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STUDIES ON THE CHEMICAL COMPONENTS OF *MORINGA OLEIFERA* PLANT GROWN UNDER EGYPTIAN CONDITIONS

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ABSTRACT: This study was conducted in Department of Medicinal and Aromatic Plants, Horticultural Research Institute, ARC, Dokki, in two successive seasons of 2012 and 2013 on *Moringa oleifera* plant in 4 (four) different regions in the Upper Egypt (A1 and A2) and Delta (A3 and A4). It aimed to study the effect of different environments on chemicals and food ingredients, as well as determine the adaptation to different environments to identify the best region for growth. The seeds were germinated in the greenhouse of National Gene Bank, and then seedlings were transferred into (A1, A2, A3 and A4 regions) in plots with 20 × 30 m distance with 2 m distance between the plant and 3 m distance between rows. Samples were taken in different growth stages (2, 4, 6, 8, 10 and 12 month).

The obtained results showed that there were significant differences in chemical components in the whole regions under study. The region (A1) showed the best values in respect to acid ascorbic (vitamin C), beta carotene (vitamin A), thiamine (vitamin B1), riboflavin (vitamin B2), niacin (vitamin B3), and tocopherols (vitamin E), calcium, iron, protein, zinc and phosphorus at a rate value higher than the region (A2) by 2%, region (A3) by 15% and region (A4) by 8%. The obtained results explained that the differences among regions in chemical and food components during plant growth. The best results were obtained from the Upper Egypt under study in respect to the quantity of nutrition in addition to region (A4) which were good for cultivating of Moringa tree in Egypt.

Key words: *Moringa oleifera*, Moringa trees, Nutritional Value of Moringa, *Moringa oleifera* medicinal properties.

INTRODUCTION

The *Moringa oleifera* genus is a common member of the family Moringaceae, which containing a wide range of plants, including flowering herbs and trees. It is common known as Horseradish tree, Benzolive, Kelor or Drumstick tree. The drumstick-like shape, curved seed pods is the characteristic for this species calling Drumstick tree (Asres, 1995). This tree is origin in Himalayas, India and it grows in tropical and semi-arid climates. Moringa tree reaches to about ten meters in height and be drought tolerant allowing it to thrive in arid climates. In addition, the Moringa trees has multi-uses as a food and medicinal plant (Costa-Lotufo *et al.*, 2005), and each part of tree utilized to benefit humans, provided food, and other valuable materials for farming and fuel (Dahot, 1998).

The pods and leaves of Moringa trees was used for food in numerous cultures throughout the world. According to Bharali *et al.* (2003), it cultivated first in Northern India and incorporated into a number of

religious and cultural observances. Derived-oils from the seeds used as food and in unguents by the ancient Greeks, Romans and Egyptians and were part of the Ayurvedic health diet in India (Badgett, 1964; Anderson *et al.,* 1986). Oil products, valuable food source, changing in environment and culture and increasing interest of Moringa uses in over the world has led to its cultivation in many regions as well as the West India. The leaves, flowers and pods have highly nutritional and provide a number of necessary nutrients, including protein, beta-carotene, calcium and vitamin C (Bharali *et al.*, 2003). Because of it made spread in a wide range of climates in order to produce the different parts of plant for utilizing in more uses. It is well good to use as a nutrition (either humans or animals) in the poor regions in over the world, including Asia and Africa, making it more useful for fighting malnutrition in these regions (D'Souza and Kulkarni, 1993).

The shelf life of food is the biggest one advantage in Moringa tree for malnutritional fighting. The leaves of Moringa are consumed fresh, dried or cooked as spinach, in addition to store for months without requiring refrigeration (Caceres and Lopez, 1991; Caceres *et al.*, 1991 and 1992). The fresh leaves are a source of vitamin C, while the dried leaf powder has Vitamin A equal about ten times available than fresh carrot, according to Akhtar and Ahmad (1995) and Anwar and Bhanger (2003). Moreover, the plant has other vitamins and minerals, including high concentrations of calcium, iron, potassium, magnesium and the vitamin B (Babu, 2000; Barminas *et al.,* 1998 and Chawla *et al.,* 1988). The Moringa plant is utilized as a supplemental nutrition specially vitamin and mineral supplements (Bharali *et al.*, 2003).

This study was carried out to study the effect of different environments on plant growth, chemical and food ingredients at different plant growth stages through cultivating in four Egyptian regions.

MATERIALS AND METHODS

This investigation was carried out at the Experimental Farm of National Gene Bank, and Medicinal and Aromatic Plant Research Department, Horticulture Research Institute, Agricultural Research Center, Dokki.

Seeds used in the experiment:

Moringa (*Moringa oleifera*) was planted in four regions in Egypt, in order to study the effect of different environments on the food ingredients and chemicals, as well as determine the significance of this plant and the extent to adapt it to the different environments in Egypt and determine the best Egyptian conditions for growth.

Place of agriculture:

Seeds of Moringa were planted in two successive seasons of 2012 and 2013 in the four Egyptian regions as the following in: (1) Upper Egypt: (Al-Saf) Giza Governorate (A_1), and (Beni Mazar) Minya Governorate (A_2) and (2) Delta area of Egypt: (Nubaria) Beheira Governorate (A_3) and (Sarabum) Ismailia Governorate (A_4).

Characteristics of soil:

In the Upper Egypt (A_1, A_2) soil was characteristic as light clay, good drainage and irrigated with water from the Nile River, while in the area North of Egypt (A_3, A_4) soil was a good sandy, high penetrating and irrigated with groundwater.

Seedlings of plants in the field experiment:

Moringa was germinated in the Greenhouse of National Gene Bank before transfer the seedlings to four regions (A_1, A_2, A_3 and A_4) under study. After seedling, the planted plots were 20 × 30 m; with 2 m distance between plants and 3 m distance between the rows. It applied in both seasons (2012 and 2013) in all regions under study. This aimed to study the impact of Egyptian conditions (climatic factors and soil conditions) on food ingredients and chemical components for this plant.

Sampling of Moringa leaf:

Samples of leaves were taken at different stages of fresh weight of leaves after seedling (2, 4, 6, 8, 10 and 12 months in both successive seasons), in order to study the chemical and food ingredients and stages of their formation and quantity through the stages of plant growth under Egyptian conditions in different regions under study.

Sampling of Moringa seeds and roots:

At the end of growth in two successive seasons of 2012 and 2013, seed samples was be taken from mature pods as well as samples of roots for this plant.

Plant samples analysis:

Moringa samples were analyzed at the National Institute of Nutrition Canada, Ottawa, Canada.

Chemical characterization of *Moringa oleifera*:

Moringa seeds were analyzed for various quality attributes including proximate analysis, mineral composition, polyphenols and alkaloids. The procedures followed are given:

1- Proximate analysis:

a. Moisture content:

Moisture contents of Moringa seeds were estimated by drying the samples in an Air Forced Draft Oven (Model: DO-1-30/02, PCSIR, Canada) at 105 ± 5°C until a constant weight was obtained (A.A.C.C., 2000; Method No. 44-15A).

b. Crude protein:

Crude protein content was determined by using Kjeldahle Apparatus (Model: D-40599, Behr Labor Technik, Gmbh-Germany) as described in A.A.C.C. (2000) Method No. 46-30.

c. Crude fat:

Content of crude fat was determined using hexane as a solvent in Soxhlet System (Model: H-2 1045 Extraction Unit, Hoganas, Sweden) according to the procedure give in A.A.C.C. (2000) Method No. 30-25.

d. Crude fiber:

Crude fiber was estimated in fat free samples by treating with 1.25% H_2SO_4, left over material was subjected to further treatment with 1.25% NaOH solutions. Crude fiber of the samples was determined through Labconco Fibertech (Labconco Corporation Kansas, USA) as per procedure in A.A.C.C. (2000) Method No. 32-10.

e. Nitrogen free extract (NFE):

NFE was calculated according to the following expression: NFE % = 100 – (moisture contents % + crude protein % + crude fat % + crude fiber % + ash %)

2- Mineral contents:

Moringa was analyzed for its mineral profile following A.O.A.C. (2003). Concentrations of calcium (Method 968.08), magnesium (Method 968.08), zinc (Method 991.11), iron (Method 985.01) and phosphorous (Method 965.17) were determined by Atomic Absorption Spectrophotometer (Varian AA240, Australia), while sodium (Method 968.08) and potassium (Method 968.08) were measured through Flame Photometer-410 (Sherwood Scientific Ltd., Cambridge).

a. Polyphenols:

Total polyphenols were determined using Folin-Ciocalteu method and values were expressed as gallic acid equivalent (Singleton *et al*., 1999; Akowuah *et al.*, 2005). 20 gm of seeds were slurred in 200 ml of methanol. One ml of methanolic extract (10 g/l) was mixed with 5 ml of Folin-Ciocalteu reagent (10%) and 4 ml of sodium carbonate solution (75 g/l) and after 30 min absorbance (765 nm) was noted on UV/VIS light spectrophotometer (CECIL CE 7200). Calibration/standard curve for gallic acid was drawn with concentrations of 0.05, 0.10, 0.15, 0.20, 0.25 and 0.30 mg/ml methanol mixed with the same reagents. Total polyphenols content was calculated by the following formula:

$C = c \times V/m$

C = total content of phenolic compounds in mg/g plant extract, in GAE.

c = the concentration of gallic acid calculated from the calibration curve in mg/ml.

V = the volume of extract in ml.

m = the weight of plant methanolic extract in g.

b. Alkaloids:

Total alkaloids were determined by following the Method No. 20.20 as described in A.A.C.C. (2000).

3. Extraction of fixed oil:

The oil from the Moringa seed was extracted through solvent extraction technique as described in A.O.C.S. (1998); Rotary Evaporator (Eyela, Japan) recovered hexane used as solvent. The extracted oil was stored in dark place at room temperature. *Moringa oleifera* fixed oil was analyzed for physical & chemical characteristics and fatty acid profile using their respective methodologies as presented below Acid value Acid value is defined as the milligrams of KOH required for neutralization of free fatty acids present in one gram of oil. Neutral alcohol was added to fixed oil of *Moringa oleifera* sample and titrated against KOH solution according to A.O.C.S. (1998); Method No. Cd 3d-63.

4. Antioxidant potential of fixed oil:

Antioxidant activity:

Antioxidant activity based on coupled oxidation of β-carotene and linoleic acid were evaluated by using the method described by Taga *et al.* (1984). Oxidation of β-carotene emulsion was spectrophotometric monitored by measuring absorbance at 470 nm after 0, 10, 20, 30 and 40 min. The degradation rate of the extracts was calculated according to first order kinetics using following equation (Al-Saikhan *et al*., 1995).

$\ln (a/b) \times 1/t$ = sample degradation rate

In = the natural log.

a = the initial absorbance (470 nm) at time zero.

b = the absorbance (470 nm) after 40 min.

t = the time (min).

The antioxidant activity (AA) was expressed as % inhibition relative to the control using following equation its use in the study plan

RESULTS AND DISCUSSION

Data presented in Table (1) show the nutrient values after two months in Moringa plant in the conditions of four Egyptian regions in two successive seasons of 2012 and. The obtained data showed that vit A values ranged from 5.1935 to 6.11 mg. A deficiency of vit. A may be caused blindness each year especially in the developing countries may reach approximately 250,000 to 500,000 malnourished children (Abrams *et al.,* 1993 and Abuye *et al.*, 1999). In 2002, the set of United Nations Special Session on children reported that the elimination of vitamin A deficiency by 2010 (Wikipedia, 2010). It is unfortunate that over 100 million children around the world may go blind simply because they are not getting enough vit A. A few spoonful in the children's food could easily save them from going blind (Wikipedia, 2010).

From Table (1), the values of vit. C ranged from 186.167 to 219.022 mg. The values of calcium in the experiment ranged from 359.55 to 423 mg. Iron in the experiment ranged from 0.679 to 0.799 mg. The values of niacin (vit. B_3) ranged from 0.639 to 0.752 mg. The values of protein ranged from 5433.2 to 6392 mg. The values of tocopherols in the experiment ranged from 23.171 to 27.26 mg. Zinc in the experiment ranged from 0.14382 to 0.169 mg. vitamin B_2 (riboflavin) ranged from 0.0399 to 0.047 mg. The values of thiamin (vit. B_1) ranged from 0.479 to 0.564. The obtained data from Table (1) showed region (A_1) representing Al-Saf, Giza Governorate are higher in nutrients and chemical components while the

Table 1. Analysis of the components of Moringa cultivated under Egyptian conditions after 2 months of agriculture.

Compound	2012				2013			
	A_1	A_2	A_3	A_4	A_1	A_2	A_3	A_4
ASCORBIC-ACID *	219.020	214.640	186.167	201.498	219.022	214.642	186.169	201.500
BETA-CAROTENE	6.110	5.988	5.194	5.621	6.112	5.990	5.196	5.623
CAFFEIC-ACID	1.410	1.382	1.199	1.297	1.412	1.384	1.201	1.299
CALCIUM	423.00	414.54	359.55	389.16	423.00	414.54	359.55	389.16
CARBOHYDRATES	11750	11515	9987.5	10810	11750	11515	9987.5	10810
CHOLINE	282	276	240	259	282	276	240	259
COPPER	0.0658	0.0645	0.0559	0.0605	0.0678	0.0665	0.0579	0.0625
FAT	1598	1566	1358	1470	1598	1566	1358	1470
FIBER	846	829	719	778	846	829	719	778
FLUORINE	1.880	1.842	1.598	1.730	1.882	1.844	1.600	1.732
IODINE	0.470	0.461	0.400	0.432	0.472	0.463	0.402	0.434
IRON	0.799	0.783	0.679	0.735	0.801	0.785	0.681	0.737
KAEMPFEROL	1.880	1.842	1.598	1.730	1.882	1.844	1.600	1.732
Magnesium	0.376	0.369	0.320	0.346	0.378	0.371	0.322	0.348
NIAZIMIN	2.820	2.764	2.397	2.594	2.822	2.766	2.399	2.596
Niacin (vitamin B3)	0.7520	0.7370	0.6392	0.6918	0.7540	0.7390	0.6412	0.6938
OXALATE	0	0	0	0	0	0	0	0
OXALIC-ACID	0	0	0	0	0	0	0	0
PHOSPHORUS	65.800	64.484	55.930	60.536	65.802	64.486	55.932	60.538
PROLAMINE	81.592	79.960	69.353	75.065	81.594	79.962	69.355	75.067
PROTEIN	6392	6264	5433	5880	6392	6264	5433	5881
Potassium	239.70	234.91	203.75	220.52	239.70	234.91	203.75	220.51
RIBOFLAVIN (vitamin B2)	0.0470	0.0461	0.0400	0.0432	0.0490	0.0481	0.0420	0.0452
Zinc	0.1692	0.1658	0.1438	0.1557	0.1712	0.1678	0.1458	0.1577
TOCOPHEROLS	27.260	26.715	23.171	25.079	27.262	26.717	23.173	25.081
Thiamin (vitamin B1)	0.5640	0.5527	0.4794	0.5189	0.5660	0.5547	0.4814	0.5209

All values are per 100 grams of edible portion; * The whole concentration values are mg.

region (A3) representing Nubaria, El-Beheira Governorate gave less values, in respect to the values of nutrients ascorbic acid, beta-carotene, calcium, iron, tocopherols, vit. B_1, B_2 and B_3 and phosphorus. Whereas regions A4 (Sarabum, Ismailia Governorate) and A2 (Beni Mazar, El-Minya Governorate) gave the moderate values. The obtained results reveal the significant differences in nutrient components.

The region A1 was at a rate value higher than the region A2 by 2%, region A3 by 15% and region A4 by 8%. The obtained results explained the differences among regions in chemical and nutrient components during plant growth. The best results was obtained from Upper Egypt under study in respect to the quantity of nutrients. This may be due to the relative variation of the climate and the nature of the soil and irrigation water in each region. The moral differences through growth in 2012 and 2013 seasons, about +/- 0.002.

Table (2) showed the chemical and nutrient components after four months. It was noted the increasing in the nutrient contents in each region after four months than at two months. This explains that the nutrients components may increase the effective life of the plant. The values of these nutrient in Table (1), (219.02, 6.11, 423, 1.88, 0.376, 0.752, 65.8, 6392, 239.7, 0.047, 0.1692, 27.26 and 0.564; respectively); while in Table (2) (221.35, 6.175, 427.5, 1.90, 0.38, 0.76, 66.5, 6460, 242.25, 0.0475, 0.171, 27.55 and 0.57; respectively).

The analysis of chemical and nutrient components after six months are show in Table (3). The values of these nutrients in Table (1), respectively (219.02, 6.11, 423, 1.88, 0.376, 0.752, 65.8, 6392, 239.7, 0.047 0.1692, 27.26 and 0.564), while in Table (3) (223.68, 624, 432, 1.92, 0.384, 0.748, 67.2, 6528, 244.8, 0.0480, 0.1728, 27.84 and 0.576). It was noted the increasing in the nutrient contents in each region after four months than after two months. This explains that the nutrient components may increase the effective life of the plant.

Table (4) showed the components of chemicals and nutrient after 8 months. The values of these nutrient in Table (1), respectively (219.02, 6.11, 423, 1.88, 0.376, 0.752, 65.8, 6392, 239.7, 0.047, 0.1692, 27.26 and 0.564), while in Table (4) (226.01, 6.305, 436.5, 1.94, 0.388, 0.776, 67.9, 6596, 247.35, 0.0485, 0.1746, 28.13 and 0.582). It was noted the increasing in the nutrient contents in each region after four months than after two months. This explains that the nutrient components may increase the effective life of the plant.

Table (5) showed the chemical and nutrient components after 10 months of agriculture. The values of these nutrients in Table (1), respectively (219.02, 6.11, 423, 1.88, 0.376, 0.752, 65.8, 6392, 239.7, 0.047, 0.1692, 27.26 and 0.564), while in Table (5) (228.34, 6.37, 441, 196, 0.392, 0.784, 68.6, 6664, 249.9, 0.4, 049, 0.1764, 28.42 and 0.588). It was noted the increasing on the nutrient contents in each region after four months than after two months. This explains that the nutrient components may increase the effective life of the plant.

Table (6) showed the analysis of chemical and nutrient components after 12 months of agriculture. The values of these nutrient in Table (1), respectively (219.02, 6.11, 423, 1.88, 0.376, 0.752, 65.8, 6392, 239.7, 0.047, 0.1692, 27.26 and 0.564), while in Table (3) (233, 6.500, 450, 2.00, 0.400, 0.800, 70, 6800, 255, 0.050, 0.180, 29.00 and 0.600). It was noted the increasing in the nutrient contents in each region after four months than after two months. This explains that the nutrient components may increase the effective life of the plant.

Table (7) shows the analysis of chemical components in Moringa roots in four regions under study. The obtained results from show that the highest value of chemical components in roots was in region A_1, while the lowest value was in region A_3.

Table (8) shows the results of the chemical components of Moringa seeds in four places under study. The region A_1 was

Table 2. Analysis of the components of Moringa cultivated under Egyptian conditions after 4 months of agriculture.

Compound	2012				2013			
	A_1	A_2	A_3	A_4	A_1	A_2	A_3	A_4
ASCORBIC-ACID *	221.350	216.923	188.148	203.642	221.352	216.925	188.150	203.644
BETA-CAROTENE	6.175	6.052	5.249	5.681	6.177	6.054	5.251	5.683
CAFFEIC-ACID	1.425	1.397	1.211	1.311	1.427	1.399	1.213	1.313
CALCIUM	427.50	418.95	363.38	393.30	427.502	418.952	363.377	393.302
CARBOHYDRATES	11875	11638	10094	10925	11875	11638	10094	10925
CHOLINE	285.00	279.30	242.25	262.20	285.002	279.302	242.252	262.202
COPPER	0.0665	0.0652	0.0565	0.0612	0.0685	0.0672	0.0585	0.0632
FAT	1615.0	1582.7	1372.8	1485.8	1615.002	1582.702	1372.752	1485.802
FIBER	855.00	837.90	726.75	786.60	855.002	837.902	726.752	786.602
FLUORINE	1.900	1.862	1.615	1.748	1.902	1.864	1.617	1.750
IODINE	0.4750	0.4655	0.4038	0.4370	0.4770	0.4675	0.4058	0.4390
IRON	0.8075	0.7914	0.6864	0.7429	0.8095	0.7934	0.6884	0.7449
KAEMPFEROL	1.900	1.862	1.615	1.748	1.902	1.864	1.617	1.750
Magnesium	0.3800	0.3724	0.3230	0.3496	0.3820	0.3744	0.3250	0.3516
NIAZIMIN	2.850	2.793	2.423	2.622	2.852	2.795	2.425	2.624
Niacin (vitamin B3)	0.7600	0.7448	0.6460	0.6992	0.7620	0.7468	0.6480	0.7012
OXALATE	0	0	0	0	0	0	0	0
OXALIC-ACID	0	0	0	0	0	0	0	0
PHOSPHORUS	66.500	65.170	56.525	61.180	66.502	65.172	56.527	61.182
PROLAMINE	82.460	80.812	70.091	75.863	82.462	80.813	70.093	75.865
PROTEIN	6460	6330.8	5491	5943.2	6460	6330.8	5491	5943.2
Potassium	242.250	237.405	205.911	222.870	242.252	237.407	205.915	222.872
RIBOFLAVIN (vitamin B2)	0.0475	0.0466	0.0404	0.0437	0.0495	0.0486	0.0424	0.0457
Zinc	0.1710	0.1676	0.1454	0.1573	0.1730	0.1696	0.1474	0.1593
TOCOPHEROLS	27.550	26.999	23.418	25.346	27.552	27.001	23.450	25.348
Thiamin (vitamin B1)	0.5700	0.5586	0.4845	0.5244	0.5720	0.5606	0.4865	0.5264

All values are per 100 grams of edible portion; * The whole concentration values are mg.

Table 3. Analysis of the components of Moringa cultivated under Egyptian conditions after 6 months of agriculture.

Compound	2012				2013			
	A_1	A_2	A_3	A_4	A_1	A_2	A_3	A_4
ASCORBIC-ACID *	223.680	219.206	190.128	205.786	223.682	219.208	190.130	205.788
BETA-CAROTENE	6.240	6.115	5.304	5.741	6.242	6.117	5.306	5.743
CAFFEIC-ACID	1.440	1.411	1.224	1.325	1.442	1.413	1.226	1.327
CALCIUM	432	423.36	367.20	397.44	432.002	423.362	367.202	397.442
CARBOHYDRATES	12000	11760	10200	11040	12000	11760	10200	11040
CHOLINE	288	282.24	244.80	264.96	288.002	282.242	244.802	264.962
COPPER	0.0672	0.0659	0.0571	0.0618	0.0692	0.0679	0.0591	0.0638
FAT	1632	1599.36	1387.20	1501.44	1632.002	1599.362	1387.202	1501.442
FIBER	864	846.72	734.40	794.88	864.002	846.722	734.402	794.882
FLUORINE	1.920	1.882	1.632	1.766	1.922	1.884	1.634	1.768
IODINE	0.4800	0.4704	0.4080	0.4416	0.4820	0.4724	0.4100	0.4436
IRON	0.8160	0.7997	0.6936	0.7507	0.8180	0.8017	0.6956	0.7527
KAEMPFEROL	1.920	1.882	1.632	1.766	1.922	1.884	1.634	1.768
Magnesium	0.3840	0.3763	0.3264	0.3533	0.3860	0.3783	0.3284	0.3553
NIAZIMIN	2.880	2.822	2.448	2.650	2.882	2.824	2.450	2.652
Niacin (vitamin B3)	0.7680	0.7526	0.6528	0.7066	0.7700	0.7546	0.6548	0.7086
OXALATE	0	0	0	0	0	0	0	0
OXALIC-ACID	0	0	0	0	0	0	0	0
PHOSPHORUS	67.200	65.856	57.120	61.824	67.202	65.858	57.122	61.826
PROLAMINE	83.328	81.661	70.829	76.662	83.330	81.663	70.831	76.664
PROTEIN	6528	6397.44	5548.80	6005.76	6528.002	6397.442	5548.802	6005.762
Potassium	244.8	239.904	208.08	225.216	244.802	239.906	208.082	225.218
RIBOFLAVIN (vitamin B2)	0.0480	0.0470	0.0408	0.0442	0.0500	0.0490	0.0428	0.0462
Zinc	0.1728	0.1693	0.1469	0.1590	0.1748	0.1713	0.1489	0.1610
TOCOPHEROLS	27.840	27.283	23.664	25.613	27.842	27.285	23.666	25.615
Thiamin (vitamin B1)	0.5760	0.5645	0.4896	0.5210	0.5780	0.5665	0.4916	0.5319

All values are per 100 grams of edible portion; * The whole concentration values are mg.

Table 4. Analysis of the components of Moringa cultivated under Egyptian conditions after 8 months of agriculture.

Compound	2012				2013			
	A_1	A_2	A_3	A_4	A_1	A_2	A_3	A_4
ASCORBIC-ACID *	226.010	221.490	192.109	207.929	226.012	221.492	192.111	207.931
BETA-CAROTENE	6.305	6.179	5.359	5.801	6.307	6.181	5.361	5.803
CAFFEIC-ACID	1.455	1.426	1.237	1.339	1.457	1.428	1.239	1.341
CALCIUM	436.500	427.770	371.025	401.580	436.502	427.772	371.027	401.582
CARBOHYDRATES	12125	11882.5	10306.3	11155	12125	11882.5	10306.3	11155
CHOLINE	291.00	285.18	247.35	267.72	291.002	285.182	247.352	267.722
COPPER	0.0679	0.0665	0.0577	0.0625	0.0699	0.0685	0.0597	0.0645
FAT	1649	1616.02	1401.65	1517.08	1649.002	1616.022	1401.652	1517.082
FIBER	873	855.54	742.05	803.16	873.002	855.542	742.052	803.162
FLUORINE	1.940	1.901	1.649	1.785	1.942	1.903	1.651	1.787
IODINE	0.4850	0.4753	0.4123	0.4462	0.4870	0.4773	0.4143	0.4482
IRON	0.8245	0.8080	0.7008	0.7585	0.8265	0.8100	0.7028	0.7605
KAEMPFEROL	1.940	1.901	1.649	1.785	1.942	1.903	1.651	1.787
Magnesium	0.3880	0.3802	0.3298	0.3570	0.3900	0.3822	0.3318	0.3590
NIAZIMIN	2.910	2.852	2.474	2.677	2.912	2.854	2.476	2.679
Niacin (vitamin B3)	0.7760	0.7605	0.6596	0.7139	0.7780	0.7625	0.6616	0.7159
OXALATE	0	0	0	0	0	0	0	0
OXALIC-ACID	0	0	0	0	0	0	0	0
PHOSPHORUS	67.900	66.542	57.715	62.468	67.902	66.544	57.717	62.47
PROLAMINE	84.196	82.512	71.567	77.460	84.198	82.514	71.569	77.462
PROTEIN	6596	6464.08	5606.60	6068.32	6596.002	6464.082	5606.602	6068.322
Potassium	247.350	242.403	210.248	227.562	247.352	242.405	210.250	227.564
RIBOFLAVIN (vitamin B2)	0.0485	0.0475	0.0412	0.0446	0.0505	0.0495	0.0432	0.0466
Zinc	0.1746	0.1711	0.1484	0.1606	0.1766	0.1731	0.1504	0.1626
TOCOPHEROLS	28.130	27.567	23.911	25.880	28.132	27.569	23.913	25.882
Thiamin (vitamin B1)	0.5820	0.5704	0.4947	0.5354	0.5840	0.5724	0.4967	0.5374

All values are per 100 grams of edible portion; * The whole concentration values are mg.

Table 5. Analysis of the components of Moringa cultivated under Egyptian conditions after 10 months of agriculture.

Compound	2012				2013			
	A_1	A_2	A_3	A_4	A_1	A_2	A_3	A_4
ASCORBIC-ACID *	228.34	223.773	194.089	210.073	228.342	223.775	194.091	210.075
BETA-CAROTENE	6.370	6.243	5.415	5.860	6.372	6.245	5.417	5.862
CAFFEIC-ACID	1.470	1.441	1.250	1.352	1.472	1.443	1.252	1.354
CALCIUM	441.00	432.18	374.85	405.72	441.002	432.182	374.852	405.722
CARBOHYDRATES	12250	12005	10413	11270	12250	12005	10413	11270
CHOLINE	294.00	288.12	249.90	270.48	294.002	288.122	249.902	270.482
COPPER	0.0686	0.0672	0.0583	0.0631	0.0706	0.0692	0.0603	0.0651
FAT	1666.00	1632.68	1416.10	1532.72	1666.002	1632.682	1416.102	1532.722
FIBER	882.00	864.36	749.70	811.44	882.002	864.362	749.702	811.442
FLUORINE	1.960	1.921	1.666	1.803	1.962	1.923	1.668	1.805
IODINE	0.4900	0.4802	0.4165	0.4508	0.4920	0.4822	0.4185	0.4528
IRON	0.8330	0.8163	0.7081	0.7664	0.8350	0.8183	0.7101	0.7684
KAEMPFEROL	1.960	1.921	1.666	1.803	1.962	1.923	1.668	1.805
Magnesium	0.3920	0.3842	0.3332	0.3606	0.3940	0.3862	0.3352	0.3626
NIAZIMIN	2.940	2.881	2.499	2.705	2.942	2.883	2.501	2.707
Niacin (vitamin B3)	0.7840	0.7683	0.6664	0.7213	0.7860	0.7703	0.6684	0.7233
OXALATE	0	0	0	0	0	0	0	0
OXALIC-ACID	0	0	0	0	0	0	0	0
PHOSPHORUS	68.600	67.228	58.310	63.112	68.602	67.230	58.312	63.114
PROLAMINE	85.064	83.363	72.304	78.259	85.066	83.365	72.306	78.261
PROTEIN	6664.00	6530.72	5664.40	6130.88	6664.002	6530.722	5664.402	6130.882
Potassium	249.90	244.902	212.415	229.908	249.902	244.904	212.417	229.91
RIBOFLAVIN (vitamin B2)	0.0490	0.0480	0.0417	0.0451	0.0510	0.0500	0.0437	0.0471
Zinc	0.1764	0.1729	0.1499	0.1623	0.1784	0.1749	0.1519	0.1643
TOCOPHEROLS	28.420	27.852	24.157	26.146	28.422	27.854	24.159	26.148
Thiamin (vitamin B1)	0.5880	0.5762	0.4998	0.5410	0.5900	0.5782	0.5018	0.5430

All values are per 100 grams of edible portion; * The whole concentration values are mg.

Table 6. Analysis of the components of Moringa cultivated under Egyptian conditions after 12 months of agriculture.

Compound	2012				2013			
	A_1	A_2	A_3	A_4	A_1	A_2	A_3	A_4
ASCORBIC-ACID *	233.00	228.34	198.05	214.36	233.002	228.342	198.052	214.362
BETA-CAROTENE	6.500	6.370	5.525	5.980	6.502	6.372	5.527	5.982
CAFFEIC-ACID	1.500	1.470	1.275	1.380	1.502	1.472	1.277	1.382
CALCIUM	450.0	441.0	382.5	414.0	450.002	441.002	382.502	414.002
CARBOHYDRATES	12500	12250	10625	11500	12500	12250	10625	11500
CHOLINE	300	294	255	276	300.002	294.002	255.002	276.002
COPPER	0.0700	0.0686	0.0595	0.0644	0.0720	0.0706	0.0615	0.0664
FAT	1700	1666	1445	1564	1700.002	1666.002	1445.002	1564.002
FIBER	900	882	765	828	900.002	882.002	765.002	828.002
FLUORINE	2.00	1.96	1.70	1.84	2.002	1.962	1.702	1.842
IODINE	0.500	0.490	0.425	0.460	0.502	0.492	0.427	0.462
IRON	0.850	0.833	0.723	0.782	0.852	0.835	0.725	0.784
KAEMPFEROL	2.00	1.96	1.70	1.84	2.002	1.962	1.702	1.842
Magnesium	0.400	0.392	0.340	0.368	0.402	0.394	0.342	0.370
NIAZIMIN	3.00	2.94	2.55	2.76	3.002	2.942	2.552	2.762
Niacin (vitamin B3)	0.800	0.784	0.680	0.736	0.802	0.786	0.682	0.738
OXALATE	0	0	0	0	0	0	0	0
OXALIC-ACID	0	0	0	0	0	0	0	0
PHOSPHORUS	70.00	68.60	59.50	64.40	70.002	68.602	59.502	64.402
PROLAMINE	86.800	85.064	73.780	79.856	86.802	85.066	73.782	79.858
PROTEIN	6800	6664	5780	6256	6800.00	6664.00	5780.00	6256.00
Potassium	255.00	249.90	216.75	234.60	255.002	249.902	216.752	234.602
RIBOFLAVIN (vitamin B2)	0.050	0.049	0.043	0.046	0.052	0.051	0.045	0.048
Zinc	0.1800	0.1764	0.1530	0.1656	0.1820	0.1784	0.1550	0.1676
TOCOPHEROLS	29.00	28.42	24.65	26.68	29.002	28.422	24.652	26.682
Thiamin (vitamin B1)	0.600	0.588	0.510	0.552	0.602	0.590	0.512	0.554

All values are per 100 grams of edible portion; * The whole concentration values are mg.

Table 7. Analysis of the chemical components of Moringa roots cultivated under Egyptian conditions.

Compound	2012				2013			
	A_1	A_2	A_3	A_4	A_1	A_2	A_3	A_4
1-BETA-D-GLUCOSYL-2,6-DIMETHYL-BENZOATE	2.568	2.517	2.183	2.363	2.570	2.519	2.185	2.365
4-(ALPHA-L-RHAMNOSYLOXY)-BENZYLGLUCOCYANATE	10.00	9.80	8.50	9.20	10.00	9.80	8.50	9.20
BENZYL-ISOTHIOCYANATE	6.998	6.858	5.948	6.438	7.000	6.860	5.950	6.440
GLUCOTROPAEOLIN	0.500	0.490	0.425	0.460	0.502	0.492	0.427	0.462
PHYTOSTEROLS	200.559	196.548	170.475	184.514	200.561	196.550	170.477	184.516
PTERYGOSPERMIN	185.569	181.858	157.734	170.724	185.571	181.860	157.736	170.726
SPIROCHIN	6.590	6.458	5.602	6.063	6.592	6.460	5.604	6.065
ALKALOIDS	1.000	0.980	0.850	0.920	1.002	0.982	0.852	0.922
BENZYL-AMINE	3.800	3.724	3.230	3.496	3.802	3.726	3.232	3.498
MORINGINE	5.200	5.096	4.420	4.784	5.202	5.098	4.422	4.786
MORINGININE	4.900	4.802	4.165	4.508	4.902	4.804	4.167	4.510

All values are per 100 grams of edible portion.

Table 8. Analysis of chemical constituents of Moringa seeds cultivated under Egyptian conditions.

Compound	2012				2013			
	A_1	A_2	A_3	A_4	A_1	A_2	A_3	A_4
2,4-METHYLENE-CHOLESTEROL	11.00	10.78	9.35	10.12	11.00	10.78	9.35	10.12
28-ISOAVENASTEROL	5.00	4.90	4.25	4.60	5.00	4.90	4.25	4.60
4-(ALPHA-L-RHAMNOSYLOXY)-BENZYLGLUCOSINOLATE	6.000	5.880	5.100	5.520	6.002	5.882	5.102	5.522
4-(ALPHA-L-RHAMNOSYLOXY)-BENZYLISOTHIOCYANATE	90.000	88.200	76.500	82.800	90.002	88.202	76.502	82.802
ALPHA-TOCOPHEROL	38.000	37.240	32.300	34.960	38.002	37.242	32.302	34.962
ARACHIDIC-ACID	28.600	28.028	24.310	26.312	28.602	28.030	24.312	26.314
ASH	32.000	31.360	27.200	29.440	32.002	31.362	27.202	29.442
BEHENIC-ACID	33.200	32.536	28.220	30.544	33.202	32.538	28.222	30.546
BETA-CAROTENE	0. 100	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BETA-SITOSTEROL	0.800	0.784	0.680	0.736	0.802	0.786	0.682	0.738
BRASSICASTEROL	0.9950	0.9751	0.8458	0.9154	0.9970	0.9771	0.8478	0.9174
CAMPESTANOL	1.5560	1.5249	1.3226	1.4315	1.5580	1.5269	1.3246	1.4335
CAMPESTEROL	2.590	2.538	2.202	2.383	2.592	2.540	2.204	2.385
CARBOHYDRATES	207.29	203.14	176.20	190.71	207.29	203.15	176.20	190.71
CHOLESTEROL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CLEROSTEROL	0.500	0.490	0.425	0.460	0.502	0.492	0.427	0.462
DELTA-5-AVENASTEROL	0.0050	0.0049	0.0043	0.0046	0.0070	0.0069	0.0063	0.0066
DELTA-7,14-STIGMASTANOL	0.0520	0.0510	0.0442	0.0478	0.0540	0.0530	0.0462	0.0498
DELTA-7-AVENASTEROL	0.0010	0.0010	0.0009	0.0009	0.0030	0.0030	0.0029	0.0029
DELTA-TOCOPHEROL	22.000	21.560	18.700	20.240	22.002	21.562	18.702	20.242
EICOSANIC-ACID	3.250	3.185	2.763	2.990	3.252	3.187	2.765	2.992
ERGOSTADIENOL	8.259	8.094	7.020	7.598	8.261	8.096	7.022	7.600
FAT	250.00	245.00	212.50	230.00	250.002	245.002	212.502	230.002
FIBER	35.00	34.300	29.750	32.200	35.002	34.302	29.752	32.202
GADOLEIC-ACID	4.800	4.704	4.080	4.416	4.802	4.706	4.082	4.418
GAMMA-TOCOPHEROL	35.00	34.30	29.75	32.20	35.002	34.302	29.752	32.202
GLUCOSINOLATES	70.00	68.60	59.50	64.40	70.002	68.602	59.502	64.402
LIGNOCERIC-ACID	25.002	24.501	21.251	23.009	25.004	24.503	21.253	23.011
MYRISTIC-ACID	7.500	7.350	6.375	6.900	7.502	7.352	6.377	6.902
OLEIC-ACID	330.00	323.40	280.50	303.60	330.002	323.402	280.502	303.602
PALMITIC-ACID	6.00	5.88	5.10	5.52	6.002	5.882	5.102	5.522
PROTEIN	384.00	376.32	326.40	353.28	384.002	376.322	326.402	353.282
STEARIC-ACID	56.00	54.88	47.6	51.52	56.002	54.882	47.602	51.522
STIGMASTANOL	6.540	6.409	5.559	6.017	6.542	6.411	5.561	6.019
STIGMASTEROL	2.5	2.45	2.125	2.30	2.502	2.452	2.127	2.302
TOCOPHEROLS	44.00	43.12	37.40	40.48	44.002	43.122	37.402	40.482
WATER	4.00	3.92	3.40	3.68	4.002	3.922	3.402	3.682

All values are per 100 grams of edible portion.

the best region, while the A_3 showed the least response for chemical components in seeds (Bennett *et al.*, 2003 and Berger *et al.,* 1984).

Table (9) refers to the weight of the fresh leaves plant in places under study during the growing in two successive seasons of 2012 and 2013. The best region was A1, which gave 1667and1667.012 grams successively, while region A3 gave 1500.3 and 1500.312 grams successively, for fresh leaves weight. The best harvest period was after six months and twelve months, respectively. The obtained results explain that the environment of all regions was suitable for plant growth in respect to the high yield of Moringa leaves.

Table 9. Fresh weight per plant of fresh Moringa leaves cultivated under Egyptian conditions.

Compound	2012				2013			
	A_1	A_2	A_3	A_4	A_1	A_2	A_3	A_4
After 2th months of Agriculture	115.0	112.7	103.5	105.8	115.0	112.7	103.5	105.8
After 4th months of Agriculture	236.0	231.3	212.4	217.1	236.0	231.3	212.4	217.1
After 6th months of Agriculture	283.0	277.3	254.7	260.4	283.0	277.3	254.7	260.4
After 8th months of Agriculture	305.0	298.9	274.5	280.6	305.0	298.90	274.50	280.60
After 10th months of Agriculture	338.0	331.24	304.2	310.96	338.00	331.24	304.20	310.96
After 12th months of Agriculture	390.0	382.2	351.0	358.8	390.0	382.2	351.0	358.8
Total weight of fresh Moringa leaves (g)	1667.0	1633.7	1500.3	1533.6	1667.0	1633.7	1500.3	1533.7

All values for each gram of the weight of fresh Moringa leaves.

RECOMMENDATIONS

Moringa plants are cultivated in Egyptian soils whereas the Upper Egypt soil was better than Delta Egypt soil. In addition, it is advised to increase research and studies for this plant because of its nutritional and economic values, specially facing poverty and the shortage of proteins source for Egyptian people.

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دراسات على المكونات الكيميائية لنبات المورينجا اوليفيرا النامية تحت الظروف المصرية

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أجريت التجربة بقسم النباتات الطبية والعطرية – معهد بحوث البساتين – مركز البحوث الزراعية – الدقي، خلال موسم ٢٠١٢ و ٢٠١٣ على نبات المورينجا اوليفيرا في أربع مناطق مختلفة بشمال وجنوب جمهورية مصر العربية، المنطقة الأولى بالصف بمحافظة الجيزة (A_1) والمنطقة الثانية ببني مزار بمحافظة المنيا (A_2) ويمثلان مناطق جنوب مصر، والمنطقة الثالثة بالنوبارية بمحافظة البحيرة (A_3) والمنطقة الرابعة بسرابيوم بمحافظة الإسماعيلية (A_4) ويمثلان مناطق شمال مصر، بهدف دراسة مدى تأثير البيئات المناخية المختلفة على المكونات الغذائية والكيمائية التي توجد في النبات، وتحديد أهميته ومدى تكيفه مع البيئات المناخية المختلفة لتحديد أفضلها بالإضافة إلى تأثير العوامل المناخية وظروف التربة التي زرعت بها النباتات تحت الظروف المصرية، وقد زرعت النباتات بصوبه البنك القومي للجينات – مركز البحوث الزراعية وبعد الإنبات تم النقل الي المناطق المذكورة وزُرعت الشتلات بمواقع الدراسة في نفس اليوم في موسم ٢٠١٢ و ٢٠١٣، وزرعت النماذج (A_1, A_2, A_3, A_4) في أحواض أبعادها (٢٠×٣٠م) على مسافة ٢م بين النبات والأخر ومسافة ٣م بين الخطوط في كل النماذج، وتم أخذ عينة الأوراق على مراحل مختلفة بعد زراعتها كل (٢-٤-٦-٨-١٠-١٢ شهر) وأخذت عينات البذور من القرون الناضجة بعد اكتمال مراحل النمو لتلك القرون وعينات الجذور بعد اكتمال النمو الكامل لنبات المورينجا اوليفيرا في نهاية عام ٢٠١٢، ٢٠١٣وأظهرت النتائج أن هناك فرق في محتوى المواد الكيميائية والغذائية الموجودة في عينات نبات المورينجا المأخوذة من أماكن الدراسة، وكانت نتائج منطقة الصف بالجيزة (A_1) تحتوي على حمض الأسكوربيك (فيتامين C)، البيتا كاروتين (فيتامين A)، الثيامين (فيتامين B1)، الرايبوفلافين (فيتامين B2)، النياسين (فيتامين B3)، والتوكوفيرول (فيتامين E) والكالسيوم والحديد والبروتين والزنك والفوسفور بمعدل يفوق منطقة بني مزار بالمنيا (A_2) بنسبة ٢ ٪ من محتوى العناصر الغذائية للنبات، كما أظهرت النتائج أن منطقة الصف بالجيزة (A_1) تزيد بمعدل ١٥٪ بالمقارنة بمنطقة النوبارية بالبحيرة (A_3) وتزيد بنسبة ٨ ٪ مقارنة مع منطقة سرابيوم بالإسماعيلية (A_4)، وهو ما قد يفسر الاختلافات في محتوى المغذيات النباتية والمواد الكيميائية والفيتامينات، باختلاف مكان التربة والمناخ الذي نما فيه النبات، وكانت أفضل الأماكن التي أخذت منها العينات موضع الدراسة والتي تحتوى على كميات ممتازة من المغذيات هي المناطق الجنوبية بصعيد مصر وسرابيوم بمحافظة الإسماعيلية.