

An Ethnomedicinal Study of ‘Munga’ (*Moringa oleifera*) with its Special Reference to the Pandemic among the Santal of Jharkhand

¹DOLLY FLORENCE MURMU* & ²P. C. JOSHI‡

¹Department of Human Development & Childhood Studies,
Lady Irwin College, New Delhi 110001

²Department of Anthropology,
University of Delhi, Delhi 110007
E-mail: dolly.florence@lic.du.ac.in

KEYWORDS: *Moringa oleifera*. Santal. Dumka. Jharkhand. Pandemic. Medicinal Food. Traditional Knowledge. WHO. AYUSH.

ABSTRACT: A balanced diet can help to reach and maintain a healthy lifestyle. Santal uses (*munga*) *Moringa oleifera* in their daily diet. *Moringa oleifera*. Lam is a well-known medicinal plant and a great source of medicinal food for Santal. The present study was conducted in the Dumka district of Jharkhand to illuminate the widespread usage of *Moringa oleifera* among Santal. The plant possesses minerals, vitamins, amino acids, beta carotene and protein and is rich in antioxidants and vitamin C. The decoction of Moringa leaves was taken daily on an empty stomach which helped Santal people boost their immunity and fight against coronavirus during the pandemic. Nutrients found in moringa help regulate blood pressure and diabetes. This study was fruitful in understanding the traditional knowledge of Santal about how they use Moringa as a source of medicinal food in their day-to-day life. Elderly women were interviewed to understand the recipe for moringa leaves that Santal people consumed. The research study illuminates the various uses of *Moringa oleifera* at different levels in Santal culture, and it recommends the benefits of moringa to the general public. This can further help the WHO and AYUSH promote and make public awareness about the Moringa plant's health benefits. Data collection has been done with primary sources such as interviews, observation and secondary sources such as journals.

INTRODUCTION

Moringa oleifera is universally called the miracle plant or the tree of life. The Moringa plant derives this name from its uses, particularly in medicine and nutrition. It is a plant native to the sub-Himalayan tracts of India, Pakistan, Bangladesh and Afghanistan (Fahey, 2005). *Moringa oleifera* is the most widely cultivated among the 13 species of the Moringaceae family and is exceptionally nutritious with various uses. Almost all the parts of this miracle tree are very

useful. Leaves are used as forage, tree trunks for making gums, flower nectar in honey and powdered seeds for water purification (Fuglie, 1999). *Moringa oleifera* leaf has been used as an alternative food source to combat malnutrition, especially among children and infants (Anwar *et al.*, 2006). In some parts of Africa, *Moringa oleifera* is used to combat child malnutrition (Thurber and Fahey, 2009). *Moringa oleifera* leaves contain substantial amounts of vitamins A, C, and E. *Moringa oleifera* leaves have also been found to contain appreciable amounts of total phenols, proteins, calcium, potassium, magnesium, iron, manganese and copper (Hekmat *et*

* Research Scholar, Corresponding author

‡ Professor

al., 2015). *Moringa oleifera* leaves are also good sources of phytonutrients such as carotenoids, tocopherols and ascorbic acid, which are majorly used as food supplements. (Saini *et al.*, 2014a, 2014b, 2014c, 2014d). Besides the leaves, the flowers and fruits of *Moringa oleifera* have also been found to contain appreciable amounts of carotenoids, one of the richest sources of Vit. A (Saini *et al.*, 2014e). Recent research has shown that *Moringa oleifera* leaf extracts have several beneficial biological properties, including antihypertensive, antifungal, and antitumor activities (Zhao and Zhang, 2013). *Moringa oleifera* Lam. has high nutritional value and medicinal, functional, and coagulant properties.

General Characteristics of Moringa oleifera (origin and botanical description)

Moringa oleifera is a culture dating from ancient times, coming from the Indo-Pakistan ecological region (Shahzad *et al.*, 2013); the ancient Romans, Greeks, and Egyptians used extracted oil for food and cosmetics.

The taxonomic description includes kingdom: Plantae, sub-kingdom: Tracheobionta, superdivision: Spermatophyta, division: Magnoliophyta, class: Magnoliopsida, subclass: Dilleniidae, order: Brassicales, family: Moringaceae, genus: *Moringa* and species: *oleifera* (Fahey, 2005). There are still 13 known species of *Moringa* (Leone *et al.*, 2015), but *Moringa oleifera* is the most used for production and research. The tree adapts well between 19 to 35°C, under direct sunlight, at an altitude of 500 m in a slightly acidic to alkaline soil (pH 5.0 to 9.0). Moreover, it can tolerate over-temperature, up to 48°C, winter frost, altitude, and a wide range of soil conditions (Saini *et al.*, 2016)

Nutritional Value of Different Parts of Moringa oleifera

Moringa oleifera leaves are traditionally used for human and animal consumption. However, recent research has shown a range of other medicinal and pharmacological uses; about 70% of publications indexed in the Scopus database last year on *Moringa oleifera* reflected this species' various forms of sustainable usage. According to (Gopalakrishnan *et al.*, 2016), *Moringa oleifera* leaves have excellent antidiabetic and anticancer properties; their presence

in formulated foods brings high content and nutritional quality. The seeds also have considerable amounts of macronutrients, including sodium, potassium, calcium, and magnesium; micronutrients as iron, copper, and zinc; and seven essential amino acids and seven hydrophobic amino acids that contribute to antioxidant activity (Liang *et al.*, 2019)

Moringa oleifera flowers are rich in bioactive compounds with effective antioxidant activity, and their crude extracts showed potential antibacterial, antifungal, anti-inflammatory, and anticancer activity (Kalappurayil and Joseph, 2017)

Moringa oleifera flower powder is cream, more acceptable, and more appealing than leaf powder for food applications. *Moringa oleifera* flower powder was reported in various applications and is a promising alternative for fortifying bread, biscuits, cake, dairy products, and soups (Oyeyinka and Oyeyinka, 2018). *Moringa oleifera* is a functional food, and leaves, flowers, and seeds powder are used to formulate other food products, bringing highly beneficial substances to human health. After oil extraction, leaves, stems, pods, and seeds can be used for animal nutrition. Moreover, oil is extracted from seeds to produce or improve biodiesel. Other representative uses are cosmetics, medicine, and pharmaceuticals (Granella *et al.*, 2020). A recent study showed that iron from *Moringa oleifera* could overcome iron deficiency and modulate the expression of iron-responsive genes better than conventional iron supplements (Saini *et al.*, 2014a). *Moringa oleifera* tree is a plant rich in several nutrients such as proteins, fibre and minerals (Jongrungruangchok *et al.*, 2010; Moyo *et al.*, 2011) that play an essential role in human nutrition. Many reported studies have shown that *Moringa oleifera* leaves are exceptionally high in protein compared to others consumed as food. Other studies showed that *Moringa oleifera* plant might find application in the livestock industry for improving meat quality in terms of chemical composition, colour and lipid stability (Nkukwana *et al.*, 2014a, 2014b, 2014c; Qweleet *et al.*, 2013).

Moringa Oleifera is Used as a Bio Stimulant

The diversity of compounds in the *Moringa oleifera* species are mainly phytochemicals and can act as a stimulant in plants; by accelerating

photosynthetic and biochemical rates and stress relief. Minerals present in large quantities in the leaves as Ca and K, also act on the physiological performance of treated plants. In this sense, ornamental plants have been treated with *Moringa oleifera* leaf extracts, allowing early flowering and constant production growth, replacing the traditional plant growth regulators. (Granella. *et al*, 2021)

Moringa Oleifera is a Portion of Healing Food for Santal

Healing foods or food that can be eaten raw or cooked with other items were essential to maintaining well-being in Santal culture. With their age-old experience, Santal people have mastered doctoring foods with spices or herbs, a basic form of preventive medicine traditionally used as a healing system. The preparation of medicinal dishes may involve cooking or boiling to tap the healing properties of the herbs or spices. What we eat and how we eat are deeply embedded in our cultural practices. Eating is also related to how we medicate. Santal's traditional medical system views food as inseparable from medicine and regards medicinal foods as the first step of healing. The basic understanding of the Santal medical system on healing foods is to purify, tone and heal the body. They follow strict dietary habits when it comes to healing foods. *Moringa oleifera* is one of the healing foods of the Santal culture, consumed as leafy vegetables.

Moringa oleifera is commonly known as drumstick, which we must have tasted in *sambhar*, the south Indian cuisine. This plant species is widely used by Santal tribal people as a medicinal food in their daily diet. During the pandemic, Researcher happened to observe an important behaviour change within my family was that every member was made to consume a cup of boiled moringa leaves extract, which was mandatory every morning on an empty stomach to prevent the infection of coronavirus. This made me curious why this plant is essential in Santal culture. Therefore, with this idea in mind, researcher started to acquire more information about the different uses of moringa plants in the Santal community. In Santal culture, this plant is known as *munga dari*. Researchers have observed that every Santal house will have a moringa plant in their kitchen garden. This

plant also exists in our kitchen garden. *Moringa oleifera* is a popular medicinal and vegetable plant.

The different parts of the plant used are leaves, buds, and pods. Santal often consumes this plant in their diet.

They mix moringa leave in dal for their daily intake. They also consume in the form of *khichdi*. The leaves are dried and stored for future use. They sprinkle dried leaves in a mixed veg soup. The leaves of moringa plants are commonly used as a substitute for any leafy vegetable. Santal loves to eat rice and green leafy *dal*, which is generally made up of *munga sakam* literally means the leaves of moringa. Researcher have often observed her mom going to the kitchen garden to pluck a few moringa branches, and then she will cook the dried form of *munga arak tiki saag* to consume with the rice. *Munga arak*, or the leaves of *Moringa oleifera*, is eaten in the form of curry, with dal, it is cooked or roasted into a hash with rice. The *munga* tree is one of the few trees that are commonly planted. Besides the leaves, the flowers and fruits are also eaten; it has many other uses practised by the Santal people. The bark is crushed and moistened to use as a remedy for headaches. Sometimes the bark of the moringa tree is crushed, and water is added, which emits a strong, pungent smell and is doused into the hole of the snake, and it is believed to drive the snake out. The same sample is also used to poison fish in a pond to catch fish effortlessly (Bodding, 1986).

Santal believes that moringa leaves have a medicinal property that helps boost immunity and thus prevents catching colds or infections. Santal explains immunity as *daar igi aaekauwa* which means a person will feel energetic and will not see disease easily. The study researcher conducted was a short field visit to a village called Inderbani, 35 km outskirts of Dumka district, during winter break. A thick forest surrounds this village. Researchers went to interview a medicine man to learn more about the medicinal usage of the moringa plant and to enquire if it is true that the decoction of the plant leaves benefitted people during the pandemic. Researcher interviewed a medicine man named Mangal Murmu, age 57, with this idea. He is popularly known as a Janguru in the village. He has learnt the knowledge to treat patients who suffer from various diseases from his grandfather at the tender age of 17yrs; he used to assist his grandfather in

collecting wild medicinal plants and herbs from the nearest forest and was able to recognise and memorise different plant species which are of therapeutic importance, so he gradually learnt to treat and cure patients. Researcher primary purpose of the visit was to enquire about the usage of the moringa plant during the pandemic. He told the researcher he could cure more than a thousand Corona patients with specific herbs. He elaborated on the fact that the moringa plant has many medicinal uses, and he has used this plant variety to treat diabetes and hypertension in his daily practices.

The cultural implication of the moringa tree in the life of Santal was very well explained to me in detail by the medicine man. He told researchers that munga *arak* is a natural medicinal or healing food source, which the Santal people commonly consume to keep themselves healthy. Since the roasted leafy vegetable tastes bitter, people prefer to eat it with rice and *dal*. If there is no vegetable available at home, in that case, these plant leaves are used in the form of curry.

During the pandemic, people were so scared that almost every day, the decoction of *moringa* leaves and *raketr uhin* bark (the bark of *Soymida febrifuga*) was taken on an empty stomach to boost their immunity level. *Soymida* is believed to increase haemoglobin; the hydro-alcoholic bark extract of *Soymida febrifuga* has suitable antioxidant properties (Priya et al., 2014). Therefore, people could prevent infections during covid. The medicine men advised the villagers to eat cooked moringa leaves for various reasons. Apart from different medicinal properties, moringa is commonly available in each Santal household kitchen garden. Secondly, people used to avoid going to the village market to get other vegetables to prevent people from catching infections. Moringa is a rich source of Vit C, which is pharmacologically proven in other studies.

MATERIALS & METHODS

Researcher conducted a qualitative research investigation with ten elderly women aged 50 to 60 yrs and one medicine man from the village Inderbani, which is 28 km outskirts of Dumka town. Semi-structured interview questions were developed to take all the interviews, and it was recorded. This research results from a short field visit to the village of Inderbani

during the winter break. Researcher have been associated with the medicine man of the Inderbani village for quite some time. During covid, researcher used to have telephone conversations with medicine men regarding many research questions which researcher wanted to know. Researcher was interested in taking detailed information about the various uses of moringa plants among Santal, which they have been consuming for ages as a source of medicinal food in their diet. Therefore, researchers planned their field visit during break time. On the first day of visit to the medicine man Mangal Murmu proved to be a source of a wealth of information about research questions. He states that “nature has created plants in the world for every ailment, and there is a cure for every disease only man has to find out” he has been practising as a medicine man from the tender age of 14. He worked as an apprentice under his uncle for almost 20 years. He has a small clinic in the village. People from all socio-economic classes visit him for the treatment of different ailments. He is an expert in treating people suffering from Jaundice, diabetes, blood pressure, gastric problem and women-related gynecological issues. When researchers went to interview him, the first thing he told her was about saving thousands of lives during covid. He could cure critical covid patients with herbal medicine; this surprised me. Researchers went to find out the answers about the moringa plant species. Still, the Mangal Murmu gave her a very well understanding of the herbal application of medicine for corona treatment. Researchers used snowball techniques to find the medicine man to investigate the research query. One of the key resource persons who introduced researchers to the medicine man was her distant cousin, Mr. John Soren. He took researchers to the village Inderbani because he had heard much about this medicine man. During the visit, researchers saw almost 100 patients in a queue to visit the medicine man. This medicine man was busy and did not have time to talk to the researchers for nearly half an hour. He just nodded his head, greeting her with a smile. Researchers carried out participant observation in his small clinic and was able to collect few information about the kind of patients visiting the medicine man. At that moment of researchers entry into his clinic, medicine man was treating a jaundice patient who was very elderly.

His small clinic was run with the help of an assistant herbalist who generally does the herbal medicine grinding. Researchers observed that the grinder machine was used to grind the mixture instead of the old traditional stone grinder, which was tedious. The medicinal herbs are collected from the Paharia tribes who live in deep forests, and they sell the valuable medicinal plants to the medicine man who prepares the medicine. After her enquiry, the medicine man suggested that he was so busy with the patient that he had no time to go to the forest to look for medicinal herbs, so he asked the Paharia people to supply the herbs as per his demand.

An important observation researcher would like to mention is that he will equally divide different plant products and then hand them over to the patient. Sometimes he will grind the herbs or ask the patient to grind or boil the herbal medicine as required. Researcher got a chance to smell some of the medicinal plants. Some plants emitted a pungent smell, some tasted bitter, and a few herbs were tasteless. There is no visiting charge; only medicine was charged @ Rs 100 from every patient. After researchers enquiry about various forms of usage of the moringa plant, the medicine man replied that moringa is a rich medicinal food source. Santal often consumes it in their daily food habit. Santal perceives every kind of leafy vegetable as containing "ran" meaning a huge potential for healing properties. Knowing that Santal precisely understands the concept of ran or medicine is fascinating. It is not only understood as an ingredient with a healing property and is consumed when someone is found sick, but Santal always uses it as food or drinks. They have a solid knowledge about taking many vitamins expressed as *dari ran*, which are found in different plants and animal products, so they live healthily. Santal perceives every kind of leafy vegetable as containing *ran*; therefore, it is culturally practised in their food habits. They know that the *Moringa oleifera* leaf is a good source for purifying blood; it reduces blood pressure and the risk of gastric problems. The elderly women of the village were initially reluctant to answer my questions gradually; as researcher developed rapport formation with them in a focus group discussion, they were easy to comprehend. All of them mentioned that moringa plants are consumed in their food habits. It

is easily available in their kitchen garden and accessible throughout the year. Leaves are used in the dal and cooked for their daily consumption. Sometimes chutney is also preferred. Decoction of the boiled leaves is consumed empty stomach to boost their immunity. All parts of the moringa plants are used as food. The pods' flowers and leaves are trendy in making different cuisines and adding flavours to their taste buds. One of the favourite cuisines of the Santal diet is leafy vegetables. Their daily diet will have boiled semi-cooked leafy vegetables; the most common is *munga arak*, i.e., *moringa saag*. Mostly women folk prefer to collect the moringa leaves and put them under the sun to dry during summer. They will then store it for future use. Santal women whom I interviewed also stated that none of their family members was suffering from diabetes, high blood pressure or gastric problem. Few had low bp, and they knew how to eat moringa saag in a limited way. They consume once a week because it lowers their blood pressure. A similar answer was obtained from a medicine man. He stated that moringa leaves are beneficial, but one must be careful in their usage. People with low blood pressure must avoid the daily intake of moringa in their food. Women folk mentioned in their interview that they labour hard in the field. Sometimes they go to the nearby forest to collect dry wood; all this hard work requires energy, and many women are believed to use *moringa* leaf decoction *kada* as an energy drink. Sometimes they add little cinnamon and bay leaf to add taste. One of the exciting pieces of information shared with me by the medicine man is that most hypertension and diabetic patients are from the outside village. He has the most patients visiting him from near by towns and cities. West Bengal is very nearby, and he has witnessed many patients coming from Kolkata and Burdwan. To his knowledge, till now, no one from his village suffers from diabetes or blood pressure. This might be true, but to validate this information, further research is needed to pinpoint the exact reason. Is the moringa plant keeping people from diabetes, or does the lifestyle of the Santal keep them away from these diseases? Researcher aimed to understand Santal's holistic approach to considering moringa plant species and their importance in life. A few elderly women were also interviewed to understand the various uses of moringa in their food culture. They responded

randomly that Santal generally eats meals of rice which are known as *dakka*, *dal* (pulses), maize rice (*jondra dakka*), maize bread (*jondra pitthe*), millet bread (*kode pitthe*), millet porridge (*kodedakka*), rich amount of leafy green vegetables which they call *uttu*. Santal's daily diet contains rice *dal* and green leafy *saag*, either mixed in *dal* or eaten in roasted form. Santal is always fond of *arak*, which is leaves, pot herbs of plants and bushes and even trees that are eaten mostly in curry. Some of these are cultivated but mostly grow in the wild. *Munga dari* is the *Moringa oleifera* plant commonly grown and found in every Santal house. The flowers are cooked as *pakoda* and used as curry. The leaves are used in the form of chutney and *saag*. The pods are cooked in liquid form and consumed with rice. Leaves are boiled, and the juice is used as a beverage among Santal. It is believed to increase immunity and is used as a *kada* against cough and cold. This form of *kada* was generally consumed by researcher family during the pandemic time.

RESULT & DISCUSSION

The study was conducted to find out the medicinal usage of *Moringa oleifera* in the life of Santal. It was interesting to learn that Santal used moringa plants in their daily diet, particularly during the pandemic people consumed decoction of the moringa leaves to get themselves immune. The plant moringa has a special place in the life of Santal, and it is always consumed as a medicinal food by them. Santal people do not have a scientific explanation for the miracle tree. Still, because of their age-old experiences, they know that *munga*, the *moringa* plant has medicinal properties that benefit humankind.

Health Benefits of Moringa Plant

Moringa plants have many therapeutic effects. It is also known for its nutritional value. It contains many minerals such as calcium, potassium, magnesium, Vit A and C, and Beta-carotene (Hekmat *et al.*, 2015). Almost all the parts of the tree are eaten and used as ingredients in traditional herbal medicine. The leaves, pods, and flowers are eaten in parts of India and Africa. It is loaded with excellent sources of vitamins and minerals.

According to the study *Moringa oleifera* is fast

growing, multipurpose and one of the most valuable trees in the world because all parts of the plant are used in food, pharmaceutical products, industrial purposes, and they exhibit many medicinal properties etc. (Mekonnen *et al.*, 2016). The leaves of *Moringa* plants are purgative and used to treat constipation and eye and ear infections; the juice of leaves is used to control the glucose level in the blood, scurvy (lack of vitamin C) and some other diseases, like useful in bronchitis (respiratory infection), headaches, fever, piles etc. (Anwar, 2007). The plants are highly nutritious value and rich in amino acids, vitamins, proteins, minerals, and other essential phytochemicals, and it is also a good source of natural antioxidants, thus enhancing the shelf-life of fat-containing foods due to the presence of various types of antioxidant compounds like ascorbic acid, flavonoids, phenolic and carotenoids etc. Some research studies showed that all parts of the plant, such as leaves, stems, seeds and flowers, and whole pod, are helpful for the treatment of various diseases. They exhibit different pharmacological and medicinal properties such as analgesic, anti-inflammatory, antipyretic, anti-tumour, anticancer activity, antioxidant, hepatoprotective properties, gastroprotective, anti-ulcer, cardiovascular and circulatory stimulant, anti-obesity, antiepileptic, anti-asthmatic, anti-diabetic, anti-epileptic, diuretic, local anaesthetic, anti-allergic, anthelmintic, wound healing, antimicrobial agent, malnutrition and the leaves of the plant are helpful for breast milk in lactating mothers etc. (Saini *et al.*, 2016)

Antioxidant Activity

Kumar and Pari (2003) investigated the antioxidant potential of moringa on hepatic marker enzymes, lipid peroxidation and antioxidants. This study revealed that moringa extract and silymarin significantly decreased hepatic marker enzymes and lipid peroxidation with increased antioxidants. Bajpai *et al.*, (2005) tested the antioxidant activity of moringa leaves and inferred that kaempferol content is mainly responsible for this antioxidant property. Various types of antioxidant compounds present in the leaves and roots of moringa make this plant a valuable source of natural antioxidants.

Cardiovascular Activity

The widespread combination of diuretic, lipid, and blood pressure-lowering constituents makes this plant highly useful against cardiovascular disorders. According to Dahot (1998), *Moringa* leaf juice is known to have a stabilising effect on blood pressure. It is observed that Santal medicine men use moringa leaves to treat blood pressure and diabetes.

Hypocholesteremia Activity

The leaf extract of the moringa plant plays a significant role in reducing cholesterol levels, i.e. hypocholesteremia effect in the serum of a high-fat diet. The moringa plants fruit exhibits activity like low cholesterol, phospholipids, triglycerides, low lipid density, and very low lipid density, which shows the plant helps reduce the lipid profile of the liver (Anwar *et al.*, 2007)

CONCLUSION

We generally interpret plant medicine in both biological and behavioural frameworks. The implication of plant use under all circumstances should appreciate not only just their medicinal context. The most substantial impact that the plant has on human physiology outside therapeutic use is through dietary consumption. Santal has been using plants for therapeutic purposes and incorporating healthy foods, nutritional medicine, tonics, etc. Santal has a rich knowledge of medicinal plants, but at present, they are confronted with the dispossession of their lands and resources by multinational companies and various govt policies. It is, therefore, an urgent need of the hour to safeguard their indigenous knowledge. This study helped me learn the moringa plant's cultural implication and how Santal uses it as a source of healing foods. The facts remain that Santal people have no scientific knowledge about the moringa plant they use daily. Even the medicine men have no clue about the science behind this plant. He tells me that he knew this plant works miraculously in treating hypertension and diabetes with his 27 years of experience. The *Moringa* plant is also known as the "miracle plant". During researchers visit, they also observed that a few patients were from West Bengal. He also elaborated on the fact that village people do not suffer from hypertension or diabetes because the

people are aware of the medicinal property, and they consume the leaves of the plant in the form of saag in their daily life. He has patients coming from all over Jharkhand, Bengal, and Orissa. He made one vital observation that people who live in towns suffer predominantly from hypertension due to their lifestyle. They don't eat moringa plants as frequently as villagers do because they are not aware of the medicinal property of this plant, so they suffer the most. People who have visited him for hypertension and other ailments have been healed. With this observation, researchers would like to conclude that the moringa plant's leaves, flowers, and pods could be essential for the food, medicine, and pharmaceutical industries. The moringa leaf powder can become a vital ingredient of malnutrition programs and can be effectively promoted by govt Anganwadi workers to breastfeeding mothers. *Moringa oleifera* is a valuable medicinal plant. Its different parts possess different therapeutic effects and are used in many disorders. Other pharmacological effects were reported, such as anti-microbial, anti-inflammatory, anti-cancer, antifungal, analgesic, anti-ulcer, anthelmintic, antioxidant, and wound healing properties. It is suggested to investigate further to isolate active molecules for novel herbal medicine. WHO can also promote and make awareness about the health benefits of moringa plants to the public. Hence, the moringa plant has great potential and could be cultivated as an economically profitable crop to alleviate poverty.

In many parts of the world, including Africa, the use of *Moringa oleifera* as a food fortificant is increasing. For instance, fresh and dried moringa leaves are included in meals in African countries such as Ghana, Nigeria, Ethiopia, East Africa and Malawi (Agbogidi and Ilondu, 2012). Many studies have shown the potential use of different parts of *Moringa oleifera* in food applications such as in making soups (Babayehu *et al.*, 2014), weaning foods (Arise *et al.*, 2014), amala, a stiff dough made from yam and plantain flour (Karim *et al.*, 2015), herbal biscuits (Alam *et al.*, 2014), bread (Chinma *et al.*, 2014), cake (Kolawole *et al.*, 2013) and yoghurt (Hekmat *et al.*, 2015). The use of this nutrient-rich plant in fortifying foods is getting much attention.

Moringa oleifera is a miracle plant with enormous

potential yet to be fully explored in food application among Santal food habits. To promote the medicinal plant sector, the government of India set up a National Medicinal Plant Board (NMPB) on 24th November 2000. The board is in the Ministry of AYUSH (Ayurveda, Yoga & Naturopathy, Unani, Siddha & Homeopathy) Government of India. The primary mandate of NMPB is to develop an appropriate mechanism for coordination between various ministries/departments/organisations in India and implementation of support policies/programs for the overall (conservation, cultivation, trade and export) growth of the medicinal plant sector both at central / state and international level. To date, under AYUSH “Aapke Dwaar” campaign 8345393, saplings of ashwagandha, bael, kalmegh, lemon grass, shatvari, amla, tulsi, giloe, grit kumari etc., have been distributed among farmers, students, households and the general public in 30 states including UTs. Therefore, researchers wish to take Ayush’s attention to promoting Moringa Tree saplings to farmers for cultivation and preservation at the commercial level. It is therefore recommended that more workshop can be conducted with farmers and tribal people to make awareness of Moringa’s commercial benefits, which can empower tribal folk in a holistic approach.

REFERENCES CITED

- Agbogidi, O. and E. Ilondu 2012. *Moringa oleifera Lam*: Its potential as a food security and rural medicinal item. *Journal of Biomedical Engineering and Innovation*, 1:156–167.
- Alam, M., M. Alam, M. Hakim, Huq. Abdul, A. Obidul, Moktadir and S. Golam 2014. Development of fibre enriched herbal biscuits: A preliminary study on sensory evaluation and chemical composition. *International Journal of Nutrition and Food Science*, 3: 246–250.
- Anwar, F., S. Latif, M. Ashraf and A.H. Gilani 2007. *Moringa oleifera*: A food plant with multiple medicinal uses. *Phytotherapy Research*, 21:17–25.
- Arise, A., R. Arise, M. Sanusi, O. Esan and S. Oyeyinka 2014. Effect of *Moringa oleifera* flower fortification on the nutritional quality and sensory properties of weaning food. *Croatian Journal of Food Science and Technology*, 6:65–71.
- Babayeju, A., C. Gbadebo, M. Obalowu, G. Otunola, I. Nmom, R. Kayode, A. Toye and F. Ojo 2014. Comparison of Organoleptic properties of egusi and eforiro soup blends produced with moringa and spinach leaves. *Food Science and Quality Management*, 28:15–18.
- Bodding, P.O. 1986. *Studies in Santal Medicine and Connected Folklore part I, II, III*. The Asiatic Society 1 Park Street:Kolkatta.
- Bajpai, M., A. Pande, S. K. Tewari and D. Prakash 2005. Phenolic contents and antioxidant activity of some food and medicinal plants. *International Journal of Food Science and Nutrition*, 56(4):287–291.
- Chinma, C., J. Abu and S. Akoma 2014. Effect of germinated tiger nut and moringa flour blends on the quality of wheat-based bread. *Food Processing and Preservation*, 38: 721–727.
- Dahot, M. 1998. Vitamin contents of flower and seeds of *Moringa oleifera Lam*. *Journal of Islamic Academy of Science*, 11(1):27–32.
- Fahey, J.W. 2005. *Moringa oleifera*: A review of the medical evidence for its nutritional, therapeutic, and prophylactic properties. Part 1. *Trees Life Journal*, 1:1–15.
- Fuglie, L. 1999. *The Miracle Tree: Moringa oleifera: Natural Nutrition for the Tropics*. Church World Service: Dakar.
- Gopalakrishnan, L., K. Doriya and D. S. Kumar 2016. *Moringa oleifera*: A review on nutritive importance and its medicinal application. *Food Science and Human Wellness*, 5: 49–56.
- Granella, S. J., T. R. Bechlin, D. Christ, S. R. M. Coelho and C. H. O. Paz 2021. An approach to recent applications of *Moringa oleifera* in the agricultural and biofuel industries. *South African Journal of Botany*, 137: 110–116.
- Hekmat, S., K. Morgan, M. Soltani and R. Gough 2015. Sensory evaluation of locally-grown fruit purees and inulin fibre on probiotic yoghurt in Mwanza, Tanzania and the microbial analysis of probiotic yoghurt fortified with *Moringa oleifera*. *Journal of Health, Population and Nutrition*, 33: 60–67.
- Jongrungruangchok, S., S. Bunrathep and T. Songsak 2010. Nutrients and minerals content of eleven different samples of *Moringa oleifera* cultivated in Thailand. *Journal of Health Research*, 24:123–127.
- Kalappurayil, T.M. and B.P. Joseph 2017 A review of pharmacognostic studies on *Moringa oleifera Lam*. *Flower Pharmacognosy Journal*, 9:1–7.
- Karim, O., R. Kayode, S. Oyeyinka and A. Oyeyinka 2015. Physicochemical properties of stiff dough ‘amala’ prepared from plantain (*Musa Paradisica*) flour and Moringa (*Moringa oleifera*) leaf powder. *Food in Health and Disease*, 4: 48–58.
- Kolawole, F., M. Balogun, D. Opaleke and H. Amali 2013. An evaluation of nutritional and sensory qualities of wheat-moringa cake. *Agrosearch*, 13:87–94.
- Kumar, A. N. and L. Pari 2003. The antioxidant action of *Moringa oleifera Lam*. (drumstick) against antitubercular drugs induced lipid peroxidation in rats. *Journal of Medicinal Food*, 6(3):255–259.
- Leone, A., A. Spada, A. Battezzati, A. Schiraldi, J. Aristil and S. Bertoli 2015. Cultivation, genetic,

- ethnopharmacology, phytochemistry and pharmacology of *Moringa oleifera* leaves An overview. *International Journal of Molecular Science*, 16: 12791–12835.
- Liang, L., C. Wang, S. Li, X. Chu and K. Sun 2019. Nutritional compositions of Indian *Moringa oleifera* seed and antioxidant activity of its polypeptides. *Food Science and Nutrition*, 9: 1754–1760.
- Mekonnen, D. H. 2016. Miracle tree: A review on multi-purposes of *Moringa oleifera* and its implication for climate change mitigation. *Journal of Earth Science and Climate Change*, 7(8):2-5
- Moyo, B., S. Oyedemi, P. Masika, and V. Muchenje 2011. Nutritional characterization of *Moringa (Moringa oleifera Lam.)* leaves. *African Journal of Biotechnology*, 10:12925–12933.
- Nkukwana, T., V. Muchenje, P. Masika, L. Hoffman and K. Dzama 2014a. The effect of *Moringa oleifera* leaf meal supplementation on tibia strength, morphology and inorganic content of broiler chickens. *South African Journal of Animal Science*, 44:228–239.
- Nkukwana, T., V. Muchenje, P. Masika, L. Hoffman, K. Dzama and A. Descalzo 2014b. Fatty acid composition and oxidative stability of breast meat from broiler chickens supplemented with *Moringa oleifera* leaf meal over a period of refrigeration. *Food Chemistry*, 142:255–261.
- Nkukwana, T., V. Muchenje, E. Pieterse, P. Masika, T. Mabusela, L. Hoffman and K. Dzama 2014c. Effect of *Moringa oleifera* leaf meal on growth performance, apparent digestibility, digestive organ size and carcass yield in broiler chickens. *Livestock Science Journal*, 161: 139–146.
- Oyeyinka, A.T. and S.A. Oyeyinka 2018. *Moringa oleifera* as a food fortificant: Recent trends and prospects. *Journal of Saudi Society Agricultural Science*, 17:127–136.
- Priya, V.G., G. Rao and S.K. Priya 2014. Antioxidant activity of Soyamidafebrifugaroxb.a.juss. *International Journal of Pharmaceutical Science and Research*, 5(5):1847-1851
- Qwele, K., A. Hugo, S. Oyedemi, B. Moyo, P. Masika, V. Muchenje 2013. Chemical composition, fatty acid content and antioxidant potential of meat from goats supplemented with *Moringa (Moringa oleifera)* leaves, sunflower cake and grass hay. *Meat Science Journal*, 93: 455–462.
- Saini, R., P. Manoj, N. Shetty, K. Srinivasan and P. Giridhar 2014a. Dietary iron supplements and *Moringa oleifera* leaves influence the liver hepcidin messenger RNA expression and biochemical indices of iron status in rats. *Nutrition Research*, 34:630-638.
- Saini, R., K. H. Prashanth, N. Shetty and P. Giridhar 2014b. Elicitors, SA and MJ enhance carotenoids and tocopherol biosynthesis and expression of antioxidant-related genes in *Moringa oleifera Lam.* leaves. *Acta Physiologiae Plantarum*, 36:2695–2704.
- Saini, R., N. Shetty and P. Giridhar 2014c. GC-FID/MS analysis of fatty acids in Indian cultivars of *Moringa oleifera*: Potential sources of PUFA. *Journal of American Oil Chemist Society*, 91:1029–1034.
- Saini, R., N. Shetty, M. Prakash and P. Giridhar 2014d. Effect of dehydration methods on retention of carotenoids, tocopherols, ascorbic acid and antioxidant activity in *Moringa oleifera* leaves and preparation of a RTE product. *Journal of Food Science and Technology*, 51:2176–2182.
- Saini, R. K., N.P. Shetty and P. Giridhar 2014e. Carotenoid content in vegetative and reproductive parts of commercially grown *Moringa oleifera Lam.* cultivars from India by LC–APCI–MS. *European Food Research and Technology*, 238: 971–978.
- Saini, R. K., I. Sivanesan and Y.S. Keum 2016. Phytochemicals of *Moringa oleifera*: a review of their nutritional, therapeutic and industrial significance. 3 *Biotech*, 6: 203.
- Shahzad, U., M.A. Khan, M.J. Jaskani, I.A. Khan and S.S. Korban 2013. Genetic diversity and population structure of *Moringa oleifera*. *Conservation Genetics*, 14:1161–1172.
- Thurber, M. D. and J.W. Fahey 2009. Adoption of *Moringa oleifera* to combat under-nutrition viewed through the lens of the “Diffusion of innovations” theory. *Ecology of Food and Nutrition*, 48:215-223.
- Zhao, S. and D. Zhang 2013. Supercritical fluid extraction and characterisation of *Moringa oleifera* leaf oil. *Separation and Purification Technology*, 118: 497–502.



This document was created with the Win2PDF "print to PDF" printer available at <http://www.win2pdf.com>

This version of Win2PDF 10 is for evaluation and non-commercial use only.

This page will not be added after purchasing Win2PDF.

<http://www.win2pdf.com/purchase/>