Journal of Rural Advancement
[ISSN 2347-2561 (P); 2583-6102 (E)]
Vol. 10, Issue 01, April 2022

Seasonal variation in antioxidant properties of various parts of the *Moringa oleifera* plant collected from different Indian locations

Tushar Sharma*, Aditya Kumar* and Awadhesh Kishore

School of Agriculture, ITM University, Gwalior-474001, India

[*]College of Biotechnology, Uttar Pradesh Pandit Deen Dayal Upadhyaya Pashu Chikitsa Vigyan Vishwavidyalaya Evam Go-Anusandhan Sansthan, Mathura-281001, India

Abstract

The present study was an attempt to find out the antioxidant properties of various parts of the Moringa oleifera plant collected from different Indian locations in various seasons. Three Indian locations viz Jaipur, Dehra Dun, and Gwalior were selected randomly for collection of the samples of the fresh flowers, tender and mature leaves, and seeds of Moringa oleifera. The samples were collected from three different agroforest locations selected randomly from each district during each calendar month of the year 2021-22. The samples were extracted and antioxidant properties were determined according to the DPPH method, based on the quantification of free radical scavenging. For comparing antioxidant properties, the factorial ANOVA technique of statistical analysis was implemented and an analysis pack of MS Office Excel, 2016 was used to compare data. The flowers collected from Jaipur had superior and seeds from Gwalior had inferior antioxidant properties. Flowers and tender leaves were better compared to mature leaves and seeds and the month of January was the better and June poor season to yield antioxidant properties in the plant.

Keywords: Antioxidant, Locations, Months, *Moringa oleifera*, Organs.

Introduction

Human beings are exposed to both endogenous and exogenous sources of free radicals including exposure to UV light, smoking, ionizing radiation, certain organic solvents, pollutants, and industrial waste or the metabolism (Boonchum et al 2011). Free radicals are supposed to be harmful as they influence several metabolic activities of the cells. The presence of free radicals in the human body might lead to dangerous diseases such as coronary heart disease, cancer, diabetes mellitus, atherosclerosis, arthritis, neurodegenerative diseases, and Alzheimer's disease and contribute to the aging process of the body (Gutteridge 1995, Pong 2003, Pezzuto and Park 2015). The inclusion of antioxidants in food or as supplements can protect the body against these diseases (Moon and Shibamoto 2009). These issues can occur if antioxidant defenses in the body are inadequate. Therefore, it is desirable to increase dietary antioxidants (Soong and Barlow 2004). Safety concerns about the use of synthetic antioxidants have been expressed in recent reports (Sun and Ho 2005, Hossain et al 2008), while edible plant parts rich in antioxidants, especially spices and herbs,

are attracting the focus of current interest (Nakatani 1997, Rice-Evans et al 1997). Natural antioxidants are always recommended over synthetic ones because they are viewed as less toxic and more potent than synthetics (Boonchum et al 2011). For example, a cup of coffee contains 200-550 mg, while a cup of tea 150–200 mg, and a glass of wine 200–800 mg of polyphenols (Lakenbrink et al 2000). As the natural antioxidant vitamin C, tocopherols, flavonoids, and other phenolic compounds are well known and present in certain plants (Laandrault et al 2001).

Moringa oleifera is a plant that has been identified to contain natural antioxidants (Iqbal and Bhanger 2006). Siddhuraju and Becker (2003) analyzed the antioxidant activity of this plant from India, Nicaragua, and Niger. The antioxidant properties of the various parts of the *Moringa oleifera* plant especially leave and flowers were superior to those of selected vegetables (cabbage, spinach, broccoli, cauliflower, and peas) (Pakade et al 2013). Antioxidants of the leaves could quench ABTS+ rather than reducing power and ability to quench DPPH radicals, while antioxidants of the pods and seeds possessed reducing power equal to or higher than the ability to quench DPPH and ABTS radicals (Wangcharoen and Gomolmanee 2011). It protects against STZ-induced diabetes. The MOMtE exhibited significant antidiabetic and antioxidant activity and active constituents that may be isolated from the extract for evaluation in future clinical studies (Gupta et al 2012). The plant has been associated with a variety of nutritional, medicinal, and miscellaneous uses (Singh et al 2014) along with its antioxidant properties (Santos et al 2012). Pakade et al (2013) explained why *Moringa oleifera* forms part of the diet of people in many developing countries.

The present study was an attempt to find out the antioxidant properties of various parts of the *Moringa oleifera* plant collected from different Indian locations in various seasons.

Materials and Methods

Three Indian locations viz Jaipur (Rajasthan), Dehra Dun (Uttarakhand), and Gwalior (Madhya Pradesh) were selected randomly (one from each state) for collection of the samples of the fresh flowers, tender and mature leaves, and seeds of *Moringa oleifera*. The samples were collected from three different agroforest locations selected randomly from each district during each calendar month of the year 2021-22. The samples were extracted using the method of Swain and Hills (1959); with the necessary modifications (Torres et al 2002). The antioxidant capacity was determined according to the DPPH method (Maria do Socorro et al 2010), based on the quantification of free radical scavenging. For comparing antioxidant properties of various parts of Indian moringa during different calendar months of the year from different locations, factorial ANOVA with the replication technique of statistical analysis was implemented (Snedecor and Cochran 1994) to compare the results. The analysis pack of MS Office Excel, 2016 (UQ Library 2016) was used for the purpose.

Results and Discussion

Antioxidant properties (µM Eq. Trolox/g) of various organs of the *Moringa oleifera* plant collected from various Indian locations along with their interaction have been presented in Tables 1 and 2. The antioxidant properties were significantly higher ($P<0.05$) in the flower in comparison to those in mature leaves and seeds but nonsignificant ($P>0.05$) than in tender leaves. The interaction between location and various parts of the *Moringa oleifera* tree was also recorded as significant ($P<0.05$) and revealed that the flowers collected from Jaipur had superior and

seeds from Gwalior had inferior antioxidant properties. The trends recorded revealed that the exposure to the antioxidant properties produced in various parts of the plant was responsible to reduce its potential. This was the reason the tender leaves were recorded as superior in comparison to mature leaves. A similar trend was also observed in flowers and seeds. Pakade et al., 2013 observed superior antioxidant properties of the *Moringa oleifera* plant in leaves and flowers. Wangcharoen and Gomolmanee (2011) also reported similar results in their experiment with this plant.

Table 1: Antioxidant properties (µM Eq. Trolox/g) of various organs of *Moringa oleifera* plant collected from various Indian locations

Organ and locations	Flower	Tender leaves	Mature leaves	Seed	Overall
Gwalior	27.40±0.29	22.95±0.16	20.11±0.29	9.99±0.06$^{\#}$	20.11±0.48
Jaipur	28.20±0.28$^{\$}$	23.36±0.23	20.47±0.22	10.04±0.16	20.52±0.49
Dehra Dun	25.38±0.39	25.72±0.22	20.23±0.17	10.26±0.07	20.40±0.47
Overall	26.99±0.21^{a}	24.01±0.16^{a}	20.27±0.13^{b}	10.10±0.06^{c}	20.34±0.28

P-Values: Organs 0.00, Location 0.05 & Interaction, 0.00, $^{\$}$ Higher figure & $^{\#}$ Lower figure.
^{a,b,c}-Values bearing different superscripts within the row differed significantly i.e. P<0.05.

Antioxidant properties (µM Eq. Trolox/g) of various organs of the *Moringa oleifera* plant collected during different seasons along with their interaction have been presented in Tables 2 and 3. The antioxidant properties remained nonsignificant (P>0.05) at three Indian locations viz. Gwalior, Jaipur, and Dehra Dun. The interaction in this regard between the organs of the plant and the month of sample collection was nonsignificant (P>0.05). The reason for such types of findings could be perhaps because the climatic conditions in various calendar months of the year were not very different. The results could not be verified because of the scanty literature in this regard.

Antioxidant properties (µM Eq. Trolox/g) of various organs of the *Moringa oleifera* plant collected during different seasons along with their interaction have been presented in Tables 1 and 3. The antioxidant properties were significantly higher (P<0.05) during January in comparison to that June. The interaction in this regard between three locations and the month of sample collection was nonsignificant (P>0.05). The weather records of three locations reported that the average environmental temperature was lowest and relative humidity highest in January and environmental temperature highest and relative humidity lowest in June in the year 2021-22. Thus, it was indicated that the antioxidant properties increased with the decrease in the environmental temperature and the increase in the relative humidity. The results could not be confirmed because the information in the literature was deficient in this regard.

The interaction between three locations of sample collection, four organs of *Moringa oleifera,* and 12 months of the sampling remained nonsignificant (P>0.05).

Based on interaction data between various parts of the tree and locations of collection, the flowers collected from Jaipur had superior, and seeds from Gwalior had

inferior antioxidant properties. Flowers and tender leaves were better compared to mature leaves and seeds and the month of January was the better and June poor season to yield antioxidant properties in the plant.

Table 2: Antioxidant properties (µM Eq. Trolox/g) of various organs of *Moringa oleifera* plant collected during different seasons

Organs and months	Flower	Tender leaves	Mature leaves	Seed	Overall
Jan	27.76±0.76	24.69±0.56	20.84±0.47	10.39±0.22	20.92±0.99^{x}
Feb	27.48±0.75	24.44±0.55	20.63±0.46	10.29±0.22	20.71±0.98^{xy}
Mar	27.20±0.75	24.20±0.55	20.42±0.46	10.18±0.21	20.50±0.97^{xy}
Apr	26.65±0.73	23.70±0.53	20.01±0.45	9.98±0.21	20.08±0.95^{xy}
May	26.09±0.72	23.21±0.52	19.59±0.44	9.77±0.21	19.67±0.93^{xy}
Jun	25.82±0.71	22.96±0.52	19.38±0.43	9.66±0.20	19.46±0.92^{y}
Jul	26.37±0.72	23.46±0.53	19.80±0.44	9.87±0.21	19.87±0.94^{xy}
Aug	26.93±0.74	23.95±0.54	20.22±0.45	10.08±0.21	20.29±0.96^{xy}
Sep	27.20±0.75	24.20±0.55	20.42±0.46	10.18±0.21	20.50±0.97^{xy}
Oct	27.34±0.75	24.32±0.55	20.53±0.46	10.24±0.22	20.61±0.98^{xy}
Nov	27.48±0.75	24.44±0.55	20.63±0.46	10.29±0.22	20.71±0.98^{xy}
Dec	27.62±0.76	24.57±0.55	20.74±0.47	10.24±0.21	20.79±0.99^{x}
Overall	26.99±0.21^{a}	24.01±0.16^{a}	20.27±0.13^{b}	10.10±0.06^{c}	20.34±0.28

P-Values: Organs 0.00, Months 0.00 & Interaction 1.00.

^{a,b,c}-Values bearing different superscripts within the row differed significantly i.e. P<0.05.

^{x,y}-Values bearing different superscripts within the column differed significantly i.e. P<0.05.

Table 3: Antioxidant properties (µM Eq. Trolox/g) of *Moringa oleifera* plant collected during different seasons from various Indian locations

Months and locations	Gwalior	Jaipur	Dehra Dun	Overall
Jan	20.68±1.74	20.30±1.61	21.78±1.88	20.92±0.99^{x}
Feb	20.47±1.72	20.96±1.81	20.70±1.67	20.71±0.98^{xy}
Mar	20.27±1.71	20.75±1.79	20.49±1.66	20.50±0.97^{xy}
Apr	19.85±1.67	20.33±1.75	20.07±1.62	20.08±0.95^{xy}
May	19.44±1.64	19.90±1.72	19.65±1.59	19.67±0.93^{xy}
Jun	19.23±1.62	19.69±1.70	19.44±1.57	19.46±0.92^{y}
Jul	19.65±1.65	20.12±1.74	19.86±1.60	19.87±0.94^{xy}
Aug	20.06±1.69	20.54±1.77	20.28±1.64	20.29±0.96^{xy}
Sep	20.27±1.71	20.75±1.79	20.49±1.66	20.50±0.97^{xy}
Oct	20.37±1.71	20.86±1.80	20.59±1.66	20.61±0.98^{xy}
Nov	20.47±1.72	20.96±1.81	20.70±1.67	20.71±0.98^{xy}
Dec	20.58±1.73	21.07±1.82	20.72±1.71	20.79±0.99^{x}
Overall	20.11±0.48	20.52±0.49	20.40±0.47	20.34±0.28

P-Values: Locations 0.05, Months 0.00 & Interaction 1.00.

^{x,y}-Values bearing different superscripts within the column differed significantly i.e. P<0.05.

References

Boonchum W, Peerapornpisal Y, Kanjanapothi D, Pekkoh J, Pumas C, Jamjai U, Amornlerdpison D, Noiraksar T and Vacharapiyasophon P. 2011. Antioxidant activity of some seaweed from the gulf of Thailand, International Journal of Agriculture and Biology, 13: 95-99.

Gupta R, Mathur M, Bajaj V K, Katariya P, Yadav S, Kamal R and Gupta R S. 2012. Evaluation of antidiabetic and antioxidant activity of *Moringa oleifera* in experimental diabetes. Journal of diabetes. 4(2): 164-171.

Gutteridge J M C. 1995. Free radicals in disease processes: a complication of cause and consequence. Free Radical Research Communications. 19: 141-158.

Hossain M B, Brunton N P, Barry-Ryan C, Martin-Diana A B and Wilkinson M. 2008. Antioxidant activity of spices extracts and phenolics in comparison to synthetic antioxidants. Rasayan Journal of Chemistry. 4: 751-756.

Iqbal S and Bhanger M I. 2006. Effect of season and production location on antioxidant activity of *Moringa oleifera* leaves grown in Pakistan. Journal of Food Composition and Analysis. 19: 544–551.

Laandrault N, Pouchert P, Ravel P, Gase F, Cros G and Teissedre P L. 2001. Antioxidant activities and phenolic level of French wines from different varieties and vintages. Journal of Agricultural and Food Chemistry. 49: 3341-3348.

Lakenbrink C, Lapczynski S, Maiwald B and Engelhardt U H. 2000. Flavonoids and other polyphenols in consumer brews of tea and other caffeinated beverages. Journal of Agricultural and Food Chemistry. 48: 2848-2852.

Moon J and Shibamoto T. 2009. Antioxidant assays for plant and food components. Journal of Agricultural and Food Chemistry. 57: 1655-1666.

Pakade V, Cukrowska E and Chimuka L. 2013. Comparison of antioxidant activity of *Moringa oleifera* and selected vegetables in South Africa: research article. South African Journal of Science. 109 (3/4): 1-5.

Pezzuto J M and Park E J. 2015. Autooxidation and antioxidants. In: Encyclopedia of pharmaceuticals technology, Vol 1 and 2nd, ed. J Swarbrick and J C Boylan. Marcel Dekker Inc. NY p. 97–113.

Pong K. 2003. Oxidative stress in neurodegenerative diseases: therapeutic implications for superoxide dismutase mimetics. Expert Opinion on Biological Therapy. 3: 127-139.

Rice-Evans C A, Miller N J and Paganga G. 1997. Antioxidant properties of phenolic compounds. Trends in Plant Science. 2: 152-159.

Santos A F, Argolo A C, Paiva P M and Coelho L C. 2012. Antioxidant activity of *Moringa oleifera* tissue extracts. Phytotherapy Research. 26(9): 1366-1370.

Singh D, Arya P V, Aggarwal V P and Gupta R S. 2014. Evaluation of Antioxidant and Hepatoprotective Activities of *Moringa oleifera* Leaves in Carbon-Tetrachloride Intoxicated Rats. Antioxidants. 3: 569-591.

Snedecor G W and Cochran W G. 1994. Statistical Methods. 8th ed, Iowa State University Press, Ames p. 491.

Soong Y Y and Barlow P J. 2004. Antioxidant activity and phenolic content in the selected fruit seeds. Food Chemistry. 88: 411-417.

Sun T and Ho C T. 2005. Antioxidant activities of buckwheat extracts. Food Chemistry. 90: 743-749.

Swain T and Hillis W E. 1959. The phenolic constituents of Prunus domestica. I. The quantitative analysis of Food and Agriculture. 10: 63-68.

Torres D E G, Assuncao D, Mancini P, Torres R P and Mancini-Filho J. 2002. Antioxidant activity of macambo (*Theobroma bicolor* L.) extracts. European Journal of Lipid Science and Technology. 104: 278-281.

UQ Library. 2016. Excel 2016: Data analysis. The University of Queensland, Brisbane.

Wangcharoen W and Gomolmanee S. 2011. Antioxidant Capacity and Total Phenolic Content of *Moringa oleifera* Grown in Chiang Mai, Thailand. Thai Journal of Agricultural Science. 44 (5): 118-124.