

Research Application Summary

Physicochemical and sensory properties of pineapple blended with coconut water, lime and lemon juice

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Abstract

A refreshing beverage was prepared from coconut, pineapple, lime and lemon to form a functional juice in which the pineapple fibre was incorporated into the drink to improve its functionality. The Box-Behnken Design (BBD) Response Surface Methodology (RSM) was used to prepare 15 formulations of the pineapple-coconut-lime beverage and the pineapple-coconut-lemon beverage. The data obtained for titrable acidity, pH, total soluble solids (TSS), and sensory attributes (colour, aroma, taste, consistency and overall acceptability) under dissimilar experimental conditions were optimized using the overall desirability techniques in Design Expert version 10.0 (Design-Expert, 2010). Responses for independent variables were optimized by setting goals to optimize the two beverages. The packaged beverage samples were immediately stored at -24 °C. There were significant changes in pH, total soluble solids and titrable acidity. The result shows that the beverage could be considered by the fresh fruit juice industry for juice preparation.

Key words: Coconut, lime, pineapple blended juice, titrable acidity, total soluble solids, quality, pH

Résumé

Une boisson rafraîchissante a été préparée à partir de noix de coco, d'ananas, de citron vert et de citron pour former un jus fonctionnel dans lequel la fibre d'ananas a été incorporée à la boisson pour améliorer sa fonctionnalité. La méthode RSM (Response Surface Methodology) du Box-Behnken Design (BBD) a été utilisée pour préparer 15 formulations de la boisson ananas-coco-citron vert et de la boisson ananas-coco-citron. Les données obtenues pour l'acidité titrable, le pH, les solides solubles totaux (TSS) et les attributs sensoriels (couleur, arôme, goût, consistance et acceptabilité globale) dans des conditions expérimentales dissemblables ont été optimisées en utilisant les techniques de désirabilité globale dans Design Expert version 10.0 (Design-Expert, 2010). Les réponses aux variables indépendantes ont été optimisées en fixant des objectifs pour optimiser les deux boissons. Les échantillons de boissons emballés ont été immédiatement stockés à -24 °C. Des changements significatifs ont été observés dans le pH, les solides solubles totaux et l'acidité titrable. Le résultat montre que la boisson pourrait être considérée par l'industrie des jus de fruits frais pour la préparation des jus.

Mots clés : Jus mélangé de noix de coco, citron vert, ananas, acidité titrable, solides solubles totaux, qualité, pH.

Introduction

Pineapple is thought to have originated from southern America. It was discovered by the Europeans by (Christopher Columbus). About 70% of the pineapple produced in the world is consumed as fresh fruit in the country of origin (Bartholomew *et al.*, 2003). Pineapple is an important crop cultivated in the tropical regions of the world (Sripaoraya *et al.*, 2003). The average pineapple contains 81.2 to 86.2% moisture, and 13-19% total solids, of which sucrose, glucose and fructose are the main components. Pineapple fruit forms a vital part of human diet. It is extremely rich in vitamin and aids in providing our body with vital food nutrient. The pineapple fruit is well-known to contain proteolytic enzyme called bromelain that helps to digest food by breaking down protein. It has been used for centuries to treat indigestion and also reduce inflammation (Gautam *et al.* 2010).

The wide applications of coconut water for health and nutritional benefits can be justified by its unique chemical composition of sugars, vitamins, minerals, amino acids and phyto-hormones (Chauhan *et al.*, 2014). In Ghana, coconut is found in all markets being sold in their fresh state without its being processed into fruit juice or other products of citrus fruit or juice is found to be inversely associated with several diseases (Guimaraes *et al.*, 2010). Several studies have pointed out that lemon is a rich source of nutrients and phytochemicals, including flavonoids, citric acid, vitamin C and minerals and these have numerous health promoting properties. Lemon juice is often used in food matrix for designing new beverages (Girones-Vilaplana *et al.*, 2012). Lime juice on the other hand contains a variety of vitamins, minerals, fibre, and phytonutrients such as carotenoids, flavonoids, and limonoids, which appear to have biological activities and health benefits (Tripoli *et al.*, 2007).

Fruits such as coconut, pineapple, lemon and lime are important source of energy for human-beings but they are perishable items. Hence, it is suggested to undertake fruit processing activity to process these fruits into juices, so that consumers can consume fruit during off season as well. Hence, the objective of this study was to investigate the effect of the different blend composition of coconut, pineapple, lemon and lime on the titratable acidity, pH, total soluble solids and sensory properties (taste, aroma, colour, texture, overall acceptability) of pineapple-coconut, lemon and lime beverages.

Study description

The coconuts, pineapples and lemon were washed thoroughly with aquatabs troelosene sodium water to get rid of the dirt and sand on them. The cleaned pineapple fruits were manually peeled using stainless steel knife and chopped into small pieces and the juice extracted by use of a commercial juice machine (FT-0.5, China) after blending with commercial type juice blender (Philips electric blender, high horse power XTY-767). A stainless knife was used to cut the lemons and limes into two halves; the lemon juice was squeezed manually and also with manual citrus juicer, whereas the lime juice was squeezed manually from the split limes. The coconut fruits were split with a stainless cutlass, after which the coconut water was poured into a cleaned container. The obtained juice was stored at -24 °C to prevent quality degradation until use for mixing.

Experimental design. Box-Behnken Design (BBD) was used to study the combined effect of three independent variables (coconut water, pineapple juice and lime juice) coded X_1 , X_2 , and X_3 where X_1 were temperate ranges from 40 to 60% coconut water, X_2 in the range of 50 to 80% pineapple juice concentration, X_3 in the range of 5 to 10% lime juice concentration and (coconut water, pineapple juice and lemon juice) coded X_1 , X_2 , and X_3 respectively. The Box-Behnken Design (BBD) Response Surface Methodology (RSM) was used to prepare 15 formulations of the pineapple-coconut-lime beverage and the pineapple-coconut-lemon beverage. The effect of each factor was assessed on the responses and partitioned into linear, quadratic and interactive components as represented in equation (1):

$$Y = b_0 + \sum_{i=1}^j b_i x_i + \sum_{i=1}^j b_{ii} x_i^2 + \sum \sum b_{ij} x_i x_j \dots\dots\dots (1)$$

Where Y= the dependent variable (response), b_0 =constant, b_i =linear coefficient, b_{ii} the quadratic coefficient and b_{ij} the interaction coefficient. x_i and x_j are the levels of the independent variables. Response surface quadratic models were developed to represent the data thus collected and to graphically describe the effects of the factors on the responses.

Optimization of the juice processing parameters. The data obtained for titrable acidity, pH, total soluble solids (TSS), and sensory attributes (colour, aroma, taste, consistency and overall acceptability) under dissimilar experimental conditions were optimized using the overall desirability techniques in Design Expert version 10.0 (Design-Expert, 2010). The optimized beverage was prepared and packaged in pre-sterilized 250 mL plastic bottles and corked tightly without pasteurization for storage. The packaged beverage samples were immediately stored at -24 °C.

Results and discussion

Data in Table 1 shows that addition of lime juice significantly ($p<0.05$) decreased the pH of the pineapple-lime-coconut beverage and on the other hand an increase in the lemon concentration significantly decreased the pH of the pineapple-lemon-coconut beverage ($p< 0.01$). Lime juice, lemon juice and coconut water significantly decreased the TSS of the beverage but increasing pineapple concentration increased the TSS of the two beverages ($p<0,01$). In the case of the titrable acidity, increasing lime and lemon juice significantly increased the TA of the two beverages ($p<0.01$).

Table 1. Results of pH, TSS, titrable acidity and sensory attributes of pineapple-coconut-lemon beverage

Run	X ₁	X ₂	X ₃	TSS (brix)	pH	TA (%) S	Colour	Aroma	Taste	Consistency
1	40	80	5	13.43	4.06	0.2511	6.5789	6.3684	6.6316	7.1053
2	40	65	2.5	12.83	4.3	0.2613	6.6842	6.8947	6.7895	6.4737
3	50	65	5	12.5	4.03	0.2149	6.3684	6.3158	7.0000	6.7368
4	60	80	5	12.3	3.665	0.2130	6.3158	6.6842	6.7368	6.7368
5	50	80	7.5	12.8	3.94	0.2528	6.5263	6.4737	6.3158	6.6842
6	40	50	5	12.4	3.845	0.2036	6.0526	6.3684	6.0526	6.3158
7	50	50	7.5	11.63	3.73	0.2214	6.3158	5.4737	4.7368	6.0526
8	60	50	5	10.9	3.82	0.1663	5.9474	5.7368	5.9474	6.2105
9	50	65	5	12.13	4.08	0.2659	6.4737	6.6842	6.7895	6.7895
10	40	65	7.5	12.97	3.71	0.2751	5.8947	6.6842	6.0526	7.0526
11	50	65	5	12.4	3.78	0.2035	5.8421	5.5789	6.0000	6.4737
12	60	65	7.5	11.57	3.94	0.2337	6.3158	5.8421	5.4737	6.2632
13	60	65	2.5	11.73	4.63	0.2325	6.0000	6.8421	6.3684	6.5789
14	50	80	2.5	13.07	4.66	0.2260	6.2632	6.6842	7.5263	7.4737
15	50	50	2.5	11.4	4.76	0.1647	6.4737	6.2632	7.0526	6.5263

Coconut (X1) in ml, Pineapple (X2) in ml, Lime (X3) in ml, Total soluble solutes (TSS), Titratable acidity (TA), Color (L¹) Consistency (Cons). Overall Acceptability (OAA)

An increase of coconut water to the beverage significantly ($p < 0.05$) increased the overall acceptability of the pineapple-lime-coconut beverage but surprisingly, the coconut water insignificantly decreased OAA ($p > 0.05$) of the pineapple-lemon-coconut water beverage. Pineapple juice concentration increased the OAA of both beverages while the addition of lime and lemon decreased the beverages OAA ($p < 0.05$). The overall acceptability of the two beverages was good for the whole experiment due to the increase in pineapple juice concentration. However, the beverages were stored for few days (max. 5 days) at $-24\text{ }^{\circ}\text{C}$ where the two beverages were acceptable then.

Acknowledgement

The authors gratefully appreciate the support of Mr. Francis Abambey for assisting in data collection for this work and MARVEN Fruit Juice Company Limited, Elmina for participating in the study. This paper is a contribution to the Fifteenth RUFORUM Annual General Meeting held 2-6 December 2019 in Cape Coast, Ghana.

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