

Evaluation of Some Quality Attributes of Pineapple, Golden Melon and Watermelon Juice Spiced with Ginger

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Abstract: Fruits and vegetables are among the most important foods of mankind because of their nutritive and indispensable effect in the management of health. A wide range of drinks can be made using extracted fruit juice or fruit pulp as the base material. This research aimed at determining some quality attributes of pineapple-watermelon-golden melon juice spiced with ginger using optimization technique. Ginger, watermelon, golden melon and pineapple juice was extracted using standard methods. A D-optimal design was used to generate 13 juice blends. Different methods were used to analyse the blends. The blends were analysed for ascorbic acid, pH, total soluble sugar, sugar acid ratio, titratable acidity and sensory properties. The results shown that vitamin C content of the blend increased with increase in inclusion of pineapple. The ascorbic acid, pH, total soluble solids, sugar acid ratio and titratable acidity ranged from 12.24-19.72 mg/100, 4.09-4.20, 11-12.00%, 26.04-42.92 and 0.2624-0.4160. The blends were rated between 6 (like slightly) and 7 (like moderately). The inclusion of pineapple created an increase in the ascorbic acid and total solids of the juice blend increased but addition of the watermelon and golden melon fruit decreased the total soluble solids of the fruit juice while the pH properties observed decrease. The inclusion of golden melon also decreases the sugar acid ratio. An optimized sample was obtained from 50% pineapple, 30% watermelon and 20% golden melon with a desirability of 0.70. Total phenolic values observed was 333.68mg GAE/100 ml but the total phenol content of GAE/100ml for golden melon increased to GAE/150ml with the addition of water melon. The sensory analysis of the products review that 100% pineapple juice used in the blend was the most acceptable. Conclusion, blend of different types of fruits contains high content of micronutrients.

Keywords: Watermelon, Golden Melon, Pineapple, Juice Spiced, D-Optimal

1. Introduction

Fruit drinks are important sources of nutrients and contain several important therapeutic properties that may reduce the risk of various diseases. They contain large amounts of antioxidants, vitamins C and E, and possess pleasant taste and aroma [1]. Fruits are highly perishable, non-staple foods which make up about 39% of the food intake (fresh state or

processed form) of people living in developing countries of Africa [2]. Based on antioxidant capacities of fruits, they are used as indicators for healthy nourishment as well as protection factors of the human body against oxidative destruction [3]. Fruits have been shown to contain high amount of minerals, moisture, low ash and crude fibre and are sources of sugar, vitamin A, C and B groups, low protein and lipid [4].

Fruits being a seasonal crop by nature have prompted many scientists to embark on researches on how to process fruit juices and preserve them for usage during off-season. [5] Combination of fruits into a blend for nutrients dense product, so the study tend to address some of these questions: will combination of fruits increase in Vitamin C content? What is going to be the effect of ingredients combination on the sugar acid ratio and PH of fruit juice blend and consumers acceptability?

Pineapple is an excellent source of antioxidant vitamin C which is required for the collagen synthesis in the body [6]. The water melon is a full array of nutrients, including carbohydrates, sugar, soluble and insoluble fiber, sodium, vitamins, minerals, fatty acids, amino acids etc [7, 8, 9]. Golden melon, nutritional a great constituent of essential minerals and nutrients such as vitamin C, pantothenic acid, calcium, zinc, vitamin B6, fibre, magnesium, iron, potassium, vitamin A and omega-3 & 6 [10].

Ginger has been a part of healing strategies in Asia, India, Europe, and the Middle East for centuries for treatment of such disorders as arthritis, stomach upset, asthma, diabetes, and menstrual irregularities, to name a few. [11]

Juices produced from tropical fruits have increasingly gained global importance due to their health effect. The significant of the study is to identify other different types of tropical fruits (e.g., orange, grape, pineapple, banana, guava and watermelon) readily available for the production of fruit juices. The juice may be produced from single fruit or

combination of fruits and sold by the street vendors.

Fruits consumption is beneficial to health and contributes to the prevention of degenerative processes, particularly in lowering the incidence and mortality rate of cancer and cardiovascular diseases [6].

2. Materials and Methods

Pineapple, ginger and watermelon, and golden melon were purchased from Osiele market in Abeokuta. The chemicals and, the equipment used were of analytical grade and food, standard and were obtained from the Department of Food Science and Technology, FUNAAB.

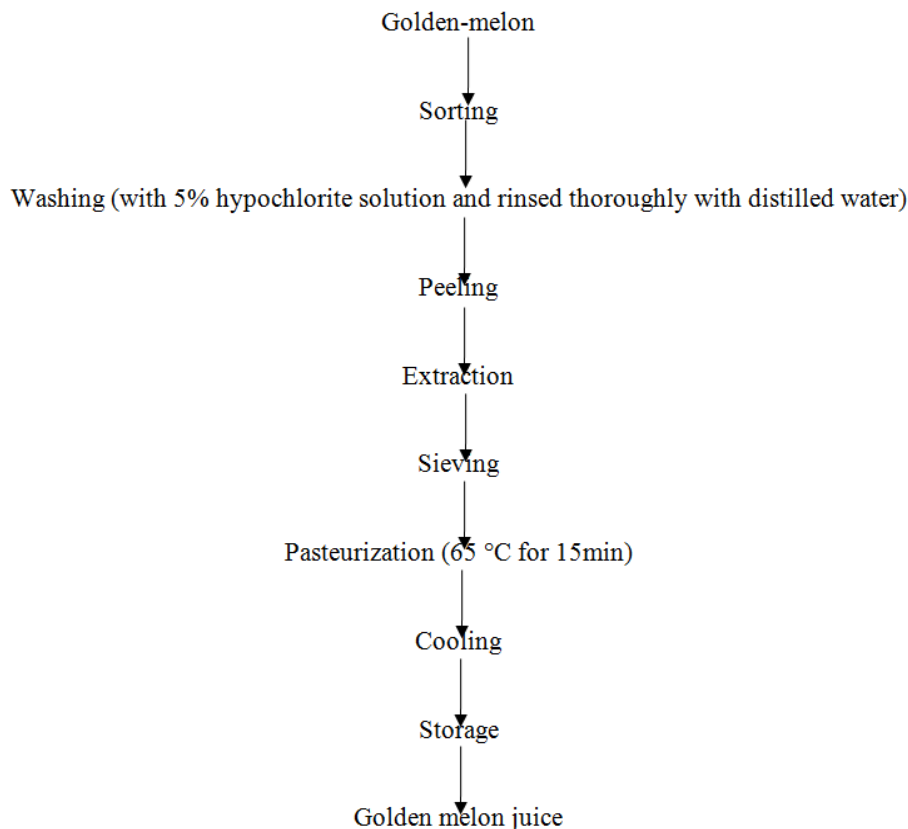
2.1. Methods

2.1.1. Preparation of Watermelon Juice

The watermelon juice was well prepared using the following process: the fruits were washed with clean water, peeled using a knife, and the seeds removed and cut into small pieces. The fruit was then blended in an electric fruit processor to produce pulp, sieved using a clean cheesecloth, then pasteurized at 65°C for 15 minutes, cooled to room temperature, and packaged in sterilized pet bottles [12].

2.1.2. Preparation of Golden-Melon Juice

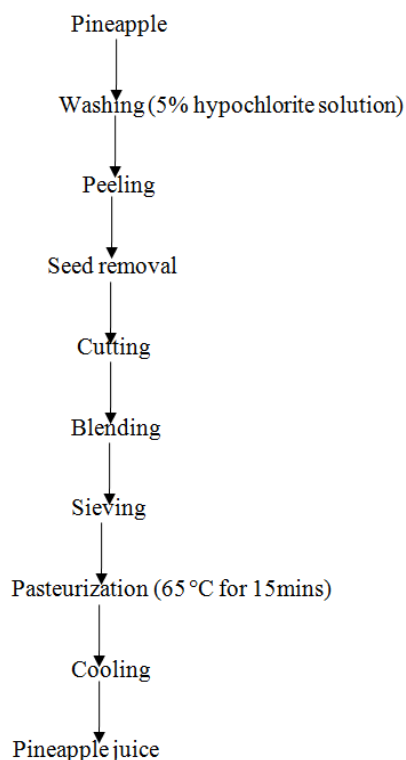
Golden melon-watermelon fruits juice blend was prepared using a modified method as contained in the flow chart [13].



Source: [13]

Figure 1. Preparation of Golden melon.

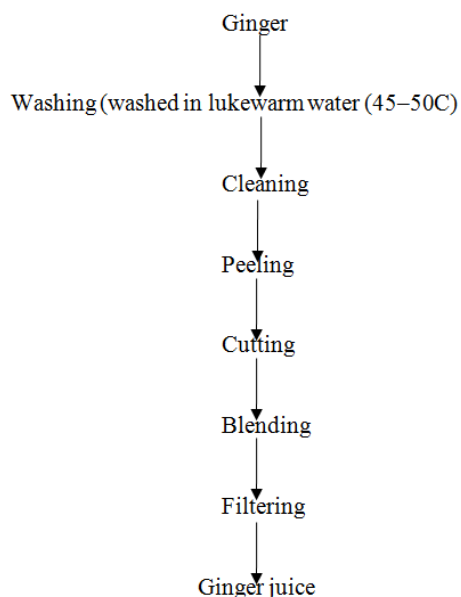
2.1.3. Preparation of Pineapple Juice



Source: [5]

Figure 2. Preparation of pineapple juice.

2.1.4. Production of Ginger Juice



Source [14]

Figure 3. Preparation of ginger juice.

2.2. Blending of Fruit Juice

D-optimal, mixture design with three components was used to generate a mixture of water melon, pineapple and

golden melon (Table 1). A total of 13 blends were generated.

Table 1. Composition of the different formulations based on experimental design.

Sample	Pineapple juice (%)	Water melon juice (%)	Golden melon juice (%)
1	55.00	25.00	20.00
2	45.00	30.00	25.00
3	45.00	25.00	30.00
4	55.00	22.50	22.50
5	50.00	25.00	25.00
6	49.37	28.13	22.50
7	53.13	23.13	23.75
8	47.50	30.00	22.50
9	55.00	25.00	20.00
10	55.00	20.00	25.00
11	51.88	26.88	21.25
12	55.00	20.00	25.00
13	50.00	30.00	20.00

2.3. Physiochemical Properties

The determination of vitamin C content, sugar-acid ratio of the juice, titratable acidity (TTA), total solids (TS), and total soluble solids (oBrix) content of the juices was determined as described by the method of AOAC [15].

The amount of total phenol content was also determined using Folin-Ciocalteu colorimetric method [16], using gallic acid as a standard following the method described by [17].

2.4. Sensory Evaluation

The sensory analysis was carried out using fifty-member panelists. The sensory qualities that were evaluated are Colour, Flavour, Taste, and overall acceptability. The 100% watermelon, 100% pineapple, 100% golden melon, and optimised sample juice blends were served with clean glasses to an individual panelist. The order of presentation of samples to the panel was randomized. Each sensory attribute was on a 9 – point Hedonic Scale with 1 = disliked extremely while 9 = liked extremely as reported by [18].

2.5. Statistical Analysis

The data obtained during sensory analyses were statistically analyzed for a significant effect of the independent variables on the responses at a 5% level using the analysis of variance (ANOVA) of SPSS version 21. The effect of ingredient combination and optimization procedure was investigated using Design expert version 6.

3. Results and Discussion

3.1. Effect of Ingredient Combination on Vitamin C of Fruit Juice from Blends of Pineapple, Watermelon, and Golden Melon

The effect of fruit combination on vitamin C content was investigated using mixture design according to D-optimal design. The vitamin C ranged from 12.24 to 19.72 mg/100 as

shown in Table 2. The vitamin C contents of the formulated juice of great health significance and this implies that the formulated juice is very high in vitamin C and may take care of vitamin C deficiency related ailment like scurvy [19]. From the response surface plot (Figure 4), vitamin C was found to increase with increase in inclusion of pineapple but addition of watermelon and golden melon juice decrease the value of the ascorbic acid (vitamin C). Vitamin C is involved

in protein metabolism, collagen synthesis and an important physiological antioxidant [20]. It also plays an important role in immune function, improves absorption of non-heme iron and participates in biosynthesis of glucocorticoids [21]. From Table 3, interaction effects of pineapple juice, watermelon and golden melon had no significant effect ($P < 0.05$) on the vitamin C content. The coefficient of determination (R^2) was 0.72.

Table 2. Physicochemical properties of fruits juice from the blends of pineapple, water melon and golden melon.

Sample	Pineapple juice (%)	Watermelon juice (%)	Golden melon juice (%)	Vitamin C (mg/100)	Total solid (%)	Sugar acid Ratio	pH range	Total Soluble solids%	Titrateable acidity
1	55.00	25.00	20.00	16.32	7.13	28.85	4.12	12	0.4160
2	45.00	30.00	25.00	17.68	10.00	30.28	4.18	11	0.3963
3	45.00	30.00	25.00	14.28	5.20	30.15	4.19	11	0.3648
4	55.00	22.50	22.50	14.96	9.83	26.04	4.09	11.5	0.4160
5	50.00	25.00	25.00	12.92	10.76	32.41	4.14	11.2	0.3456
6	49.37	28.13	22.50	15.64	8.06	33.05	4.20	11	0.3328
7	53.13	23.13	23.75	19.72	11.69	37.50	4.13	12	0.3200
8	47.50	30.00	22.50	19.04	4.56	30.69	4.17	11	0.3584
9	55.00	25.00	20.00	17.00	15.60	33.90	4.10	11.5	0.3392
10	55.00	20.00	25.00	13.60	7.30	29.13	4.12	11	0.3776
11	51.88	26.88	21.25	18.36	7.73	36.57	4.13	11	0.3008
12	55.00	20.00	25.00	19.04	15.12	32.67	4.11	11.5	0.3520
13	50.00	30.00	20.00	12.24	8.29	41.92	4.13	11	0.2624

*Values are means of duplicate determination.

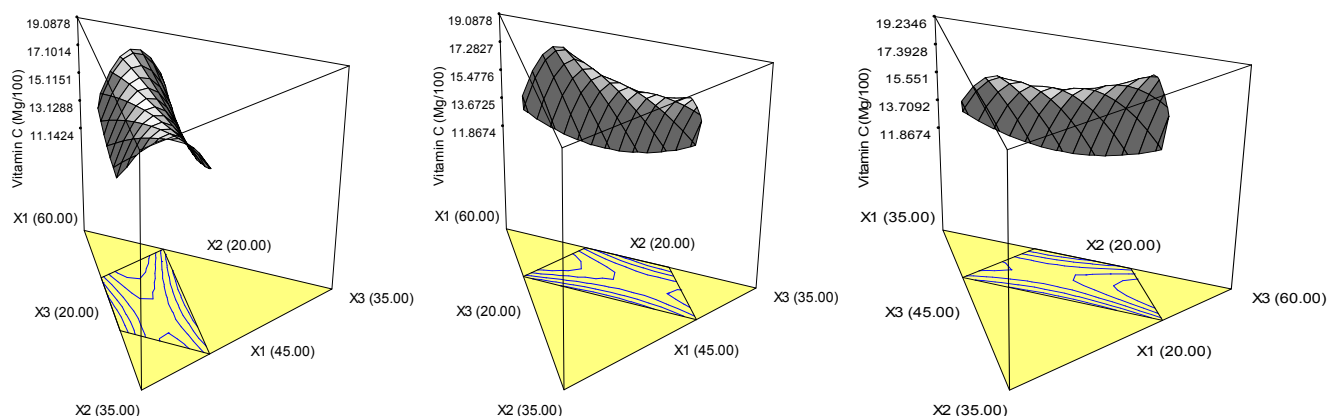


Figure 4. Response surface plots of vitamin C content of pineapple- watermelon -golden melon fruit blend at different ingredient combination.

Table 3. Regression coefficient of the responses as a function of the independent variables.

Parameters	Vitamin C	Total solids	Sugar acid	Ph
A	21.11	11.41	12.88	4.05
B	14.93	-0.02	38.57	4.18
C	-49.24	60.62	104.07	3.97
AB	-13.76	17.16	47.57	0.04
AC	82.17	-73.77	-53.96	0.38
BC	101.10	-57.39	-140.29	0.36
R ²	0.72	0.62	0.92	0.80

*Values are significant at 5% level, Where

A, B, and C = pineapple, watermelon and golden melon fruits, respectively

AB= Interaction effect of pineapple and water melon fruits

AC= Interaction effect of pineapple and golden melon fruit

BC= Interaction effect of water melon and golden melon fruits.

3.2. Effect of Ingredient Combination on Total Solids of Fruit Juice from Blends of Pineapple, Watermelon, and Golden Melon

The total solids of the juice blends ranged from 4.56 to 15.60% (Table 2). The interaction effect of the independent variables was not significant in the total solids of the juice blends. (Table 3) shows that the quadratic model best explains the relationship between the processing variables and total soluble solids. The coefficient of determination (R^2) of the models was relatively low (0.62), and this guarantees the good fitness of the models when applied. The coefficients of the model's parameters indicate the magnitude and significance of each model parameter concerning their effects on the response variables, which means, the higher the coefficient of a model parameter, the higher the significance of such parameter [22].

From Figure 5, an increase in total solid was observed with an increase in pineapple inclusion, but the addition of the watermelon and golden melon fruit decreased the total soluble

solids of the fruit juice. This pattern of increase might be due to partial hydrolysis of complex polysaccharides and solubilisation of pulp constituents during processing.

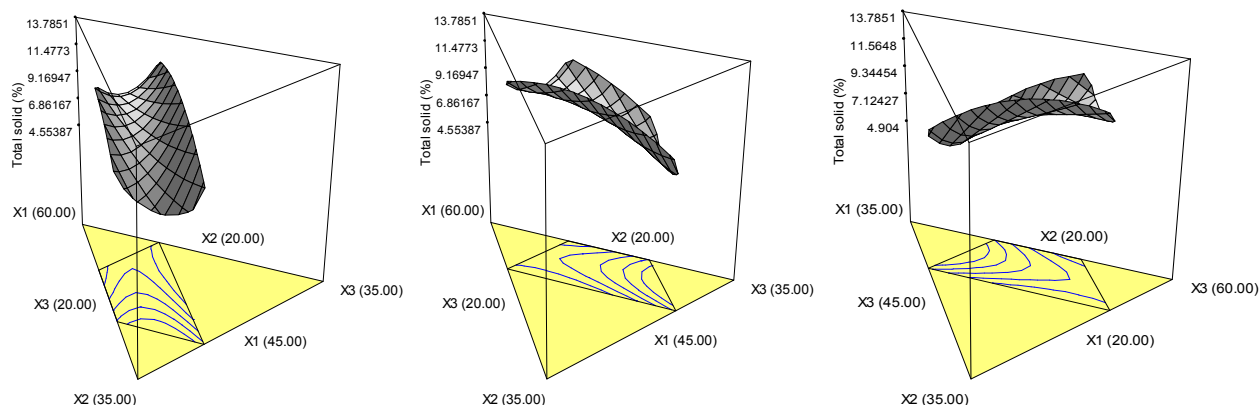


Figure 5. Response surface plots of total solid content of pineapple-watermelon-golden melon fruit blend at different ingredient combination.

3.3. Effect of Ingredient Combination on Sugar Acid of Fruit Juice from Blends of Pineapple, Watermelon and Golden Melon

Sugars are the major soluble solids in fruit juice [23, 24]. The fruit quality can be measured by total soluble solids to Titrate table acidity ratio. Consequently, the total soluble sugar TSS:TA ratio is very important, because it provides information on the balance of sugars and acids in the fruit [25]. It is generally realized that quality fruits benefit from a

higher sugar: acid ratio which refers to sweetness [26]. The sugar acid ratio of the juice blends ranged from 26.04 to 41.92 (Table 2) The coefficients of the models' parameters was 0.92 The interaction effects (Table 3) of pineapple juice and watermelon had no significant effect ($P>0.05$) on sugar acids ratio of the juice blends. From figure 6, an increased was observed with an increase in pineapple and watermelon juice inclusion, but addition of golden melon decreased the sugar acid ratio of the fruit blend.

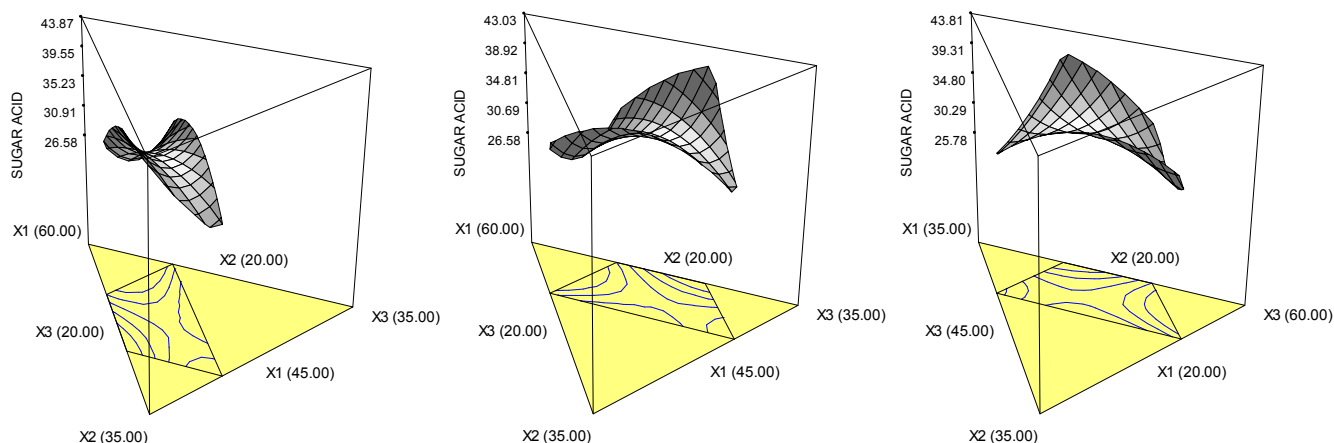


Figure 6. Response surface plots of sugar acid of pineapple- watermelon -golden melon fruit blend at different ingredient combination.

3.4. Effect of Ingredient Combination on pH of Fruit Juice from Blends of Pineapple, Water Melon and Golden Melon

The coefficient of the model parameters for pH was 0.80. The interaction effects (Table 3) of pineapple juice and watermelon had no significant effect ($P>0.05$) on pH of the juice blends. From Figure 7, a decrease in pH was observed with an increase in pineapple inclusion, but addition of golden melon and watermelon increased the pH of the fruit

blend. The pH value of the juice is important to be measured. It represents the degree of acidity and alkalinity of a substance. The PH value of the fruit juice ranged from 4.09 to 4.20 (Table 2) This indicated that the juice was in acidic condition and suitable to be served as ready-to-drink (RTD) beverages [27]. In beverage industry, the addition of organic acid into commercial juice was intended to lower the original pH of the juices [28]. Recent studies have found that, the lower the pH of fruit juices, the greater the heat effect given to the microorganisms, especially in terms of pressure and radiation levels [29].

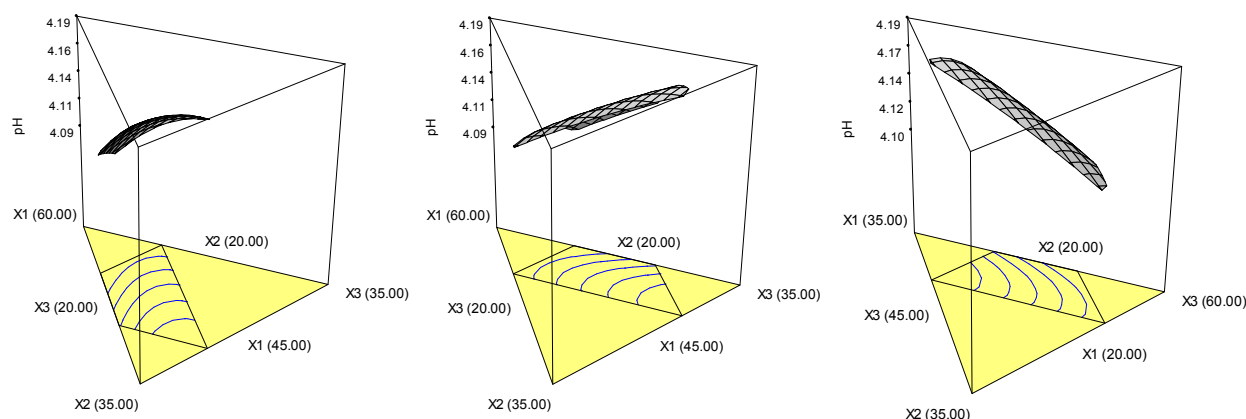


Figure 7. Response surface plots of pH of pineapple- watermelon -golden melon fruit blend at different ingredient combination.

3.5. Optimization of the Fruit Juice Blend

Response Surface Methodology was used for the optimization of the fruit juice and for understanding the factors affecting the process. Based on response surface regression analysis of each blend, the quality attributes evaluated in this study were useful for indicating the direction in which to change variables in order to minimize or maximize the process. In the (Table 4), the desirability lies between 0 and 1 and it represents the closeness of a response to its ideal value. Desirability of the solution was 0.60. Two possible optimum ingredient blends solutions were found with desirability ranging from 0.69 to 0.70. The better of the

two ingredients was 50% of pineapple blended with 30% of water melon and 20% of golden melon fruit (Table 5).

Table 4. Constraints to optimization of process variables for juice production.

Name	Goal
Pineapple juice	is in range
Water melon juice	is in range
Golden melon juice	is in range
Vitamin C	Maximize
Sugar acid	Maximize
Lightness	Minimize
Yellowness	Maximize

Table 5. Solutions to the optimization of pineapple-watermelon-golden-melon juice.

PJ	WMJ	GMJ	Vit C.	L*	A*	Sugar: acid	Desirability
49.61	30.00	20.01	14.75	41.19	10.80	39.26	0.70
53.37	21.63	25.00	15.10	42.57	8.54	33.83	0.69

Where PJ = Pineapple juice, WMJ= water melon juice, GMJ=golden melon juice
Vit C= vitamin C, L*= Lightness, A*= Redness.

3.6. Total Phenolic Content of the Optimized Sample

World Health Organization recommended the intake of five servings or equivalent to 400 g of fruits and vegetables in daily diet. Previous studies reported that oxidative stress in human body resulted from excessive free radicals which was associated with high risk of non-communicable diseases [30, 31, 32]. Consumption of fruits rich in antioxidant substances such as phenolic compounds is inversely associated with risks of non-communicable diseases. Phenolic compounds have a wide spectrum of health benefits such as anti-bacterial, anti-mutagenic and anti-inflammatory, antioxidant activity and minimize oxidative stress [33]. Generally, it was known that total phenolic content is highly correlated with antioxidant activity and bioavailability of polyphenols [34]. Total phenolic values observed in this study was 333.68mg GAE/100 ml. [35] reported a total phenol content of GAE/100ml for golden melon and that this increased to GAE/150ml with the addition of watermelon.

3.7. Sensory Attributes of Optimized Drinks Produced from the Blends of Pineapple, Watermelon, and Golden Melon

The result of the sensory rating for the juice blend of pineapple, watermelon and golden melon is shown in Table 6. In terms of colour, it was observed that for all the four-sample golden melon (GMJ), water melon (WMJ), pineapple (PJ), and optimised sample (OPS), there was a significance difference ($P < 0.05$). Also, the mean response of the hedonic scale test among the four sample were slightly liked. Colour has a prominent effect on sensory scores of a food. Rating of appearance was observed to be slightly liked for watermelon and pineapple juice, however golden melon and the optimised sample were moderately liked with significant difference among them all ($P < 0.05$).

Flavour of food ultimately determines its acceptance or rejection even though its appearance may evoke initial response [36]. There is no significance difference among sample WMJ, PJ, and OPS in terms of flavour and aroma attributes as shown

in Table 6, but a significant difference was observed in sample GMJ. 100% golden melon juice was moderately liked when compared to other samples. No significant difference was

observed among samples WMJ, PJ and OPS in terms of overall acceptability but there is a significant difference between the 100% golden melon juice ($p > 0.05$).

Table 6. Sensory properties of the optimised drinks from the blends of water melon, pineapple, golden melon blend spiced with ginger.

Sample	Colour	Appearance	Taste	Flavour	Aroma	Overall Acceptance
GMJ	6.62±0.97 ^b	7.1±1.62 ^a	6.80±1.09 ^a	7.20±1.54 ^b	6.68±1.27 ^b	6.96±1.05 ^{ab}
WMJ	6.98±1.17 ^a	6.10±1.86 ^b	7.26±1.29 ^b	6.35±1.81 ^a	6.96±1.14 ^a	7.36±1.14 ^b
PJ	6.82±1.02 ^c	6.45±1.36 ^c	7.12±1.36 ^c	6.15±1.73 ^a	7.02±1.06 ^a	7.38±1.05 ^b
OPS	6.96±1.09 ^d	7.00±1.12 ^{bc}	7.22±1.42 ^{bc}	7.15±0.99 ^a	6.90±0.99 ^a	7.30±1.09 ^b

Values are means of duplicate determination.

Mean values with different superscripts within the same column are significantly different at $p \leq 0.05$:

GMJ = 100% golden melon juice

WMJ = 100% water melon juice

PJ = 100% pineapple juice

OPS = optimized sample (50% pineapple, 30% watermelon and 20% golden melon).

4. Conclusion and Recommendation

4.1. Conclusion

Pineapple/watermelon and golden melon juice blends were successfully produced and analysed for physicochemical and sensory properties. It can be inferred from this study that the vitamin C, total solids content, and a lightness of juice from blends of pineapple, watermelon, and golden melon increase with the inclusion of pineapple but the addition of watermelon and golden melon decrease the value of the ascorbic acid. The sugar/acid ratio increased with the inclusion of pineapple and watermelon juice but decreased with the inclusion of golden melon. The pH decreased with the inclusion of pineapple but the addition of watermelon and golden melon increased the PH. The redness increased with the addition of watermelon but decreased with the addition of pineapple and golden melon. The yellowness increased by the inclusion of pineapple and golden melon.

4.2. Recommendation

The flavonoid and other therapeutic properties of fruit blends from pineapple, golden melon and watermelon juice spiced with ginger should be investigated, also the effect of packaging and storage conditions on the quality of fruit blends from pineapple, golden melon, watermelon juice spiced with ginger should be carried out.

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