



International Journal of Nutrition and Agriculture Research

Journal home page: www.ijnar.com



MORINGA-TREE OF LIFE FOR PREVENTING MALNUTRITION AMONG WOMEN AND CHILDREN

A. Beulah^{*1} and S. Mariappan¹

^{1*}Department of Vegetable crops, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India.

ABSTRACT

Moringa is one of the important crop originated from India and Africa which can be exploited for its nutritive richness present in leaves, flowers and pods. The crop is suitable for cultivation in arid and semi-arid regions of India and Tamil Nadu. Recently the crop is rediscovered for its potentiality in alleviating malnutrition which is the severe problem among young children and women throughout the world. Apart from its leaves, the flowers and pods are also useful in preventing many diseases and widely used in homeopathy, sidha and ayurvedic preparations. Moringa trees can be grown in social forestry eco-system, there by the livelihood, socio-economic status of the rural people may be improved. Moringa leaves when fed to cattle increases the milk yield and quality. India is one of the highly populated country and the economic growth is surged ahead since independence but, the nutritional security of the rural women and children is the biggest threatening issue to be addressed. This review article aims at gathering information about moringa particularly its nutritional value and research carried out in moringa for further exploitation.

KEYWORDS

Moringa Tree, Malnutrition in Women and Children, Flowers and Pods.

Author for Correspondence:

Beulah A,
Assistant Professor, Horticultural College and
Research Institute,
Tamil Nadu Agricultural University,
Coimbatore, Tamil Nadu, India.

Email: krrthanmayi@yahoo.co.in

INTRODUCTION

Moringa is one of the most important crop originated from India and Africa which can be exploited for its nutritive richness present in leaves, flowers and pods. The crop is suitable for cultivation in arid and semi-arid regions of India and Tamil Nadu. Recently the crop is rediscovered for its potentiality in alleviating malnutrition which is the severe problem among young children and women throughout world. Moringa is especially promising as a food source in the tropics because the tree produces leaves at the

end of the dry season when other foods are typically scarce. Apart from its leaves, flowers and pods are also useful in preventing many diseases and widely used in homeopathy, sidha and ayurvedic preparations.

Among the thirteen species of Moringaceae, *Moringa oleifera* Lam alone has the multitude uses. Armelle de saint Sauveur (2001)¹ has documented the world wide status of moringa which includes production systems, breeding, propagation, ben oil production and trade, seed powder as flocculent, moringa leaves for nutrition, health and medicinal uses. Fuglie (2003)² has established the nutritive value of moringa and recommends especially to alleviate micronutrient malnutrition in human in many of the African countries.

Over the past ten years the interest on moringa has increased tremendously, owing to its nutritive richness. Considerable new research have also been done into its cultivation, processing of leaves, utilization of seed oil, water purification properties and its medicinal and nutritional benefits. With all of its attributes, it is commonly referred as “Tree of life”, “Miracle Tree”, “Mothers Best Friend” and “Never Die tree” etc.

Nutritional Value of Moringa

Most sources seem to agree on the excellent nutritional benefits of moringa (Folkard and Sutherland, 1996)³. The moringa leaves provide many vitamins and minerals and can be consumed in cooked or dried forms. The foliage is comparable to spinach in both its appearance and nutritional quality (Table No.1).

Nearly 46 Antioxidants and 36 Anti-Inflammatory compounds are available in the moringa plant. The more antioxidants in the body, the less is the aging and disease occurrence.

Moringa leaves contain all 8 essential amino acids and 18 amino acids required for normal growth and development. Moringa is also rich in Omega 3, Omega 6, and Omega 9 oils.

The moringa plant has the highest content of chlorophyll in the plant kingdom and this chlorophyll is very important in helping the body to reach a required balanced pH level.

Moringa has no known impurities or adverse reactions so it's safe to take with most medications.

The plants of moringa are also having carotenoids at the precursor of vitamin A at different morphological fractions (Table No.2).

Above to all these nutrient properties, moringa leaves contains phytochemicals which are beneficial in controlling various diseases (Table No.3).

Alleviating malnutrition using moringa

The World Bank estimates that India ranked 2nd in the world in terms of prevalence of malnutrition among the poor children. It is highly painful to note that India contributes to about 5.6 million child deaths every year due to malnutrition which is more than half the world's total reported. World Health Organisation opined that malnutrition is the greatest single threat to the entire world's public health.

Three non-governmental organizations viz., Trees for Life, Church World Service and Educational Concerns for Hunger Organizations (ECHO) have identified moringa to combat malnutrition, especially among infants and nursing mothers. Moringa leaves can be eaten fresh, cooked, or stored as dried powder for many months without refrigeration, without loss of its nutritional value (Fahey, 2005)⁴. Leaf powder can be added to any food or beverage that can increase the vitamin, mineral and protein content Table No.4. According to FAO/WHO standards, the recommended daily allowances of nutrients for child and woman varies and details are given in Table No.5.

Case studies on the usage of moringa leaves for curing mal nutrition

Vijayaraghavan *et. al.*, 1997⁵ in a three-year study at 20 villages, affecting 3585 households, across 2 agroclimatic regions Andhra Pradesh, India reported that continuous consumption of moringa leaves resulted in the complete reduction in the Bitot's spots (Eye disease).

Kurma *et. al.*, 1998⁶ stated that the powder and different extracts of pods of moringa obtained from a local market in India and given to people to treat rheumatism, liver and spleen diseases. University of Florida News reveals that the "extracts from moringa powder have destructs leukemia cells up to 86%. Levette Truette of USA opines that moringa contains

all essential nutrient required for humans and also contains every essential amino acid that humans require to lead a healthy life.

During the second half of 1997, Church world Services began collaborating with the Senegalese organization viz., Alternative Action for African Development (AGADA) to test the effectiveness of moringa products in preventing malnutrition. The project's target groups were infants and women of child-bearing age living in south-western Senegal and malnutrition was a considerable problem in this region. The pediatrics unit in the town of Bignona treated over six hundred cases of malnourished infants every year. Country-wide, the infant mortality rate of 13% reported was largely caused by malnutrition. During the initial pilot project period, AGADA personnel have given training to the doctors, nurses and mid-wives attached to eight health centres on methods of drying the leaves into a powder for using as a food supplements in the treatment of malnourished children. The health workers were asked to keep records of the progress of the patients. In addition, AGADA trainers conducted many seminars in those villages to teach women folk how to make hygienic moringa leaf powder, how to cook moringa pods and flowers, and the recipes for preparing the leaf sauce. Training manuals, brochures, posters, radio spots and a film were prepared together by CWS and AGADA personnel. The positive findings led CWS and AGADA to expand the project. By the year 2000, virtually all government health workers, NGOs and many communities within the south-west region of Senegal had received training and the project was successfully expanded in the entire south-central Senegal (Fugile, 2003)².

Effect of moringa on women and children

1. Interviews with people who have made moringa a regular part of their diets point out that they have awareness of improvements in their health and energy.
2. Women who consumed moringa regularly during pregnancy had their babies with higher birth weights. During lactation, mothers had secreted more milk and had increased appetites

3. Improves the nutritional status of woman and children.
4. Unexpected benefits of moringa included an apparent cure of tapeworms and help in controlling diabetes and high blood pressure.
5. Sharpens mental abilities and concentration.
6. Improves immune system.
7. Improves the vision.

MORINGA: A MEDICAL PHARMACOPOEIA

Moringa oleifera is already highly recognized by people in the tropics and sub-tropics for the many ways it is used medicinally by local herbalists. Some of the traditional uses help to identify the nutritional content of the various tree parts of moringa. In recent years, laboratory investigation has confirmed the efficacy of some of these traditional applications. In India, the East Indies, Philippines and tropical Africa all parts of the moringa and infusions, decoctions and extracts made from them are variously employed in native medicine Table No.6. In the Tropics of the New World, the tree has served mainly as a source of remedies. All parts have been employed as cardiac and circulatory stimulants. The seeds are pungent and stimulant (Chopra *et al.* 1958)⁷.

Use of moringa in folk medicine

All parts of the tree have been used in folk medicine practices. According to Fahey (2005)⁴.

India

In India, juice from leaves is believed to have a stabilizing effect on blood pressure and is used to treat anxiety. The leaves and young buds are rubbed for head ache. A poultice made from fresh leaves is applied to reduce glandular swelling. Leaves are used to treat fevers, bronchitis, eye, ear infections, scurvy and catarrh. The juice pressed from the flowers is said to alleviate sore throat and catarrh. The ayurvedic medicine of India has highlighted the uses of moringa products, such as a natural antibiotic, an aid in childbirth, for treating liver disorders, and many other uses. The roots are used as a carminative and as a laxative. Roots are considered to cure intermittent fever and cold. Juice from roots is applied externally as a rubefacient (skin tonic), counter irritant or vesicant (agent to induce blistering). Roots are used as an abortifacient,

diuretic, cardiac, circulatory tonic, roots are used to treat epilepsy, nervous debility and hysteria. The root bark is said to prevent enlargement of the spleen and formation of tuberculous glands of the neck, to destroy tumors and to heal ulcers. India, seed oil is applied externally to relieve pain and swelling in case of gout or rheumatism, and to treat skin diseases.

Senegal

In Senegal, a infusion of leaf juice is believed to control glucose levels in cases of diabetes. Bark regarded is used for treating diarrhea. A decoction prepared from leaves, flowers, bark and root, are used to treat epilepsy, hysteria, and intestinal spasms. Juice from root bark is used to relieve earaches and tooth ache. Bark is used as a treatment for delirious patients. In Senegal, this poultice is also used to relieve lower back or kidney pain.

Puerto Rico

An infusion of the flowers is used in Puerto Rico as an eyewash, and a floral decoction has been taken as a cough remedy. Leaf juice, sometimes with carrot juice added, used as a diuretic. Eating leaves is recommended in cases of gonorrhea on account of the diuretic action.

Malaysia

It was reported that Malaysians moringa leaves are used to kill intestinal worms. Leaf juice is sometimes used as a skin antiseptic. Leaves are used as an irritant and as a purgative.

Nicaragua

In Nicaragua, leaves are applied as poultice on sores and skin infections.

Philippines

In the Philippines, eating leaves is believed to increase a woman's milk secretion and is sometimes prescribed for anemia. It is also believed that, roots, chewed and applied to a snakebite, keep the poison from spreading. Flowers are traditionally used as a tonic and abortifacient. Flowers are used to cure inflammations, muscle diseases, tumors and enlargement of the spleen. Pods are used in affections of the liver and spleen, and in treating articular pains (pain in the joints).

China

A root poultice is being used to treat inflammations, especially swelling of tissues in the foot (pedal edema). Root juice mixed with milk is considered useful against in high coughs, asthma, gout, rheumatism, enlarged spleen or liver, internal and deep-seated inflammations, and calculous affections. A snuff made from roots is inhaled to relieve earache and toothache. A juice made from a combination of fresh roots, bark and leaves is inserted into the nostrils to arouse a patient from coma or stupor.

Java

In Java, gum is given for intestinal complaints.

Aruba

A paste of crushed seeds is spread on warts.

Oman

Villagers in Oman use moringa oil to treat stomach disorders. They also use it in perfume and hair oil.

GENETIC RESOURCES OF MORINGA IN INDIA AND TAMIL NADU

Crop Improvement

India is the presently the largest producer of moringa with an annual production of 1.1 to 1.3 million tonnes of tender fruits from an area of 38000 ha. Among the states, Tamil Nadu is one of the leading states in moringa production. Tamil Nadu is the pioneering state in so much as it has varied existing genotypes from diversified geographical locations, as well as introductions from Sri Lanka. In India both perennial and annual moringa are under cultivation. Previously moringa were trees of homestead gardens but after the release of PKM 1 annual moringa in 1990 commercial cultivation gained momentum. The seeds of PKM 1 moringa is supplied every year for the needy farmers with an approximate quantity of around 500 kg from Horticultural College and Research Institute, Periyakulam alone, the same variety seeds are also multiplied from different centres of SAU's, ICAR Institute and private company are also selling the seeds of this variety. The area expansion is approximately 400-500 ha since the release of this potential variety.

In Tamil Nadu, lot of perennial moringa eco types are being cultivated and they are, Moolanur moringa,

valayapatti moringa, Chavakacheri moringa, chemmurungai, Jaffna type, kodikal moringa, Pal murungai, Puna murungai, Palamedu murungai.

PKM 1

It is a pure line selection from Eppothum vendran and released in the year 1989. It is propagated through seeds, plant grows to a height of 3-4 m, flowering within 3-4 months of sowing and comes to harvest in 5-6 months. Pods are 75 cm long with 70 % flesh, individual pod weight 150 g, yields 50-55 tonnes / ha. It can be ratooned for 3 years.

PKM 2

It is a hybrid derivative of cross between MP 31 and MP 38, released in the year 2000, by HC and RI, Periyakulam very long poded variety with the length of pod is 126 cm with 70 % flesh, flowering within 3-4 months of sowing comes to harvest in 5-6 months, individual fruit weight 280 gms and yield 98 t / ha.

Collection and evaluation of different moringa types are carried out at Horticultural College and Research Institute, Periyakulam for further improvement. Further, hybridization programme using PKM 1 as female parent and perennial as male parent work was carried out and the F₁ are planted in the field for evaluation.

Crop Management

Vijayakumar (2000)⁸ conducted crop regulation studies and found that moringa PKM 1 yield can be increased by the application of growth regulators particularly, Mepiquat chloride at 50 ppm. Devi (2003)⁹ stated that pruning a wider spacing of 2.5 x 2.5 m with pinching on 80th day after sowing proved to be the best from the stand point on growth, yield and quality of annual moringa cv. PKM -2.

Beulah (2001)¹⁰ reported that integrated nutrient management in annual moringa encompassing organic manures, bio-fertilizers and varying levels of N, P and K. The results obtained a positive response from moringa to the application of manures and fertilizers. Initial vigour was higher in treatment with poultry manure (500 g / pit) + Neem cake (250g/pit) + panchakavya (2%) spray along with 150:150:100g NPK/tree. In ratoon crops, similarly, the same treatment resulted in early and vigorous growth

confirming the superiority of integrated nutrient management in moringa.

To increase the leaf yield and protein content of moringa PKM1, ultra high density planting and organic manure application experiment is being carried out at HC and RI, Periyakulam and the trial is in progress. Similarly, to increase the pod production, effect of high density planting and fertigation on PKM 1 was carried out and found that the closest spacing of 1.5X1.0 m with two plants per hill and application of 135:23:45g NPK per pit through drip increased the yield of pod.

Field trial was conducted to investigate the effect of different IPM modules for the management of moringa fruit fly i.e., soil application of thiamethoxam 25 WG @ 200 g a.i. ha⁻¹ on 150, 180 and 210 days after sowing, use of fermented tomato in a trap, collection and destruction of fruit fly damaged fruits and foliar spray of spinosad 45 SC @ 56 g a.i. ha⁻¹ and profenofos 50 EC @ 250 g a.i. ha⁻¹) was the best IPM module in minimizing pod damage and soil pupae, and increasing pod yield and benefit cost ratio. Damodharan *et.al.* (1999)¹¹ conducted packaging studies in annual moringa PKM 1 and found that moringa can be packed in corrugated fibre board box of size 80cm length X 30cm width X 20 cm height which can hold 5 kg pods and the shelf life of fruits is also more by this method of packing.

Summary

Healthy life depends on healthy food we consume and the food we consume must be a balanced one containing essential elements required for growth and development. But in everyday life, for a majority of the world's population such balanced food is unaffordable or seasonally unavailable. In this context, moringa is in handy as a very simple and readily available solution to the problem of malnutrition. The edible leaves of the moringa plant are available throughout the year. Apart from this, moringa is used successfully in preventing malnutrition in woman and children. Also moringa possesses nutraceutical properties that boost the immune system, cures many diseases and prevents the occurrence of diseases. It is also used in traditional medicine for the treatment of various illnesses including fever, stomach ache, liver

damage etc. Consequently, moringa is currently being identified as a bio-enhancer of drugs and nutrients because of its production of compounds with antibiotic activity. Hence, moringa can be

introduced in home garden, roof garden, peri urban horticulture and for commercial cultivation to improve the nutritional status of rural as well as urban population.

Table No.1: Composition of leaves and Pods (per 100g of edible portion)

S.No	Composition	Leaves	Leaf powder	Pods
1	Edible portion (%)	75	100	83
2	Moisture (%)	75.0	7.5	86.9
3	Protein(g)	6.7	27.1	2.5
4	Fat (g)	1.7	2.3	0.1
5	Carbohydrate (g)	13.4	38.2	3.7
6	Minerals (g)	2.3	2.0	2.0
7	Fibre (g)	0.9	19.2	4.8
8	Calories	92	205	26
9	Calcium (mg)	440	2,003	30
10	Magnesium (mg)	24	368	24
11	Oxalic acid (mg)	101	0.0	101
12	Phosphorus (mg)	70	204	110
13	Potassium (mg)	259	1,324	259
14	Copper (mg/g)	1.1	0.57	3.1
15	Iron (mg)	7	28.2	5.3
16	Sulphur (mg)	137	870	137
17	Vitamin A (I.U)	11,300	18.9	184
19	Thiamine (mg)	0.06	2.6	0.05
20	Riboflavin (mg)	0.05	20.5	0.07
21	Nicotinic acid (mg)	0.8	8.2	0.2
22	Vitamin C (mg)	220	17.3	120
Amino acids				
23	Arginine (mg)	402	1325	90
24	Histidine (mg)	141	613	27.5
25	Isoleucine (mg)	422	825	110
26	Leucine (mg)	623	1950	163
27	Lysine (mg)	288	1325	37.5
28	Methionine (mg)	134	350	35
29	Phenylalanine (mg)	429	1388	108
30	Threonine (mg)	328	1188	98
31	Tryptophan (mg)	127	425	20
32	Valine (mg)	476	1063	135

[Morton, 1981]¹²

Table No.2: Carotenoids in different morphological fractions of moringa

S.No	Carotenoid	Leaves(mg kg ⁻¹ DM)
1	alpha-Carotene	6.5
2	Beta-Carotene	401
3	Lutein	702
4	Neoxanthin	219
5	Violaxanthin	76.5
6	Zeaxanthin	19.4
7	Xanthophyll	83.1
8	Carotenoids	1508
9	hlorophyll	6890

[Fugile, 2003]²

Table No.3: Phytochemical constituents isolated from *Moringa oleifera* Lam

S.No	Plant Parts	Phytochemical constituents
1	Roots	4-(α -L-rhamnopyranosyloxy)-benzylglucosinolate and benzylglucosinolate
2	Stem	4-hydroxymellein, vanillin, β -sitosterone, octacosanic acid and β -sitosterol
3	Bark	4-(α -L-rhamnopyranosyloxy)-benzylglucosinolate
4	Whole gum exudates	L-arabinose, D-galactose, D-glucuronic acid, L-rhamnose, D-mannose, D-xylose and leucoanthocyanin
5	Leaves	Glycoside niazirin, niazirinin and three mustard oil glycosides, 4-[4'-O-acetyl- α -L-rhamnosyloxy) benzyl] isothiocyanate, niaziminin A and B
6	Mature flowers	D-mannose, D-glucose, protein, ascorbic acid, polysaccharide
7	Whole pods	Nitriles, isothiocyanate, thiocarbanates, 0-[2'-hydroxy-3'-(2''-heptenyloxy)]-propylundecanoate, 0-ethyl-4-[(α -1-rhamnosyloxy)-benzyl] carbamate, methyl-p-hydroxybenzoate and β -sitosterol
8	Mature seeds	Crude protein, Crude fat, carbohydrate, methionine, cysteine, 4-(α -L-rhamnopyranosyloxy)-benzylglucosinolate,benzylglucosinolate, moringyne, mono-palmitic and di-oleic triglyceride
9	Seed oil	Vitamin A, beta carotene, precursor of Vitamin A

[Armando caceres *et.al.*, 1991]¹³

Table No.4: Moringa leaves in comparison to other common foods Values per 100g edible portion

S.No	Nutrient	Moringa Leaves	Other Foods
1	Vitamin A	6780 mg	Carrots : 1890 mg
2	Vitamin C	220 mg	Oranges : 30mg
3	Calcium	440 mg	Cow's Milk : 120mg
4	Potassium	259mg	Bananas:88mg
5	Protein	6.7g	Cow's Milk: 3.2 g

[Burkill, 1935]¹⁴

Table No.5: FAO/WHO standards on recommended daily required allowances of nutrients for child and woman

S.No	Composition	Child (RDA)	Woman (RDA)	Composition	Child (RDA)	Woman (RDA)
1	Protein(g)	16.0	65	Vitamins		
2	Calcium (mg)	400	1,200	Vit A (mg)	1.5	5.7
3	Copper(mg)	0.8	2	Vit B1 (mg)	0.5	1.6
4	Iron(mg)	10.0	15	Vit B2(mg)	0.8	1.8
5	Potassium(mg)	800	3000	Vit B3 (mg)	9.0	20
6	Magnesium(mg)	150	340	Vit C (mg)	20.0	95
7	Phosphorus(mg)	800	1200			
8	Zinc(mg)	3.9	13.7			

Table No.6: Traditional uses of moringa

S.No	Mode of application	Controlling power	Authority
1	Crushed leaves	Skin disease	Manfred [1947] ¹⁵
2	Leaves taken orally	Powerful purgative	Allen [1943] ¹⁶
3	Leaf poultices on abdomen	Expelling intestinal worms	Burkill [1935] ¹⁴
4	Drinking leaf decoction	Build up blood	Higgs [1969] ¹⁷
5	Eating the leaves	Gonorrhea	Fahey [2005] ⁴
6	Juice from root, bark and leaves inserted to nostrils	To arose patients from coma	Dastur [1952] ¹⁸
7	Essential oil from shells applied to inflammations	Heals	Friese [1934] ¹⁹
8	The flowers and root contain pterygospermin, a recognized antibiotic	highly effective in cholera	Lizzy <i>et al.</i> [1968] ²⁰
9	High concentration of root juice	Fungicide	Fahey [2005] ⁴
10	Juice from the flowers	Alleviate sore throat	Benthall [1946] ²¹
11	Gargle root decoction	Relieve cold	Morton [1981] ¹²
12	A paste from grated root with or without salt	Treats skin diseases	Irvine [1961] ²²
13	The fresh trunk bark contains β - sitosterol and moringine (benzylamine) taken internally	Headache and other pains	Watt and Breyer – Brandwiki [1962] ²³

CONCLUSION

India is one of the fast growing country in terms of population and economics, sitting at a population of 1.34 billion (2016) and growing at 1.2 annually. Today malnutrition is prevalent in 7 percent of children under the age of 5 in China and in sub-Saharan African 28 percent compared to a prevalence of 43 percent in India. Considerable investments have been made by governments and aided agencies in programs designed to prevent malnutrition but still it could not be eradicated completely. In this context, Moringa which is the native of India could combat malnutrition and in

African countries and several NGO's, Charities, missionaries who work on alleviating malnutrition among children identified moringa tree as the cheapest source of nutrition and they supply the leaves to their children. Since India's population is increasing at steady state and the land degradation occurs and the people will not afford to buy costly nutrients for improving the nutritional status. Scientific evidences proves that moringa has tremendous potential to alleviate malnutrition and to prevent the occurrence of many diseases. Hence, moringa can be recommended for cultivation

throughout India and rural people can be educated on the benefits of consuming moringa.

ACKNOWLEDGEMENT

The author wishes to express their sincere gratitude to Assistant Professor, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India for providing necessary facilities to carry out this research work.

CONFLICT OF INTEREST

We declare that we have no conflict of interest.

BIBLIOGRAPHY

1. Armelle de saint Sauveur. Moringa exploitation in the world, State of knowledge and challenges, *Development potential for moringa products*, 2001.
2. Fuglie L. *The Miracle Tree*. Church World Service, 60(1-3), 2003, 114-119.
3. Folkard G and Sutherland J. *Moringa oleifera*: a tree with enormous potential, *Translated from Agroforestry Today*, 8(3), 1998, 5-8.
4. Fahey J W. The chemical diversity and distribution of glucosinolates and isothiocyanates among plants, *Phytochemistry*, (corrigendum: *Phytochemistry* 59, 237). *ANT GEN*, 56(1), 2005, 5-51.
5. Vijayaraghavan-K, Nayak-M U, Bamji-M S, Ramana-G N V, Vinodini-Reddy, Reddy-V. Home gardening for combating vitamin A deficiency in rural India, *Food-and-Nutrition-Bulletin*, 18(4), 1997, 337-343.
6. Kurma S R, Mishra S H and Kurma S. Anti-inflammatory and hepatoprotective activities of fruits of *Moringa pterygosperma* Gaertn, *Indian-Journal-of-Natural-Products*, 14(1), 1998, 3-10.
7. Chopra I C, Chopra K L, Handa and Kapur L D. Chopra's indigenous drugs of India, U.N. Dhur and Sons, *Private Ltd., Calcutta*, 2nd edition, 1958, 336-339.
8. Vijayakumar R M. Studies on influence of months of sowing and growth regulation on annual moringa (*Moringa pterygosperma* Gaertn). Ph.D., Thesis, submitted to the *Tamil Nadu Agricultural University, Coimbatore, India*, 3(5), 2000, 301-302.
9. Devi. Standardization of spacing and levels of pruning on growth and yield of annual moringa (*Moringa oleifera* Lam), Var. PKM 2, M.Sc., Thesis, submitted to the *Tamil Nadu Agricultural University, Coimbatore, India*. 2003.
10. Beulah A. Growth analysis of moringa cv., PKM-1. under organic and inorganic systems of culture PKM Ph.D. thesis, HC and RI, PKM. 2001.
11. Damodaran T, Anbu S, Azhakia Manavalan R S and Vennila P. Effect of packaging methods on extension of shelf life in moringa, *South Indian Hort.*, 47(1/6), 1999, 292-293.
12. Morton J F. Atlas of medicinal plants of Middle America-Bahamas to Yucatan, Charles C Thomas, Pub., *Springfield, IL*, 22(1), 1981, 87-102.
13. Armando caceres, Ofyluz Cabrera, Ofelia Morales, Patricia Mollinedo and Patricia Mendia. Pharmacological properties of *Moringa Oleifera*: Preliminary screening for antimicrobial activity, *J. of ethnopharmacology*, 33(3), 1991, P213-216.
14. Burkill I H. Dictionary of the economic products of the Malay Peninsula, *Crown Agents for the Colonies, London*, 1935.
15. Manfred L. 7,000 recetas botanicas, a base de 1,300 plantas medicinales Americanas, *Editorial Kier, Buenos Aires, Argentina*, 1947.
16. Allen, Giron J I. Relacion de unos aspectos de la flora util de Guatemala, Tipografia Nacional de Guatemala for "Amigos del Bosque", 2nd edition, 1943.
17. Higgs H B. Bush medicine in the Bahamas, *Author, Nassau, Bahamas*, 1969.

18. Dastur J F. Useful plants of Indian and Pakistan. Indian. D.B, *Taraporevala Sons and Co., Ltd., Bombay*, 2nd edition, 1952.
19. Friese F W. Plantas medicinaes Brasileiras (Bull.) Instituto Agron, do Estado, *Sao Paulo, Brasil*, 7(1), 1934, 49-53.
20. Lizzy K S, Narasimha Rao P L and Puttaswamy T L. Chemotherapy of bacterial infections. Pt. 4-Potential anticholera agents, *Indian J. Exper. Biol*, 6(3), 1968, 168-169.
21. Benthall A P. Trees of Calcutta and its neighbourhood, Thacker, Spink and Co. 1933, Ltd., Calcutta. 1946.
22. Irvine F R. Woody plants of Ghana, with special reference to their uses, *Oxford Univ. Press, London*, 1961.
23. Watt J M and Breyer-Brandwijk M G. Medicinal and poisonous plants of southern and eastern 7 Africa. E. and S. Livingstone, Ltd., *Edinburgh and London*, 2nd edition, 1962.

Please cite this article in press as: Beaulah A and Mariappan S. Moringa-tree of life for preventing malnutrition among women and children, *International Journal of Nutrition and Agriculture Research*, 3(1), 2016, 34 - 43.