

Proximate and mineral composition of some Nigerian fruits

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ABSTRACT

Aims: To determine the proximate and mineral composition of juices of some Nigerian fruits.

Study design: Completely randomized design (CRD) was used in the experiment. The data obtained were subjected to analysis of variance (ANOVA) to determine if significant differences existed between the means of the different fruits. Where differences existed, Duncan's Multiple Range Test (DMRT) was used to compare the difference between the means. The experiment was conducted at the Department of Chemistry, Ignatius Ajuru University of Education Port Harcourt between January to March 2012.

Methodology: *Psidium guajava*, *Musa paradisiaca*, *Carica papaya* L., *Citrus sinensis*, *Malus domestica*, *Citrus lanatus*, *Annona muricata*, *Irvingia gabonensis*, and *Ananus comosus* were purchased in Rumuolumeni market, Port Harcourt in Rivers State of Nigeria and were analysed. The determinations of the proximate and mineral composition of the juice samples of the fruits were determined with the use of Atomic Absorption Spectrophotometer (AAS) (Perkin-Elmer Model 372) instrument according to Association of Analytical Chemist (AOAC), (1990) procedures.

Results: The least crude fibre was found in *Malus domestica* (0.00%) and the highest in *Citrus sinensis* 3.55 ± 0.02%; protein values, of 1.28 ± 0.10%, 1.25 ± 0.21%, 1.05 ± 0.01% were obtained for *Psidium guajava*, *Musa paradisiaca* and *Citrus lanatus* respectively. Low lipid contents were obtained from analysed samples. High carbohydrate values of 18.46 ± 2.80%, 18.26 ± 2.51% and 16.05 ± 1.32% were obtained for *Citrus sinensis*, *Carica papaya* L. and *Annona muricata* respectively. The value of dry matter was highest in *Malus domestica* (27.44 ± 4.21%) and least in *Citrus lanatus* (10.40 ± 0.63%). High moisture values of 89.60 ± 3.52%, 87.30 ± 4.32% and 85.07 ± 2.50% were obtained in *Citrus lanatus*, *Carica papaya* L. and *Ananus comosus* respectively. Generally ash content of the fruits was found to be low. The mineral analyses showed that the potassium content of these samples were relatively high with *Musa paradisiaca* having the highest value of 380.05±6.85 mg/g compared with *Annona muricata* 26.15 ± 4.21 mg/g with the least value. Concentrations of iron, magnesium, zinc, and calcium were highest in *Malus domestica* (3.28 ± 0.20 mg/g), *Musa paradisiaca* (45.71 ± 4.55 mg/g), *Irvingia gabonensis* (1.26±0.30 mg/g) and *Carica papaya* L. (84.90 ± 3.57 mg/g) respectively

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42 **Conclusion:** The results showed that these fruits have safe and adequate dietary nutrients if
43 consumed in the right proportion.

44 Key words: Fruits, mineral content, carbohydrate, ash, lipid, protein, Nigeria

45 INTRODUCTION

46 Nigeria has abundant variety of fruits which are rich sources of nutrients and minerals to the
47 populace. Nigeria as a developing country is experiencing food shortage as a result of
48 population growth, competition for fertile land, poverty, lack of agricultural inputs, poor loan
49 scheme and incentives [1]. The diets of most Nigerians are high in carbohydrates and
50 deficient in protein. Nutritionists have advised that eating at least five portions of fruits and
51 vegetables a day can help people to maintain good health throughout their lives, protecting
52 them from heart disease and cancer, type 2 diabetes and kidney stones [2, 3, 4]. Fruits, such
53 as oranges, banana, watermelon, pineapple, guava, pawpaw abound in Nigeria and are
54 consumed heavily in season because storage technology is not available to preserve the
55 excess production. Fruits contain organic acids especially ascorbic and citric acids with the
56 latter predominating. Dietary fiber is an essential aspect of good nutrition. Intake of dietary
57 fiber alters the water content, viscosity, and microbial mass of the intestinal contents,
58 resulting in changes in the rate and ease of passage through the intestine. High intake of
59 dietary fiber plays a significant role in weight control and the prevention of several diseases.
60 For example, dietary fiber improves glucose tolerance by delaying the transport of
61 carbohydrates into the small intestine, thereby reducing the risk of diseases and constipation
62 [5]. Fruits contain high quantity of water, carbohydrates, vitamins A, B1, B2, C, D and E; and
63 minerals such as calcium, magnesium, zinc, iron, potassium and organic compounds which
64 are required in small amounts, to make the body function properly [6-9]. Many fruits are used
65 to make beverages and fruit juice (orange, apple, grape juices etc.) or alcoholic beverage
66 such as wine and brandy. Iron (Fe) is required for energy and endurance because it delivers
67 oxygen throughout the body. Iron is said to be an important element in the diet of pregnant
68 women, nursing mothers, infants, convulsing patients and the elderly to prevent anaemia
69 and other related diseases [10]. The recommended daily allowance of iron for men is 7mg
70 /day and 12-18 mg/day for women during pregnancy [9, 11-12].

71 Magnesium (Mg) is used to prevent muscle cramping and it enhances nerve functioning,
72 relieves tight sore muscles and improve bone density [1]. Magnesium plays a major role in
73 relaxing muscles along the airway to the lung thus allowing asthma patients to breathe
74 easier. The daily value for magnesium is 320mg/day and deficiency of magnesium in man is
75 responsible for severe diarrhoea, migraines, hyper-tension, cardiomyopathy, arteriosclerosis
76 and stroke [1]. Zinc deficiency has been largely attributed to the high phytic acid content of
77 diets leading to poor growth, impaired immunity, and increases morbidity from common
78 infectious diseases and increases mortality [13]. Zinc is involved in thousands of bodily
79 functions such as proper cell growth and testosterone production [9]. Zinc is said to be an
80 essential trace element for protein and nucleic acid synthesis and normal body development.
81 It plays a central role in growth and development. It is vital during periods of growth in
82 infancy, adolescence and during recovery from illness [13]. In view of the nutritional and
83 health benefits of fruits, the pulp of nine known fruits from Rivers State were analysed for

84 their proximate and mineral composition which was designed to contribute to the growing
85 body of knowledge.

86 MATERIALS AND METHODS

87 **Sample preparation:** The pulp of fresh ripe samples of pawpaw (*Carica papaya* L.), banana
88 (*Musa paradisiaca*), apple (*Malus domestica*), orange (*Citrus sinensis*) guava (*Psidium*
89 *guajava*), watermelon (*Citrus lanatus*), soursop (*Annona muricata*), bush mango (*Irvingia*
90 *gabonensis*) and pineapple (*Ananus comosus*) were purchased at Rumuolumeni market in
91 Port Harcourt, Rivers State, Nigeria. They were washed in distilled water and refrigerated for
92 a day to prevent spoilage before extraction of juice for laboratory analysis. Banana, guava,
93 bush mango, pineapple, soursop and pawpaw were blended in moulinex blender separately
94 and the juice were sieved into different clean beakers while the apple, orange, and
95 watermelon juices were extracted using juice extractor into a clean beaker before the
96 analysis.

97 PROXIMATE COMPOSITION

98 The ash, moisture, dry matter, crude protein and lipid composition of samples were
99 determined using the standard methods [14]

100 DETERMINATION OF MINERAL COMPOSITION

101 Two grams of each sample of fruits were dried and ashed at 500°C for 1hr. The ash was
102 dissolved in 10% 25ml HCl and made up to 100ml with deionized water in a standard flask.
103 Ca, Mg, K, Zn, Fe, contents were determined according to [14] using Atomic Absorption
104 Spectrophotometer (AAS) (Perkin-Elmer Model 372).

105 RESULTS AND DISCUSSION

106 Table 1 shows the proximate composition of the fruits investigated, moisture content varied
107 between 75.00±01.34% for *Citrus sinensis* to 89.60±3.52% for *Citrus lanatus*. The moisture
108 contents for *M. paradisiaca* (79.58±2.10%), *C. lanatus* (89.60±3.52%) and *A. comosus*
109 (85.07±2.50%) were lower than the reported value by [15] for *M. paradisiaca* (81.1%), *C.*
110 *lanatus* (96.4%) and *A. comosus* (86.4%) respectively. Also higher moisture contents were
111 reported for *A. comosus* (87.3%) and *C. sinensis* (90.3%) respectively [16]. The moisture
112 content values for *C. papaya* L. (87.30±4.32%) and *P. guajava* (80.53±3.54%) in this work
113 are comparable to the values reported by [17] for *C. papaya* L. (87.67%) and *P. guajava*
114 (82.00%) respectively. All the fruits studied had high moisture content which is typical of
115 fresh fruits at maturity [18]. The high moisture content in fruits provides part of the medium
116 for normal functioning of enzymes and general metabolic processes.

117 There is no significant difference between the ash content of *C. sinensis* (2.05±0.30%), *I.*
118 *gabonensis* (2.50±0.34%) and *C. lanatus* (2.50±0.23%). The ash content value compared
119 favourably with most fruits' value [19] but lower than those reported by [20]. The percentage
120 ash of the sample gave an idea about the inorganic content of the samples from where the
121 mineral content could be obtained. Samples with high percentages of ash contents are

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122 expected to have high concentrations of various mineral elements, which are expected to
123 speed up metabolic processes and improve growth and development [1].

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Table 1. Proximate composition of some fruits samples (%)

	Moisture (%)	Ash (%)	Dry matter (%)	Carbohydrate (%)	Protein (%)	Lipid (%)	Crude fibre (%)
A	79.58±2.10 ^a	0.30±0.01 ^c	20.42±1.50 ^{ab}	15.95±1.72 ^a	1.25±0.21 ^a	0.99±0.05 ^a	0.75±0.03 ^c
B	80.53±3.54 ^a	1.53±0.41 ^b	19.47±2.14 ^{ab}	15.43±1.26 ^a	1.28±0.10 ^a	0.53±0.02 ^b	0.21±0.01 ^d
C	87.30±4.32 ^a	0.27±0.01 ^c	12.70±1.32 ^c	18.26±2.51 ^a	0.82±0.02 ^b	0.65±0.01 ^a	1.23±0.01 ^b
D	75.00±1.34 ^{ab}	2.05±0.30 ^a	25.00±3.13 ^a	18.46±2.80 ^a	0.87±0.01 ^b	0.11±0.00 ^d	3.55±0.02 ^a
E	85.05±4.10 ^a	0.50±0.01 ^c	14.95±4.21 ^c	13.55±0.94 ^{ab}	0.29±0.01 ^d	0.40±0.01 ^c	0.00
F	89.60±3.52 ^a	2.50±0.23 ^a	10.40±0.63 ^c	7.50±0.64 ^c	1.05±0.01 ^a	0.55±0.02 ^b	1.50±0.30 ^b
G	80.25±1.25 ^a	1.03±0.11 ^b	19.75±0.8 ^b	16.05±1.32 ^a	0.51±0.05 ^c	0.69±0.03 ^a	0.77±0.02 ^c
H	77.30±1.02 ^a	2.50±0.34 ^a	22.70±1.2 ^{ab}	15.97±1.01 ^a	0.61±0.03 ^b	0.21±0.01 ^d	3.50±0.05 ^a
I	85.07±2.50 ^a	1.23±0.15 ^b	14.93±2.54 ^c	12.06±1.62 ^{ab}	0.39±0.02 ^c	0.10±0.00 ^d	0.61±0.01 ^c

128 Mean ± standard deviation of triplicate determinations.

129 Mean with the same superscripts in the same column are not significantly different ($P \geq 0.05$).

130 A=*Musa paradisiaca*, B=*Psidium guajava*, C=*Carica papaya*. L. D=*Citrus sinensis*, E= *Malus domestica*, F=*Citrus lanatus*, G=*Annona muricata*, H=*Irvingia gabonensis*, I=*Ananus comosus*.

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134 The observed wide range in moisture and dry matter in the fruits are similar to those
135 reported by Kohler and Bickoff [21] and this accounts for rapid deterioration of fruits if left
136 unprocessed for long time after harvesting. The carbohydrate content of these fruits ranged
137 from 7.50±0.64% to 18.46±2.80%. Samples with low carbohydrate content might be ideal
138 for diabetic and hypertensive patients requiring low sugar diets. The crude protein content
139 showed generally low values. The protein concentration ranged from 0.29±0.01% to
140 1.28±0.10% for *M. domestica* and *P. guajava*. Proteins are essential component of diet
141 needed for survival of animals and human beings whose basic function is to supply
142 adequate amounts of required amino acids for nutrition [22]. Protein deficiency causes
143 growth retardation, muscle wasting, edema, abnormal swelling of the belly and collection of
144 fluids in the body [23].

145 The mineral compositions of the fruits' samples were reported in table 2. Potassium is the
146 most abundant mineral found in the fruits followed by Mg > Ca > Fe > Zn respectively. The
147 levels of potassium ranges from 26.15±4.21 mg/g for *A. muricata* to 380.05±6.85 mg/g in *M.*
148 *paradisiaca*. A similar value for *M. paradisiaca* is reported by [7] and [24] as (398.56 mg/g)

and (400 mg/g) respectively. It is different for *P. guajava* (86.66 mg/g), *C. papaya* L. (27.12 mg/g) *M. domestica* (86.66 mg/g) and *C. sinensis* (27.12 mg/g). The least calcium

Samples	K	Fe	Ca	Mg	Zn
of fruits					
A	380.05±6.85 ^a	0.86±0.01 ^c	7.24±0.05 ^d	45.71±4.55 ^a	0.45±0.01 ^b
B	166.18± 2.58 ^c	2.40±0.01 ^a	16.46±1.02 ^c	15.67±1.13 ^c	0.06±0.01 ^c
C	358.37± 4.67 ^a	0.46±0.02 ^d	84.90±3.57 ^a	44.04±2.10 ^a	0.24±0.00 ^c
D	125.00±5.90 ^c	0.40±0.02 ^d	7.00±0.04 ^d	30.21±1.40 ^{ab}	0.75±0.02 ^b
E	26.15±4.21 ^e	1.40±0.03 ^b	17.43±2.10 ^c	32.50±1.23 ^{ab}	0.57±0.01 ^b
F	77.95±5.34 ^d	3.21±0.56 ^a	14.35±1.50 ^c	14.67±2.49 ^c	1.26±0.30 ^a
G	126.36±4.27 ^c	1.19±0.30 ^b	33.35±4.26 ^b	20.10±1.68 ^c	0.35±0.01 ^c
H	280.10±8.58 ^b	0.43±0.01 ^d	18.65±1.20 ^c	27.12±3.48 ^b	0.51±0.02 ^b

level was in *C. lanatus* (7.00±0.04 mg/g), and highest in *C. papaya* L. (84.90±3.57 mg/g).

Table 2. The result of the mineral composition of the fruits analysed (mg/g).

I	261.03±7.77 ^b	3.28±0.20 ^a	16.45±1.50 ^c	25.20±1.30 ^b	0.15±0.01 ^c
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156 Mean ± standard deviation of triplicate determinations.

157 Mean with the same superscripts in the same column are not significantly different ($P \geq 0.05$)

158 A=*Musa paradisiaca*, B=*Psidium guajava*, C=*Carica papaya* L. D=*Citrus lanatus*, E=

159 *Annona muricata*, F=*Irvingia gabonensis*, G=*Citrus sinensis*, H= *Malus domestica*, I=

160 *Ananus comosus*

161 The values obtained for A. *comosus* (16.45±1.50 mg/g), C. *lanatus* (7.00±0.04 mg/g), M.
162 *paradisiaca* (7.24±0.05 mg/g) were similar to that of Ihekoronye and Ngoddy [25], (16.00, 7.00,
163 7.24 mg/g), but different for C. *papaya* L. (15.80 mg/g). Also the calcium content is similar to
164 the work of Onibon et al., [7] for P. *guajava* (14.56 mg/g) but lower for M. *paradisiaca* (0.016
165 mg/g), M. *domestica* (0.88 mg/g), C. *sinensis* (0.93 mg/g) and C. *papaya* L. (29.64 mg/g)
166 respectively.

167 The iron content of I. *gabonensis* is similar to that of A. *comosus* and P. *guajava* but
168 significantly different from M. *paradisiaca*, C. *papaya* L., C. *lanatus*, and M. *domestica*
169 respectively. A lower iron content was reported [25] for C. *Papaya* L. (0.40 mg/g), C. *lanatus*
170 (0.20 mg/g), A. *comosus* (0.30 mg/g) and C. *sinensis* (0.40 mg/g) and higher for M.
171 *paradisiaca* (0.93 mg/g) compared to this work. Higher concentrations of iron was obtained
172 in this study compared to the values obtained by [7] for M. *paradisiaca* (0.52 mg/g), M.
173 *domestica* (0.28 mg/g), P. *guajava* (0.28 mg/g), C. *papaya* L. (0.19 mg/g). The value of 3.21
174 mg/g for I. *gabonensis* in this work is small compared to 64.58 mg/g [26].

175 The magnesium content for M. *paradisiaca* is similar to that of C. *papaya* L and significantly
176 different from I. *gabonensis*, C. *sinensis* and P. *guajava* respectively. Higher magnesium
177 concentrations are reported in this work compared to the work of Onibon et al., (2007) for M.
178 *paradisiaca* (0.05 mg/g), M. *domestica* (13.29 mg/g), P. *guajava* (13.29 mg/g) C. *sinensis*
179 (0.85 mg/g) and C. *papaya* L. (28.24 mg/g). Also the values for C. *sinensis* (26 mg/kg) and
180 A. *comosus* (36 mg/kg) are lower as reported in Falade et al., 2003 [16]. Magnesium is
181 required for our body's muscular contraction.

182 The zinc concentration for I. *gabonensis* is significantly different from the other fruits studied.
183 The reported values of 0.48 mg/g, 22.9 mg/g, 22.9 mg/g, 0.1 mg/g, 0.10 mg/g for M.
184 *paradisiaca*, M. *domestica*, P. *guajava*, C. *sinensis*, and C. *papaya* L., reported in Onibon et
185 al., 2007 [7] were lower for M. *paradisiaca*, 0.45 mg/g, M. *domestica*, 0.51 mg/g, P. *guajava*
186 0.06 mg/g but higher for C. *sinensis* 0.35 mg/g, and C. *papaya* L., 0.24 mg/g in this present
187 work. Ayivor et al., 2011 [26] reported zinc content of (6.72 mg/g) for I. *gabonensis* which is
188 higher than (1.26 mg/g) reported in this work. The differences in result could be due to
189 environmental and method of analysis.

190 CONCLUSION

191 C. *lanatus* had the highest composition of moisture and ash, C. *sinensis* for crude fibre and
192 carbohydrates, lipid was M. *paradisiaca*, while protein was P. *guajava* respectively. It can be
193 concluded that the edible parts of the fruits studied are rich in nutrients. This work indicates
194 that the best sources of potassium, magnesium and calcium are banana and pawpaw while
195 pineapple and bush mango are rich in iron and zinc respectively.

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