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Nutritional and Physico-Chemical Evaluations of *Moringa oleifera* Seedlings and Oil

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Abstract

This work was intended to respectively examine the proximate analysis; mineral compositions and physico-chemical parameters of *Moringa oleifera* seeds and its extracted seed oil. Harvested seedlings of *Moringa oleifera* plant obtained from Chukwun community in Kaduna State of Nigeria presented an oil yield of 42.51%. Percentage values of 3.47, 6.84, 3.99, 26.48, 48.29 and 12.44 respectively represents the moisture content, crude fibre content, total ash, protein content, crude fat content and carbohydrate content of the seeds. The mineral elemental concentration carried out showed potassium having the highest concentration of 368.95 mg/kg while zinc concentration was the lowest (6.82). Physico-chemical examinations of its seed oil reveal 194.75 mg KOH/g sample, 68.41 gICI/100g sample, and 5.6 mg KOH/g sample respective values for saponification, iodine and acid values. The findings from this investigation show that *Moringa oleifera* seed and oil extracted from it could be consumed and its oil could be used as base materials for several industrial processes.

Keyword: Chukun, *Moringa oleifera*, Crude fibre, Physico-chemical, Industrial, Mineral.

Introduction

Moringa oleifera is a popular domestic plant known for its versatile use in the area of food and medicine. It is native to Indian subcontinent and now domesticated in the tropics and subtropical areas of the world (Fozia *et al.* 2012). It is commonly called “benzoil tree”, “drumstick tree” or “horse radish tree”, “miracle tree” in English (USDA, 2014), “Okwe oyibo” in Igbo, “Zogeli” in Hausa and “Ewe igbale” in Yoruba speaking people of Nigeria (Anwar *et al.*, 2007). *Moringa oleifera* belongs to the family Moringaceae comprising of about fourteen different species. The 5 to 10 m height tree can survive severe climatic conditions such as wide range of rainfall calculated at 250 mm and above 3000 mm, pH 5.0 to 9.0 and in barren soil (Morton, 1991; Fozia *et al.* 2012). In the tropical and sub-tropical countries, the leaves, flowers, fruits and immature pods of the tree form part of orthodox diets. The leaves are extremely rich in Vitamin A, B and C, protein and essential

minerals such as iron and calcium when compared with regular fruits such as oranges, bananas, spinach and milk (Dahot, 1988; Anhwange *et al.*, 2004, Kamal, 2008). The medicinal potential cum antimicrobial activities of *Moringa oleifera* is tremendous. The root, leaf, bark, fruit, flowers, gum, seed and seed oil have been utilized for various ills in the autochthonous medicine (Odebiyi and Sofowora, 1999; Fozia *et al.* 2012). Aqueous extract of the plant have been found to possess inhibitory activity against micro-organisms including *Escherichia coli*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Bacillus subtilis*, *Basidiobolus ranarums* and *Basidiobolus haptosporus* (Nwosu and Okafor, 1995; Saadabi and Abu Zaid, 2011). The fatty acid profile of its seed oil allows for *Moringa oleifera* seed oil to be formulated into useful organic coatings (Siyabola *et al.* 2015). The locals in the Northern states of Nigeria have shown a lot of interest in the cultivation and process of *Moringa oleifera* plant due to the numerous applications the plant provides. They use the seed flour as natural coagulant for their water treatment purposes. This study became imperative as these locals could hardly prepare anything without adding part(s) of this plant as supplement. Therefore, this work evaluates the proximate and mineral analyses of *Moringa oleifera* seed flour.

Materials and Methods

Moringa oleifera seeds were obtained from Chukwun in Kaduna State, Nigeria. The pods were air dried and de-hulled to obtain the seeds. Seed oil was extracted using the Soxhlet extractor with n-hexane as solvent for extraction. The moisture content of the defatted *Moringa* seeds was determined by heating 2.0 g of the sample in a crucible placed in an oven at 105 °C till a constant weight of the crucible was obtained. The ash content was determined by the incineration 1.5 g samples placed in a muffle furnace maintained at 550 °C for 3-4 hours. The crude fibre content was determined by digestion of samples. The protein content was determined through the Kjeldah method (AOAC, 1990). The mineral analysis was carried out according to Novozamsky *et al.*, 1983. The physico-chemical analyses such as iodine value, saponification value, peroxide value and acid value were all carried out on the seed oil using AOCS, 2003 and Hundiwale *et al.*, 2009 methods.

Results and Discussions

Table 1 presents the result of proximate composition of *Moringa oleifera* seeds. The 3.47% moisture content of *Moringa oleifera* seed is by far less than that of African nutmeg (*Monodora myristica*) having 14.7% moisture content (Dawodu, 2009). Kernels from both seeds are used as condiment for food spicing in Nigeria. The low moisture content is an indication that the seeds could be stored for longer period of time. The low ash content value of 3.99% is correspondent to some staples as being good source of minerals. The high protein content of 26.48% gives an indication of its relevance for human and animal consumption. This value is within the range of important legumes and high protein bearing animals (Bhuiyan *et al.*; 1986). The fat content of the *Moringa oleifera* seed under study (48.29%) is higher than that reported for melon seeds (17.36-25.06%) by Ebuchi and Avwobobe (2006) but slightly above the 45.84% reported by Abiodun *et al.* (2012) for *Moringa oleifera* seed, this difference may be due to variation of weather conditions and the species used for analysis.

Table 1: Proximate analysis of the *Moringa oleifera* seed (w/w %)

| Constituents | Percentage (w/w %) |
|----------------------|--------------------|
| Moisture content | 3.47 ± 0.06 |
| Crude fibre content | 6.84 ± 0.42 |
| Total ash | 3.99 ± 0.21 |
| Protein content | 26.48 ± 0.84 |
| Crude Fat content | 48.29 ± 0.68 |
| Carbohydrate content | 12.44 ± 0.53 |

Mean values ± Standard deviation, n=3

The mineral concentrations of the seeds investigated are presented in Table 2. From the results, the highest concentration of 368.95 mg/kg represents the mineral composition of potassium in the seed sample. The

concentrations in mg/kg for calcium, magnesium, sodium and iron were 215.68, 198.79, 129.34 and 125.72 respectively. The mineral concentration of iron from the sample under study is 400% higher than the value report by Abiodun *et al.* (2012). The differences observed may be ascribed to soil composition, analytical methods used as well as weather conditions of the area under study. The significant high concentration of potassium in the seed is responsible for the claimed treatment for blood pressure by its consumers. Potassium also assists in controlling kidney failure and respiratory defects. Potassium, calcium and magnesium are all regarded as macro-minerals. The high concentrations of calcium and magnesium in the sample will enhance quality bones and teeth, relaxation and contraction of muscles, blood clotting, blood pressure regulation, protein building and nerve transmission. The 125.72 mg/kg concentration level for iron (micro-mineral) place *Moringa oleifera* seed as a good source of iron mineral for metabolism, DNA synthesis, immune function, healing and anemia prevention. Primarily, it's essential presence in proteins, hemoglobin and myoglobin which channel oxygen through the muscles and blood assert the relevance of *Moringa oleifera* seed as a "Miracle seed" as it's been adjudged in some quarters

Minerals such as cadmium, Nickel and lead were not detected in the sample under study.

Table 2: Minerals composition of *Moringa oleifera* seed

| Mineral Elements | Concentration (mg/kg) |
|------------------|-----------------------|
| Manganese | 8.36 ± 0.25 |
| Zinc | 6.82 ± 0.02 |
| Iron | 125.72 ± 0.15 |
| Potassium | 368.95 ± 0.21 |
| Magnesium | 198.79 ± 0.48 |
| Calcium | 215.68 ± 0.19 |
| Sodium | 129.34 ± 0.42 |
| Cadmium | N.D |
| Nickel | N.D |
| Lead | N.D |

N.D: Not Detected

The results presented for physico-chemical properties of *Moringa oleifera* seed oil (Table 3) were seen to have absolute dependence of the method of extraction and climatic conditions prior to the harvest of samples. Lalas and Tsaknis (2002) used cold pressure, n-hexane and (1:1) chloroform methanol ratio in carrying out their extractions, their samples were harvested in India. The contrary is for the sample under investigation, which was harvested in Nigeria but n-hexane, was used for the extraction process. The values for refractive index, saponification value and iodine value are respectively 1.461; 194.75 mg KOH/g sample and 68.41 gICl/100g samples, these values respectively slightly differ from those obtained through cold pressure extraction by Lalas and Tsaknis (2002). The acid value (5.6 mg KOH/g sample) is lower than the maximum permitted for unrefined oil (FAO/WHO, 1993). This connotes that *Moringa oleifera* seed oil possess low rancidity degree.

Table 3: Physico-chemical properties of *Moringa oleifera* seed oil

| Parameters | Values |
|---|--------|
| Refractive index (at 40 °C) | 1.461 |
| Specific gravity (at 40 °C) | 0.894 |
| Iodine value (gICl/100g) | 68.41 |
| Saponification value (mg KOH/g sample) | 194.75 |

| | |
|---------------------------------|-----|
| Acid value (mg KOH/g sample) | 5.6 |
| Viscosity (cSt at 40 °C) | 68 |

Conclusion

The nutritional, mineral elemental composition and physico-chemical parameters of *Moringa oleifera* seed and oil have been studied. The nutritional aspect shows that the seed and oil from the plant could be consumed. Though the seed oil is non-drying oil (having acid value less than 130 mg KOH/g sample) but through appropriate formulations it could also serve as a useful base material for industrial purposes. The seedlings are rich in mineral element contents hence, could be used to fortify food.

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