Chemical Composition of Egyptian Moringa Oleifera Grown in Different Agro-Ecological Regions

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ABSTRACT

Moringa Oleifera plant is successfully grown in Egypt now their leaves are highly nutritious and can be eaten either fresh or cooked. **Aim** Evaluate chemical composition of Egyptian *Moringa Oleifera* leaves grown in different agro-ecological regions. **Methods**; Same age leaves were collected from private farm in Gharbiya governorate (loam soil) and from western dessert (sandy soil). Leaves were subjected to proximate, vitamin, minerals and antioxidants analysis. **Results;** soil types widely affect the results depending on the nutrients and ph value. Fresh leaves contain the highest moisture content and the lowest nutrients comparing to dried leaves. *Moringa Oleifera* grown in sandy soil had the highest content of ash, carbohydrate and minerals including; Ca, Zn, Na, K, Mg and Fe compared to which grown in loam soil. Vitamin C, beta carotene, total phenolic, total flavonoids, and total antioxidant capacity were higher in leaves cultivated from loam soil than sandy soil as 67.93, 1497, 58.9, 90.8 mg/g , 65% and 60.5, 1303.9, 50.4, 80.5mg/g, and 59% respectively. Variability in chemical composition is likely due to differences in soil, climate, and plant age. These relatively diverse chemical constituents may be responsible for the medicinal properties of *Moringa Oleifera* leaves.

Keywords: Moringa Oleifera, Total antioxidant capacity, agro-ecological

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INTRODUCTION

Moringa oleifera Lam (Moringaceae) is a highly valued plant, it also known as mother best friend and tree of life due to rich in nutrients needed for healthy life, it distributed in many countries of tropics and subtropicsdue to its high adaptability to environmental conditions such as dryness, low or high Ph value, poor soil and climate changes. [1] Moringaoleifera is successfully grown recently in Egypt, a strong and rapidly growing *Moringa oleifera* tree is widely cultivated, it used in many branches such as herbal medicine, beverage like moringa tea flavour, as spices to improve taste and flavour of meals, production of biodesil, and also used as animal feed to increase milk and meat mass production. It considered as one of the most useful trees in the world because almost all parts of this plant can be used such as leaves, pods, seed, park and flowers in food, in medicines and for industrial purposes. [2,3]

There is a universe demand to increase the cultivation area of Moringa Oleifera worldwide, due to it is a high nutrious plant. Its leaves contains high and varied amounts of vitamins, phytochemicals, antioxidants, flavonoids, minerals, and high quality protein as it resemble milk protein (contains eight essential amino acids) which is very rare for a vegetable to contain all of these amino acids. [4]

Pharmacological properties ascribed to Moringa oleifera leaves due to high contribution in bioactive compounds. Moringa Oleifera leaves are widely used as a nutritive herb and possesses valuable activities with low toxicity of seeds and leaves. Leaves, seed, pods and flowers of this plant have drawn much attention as a reason of their various biological activities, epidemiological studies have indicated that leaves exhibitanti atherosclerotic, antioxidant, anti cardiovascular diseases, antiviral, hypochlosterolnemia, hypotension, antimicrobial, anti-inflammatory properties and tumor suppressive effect. [5,6]

Moringa Oleifera trees have been used to combat malnutrition, especially among infants and nursing mothers. Leaves can be eaten fresh, cooked, or stored as dried powder for many months without refrigeration without loss of nutritional value. Moringa is especially promising as a food source in the tropics because the tree is in full leaf at the end of the dry season when other foods are typically scarce.[7,9]

MATERIALS AND METHODS

Sampling technique and data collection methods:

Leaves of M. oleifera leaves were collected from two different cultivation area; loam soil in Elgharbya Governorate, and sandy soil in western desert, Egypt. The same age leaves were collected and dried at 35˚C - 40˚C in van air circulating oven till dryness. The dried leaves were crushed to obtain the powdered form. Leaves were divided into three treatments of 100g each; A, B & C. A and B represent fresh and dried leaves obtained from loam soil respectively while C; represent dried leaves obtained from sandy soil. All samples were subjected to proximate, vitamin, mineral and antioxidant analysis.

Laboratory analysis:

Proximate Analysis:

1.1. Moisture content; using method of A.O.A.C (2012)[10]. Air dried oven was used and the loss of weight after drying to actual wet weight gave us the quality of moisture present in the sample.

1.2. Ash content; using the method of A.O.A.C (2012)[10]. Ash content of food stuffs is the inorganic residue remaining after the organic matter has been burnt off which can be determined by heating known amount of dried sample in a muffle furnace at 550 0C.

1.3. Crude protein; using semi micro Kjeldahl, according to AOAC [10] It was done using Kjeldhal procedure; samples were heated with concentrated H_2S0_4 in the presence of metallic catalyst. This reduces organic Nitrogen to form ammonia. The ammonia was retained in the solution in form of NH_3SO_4. The alkaline

solution was distilled to release ammonia which was trapped in a standard acid and finally titrated against sodium thiosulphate to obtain the total N content released from digested protein molecules in the sample.

1.4. Total fat; according to Pearson (1981) [11] using soxhlet apparatus. Samples were refluxed with diethyl ether to dissolve the fat present in the sample.

1.5. Total Carbohydrate; by the method of A.O.A.C (2012)[10]. The percentages of the remaining constituents are summed up and subtracted from 100%. The obtained value gave us the crude carbohydrate content of the sample. % carbohydrate = 100 - (%moisture + %ash + %protein + %fat).

2. Mineral determination; Metals including Calcium, Magnesium, Potassium, Iron, Sodium, and Zinc were determined in Moringa Oleifera leaves using Atomic Absorption Spectroscopy Shimadzu Model (AA-6650) according to AOAC (2012). [10]

3. β carotene; was determined according to methods of Lees, H.S [12]for carotenoid extraction using HPLC.

4. Vitamin C; according to the modified method of Abdulnabi et al. [13] using HPLC.

5. Total poly phenol content; according to the method of Haetzfled, 2002 et al [14] that was based on the estimation of the color resulted from the reaction between the folinciocalteu reagent (phosphomolybdictungestic acid) and the hydroxyl groups of the phenolic compounds under alkaline condition using spectrophotometer

6. Total phenolic and total antioxidant determination; extraction procedure was a modification of the method described by Barakat[15] using spectrophotometer

Statistical Analysis

The statistical analysis was carried out using SPSS program with multi-function utility regarding to the experimental design under significance level of 0.05 for the whole results. Multiple comparisons applying LSD was carried out according to Steel et al. [16]

RESULTS AND DISCUSSION

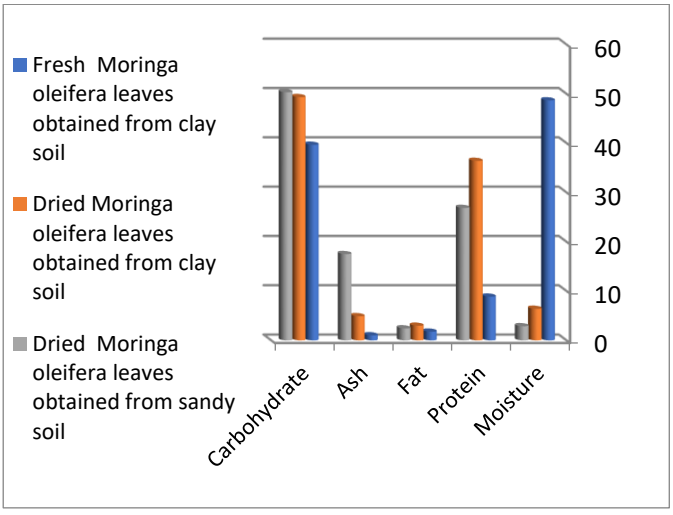

Figure 1: proximate composition of *Moringa oleifera* leaves.

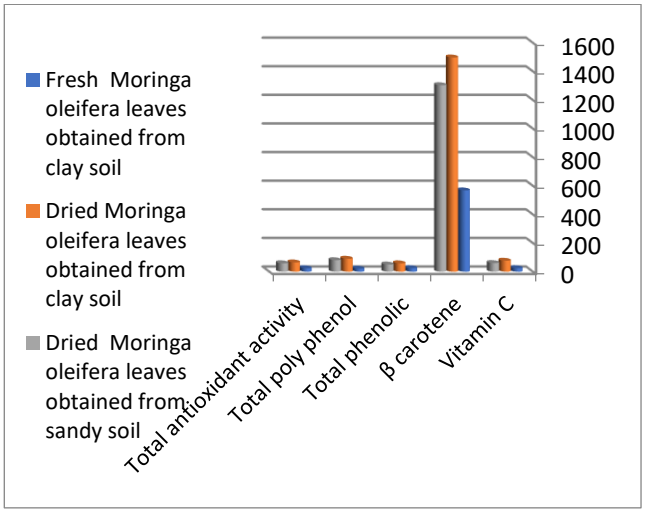

Figure 2: Vitamins and antioxidants of *Moringa oleifera* leaves.

This figure (1) showed that dried *Moringa oleifera* leaves grown in loam soil had the highest protein content comparing to sandy soil leaves which had the highest carbohydrate and ash %, while fresh leaves contained the highest moisture percentage.

Figure 2 clarified that dried leaves grown in loam soil had the highest content of vitamins and antioxidants comparing to fresh and sandy dried leaves, hence they have the highest total antioxidant activity.

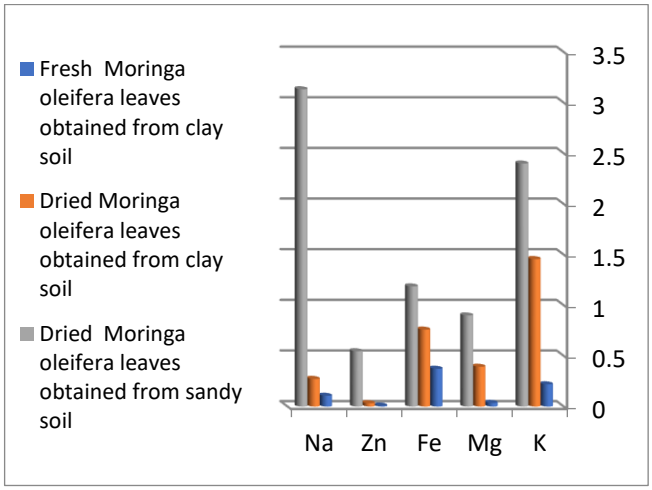

Figure 3: Mineral content of *Moringa oleifera* leaves.

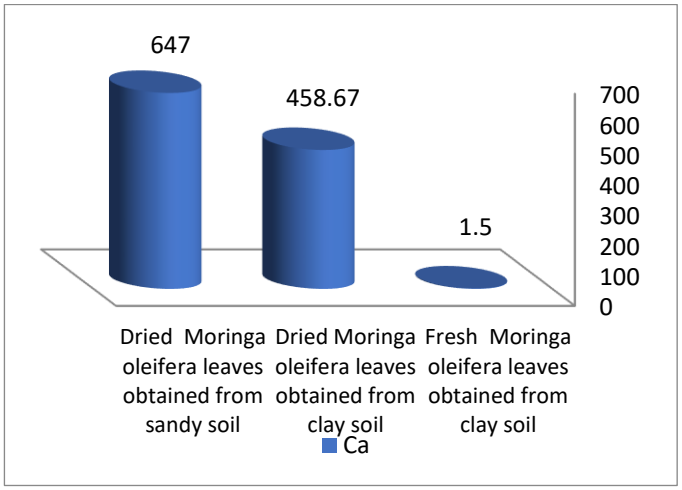

Figure 4: Calcium content of *Moringa oleifera* leaves.

These figures(3 and 4) showed that dried *Moringa Oleifera* grown in sandy soils contained the highest mineral content followed by leaves from clayey soil, while fresh leaves contained the lowest mineral content

Data presented in table 1 revealed the following; **Proximate analysis**; there was a significant decrease in moisture content among three groups, while in case of protein, ash, and carbohydrate there were a significant increase, that may be due to lose of moisture during drying while other nutrients concentrated in Moringa Oleifera leaves and that agreed with Melesse A. [17] Otherwise there wasn't a significance change in case of fat content among three groups, dried *Moringa Oleifera* leaves grown in loam soil had the highest content of fat and protein, while ash content was the highest in leaves grown in sandy soil that may be due to high content of minerals in sandy soil and that agreed with [18] who stated that ash and crude fiber analysis were higher in Moringa obtained from Oraby comparing to Moringa obtained from Assuit and Monofya. Soil type and climate conditions affect on the grown crops. The obtained results are closely pertinent to observed results by. [19, 20] However, the variation of obtained results in the chemical composition might be related to samples collection, preparation, cultivation conditions, and age of the plant, while in case of **mineral analysis**; *Moringa Oleifera* grown in sandy soil had the highest content of mineral; Ca, Fe, Zn, Na, K, and Mg comparing to which grown in loam soil, these results may be due to difference in the environment and the effect of cultivation. That was confirmed by [18]. *Moringa Oleifera* leaves contained high concentration of Zn, Mg, Ca, and K which agreed with Okiki [21] Obtained results which reflected that dried leaves of *Moringa oleifera* cultivated from different regions in Egypt considered a rich source of dietary minerals, there was a strong significant increase in Ca content among fresh to dried leaves obtained from clay and sandy soil as 1.53, 458.67, and 647 ppm respectively. Otherwise there wasn't significant change between fresh and dried leaves from clay soil in Zn and Na content but there was a significant increase between dried leaves from clay and sandy soils. **Vitamins and antioxidants**; obtained data showed that Moringa Oleifera leaves from loam soil had the highest content of vitamin C, beta carotene, total phenolic and total poly phenol comparing to Moringa obtained from sandy soil so higher in total antioxidant capacity when compared to other two groups. That may be due to sandy soil characterized by low nutrient content and low ph value which agreed with [18, 22]. Barakat [18] stated that *Moringa Oleifera* grown in Monofya (loam soil) had the highest content of beta carotene, vitamin C, and total antioxidant capacity and that agreed with our obtained results. there were a strong significant increase in vitamin C, β carotene, total phenolic, total poly phenol, and total antioxidant activity in dried *Moringa Oleifera* leaves $p < 0.001$ compared to fresh and dried leaves obtained from sandy soil

Table (1): Descriptive analysis of fresh and dried *Moringa Oleifera* leaves obtained from different soils.

Descriptive analysis

		N	Mean+- Std	Minimum	Maximum	Sig
Moisture	Fresh *Moringa oleifera* leaves from clay soil	3	48.67+_0.57	48.00	49.00	
	Dried *Moringa oleifera* leaves from clay soil	3	6.4+_0.17	6.30	6.60	0.005[abc]
	Dried *Moringa oleifera* from sandy soil	3	2.87+_0.35	2.50	3.20	
	Total	9	19.3+_22.07	2.50	49.00	
Protein	Fresh *Moringa oleifera* leaves from clay soil	3	8.87+_0.15	8.70	9.00	
	Dried *Moringa oleifera* leaves from clay soil	3	36.4+_0.36	36.00	36.70	0.005[abc]
	Dried *Moringa oleifera* from sandy soil	3	26.87+_0.35	26.50	27.20	
	Total	9	24.04+_12.1	8.70	36.70	
Fat	Fresh *Moringa oleifera* leaves from clay soil	3	1.77+_0.2	1.60	2.00	0.001[a]
	Dried *Moringa oleifera* leaves from clay soil	3	2.97+_0.32	2.60	3.20	0.014[b]
	Dried *Moringa oleifera* from sandy soil	3	2.43+_0.15	2.30	2.60	0.34[c]
	Total	9	2.39+_0.56	1.60	3.20	
Ash	Fresh *Moringa oleifera* leaves from clay soil	3	1.03+_0.94	0.30	2.10	
	Dried *Moringa oleifera* leaves from clay soil	3	4.9+_0.45	4.40	5.30	0.001[abc]
	Dried *Moringa oleifera* from sandy soil	3	17.5+_0.26	17.30	17.80	
	Total	9	7.81+_7.47	.30	17.80	
Carbohydrate	Fresh *Moringa oleifera* leaves from clay soil	3	39.67+_0.57	39.00	40.00	0.001[a]
	Dried *Moringa oleifera* leaves from clay soil	3	49.3+_0.57	49.00	50.00	0.078[b]
	Dried *Moringa oleifera* from sandy soil	3	50.3+_0.57	50.00	51.00	0.078[c]
	Total	9	46.4+_5.12	39.00	51.00	
Vitamin C	Fresh *Moringa oleifera* leaves from clay soil	3	25.3+_0.3	25.00	25.60	
	Dried *Moringa oleifera* leaves from clay soil	3	76.9+_0.1	76.80	77.00	0.001[abc]
	Dried *Moringa oleifera* from sandy soil	3	60.5+_1.51	59.00	62.00	
	Total	9	54.2+_22.82	25.00	77.00	

Descriptive analysis

		N	Mean+- Std	Minimum	Maximum	Sig
Beta	Fresh *Moringa oleifera* leaves from clay soil	3	568.3+_1.17	567.00	569.00	
	Dried *Moringa oleifera* leaves from clay soil	3	1497.72+_3.06	1494.25	1499.90	0.001[abc]
	Dried *Moringa oleifera* from sandy soil	3	1303.9+_5.16	1300.00	1309.80	
	Total	9	1123.38+_424.6	567.00	1499.90	
TP	Fresh *Moringa oleifera* leaves from clay soil	3	25.26+_0.80	24.40	26.00	
	Dried *Moringa oleifera l*eaves from clay soil	3	58.7+_0.49	58.40	59.30	0.001[abc]
	Dried *Moringa oleifera*from sandy soil	3	50.43+_0.67	49.80	51.00	
	Total	9	44.8+_15.1	24.40	59.30	
TPP	Fresh *Moringa oleifera* leaves from clay soil	3	21.7+_1.708	20.00	23.40	
	Dried *Moringa oleifera* leaves from clay soil	3	90.67+_0.82	89.90	91.54	0.001[abc]
	Dried *Moringa oleifera* from sandy soil	3	80.5+_1.4	79.20	82.00	
	Total	9	64.30+_32.2	20.00	91.54	
TAA	Fresh *Moringa oleifera* leaves from clay soil	3	24.67+_0.57	24.00	25.00	
	Dried *Moringa oleifera*leaves from clay soil	3	65.0+_1.0	64.00	66.00	0.001[abc]
	Dried *Moringa oleifera*from sandy soil	3	59.0+_0.0	59.00	59.00	
	Total	9	49.56+_18.8	24.00	66.00	
Ca	Fresh *Moringa oleifera* leaves from clay soil	3	1.53+_0.05	1.50	1.60	
	Dried *Moringa oleifera*leaves from clay soil	3	458.67+_3.5	455.00	462.00	0.001[abc]
	Dried *Moringa oleifera*from sandy soil	3	647.0+_6.2	640.00	652.00	
	Total	9	369.07+_287.4	1.50	652.00	
K	Fresh *Moringa oleifera* leaves from clay soil	3	0.22+_0.24	0.07	.50	0.005[a]
	Dried *Moringa oleifera*leaves from clay soil	3	1.47+_0.31	1.17	1.80	0.001[b]
	Dried *Moringa oleifera*from sandy soil	3	2.4+_0.45	2.00	2.90	0.017[c]
	Total	9	1.39+_0.99	0.07	2.90	
Mg	Fresh *Moringa oleifera* leaves from clay soil	3	0.07+_0.01	0.03	.05	0.01[a]

Descriptive analysis

		N	Mean+- Std	Minimum	Maximum	Sig
Fe	Dried *Moringa oleifera*leaves from clay soil	3	0.39+_0.02	0.37	.42	0.001[b]
	Dried *Moringa oleifera* from sandy soil	3	0.9+_0.2	0.70	1.10	0.002[c]
	Total	9	0.44+_0.38	0.03	1.10	
	Fresh *Moringa oleifera* leaves from clay soil	3	0.37+_0.05	0.31	.42	0.029[a]
	Dried *Moringa oleifera*leaves from clay soil	3	0.76+_0.03	0.74	.80	0.001[b].
	Dried *Moringa oleifera*from sandy soil	3	1.187+_0.2	0.96	1.50	0.02[c]
	Total	9	0.77+_0.38	0.31	1.50	
Zn	Fresh *Moringa oleifera* leaves from clay soil	3	0.01+_0.0	0.01	.01	0.725[a]
	Dried *Moringa oleifera* leaves from clay soil	3	0.03+_0.005	0.03	.04	0.001[b]
	Dried *Moringa oleifera* from sandy soil	3	0.57+_0.13	0.45	.70	0.001[c]
	Total	9	0.19+_0.2	.01	.70	
Na	Fresh *Moringa oleifera* leaves from clay soil	3	0.1+_0.04	0.07	.16	0.297 [a]
	Dried *Moringa oleifera* leaves from clay soil	3	0.27+_0.02	0.25	.290	0.001[b]
	Dried *Moringa oleifera* from sandy soil	3	3.13+_0.3	2.80	3.40	0.001[c]
	Total	9	1.17+_1.48	.07	3.40	

Where p value is significance less than 0.05

Where p value is strong significance less than 0.001

Significance between fresh and dried moringa from clay soil

b- Significance between fresh and dried moringa from sandy soil

c- Significance between dried moringa from clay and sandy soil

CONCLUSIONS

In the last few years, M. oleifera has been in the limelight of research and many researchers have reported that. *Moringa Oleifera* can be cultivated in a wide range of soil type but prefers a well-drained sandy loam or loam soil. It tolerates a soil pH 5.0–9.0 with an optimum of 6.3-7.0. All these environmental factors and soil conditions are highly favorable for cultivation of Moringa. [(17)]The nutritional and medicinal potentials of M. oleifera was assessed in this study through determination of proximate analysis, minerals and vitamin composition as well as phytochemicals, and antioxidants. *Moringa Oleifera* fresh leaves contained the highest content of moisture due to they retained most water content of them, while dried leaves contained the highest of other ingredient because of they are concentrated in leaves due to lose of

water. Dried leaves obtained from loam soil had the highest content of vitamin, polyphenol, and antioxidant compared to leaves obtained from sandy soil, but in the other side sandy soil improves mineral content of these leaves

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