



Antioxidant properties, physiochemical status and sensory evaluation of drumstick tree (*Moringa oleifera* Lam.): Herbal infusion for better health

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Abstract

Moringa oleifera is a plant having plenty of nutrients, minerals and phenolics content which can be utilized as a powerful solution of malnutrition. The main purpose of current study is evaluation of nutritional attributes, antioxidant activity and amount of tannins in *Moringa oleifera* leaves as well as furthers its utilization in preparation of herbal infusion. Moisture, Ash, acid insoluble ash, water soluble ash and water extract of *Moringa* dried leaves were determined as $7.39 \pm 0.30\%$, $3.45 \pm 0.07\%$, $3.33 \pm 0.17\%$, $0.12 \pm 0.06\%$ and $29.75 \pm 0.07\%$, respectively. A significant value of tannins and crude fiber were found as 2.05 ± 1.32 TAE/100g and $18.17 \pm 0.07\%$, respectively. Antioxidant activity of dry leaves powder of *Moringa oleifera* was estimated through DPPH free radical scavenging assay which is 91.81% at 1.0mg/mL concentration. Current results exhibited that *M. oleifera* herbal infusion comprises of considerable dietary value and towering antioxidant properties may be exploited as functional food with immense therapeutic /remedial benefits.

Keywords: *Moringa oleifera*, Malnutrition, Proximate analysis, sensory evaluation, Antioxidant activity.

Introduction

In Pakistan malnutrition is a major social problem associated with poor nutritional status of available food. More than 40% of world population is affected from micronutrient malnutrition especially in developing countries¹. Scientific community is searching for natural products that can be used as alternative to synthetic supplements. *Moringa oleifera* having a place in *Moringaceae* family is the most extensively produced genus of monogeneric family that spread to the sub-Himalayan territory of Pakistan, India, Afghanistan and Bangladesh². *Moringa oleifera* which is a naturally propagated plant, flourishes well in brutal natural conditions. It is progressively increasing worldwide consideration because of an incredible profile of supplements and antioxidants in its leaves, pods and seed³. Leaves of *Moringa oleifera* comprises of a range of essential minerals including zinc, magnesium, iron, potassium, copper and calcium etc⁴. They are enriched with phytochemicals, for example, sterols, anthraquinones, alkaloids like flavonoids, terpenoids, tannins, saponins, quercetin, as well as reducing sugar present along with anti-cancerous agents such as glycerol-1-9 octadecanoate, glucosinolates, glycoside mixes and isothiocyanates⁵. It additionally contains an uncommon mixture of compounds such as zeatin, caffeoylquinic acid, kaempferol and sitosterol that act as health enhancers³. Due to its medicinal properties, there is developing enthusiasm for the utilization of *Moringa* leaf as herbal tea⁶. *Moringa* leaves are rich source of

calcium which is very vital mineral, important for human growth and development. Eight ounces of moringa leaf powder can provide 4000 mg of calcium in comparison to same amount of milk which contain only 300–400mg of calcium. Similarly 6 spoonfull of *Moringa oleifera* leaf powder comprises of 28 mg of iron due to which it can be used as replacement of iron tablets and as dietary cure for anemia⁷. In one kilogram of *Moringa* leaf powder 25.5–31.03mg of zinc is present, which is the sufficient to fulfill the daily ration of zinc in the diet⁸.

Most plants drop their nutritional quality when processed in to any edible form⁹. Previous studies has explored that the process of boiling and stewing had impact on nutritional composition of *M. oleifera*. Strangely, Boiling was the best of the considerable number of strategies as it diminished the non nutritive substances like phytate, oxalate and cyanide more efficiently than the other one¹⁰. The use of *M.oleifera* as a part of home grown medication by Indians and Africans is a common practice. The plenty of phytochemicals makes it a decent medicinal agent¹¹. *Moringa* has ability to cure diabetes of both Type I (patient experience the ill effects due to non-creation of insulin) and Type II (insulin resistance to maintain blood glucose level at the required typical esteem)¹². In modern society, Cancer is penetrating deeply and one in seven deaths is related to this disease because of despicable medication¹³. *Moringa* leaves extract have the ability to act as an agent to stop proliferation of body cell so as to suppress the development of

cancerous cells and can be called as a natural, reliable and safe anticancer source¹⁴. *Moringa oleifera* leaves also shows great antioxidant properties due to the occurrence of active phytochemicals in their leaves. Antioxidants play a considerable role in reduction of free radicals that produce during cellular metabolic activities and protect the body against diseases. The immense antioxidant property of *Moringa oleifera* leaves revealed that it has incredible cell reinforcement action which might be useful in moderation of oxidative harm and give assurance¹⁵.

Herbal infusion made solely from *Moringa* is poor in sensory appeal. This may probably be due to the absence of distinctive flavor properties⁹. This study was designed to *Moringa oleifera* with other herbs to prepare herbal infusion with good sensory appeal and explore its physiochemical nature as well as its antioxidants value so that we can use it as a functional/nutraceutical food.

Materials and Methods

Herbal infusion preparation: Fresh leaves of *Moringa Oleifera* were plucked from garden of PCSIR labs complex Lahore. Leaves were washed with distilled water to get free from dirt and impurities and then placed for drying in vacuum oven (Eyela, NDS-450D) for 24 hours. For the preparation of herbal infusion, 50mL of water was taken and allowed to boil. After boiling of water, add pinch of *Moringa* leaves (0.3g) along with 0.05g each of cardamom and lemon grass for flavor/taste enhancement and allowed to steep for three minutes. Furthermore these dried drumstick tree leaves were subjected to nutritional analysis.

Proximate analysis: Proximate analysis of dried *Moringa oleifera* leaves i.e. moisture, total ash, acid insoluble ash, water soluble ash, crude fiber and water extract tests were carried out according to Pakistan standard methods for tea/infusion analysis¹⁶.

In vitro Antioxidant capacity: 1, 1-Diphenyl-2-picrylhydrazyl radical scavenging activity: Aqueous extraction of dried *Moringa* leaves was prepared in the concentration of 1mg/mL according to the reported method¹⁷. 0.004% DPPH (Alfa Aesar, Germany) solution was prepared in ethanol. A series of ethanolic test solutions were prepared ranges from 20% to 100% and mixed in appropriate amount with DPPH (0.1mM) solution. BHT (Butylated hydroxyToluene) which is a synthetic antioxidant was used as a test positive control. After completion of incubation period of 30 minutes, at 517 nm absorbance of the tested solution was carefully taken using UV-spectrophotometer (Nicolet, Evlution-300, Germany).

Following equation was used to calculate percentage (%) scavenging activity of DPPH:

Antioxidant activity (%) = {(OD blank – OD sample) / OD blank} × 100

Estimation of Tannins: Estimation of tannins from dried leaves of *Moringa oleifera* is based on colorimetric method described by Rangana¹⁸. Briefly, 5g of sample was digested for 30 minutes. The digest was diluted further with distilled water to get 250mL solution. Use an aliquot of the filtrate for colour development by using Folin Denis reagent along with saturated sodium bicarbonate in appropriate amounts. After incubation time of 30 minutes, absorbance of developed colored solution was taken on spectrophotometer at 760nm. Tannic acid was used for standard curve preparation in range of 0.1mg-5mg.

Sensory Evaluation: Developed *Moringa oleifera* herbal tea was subjected to sensory evaluation. Sensory evaluation of tea samples was performed by method of Adnan *et al.*¹⁹ and conducted to evaluate rating of tea for flavor, taste, color and overall acceptability. Sensory evaluation of prepared tea was carried out by a qualified panel of six judges. They were provided with recommended poll to record their physical perceptions. Information written on sensory performa was pointed toward the scoring pattenen such as 9-10=like Extremely, 9-8= Like very much, 8-7= very Like, 7-6= Like slightly, 6-5= Neither like nor dislike, 4-3= Dislike slightly, 3-2=Dislike, 2-1=extremely dislike.

Statistical analysis: All data is presented as mean ±SD. Data of at least three independent experiments was taken as mean value. Graph pad Prism 5 (Version 5, 2009)²⁰ was used to perform two ways Analysis of Variance (ANOVA) to observe the noteworthy variation among results. Results exhibiting probability value of <0.05 were considered to be statistically significant.

Results and discussion

Proximate analysis: Outcomes of nutritional analysis of *Moringa oleifera* dried leaves, used for tea preparation, are shown in Figure-1. Present results indicate that the tea leaves exhibited significant value of water extract (29.37±0.07%) followed by crude fiber (18.17±0.07%), moisture (7.39±0.30%). A high value of mineral content (3.45±0.07%) was observed in tea leaves. Each water soluble and acid insoluble ash were found as 3.33±0.17% and 0.12±0.06%, respectively. Considerably high fiber content in leaves of *Moringa oleifera* makes it more accommodating in digestion and to stop chronic diseases like gastrointestinal disorders, diabetes and cancer⁴. Various parts of *Moringa oleifera* plant including stem, leaves, roots and seeds have been used traditionally as vegetables to improve dietary ration¹⁵.

Sensory Assessment of herbal tea: Overall acceptability value of herbal tea given by panel of five judges is 7.27 that fall in very like category (Figure-2).

Tannins Determination: Tannins estimation was carried out through color development method and the results are depicted in Figure-3. Tannic acid was used as reference standard for

tannins estimation. The estimated quantity of tannins in tea leaves was found 2.05 ± 1.32 TAE/100g of dry matter. Tannins are naturally present polyphenols in various plant leaves, seeds, vegetables and fruits. These are water soluble antioxidants having molecular weight of 500 to 3000g/mol. This substance in *M. oleifera* leaves enhances its therapeutic properties to battle against the contaminations, ulcers and different maladies in body²¹.

In vitro Antioxidant activity: For antioxidant activity determination a lot of models are used in scientific community, among which DPPH assay is easy to work and give more reliable results. Figure 2 shows results of percent Scavenging capability of *Moringa oleifera* leaves to free radical species produce during DPPH in vitro assay. Antioxidants play a vital role in inhibition of free oxygen species production during

cellular metabolism, providing protection to human cells against oxidative damage that lead towards chronic diseases such as cancer. Butylated hydroxyl toluene (BHT) which is a strong antioxidant is used as positive control. At 100% conc. of dried *M.oleifera* leaves exhibited 85.45% of free radical scavenging activity which is compare able to BHT antioxidant activity (85.1%) at 60% concentration. As scientific community is searching for natural antioxidants due to hazardous effects of synthetic antioxidants, so *Moringa oleifera* leaves can be used as a good source of natural antioxidants. Similarly, Iqbal et al.²² reported that *M. oleifera* leaves produced in Pakistan have high antioxidant potential in comparison to other varieties of various countries. The results also depicted that it is dose based response increased along with increasing sample conc (Figure-4).

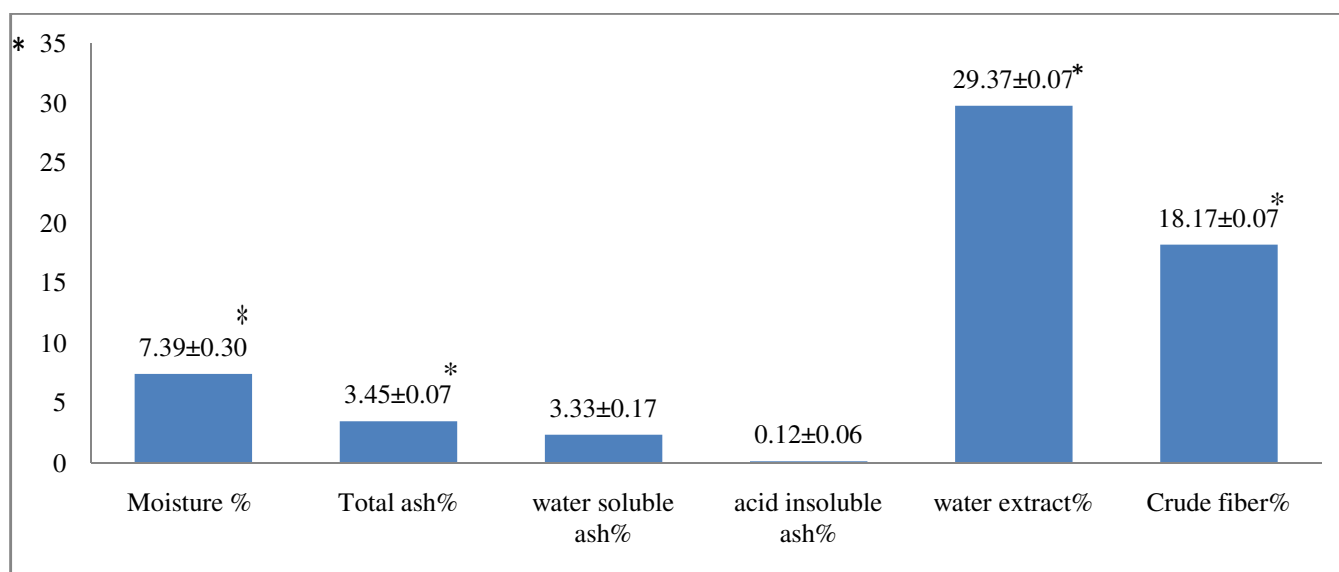


Figure-1: Proximate/Nutritional analysis of *Moringa oleifera* dried leaves. (*) Significantly different at $P < 0.05$.

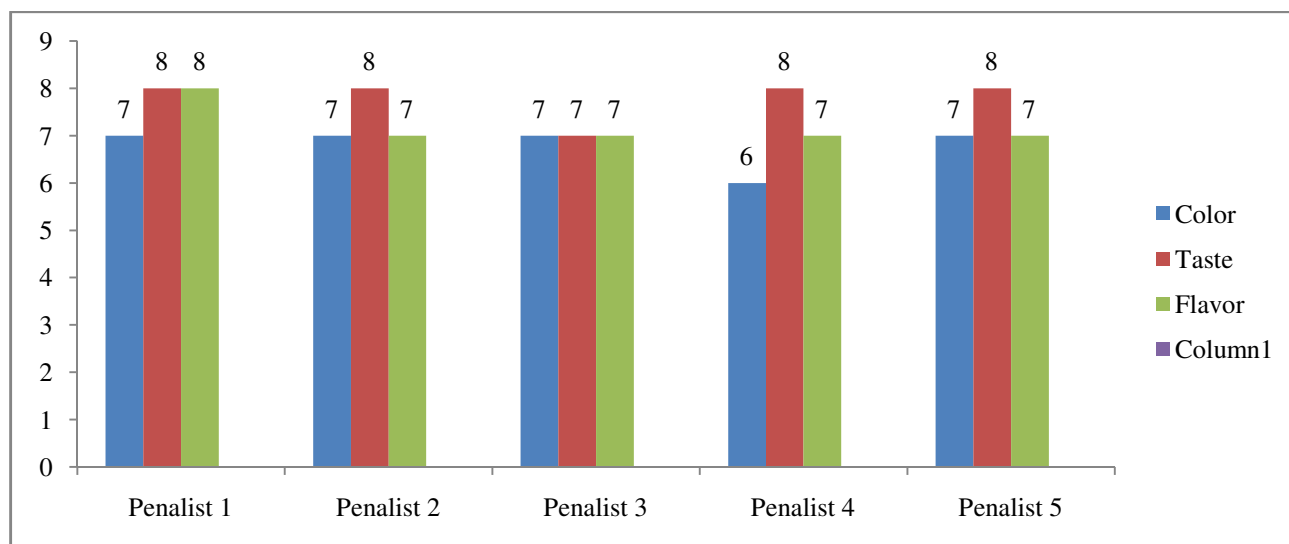


Figure-2: Sensory evaluation of *Moringa oleifera* herbal tea.

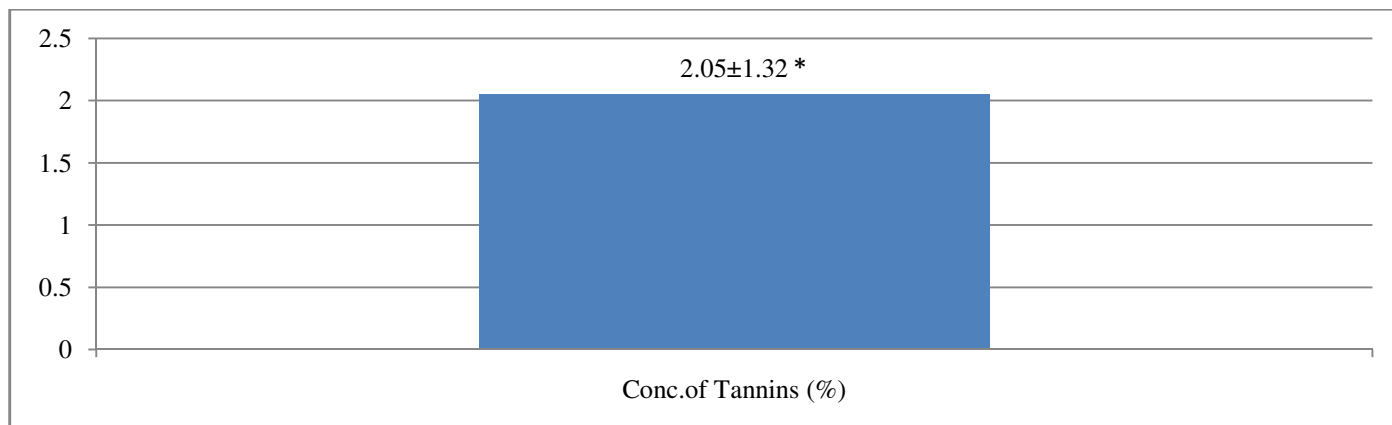


Figure-3: Concentration of tannins in *Moringa oleifera* leaves which is calculated from standard curve of tannic acid.

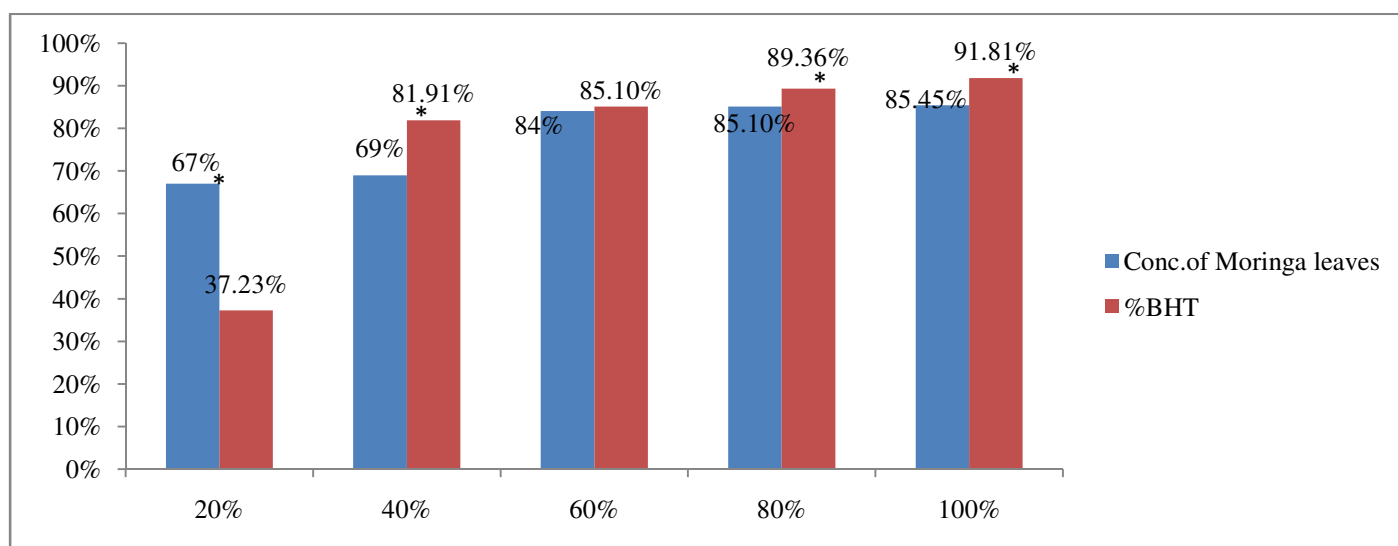


Figure-4: *In vitro* antioxidant activity was carried out through DPPH assay showing percent scavenging of BHT (butylated hydroxytoluene) used as positive control and *Moringa Oleifera* leaves sample. (*) Significantly different at $P < 0.05$.

Conclusion

Moringa oleifera dried leaves powder shows very high-quality nutritional values. It is enriched with phytochemicals exhibiting potent antioxidant activity comparable to synthetic antioxidants such as BHT. Due to good dietary value, it can be used as additional functional/natural therapeutic food along with routinely used vegetables.

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