytical Methods: The beverages were analyzed for pH, Titratable acidity, Total soluble solids (°Brix), Protein (%), Viscosity (cP), Serum separation (%), Cloud stability (%), Sedimentation index (%), Standard AOAC (2005) methods were followed.

Cloud Stability: Cloud stability was determined by measuring the percentage of suspended solids retained after centrifugation.

Sensory Evaluation: Sensory evaluation was conducted by ten semi-trained panelists using a 9-point hedonic scale. The attributes evaluated were Color and appearance, Flavor, Mouthfeel, Consistency and Overall acceptability

Microbiological Analysis: Samples were analyzed for Standard plate counts, Yeast and mold counts and Coliform counts. Analyses were conducted at 0, 7, 14, and 21 days of storage.

Statistical Analysis: The experiment was conducted using a Completely Randomized Design (CRD). Data were subjected to one-way analysis of variance (ANOVA), and treatment means were compared at P<0.05.

Results and Discussion

Physicochemical Characteristics

Table 2. Physicochemical Properties of Stabilized Whey Beverages

Parameter	T_0	T_1	T_2	T_3	T_4
pH	4.42±0.03	4.40±0.02	4.39±0.02	4.38±0.03	4.40±0.02
Acidity (%)	0.36±0.01	0.37±0.01	0.37±0.01	0.38±0.01	0.37±0.01
TSS (°Brix)	14.6±0.2	14.7±0.2	14.6±0.2	14.6±0.1	14.7±0.2
Protein (%)	0.68±0.02	0.68±0.02	0.68±0.03	0.68±0.02	0.68±0.03

Stabilizer addition did not significantly affect pH, acidity, TSS, or protein content.

Viscosity and Physical Stability

Table 3. Effect of Stabilizers on Rheological and Stability Parameters

Treatment	Viscosity (cP)	Serum Separation (%)	Cloud Stability (%)	Sedimentation Index (%)
T_0	18.4±0.6	12.84±0.42	81.24±1.12	10.48±0.36
T_1	42.6±1.2	2.14±0.10	97.86±0.84	1.62±0.08
T_2	38.8±1.0	3.28±0.14	95.48±0.92	2.84±0.12
T_3	56.4±1.4	4.62±0.16	94.16±1.04	3.72±0.14
T_4	48.2±1.2	3.84±0.14	96.22±0.88	2.26±0.10

Pectin significantly improved beverage stability by reducing serum separation and enhancing cloud retention. Guar gum produced the highest viscosity but imparted excessive thickness.

Sensory Evaluation

Table 4. Sensory Scores of Stabilized Whey Beverages

Treatment	Color and Appearance	Flavor	Mouthfeel	Consistency	Overall Acceptability
T_0	7.84±0.12	7.76±0.14	7.62±0.16	7.54±0.14	7.68±0.14
T_1	8.78±0.08	8.72±0.10	8.68±0.08	8.70±0.10	8.72±0.08
T_2	8.52±0.10	8.44±0.12	8.42±0.10	8.46±0.12	8.46±0.10
T_3	8.22±0.12	8.14±0.14	7.98±0.12	7.86±0.14	8.04±0.12
T_4	8.48±0.10	8.56±0.10	8.50±0.10	8.52±0.10	8.52±0.10

Pectin-stabilized beverage received the highest overall acceptability score due to its balanced mouthfeel and improved consistency.

Storage Stability

Table 5. Standard Plate Count During Refrigerated Storage

Storage Period (Days)	T_1 (log cfu/mL)
0	1.84±0.04
7	2.28±0.06
14	2.82±0.08
21	3.36±0.10

No coliform organisms were detected during storage.

All treatments remained microbiologically acceptable throughout the storage period. The findings demonstrated that stabilizer selection significantly influences the physical stability and sensory quality of whey-based fruit beverages. Pectin exhibited superior performance owing to its ability to form electrostatic complexes with whey proteins under acidic conditions, thereby preventing phase separation and improving cloud stability. CMC and xanthan gum also enhanced beverage stability but were less effective than pectin in minimizing serum separation.

Although guar gum provided maximum viscosity, excessive thickening adversely affected mouthfeel and consumer acceptability. The results are consistent with previous reports indicating that hydrocolloid stabilizers improve beverage stability by increasing serum viscosity and reducing particle sedimentation.

Industrial Significance

The application of suitable stabilizers in whey-based beverages offers several advantages like Improved product stability during storage, Enhanced consumer acceptability, Reduced sedimentation and phase separation, Extended shelf life and Better commercialization potential for whey beverages.

Conclusion

Among the stabilizers evaluated, pectin at 0.20% concentration was found to be most effective in improving the quality of whey-based fruit beverages. The pectin-stabilized beverage exhibited superior cloud stability, lower serum separation, improved mouthfeel, and the highest sensory acceptability. The study highlights the importance of appropriate stabilizer selection for successful commercialization of whey-based functional beverages.

References

1. AOAC (2005). *Official Methods of Analysis*. 18th edn. Association of Official Analytical Chemists, Washington DC, USA.
2. Jelen P and Tosoni S (2003). Whey processing and utilization. In: Roginski H, Fuquay JW and Fox PF (eds), *Encyclopedia of Dairy Sciences*. Academic Press, London, pp. 2739–2745.
3. Kosikowski FV (1979). *Cheese and Fermented Milk Foods*. 2nd edn. Edwards Brothers Inc., Ann Arbor, Michigan.
4. Mawson AJ (1994). Bioconversions for whey utilization and waste abatement. *Bioresource Technology* 47: 195–203.
5. Patel AA and Prajapati JP (1998). Utilization of whey in beverage preparation. *Indian Dairyman* 50: 37–42.
6. Walstra P, Wouters JTM and Geurts TJ (2006). *Dairy Science and Technology*. CRC Press, Boca Raton, Florida.
7. Zadow JG (1992). *Whey and Lactose Processing*. Elsevier Applied Science, London.