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Review Article

A Review on Medicinal uses of *Moringa oleifera*

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Abstract

There are about thirteen species of Moringa trees in the family Moringaceae. *Moringa oleifera* Lam. (synonym: Moringa pterygosperma Gaertn.) is the most widely known species. All part of the *Moringa tree is* useful in some way and people depends on it for their livelihood. The leaves of the Moringa tree are an excellent source of Nutrients like Minerals, Protein and Vitamins (A and C). Moringa tree has approximately 46 antioxidants and it is one of the cheapest sources of natural anti-oxidants. Anti-oxidants supply the free atoms needed by the human body and mitigate the effect of free radicals. *M. oleifera* contains active compounds such as flavonoids, tannins, saponins, alkaloids, phenolics, and triterpenoids which possess antibacterial effects. Moringa leaves contains flavonoids and tannins that are thought to have anti-inflammatory effects *Moringa oleifera* has high mineral and protein content and has been previously investigated for its potential in treating different oral soft tissue diseases. Present review summarises the various medicinal uses of *Moringa oleifera*.

Keywords: *Moringa oleifera,* Anti-oxidants, Oral diseases, dentistry

Introduction

Moringa oleifera is the most widely cultivated pan-tropical species of a monogeneric family, the Moringaceae, which is native to the sub-Himalayan tracts of India, Pakistan, Bangladesh and Afghanistan. *Moringa oleifera* is known by such regional names as benzolive, drumstick tree, kelor, marango, mlonge, mulangay, nébéday, saijhan, and sajna.[1]. Virtually every part of the tree is beneficial in some way and both rural and urban people depend on it for their livelihood. In developing tropical countries, Moringa trees have been used to combat malnutrition, especially among infants and nursing mothers [2,3]. The leaves of the Moringa tree are an excellent source of Nutrients like Minerals, Protein and Vitamins (A and C) [4, 5, 6], Moringa has approximately 46 antioxidants and is one of the most powerful sources of natural anti-oxidants. Anti-oxidants supply the free atoms needed by the human body and mitigate the effect of free radicals. *M. oleifera* contains active compounds such as flavonoids, tannins, saponins, alkaloids, phenolics, and triterpenoids which possess antibacterial effects.[7]

Medicinal usus of Moringa oleifera

Moringa has approximately 46 antioxidants and is one of the most powerful sources of natural anti-oxidants. Anti-oxidants supply the free atoms needed by the human body and mitigate the effect of free radicals. *M. oleifera* contains active compounds such as flavonoids, tannins, saponins, alkaloids, phenolics, and triterpenoids which possess antibacterial effects hence it can be used as safe and cheap plant antimicrobial agent. The extract from leaves of *Moringa oleifera* has high mineral and protein content and its historic reputation as a traditional medicine for different diseases has been previously investigated for its potential in treating different oral soft tissue diseases [16, 17].

Enamel Tissue Remineralization

Moringa oleifera extract contains the highest values of calcium and phosphate that are required for the remineralization process. Therefore, *Moringa oleifera* extract is investigated by Younis et al for its ability to treat induced enamel lesion.[18] Scanning electron microscopy revealed that Leaves extract of *Moringa oleifera* loaded-varnish groups IV & V showed the most re-establishment of normal enamel architecture. Elemental analysis of the treated surfaces of Groups IV and V showed the surfaces treated by *Moringa oleifera* leaf extract loaded-varnish groups had significantly higher Ca, P, and O deposition than the fluoride varnish group. Leaves extract of *Moringa oleifera* might be considered as a biomimetic material which having capacity to guiding enamel tissue remineralization.[19]

Study by Risnayanti Anas et al, concluded that there is an increase in the amount of calcium in the teeth after the application of *Moringa oleifera* based paste and Casein phosphopeptide-amorphous calcium phosphate (CPP-ACP) application. *Moringa oleifera* based paste and CPP-APP are effective to increasing calcium levels in teeth compared to the pre-test group.[20]

Dental caries is closely related with cariogenic biofilm, an oral biofilm containing a high proportion of *Streptococcus mutans* [1]. Generally, oral biofilm is structurally and functionally organized and contains a balance of normal flora and pathogenic bacteria like *S. mutans* [22]. Su-Kyung Jwa has studied the antimicrobial effects of the *M. oleifera* leaf extracts on *S. mutans* and formation of cariogenic biofilm. Extract from *M. oleifera* leaves was derived using distilled water (DW) and ethyl alcohol (EtOH). *S. mutans* susceptibility assays were performed for each extract. Cariogenic biofilm was formed with or without DW and EtOH extract, and cariogenic biofilm was treated with both extracts. Both extracts showed antimicrobial activity against *S. mutans* and inhibited formation of cariogenic biofilm. [23]

Figure 1: Various parts of *Moringa Oleifera* [8-15]

As Antimicrobial Agent

The leaf extracts of *M. oleifera* showed varying antimicrobial activity on wide range of microorganisms.

In a study by Singh et al. (2012), the antimicrobial activity of *Moringa oleifera* was examined using the main model Kirby-bauer disc diffusion method in which 50% *of Moringa oleifera* leaf extract was used. The results showed that 50% ethanolic extract successfully displayed anti-bacterial activity however only little. Even at higher concentration, the extract displayed mild inhibitory activity and no activity at all against pseudomonas. [24]

Hanaa Elgamily et al carried out a study to assess the antibacterial and antifungal potentials of different parts of *Moringa oleifera* plant using different extraction methods in attempts to formulate natural dental remedies from this plant. The different extracts of different parts of *Moringa oleifera* showed an antibacterial effect against *Staphylococcus aureus* and *Streptococcus mutans* growth. The novel toothpaste of ethanolic leaves extract has antimicrobial and antifungal potential effects all selected strains.[19]

Another study indicated that *E.coli* was found to be equally sensitive to ethyl acetate, acetone and chloroform extracts and had the maximum antibacterial activity among the extracts. *S.aureus* was sensitive to all the extracts studied. The ethyl acetate had maximum antibacterial activity against *S. aureus* in comparison to the other extracts. The study revealed that *S. gallinarum* was also sensitive to all the extracts showing maximum antibacterial activity with ethyl acetate extracts and moderate and equal sensitivity to methanol and chloroform extracts. The ethyl acetate, acetone and methanol extracts showed maximum and equal antibacterial activity against *P.aeruginosa*. The disc diffusion study revealed that both the Gram positive and Gram-negative organisms showed variablesensitivity to different extracts of *M. oleifera*. In general, ethyl acetate and acetone extracts showed maximum antibacterial activity against *E. coli*, *S. aureus*, *S. gallinarum* and *P. aeruginosa*. The antibacterial potential of different extracts of *M. oleifera* specially of those of ethyl acetate and acetone extracts, demand further *in vitro* and *in vivo* studies to exploit their antibacterial action in the treatment of bacterial diseases of man and animals[25].

As anti-diabetic agents

Ajit et al., 2003 reported that hypoglycemic activity of *Moringa oleifera*, with significant blood glucose lowering activities has been confirmed.[26] From work of Francis et al., 2004 et al, Methanolic extract of its dried fruits powder has produced N-Benzyl thiocarbamates, N-benzyl carbamates, benzyl nitriles and a benzyl; which prove to trigger insulin release significantly from the rodent pancreatic beta cells and have cyclooxygenase enzyme and lipid peroxidation inhibitory activities .[27]

As anti-inflammatory agents

Now a days, herbal medicine is being widely used as alternative medicine in developed countries. Leaves of Moringa plant have been shown to have anti-inflammatory activities. Moringa leaves contains flavonoids and tannins that are thought to have anti-inflammatory effects.[28]

Tannins are polyphenolic compounds that are abundant in Moringa leaves. The amount of tannin in *M. oleifera* ranged between 13.2 gTAE/kg and 20.6 gTAE/kg in dry leaves. Tannins have anti-inflammatory activity and antioxidant activity. In the inflammatory process, tannins can inhibit the production of oxidants by neutrophils, monocytes, and macrophages and directly inhibit reactive oxidants such as OH and NO.[29-31]

Utilization of the efficacy of moringa leaves developed in various dosage forms has also begun to be widely studied. The results showed that moringa leaves extract could be applied topically in the form of gels, ointments, and creams. The advantage of giving topical anti-inflammatory drug preparations is that it is easy to use because it can be directly applied to the inflamed area and has fast absorption, therefore, it can directly provide a therapeutic effect. Previous research has conducted an anti-inflammatory test of 5% moringa extract in gel preparations and found that inflammation was reduced by 47.09%.[32] Similar research was also carried out using preparations in the form of cream of Moringa leaves extract with a concentration of 12%, and the results showed that the cream of Moringa leaves extract had a fairly good anti-inflammatory effect.[33]

Hepatoprotective Activity[34]

Alaaeldin A. Hamza et al investigated that the administration of M.O seed extract decreased the CCl4-induced elevation of serum aminotransferase activities and globulin level[35]. The elevations of hepatic hydroxyproline content and myeloperoxidase activity were also reduced by M.O treatment. Liver fibrosis was induced by the oral administration of 20% carbon tetrachloride (CCl4), twice weekly and for 8 weeks[36]. The biochemical and histological results showed that M.O. reduced liver damage as well as symptoms of liver fibrosis. S. Fakurazi et al showed that initiation of acetaminophen toxicities is believed to be promoted by oxidative stress during the event of overdosage. MO showed that the hepatoprotective activity gives significant histopathological analysis and reduction of level of alanine aminotransferase (ALT), aspartate aminotransferase (AST), and alkaline phosphatase (ASP) in the group treat with MO compared to those treated with acetaminophen alone. The level of glutathione (GSH) was found to be restored in MO treated animal[37,38]

Table 1: Some reported work of *Moringa oleifera* [7]

S.N.	Author	Objective of study	Application	Ref
1	Rao P K, et al 2011	To assess the antibacterial activity of isolated compounds from *M. oleifera* against selected oral bacteria	All the isolated compounds from *M. oleifera* were active against Streptococcus mutans (MTCC 497), Streptococcus salivarius, Lactobacillus fermentum, Streptococcus anginosus, Streptococcus gordonii, Lactobacillus acidophilus.	39
2	Hanaa Elgamily et al 2016	To assess the antibacterial and antifungal potentials of different parts of *Moringa oleifera*	For dental remedies, experimental toothpaste exhibited higher mean inhibition than the mouthwash against *Staphylococcus aureus, Streptococcus mutans* and only the toothpaste revealed antifungal effect against *Candida albicans*	18
4	Carranza J B, 2017	To identify the secondary compounds of three varieties of *Moringa oleifera* Lam. Extracts namely; Native, Chinese, and Yard Long malunggay using phytochemical analysis	The extracts of moringa varieties contain flavonoids, alkaloids and tannins that are known to have antimicrobial and anti-inflammatory properties; thus, these have potential natural components in the manufacture of toothpastes	40
5	Su-Kyung Jwa et 2019	to investigate the antimicrobial effects of the *M. oleifera* leaf extracts	extracts showed antimicrobial activity against *S. mutans* and inhibited formation of cariogenic biofilm	23
6	Piasti Sopandani et al 2020	to assess the antibacterial effect of *M. oleifera* extract as an irrigation solution against *E. faecalis*	*M. oleifera* extract solution at concentrations of 75% and 100% is as effective as 5.25% NaOCl against *E. faecalis*	41
7	Mahassen M Farghaly et al 2020	to formulate a nontoxic mouthwash from *Moringa oleifera*	Moringa extract showing antibacterial and antiplaque effect will be used	42
8	Younis SH 2020	To assess the effect of Leaves extract of *Moringa oleifera* loaded-varnish groups IV & V on enamel	Moringa leaf extract loaded-varnish groups had significantly higher Ca, P, and O deposition than the fluoride varnish group. Leaves extract of *Moringa oleifera* might be considered as a biomimetic material which having capacity to guiding enamel tissue remineralization	18
9	Anas R et al 2021	To study the Effectiveness of Paste Based *Moringa oleifera* To Increase Calcium Levels Human Tooth	Results of this research showed that *Moringa Oleifera* paste has higher calcium level compared to Pre-test groups and *Moringa oleifera* paste can be effective in increasing calcium levels of human teeth	20
10	Nawal Aidaros et al 2021	To investigate and compare the effect of green tea, black tea and *Moringa oleifera* on artificially	In dentin, the highest mean value was found in *Moringa oleifera*. Study concluded that *Moringa tree* enhanced the remineralization process and thus, might be considered as an	43

		demineralized enamel and dentin	effective natural remineralizing agents	
11	Buakaew et al 2021	*Moringa oleifera* and *Azadirachta indica* were assessed for oral healthcare and gingivitis adjunctive treatment	Author state that accumulative reduction percentages of both Staphylococcus spp. and Candida spp. were found and indicated that the herbal mouthwashes reduced Gingival index and plaque index and showed potential as oral healthcare products	44

Conclusion

M. oleifera contains active compounds such as flavonoids, tannins, saponins, alkaloids, phenolics, and triterpenoids which possess antibacterial effects hence it can be used as safe and cheap plant antimicrobial agent. The extract from leaves of *Moringa oleifera* has high mineral and protein content. As traditional medicine it has potential in treating different oral soft tissue diseases. Study by Nawal Aidaros et al concluded that *Moringa oleifera* enhanced the remineralization process of demineralized enamel and dentin, and thus, might be considered as an effective natural remineralizing agent[27]. Further research on *Moringa oleifera* needed to exploit the pharmacological uses for management and prevention of oral disease.

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