Hypothesis

Formulation and Physiochemical Evaluation of Juice Blends Produced from Orange, Tigernut and Carrot

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Formulation and Physiochemical Evaluation of Juice Blends Produced from Orange, Tigernut and Carrot

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Abstract: The study was conducted to prepare juice blend by using Orange, Carrot and Tiger-nut juices. Fully mature raw Orange, Tiger-nut and Carrot were processed into juice forms and combined in different ratios which were analyzed for their composition and Consumer's acceptability. The analysis showed that the juice with higher Orange juice content had higher levels of acidity. This implies that they would last longer as they are not susceptible to spoilage by most organisms. The Juice with higher orange juice content was also found to be very rich in Vitamin C, due to inherent high amount of Vitamin C in raw Orange Fruit. However, it scored lowest in terms of general acceptability because the raw fruit was purchased separately and there's a likelihood some of the Orange used in the Juice preparation were sour. This led to a sour taste in this Juice blend. The Juice blend that contained equal proportions of all three juices was the most acceptable to the consumers in terms of color, taste and Nutritional composition. It gave equal amounts of the unique properties of each fruit and provided a unique color and taste that was very appealing to the panelists. This product makes it possible to properly utilize these fruits, reduce post harvest losses, cater to different health needs of the consumers and ensure food security. It is recommended that further work should be done on antioxidant properties, other fruit blends and storage stability of the beverage to determine the shelf-life.

Keywords: juice; fruits; nutrients; orange; tiger-nut; carrot

1.0 Introduction

A balanced diet plays a significant role in maintaining good health and ensuring that all the organs of the body function at the optimum level. It also helps to boost the immune system. Because of their numerous health benefits and the abundance of naturally-occurring antioxidants that they contain, Fruits, nuts and vegetables are essential additions to the human diet. Fruits are an excellent source of fiber, protein, carbohydrates and vitamins. Known for their high lipid and carbohydrate content, nuts are considered an excellent source of energy for the body. They also contain vitamins, minerals and dietary fiber (Abobatta, 2021). All fruits are unique in their nutritional value. However, no fruit contains all the essential nutrients that are required by the body. The concept of combining different fruits is essential to get the best nutritional value from fruits (Harvard School of Public Health, n.d.).

The inadequate intake of fruits is a universal concern since they have an important function in ensuring a healthy body. The emergence of fruit juices as an alternative to raw fruits has helped to address this problem to a large extent as fruit juices provide the convenience that raw fruits do not provide. Fruit Juices that are properly processed are not essentially different from the fruits from which they were extracted. They consist of a similar amount of chemicals and nutrients that can be gotten from the raw fruit (International Federation of Fruit Juice Producers, 2017).

Citrus sinensis, also commonly referred to as sweet Orange, is a fruit that was first discovered in South East Asia but is now consumed worldwide. Orange is a rich source of Vitamin C. It also contains significant amounts of anti-oxidants that exist naturally. These anti-oxidants are essential in

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boosting the immune system, thereby helping the body fight off diseases. (Etebu, et al., 2014). Carrot is a root vegetable that can be found in several regions worldwide. It is an important member of the A*piaceae* family. It contains Carotenoids, Flavanoids, Polyacetylenes, Vitamins and Minerals that are very beneficial and essential to health (Silvia Dias, 2014). It is most popular for its β-carotene content which is a precursor for Vitamin A. *Cyperus esculentus*, widely known as Tiger-nut is a plant that is native to Africa and Tropical Asia. Some researchers believe that it originated from tropical and Subtropical regions worldwide. It has anti-inflammatory properties and is a rich source of starch, glucose, protein and minerals (Bazine and Arslanoğlu, 2020).

Because some fruits lack nutrients that are present in others, producing juice blends will increase the possibility of obtaining a single product that combines the nutritional value of the single fruit. There's a high volume of post-harvest losses for these plants due to poor processing and preservation facilities. By processing them into juice form, they will be more utilized and the problem of post-harvest losses will be mitigated to a huge extent. There is also a problem of low consumption of raw fruits and vegetables. This work will offer an option that is convenient and equally nutritional as the consumer can obtain so many health benefits from one single product. Juice blends will be attractive to consumers as it will combine the taste, Flavor and color of the individual components to form a unique product.

This study aims to carry out the following: a) To discover an acceptable formulation of Juice blend produced from Orange, Tiger-nut and Carrot; b) To perform proximate analysis on the juice blends combined in four different ratios; c) To carry out sensory evaluation on the different juice blends.

2.0 Materials and Methods

2.1 Materials

Tiger-nut, Carrot and Orange were purchased from local traders around Umuofocha Nekede, Owerri, Imo state, Nigeria. The facilities and equipment that was used for the processing of this Juice was gotten from the Food processing workshop, and the analysis was conducted at the food quality control laboratory located at Federal Polytechnic Nekede.

2.2 Methods

2.2.1 Preparation of Orange Juice

Fresh and fully ripened Oranges were sorted. They were properly washed with potable water and vinegar to remove dirt and reduce microbial load. The oranges were peeled and their seeds were carefully removed before blending with an electric blender. The pulp was then filtered to obtain a clear juice. The filtered juice was then blanched at 80 °C for 5 seconds and cooled immediately. Afterwards, the juice was transferred into sterile bottles and immediately stored at −20°C till further use (Begum, et al., 2018).

2.2.2 Preparation of Carrot Juice

In a bid to get rid of sand and other harmful materials, the carrot was properly sorted and washed using potable water and vinegar. A stainless steel knife was used to scrape the outer skin and the carrot was cut into cubes After wards, water was added to the carrot at a ratio of 1:1 w/v Carrot:water; The carrot and water were blended using an electric blender. The mash was sieved using a sterile muslin cloth; the clear Juice was blanched for 5seconds at 80°C, cooled, bottled in sterile containers and stored at −20°C till further use.

2.2.3 Preparation of Tiger-nut Juice

Fresh Tiger-nut was carefully sorted to eliminate foreign material and remove nuts with defects. The sorted nuts were properly washed and filtered to further remove sand and dirt. After draining

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the wash-water, the nuts were blended with water with water to nut ratio of 1:3. A sterile muslin cloth was used to filter the mash by continuously squeezing till all juice was extracted. The juice was cooled, bottled and stored in sterile bottles at −20°C till further use.

2.3 Formulation of Blended Juice

Table 1 shows the formulation of the juice blend with different combination of Orange, Carrot, and Tiger-nut juice. The sample AOA contained 50% Orange juice, 25% Tiger-nut juice and 25% Carrot juice. The sample BOB contained 25% Orange juice, 50% Tiger-nut juice and 25% Carrot juice. The sample COC contained 25% Orange juice, 25% Tiger-nut juice and 50% Carrot juice and the sample DOD had all juices in equal proportions of 33.3%. All samples were properly homogenized and pasteurized at 72°C for 15 seconds, cooled, filled into air-tight sterile bottles and stored at 4°C prior to analysis.

Table 1. Formulation of juice blends.

Ingredients	AOA	BOB	COC	DOD
Formulation				
Orange Juice (%)	50	25	25	33.3
Tiger-nut Juice (%)	25	50	25	33.3
Carrot Juice(%)	25	25	50	33.3

2.4 Proximate Chemical Analysis

The Juice blends were analyzed for total soluble solids (TSS), total titratable acidity (TTA), pH, vitamin C, Vitamin A, and Vitamin E. All the determinations were done in triplicate and the results were expressed as the average value. The total titrable acidity and Vitamin C (ascorbic acid) were determined by the methods described by Ranganna (2005), total soluble solids (TSS) by using a digital refractometer as described by AOAC (2010), pH by the conventional procedure followed by Islam et al. (2015) using a pH meter. Vitamin A and Vitamin E were determined using the methods described by AOAC (2010).

2.6 Sensory Evaluation

Sensory evaluation was determined according to Lamond (1997). Sensory evaluation of the processed samples was carried out with untrained panelist selected randomly from the community of Federal Polytechnic, Nekede, Owerri, Imo state. Using the 9-point Hedonic scale, the panelists were asked to indicate the degree they like or dislike each of the blended juices on their taste, flavor, and color.

The 9 point Hedonic scale used is as follows; Extremely like – 9, Like very much – 8, Like moderately – 7, Like slightly – 6, Neither like nor dislike – 5, Dislike lightly – 4, Dislike moderately – 3, Dislike very much – 2, Dislike extremely – 1.

3.0 Results and Discussion

3.1 Composition of Juice Blend

The mean values of the pH, TSS and TA of orange-tiger-nut-carrot juice is shown in Table 2 below

Table 2. Mean values of pH, TSS and TTA results.

Samples	Ph	TTA (%)	TSS (%)
AOA	3.86^{a}	0.47^{a}	12.7^{a}
BOB	4.21^{b}	0.34^{b}	11.5^{b}

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COC	4.34[b]	0.39[b]	12.3[c]
DOD	3.91[a]	0.44[a]	12.80[a]

KEY NOTE: *Sample AOA contained 50% orange juice, 25% tiger-nut milk and 25% carrot, Sample BOB contained 25% orange juice, 50% tiger nut milk, 25% carrot juice, Sample COC contained 25% orange juice, 25% tiger-nut milk, and 50% carrot juice, Sample DOD contained 33.3% orange juice, 33.3% tiger-nut milk, and 33.3% carrot juice. Samples with the same superscript are not significantly different, while samples with different superscript are significantly different from each other.*

The pH values varied from 3.86 - 4.34. This variability may be due to the various compositions of the various juices in the samples. Sample COC had the highest value of 4.34; this indicates weak acidity of the sample. Sample AOA had the least value of 3.86; this implies that it is more acidic than the other samples. This can be attributed partly to the inherent acid naturally present in orange fruit. Sample DOD and BOB had pH values of 3.91 and 4.21 respectively.

Total Tiratable acids indicate the amount of Organic acids such as Citric acid and L-Malic acid that is contained in the juice (Featherstone, 2016). The TTA values ranged from 0.34% - 0.47%. Sample AOA had the highest value of 0.47%; indicating that it contains more titratable acids than all other samples. Sample BOB has the least percentage of titrable acids which is 0.34%. Sample DOD and COC contain 0.44% and 0.39% of TTA respectively. Similar to the study undertaken by Jan et al. (2012), the results showed that as pH values of juice blends decrease, TTA increase.

The total soluble solid (TSS) of juice is significantly influenced by the combined effect of stages of maturity and ripening conditions. The content depends mostly on the percentage of solid materials dissolved in water in the juice. Juice blends or beverage with less than 7°Brix are categorized as weak and watery, meaning that the total soluble solids are low (Inyang and Awara, 2018). The TSS values range from 11.52 - 12.80°Brix, with sample DOD having the highest value of 12.80°Brix indicating a higher amount of sugar in this sample than in the others. The TSS value of the samples is high, this indicates that the samples contain large amount of soluble sugars and the amount of solid materials dissolved in them are high.

Table 3 shows the Vitamin A content of the different Juice blends. The vitamin A content of the formulated beverages varied from 83.5mg/100g to 167.0/100g, with sample COC having the highest vitamin A content of 167.0mg/100g. This is attributed to the higher percentage of carrot juice which also contains a great amount of beta-carotene, the precursor for Vitamin A. Sample BOB contained 83.5mg/100g of Vitamin A.

Table 3. Mean values of Vitamin A, Vitamin C, and Vitamin E results.

SAMPLE	VIT.A. (mg/100g)	VIT.C (mg/100g)	VIT.E (mg/100g)
AOA	89.7[a]	32.61[a]	2.32[a]
BOB	83.5[a]	29.58[b]	5.24b[b]
COC	167.0[b]	28.95[b]	2.30[a]
DOD	111.2[c]	31.61[a]	3.31[c]

The vitamin C content of the samples ranked from 32.61mg/10g to 28.95mg/100g. Sample AOA ranked the highest with 32.61mg/100g. This could be attributed to the fact that it had the highest percentage of orange juice concentration which is known for its high vitamin C content. Sample BOB, COC and DOD contained 29.58mg/100g, 28.95mg/100g, and 31.61mg/100g respectively.

The vitamin E content of the samples ranged from 5.24mg/100g - 2.30mg/100g, with sample BOB having the highest value of 5.24mg/100g. This high value may be attributed to the high tiger-nut content of the sample. Sample COC had had the least value of 2.30mg/100g. AOA and DOD had values of 2.32mg/100g and 3.31mg/100g respectively. The recommended daily intake of vitamin E is 4mg-15mg/day (NIH, 2021), sample BOB is the best source of this vitamin.

3.3 Sensory Evaluation Results

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Table 4 shows the mean values of the sensory analysis of the different samples. Sensory evaluation of any food item contributes significantly to its consumer acceptance or rejection. Sensory evaluation of food is routinely carried out by Food Scientists to help evaluate the acceptability or otherwise of any new food product. In the present study, the mean sensory scores for colour, taste, and overall acceptability varied with the proportion of individual juice in the blends. Colour, taste and aroma are important sensory attributes that affect the acceptability of food products (Inyang and Awara, 2018).

Table 4. Mean Values of Sensory Evaluation Results.

Samples	Appearance	Taste	Overall Acceptability
A0A	7.9[a]	3.6[a]	5.4[a]
B0B	4.76[b]	6.5[b]	6.56[b]
COC	6.8[c]	7.3[c]	6.5[b]
DOD	8.2[a]	6.2[b]	7.2[b]

In terms of appearance, sample DOD had the highest value of 8.2; this could be attributed to the high carrot content which gave the juice a pleasant orange coloration due to the presence of Anthocyanin and Carotenoids in carrot. Sample BOB had the least value in terms of appearance. This can be attributed to the high tiger nut milk content which gave it a pale appearance. For taste, sample COC also had the highest value of 7.3. This could also be attributed to the high carrot juice content, as carrot was the sweetest fruit used in the production, while sample AOA had the least value of 3.6. This is attributed to the sour taste of the orange fruit used. Sample BOB and DOD had values of 6.5 and 6.2 respectively.

For overall acceptability, sample DOD had the highest value of 7.2. It was the most accepted sample by the panelist, while sample AOA, with a mean value of 5.4 was the least accepted. Sample BOB and COC had values of 6.5 respectively

4.0 Conclusion and Recommendation

4.1 Conclusion

Orange juice blended with tiger-nut and carrot is a beverage that can be consumed by old and young people due to its high nutritional content. Sample COC and DOD were the most acceptable samples from the sensory analysis, while BOB was the most acceptable in terms of mineral and vitamin content. This will make it possible to properly utilize these fruits, reduce post harvest losses, cater to different health needs of the consumers and ensure food security. The product contains nutrient that can be obtained in the individual fruits, thus making it more nutritious than single fruit juices. Successful implementations of orange and carrot juice blend with tiger nut juice will enhance the utilization of tiger nut that is currently underutilized in Nigeria.

4.2 Recommendation

Based on the findings of this research work, the following recommendations are stated; The juice obtained from orange, tiger-nut and carrot should be pasteurized and stored in sterile, airtight and suitable packaging material. Once the juice is opened, it should be consumed in 24 hours to prevent development of off taste due to the presence of orange juice. The juice is healthy but should be avoided by ulcer patients as it contains some level of acidity caused by the presence of orange juice. This juice contains necessary vitamins and minerals in appropriate amounts and should be consumed by both old and young individuals. It is important to check the consistency of the taste of the raw materials to prevent variation in the final product in terms of taste and color.

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