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Production and Evaluation of Smoothies made from Various Fruits Sold in Lagos Market

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Abstract:- Evaluation of Proximate, Physicochemical and mineral composition of various fruit blends made as smoothies was reported. The four samples namely: Watermelon-Pineapple Blend (WPB), Pineapple-Cucumber Blend (PCuB), Banana-Coconut Blend (BCoB) and Watermelon-Pineapple-Banana Blend (WPBB) were prepared by homogenizing equal weights of the fruits and mixing to have a blend of two fruits for WPB, PCuB and BCoB while three fruits were homogenized for WPBB. This is aimed at having more of their individual nutritive and health values packed together for easy consumption by both young and old together with the convalescents. These blends were analyzed for proximate and physicochemical analysis such as moisture, ash, crude fibre, protein, fat, carbohydrates, reducing sugar and Brix. The mineral elements such as sodium, potassium, magnesium, calcium and iron were also analyzed in the samples. From this study, it was indicated that BCoB had the highest proximate value (ash = 0.88±0.01%, protein = 1.01±0.00%, fat = 0.70±0.01%, carbohydrates = 33.95±0.01% and energy level = 146.14±0.02kcal) and physicochemical properties (pH = 5.23±0.00@26.2^{0}C, reducing sugar = 7.23±0.01% and total solids = 36.73±0.01%). The highest amount of calcium was found in WPBB = 292.14±0.01mg/100g. WPBB also had the highest iron content = 79.11±0.00mg/100g; BCoB had the highest potassium and sodium contents 131.08±0.28mg/100g and 296.97±0.28mg/100g respectively. The aim of this research is to encourage easier and better quality consumption of various blends of fruits based on our findings. Further studies will look into other nutritional and antinutritional properties of these smoothies.

Keywords:- *Smoothies, Proximate, Physicochemical, Mineral evaluation, Atomic Absorption Spectrophotometry (AAS), Anti-oxidants.*

I. INTRODUCTION

The need for consumption of fruits in human diets cannot be over emphasized. Fruits are excellent sources of essential vitamins and minerals. They provide a wide range of health-boosting anti-oxidants including flavonoids. Fruits are high in fibre. Adequate and regular consumption of a diet high in fruits and vegetables provides essential nutrients to the body, maintain good health and also help to reduce the risk of developing heart disease, cancer, inflammation, diabetes, Alzheimer disease, cataracts, and age-related functional decline[1,2,3]. A healthy diet should compose of an appreciable quantity of fruits and vegetables, and regular consumption of sufficient amounts to avert major chronic diseases [4,5,6].

Smoothie is a general term which refers to blended fruits consumed without any form of filtration and preservation process. Preferably, smoothies are consumed immediately for the benefits of freshness and quality. The high amounts of fruits and vegetables in smoothies make them an excellent source of fiber. Smoothie can help to bridge the gap between normal daily intake and the USDA's (United State Department of Agriculture) suggested fiber intake, thereby lowering the risk of chronic illness and increasing overall health. In this study we evaluated the proximate, physicochemical and mineral composition of various fruit smoothies.

II. MATERIALS AND METHOD

A. Sample collection

Five different fruits namely: watermelons (*Citrullus lanatus*), pineapples (*Ananas comosus*), cavendish bananas (*Musa acuminata.*), coconuts (*Cocos nucifera*) and cucumbers (*Cucumissativus*) were purchased at Mile 12 Market, Ketu, Lagos, Nigeria. The collected samples were fresh, matured, and free from insect's bites and other organoleptic deterioration. The freshly collected samples were washed to eliminate visible dirt. The coconuts were broken with the aid of a hammer and knife was used to separate the coconut kernels from the shells while the other three fruits were peeled with a knife and they were cut into small pieces. 10g each of watermelon and pineapple were measured into the blender cup (Domestic Electric Blender: 230V, A/C 50Hz, 600W, 18000 RPM), set to the fourth setting, This was switched on for 5 minutes to thoroughly homogenized the samples and form a smoothie which was collected into a clean container, properly corked and labeled as WPB. This procedure was repeated for the Pineapple and cucumber; banana and coconut; and for watermelon, pineapple and banana to form PCuB, BCoB and WPBB respectively. The samples were kept in a refrigerator set at 20^{0}C for 6 hours. All analyses as stated in this study were carried out at Central Laboratory Services, Federal Institute of Industrial Research, Oshodi (FIIRO).

B. Proximate Analysis

Moisture, Ash, Crude Fibre, Protein and Fat Content were carried out in accordance to AOAC Official Methods of Analysis, 20th Edition, 2016 [7]. Carbohydrate content was determined by estimation using the following equation:

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Carbohydrate (%) = 100- {Moisture (%) + Protein (%) + Fat (%) + Ash (%) + Crude fibre (%)}.

Energy value was expressed by:
(% Carbohydrates x 4) + (% Fat x 9) + (% Protein x 4) [8]

C. Physicochemical Analysis

The pH value of the samples was measured using OAKTON™ pH Meter at room temperature. The Brix value of the samples was measured using a hand-held sugar refractometer. Total solids of the samples were estimated using a stainless evaporating dish at 60°C and Reducing sugars were evaluated using Lane and Eynon's-Fehling Solution Method [8]

D. Minerals

Samples were ashed and digested according to AOAC Official Methods of Analysis, 20th Edition, 2016. Sodium, Calcium, Iron, Potassium and Magnesium content were determined using the Shimadzu AA-7000 series Flame-Atomic Absorption Spectrophotometry (F-AAS).

III. RESULT AND DISCUSSION

PARAMETERS	UNITS	WPB (1:1)	PCuB (1:1)	BCoB (1:1)	WPBB (1:1:1)
Proximate Analysis					
Moisture	%	80.4±0.00	85.12±0.01	63.27±0.00	64.90±0.00
Ash	%	0.31±0.01	0.32±0.00	0.88±0.01	0.43±0.02
Crude Fibre	%	0.09±0.00	0.06±0.00	0.19±0.01	0.28±0.00
Protein	%	0.42±0.00	0.28±0.01	1.01±0.00	0.71±0.00
Fat	%	0.02±0.00	0.02±0.00	0.70±0.01	0.07±0.00
Carbohydrates	%	18.76±0.01	14.20±0.00	33.95±0.01	33.61±0.01
Energy value	kcal	76.90±0.01	58.10±0.01	146.14±0.02	137.91±0.02

Table 1: Proximate of the four blends of smoothies

Key: (1:1) = equal weights, WPB = Watermelon-Pineapple Blend, PCuB = Pineapple-Cucumber Blend BCoB = Banana-Coconut Blend, WPBB = Watermelon-Pineapple-Banana Blend from Table 1.0 above, it can be seen that PCuB had the highest moisture content of 85.12% while BCoB has the lowest moisture content of 63.27%. The moisture content of different fruits depends on some factors including rainfall, soil water and type of soil. Soil moisture supply mainly depends on rainfall[9]. The moisture content of any food is an index of its water activity which is a measure of its stability and susceptibility to microbial contamination. The higher the moisture content, the greater the tendency for microbial growth and eventual contamination. Hence this indicates that a smoothie like PCuB should be consumed immediately after preparation if not refrigerated.

The Ash content analysis indicated that BCoB had the highest value of 0.88±0.01%, WPBB with 0.43±0.02% with 0.32±0.00% and WPB with the least ash content of 0.31±0.01%.

For the crude fibre content analysis, the highest value occurred in WPBB with 0.28±0.00% followed by BCoB with 0.19±0.01%. From this study, it indicated that the blend of smoothies with banana have higher crude fibre content while the blends without banana have lower fibre content. Since crude fibre aids metabolism and digestion, as well as preventing constipation [10]. WPBB and BCoB can be recommended as good sources of fibre.

- **Protein**
  The protein contents of the smoothies varied between 0.28±0.01% (PCuB) and 1.01±0.00% (BCoB). The protein contents of smoothies containing banana were found to be higher hence regular consumption of BCoB and WPBB can be recommended as great sources of protein.
- **Fat**
  The fat contents of the fruit blends were generally low ranging from 0.02±0.00% (WPB and PCuB) to 0.70±0.01% (BCoB). The observed low fat contents in these fruit blends have been found to be beneficial, since low fat containing foods have been recommended to avoid problem of obesity and related diseases [11].

- **Carbohydrates**
  In this study, total carbohydrate present in the fruits blend ranged between 14.20±0.00% (in PCuB) and 33.95±0.01% (in BCoB).Energy is needed to drive the metabolic activity by cells such as active transport, respiration, circulation, physical work and maintenance of body temperature among others [12, 13]. Consequently, fruits that are rich in carbohydrate can provide high amount of energy. It can be observed from Table 1.0 above that BCoB with the highest value for Carbohydrates had the highest Energy Value of 146.14±0.02kcal, followed by WPBB with 137.91±0.02kcal while WPB and PCuB had 76.90±0.01kcal and 58.10±0.01kcal respectively. It is observed that fruit blends containing banana have higher amount of carbohydrates.

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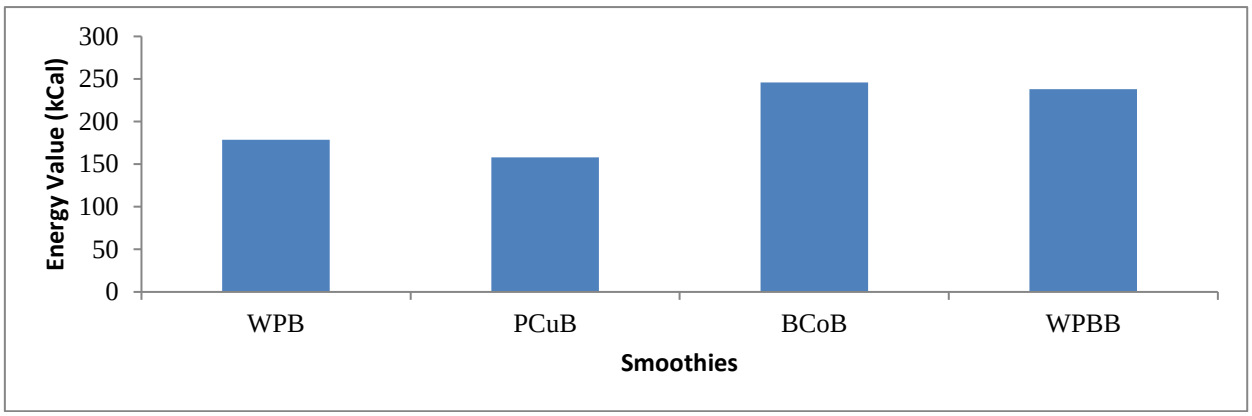

Fig. 1: The energy value of the smoothies

The energy value of the samples (Figure 1) varied in the order BCoB (146.14kcal)>WPBB (137.91kcal)>WPB (76.90kcal)>PCuB (58.1kcal). The blend containing banana (BCoB and WPBB) have the highest proximate values hence; they have the higher energy values than other blends.

The total fat contents of all the smoothies fall within recommended value by WHO of less than 30% of the total energy intake . Regular consumption of these smoothies will help avoid unhealthy weight gain [14,15,16,17].

Physicochemical Analysis	**UNITS**	**WPB (1:1)**	**PCuB (1:1)**	**BCoB (1:1)**	**WPBB (1:1:1)**
pH		4.12±0.00 @26.3^{0}C	4.13±0.00 @26.2^{0}C	5.23±0.00 @26.2^{0}C	4.36±0.01 @26.3^{0}C
Sugar in °Brix	%	10.21±0.20	10.21±0.00	12.21±0.28	14.21±0.00
Total Solid	%	19.96±0.02	14.88±0.28	36.73±0.01	35.10±0.01
Reducing Sugars	%	6.57±0.01	3.70±0.00	7.23±0.01	5.78±0.00

Table 2: physicochemical analysis result of the four blends of smoothie

- **Key:** (1:1) = equal weights, WPB = Watermelon-Pineapple Blend, PCuB = Pineapple-Cucumber Blend BCoB = Banana-Coconut Blend, WPBB = Watermelon-Pineapple-Banana Blend
- **pH**
  The pH values of the fruits blends ranged from 4.12±0.00 to 5.23±0.00. According to literature reports, pH range of ripe fruits is between 4.5 and 5.35, which is slightly acidic [18]. Based on their values from this study, BCoB and WPBB being slightly acidic fell within the range from literature.
- **Brix Value**
  The Brix values for sugar was the highest in WPBB with 14.21±0.00% followed by BCoB with 12.21±0.28% while WPB and PCuB had 10.21±0.20% and 10.21±0.00% Brix values respectively. It can be observed from this result, that blends with bananas have higher Brix values.
- **Reducing Sugar**
  Reducing Sugars consists of all monosaccharides such as glucose, fructose and galactose. The BCoB smoothie contained the highest amount of reducing sugars with a value of 7.23±0.01%, WPB with 6.57±0.01%, WPBB with 5.78±0.00% and the lowest value occurred in PCuB with 3.70±0.00%

Mineral Elements	**UNITS**	**WPB (1:1)**	**PCuB (1:1)**	**BCoB (1:1)**	**WPBB(1:1:1)**
Calcium	mg/100g	254.09±0.28	208.91±0.01	96.09±0.00	92.14±0.01
Iron	mg/100g	54.45±0.00	78.63±0.28	32.13±0.10	79.11±0.00
Potassium	mg/100g	34.63±0.01	125.75±0.00	131.08±0.28	14.43±0.00
Magnesium	mg/100g	37.21±0.01	24.32±0.01	83.55±0.01	93.20±0.00
Sodium	mg/100g	141.44±0.28	35.84±0.00	296.97±0.28	71.53±0.01

Table 3: Mineral compositions of the four blends of smoothies

Key: (1:1) = equal weights, WPB = Watermelon-Pineapple Blend, PCuB = Pineapple-Cucumber Blend BCoB = Banana-Coconut Blend, WPBB = Watermelon-Pineapple-Banana Blend.

The mineral contents of the smoothies fell within the maximum allowable limit.

Calcium functions as constituent of bones and teeth, regulation of nerve and muscle function and takes part in milk clotting [18]. WPBB had the highest value for calcium

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at 292.14±0.01mg/100g while the lowest value occurred in BCoB at 96.09±0.00mg/100g whereas WPB and PCuB had values of 254.09±0.28 and 208.91±0.01 respectively.

Iron content of the blends was between 32.13±0.10mg/100g for BCoB and 79.11±0.00mg/100g for WPBB.

Potassium is abundant in fruits [19, 20] and BCoB was observed to have the highest value for potassium at 131.08±0.28mg/100g, followed by PCuB with 125.75±0.00mg/100g, WPBB was found with 114.43±0.00mg/100g and the least value was 34.63±0.01mg/100g for WPB.

Magnesium plays a vital role in muscle relaxation along the airways to the lungs thus, allowing asthma patients to breathe easily [20]. WPBB had the highest value of Magnesium with 93.20±0.00mg/100g, while PCuB had the lowest value of 24.32±0.01mg/100g. BCoB had a closer value of 83.55±0.01mg/100g, the lowest value was obtained in WPB as 37.21±0.01mg/100g.

Sodium regulates plasma volume and acid-base balance, and it is also involved in the maintenance of osmotic pressure of the body fluids [19, 21]. The highest value was observed in BCoB with 296.97±0.28mg/100g, followed by WPBB with 171.53±0.00mg/100g, WPB had 141.44±0.28mg/100g while the least value was observed in PCuB with 35.84±0.00mg/100g.

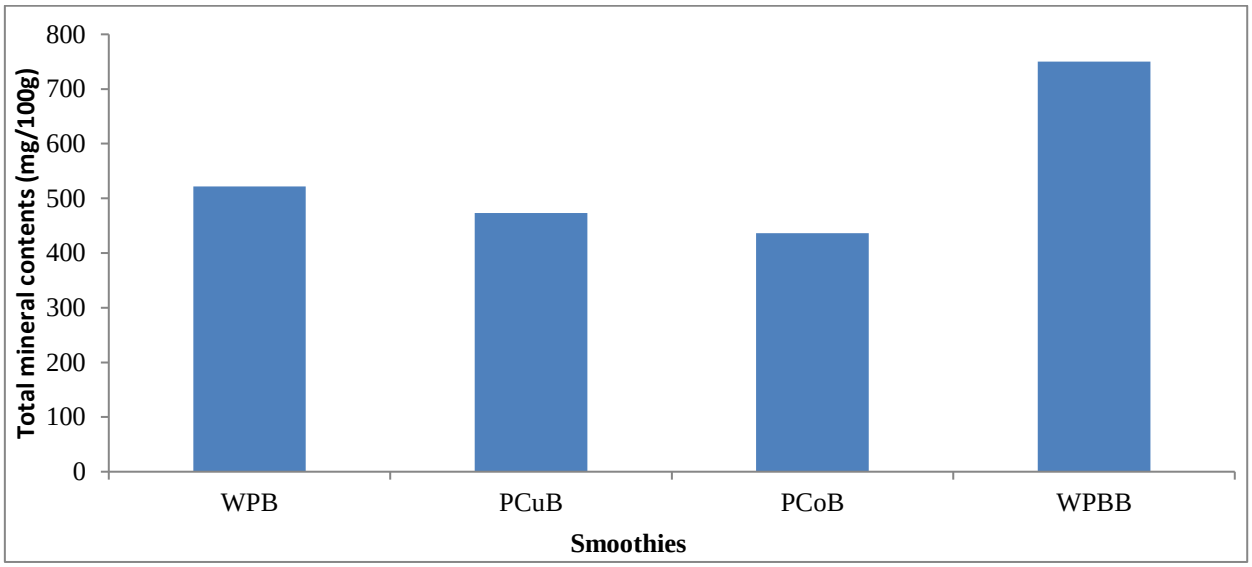

Fig. 2: Total mineral contents of the smoothies

The total mineral content of the samples (Figure 2) varied in the order WPBB (750.41mg/100g)>WPB (521.82mg/100g)>PCuB (473.45mg/100g)>BCoB (436.05mg/100g). The high mineral contents observed in WPBB, WPB and PCuB could be because due to the presence of pineapple in the two blends. Regular consumption of these smoothies will furnish body with the essential minerals within the allowable limit.

IV. CONCLUSION

This study showed that smoothies are beneficial, it could be recommended for human consumption to improve metabolism, maintain good health and reduce the risk of developing heart disease, cancer, inflammation, diabetes, Alzheimer disease, cataracts, and age-related functional decline. This study also showed that blends containing banana especially BCoB have the highest proximate, physicochemical and acceptable level of mineral properties for consumption.

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