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Formulation and Quality Evaluation of a Whey Protein-Enriched Pineapple Drink for Enhanced Nutrition and Functional Benefits

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ABSTRACT

This study aimed to formulate and evaluate a nutritious and functional pineapple drink enriched with whey protein. The drink was prepared using pineapple pulp, whey water (a byproduct of cheese production), citrus pectin as a stabilizer, food-grade white sugar for sweetness, pineapple flavor 90 for enhanced aroma, and colour mist lemon yellow for visual appeal. The formulation process involved optimizing the proportions of these ingredients to achieve a palatable and stable product. The quality evaluation encompassed physicochemical analysis, including pH, titratable acidity, total soluble solids, viscosity, and protein content. Sensory evaluation was also conducted to assess consumer acceptability in terms of taste, aroma, color, and overall preference. Furthermore, the functional benefits of the whey protein enrichment, such as its potential contribution to muscle protein synthesis and satiety, were considered. The findings of this study provide insights into the feasibility of utilizing whey water to create a value-added, protein-rich beverage with the refreshing taste of pineapple, offering both nutritional enhancement and potential functional advantages.

KEYWORDS: *Whey protein, Pineapple drink, Formulation, Quality evaluation, Nutritional enhancement, Functional benefits, Whey water, Citrus pectin, Physicochemical analysis, Sensory evaluation.*

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1. INTRODUCTION

This research investigates the development of a novel functional beverage combining whey protein and pineapple. Driven by increasing consumer interest in health and wellness, the study aims to leverage the nutritional benefits of whey protein (high-quality protein, essential amino acids, BCAAs for muscle synthesis, satiety, potential immunomodulation) and pineapple (vitamins, minerals, fiber, and bromelain with potential anti-inflammatory and digestive benefits).The research will focus on optimizing a formulation that includes whey protein concentrate and pineapple pulp, along with citric acid for tartness and preservation, sugar for sweetness, pectin as an emulsifier, and potassium metabisulphite as a preservative. A comprehensive quality evaluation will assess the drink's physicochemical properties (pH, viscosity, total soluble solids), sensory attributes, and stability (sedimentation, phase separation, microbial growth). Nutritional analysis (protein, vitamin C, sugar content) will also be conducted. The rationale for combining these ingredients lies in their potential synergistic effects. Whey protein offers muscle-building and satiety benefits, while pineapple provides vitamins, minerals, fiber, and bromelain, which may aid in recovery and digestion. The combination aims to create a palatable and nutritious beverage catering to health-conscious consumers. The formulation process will involve carefully selecting ingredient concentrations to achieve optimal sensory properties, physical stability, and microbiological safety. The research will build upon existing literature on whey protein and pineapple in food science and nutrition, identifying any gaps in knowledge regarding their combined use in beverages. The

expected outcomes include a well-characterized formulation for a whey protein-enriched pineapple drink with enhanced nutritional value and desirable sensory attributes. The study will provide insights into ingredient interactions and their impact on beverage quality, establishing the drink's potential as a functional food product. This research could benefit the dairy and fruit processing industries and offer consumers a convenient way to improve their protein intake and access the bioactive compounds in pineapple. Further exploration will delve into the detailed composition, processing methods, and specific health implications of whey protein, including its amino acid profile, different forms (concentrate, isolate, hydrolysate), and processing techniques. The scientific literature supporting its effects on satiety, glucose regulation, and immunity will be examined. Similarly, a deeper dive into pineapple will cover its diverse phytochemicals (phenolic acids, flavonoids, carotenoids) and the enzymatic activity of bromelain (cysteine proteases). The mechanisms of action attributed to bromelain, its traditional uses, and its stability in food matrices will be discussed.

2. MATERIALS AND METHODS:

Raw Materials: The raw materials required for the preparation of the product: i.e. pineapple pulp, whey water, citrius pectin, food grade white sugar, pineapple flavor 90,colour mist lemon yellow.

preparation of pineapple pulp:

Select ripe pineapples, as they will offer the most vibrant flavor and sweetness. Carefully remove the crown and the base of the pineapple. Stand the pineapple upright and slice off the skin from top to bottom, ensuring all the "eyes" are removed. Cut the pineapple flesh into chunks, removing the hard core. Further cut the chunks into smaller cubes to ensure efficient blending. Transfer the pineapple cubes into a blender or food processor. Blend until a smooth consistency is achieved. Strain the blended pineapple through a fine mesh sieve to remove any remaining fibers (adapted from a common fruit processing technique). Collect the smooth pineapple pulp.

preparation of whey water:

Whey, a byproduct of cheese making or yogurt straining, was collected. This liquid byproduct, often cloudy, can be used directly. If the whey contains large particulate matter, it can be strained through a fine mesh sieve or cheesecloth to obtain a clearer liquid. The collected liquid is the whey water. Whey water contains valuable proteins and nutrients. The properties of whey water can contribute to the overall texture and nutritional profile of the final product. The amount of whey water used will depend on the desired consistency and the specific recipe requirements.

preparation of whey based pineapple beverage:

Whey-based pineapple beverage is a refreshing drink crafted from whey, a byproduct of cheese production, combined with pineapple and other ingredients. To create this beverage, select and accurately weigh the whey, pineapple (fresh or processed), sweeteners, and any additional flavorings or stabilizers. Blend these ingredients thoroughly to create a homogenous mixture. Next, the mixture undergoes pasteurization at a temperature of 72°C-75°C for 15-20 seconds to ensure safety and extend shelf life. Following pasteurization, the beverage is cooled rapidly to around 4°C to preserve its quality and flavor. Depending on the desired texture and stability, homogenization may be performed at a pressure of approximately 1500-2000 psi. Finally, the whey-based pineapple beverage is chilled further and packaged for consumption. Different variations of the beverage can be formulated by altering the proportions of pineapple, sweeteners, and additional flavorings, and sensory analysis can be conducted to evaluate these variations.

Table 1 Different sample forumulations:

Ingredient	Trial 1	Trial 2	Trial 3
Whey Water (mL)	600	550	500
Pineapple Pulp (mL)	300	350	400
White Sugar (g)	50	60	65
Pineapple Flavor 90 (mL)	2.5	3	3.5
Colour Mist Lemon Yellow (drops)	2	3	4
Citrus Pectin (g)	5	6	7

Trail 1

Trail2

Trail3

3. PHYSIO CHEMICAL ANALYSIS:

Moisture: Moisture content in the whey-based pineapple beverage was determined using a digital moisture analyzer. A 2-5 gram liquid sample was evenly spread on a tared pan and dried at a preset temperature (around 100°C) until weight stabilization. The analyzer displayed the moisture percentage (e.g., 88.5%), dry weight (e.g., 0.45 grams), and drying time (e.g., 210 seconds), with the dry matter content (e.g., 11.5%). This rapid method is crucial for quality control and shelf-life prediction.

Protein: Protein content in the whey-based pineapple beverage, crucial for nutrition and texture, was determined using the Kjeldahl method. [1] A 5-10 g sample was digested with sulfuric acid and a catalyst, then distilled after alkalization with NaOH, and the liberated ammonia was collected in boric acid. Titration of the ammonia with standard HCl allowed for nitrogen content calculation, which was then converted to protein percentage using a factor of 6.38. This method provides a quantitative measure of the protein present in the beverage.

Fat: The Gerber method, adapted for the whey-based pineapple beverage, involves dissolving non-fat solids with sulfuric acid and using amyl alcohol for clear fat separation. Centrifugation forces the fat into the calibrated neck of a butyrometer, where the fat percentage is directly read after incubation in a 65°C water bath. Adjustments to sample volume and butyrometer scale might be necessary for accurate low-fat content measurement in this specific beverage.

Titratable acidity: Titratable acidity in the well-mixed whey-based pineapple beverage was determined by titrating a 10 ml sample (diluted with 20-30 ml distilled water and 2-3 drops of phenolphthalein) against 0.1 N NaOH until a persistent pale pink endpoint was reached. The volume of NaOH used was recorded and then calculated as a percentage of citric acid equivalent, providing a measure of the total acidity crucial for flavor and stability.

4. RESULT AND DISCUSSIONS:

Sensory analysis identified Variation-3 as optimal due to its highest overall acceptability. This preference was driven by its appealing color, flavor, taste, texture, and appearance. Variation-3's flavor received the highest score, indicating a well-balanced and desirable aromatic profile. Its taste was also highly rated, suggesting a pleasant and satisfying flavor experience. The color of Variation-3 was appreciable, contributing positively to its appeal. While its texture might have presented slight differences from a control, it remained acceptable to the panelists. Overall acceptability, reflecting a holistic sensory experience, was highest for Variation-3, highlighting its potential for consumer satisfaction.

TABLE 2. RESULTS OF SENSORIAL ANALYSIS

Sensory attributes	Control	Variation-1	Variation-2	Variation-3
Colour	9	9	8	9
Taste	9	8	7	9
Appearance	9	8	9	9
Flavor	9	8	7	8
Texture	9	7	8	8
Overall acceptability	9	8	8	9

According to the results of the physico-chemical analysis, the developed and optimized variation (Variation-3) exhibited notable differences compared to a typical whey-based pineapple beverage (considered as a baseline).

The analysis revealed that Variation-3 demonstrated a specific protein enrichment, as intended by the formulation. Additionally, the analysis indicated variations in moisture content, potentially influenced by the added whey protein and pectin. The titratable acidity and total soluble solids of Variation-3 were within an acceptable range for a fruit-based beverage, possibly showing slight deviations due to the incorporation of whey. The fat content in Variation-3, originating from the whey, was also quantified. The specific values for these parameters would be detailed in a table to illustrate the impact of the formulation on the final product characteristics.

TABLE 3.PHYSCIO-CHEMICAL ANALYSIS

S. NO	PARAMETERS	CONTROL	OPTIMIZED VARIATION
1	Moisture%	87.50%	86.40%
2	Fat%	0.30%	0.105%
3	Titratable acidity	0.18%	0.27%
4	Protein%	1.1%	1.20%
5	PH	4.60	3.67
6	TSS	12.5°Brix	13.2°Brix

CONCLUSION:

Incorporating whey protein into a pineapple beverage presents a novel and intriguing approach to enhance its nutritional profile. The subtle creamy notes of whey protein blend surprisingly well with the refreshing tropical sweetness of pineapple, creating a unique fusion of flavors and textures. The addition of whey protein not only boosts the beverage's protein content but also introduces potential functional benefits, such as increased satiety. This innovative combination offers a nutritious and palatable alternative to traditional fruit drinks, catering to health-conscious consumers and those seeking convenient protein sources. Further exploration into different whey protein concentrations and flavoring adjustments could unveil even more appealing variations and applications in beverage development. Overall, whey protein-enriched pineapple beverage presents a promising opportunity for nutritional innovation, appealing to a diverse audience seeking both refreshment and added protein intake.

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