PROXIMATE AND VITAMINS ASSESSMENT OF NONI JUICE, LEAVES AND SEEDS AS A FUNCTIONAL FOOD SECURITY WELLNESS FOOD IN GLOBAL HEALTH

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Abstract
Rapid changes in dietary lifestyles, global challenges of diseases present in developing countries like Nigeria is constantly increasing making the researcher to investigate the proximate and Vitamins assessment of homemade Noni juice, leaves and seeds as a functional food security wellness food in global health. The main purpose of the study was to produce juice from Noni (MorindaCritifolia). Specifically, the study determined the proximate composition of Noni Juice, Leaves and seeds, and determined the Vitamin A, B_2 and C composition of Noni Juice, leaves and seeds. The study adopted research and Development (R&D) design to produce wellness fruit juice from Noni fruits, processed Noni seeds and leaves into powdered form. All the produced samples were subjected to analysis to ascertain their contents. The proximate analysis results revealed moisture content of the samples ranged from 8.27 ± 0.04 to 92.55 ± 0.40, protein ranged 0.04 ± 0.01 to 14.33 ± 0.02, and fat content ranged 2.0 ± 0.01 to 3.98 ± 0.03%. Ash content ranged 1.06 ± 0.04 to 9.76 ± 0.03% crude fibre ranged 0.03 ± 0.01 to 28.70 ± 0.01%, Carbohydrate ranged 2.36 ± 0.39 to 53.45± 0.05% respectively. The vitamins results revealed the presence of reasonable amount of Vitamin A, B2 and C in the Noni Juice, leaves and seeds which shows that when taken it will help to prevent diseases like cancer, diabetes etc that is prevalent in Nigeria. This work had proved that Noni plant is a zero waste plant. It was recommended that home makers in Nigeria should plant the crop in their various home gardens. The vegetables of Noni (MorindaCritifolia) can be diversified into different processing methods and utilized in food preparation. The seeds can be grounded into powdered form and use as a substitute to other beverages and sauce for food preparation. Value added products will helps to alleviate nutrients deficiency diseases. Consumers' awareness on the potential of Noni (MorindaCritifolia) should be reawakened through advertisement. Sensory evaluation should be conducted by another researcher; this will help to popularize the crop.

Keywords: ***Noni, Juice production, proximate, food security, vitamins, wellness***

Introduction

Rapid changes in dietary lifestyles have resulted to excessive consumption of snacks and drinks among individuals in the society not withstanding their health benefits. Similarly, global challenges of diseases like micronutrients deficiency diseases (hidden hunger) have continued to be a major public health problem facing most families in Nigeria. Okudu & Eneobong, (2015) noted that despite the great strides in agricultural development, hunger, malnutrition and other related diseases are still prevalent in developing countries as a result of food insecurity.

Several attempts have been made by researchers on the nutrients intake of some fruits like oranges, paw-paw, water melon, banana among others yet fruits like Noni *(Morindacitrifolia)* are underutilized in Nigeria due to non-availability, lack of knowledge on the health benefits, utilization, cultivation and potentials of such wellness fruits are scarce. Many studies have been carried out in countries like Asia and Australia where it is found to be abundant but there is paucity of studies in Nigeria despite its health beneficial properties.

Nigeria is blessed with good climatic zones that could facilitate the cultivation of agro products that have great potentials like noni *(Morindacitrifolia)*which can be successfully grown. WHO (2018) noted that more than 1.7 million deaths worldwide are attributed to low fruits and vegetables consumption. Also insufficient healthy fruits and vegetables intake causes about 14% of gastrointestinal cancer. In 2003, WHO and FAO collaborated and launched a joint initiative to promote intake of fruits for health Worldwide. WHO also recommended consumption of at least- 400g or five portions of fruits and vegetable per/day. This will help in the reduction of Non communicable diseases and will help to ensure an adequate diet intake of dietary fiber.

Noni (*Morindacitrifolia*) is a fantastic plant in the coffee family, Rubbiacaae kingdom planta. A fruit bearing plant that is regarded as a zero waste nutritional plant, its native extends through south East Asia, Australia and the Islands of Polynesia. About 80 species, are cultivated throughout the tropical and sub tropical regions widely naturalized (Scot, 2003). The history of the plant is traced to Polynesians who used it as traditional medicinal plant where the fruits are known to relief many diseases, help in immune system and also fight against bacterial infection (Yashaswini, Venugopal, Hegde & Mokashi, 2014). The plant has

green leaves, straight stem and green fruits, when fresh. The fruit has a pungent smell (odour) when ripening; the flavor is very signature of fresh fermentation (Deng, West and Jenson, 2008). The fruit despite its strong smell and distinctive flavor is still regarded as staple food in Asian countries.

A lot of health benefits have been attributed to the Noni fruits and other parts of the plant (West et al 2007). Noni contains antioxidant properties due to the presence of oxophytodienoic acid and citrifolinin. These antioxidant properties neutralize oxygen free radicals and its effects. This scavenging effect provides relief from oxidative stress. Many studies claim that Noni juice is effective in reducing arthritis pain, Joint problems due to analgesic properties the fruit contains. The fresh fruits possess anticancer properties that help in the prevention of several types of cancer like liver cancer, lung cancer and ranal cancer. Noni Juice has tumor fighting and immune stimulating properties. This is possible because it blocks the carcinogen DNA binding and also fights against tumor in the mammary gland. Ali, Kenganora & Manjula (2016) noted Noni plant exhibits a remarkably high therapeutic and safety profile that makes it popular as a health enhancer and food supplement worldwide. Others are

Cardiovascular Ailment Management: Noni has the ability to dilate cell wall that results in the proper flow in the arteries. This helps in managing of blood pressure and maintenance of overall heart diseases. It reduces the level of cholesterol in the body.

Lowers risk of Gout: This is as a result of the buildup of uric acid crystals in the joint; gout is a kind of arthritis which causes joint pain.

Diabetes management: It is useful in the treatment of type 2 diabetes, the extracts from the leaves and fruits have effects in lowering glycosyalated hemoglobin level, lipoprotein cholesterol and serum triglycerides in the body. Additionally it enhances sensitively of insulin and glucose up take. It further activates peroxisome proliferators activated receptor (Furusawa, Hirazumi, Story, & Jesen 2003; Ali, Kenganora & Manjula, 2016)

Noni *(MorindaCitrifolia)* provides rapid energy, helps in the prevention of blindness, controls cholesterol levels and helps in the regulation of digestive process.

Boosts immunity: Noni *(MorindaCitrifolia)* hasantipsychatic, anti-fungal, anti inflammatory properties that helps boost immunity.

Folk Medicinal uses of Noni (*MorindaCitrifolia*): The Chinese use Noni pulp (juice) and seeds for tonic, the fruits are dried and are useful in overcoming the influence of alcohol on the system. Noni pulp can be mixed with vinegar; the latex promotes healing of abscesses, snakebite and granular swellings. The root is a remedy for skin diseases and Asthma. In traditional medicine the fruits, seeds and leaves have potentials in managing different health conditions like arthritis, liver diseases, broken wound, tuberculosis, depression, colds, diabetics, inflammation of the eye, fungal infections among others. Therapeutically, the fruits can be used as capsules, pills, and tablets syrups, dried leaves can be crushed into powder and used for tea. The dried leaves are also used in various medicinal preparations, healing protocols and treatment methods throughout the pacific region. The bark of Noni is used in various medicinal preparations and for cosmetic use.

Studies have shown improvement in the nutritional content of Noni (*MorindaCitrifolia*). The chemical composition of Noni plants differs significantly according to the part of the plant. The complete physio chemical composition of the fruit has not yet been reported. Brett, West & Jenson(2008) noted that only partial information is available on the chemical composition. The fruits contain 90% of water and the main component of the dry matter appears to be soluble solids, dietary fibre and protein (Chunhieng, 2003). The macronutrients are present in sparse amounts depending on the part of the plant of reference. Noni (*MorindaCitrifolia*) contains appreciable carbohydrate and dietary fibre in moderate amounts. These macronutrients evidently reside in the fruit pulp.

The main micronutrients of Noni (*MorindaCitrifolia*) pulp powder include vitamin C, Niacin, (vitamin B_3), vitamin A and potassium. The vitamin content of Noni is very high compared to other fruits like oranges, mangos, apples and sour soup.Calcium and sodium are present in moderate amounts. Noni *(morindaCitrifolia*) seed, leaf, pulp and bark are rich in nutrients. They also contain phytochemicals with strong potentials and can be used in food enrichment or as food supplements. Phyto chemical is a term that refers to a variety of plant derived compounds with therapeutic activities such as anti-carcinogenic, anti-mutagenic, anti inflammatory and anti oxidant properties.

In Nigeria utilization of Noni (*MorindaCitrifolia*) is limited, therefore there is need to explore an affordable and easily adoptable domestic food processing methods that can be used to produce Noni fruit juice. There is reawakening of interest among researchers in the consumption of fruit juice that plays vital roles in the lives of consumers more especially on the health

aspects of Noni *(MorindaCitrifolia)*.

Purpose of the Study

The purpose of this study was to produce healthy fruit juice from Noni (*MorindaCitrifolia*) fruit, specially the study.

1. determined the proximate composition of Noni (*MorindaCitrifolia*) juice, leaves and seeds.
2. determined the vitamin A, B2 and C composition of Noni (*MorindaCitrifolia*) juice, leaves and seeds.

Materials and methods

Procurement of Materials: Freshly harvested Noni (*MorindaCitrifolia*) plant was sourced from green health care foundation botanical garden in Owerri West Local Government Area of Imo State. The fruit maturity was determined by its colour from greenish to yellowish colour.

Dates samples were purchased from Amakohiamarket OwerriImo State. All equipment, reagents and chemicals to be used for the experiment were of analytical grade.

Research Method

In this study, Research and Development (R & D) method was adopted.

Sample Preparation for Noni

A matured fresh green colour Noni fruits were plucked, sorted manually to ensure that there were no moldy fruits, it was then washed with clean water to remove surface pollutants. The fresh fruits were allowed to dry and then kept in a protected room at room temperature for twenty four hours to soften after which they were cut into two pieces to remove some seeds; others were grinded with electric blender. Part of the fruit pulp were packaged in a plastic container labelled, stored in an ice-pack before used for analysis.

Figure 1: FLOW CHART FOR THE PRODUCTION OF NONI (*MORINDA CITRIFOLIA*) JUICE

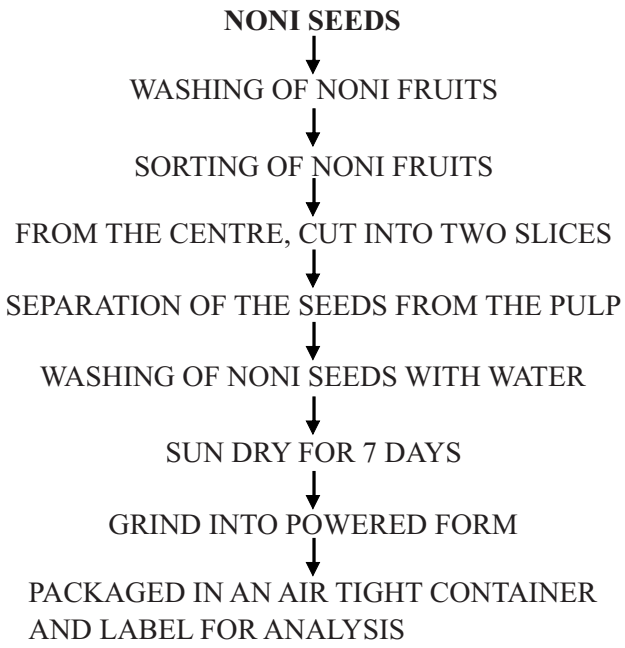

Figure 2: FLOW CHART FOR THE PRODUCTION OF NONI (*Morinda Citrifolia*) SEEDS INTO POWDERED FORM

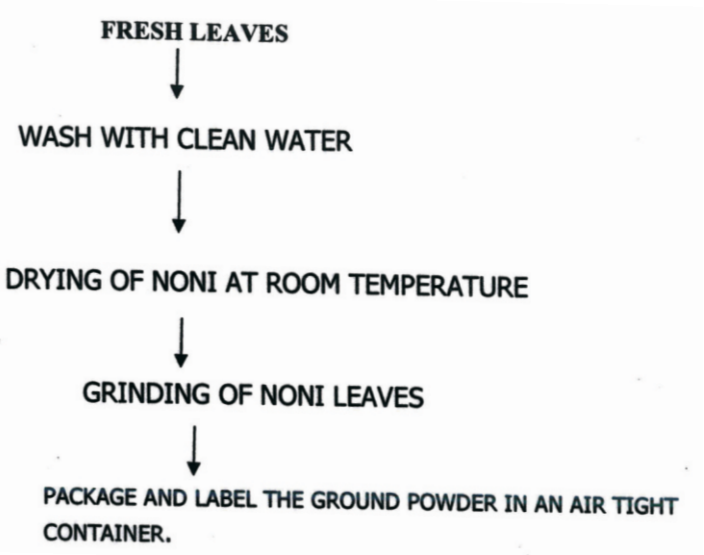

Figure 3: FLOW CHART FOR THE PREPARATION OF NONI LEAVES

DIVERSIFICATION / UTILIZATION OF NONI JUICE: Noni (*MorindaCitrifolia*) can be taken with date's syrup, Guava drink, apple drink, water lemon juice, as smoothie etc. This seminar study recommends dates due to its potentials/ phytochemical composition which are in line with the study.

Dates (*Phoenix Dactylifera*)

Dates are used as staple food in Middle East for thousands of years. They are sweet fruits of date palm tree scientifically known as *phoenix dactylifera*. They are very versatile having gained popularity in recent times. Dates originated in the arid lands of Egypt/ Mesopotamia.Date palm tree are cultivated all over the world especially across the tropical regions, the date molasses, a natural sweetener made from date syrup is used as smoothies or desserts in place of sugar. It is an ideal food that provides a wide range of essential nutrients with many potential health benefits.

Dates helps in muscle development, brain development, promotion of healthyeyes, anti-inflammatory, sex hormones, aids healthy bowel movements, reduces risk of cancer, prevents microbial infections, helps in fighting diabetes, anti-tumor (Arshad, Salah, Habeeb, Babiker, Sauda and Amjad, 2014).

Nutritive value of Dates

Nutrients	Value
Water (g)	21 .32
Energy (kcal)	2.77
Protein (g)	1.81 or 1.3%
Total lipid fat (g)	0.15
Carbohydrate diff (g)	74. 97
Fiber total (g)	6.7
Sugar total (g)	66.47
Calcium ca mg	64
Iron fe (mg)	0.9
Magnesium (mg)	54
Phosphorous (mg)	62
Potassium (mg)	69.6
Sodium Na (mg)	1

Source: USDA 2011

Preparation of Dates Syrup

200g of date fruits were sorted out to remove the bad ones, washed, soaked for 2 hours in water, deseeded, blended and sieved to obtain date juice.

The extracted juice was poured into a clean saucepan and simmer for 35 minutes to obtain the date syrup which is thick honey like consistency.

LABORATORY ANALYSIS

The Association of Analytical Chemist's Methods (2005) was used for proximate analysis.

The analysis were carried out on the moisture content, total carbohydrate, protein, fat, crude fiber, ash content of Noni (*MorindaCitrifolia*), fruit juice, seed and leaves.

Determination of Moisture Content, the oven method was used, 3 gms of each sample was weighed into a dried crucible. The samples were dried in a moisture extraction over at 105^0c for 3 hours. The dried samples was cooled in desiccators and reweighed. They were dried again, cooled and reweighed. This process was repeated until a constant weight was obtained.

The differences in weight before and after drying was recorded as moisture content % moisture content $= \frac{W_2 - W_3 \times 100}{W_2 - W_1 \quad 1}$

Where W1 = initial weight of the empty dish
W2 = Weight of the dish + undried sample
W3 = Weight of the dish + dried sample

Determination of Crude Protein

The determination of crude protein content was determined by micro Kjeldahl method as described by AOAC (2005) five grams (5g) of each sample were weighed respectively into the micro Kjeldahl digestion flask, then 1g of copper sulphate and 2g of anhydrous sodium sulphate was added to the flask as catalyst. Additionally, a pinch of selenium powder (anti bumps) and 10g of concentrated sulphuric acid were added. The flasks were thoroughly shaken and were placed on the digestion rack in an inclined position and the content of the flask were digested by heating in a fume chamber with occasional swirling until colour changes. The temperature was increased and the samples were allowed to boil for about 90mins until a clear solution was obtained. Then the digest were transferred into a Kjeldehl distillation flask and 5ml of 40% sodium hydroxide solution were added. The flask was immediately fixed to the splash head of the distillation apparatus. Five (5ml) milliliters of 20% boric solution and 2 drops of methyred indicator were placed into the 100ml receiving conical flask which were kept under the condenser of the distillation apparatus in such a way that the tip of the delivery tube were placed in the conical flask containing the boric acid solution. Later, the mixture was heated and the ammonia liberated from the samples was condensed into the receiving conical flask containing boric acid solution and methyl red indicator. This was continued until bluish green distillate was obtained. Then the distillate was titrated with O.IN of hydrochloric acid until the end point of pink colouration was obtained. The titre value immediately were taken and recorded. The percentage crude protein of each sample was calculated from the formular using 6.25 as the factor for the conversion of percentage nitrogen to percentage crude protein in each sample.

$$\% \text{ crude protein} = \frac{(T - B) \times NHCL \times 1.4 \times 100 \times 6.25}{\text{Weight of the sample}}$$

Where T = Titre value for the sample
B = Titre value for the blank
N = Normality of the HCL used
1.4 = Correction factor for the acid

Determination of Fat

Fat content of the samples were determined using soxhlet extraction method AOAC (2005). Five grams (5g) of the samples were measured directly into a fat-free thimble which was weighed and plugged with cotton. A flat bottom flask was weighed and reflux flask mounted on it. Then the thimble was dropped into extractor and petroleum either poured into it to reach about two third of the volume of the flask. The sample immersed in the solvent remained in contact with it until the flask filled up and siphoned over, thus carrying oil extract from the sample down to the boiling flask. This process was allowed to continue on repeatedly for about 4 hours before defatted sample were removed and the solvent were evaporated off on a water bath. Then thimble dried in the sun at 60^0C for 3 mins to remove the regicidal solvent after cooling in desiccators then reweighed. Weight of the fat concentration were determined by the difference and expressed as a percentage of the sample of the weight. This was calculated as the following

$$\text{Fat} = \frac{W_2 - W_3 \times}{\text{No of sample}} \quad \frac{100}{1}$$

Where
W3 = weight of empty extraction flask
W2 = weight of flask and oil extract.

Determination of Crude Fibre

The analysis was done using the method of AOAC (2005) ten grams (10g) of each sample were measured and poured into hot 200ml of 1.25g of H_2S04 solution and boiled for 30 minutes in a beaker. The hot acid sample solution were filtered, the residue was poured into 200mlof1.5gNaOHsolution. It was boiled for 30 minutes and transferred completely into crucible and dried in an oven at 150^0C to a constant mass. Samples were reweighed and incinerated at 600^0c for 2 hours in a muffle furnace. The crucible and content were weighed after cooling in desiccators

$$\%\text{Crude fibre} = \frac{M_2 - M_4 \times}{M_3 - M_1} \quad \frac{100}{1}$$

Where
M_1 = Mass of crucible
M_2 = Mass of sample + crucible
M_3 = Mass of Crucible of + residue
M_4 = Mass of crucible + Ash after Incineration

Determination of Ash

The Ash content of each sample was determined using AOAC (2005). Ten grams (10g) of each sample were measured into previously weighed porcelain. The samples and the porcelain crucible were weighed and put in a muffle furnace and heated at 550^0c for 2 hours. The crucible were cooled in desiccators and re-weighed. Percentage of ash of the entire sample was calculated.

$$\%\text{Ash} = \frac{W3 - W1}{W2 - W1} \times \frac{100}{1}$$

$W2 - W1$ of sample

Where

W_1 = Weight of the empty crucible

W_2 = Weight of sample + empty crucible

Weight = Weight of sample + ash

Determination of Total Carbohydrate Content

Total carbohydrate content of the samples was determined using AOAC (2005) which described nitrogen free extract method. Carbohydrate content was calculated as weight by difference between 100 and the summation or addition of other components as nitrogen free extract (NFE) the (NFE) formular is as follows (NFE) = 100 – M + P + Fa + A + Fb

Were M = Moisture content

P = Protein content

Fa = Fat content

A = Ash content

Fb = Fibre content

Vitamin Analysis

Vitamins are generally classified into two major groups namely:-

Fat soluble and water soluble

Fat soluable are ADEK

Water soluable are C & B

This work determined only Vit C, Vit A $\underline{\text{Vit}B_2}$

Determination of Vitamin C

The AOAC official titrimetric method of (1990) was used for Vit C analysis. Two grams (2g) of test food were weighed into different flasks and 100ml of distilled water added. The mixture were stirred and filtered to get clear solution. Ten (10ml) of the filtrate were pipette into a small flask with 2.5mls of acetone. The mixture were titrated with indophenols solution and monitored until a light distinct rose pink colour appears and persists for more than 5 seconds. The indophenols solution was standardized daily with AA solution. All determinations were repeated ten times. This titration method only determines AA and not DHA.

The vitamin C were estimated = 20 (v) x (c)

Where V = ml indophenols solution in titration

C = Vitamin C/ ml in indophenols

Determination of Vitamin A

The method of the association of vitamin chemist (Kirk and Sawyer, 1998) was employed. A measured weight (5.0g) of the processed samples was dispersed in 30ml of absolute alcohol. 3ml of 5% KOH solution was added to the mixture and boiled under reflux for 30 minutes. After cooling rapidly in running water, 30 ml of distilled water was added to the mixture transferred into a separated funnel. Three portions of 50ml of ethanol were used to wash the mixture thus extracting vitamin A. The lower (aqueous) was discarded while the vitamin A extract was washed with 50ml of distilled water. Care was taken to avoid formation of emulsion. The extract was then evaporated to dryness and dissolved in 10ml of isopropyl alcohol and it's absorbance of vitamin A extract was also measured at 325mm, the vitamin A content was calculated as follows; vit A mg/100g = 100/w X au/as XC

W = weight of sample analyzed

au = Absorbance of sample

Ac = Absorbance of standard

C = Concentration of standard mg/ml

Determination of Riboflavin Vitamin B_2

Vitamin B_2 was determined calorimetrically using the method described by Okwu and Ndu (2006) five grams 5.0g of each sample were extracted with 50ml of ethanol after shaking for one hour. It was filtered through Whiteman No. 42 filter paper. A portion of the extract (10ml) was mixed with equal volume of $kmn0_4$ (potassium permanganate) solution followed by 100ml of 30% hydrogen peroxide solution. It was allowed to stand in a hot water bath for 30 mins. The 2ml of 40% sodium sulphate were added to it and was made up to 50ml with distilled water; its absorbance was measured in a spectrophotometer at a wavelength of 50mm. A standard riboflavin solution were prepared and treated as the sample. The formula below was used

Riboflavin mg/100g = 100 x au x C x Vt

W = weight of sample analyzed

Au = Absorbance of sample

AS = Absorbance of standard

C = Concentration of standard (mg/ml)

Vt = Total volume of extract

Va = Volume of extract

Table 1: Proximate composition of Noni (*Morindacitrifolia*)for Noni Juice, Noni leaves, Noni Seeds

Samples	Moisture %	Protein %	Fat %	Ash %	Crude fiber %	Carbohydrate %
Noni fruit juice	92.55 ±0.40	0.04 ± 0.01	3.98 ±0.03	1.06± 0.04	0.03 ± 0.01	2.36±0.39
Noni leaves	9.75 ± 0.06	14.33 ± 0.02	3.83 ±0.09	9.76 ±0.03	24.53 ± 0.03	37.82±0.23
Noni seeds	8.27 ± 0.04	4.53 ± 0.01	2.0 ± 0.01	3.07±0.02	28.70±0.01	53.45 ±0.05

The above table shows the proximate composition of Noni (*MorindaCitrifolia*) (L). This was carried out on the Noni fruit juice, leaves and seed. The moisture content of the samples ranged from 92.55 ± 0.40 to 8.27 ± 0.04, the Noni (*MorindaCitrifolia*) protein ranged 0.04 ± 0.01 to 14.33 ± 0.02 the fat content ranged 2.0 ± 0.01 to 3.98 ± 0.03. Ash contents ranged 1.06 ± 0.04 to 9.76 ±0.03, crude fibre 0.03 ± 0.01 to 28.70 ± 0.01 and carbohydrate content ranged to 2. 36 ± 0.39 to 53.45 ± 0.05

Table 2: Vitamin Composition of Noni (*MorindaCitrifolia*) Fruit Juice, Leaves and Seeds

Samples	Vitamin A (mg/100g)	Vitamin B2 (Mg/100g)	Vitamin C (mg/100g)
Noni fruit juice	0.53 ± 0.02	0.22 ± 0.0	2.38 ± 0.03
Noni leaves	0. 14 ± 0.01	1.14 ± 0.01	4.11 ± 0.01
Noni seeds	0. 04 ± 0.01	0.27 ± 0.01	2.11 ± 0.01

The vitamin composition of Noni (*MorindaCitrifolia*) (L) Noni juice, leaves and seeds were shown in table 3. The (*morindacitrifolia)* fruit juice leaves and seed results revealed the presence of vitamin A, vitamin B_2 and vitamin C. Vitamin A ranged from 0.04 ± 0.01to 0.53 ± 0.02g. Juice had 0.53 ± 0.02mg/ 100mg which is the highest, leaves had 0. 14 ± 0.01then seeds 0.04 ± 0.01. Vitamin B_2 values ranged from 0.22 ± 0.0 to 0.27 ± 0.01. Noni leaves had the highest value 1.14 ± 0.01. The vitamin C content of *morindacitrifolia* ranged 2.11 ± 0.01to 4.11 ± 0.01mg/100mg. Noni *(MorindaCitrifolia)* leaves had the highest score 4.11 ± 0.01.

Discussion

Proximate composition of Noni (*MorindaCitrifolia*) Juice, Leaves and Seeds

The proximate analysis estimates the major components which include moisture, protein, fat, and ash, crude fiber of Noni (*MorindaCitrifolia*) juice, leaves and seeds. The result of the proximate analysis revealed that the fruit juice had the highest moisture content of 92. 55 ± 0.40%, Leaves 9.75 ± 0.06, and seeds 8.27 ± 0.04. The high moisture content in the fruit juice is in agreement with the report of USDA (2008) which reported that moisture content is high in papaya fruits 85%. The high moisture content observed in the fruit juice will activate microbial growth, promotes susceptibility to microbial attack. Protein content of Noni (*MorindaCitrifolia*) ranged 0.04 ± 0.01to 14.33 ± 0.02. Protein plays vital role in biological processes. Protein was relatively low in the fruit juice and moderately high in the leaves having value of 14.33 ± 0.02. The low protein content of 0.04 ± 0.01 of the fruit juice is in disagreement with Chunhieng, (2003) who reported a protein content of 11.3% in the fruit juice of Noni (*MorindaCitrifolia*). The fat content of Noni (*MorindaCitrifolia*) ranged from 2.0 ± 0.01 to 3.98 ± 0.03, the low fat content observed in the study is on agreement with (Dike 2010) who recorded fat content 1.15% in *digitata*vegetable. Ash content ranged 1.06 ± 0.04 to 9.76 ± 0.03. Ash is the inorganic residue remaining after the water and the organic matter have been removed by heating on the presence of oxidizing agents. The appreciable quantity of ash in the samples is a reflection that they contain high amount of minerals and are also good sources of dietary minerals (Onwuka, 2005).

Crude fibre of the seeds and leaves were higher than the Noni fruits juice which ranged from 0.03 ± 0.01 to 28. 70 ± 0.01. This makes them suitable source of dietary fiber. Consumption of reasonable amount of fiber lowers the risk of coronary heart diseases, obesity and bowel cancer (Theuwissen and Mensink, 2008).

The total carbohydrate content of Noni (*MorindaCitrifolia*) fruit juice, seeds and leaves ranged significantly 2. 36 ± 0.39 to 53. 45 ± 0.05. Noni (*MorindaCitrifolia*) seeds had the highest carbohydrate content 53. 45 ± 0.05 which therefore indicates that it is a good source of energy: This is in agreement with (Vunchi, Umar, King, Liman, Jeremiah &Aigbe, 2011) who reported that most fruits

have high carbohydrate contents which depend on the fruit type, maturity and environment. The low carbohydrate contents seen in the fruit juice shows that it will be beneficial for those that are dieting for weight loss like obesity.

Conclusion

Consuming a healthy fruit drink/juice throughout the life course will help to prevent micro nutrients deficiency diseases as well as a range of non-communicable diseases, WHO (2018), emphasized consumption of a least 400g of fruits and vegetables per day. The study showed that pure Noni (MorindaCitrifolia) fruit juice can be produced and utilized by consumers as a homemade drink which can be a substitute to other popular fruits drinks like Zobo. To make it sweeter for consumption, the study suggested incorporation of date fruits for some consumers that appreciate taking it as dessert or sweetened.

Recommendations

Based on the analysis and findings of the study,

1. The researcher recommends that farmers and home makers in Nigeria should plant Noni in their home gardens since Noni can grow in wide variety of soil.Nonileaves can serve as asubstitute for pumpkin leaves. This will help to alleviate nutrients deficiencies especially minerals and vitamins. Consumer awareness on the potentials of Noni (MorindaCitrifolia) should be reawakened through advertisement.
2. The researcher recommends that intervention programmes and research on areas like underutilized fruits and vegetables will be useful in tackling dietary deficiency diseases.
3. Addition of dates will make the juice more acceptable by the consumers.
4. Further studies should be conducted by another researcher on the sensory evaluation, comparative analysis and diversification of Noni plant. This will help to popularize the crop.

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