

Chemical Analysis of Noni (*Morinda citrifolia*) Seeds and the Characterization of the Seeds Oil

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Abstract: Seeds of Noni (*Morinda citrifolia*) were analyzed for proximate composition, minerals, anti-nutritional factors and amino acid profile, while the oil extract was investigated for physicochemical properties and fatty acids contents. Values for moisture, ash, crude protein, crude fat and crude fiber are 5.46 ± 0.01 , 1.83 ± 0.01 , 1.72 ± 0.02 , 5.40 ± 0.07 and $4.67 \pm 0.06\%$ respectively. The calorific value of the seed was found to be 1585.90 KJ. The seed was found to be a potential source of minerals such as sodium, potassium, magnesium, calcium, phosphorous, iron and zinc. The anti-nutritional factors such as alkaloid, cyanide, flavonoid, oxalate and saponin were determined. The essential amino acids: glutamic acid, leucine and aspartic acid are present in higher concentrations as 6.33, 6.31 and 5.11 mg/100g crude protein, respectively. The physical and chemical properties of the seed oil were determined, thus the saponification value of the oil was found to be 32.26 mg KOH/g.

Keywords: Proximate Composition, Anti-nutritional Factors, Saponification, Essential Amino Acids, Mineral Constituents

1. Introduction

Protein-energy malnutrition which has adverse health and economic consequences is a wide spread problem throughout the world. It is the most common deficiency disease especially in developing countries [1]. In the food processing industry, edible portion of fruits are processed in to products such as puree, canned-slices, juice and pickles whereas the seeds are often discarded as wastes since they are not utilized for commercial purposes. However, seeds are promising sources of useful compounds, because of their favourable nutritional properties [2].

Although, certain seeds contain moderately high amounts of protein, calories, certain minerals and vitamins, their use as food and feeds formulations is still limited by their low amounts of sulphur-containing amino acids, low protein digestibility and the presence of several anti-nutritional components[3 – 4]. Also, despite the fact that these seeds are of high nutritional values, their intake is unfortunately lower

than what is desirable. It is in this vein that the presence of anti-nutrients in plant protein sources has constituted a major constraint in their full utilization as livestock feeds. For full utilization as either foods or animal feeds, it has been asserted that seeds should be free of anti-physiological substances, have high nutrients bioavailability and be easily processed into edible products [5]. In order to achieve these goals, appropriate and effective processing techniques are employed by either the consumer or the feeds processing companies.

Some physical and chemical processes normally used to reduce or remove anti-nutritional factors in foods include; soaking, cooking, fermentation, irradiation, enzymatic treatment and selective extraction. Industrial processes used to achieve this include canning, fractionation, toasting and isolation of protein concentrates. However, processing can also introduce undesirable compounds like volatile

aldehydes, ketones and peroxides as a direct result of lipid oxidation or reduce level of desirable compounds like protein and essential minerals [6 – 7].

Noni (*Morinda citrifolia*) is a well-known plant of the family *Rubiaceae* and found mostly in the South - East Asia and Australasia part of the world. The species has now been introduced into the tropics where it is fast naturalizing [8 – 9]. *Morinda citrifolia* is called by various names for instance the Hawaiians call it noni or mulberry, Malays refer to it as mengkudu while the Philippines call it apatots. Also in Barbados it is known as dog dumping [10 – 11]. These seeds are contained in the fruits which are sometimes known as starvation fruits. The noni seeds which have very tough and relatively thick coats are covered with cellophane-like parchment layers and are edible when roasted [12]. In general, only soft, ripened noni fruits which usually contain over 100 seeds are chosen for seed selection. The seeds are separated from the fibrous, clinging fruit flesh as depicted in figures 1 and 2 [2].



Figure 1. Noni fruit *Morinda citrifolia*.



Figure 2. Noni Seed Fibrous.

The phyto-chemical profile of *Morinda citrifolia* was studied by Senthilkumar *et al.* [13] and it was reported that this plant increases the levels of antioxidant activity in the body. It also inhibits or prevents the growth of tumors and helps the immune system [14]. *Morinda citrifolia* is also used to treat hypertension, aches, inflammation and infections by *Bacillus subtilis*, *Staphylococcus aureus*, *Proteus morgali*, *Pseudomonas aeruginosa*, *Salmonella* and *Shigella* spp [15 – 17].

The Noni plant is also used in lowering the blood sugar thus making it good for diabetics just as it is used in treating mycobacterium tuberculosis [18]. It also prevents arteriosclerosis as it inhibits low-density-lipoprotein oxidation, heart disease, gastric ulcer, mental depression and drug addiction [11, 19]. The ripe noni fruit is used as poultice for facial blemishes or as a remedy for skin sores, boils or infections. The fruits are also used in treating gastric ulcer, menstrual cramps, heart disease and cancer. The leaves and bark are made into a liquid tonic for urinary problems and muscle or joint pain [20 – 21]. Studies have also shown that noni juice lowers the number of DNA adducts in rats induced with a carcinogen [22 – 23]. The juice of this plant also affects the physical endurance of mice [24] and athletes [25] in addition to its anti-inflammatory effect [26]. This wonderful fruit has also been demonstrated to have positive effect on preventing arteriosclerosis [19].

This research, therefore, is geared towards the effective

utilization of this inexpensive plant material through the knowledge of its proximate, mineral, fatty acid, amino acid, oil characterization and anti-nutritional properties. This is because its utilization in food and industrial product development has not been accorded the attention it deserves.

2. Experimental

2.1. Sample Collection and Preparation

The fruits of *Morinda citrifolia* used in the course of this project were obtained from Bosso Local Government Area of Niger State, Nigeria and a fine powdered sample was made from them. The fresh noni (*Morinda citrifolia*) fruits were washed and opened up to remove the seeds. The seed samples were then sun dried and ground using porcelain mortar and pestle to obtain fine powder. The sample was stored at 4°C in a well labeled air-tight container prior to analysis.

2.2. Proximate Analysis

The ash, moisture, crude fat, crude protein (N x 6.25), crude fibre and carbohydrate (by difference) were determined in accordance with the methods of AOAC [27]. All proximate analyses of the sample flour/powder were carried out in triplicate and reported in percentage. All chemicals were of Analar grade.

2.3. Mineral Analysis

The minerals were analysed from solutions obtained by first dry-ashing the flour sample at 550°C and dissolving the ash in distilled deionized water in flasks [28]. All the metals (except Na and K) were determined by using atomic absorption spectrophotometer (Buck model 210 VGP). Sodium and potassium were determined using a flame photometer (Corning, UK Model 405), while NaCl and KCl were used to prepare the standards [27]. Phosphorus was determined by vanadomolybdate colourimetric method [29].

2.4. Anti-Nutritional Factors Determination

The contents of saponin, tannin, alkaloid, chemotrypsin, phytate, oxalate and cyanide were determined on flour sample by methods described by some researchers [30 – 31].

2.5. Amino Acid Analysis

The amino acid analysis was by Ion Exchange Chromatography (IEC) [32] using the Technico Sequential Multi sample (TSM) Amino Acid Analyzer (Technicon Instruments Corporation, New York). The period of analysis was 76 min for each sample. The gas flow rate was 0.50 mL/min at 60°C with reproducibility consistent within $\pm 3\%$. The net height of each peak produced by the chart recorder of the TSM (each representing an amino acid) was measured and calculated. Amino acid values reported were the averages of two determinations. Nor-leucine was the

internal standard.

2.6. Extraction of Oils

The powdered sample was oven dried and extracted with Soxhlet apparatus using n-hexane of Analar grade (British Drug Houses, London) for the recovery of undiluted oil. The crude oil extract was made free of water by filtering through the anhydrous sodium sulphate salt. The hexane was removed from the oil/hexane mixture by using a rotary evaporator.

2.7. Determination of Physicochemical Parameters of Seed Oils

The determinations of physicochemical parameters of sample oil for refractive index, acid value, iodine value, saponification value, unsaponifiable matter, peroxide value, free fatty acid and specific gravity are always carried out according to the methods of AOAC [33].

3. Results and Discussion

Table 1. Proximate Composition (%) of *Morinda citrifolia* seed.

Parameter	Value
Moisture	5.46 \pm 0.01
Ash	1.83 \pm 0.01
Crude fat	5.40 \pm 0.07
Crude fibre	4.67 \pm 0.06
Crude protein	1.72 \pm 0.02
Carbohydrate	82.08 \pm 1.68
Calorific value	1585.90 \pm 0.0

Table 2. Mineral content of Noni (*Morinda citrifolia*) seed (mg/100g).

Parameters	Concentrations
Sodium (Na)	52.50 \pm 0.71
Potassium (K)	410.50 \pm 0.71
Magnesium (Mg)	347.00 \pm 1.41
Calcium (Ca)	133.50 \pm 2.12
Phosphorous (P)	651.50 \pm 2.12
Iron (Fe)	7.48 \pm 0.07
Zinc (Zn)	8.15 \pm 0.07

Table 3. Anti-nutritional properties of *Morinda citrifolia* seed (mg/100g).

Parameters	Concentration
Alkaloid	3.05 \pm 0.05
Cyanide	1.05 \pm 0.02
Flavonoid	3.05 \pm 0.05
Oxalate	5.52 \pm 0.36
Saponin	25.63 \pm 0.15

Table 4. Amino Acid Profile of Noni (*Morinda citrifolia*) seed (g/100g crude protein).

Amino acid	Concentration
Lysine	2.15
Histidine	1.32
Arginine	4.25
Aspartic acid	5.11
Theonine	1.61
Serine	2.00
Glutamic acid	6.33
Proline	1.59

Amino acid	Concentration
Glycine	2.89
Alanine	3.71
Cystine	0.99
Valine	2.99
Methionine	1.02
Isoleucine	2.13
Leucine	6.31
Tyrosine	1.45
Phenylalanine	3.38
Tryptophan	0.37

Table 5. Physicochemical properties of *Morindacitrofoliaseed* oil.

Parameter	Values
Colour	Yellow
Smell	Pleasant
Physical state	Liquid
pH	8.31
Acid value (mgKOH/g)	30.86
Peroxide value (mg/g)	7.52
Saponification value (mg KOH/g)	32.26

The proximate compositions of Noni seed are shown in Table 1. The seed is an excellent source of carbohydrate ($82.08 \pm 1.68\%$) since its amount is high but of low crude fibre (4.67%). Also, the protein content is extremely low (1.72%) just as the fat is low (5.40%). The proximate composition of the *Morinda citrifolia* seed was compared to that reported by Magdai [34]. The protein content of the seed was extremely lower than 18.4 ± 0.5 reported for baobab seed from North-eastern Nigeria by Lockett [35].

The mineral contents of Noni seed are as shown in Table 2. The results showed that the Noni seed is an excellent source of potassium (410.50 ± 0.71 and 378.50 ± 6.34 mg/100g), phosphorous (651.50 ± 2.12 and 633.00 ± 1.91 mg/100g), magnesium (647.00 ± 1.41 and 331.00 ± 1.4 mg/100g) and calcium (133.50 ± 2.12 and 76.00 ± 2.83 mg/100g) but poor source of sodium (52.50 ± 0.71 and 48.50 ± 0.71 mg/100g), zinc (8.15 ± 0.07 and 12.50 ± 0.71 mg/100g) and iron (7.48 ± 0.07 and 6.65 ± 0.35 mg/100g). These values were comparable to the respective values of potassium (910 ± 20), Magnesium (270 ± 30), Calcium (410 ± 10), sodium (28.3 ± 2.2), Zinc (5.2 ± 0.0) and iron (6.4 ± 0.2) reported for baobab [34]. All the values obtained for the mineral contents of Noni seeds in this work for the dry ashing method except for zinc were higher than those obtained for the wet digestion method. The lower zinc value might have been due to the vaporization of this metal on ashing [35].

The amino acid compositions of the *Morinda citrifolia* seed are shown in Table 3. The seed contained high amounts of glutamic acid, leucine and aspartic acid but low amounts of the sulphur- containing amino acids. In contrast to the baobab seed, Noni seed protein contains low amount of lysine.

The physicochemical characteristics of Noni seed oil are shown in Table 4. The saponification and acid values were high (32.26 and 30.86 mgKOH/gOil). Pearson [36] reported that oils with higher saponification values contain higher proportion of lower fatty acid. Since the acid value is high, it shows that the oil from Noni seed should not be consumed since the acid value is an indicator for edibility of oil and

suitability for use in the industry. However the peroxide value (7.52 mg/g oil) is lower than expected compared to the rancid oil which range from 20.0 - 40.0 mg/g oil [37].

4. Conclusion

The long chain fatty acids found in the oil have a low saponification value because they have a relatively fewer number of carboxylic functional groups per unit mass of the oil as compared to short chain fatty acids. The triglycerides with high value of saponification value as is the case with the Noni seeds oil are considered to make better quality soaps than those with low saponification value.

The acid value which is an indirect measure of the amount of free acids is present in fats and oils. Since the Noni oil is high in the amount of acid value, the higher the deterioration or rancidity of the oils are undergone deterioration or rancid. As the rancidity increases, the oil achieves a foul smell along with a sour taste. Therefore the oil from Noni seed should not be consumed since the acid value is an indicator for edibility of oil and suitability for use in the industry.

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