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ANTIOXIDANT POTENTIAL AND NUTRITIONAL COMPARISON OF MORINGA LEAF AND SEED POWDERS AND THEIR TEA INFUSIONS

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ABSTRACT

The core objective of current study was to compare the nutritional profile and antioxidant potential of moringa leaf and seed powders and their tea infusions. For the purpose, moringa leaf powder (MLP) and moringa seed powder (MSP) were characterized and subsequently utilized for the preparation of moringa tea infusions and then evaluated for their polyphenolic contents by Folin–Ciocalteu procedure, antioxidant activity by DPPH assay and minerals profile by atomic absorption spectrophotometer. The results showed that MLP was found to possess higher fiber content (19.61±0.38%) than MSP. Whereas, the higher value of protein was exhibited by MSP (35.26±0.25%). The lower fat content was shown by MLP (2.82±0.27%), which was appreciably different from MSP (30.94±0.9%). Furthermore, among minerals, MLP and moringa leaf tea infusions possessed more calcium, phosphorus, sodium potassium, magnesium, iron, zinc and copper than MSP, moringa seed tea and their combination (leaf+ seed) tea infusions. However, the trace elements were present in relatively less quantity in both the powders and their infusions analyzed. Moreover, the higher TPC, TFC and DPPH scavenging activity were also found in MLP and moringa leaf tea infusions; these were better than MSP and moringa seed tea infusions. It is concluded that MLP, MSP and their respective infusions contained essential nutrients in significant amount and good antioxidant properties therefore, can be a part of diet based therapy for the management of chronic diseases.

Key words: Moringa leaf and seed powders, Moringa tea infusions, minerals, total phenolics, total flavonoids, DPPH scavenging activity

INTRODUCTION

In recent years, great stress is being placed on the utilization of the foods that not only nourish the body but also used to be helpful in the prevention and treatment of diseases. There are several foods available in market like functional foods, medical foods, novel foods, designer foods and nutraceutical for the management of particular diseases. Most of them are made from the plants (Arai, 1996). The native plants are usually under-explored instead of their enormous nutritional and medicinal benefits in many countries. So, it is essential to explore the potential of indigenous plants through the development of innovative functional foods (Abbey and Timpo, 1990).

Moringa is one of them which is known as a miracle tree, single genus, Moringaceae family and of 14 known species (Nadkarni, 1976). The most popular and broadly cultivated specie is *Moringa oleifera Lam* also known as 'drumstick' tree (Ramachandran *et al*., 1980). Moringa is highly nutritious plant which can save lives, nourish the deprived people and can be a good source of nutrition for the people of all age groups (Fuglie, 2001). The incorporation of bioactive compounds enriched plant materials in foods, proved to be the best strategy against the ailments (Ramaa *et al*., 2006).

Numerous studies have been carried out for the chemical composition, bioactive compounds and antioxidant activity in moringa but focus was on the extracts from the dried leaves. However, according to our best knowledge, any work on the moringa tea infusions regarding these parameters has not been reported yet. Thus, the study was planned to determine the nutritional potential and bioactive compounds of moringa (leaves and seeds) with a view of utilizing them in a food product. To develop moringa tea infusions in different combinations to estimate their mineral contents, phenolic profile and antioxidant activity.

MATERIALS AND METHODS

Procurement of raw material: The moringa leaves and seeds were procured from the Department of Crop Physiology, University of Agriculture, Faisalabad. Reagents and standards were obtained from Sigma-Aldrich (Sigma-Aldrich Tokyo, Japan) and Merck (Merck KGaA, Darmstadt, Germany).

Preparation of moringa leaf powder (MLP): The moringa leaves were washed with de-ionized water and dried for 1 week under the shed to constant weight. The dried leaves were separately ground to fine powder using a blender (Renker, Model: GMO 1 grinder). Powder was stored in air-tight plastic bags protected from heat, humidity and light (Anjorin *et al.*, 2010).

Preparation of moringa seed powder (MSP): The moringa seed coat was removed and seeds were ground using a clean, electronic blending machine (Renker, Model: GMO 1 grinder). The ground and sieved powder was then stored in air tight, plastic bags till further use (Folkard and Grand, 2001).

Proximate analysis: The moringa components were analyzed for moisture, ash, crude protein, crude fat, crude fiber and NFE according to the method of Association of the Official Analytical Chemists (AACC, 2000).

Preparation of moringa tea: Stems and branches were stripped off and the leaves were washed with the clean water, blanched and dried under the shed for one week. After drying the samples of leaves as well as seeds were pulverized and sieved. The tea prepared by different concentrations of the moringa parts (leaves and seeds) is mentioned in Table 1.

Table 1. Treatments of moringa tea used in the study plan

Treatments	Moringa leaves (g)	Moringa seeds (g)
T_0	-	-
T_1	1.0	-
T_2	2.0	-
T_3	3.0	-
T_4	-	0.5
T_5	-	1.0
T_6	-	1.5
T_7	0.5	0.25
T_8	1.0	0.5
T_9	1.5	0.75

Preparation of infusions: The three treatments of each moringa leaf tea infusion (MLT), moringa seed tea infusion (MST) and moringa leaf seed tea infusion (MLST) were prepared. Tea bags of each formulation were infused for 3 min in 200 mL of freshly boiled de-ionized water. Each tea infusion was stirred once on the addition of water and bags were then removed from the infusions.

Minerals composition: The minerals and trace elements like calcium, phosphorous, sodium, magnesium, potassium, iron, zinc, copper manganese, cadmium, lead and chromium in moringa leaf powder, moringa seed powder and their respective infusions were determined by atomic absorption spectrophotometer as illustrated in AOAC (2003).

Preparation of extract of moringa leaf and seed powders: MLP and MSP extracts were prepared for the evaluation of bioactive compounds according to the method stated by Zou *et al.* (2004).

Analysis of bioactive compounds: Total phenolics and total flavonoids contents of moringa components and their tea infusions were analyzed by their respective methods. The total phenolic contents were determined by using Folin-Ciocalteu reagent method as described by Chaovanalikit and Wrolstad (2004). Amount of total flavonoid contents were estimated according to the method reported by Hussain *et al.* (2012).

DPPH radical scavenging assay: DPPH free radical scavenging activity of moringa extracts and moringa tea infusions were measured by the method reported by Hussain *et al.* (2008).

Statistical analysis: The data obtained from the study were analyzed using a software SPSS version 17. Analysis of variance technique was applied to see the level of significance. Means were compared through Least Significance Difference Test according to the method described by Steel *et al*. (1997).

RESULTS AND DISCUSSION

Proximate composition: The amount of moisture, ash, crude protein, crude fat, crude fiber as well as the NFE in a food is of utmost importance for many scientific, technical and economic reasons. The results of proximate analysis demonstrated that an acceptable level of moisture content was present in leaf and seed powders after drying (Table 2). The fiber contents of the leaves (19.61±0.38%) were two times more than the seeds, and the high fiber contents aids in digestion and prevention of many diseases (Saldanha, 1995). The ash contents also exhibited the similar trend, showed the presence of appreciable amount of minerals in the leaves. However, the lower amount of fat (2.82±0.27%) was present in leaves as compared to seeds, resulting in the lower number of calories from MLP that can be beneficial in the control of obesity and other chronic diseases (Chinma and Gernah, 2007). Similarly, the seeds contained higher amount of protein (35.26±0.25%) than the leaves, which makes the seeds a good source of protein and would be used as a good and cheap source of protein supplement. The NFE of the leaf (38.97±0.02%) is almost double of the seed (19.89±0.02%), showed the high levels of its possible dietary value (Abdulkarim *et al*., 2005). The findings of the present study are in accordance with these reported earlier (Fuglie, 2001; Oduro *et al*., 2008). However, slight differences were observed with the findings of Ogbe and Affiku (2011) and Mutayoba *et al*. (2011). The differences in the chemical composition may be due to the differences in geographical locations, stages of maturity of the plants and drying methods.

Table 2. Proximate composition of moringa leaf and seed powders (%)

Proximate Composition	MLP	MSP
Moisture	8.07±0.15	6.53±0.08
Crude Protein	28.11±0.09	35.26±0.25
Crude Fiber	19.61±0.38	7.46±0.04
Crude Fat	2.82±0.27	30.94± 0.73
Ash	10.50±0.44	6.61±0.06
NFE	38.97±0.02	19.89±0.02

Values are expressed as means ± SD, MLP: Moringa leaf powder, MSP: Moringa seed powder

Mineral profile of moringa leaf and seed powders: The present study revealed that calcium was seven times higher (2100.7±0.54 mg/100 g) in moringa leaf powder (MLP) than moringa seed powder (MSP) (Table 3) which can be useful for the transport of oxygen and cellular activity. Magnesium also showed the similar trend which is involved in the intestinal absorption, various chemical reactions and almost functioning of 90 enzymes in the body. Sodium and potassium were present relatively in good quantity in MLP and MSP and would be helpful in the transmission of nerve impulses and electrolyte balance. Whereas, the trace elements were found in small quantities in the body however, they are fundamentally important. The MLP contained appreciably higher amount of iron (288.25±0.09 mg/kg) than MSP (11.82± 0.11 mg/kg) and can be useful for the treatment and prevention of anemia (Table 4). Copper, manganese and zinc also showed similar trends i.e. higher in MLP than MSP and they are necessary for the support of immune system. The toxic elements cadmium (0.75±0.04 mg/kg) and lead (0.33±0.01 mg/kg) were found in minute quantity in MLP but not detected in MSP showed the suitability of moringa components for human consumption.

In this study, results obtained for the minerals of leaves, were in agreement with the findings of Mutayoba *et al*. (2011). As for as the results of the moringa seeds were concerned, the variability was observed in the amount of the elements reported by Ramachandran *et al*. (1980) and Aja *et al*. (2013). The differences in the composition would be attributed to the differences in the stages of maturity of the plants as well as the soil fortified with different chemical fertilizers.

Table 3. Mean values for macro minerals of moringa leaf and seed powders (mg/100g)

Macro minerals	MLP	MSP
Calcium	2100.7±0.54	374.69± 1.6
Magnesium	449.69± 0.28	290.69±2.76
Potassium	1349.7± 0.16	1100.7±0.58
Sodium	269.69 ± 1.57	149.69±0.94
Phosphorous	259.69±0.51	124.7±0.59

Values are expressed as means ± SD, MLP: Moringa leaf powder, MSP: Moringa seed powder

Table 4. Mean values for trace elements in moringa leaf and seed powders (mg/kg)

Trace Elements	MLP	MSP
Iron	288.25±0.09	11.82±0.11
Zinc	70.09±0.13	15.50±0.31
Copper	5.620±0.09	2.02±0.07
Manganese	80.09±0.21	6.75±0.41
Cadmium	0.75±0.04	ND
Lead	0.33±0.01	ND
Chromium	0.47±0.02	0.02±0.01

Values are expressed as means ± SD, MLP: Moringa leaf powder, MSP: Moringa seed powder, ND: Not detected

Bioactive compounds of moringa leaf and seed powders: The phenolic contents (TPC) were higher in MLP i.e. 9535.3± 57.74 mg/100 g than were found in MSP i.e. 4822.3± 54.74 mg/100 g (Table 5). Similarly, MLP contained higher amount of TFC (6543.3±59.75 mg/100 g) than MSP (958.34± 11.53 mg/100 g). The polyphenolic compounds obtained in leaves and seeds make a good preventative tool against different diseases. Consequently, the presence of these compounds in moringa components can also modulate the lipid peroxidation involved in atherogenesis, carcinogenesis and thrombosis in humans (Siddhuraju and Becker, 2003). Amount of TPC are in agreement with the values (9.95 to 11.17 g/100g) reported by Iqbal and Bhanger (2006) whereas, slightly higher values of TFC were found in moringa leaves in different regions of Pakistan i.e. (9.24 to 9.88 g/100g) and (9.24 to 9.83 g/100g) than the values obtained in the present study. The variations in the results of the present study could be due to the methods of extraction of polyphenolic compounds, degree of polarity of the solvents and geographical locations of the plants.

Table 5. Mean values of bioactive compounds and DPPH scavenging activity of moringa leaf and seed powders

Bioactive compounds	MLP	MSP
Total Phenolics (mg/100g)	9535.3±57.74	4822.3±54.74
Total Flavonoids (mg/100g)	6543.3±59.75	958.34±11.53
DPPH Scavenging %	87.02±0.99	34.050±0.99

Values are expressed as means ± SD, MLP: Moringa leaf powder, MSP: Moringa seed powder

DPPH radical scavenging activity: It was obvious from the results that DPPH radical scavenging activity was higher in MLP (87.02±0.99%) as compared to MSP (34.050±0.99%) (Table 5). Their free radical scavenging ability could be due to the presence of conjugated ring structures, redox properties, and carboxylic group which are involved in the inhibition of lipid peroxidation (Oyedemi *et al*., 2010). The potential of methanolic extract of moringa leaves reduced DPPH radicals as reported by Sreelatha and Padma (2009) was lower than our observed results. This variability could be due to difference in nature of the soil, season of cultivation, temperature and the extraction methods.

Minerals composition of moringa tea infusions: The results revealed that the mineral contents (calcium, magnesium, potassium, sodium, phosphorous) were significantly ($P \leq 0.05$) different among all the treatments (Table 6). The calcium contents of different tea samples were in the range of 1.39 to 61.87 mg/100mL. Calcium appeared to be the foremost element in the tea infusions. Therefore, 3 cups (600 mL) of moringa leaf tea infusion daily can fulfill the calcium requirements of the individuals and was equivalent of about one fourth of the recommended daily intake of 1000 mg (Jensen, 2000). The moringa leaf tea infusion (T_3) had the highest potassium contents (35.36±0.05 mg/100mL) closely followed by T_2, while moringa seed tea infusion (T_4) was weakest of all. Similar trend in the results was observed for magnesium, sodium and phosphorous.

Table 6. Mean values for calcium, magnesium, potassium, sodium and phosphorous contents of moringa tea infusions (mg/100 mL)

Treatments	Calcium	Magnesium	Potassium	Sodium	Phosphorous
T_1	20.72±0.04e	4.28±0.03f	12.21±0.01d	2.64±0.00e	2.33±0.00e
T_2	41.44±0.02b	8.57±0.02b	24.43±0.01b	5.28±0.01b	4.66±0.01b
T_3	61.87±0.06a	12.63±0.05a	35.36±0.05a	7.86±0.01a	6.72±0.00a
T_4	1.39±0.02i	1.30±0.02i	3.57±0.00i	0.63±0.01i	0.46±0.02i
T_5	2.79±0.02h	2.90±0.00g	7.05±0.02g	1.33±0.02h	0.92±0.06h
T_6	3.71±0.00g	4.36±0.00e	8.81±0.05f	1.91±0.01f	1.22±0.11f
T_7	10.65±0.00f	2.60±0.01h	5.97±0.01h	1.57±0.01g	1.17±0.01g
T_8	21.30±0.02d	5.34±0.05d	11.89±0.05e	3.18±0.01d	2.35±0.02d
T_9	31.16±0.05c	7.72±0.05c	14.38±0.05c	4.64±0.00c	3.09±0.00c

Means sharing similar letter in a column are statistically non-significant ($P>0.05$), Values are expressed as means ± SD.
T_1- MLT: Moringa leaf tea infusion (1 g), T_2 - MLT: Moringa leaf tea infusion (2 g), T_3- MLT: Moringa leaf tea infusion (3 g), T_4- MST: Moringa seed tea infusion (0.5 g), T_5- MST: Moringa seed tea infusion (1 g), T_6- MST: Moringa seed tea infusion (1.5 g), T_7- MLST: Moringa leaf + seed tea infusion (0.5 g+0.25 g), T_8- MLST: Moringa leaf + seed tea infusion (1 g+0.5 g),T_9- MLST: Moringa leaf + seed tea infusion (1.5 g+0.75 g)

Other less abundant elements turned out to be iron, manganese, zinc, copper, cadmium, chromium and lead in the all estimated samples (Table 7). The iron contents of different tea infusions were in the range of 0.05 to 8.64 mg/L, whereas the significantly ($P \leq 0.05$) highest contents of iron were present in moringa leaf tea infusions (T_3) in comparison with other treatments. Iron is an essential micronutrient required for human growth and development. The results showed that the moringa leaf tea infusions can be a good source of iron. The values are in accordance to recommended daily allowance of iron – 10 mg/100 g to 13 mg/100 g for children; 7 mg/100 g for men; and 12 mg/100 g to 16 mg/100 g for women and feeding mothers (Fuglie, 2001). Similarly, copper is a fundamental micronutrient required for metabolism. Moringa leaf tea infusions contained an appreciable of amount of copper (0.01±0.00 to 0.17±0.00 mg/L). Zinc is also an essential micronutrient required for human growth, maintenance of the immune function, development, which could be enhanced the prevention and recovery from infectious diseases (Walker *et al*., 2005). Moringa leaf tea (T_3) had the highest composition (2.10±0.02 mg/L) of zinc. So, could be used as a cheap source of zinc.

The cadmium and chromium contents indicated statistically significant differences ($P \leq 0.05$) among the treatments (Table 8). The highest value for cadmium (0.023±0.00 mg/L) was observed in T_3 While, the cadmium and chromium contents were not detected in moringa seed tea infusions (T_4, T_5 and T_6). However, the mean values for all the treatments regarding the results of lead were statistically non-significant. It was identified in minute quantity in T_3 while not detected in any of the samples of moringa seed tea infusions. The minerals content of moringa leaf is higher than the reported values of green tea leaves. The amount of calcium, iron, sodium and potassium in different green tea samples were in the range of 390-740, 10.4-38, 3-11 and 1900-2800 mg/100 g, respectively (Chee and Juneja, 1997). Similarly, results of Costa *et al*. (2002) also showed variations with the findings of current study regarding Ca and Mn contents. It was evident that the moringa leaf tea infusions possessed higher amount of minerals than other green/herbal tea infusions. It can, therefore, be concluded that the drinking of moringa tea enhances the dietary intake of minerals. Minerals in water may be more readily absorbed than those from food as they are in the free ionic state. These findings could have important nutritional implications in countries where tea is consumed in substantial amount.

Table 7. Mean values for iron, zinc, copper and manganese contents of moringa tea infusions (mg/L)

Treatments	Iron	Zinc	Copper	Manganese
T_1	2.88±0.00e	0.70±0.01e	0.06±0.00c	0.80±0.00e
T_2	5.77±0.01b	1.40±0.02b	0.11±0.01b	1.60±0.00b
T_3	8.64±0.00a	2.10±0.02a	0.17±0.00a	2.40±0.00a
T_4	0.05±0.00i	0.07±0.01i	0.01±0.00e	0.03±0.00i
T_5	0.11±0.00h	0.15±0.02h	0.02±0.00de	0.06±0.00h
T_6	0.17±0.00g	0.23±0.00g	0.03±0.00d	0.10±0.00g
T_7	1.47±0.00f	0.38±0.01f	0.03±0.00d	0.41±0.00f
T_8	2.94±0.00d	0.77±0.00d	0.07±0.00c	0.83±0.01d
T_9	4.41±0.00c	1.16±0.00c	0.10±0.00b	1.25±0.01c

Means sharing similar letter in a column are statistically non-significant (P>0.05), Values are expressed as means ± SD
T_1- MLT: Moringa leaf tea infusion (1 g), T_2 - MLT: Moringa leaf tea infusion (2 g), T_3- MLT: Moringa leaf tea infusion (3 g), T_4- MST: Moringa seed tea infusion (0.5 g), T_5- MST: Moringa seed tea infusion (1 g), T_6- MST: Moringa seed tea infusion (1.5 g), T_7- MLST: Moringa leaf + seed tea infusion (0.5 g+0.25 g), T_8- MLST: Moringa leaf + seed tea infusion (1 g+0.5 g),
T_9- MLST: Moringa leaf + seed tea infusion (1.5 g+0.75 g)

Table 8. Mean values for cadmium, lead and chromium contents of moringa tea infusions (mg/L)

Treatments	Cadmium	Lead	Chromium
T_1	0.008±0.00bcd	0.003±0.00a	0.005±0.00ab
T_2	0.015±0.000ab	0.007±0.00a	0.010±0.00ab
T_3	0.023±0.00a	0.010±0.00a	0.014±0.00a
T_4	0.000±0.00d	0.000±0.00a	0.000±0.00b
T_5	0.000±0.00d	0.000±0.00a	0.000±0.00b
T_6	0.000±0.00d	0.000±0.00a	0.000±0.00b
T_7	0.004±0.00cd	0.002±0.00a	0.002±0.00b
T_8	0.008±0.00bcd	0.003±0.00a	0.005±0.00ab
T_9	0.011±0.00bc	0.005±0.00a	0.007±0.00ab

Means sharing similar letter in a column are statistically non-significant (P>0.05), Values are expressed as means ± SD
T_1- MLT: Moringa leaf tea infusion (1 g), T_2 - MLT: Moringa leaf tea infusion (2 g), T_3- MLT: Moringa leaf tea infusion (3 g),
T_4- MST: Moringa seed tea infusion (0.5 g), T_5- MST: Moringa seed tea infusion (1 g), T_6- MST: Moringa seed tea infusion (1.5 g),
T_7- MLST: Moringa leaf + seed tea infusion (0.5 g+0.25 g), T_8- MLST: Moringa leaf + seed tea infusion (1 g+0.5 g),
T_9- MLST: Moringa leaf + seed tea infusion (1.5 g+0.75 g)

Bioactive compounds of moringa tea infusions

Total phenolics and total flavonoids: The results revealed that the mean values for total phenolic contents (TPC) and total flavonoids contents (TFC) of all the treatments were statistically significant (P≤0.05) (Table 9). TPC in moringa leaf tea infusion (T_3) was highest (99.51±0.11 mg/100 mL) among all the tea infusions. Similarly, the highest TFC (57.24±0.14 mg/100 mL) was found in T_3 whereas the minimum value of TFC was recorded in T_4. The major polyphenols present in tea are flavonoids, which have been shown to inhibit the activity of nuclear factor-kappa B, TNF-α, IFN-γ, Cox-2 (Haqqi *et al*., 1999) and hence significantly reduced the severity and onset of the diseases. The phenolics contents of moringa leaf tea infusions examined in this study were higher than the values reported in green tea (38.58 mg/100 mL) and black tea i.e. 23.60 mg/100 mL (Yang *et al*., 2011). Likewise, higher amount of flavonoids contents were present in moringa leaf tea infusions compared to green tea infusions (8.4 mg/100 mL) as stated by Costa *et al*. (2002). The difference could be due to the difference in tea plants, as described in the literature that moringa plant is rich in phenolic compounds compared to other medicinal plants.

Table 9. Mean values for total phenolics and total flavonoids of moringa tea infusions

Treatments	Total Phenolics (mg GAE/100 mL)	Total Flavonoids (mg CE/100 mL)
T_1	35.51±0.05e	18.08±0.04e
T_2	74.10±0.10b	38.53±0.07b
T_3	99.51±0.11a	57.24±0.14a
T_4	4.25±0.02i	1.62±0.01i
T_5	8.51±0.03h	3.26±0.00h
T_6	12.75±0.06g	4.81±0.03g
T_7	19.83±0.08f	9.83±0.02f
T_8	41.34±0.08d	20.75±0.09d
T_9	56.14±0.06c	30.92±0.07c

Means sharing similar letter in a column are statistically non-significant (P>0.05), Values are expressed as means ± SD
T_1- MLT: Moringa leaf tea infusion (1 g), T_2 - MLT: Moringa leaf tea infusion (2 g), T_3- MLT: Moringa leaf tea infusion (3 g), T_4- MST: Moringa seed tea infusion (0.5 g), T_5- MST: Moringa seed tea infusion (1 g), T_6- MST: Moringa seed tea infusion (1.5 g), T_7- MLST: Moringa leaf + seed tea infusion (0.5 g+0.25 g), T_8- MLST: Moringa leaf + seed tea infusion (1 g+0.5 g),T_9- MLST: Moringa leaf + seed tea infusion (1.5 g+0.75 g)

DPPH radical scavenging activity of moringa tea infusions: Moringa leaf tea infusion (T_3) exhibited a strong ability (83.73%) to quench DPPH radicals while, the weakest one (20.54%) was observed in T_4 (Fig 1). The mechanism behind the free radical scavenging activity of polyphenols is to contribute in the reduction of oxidative stress and to prevent the onset of diseases (Huang *et al*., 2001). The DPPH radical scavenging activity of moringa leaf tea infusions were higher than the berry leaves tea infusion (42.70%), Carob fruit tea infusion (58.29%) and Doum fruit tea infusion (49.62%) as reported earlier by Hussein *et al*. (2011). The variations in the results of the present study could be due to the difference in tea plants.

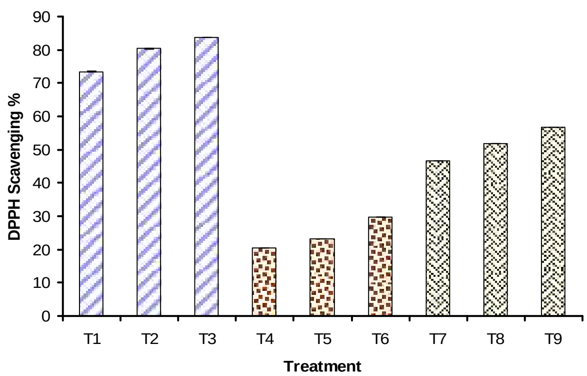

Fig 1. DPPH free radical scavenging activity of moringa tea infusions

T_1- MLT: Moringa leaf tea infusion (1 g), T_2 - MLT: Moringa leaf tea infusion (2 g), T_3- MLT: Moringa leaf tea infusion (3 g), T_4- MST: Moringa seed tea infusion (0.5 g), T_5- MST: Moringa seed tea infusion (1 g), T_6- MST: Moringa seed tea infusion (1.5 g), T_7- MLST: Moringa leaf + seed tea infusion (0.5 g+0.25 g), T_8- MLST: Moringa leaf + seed tea infusion (1 g+0.5 g),T_9- MLST: Moringa leaf + seed tea infusion (1.5 g+0.75 g)

Conclusions: The results of present study indicated that moringa leaf powders (MLP) were found to be a rich source of essential nutrients and polyphenols with high antioxidant potential than moringa seed powders (MSP). Among minerals, MLP again possessed more calcium, phosphorus, sodium potassium, magnesium, iron, zinc and copper than MSP. However, the trace elements were present in relatively less quantity in both the powders analyzed. The quality evaluation of moringa tea infusions, prepared from different combinations of its parts especially from the leaves showed good mineral profile, strong DPPH radical scavenging activity along with rich amount of phenolics and flavonoids which promote health and can provide therapeutic effects.

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