Field Diseases and the Effects of Varying Temperatures on the Nutrient Composition of Moringa (*Moringa oleifera* Lam)

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Abstract

Studies on associated field diseases and the effects of varying temperatures on the nutrient composition of Moringa oleifera was carried out in the field, Food Science and Technology and Plant Pathology Laboratories, Rivers State University of Science and Technology, Port Harcourt. Field diseases of moringa plant were sampled from plants in ten different locations in the university campus. The plant parts sampled were the leaves, stems, pods and flowers. It was observed that moringa plants played host to four field diseases namely Mosaic virus, Chlorosis, Bacterial blight and Anthracnose disease. Mosaic virus, Chlorosis, Bacterial blight infected the leaves while Anthracnose disease only infected the stems and the pods. Assessment of the nutrient status of moringa leaf also showed that it is rich in essential nutrient elements such as moisture, ash, carbohydrate, lipid, fiber and protein. Mineral elements such as potassium, phosphorus, magnesium, calcium, iron, manganese, sodium and zinc were found in sufficient quantity in the leaf. Essential vitamins such as thiamin, niacin, riboflavin, ascorbic acid and high amount of energy were also present. Varying drying temperatures had a significant effect on the proximate compositions of the moringa leaf samples.

Keywords: *diseases, moringa, nutrients, temperature.*

Introduction

Moringa (*Moringa oleifera* Lam.) is a vegetable shrub measuring about 5-15 m in height with soft and brittle stem (Rollof *et al*., 2009) with a diameter of about 30cm. It is said to have originated from India and has spread around the world. The tree is known by a multiplicity of names in different regions of the world such as Bensolive, Drumstick tree, Horseradish tree, Kelor, Marango, Mlonge, Mulangay, Saijihan and Sajna (Fahey, 2005) and one of the most cultivated species of the genus moringa (Olson, 2010). Moringa leaves are compound, pinnate double, and of small round oval shape. The fruits, called "drum stick" is long and angular, its sides form a triangle; the drum sticks are about 15-45 cm long, with around 20 seeds (Sengupta and Gupta, 1970). The moringa plant grows well in most tropical and subtropical hot dry land and can survive in less fertile soils and also not greatly affected by drought (Anwar *et al.*, 2007*).* Moringa plant is considered as one of the most useful plant as all the parts are useful as either food, medicinal purposes or for industrial use (Khalafalla, 2010). The leaves, flowers and fresh pods are used as vegetables and as livestock feed because of their high nutritive values (Anjorin

et al., 2010, Waldron *et al*., 2003; Tetteh, 2008). Moringa plant has the potential to improve nutrition, boost food security, and foster good health status (HSU, 2006, Chuku and Chuku, 2013). The utilization of Moringa plant is increasing all over the world (Reyes Sanchez *et al*., 2006, Oduro *et al*., 2008) due to its nutritional, therapeutic, and prophylactic properties (Fahey, 2005). Studies have shown that the leaves have immense nutritional values such as phytochemicals, vitamins, minerals and amino acids (Anwar *et al*., 2007; Busani *et al*., 2011; Chuku and Chuku, 2013).The leaves of Moringa have been used to combat malnutrition , especially among infants and nursing mothers. Moringa leaf products, especially the leaf powder, are becoming very popular in Nigeria because of its outstanding indigenous and medicinal attributes. The leaves are also free of antinutritive factors such as phenols, tannins, and saponins (Fuglie, 2001). The seeds have long been used as tasty vegetable and as water purifier because of its coagulant abilities (Ayotunde *et al*., 2011). The flowers, roots and barks of moringa plant have good nutritional and therapeutic attributes (Olushola, 2006). The leaves of this potent plant is consumed in various ways either as fresh leaves, sun dried or oven dried which may have effects on the nutrient composition. This study therefore investigated the associated field diseases, nutrient composition of the moringa leaf and the effects of varying drying temperatures on the nutrient composition of the leaves, the knowledge of which will enable consumers choose the best way of controlling these diseases, know the nutrient status of the leaves and the best drying method to prevent loss of nutrient from the leaves.

Materials and methods

General survey of field diseases of *Moringa oleifera*

Field diseases of *Moringa oleifera* were assessed from ten different locations within the Rivers State University of Science and Technology campus. Three plants each from the different locations that are three year old were tagged and sampled for disease infection. The plants parts sampled included the stems, leaves, flowers and pods. Sampling however was done twice per week for ten weeks. The plant parts collected from the field were carried to the plant pathology laboratory and observations carried out both visually and with the hand lens. Disease samples were identified using the Keys as described by (Onuegbu *et al*., 2009).

Collection of moringa leaf samples

Moringa leaf samples were collected from three different locations in the River State University of Science and Technology (UST) viz: the University Teaching and Research Farm, behind the Fisheries laboratory and Road G residential area. The fresh leaves were assembled in the Plant Pathology Laboratory in the Department of Applied and Environmental Biology in UST for further studies.

Preparation of moringa leaf samples for analysis

Composite sample of the leaves from the various locations was prepared by mixing 100 grams of leaves each from the different locations. The composite leaf sample was taken to the Department of Food Science and Technology for nutrient analysis.

Nutrient evaluation of fresh moringa leaf sample

100 grams of the composite moringa leaf sample was taken to the Food Science and Technology Laboratory for nutrient analysis.

The method of analysis used was the Association of the Official Analytical Chemists procedure (AOAC, 2005). The parameters estimated were the proximate, mineral, vitamins contents of the samples of Moringa leaf.

Effects of oven drying and sun drying on the nutrient composition of moringa leaf samples

To determine the effects of varying temperatures on the nutrient composition of moringa leaf samples, 100 grams of the composite leaf samples were sun dried for six hours during the hot dry season in March and oven dried at low temperature of 45^{o} C in the autoclave. The leaf samples were taken to the Food Science and Technology Laboratory for nutrient content determination according to the (AOAC, 2005) methods of analysis.

Results

Results of the field diseases of *M. oleifera* are shown in Table 1. Results showed that *Moringa oleifera* plants play host to a few diseases in the field. Four field diseases namely mosaic virus, leaf chlorosis which could be caused by various factors including biotic and abiotic components, bacterial leaf blight and anthracnose disease were found to be associated with the plant in the field. It was however observed that the leaves were greatly infected than any other plant part sampled. Anthracnose disease was the only disease that infected the stems and the pods of Moringa plants.

Mosaic viral disease of *M. oleifera:* This disease infected mainly the leaves with characteristic mottled leaves, chlorotic spots, abnormal reduction in leaf size, and general leaf curl.

Leaf chlorosis of *Moringa oleifera:* General yellowing of leaves with no special pattern which occurred on both the lower leaves and the upper leaves. The yellow leaves were spotless and eventually drop due to lack of chlorophyll and nutrient distribution.

Bacterial blight disease of *Moringa oleifera:* leaves are scotched, appeared flamed and followed by total disintegration and eventual leaf fall.

Anthracnose disease of *M. oleifera:* Infections found on stems and pods. Disease leaves brown thick scars on the infected parts.

Table 1: Field diseases of *Moringa oleifera* and the affected plant parts

Plant diseases	**Plant parts**			
	Stem	Leaves	Flowers	Pods
Mosaic virus	-	++	-	-
Chlorosis	-	+++	-	-
Bacterial blight	-	+	-	-
Anthracnose disease	+	-	-	+

Legend: - = absent
+ = few

++ = many
+++ = too many

Results of the nutrient composition of composite fresh moringa leaf samples are presented in Table 2. The leaf samples consist of relatively high moisture (76.36±0.003), moderate carbohydrate (8.28±0.001) and protein (9.40%) respectively. Ash, dietary fiber and lipid were also found in minute quantity. Vitamins such as, Thiamin (Vit. B_1), Riboflavin (Vit. B_2), Niacin (Vit. B_3) and Ascorbic acid (Vit. C) Which recorded the highest value (52.6 ±0;021 mg) was also present in moringa leaf. Energy level of fresh moringa was also high (63.68±0'031 Kcal). Essential minerals such as Calcium, Iron, Magnesium, Phosphorus, Manganese, Potassium, Sodium, and Zinc were present. Potassium however, recorded the highest value among the mineral elements present in moringa leaf (335 ±0.003mg) followed by Calcium, Magnesium and Phosphorus (1.85±0.160, 139±0.012 mg and 114±0.021 mg) respectively.

Table 2: Nutrient composition of fresh moringa leaf sample

Proximate composition	**Values (%)**
Moisture	76.36 ± 0.003
Ash	2.56 ±0.001
Carbohydrate	8.28 ±0.001
Dietary fiber	2.0 ±0.002
Lipid	1.40 ±0.002
Protein	9.40 ± 0.013
Vitamins	**Values (mg)**
Thiamin (Vitamin B1)	0.26 ± 0.011
Riboflavin (Vitamin B2)	0.660± 0.010
Niacin (B3)	2.22 ± 0.012
Ascorbic acid (Vitamin C)	52.6 ± 0.021
Mineral elements	**Values (mg)**
Calcium	1.85 ± 0.160
Iron	4.00 ± 0.023
Magnesium	139 ±0.012
Manganese	0.38 ± 0.017
Phosphorus	114 ± 0.021
Potassium	335 ± 0.003
Sodium	8.56 ±0.023
Zinc	0.48 ± 0.015
Energy (Kcal)	**63.68 ± 0.031**

Effects of drying at varying temperatures on the nutrient composition of moringa leaf

Results of the effects of drying at varying temperatures on the proximate, vitamin, mineral and energy composition of moringa leaf samples are presented in figures 1 - 4. It was revealed that fresh moringa leaf samples recorded higher values for moisture, ascorbic acid, riboflavin and thiamin. Oven dried leaf samples had higher values for carbohydrate, fiber, lipid, protein and

niacin while sun dried moringa leaf samples recorded the highest value for ash. Mineral components of moringa leaf samples treated in different ways are presented in Figure 3. Calcium contents, magnesium, manganese, phosphorus, potassium, sodium, zinc and energy were highest in oven dried leaf samples than in all other samples. However, the iron content did not vary irrespective of the drying methods employed. Sun dried leaf samples did not differ much from the oven dried samples as the values recorded for the above mentioned mineral components did not vary significantly. In general, mineral contents of fresh moringa leaf samples was low compared to those of oven dried and sun dried samples of moringa. There is a sig diff ($P<0.05$) for all the treatments indicating that the treatment affected the proximate values

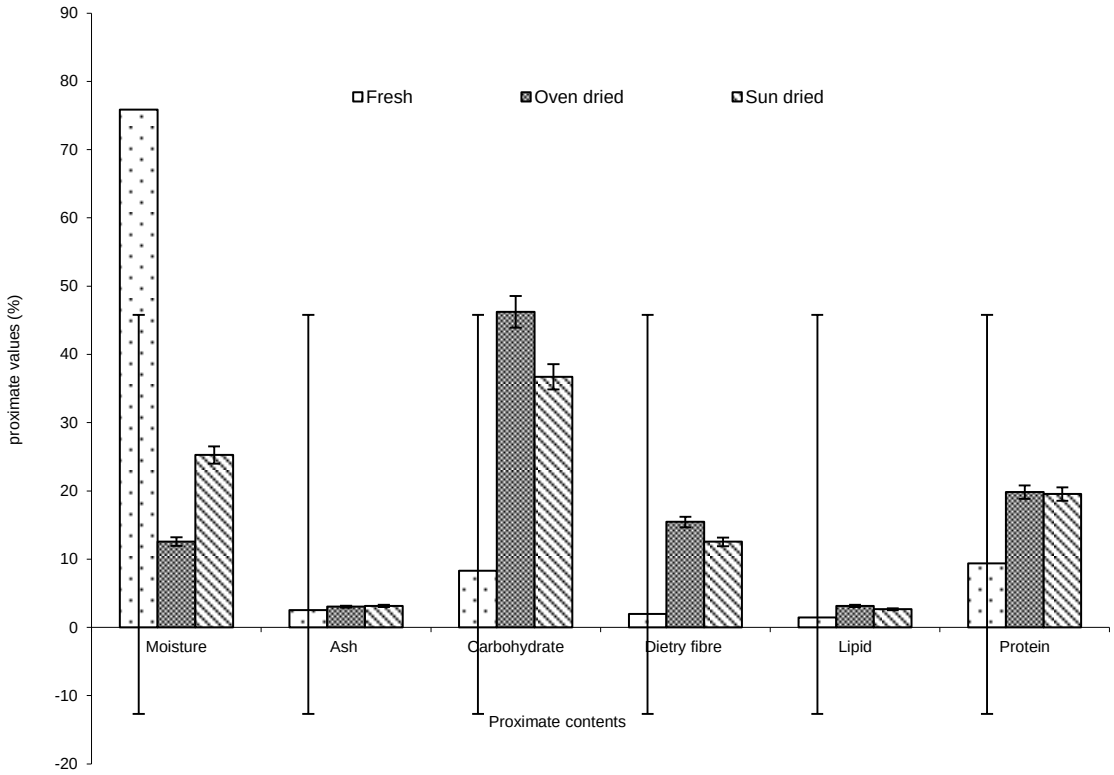

Figure 1: Effects of drying at varying temperatures on the proximate compositions of moringa leaf

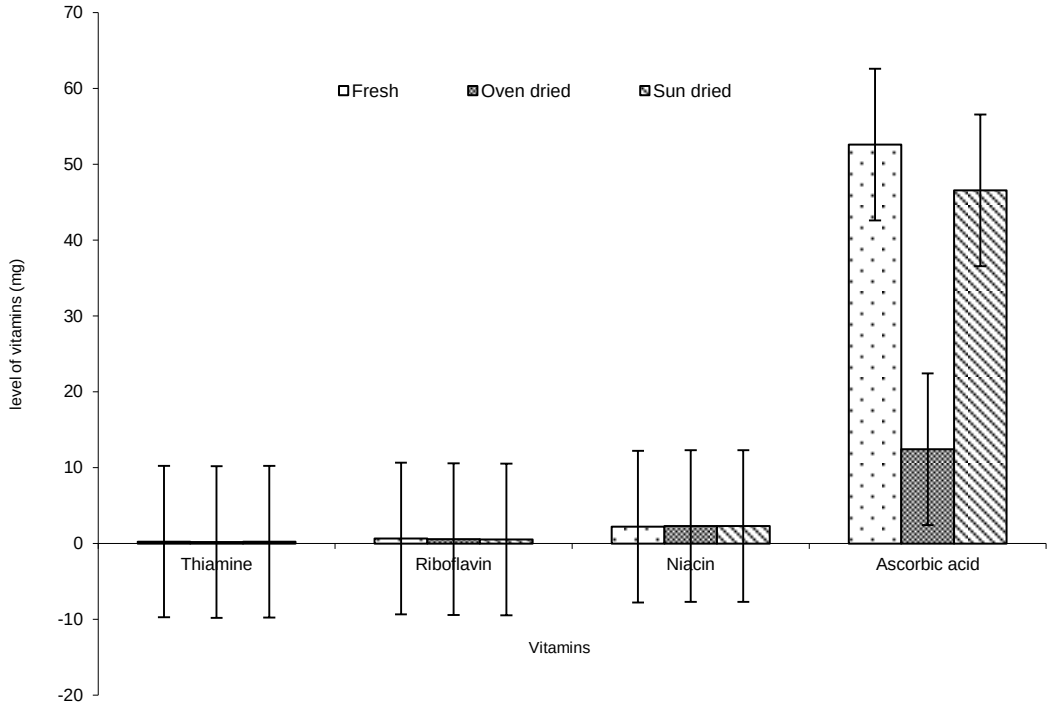

Figure 2: Effects of drying at varying temperatures on the vitamins composition of Moringa leaf.

The treatments affected the vitamins compositions of moringa leaf significantly except niacin that did not differ irrespective of the various treatments ($P<0.05$). It was also observed that ascorbic acid content of moringa leaf samples was highest in the fresh leaf samples than in the oven dried and sun dried samples.

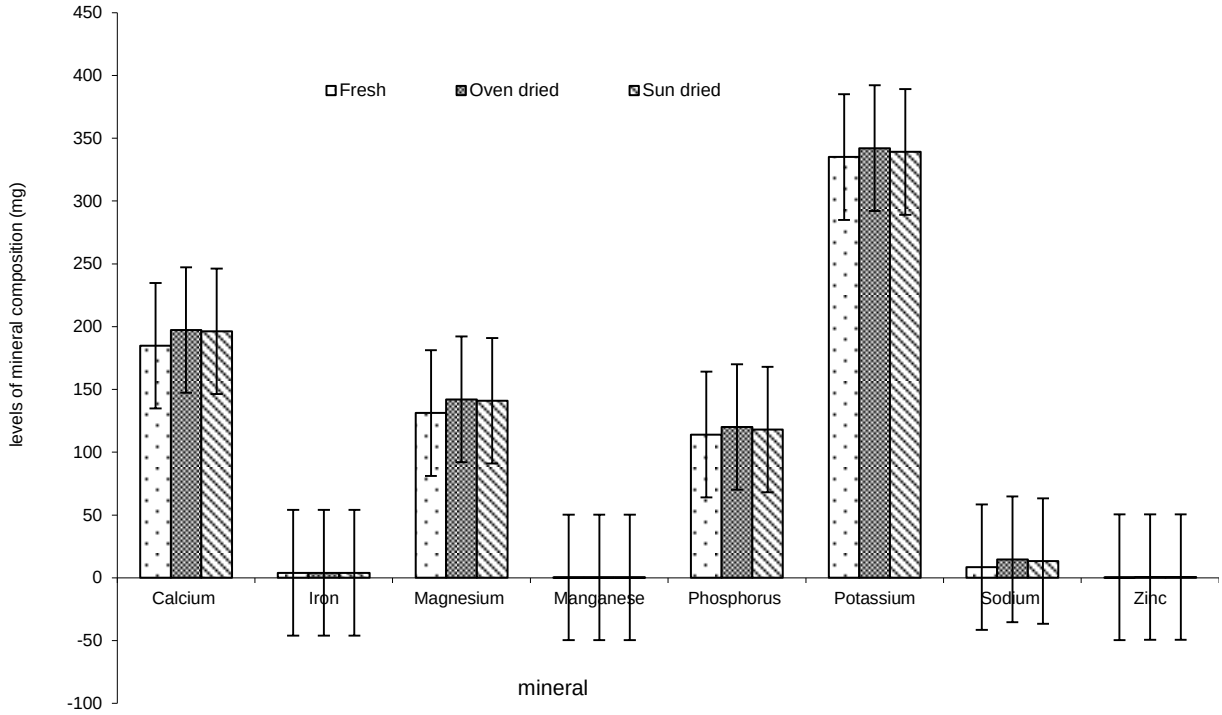

Figure 3: Effects of varying drying temperatures on the mineral compositions of moringa leaf

The mineral compositions of moringa leaf varied significantly due to the various drying methods except the iron content of the leaf that did not differ significantly ($P< 0.05$). Oven dried moringa leaf samples however, recorded significantly higher values for all the mineral elements found in moringa leaf followed by sundried samples and least in fresh samples respectively.

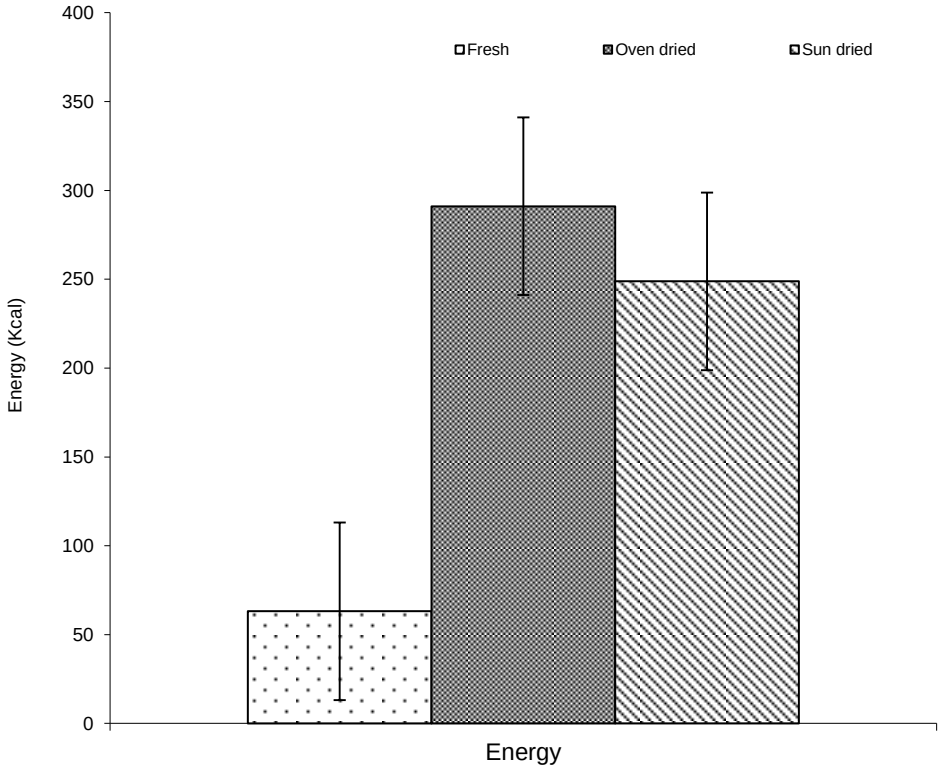

Figure 4: Effects of varying dying temperatures on the energy values of moringa leaf

Energy values for all the treatments differed significantly at ($P< 0.05$). However, energy value was highest in oven dried samples followed by sun dried samples and least in fresh moringa leaf samples.

Discussion

Field diseases of most tropical crop plants are well documented (Onuegbu, 2002). Diseases and pests are among the serious problems encountered by farmers for maximum agricultural productivity. Most of these field diseases are transferred from the field to store and also lower produce quality. *Moringa oleifera* appears not to be greatly affected by a large number of field diseases as shown in this study (http://forums2.gardenweb... Retrieved on the 19/9/2009). Mosaic viral disease and Bacterial blight are among the field diseases of most tropical crops infecting root and tuber crops, vegetables, legumes and fruits and nuts (Chuku and Ugorji, 2012, Onuegbu, 2002). Several fungi and bacteria that are known to be associated with plants diseases have been isolated from the rhizosphere of *M. oleifera* plants ((Sylvia *et al.*, 2005; Green *et al*., 2006; Obire and Isoboye, 2014.). On the nutrient composition of fresh *Moringa oleifera* leaves has shown that it is an important plant whose leaves and other plant parts are very important both as vegetables and as herbal remedies for various ailments (Ramachandran *et al*., 1980, Morton, 1999). However, the high nutrient compositions of most tropical fruits, nuts and vegetables have been reported (Achinewhu, 1996, Chuku *et al*., 2012; Chuku and Chuku, 2013, 2014 and 2015, Elochukwu *et al*, 2014). The high ascorbic acid contents, dietary fiber and moisture present in

most vegetables and especially in moringa leaf samples makes it an important vegetable for weight loss. Other researchers have reported the great benefits and potentials of most leafy vegetables consumed as food in various parts of Nigeria (Mensah *et al*, 2008, Ogbuji *et al*, 2014). Drying of moringa leaves at varying temperatures significantly affected the proximate, vitamins , mineral,and energy contents of samples. Oven drying and sun drying of *Moringa oleifera* leaves affected the nutrient composition differently. While some nutrient components such as Carbohydrate, ash, dietary fiber, protein, calcium, magnesium, manganese, phosphorus, potassium, sodium, zinc, niacin and energy were greatly improved by oven drying, others were negatively affected. It has been reported that hot air treatment of various agricultural products have led to reduction in microbial infection and therefore enhanced better storability of these products (Komolafe and Aborishade, 2013, Fallik *et a.*, 1996; Komolafe, 2014). High moisture contents of most agricultural produce have often led to faster deterioration of these products (Onuegbu, 2002; Okaka, 1997). Reducing their moisture contents to safe levels enhances storage stability and is always advocated for improved shelf life. Through oven drying of moringa leaf samples, the moisture content of the leaf samples reduced from 76.36% to 12.46% thereby enhancing the storability of the leaf samples. Sun drying also reduced the moisture content of the leaf samples to 25.41%.

Conclusion and Recommendation

This study has shown that *moringa oleifera* play host to only four field diseases with the leaves being the most infected. The study also revealed that the moringa leaf is very rich with essential nutrients for healthy growth and development. However, study on the effects of varying drying temperature also showed that oven drying at low heat concentrated most of the nutrients and therefore a better method for storage stability than the fresh and sun dried samples.

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