

Miracle Tree: A Review on Multi-purposes of *Moringa oleifera* and Its Implication for Climate Change Mitigation

Mekonnen Daba*

Oromia Agriculture Research Institutes, Bako Agricultural Research Center, P. O. Box 03, Bako, West Shoa, Oromia, Ethiopia

Abstract

Moringa oleifera is known as “horseradish tree” or “drumstick tree”, native to India, is one of the best useful tree and an enormous amount of benefits in the world. Numerous Research reports have appeared in different national and international scientific journals by studying its nutritional and medicinal properties of *Moringa* over the past decades. Different reports show that due to its multipurpose uses *Moringa* tree has recently grown attention in Ethiopia. *Moringa oleifera* is a tree that is sometimes called a “Miracle Tree” because of all its parts are used for nutritional, pharmacological properties. *Moringa* is a very valuable food crop (it is highly nutritive, grows very fast and drought resistant) and even beyond food it serves many benefits in developing countries such as having an ability to be used for some crafts (due to being a tree) and cleaning water. The *Moringa* tree can also play an important role in soil and water conservation and mitigating climate change. This study provides a brief overview about multipurpose of *Moringa oleifera* tree and its implication for climate Change mitigation. The purpose of this brief reviews was to: (a) to assess the published scientific journals suggestion on multipurpose *Moringa oleifera*, (b) to over view its medicinal and nutritional properties (c) suggest future directions for policies, research, market and development strategies and (d) finally to review its implication for climate change mitigation.

Keywords: *Moringa oleifera*; Multipurpose; Nutrient content; Medicinal use; Climate change mitigation

Introduction

The background for this study is based on previous study results in Ethiopia and as well as in other countries. *Moringa oleifera* is native to India but it is widely grown tree in Ethiopia, Pacific Islands, Florida, Sudan Caribbean, Philippines, South Africa, Asia, and Latin America [1]. *Moringa* has different names in different countries like “Shiferaw” in Ethiopia and drumstick tree or horseradish tree in India.

As reported Arora et al. [2] there were about 33 species of Moringaceae family. *Moringa oleifera* is one of the moringaceae families. Among those, best known of the thirteen species namely: *M. arborea*, *M. borziana*, *M. concanensis*, *M. drouhardi*, *M. hildebrandtii*, *M. longituba*, *M. oleifera*, *M. ovalifolia*, *M. peregrina*, *M. pygmaea*, *M. rivae*, *M. ruspoliana*, *M. stenopetala* are well known and found worldwide. Numerous studies have reported its multipurpose use like medicinal and nutritional benefits [3,4].

Moringa tree is a drought-tolerant, fast-growing, multi-purpose and one of most useful tree due to its medicinal and nutritional properties in world and therefore described as a ‘miracle tree’ [5-8]. *Moringa oleifera* is the most promising tree which has used for nutritional benefits, medicinal properties, environmental conservation, and consumption and is the perennial, multipurpose. *Moringa oleifera* is reputedly known as “cabbage tree”, “drumstick tree” or “horseradish tree”, ‘benzoin tree’ or ‘benzoin tree’, ‘miracle tree’ and ‘mother’s best friend tree’ [9]. As reported by different scholars *Moringa oleifera* has wide range of uses. Among those, water purification, human consumption, medicine, fuel wood, dye, soil and water conservation, livestock forage and green manure [10-14]. According to Dawit et al. [15] *Moringa* has multipurpose use, well adapted and significant economic importance, as it has vital nutritional, industrial, and medicinal applications.

As reported by researchers in different countries, all parts of *Moringa oleifera* (leaves, fruits, immature pods, and flowers) are combined into the traditional food for human consumption [16,17]. According to Anhwange et al. [18] in many parts of the Africa use

Moringa oleifera as a food. For example, dried *Moringa* leaves and fresh *Moringa* are involved in meals in countries such as Ethiopia, Nigeria, Malawi East Africa and Ghana used as food.

Numerous research reports have shown the multipurpose uses of most parts of *Moringa oleifera* in making food for human consumptions such as cake by Kolawole et al. [19], yoghurt [20-22], amla, [23,24], weaning foods by Arise et al. [25], bread Chinma et al. [26], soups [27,28], and biscuits by Alam et al. [29],

The seed of *Moringa oleifera* is also used for water treatment as water purification and remove bacteria from water up to 99% as indicated [30,31]. According to Foidl et al. [30] from the *Moringa* fresh leaves a juice can be extracted and used as a growth hormone that can increase yields of crop by 25-35%.

As indicated by Amaglo [32], famine is connected to climate change and therefore planting trees, which can sequester more carbon like *Moringa* tree, can play important role in climate change mitigation. There is an urgent need to implement climate -smart policies that can build more resilient food systems and combat climate change. There is great potential for the *Moringa* tree to not only store carbon, if it is grown on a much larger scale, but to improve the livelihoods of many farmers in sub-Saharan Africa [33].

The objective of this study was to review a multipurpose uses of *Moringa oleifera* and its implication for climate change mitigation.

*Corresponding author: Mekonnen Daba, Oromia Agriculture Research Institutes, Bako Agricultural Research Center, P. O. Box 03, Bako, West Shoa, Oromia, Ethiopia, Tel no: +251(0)910699411; E-mail: dabanok@gmail.com

Received July 20, 2016; Accepted July 30, 2016; Published August 05, 2016

Citation: Daba M (2016) Miracle Tree: A Review on Multi-purposes of *Moringa oleifera* and Its Implication for Climate Change Mitigation. J Earth Sci Clim Change 7: 366. doi: 10.4172/2157-7617.1000366

Copyright: © 2016 Daba M. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Nutrient contents of *Moringa oleifera*

The most amazing fact about *Moringa* is that it is a storehouse of nutrients and medicinal chemicals. As it was reported by different scholars [34,35], *Moringa* tree is rich in nutrients such as minerals, fiber and proteins that can play essential role in human nutritional consumption. Numerous of the research reports have shown that *Moringa oleifera* leaves has high protein compared to with other leaves eaten as food.

A recent research on dietary iron supplements and *Moringa oleifera* leaves influence the liver revealed that iron from *Moringa oleifera* can overcome iron deficiency [36] and Similarly, research done on the relative bioavailability of folate from the traditional food plant *Moringa oleifera* indicate that the relative bioavailability of folate from *Moringa oleifera* leaves using rat model was very high and therefore *Moringa oleifera* leaves can be a potential source of dietary folate [37].

According to Villafuerte and Villafurte-Abonal [31] research reports, *Moringa* contains full of vitamins and nutrients and therefore it is good to have as food for human consumption and as food for animal's consumption. Also it was reported that seeds *Moringa* contain about between 30-40% oil, 82% unsaturated fatty acids and 13% saturate fats [31].

Numerous research reports on the medicinal and nutritional of *Moringa oleifera* now are existent in scientific journals and the widespread literature. *Moringa* use as medicinal and nutritional purposes was started since centuries Mahmood et al. [38]. *Moringa oleifera* contains all the essential medicinal and nutritional properties and an extremely valuable food source that are vital for human and livestock consumptions [38,39-44]. Study on the potential uses of *Moringa oleifera* by Rockwood et al. [45] show that, *Moringa* contain nutritional value and can be used as bread, milk, spices juices, sauces, tea and *Moringa oleifera* is a wonderful food tree with a significant source of vitamin C, calcium, proteins and Iron. Research report by Rockwood et al. [45] confirmed that, *Moringa oleifera* dry leaves of contain 9 times proteins than yogurt, 10 times vitamin A than carrot, 25 times iron than spinach, 15 times potassium than bananas, 17 times calcium than milk and 7 times more vitamin C than orange. Because of rich in proteins source *Moringa oleifera* leaves are suggested by doctors, nutritionists and community health workers to cope with the problems of malnutrition worldwide [43,46,47]. As different research reports shown that, from the *Moringa* tree parts, *Moringa* leaves are a storehouse of nutrients. The leaves of *Moringa oleifera* are rich in minerals like copper, potassium, iron, magnesium, zinc and calcium [48]. Vitamins like beta-carotene of vitamin A, vitamin B such as folic acid, pyridoxine and nicotinic acid, vitamin C, D and E also present in *Moringa oleifera* [49]. Also Yameogo et al. [50] reported that, on a dry matter basis, *Moringa oleifera* leaves contained 27.2% protein, 17.1% fat, 5.9% moisture and 38.6% carbohydrates. According to Anwar and Rashid, [51] noticed that on a dry matter basis, *Moringa oleifera* seeds contained 34.80% ether extract, 31.65% protein, 7.54% fiber, 8.90% moisture, and 6.53% ash contents. Makkar and Becker [52].

Moringa leaves contain fiber, fat proteins and minerals like Mg, Ca, K, P, Fe, Cu, and S. Vitamins like Vitamin-A (Beta-carotene), vitamin B-choline, vitamin B1-thiamine, riboflavin, nicotinic acid and ascorbic acid are present. Various amino acids like His, Arg, Trp, Lys, Thr, Phe, Leu, Ile, Met, Val are present. Phytochemicals like sterols, tannins, trepenoids, saponins, alkaloids, phenolics and flavonoids like isoquercitin, isothiocyanates, quercitin, kaemfericitin, and glycoside compounds are present [45,49,53-56]

Moringa seed contains antibiotic (pterygospermin), fatty acids like linolenic acid, Linoleic acid, behenic acid and oleic acid (Ben oil); Phytochemicals like saponin, tannins, phytate, phenolics, terpenoids, flavonoids and lectins. Apart from these it contains, fiber, fats, minerals, proteins, and vitamins like A, B, C and amino acids [45,47,49,57,58]. The *Moringa* pods rich in lipids, fiber, non-structural carbohydrates, ash and protein. It also contain fatty acids like linoleic acid, oleic acid, palmitic acid and linoleic acid are also present [45,47].

Benefits/uses of *Moringa*

There are many uses of *Moringa* tree and these will all be: medicines, Human food, Water purification, Animal fodder, Alley cropping, Fertilizer, Living fence, Living fence, Domestic cleaning agent, Fuel wood and other uses. *Moringa* increased physical energy - Tune your body up with naturally occurring nutrients to make your energy last longer. Numerous research reports reveal that, parts of *Moringa* plant can be used in different techniques. *Moringa oleifera* seed and leaves is advantageous source of nutrients, medicines, clean dirty water and it can be used for alley cropping; because, it has lots of leafy material. The uses *Moringa oleifera* are well documented by Fahey [1], as nutritional, industrial, medicinal, and agricultural advantage

Moringa oleifera has great potential for prevention of different diseases like nutrient deficiency, cancer, anemia as well as for dirty water purification. *Moringa* powder contains sufficient amount of vitamins, nutrients and chemicals in it. This makes the tree a medicine for many different diseases [33]. *Moringa oleifera* has also promoted by World Health Organization (WHO) as an alternative to imported food source to treat malnutrition [59].

Medicinal benefits/uses of *Moringa*

Moringa has long been used in herbal medicine by Africans and Indians. *Moringa oleifera* is often referred as a panacea and can be used to cure more than 300 diseases. In this section, medicinal uses of *Moringa* leaves are reviewed. Different studies shown that, all parts of *Moringa oleifera* (leaves, fruits, immature pods, and flowers) are incorporated into the traditional food of humans in many tropical and subtropical countries.

Medicinal uses of all parts of *Moringa*

Various parts of *Moringa* tree act as cardiac and possess antitumor, circulatory stimulants, antiepileptic, antipyretic, antiulcer, anti-inflammatory, antispasmodic, anti-hypertensive, diuretic, antioxidant, anti-diabetic, cholesterol lowering, antibacterial, hepatoprotective and antifungal activities.

Leaves: *Moringa* leaves are the most commonly used part of the plant. *Moringa* leaves treat hyperglycemia, asthma, flu, heart burn, Dyslipidemia, malaria, syphilis, diarrhea, pneumonia, scurvy, headaches, bronchitis, skin diseases, eye and ear infections. Also reduces, blood pressure and cholesterol and acts as an anticancer, Antioxidant, antimicrobial, anti-atherosclerotic and antidiabetic agents, neuro protectant [45,49,53-56].

Seeds: Numerous researches reported that, *Moringa* seed powder can be used as for cleaning dirty water in a simple and quick method. Seeds of *Moringa* help in treating Chrohn's disease, hyperthyroidism, rheumatism, antiherpes-simplex virus arthritis, cramp, epilepsy gout, and sexually transmitted diseases, can act as antimicrobial and anti-inflammatory agents [45,47,48,57,58].

Root: Root bark acts as an anti-ulcer, anti-inflammatory and cardiac stimulant agent [55,60,61].

Flower: Many scholars shown that *Moringa* flowers act as anti-arthritic; hypocholesterolemic agents can cure urinary and cold problems [53,58].

Pods: *Moringa* pods treat liver, diarrhea and spleen problems, and joint pain [45,48].

Animal feed fortification: Study on the potential of *Moringa oleifera* for agricultural and industrial uses and on the naturalized exotic tree species shown that, *Moringa* leaves supplementary to livestock feed can increase up to 32% of daily weight gain. Supplementation of fresh *Moringa* leaves with 15 to 17 kg of daily feed of livestock can increase milk production by 43%. Milk production can be increased by 58% with the supplementation of 2 kg dry matter feed and milk production increased by 65% with the supplementation of 3kg dry matter feed [30,62]. Generally, milk production increased with increased *Moringa* supplementation.

Water purification: The study on the *Moringa oleifera* as a natural gift point out that, A billion people across world like; Latin America Africa, and Asia are assessed to depend on untreated water sources for their daily needs Mahmood et al. [38]. Numerous research reports shown that, *Moringa* seed powdered can be used cleaning dirty water in simple and quick method simple. The *Moringa* seed powder joins with the solids in the dirty water and sinks to the bottom. This action can remove bacteria contained in water up to 90-99%. Rather than using aluminum sulphate, which are dangerous to people and the environment, using *Moringa* seed powder to purify water is cheap. Water can be purified by adding 2 grams of *Moringa* seed powder to 20 liters into a bottle and shake for 5 minutes. Dirty water that is to be treated can be filtered through a clean cloth into the container. Until the water becomes clear and the impurities have sunk to the bottom leave the bucket undisturbed for one hour then filter the water through a clean cloth boil the water before drinking [63-66].

Implications of *Moringa* tree to climate change mitigation

In developing country climate change is affecting to smallholder farmers who dominate the agriculture sector. The study on the opportunities for linking adaptation and mitigation in Agroforestry systems indicated that, the impacts of climate change are handled at the level of natural resource base upon which smallholder farmers depend, at the individual and farming system level Vershot et al. [67]. The research reported on the environmental and medicinal value analysis of *Moringa oleifera* specified that, Farmers need to formulate adaptation strategies and mechanisms to reduce the climate change impacts [33]. To combat efficient for climate change mitigation and food shortages it is good to look at the potential that is already available in developing and third world countries. *Moringa* is therefore a very simple and readily available solution. *Moringa oleifera* is called a "Never Die" plant because of its adaptability to weather, soil and other environmental vagaries according to [41]. There is clear evidence that *Moringa oleifera* is, no doubt, a suitable crop for climate change in Nigeria given its high level of adaptability and numerous nutritional, medicinal, agricultural, domestic and industrial values Ndubuaku et al. [68]. The heavy flushes produced by the trees even during the dry season act as good sink for carbon dioxide absorption and utilization, thus reducing the level of atmospheric carbon dioxide which is one of the major courses of ozone layer depletion and global warming. *Moringa* tree is a climate-change-adaptable crop for life sustenance against food insecurity threats Ndubuaku et al. [68]. Large production of the trees is, therefore, advocated especially amongst the women. It does not only add to the

home-use foodstuff but also creates job opportunities for women and their children for their capacity building. It reduces death toll due to malnutrition and diseases Ndubuaku et al. [68]. The ability of the tree to mitigate the effects of climate change is also impressive. According to the study [31] the rate of *Moringa* tree to absorb carbon dioxide (CO₂) is fifty times (50x) higher when compared to the Japanese cedar tree and also twenty times (20x) higher than that of general vegetation. Study on *Moringa* and global warming revealed that, 1 person emits 320kg of CO₂/year; it takes 23 Japanese Cedar trees takes 50 years to absorb this amount of CO₂; it takes 2 *Moringa* trees 2 years to absorb this amount and 1 family car emits 2300kg of CO₂/year; it takes 160 Japanese Cedar trees 50 years to absorb this amount of CO₂; it takes 10 *Moringa* trees 2 years [69]. Therefore, *Moringa* tree is useful tool in the prevention of global warming; because it sequesters more carbon with its all parts. Therefore, planting such important tree in different parts of the country will mitigate the impacts of climate change.

Conclusions

Moringa oleifera tree is indeed a miracle tree with enormous potentials yet to be fully explored in medicinal and food application. All parts of *Moringa oleifera* tree is said to have useful assets that can help humankind.

This study has tried to reviews a multipurpose uses of *Moringa oleifera* and suggestion for the future mitigation of climate change. Numerous researchers concluded that, *Moringa oleifera* is a multipurpose tree and fast growing and well adapted to growing in adverse climate conditions and therefore, that is difficult to overlook in today's battle with the climate. Different studies reveal that, *Moringa* has a direct effect on agriculture, nutrition, health, water, environment, biodiversity and sanitation.

The latest research has documented that, *Moringa oleifera* is one of the medicine to reduce the occurrence of waterborne disease which is on record as one of the main causes leading to high incidence of deaths in the developing countries. Thus, *Moringa oleifera* seeds are capable of appealing and sticking fast to bacteria and viruses that are found in contaminated and turbid water.

The capacity of the *Moringa* tree is inspiring in mitigating the adverse effects of climate change. The research report by Japanese has displayed that the rate of absorption of carbon dioxide (CO₂) by the *Moringa* tree is twenty times (20x) higher than that of general vegetation. There is great potential for the *Moringa* tree to not only store carbon, but also to improve the livelihoods of many smallholder farmers. Therefore, planting of this tree in different parts of the country will mitigate the impacts of climate change.

Moringa oleifera really recognized to be a "Miracle tree", because it has multipurpose use for humankind and thus named as a nature gift at very low price. In order to discover and utilize full uses of this miracle tree, market development strategies, Strong policies, and research were required.

Given its multiple uses and wide range of adaptability, *Moringa* is an ideal crop for sustainable food production that thrives as the climate changes.

Generally, *Moringa oleifera* offers very interesting opportunities for smallholder farmers as food supplement, medicine, nutrition, water treatment, livestock feed, vegetable, oil, foliar spray, green manure, natural fertilizer, cosmetic, fooder, care products, soil and water conservation and reduce greenhouse gas emission.

Moringa should be promoted for further consumption to improve nutrition and medicinal functions and as well as for climate change mitigation.

References

1. Fahey JW (2005) *Moringa oleifera*: A review of the medical evidence for its nutritional, therapeutic and prophylactic properties. *Trees for Life Journal*; 1: 5.
2. Arora DS, Onsare JG, Kaur H (2013) Bioprospecting of *Moringa* (Moringaceae): Microbiological perspective. *J pharmacogand phytochem* 1: 193-215.
3. Dahot MU (1988) Vitamin contents of flowers and seeds of *Moringa oleifera*. *Pak J Biochem* 21: 21-24.
4. Anwar F, Latif S, Ashraf M, Gilani AH (2007) *Moringa oleifera*: a food plant with multiple bio-chemical and medicinal uses. *Phytother Res* 21: 17-25.
5. Fuglie LJ (2003) The *Moringa* trees a local solution to malnutrition. Dakar, Senegal.
6. Amaglo N (2006). *Moringa* and other highly nutritious plant resources: Strategies, standard and markets for a better impact on nutrition in Africa. Accra, Ghana.
7. Yisehak K, Solomon M, Tadello M (2011) Contribution of *Moringa* (*Moringa stenopetala*, Bac.), a Highly Nutritious Vegetable Tree, for Food Security in South Ethiopia: A Review. *Asian J Applied Sciences* 4: 477-488.
8. Ashfaq M, Basra SMA, Ashfaq U (2012) *Moringa*: A miracle plant of agro-forestry. *J Agriculture and Social Science* 8: 115-122.
9. Koul B, Chase N (2015). *Moringa oleifera* Lam.: Panacea to several maladies. *Journal of Chemical and Pharmaceutical Research* 7:687-707.
10. Demeulenaere E (2001) *Moringa stenopetala*, a subsistence resource in the Konso district. Proceedings of the International Workshop Development Potential for *Moringa* Products, October 29-November 2, 2001, Dar-Es-Salaam, Tanzania, pp: 2-29.
11. Palada MC, Chang LC (2003) Suggested cultural practices for *Moringa*, International Corporation Guide, AVRDC, Shanhua, Taiwan.
12. Jiru D, Sonder K, Alemayehu L, Mekonen Y, Anjulo A (2006) Leaf yield and nutritive value of *Moringa stenopetala* and *Moringa oleifera* Accessions: Its potential role in food security in constrained dry farming agro-forestry systems. Addis Ababa, Ethiopia.
13. ECHO (2009) Educational Concerns for Hunger Organization (ECHO's) *Moringa* Technical Note. USA.
14. Melesse A, Tiruneh W, Negesse T (2011) Effects of feeding *Moringa stenopetala* leaf meal on nutrient intake and growth performance of Rhode Island Red chicks under Tropical climate. *Tropical and Subtropical Agro ecosystems* 14: 485-492.
15. Dawit S, Regassa T, Mezgebu S, Mekonnen D (2016) Evaluation of two *Moringa* species for adaptability and growth performance under Bako conditions. *J Natural Sciences Research* 6: 76-82.
16. Siddhuraju P, Becker K (2003) Antioxidant properties of various solvent extracts of total phenolic constituents from three different agro-climatic origins of drumstick tree (*Moringa oleifera* Lam.). *J Agri Food Chem* 15: 2144-2155.
17. Anhwange BA, Ajibola VO, Oniye SJ (2004) Chemical studies of the seeds of *Moringa oleifera* (Lam.) and *Detarium microcarpum* (Guill and Sperr). *J Biol Sci* 4: 711-715.
18. Agbogidi O, Ilondu E (2012) *Moringa oleifera* Lam: its potentials as a food security and rural medicinal item. *J Bio Innov.* 1: 156-167.
19. Kolawole F, Balogun M, Opaleke D, Amali H (2013) An evaluation of nutritional and sensory qualities of wheat-moringa cake. *Agrosearch* 13: 87-94.
20. Salem AS, Salama WM, Hassanein A, El Ghandour H (2013) Enhancement of nutritional and biological values of Labneh by adding dry leaves of *Moringa oleifera* as innovative dairy products. *World Appl Sci J* 22: 1594-1602.
21. Kuikman M, O'Connor CP (2015) Sensory evaluation of *Moringa*-probiotic yogurt containing banana, sweet potato or avocado. *J Food Res* 4: 165-171.
22. Hekmat S, Morgan K, Soltani M, Gough R (2015) Sensory evaluation of locally-grown fruit purees and inulin fibre on probiotic yogurt in Mwanza, Tanzania and the microbial analysis of probiotic yogurt fortified with *Moringa oleifera*. *J Health Popul Nutr* 33: 60-67.
23. Karim O, Kayode R, Oyeyinka S, Oyeyinka A (2015) Physico-chemical properties of stiff dough 'amla' prepared from plantain (*Musa Paradisca*) flour and *Moringa* (*Moringa oleifera*) leaf powder. *Food Health Dis* 4: 48-58.
24. Karim OR, Kayode RMO, Oyeyinka SA, Oyeyinka AT (2013) Proximate, mineral and sensory qualities of 'amla' prepared from yam flour fortified with *moringa* leaf powder. *Food Sci Qual Manag* 12: 10-22.
25. Arise A, Arise R, Sanusi M, Esan O, Oyeyinka S (2014) Effect of *Moringa oleifera* flower fortification on the nutritional quality and sensory properties of weaning food. *Croat. J Food Sci Technol* 6: 65-71.
26. Chinma C, Abu J, Akoma S (2014) Effect of germinated tigernut and *moringa* flour blends on the quality of wheat-based bread. *Food Process Preserv* 38: 721-727.
27. Stevens G, Baiyeri K, Akinnnagbe O (2013) Ethno-medicinal and culinary uses of *Moringa oleifera* Lam. in Nigeria. *J Med Plants Res* 7: 799-804.
28. Babayeju A, Gbadebo C, Obalolu M, Ogunola G, Nmom I, et al. (2014) Comparison of Organoleptic properties of egusi and eforiro soup blends produced with *moringa* and spinach leaves. *Food Sci Qual Manag* 28: 15-18.
29. Alam M, Alam M, Hakim M, Abdul H, Obidul A, et al. (2014) Development of fiber enriched herbal biscuits: a preliminary study on sensory evaluation and chemical composition. *Int J Nutr Food Sci* 3: 246-250.
30. Foidl N, Harinder PS, Markar P, Becker K (2001) The potential of *Moringa oleifera* for agricultural and Industrial uses. In: The miracle tree, Lowell J Fuglie, Darkar Senegal (eds.) pp 45-76.
31. Villafuerte LR, Villafurte-Abonal L (2009) Data taken from the Forestry Agency of Japan in *Moringa*. Malunggay Philippines, Apples of Gold Publishing, Singapore, P 240.
32. Amaglo N (2013) *Moringa* as a climate change mitigation strategy? Hunan Agriculture University, Faculty of Food Science and Technology, Changsha, Hunan. China 410128.
33. Gedefaw M (2015) Environmental and medicinal value analysis of *Moringa* (*Moringa oleifera*) tree species in Sanja, North Gondar, Ethiopia. *AJCSR-480* 2: 20-35.
34. Jongrungruangchok S, Bunrathep S, Songsak T (2010) Nutrients and minerals content of eleven different samples of *Moringa oleifera* cultivated in Thailand. *J Health Res* 24: 123-127.
35. Moyo B, Masika P, Hugo A, Muchenje V (2011) Nutritional characterization of *Moringa* (*Moringa oleifera* Lam.) leaves. *Afr J Biotechnol* 10: 12925-12933.
36. Saini R, Manoj P, Shetty N, Srinivasan K, Giridhar P (2014a) Dietary iron supplements and *Moringa oleifera* leaves influence the liver hepcidin messenger RNA expression and biochemical indices of iron status in rats. *Nutr Res* 34: 630-638.
37. Saini R, Manoj P, Shetty N, Srinivasan K, Giridhar P (2016) Relative bioavailability of folate from the traditional food plant *Moringa oleifera* L. as evaluated in a rat model. *J. Food Sci. Technol.* 53: 511-520.
38. Mahmood KT, Mugal T, Haq IU (2010) *Moringa oleifera*: a natural gift- A review. *J Pharm Sci Res* 2: 775-781.
39. Duke JA (1987) Moringaceae: Horseradish- tree, benzolive - tree, drumstick - tree, sohnja, moringa, murunga-kai, malunggay, p. 19 -28. In: Bengé M (ed.) *Moringa: A multipurpose vegetable and tree that purifies water*. Sci. & Technol/ For., Environ., & Natural Resources Agro- Forestation Tech. Ser. 27. US AID, Washington, DC.
40. Fuglie LJ (1999) The miracle tree: *Moringa oleifera*: Natural nutrition for the Tropics. Church World Service, Dakar. 68 pp.; revised in 2001 and published as *The Miracle Tree: The Multiple Attributes of Moringa* pp.172
41. Fuglie LJ (2000) New uses of *Moringa* studied in Nicaragua. ECHO Development Notes #68.
42. Babu SC (2000) Rural nutrition interventions with indigenous plant foods: a case study of vitamin deficiency in Malawi. *Agronomy Soc Environ* 4 : 169- 179.
43. Razis AFA, Ibrahim MD, Kntayya SB (2014) Health benefits of *Moringa oleifera*. *Asian Pac J Cancer Prev* 15: 8571-8576.
44. Ali EN, Alfarrar SR, Yusoff MM, Rahman ML (2015) Environmentally Friendly Biosorbent from *Moringa oleifera* Leaves for Water Treatment. *IJESD* 6: 165-169.

45. Rockwood JL, Anderson BG, Casamatta DA, (2013) Potential uses of *Moringa oleifera* and an examination of antibiotic efficacy conferred by *Moringa oleifera* seed and leaf extracts using crude extraction techniques available to under-served indigenous populations. *Int J Phytotherapy Res* 3: 61–71.
46. Dhakar RC, Maurya SD, Pooniya BK, Gupta BN, Sanwamal M (2011) *Moringa*: The herbal gold to combat malnutrition. *Chronicles of Young Scientists* 2: 119-125.
47. Thurber MD, Fahey JW (2010) Adoption of *Moringa oleifera* to combat under-nutrition viewed through the lens of the diffusion of innovations theory. *Ecol Food Sci Nutr* 48: 1–13.
48. Kasolo JN, Bimenya GS, Ojok L, Ochieng J, Ogwal-okeng JW (2010) Phytochemicals and uses of *Moringa oleifera* leaves in Ugandan rural communities. *J Med Plants Res* 4: 753–757.
49. Mbikay M (2012) Therapeutic potential of *Moringa oleifera* leaves in chronic hyperglycemia and dyslipidemia: a review. *Front. Pharmacol* 3:1–12.
50. Yameogo CW, Bengaly MD, Savadogo A, Nikiema PA, Traore SA (2011) Determination of chemical composition and nutritional values *Moringa oleifera* leaves. *Pak J Nutr* 10: 264–268.
51. Anwar F, Rashid U (2007) Physico-chemical characteristics of *Moringa oleifera* seeds and seed oil from a wild provenance of Pakistan. *Pak J Bot* 39: 1443–1453.
52. Makkar HPS, Becker K (1997) Nutrients and ant quality factors in different morphological parts of *Moringa oleifera* tree. *J Agri Sci* 128: 311–322.
53. Fuglie LJ (2005) The *Moringa* tree: A local solution to malnutrition Church World Service in Senegal.
54. Ijarotimi OS, Adeoti O, Ariyo O (2013) Comparative study on nutrient composition, phytochemical, and functional characteristics of raw, germinated, and fermented *Moringa oleifera* seed flour. *Food Sci Nutr* 1: 452–463.
55. Choudhary MK, Bodakhe SH, Gupta SK (2013) Assessment of the antiulcer potential of *Moringa oleifera* root-bark extract in rats. *J Acupunct. Meridian Stud* 6: 214–220.
56. Jung IL (2014) Soluble extract from *Moringa oleifera* leaves with a new anti-cancer activity. *PLOS ONE* 9: 1–10.
57. Nair S, Varalakshmi KN (2011) Anticancer, cytotoxic potential of *Moringa oleifera* extracts on HeLa cell line. *J Nat Pharm* 2: 138–142.
58. Satalangka C, Wattanathorn J, Muchimapura S, Thukham-mee W (2013) *Moringa oleifera* mitigates memory impairment and neurodegeneration in animal model of age-related dementia. *Oxid Med Cell Longev* 2013: 1–9.
59. Sreelatha S, Padma PR (2009) Antioxidant activity and total phenolic content of *Moringa oleifera* leaves in two stages of maturity. *Plant Foods for Human Nutrition* 64: 303-311.
60. Monera TG, Maponga CC (2012) Prevalence and patterns of *Moringa oleifera* use among HIV positive patients in Zimbabwe: a cross-sectional survey. *J Public Health Africa* 3: 6–8.
61. Adeyemi OS, Elebiyo TC (2014) *Moringa oleifera* supplemented diets prevented nickel-induced nephrotoxicity in Wistar rats. *J Nutr Metab* 2014: 1–8.
62. Francis John K, Liogier Henri A (1991) Naturalized exotic tree species in Puerto Rico. Gen. Tech. Rep. SO-82. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station.
63. Jahn SA, Musnad HA, Burgstaller H (1986). Tree that purifies water: Cultivating multipurpose Moringaceae in the Sudan. *Unasylva* 38: 23 -28.
64. Sutherland, JP, Folkard GK, Grant WD (1989) Seeds of *Moringa* species as naturally occurring flocculants. *Sci Tech Develop* 7: 191-197.
65. Gassenschmidt U, Jany KD, Tauscher B, Niebergall H (1995) Isolation and characterization of a flocculating protein from *Moringa oleifera* Lam. *Biochimica Biophysica Acta* 1243: 477-481.
66. Kumar S, Gopal K (1999) Screening of plant species for inhibition of bacterial population of raw water. *J Environ Sci Health A Tox Hazard Subst Environ Eng* 34: 975 -987.
67. Vershot LV, Mackensen J, Kaadji S, Noordwijk M, Tomich T (2005) Opportunities for linking adaptation and mitigation in Agroforestry systems.
68. Ndubuaku UM, Ndubuaku TC, Ndubuaku NE (2014) Yield characteristics of *Moringa oleifera* across different ecologies in Nigeria as an index of its adaptation to climate change. *Sustainable Agriculture Research*.
69. Muriel G (2010) *Moringa* and global warming.

Citation: Daba M (2016) Miracle Tree: A Review on Multi-purposes of *Moringa oleifera* and Its Implication for Climate Change Mitigation. *J Earth Sci Clim Change* 7: 366. doi: [10.4172/2157-7617.1000366](https://doi.org/10.4172/2157-7617.1000366)

OMICS International: Open Access Publication Benefits & Features

Unique features:

- Increased global visibility of articles through worldwide distribution and indexing
- Showcasing recent research output in a timely and updated manner
- Special issues on the current trends of scientific research

Special features:

- 700+ Open Access Journals
- 50,000+ editorial team
- Rapid review process
- Quality and quick editorial, review and publication processing
- Indexing at major indexing services
- Sharing Option: Social Networking Enabled
- Authors, Reviewers and Editors rewarded with online Scientific Credits
- Better discount for your subsequent articles

Submit your manuscript at: www.omicsonline.org/submission