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Formulation & Self life Evaluation of Avocado *(persea americana)* Pulp Incorporated Instant Buttermilk Beverage

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Abstract— Buttermilk is a fermented dairy product that contains probiotics and avocado is nutrient-rich fruit. The focus of this study was to develop a buttermilk beverage with Avocado pulp to increase consumer acceptability. Different concentrations (T1 = 0%, T2 = 10 %, T3 = 15%, and T4 = 20% w/w) of Avocado pulp were extracted and added to a conventional recipe of buttermilk, sensory attributes, and overall acceptability were measured separately using thirty (12) trained panelists with five (5) points hedonic scale and selected the best formula with higher consumer acceptance. Selected formula and control samples were analyzed for pH, titratable acidity, and color within four (4) days intervals, and microbial tests were analyzed. Proximate analysis was done for moisture %, crude protein%, fat %, Energy %, Carbohydrate %, and ash% in selected formula. All the parametric and non-parametric data were analyzed using SAS, SPSS, and MS Excel at 0.05 significant levels. Avocado-incorporated buttermilk beverage (T4 = 20 %) acquired the highest sensory acceptance. The titratable acidity for the T4 formula increases during storage life from 0.12 ± 0.005 to 0.46 ± 0.005 and the pH value declined from 6.48 ± 0.01 to 5.45 ± 0.02. According to Sri Lankan standards, titratable acidity and pH value were within the acceptable limits for 14 days of storage period. Proximate analysis carried out according to the AOAC procedures revealed that the fat content was 1.00% ± 0.1, protein content 5.60% ± 0.1, Carbohydrate 8.60% ± 0.1 and ash content 0.38% ±0.03, and energy 65.8 kcal/100g ± 0.1 were in the acceptable limits. It can be concluded that the incorporation of Treatment 4 = 20% of Avocado pulp maintained the best sensory attributes, and chemical and physiochemical parameters in fourteen (14) days of storage life without adding any chemical preservative.

Index Terms— Avocado pulp, Beverage, Buttermilk, Instant, Shelf life

1 INTRODUCTION

It is important to eat, foods from each of the major food groups. In each food group, different foods provide more nutrients than others (Jakhar and Jain, 2019). Functional foods are defined as foods that, in addition to their basic nutrients, contain biologically active components, in adequate amounts, that can have a positive impact on the health of the consumer. Such foods should improve the general and physical conditions of the human organism and/or decrease the risk of occurrence of disease (Sheth and Hirdyani, 2016).

There has been a considerable increase in the consumption of fruit juices in the world and there are possibilities of its further increase (Jakhar and Jain, 2019). Fruit juices are generally a poor source of protein. This inherent lack of protein can be made up by the addition of an ingredient that provides protein and does not negatively affect the color and flavor. Milk and dairy products have been an important part of the human diet from ancient times in many parts of the world (Jakhar and Jain, 2019). Food scientists pay more and more attention to milk proteins because there is an advanced understanding of the physiological properties and biological activity of proteins. Proteins help to build and preserve muscle mass, are important to maintaining normal bone health, and affect the sense of satiety (Sekmokiene

et al., 2018).

Buttermilk is a good source of proteins, carbohydrates, minerals, vitamin A, and saturated in milk fat globule membrane (MFGM) components, and a good source of valuable milk proteins and lactose (Jakhar and Jain, 2019). Most of the buttermilk is drained out mainly because of the absence of economically viable methods of its utilization (Meshram, 2015). Sri Lankan market is still having a market gap for locally produced fermented flavored milk-based beverages. Buttermilk could be used to produce fermented milk beverages replacing milk which would result in differentiated products (Buddhadasa and Abesinghe, 2015).

Consumers are highly interested in avocado because it contains numerous types of nutrients and phytochemicals. Avocado is called butter fruit because approximately ¾ energy comes from fat, most of which are MUFAs (Monounsaturated fatty acids), which increase the level of HDL (High-density lipoprotein) that is good for the heart (Kumari and Chauhan, 2020). The excellent emulsifying properties of buttermilk and the abovementioned positive influence of its constituents on human health make it one of the most suitable food matrixes for functional beverages (Sekmokiene *et al.*, 2018).

This project aims to introduce a scientifically proven Avocado-incorporated buttermilk beverage and dried powder considering the current market demand and requirements.

2 METHODOLOGY

2.1 Research location & Experimental Site

The current study was carried out and laboratory analyses were done at Milco PVT Ltd, Ambewela, and the Faculty of Technology, University of Colombo. Well-ripened fresh avocados were collected from the local market of Ambewela. The buttermilk was collected from the butter production line of the Milco Dairy Factory at Ambewela. All other chemicals and instruments were taken from the laboratories of the Milco Dairy Factory and the Faculty of Technology, University of Colombo.

2.2 Sample Preparation

Fresh fully ripped Avocado fruits were washed with Distilled water and disinfected by using 70% ethanol. To obtain avocado pulp, peeled, and the non-edible parts: the seeds were removed and cut into small pieces by using a sharp knife and blemishes were removed. After that, the flesh was scooped out using a clean stainless-steel spoon, blended using an electric blender, and obtained homogenous avocado pulp. Then homogenized Avocado pulp was pasteurized at 80 ^{0}C for 10 min.

Buttermilk was prepared by the following method, initially, buttermilk was collected from a Churner and Filtrated. Then it was pasteurized at 85 ^{0}C for 10 min and cooled to 8 ^{0}C.

2.3 Formulation of Avocado Incorporated Buttermilk Beverage

The avocado beverage mixture was formulated (blended in an electric blender) by mixing avocado pulp, pasteurized buttermilk, sugar, pectin, CMC, and Potassium Sorbate as mentioned in Table 01. Several preliminary studies were done to select the best Avocado pulp and buttermilk incorporation level for the final product.

Table 01 Different formulations of avocado-incorporated buttermilk beverage

Treatment	Buttermilk %	Avocado Pulp %	Sugar %	Pectin %	CMC %	Potassium Sorbate %
T1(Control)	92	0	8	0.05	0.12	0.02
T2	82	10	8	0.05	0.12	0.02
T3	77	15	8	0.05	0.12	0.02
T4	72	20	8	0.05	0.12	0.02

2.4 Sensory Evaluation

Butter milk-based Avocado beverages were presented for sensory evaluations with 12 trained panelists. Their age range was in between 26 - 50 years (Graduate students and staff members of the Faculty of Technology, University of Colombo.). The sensory quality attributes under consideration were Color, Odor, Aroma, Texture, mouth feel, aftertaste, and Overall Acceptability. A five-point hedonic scale was used to point out the differences among the beverage samples. There was a well-defined key used with numbers from 1-5 numbers with 1 dislike extremely and 5 like extremely. According to the results of the sensory analysis, T4 treatment as best preferred sample. All the tests were carried considered as T1 was the control sample and T4 was the functional beverage sample.

2.5 Laboratory Analysis of the Final Product & Control

The measurements were conducted at appropriate day intervals over the 14-day storage period. Analysis of each beverage and control samples were done separately in triplicates except for microbiology. For the microbiological testing, duplicates were used. The pH, titratable acidity, color, total soluble solid, moisture content, and microbial analysis were determined at 4-day intervals for 14 days. Crude protein, crude fat, ash, Carbohydrate, total sugar, total energy, and total solids were determined only once. All the samples were analyzed according to the AOAC standard protocols.

2.6 Proximate Analysis

The selected sample was analyzed for moisture, fat, protein, ash content. Moisture Content (Oven Drying Method): Sausage samples were dried in an oven at 105°C, and the weight loss was used to calculate moisture content following the AOAC method 925.10. Fat Content (Soxhlet Extraction Method): Fat content was determined using Soxhlet extraction. Samples were processed with a solvent mixture, and the fat percentage was calculated based on the weight difference before and after extraction, according to AOAC method 2003.05. Protein Content (Kjeldahl Method): Protein content was measured using the Kjeldahl method. The process involved digestion, distillation, and titration of the samples to determine nitrogen content, which was then converted to crude protein using a specific formula, following AOAC method 960.52. (Muffle Furnace Method): Total ash content was determined by charring the sample, followed by ignition in a muffle furnace at 550-600°C until a gray ash was obtained, based on AOAC method 923.03. Total energy was calculated using Bomb Calorimeter.

2.7 Shelf-life Analysis

Selected beverage and control samples were stored under the below 4 ± 1^{o}C, for 14 days and tested the pH and Titration acidity.

2.8 Statistical Data Analysis

All physiochemical, chemical, and microbial data was analyzed by one-way analysis of variance (ANOVA) and significant differences among means were separated by using LSD and Excel. Differences at $P<0.05$ were considered to be significant. Analyses were performed by using SAS /SPSS software. Microbial data was compared with the Sri Lankan standards. Data from sensory analysis were analyzed using SPSS software.

3 RESULTS AND DISCUSSION

3.1 Sensory Properties of Avocado Incorporated Buttermilk Beverage

Table 02 Mean Values of Sensory Analysis

Treatment	Texture	Color	Taste	Aroma	Mouthfeel	After taste	Overall Acceptability
T1(Control)	3.25	2.9166	3.3333	3.1666	3.25	3.6666	3.3333
T2	3.5833	3.0833	3.3333	3.5	3.5833	3.6666	3.6666
T3	3.9166	3.8333	3.9166	3.5833	3.8333	3.6666	3.8333
T4	4.4166	4.5833	4.3333	4.25	4.25	4.1666	4.5

The primary objective of this study was to determine the optimal concentration of avocado pulp in a buttermilk beverage for enhanced palatability. To achieve this, sensory evaluations were conducted, considering various treatment levels to investigate the influence of avocado pulp concentration on sensory attributes. In sensory evaluation 04 treatment levels were conducted. When the pulp concentration was increased, acceptability for the sensory attributes (color, texture, aroma, flavor, mouth feel, aftertaste, and overall acceptability) were significantly increased. The research by Mudgil and Barak, 2020 also developed a fruit beverage with buttermilk, and sensory evaluation revealed that the higher concentration resulted in higher acceptability.

Across all sensory attributes, T4 consistently scored the highest, making it the most preferred version of the Avocado Incorporated Buttermilk Beverage. It performed especially well in color, taste, texture, and overall acceptability, indicating that the combination of ingredients in this treatment yielded the most appealing product for the panelists. T1 (Control) in contrast, received the lowest ratings across several categories, making it the least favored. This suggests that the incorporation of avocado in T4 greatly improved the sensory qualities of the beverage as shows in Fig.01 and Table 02.

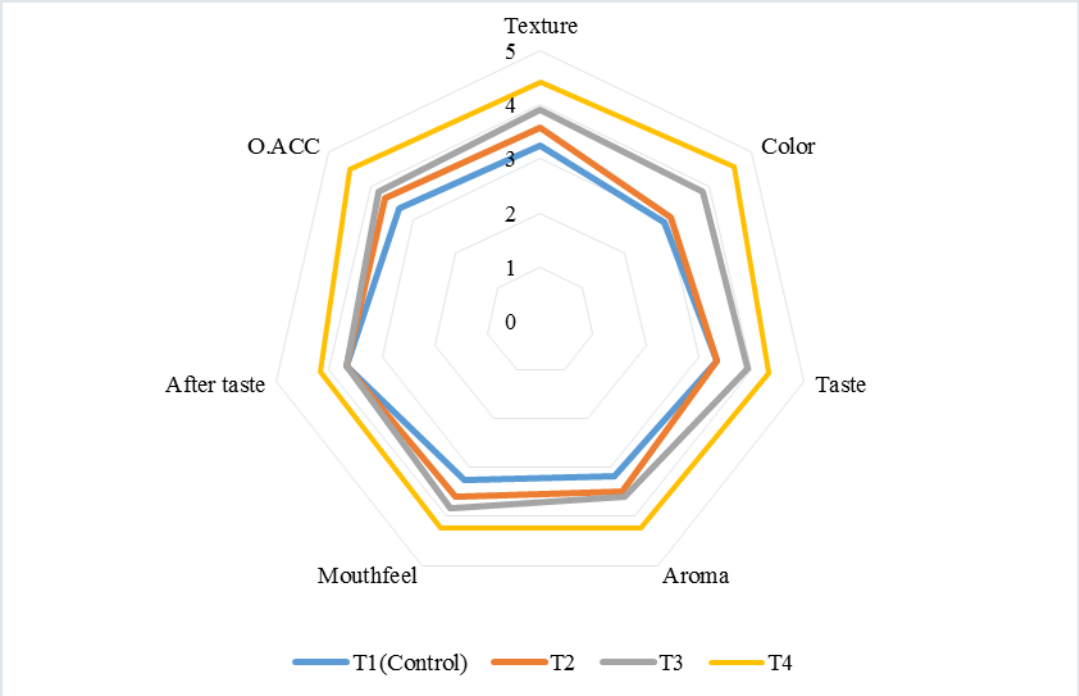

Fig 1. Results of the Sensory Analysis

3.2 Proximate Analysis of Avocado Incorporated Buttermilk Beverage

Table 03 Proximate of Avocado Incorporated Buttermilk Beverage

Parameter	Value %
Crude Protein	5.60 ± 0.1
Total Fat	1.00 ± 0.1
Total Sugar	4.50 ± 0.1
Total Carbohydrate	8.60 ± 0.1
Ash Content	0.38 ± 0.03
Total Energy	65.8 kcal/100g ± 0.1

[1]The values are expressed as the mean value ± Standard deviation (SD) of the triplicate sample (n3).

In the proximate analysis of final product of Avocado Incorporated Buttermilk Beverage contains 5.60% crude protein**,** 1.00% total fat**,** 4.50% total sugar**,** 8.60% total carbohydrate**,** and 0.38% ash content**,** with a total energy value of 65.8 kcal per 100g**.** These values provide an overall profile of the beverage's nutritional content, reflecting a balanced composition with moderate energy and a low-fat content, while still offering essential proteins and carbohydrates.

3.3 Shelf-life Analysis

Shelf-life of the Avocado pulp incorporated instant buttermilk beverage was conducted analyzing pH, Titratable Acidity (TA), Total Colony Count (TCC) and Yeast and Mold content. In terms of pH variance, a significant decrease was noted with the duration of storage days. Notably, the pH value of the selected formula exhibited a more substantial decrease compared to the control. About TA variance, there was a significant increase observed with the duration of storage days. Notably, the TA value of the selected formula demonstrated a more substantial increase compared to the control. The significant increase in Total Acidity (TA) over the storage days suggests ongoing changes in acidity levels within the sample. The Total Cell Count (TCC) exhibited a significant increase with the progression of storage days. Notably, the TCC of the selected formula demonstrated a more significant increase compared to the control. These results are similar to the results obtained by Caetano *et al.*, 2011 who analyzed the microbiological quality of buttermilk-based fruit beverages during storage. As per the Y/M count, there was a significant increase observed with the passage of storage days. Notably, the Y/M count of the selected formula exhibited a more pronounced increase compared to the control.

4 CONCLUSION

Considering the results of the study, it can be concluded that the incorporation of Avocado pulp contributed to improving the sensory qualities of the buttermilk beverage and resulting in a product with improved nutritional value and sensory characteristics.

Buttermilk is a byproduct of the butter production line but it is a more nutrient-richer product. So, buttermilk-based beverages are more cost-effective than other dairy products. Avocado fruit is available in Sri Lanka. Cost-effective than other fruit beverages in the local market.

Considering shelf-life evaluation, Consumers generally accepted the avocado-incorporated buttermilk beverages, with some slight variations in preference based on the specific formulation. (Treatment-04), 20% of Avocado pulp incorporated buttermilk beverage is more accepted. So, consumers highly appreciate the Avocado pulp. The shelf-life results showed that it could be stored for 14 days at 4°C without any undesirable microbial, chemical, or physical changes. That pH, TTA, TCC, Y & M variance is not harmful for human consumption.

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