

## Medicinal Plants In Periodontics - A Review

### Abstract

The present study was an attempt to highlight the use of medicinal plants in Periodontics. An attempt is made to evaluate four common herbs i.e Neem, Turmeric, Clove and Tulsi (Basil) from Indian flora and fauna as representatives for assessment of their use in Periodontics. The purpose for taking them as representatives is their vast utility as medicinal plants in traditional Indian medicine.

### Key Words

Medicinal plants, Periodontal diseases, Natural Products, Traditional Medicine

Medicinal plants have been used to treat diseases or to attain or maintain a condition of improved health from a long time. They are both promotive and preventive in their approach. It is a comprehensive system, which uses various remedies derived from plants and their extracts to treat disorders and to maintain good health. Natural herbs like triphala, tulsi patra, jyestiamadh, neem, clove oil, pudina, ajwain and many more used either as whole single herb or in combination have been scientifically proven to be safe and effective medicine against various oral health problems like bleeding gums, halitosis, mouth ulcers and preventing tooth decay. The major strength of these natural herbs is that their use has not been reported with any side-effects till date<sup>[1]</sup>. Use of herbal derivatives for oral healthcare and dental hygiene maintenance has been continuing since times immemorial. If we look back at the methods of oral hygiene maintenance, we can trace the use of herbal derivatives since 3000 B.C., when the ancient civilizations used what they called a "chew stick". The chew sticks were rubbed up against the teeth to clean the teeth. Similar use of plant sticks are reported from other parts of the world too - the ancient Arabs used a "Miswak". Use of Neem stick to clean the teeth has been reported in early Indian classics by Sushruta and Charaka<sup>[2],[3]</sup>. Among all, neem datun is most commonly in use<sup>[4]</sup>. Even today, 80 percent of the population in India that lives in rural areas still start their day with the datun.

It would be worth mentioning here that Medicinal plants have been used as traditional treatments for numerous human diseases for thousands of years

and in many parts of the world. In rural areas of the developing countries, they continue to be used as the primary source of medicine<sup>[5]</sup>.

As there are approximately 500,000 plant species occurring worldwide, of which only 1% has been phytochemically investigated, there is great potential for discovering novel bioactive compounds. There have been numerous reports of the use of traditional plants and natural products for the treatment of oral diseases. Many plant-derived medicines used in traditional medicinal systems have been recorded in pharmacopeias as agents used to treat infections and a number of these have been recently investigated for their efficacy against oral microbial pathogens. The general antimicrobial activities of medicinal plants and plant products, such as essential oils, have also been reviewed in literature<sup>[6],[7]</sup>.

As it is an exhaustive topic hence owing to limitations of time and space, the present study has been restricted to focus on the use of following four herbal sources:

1. Neem
2. Turmeric
3. Clove oil
4. Tulsi

Selection of these herbal sources of medicine has been made on the basis of their traditional use in India for oral healthcare and as a protectant against periodontal diseases.

### Neem (Azadirachta Indica)

Azadirachta indica is popularly known as Indian neem (margosa tree) or Indian lilac. Neem is an evergreen tree,

<sup>1</sup> Ankita Srivastav

<sup>2</sup> Vivek Govila

<sup>3</sup> Sunil Verma

<sup>1</sup> PG Student

<sup>2</sup> Dean & HOD

<sup>3</sup> Reader

Dept. of Periodontology, Babu Banarasi Das  
College of Dental Sciences, Lucknow (U.P.) India

### Address For Correspondence:

Dr. Ankita Srivastav

Final Year Student, Dept. of Periodontology  
Babu Banarasi Das College of Dental Sciences  
B.B.D. University, BBD City,  
Faizabad Road, Lucknow - 227105 (U.P.) India

Submission : 8<sup>th</sup> June 2014

Accepted : 7<sup>th</sup> January 2015

Quick Response Code



cultivated in various parts of the Indian subcontinent. Every part of the tree has been used as traditional medicine for household remedy against various human ailments, from antiquity<sup>[8],[9],[10]</sup>. The sanskrit name of the neem tree is 'Arishtha' meaning 'reliever of sickness'

### Pharmacological Actions Of Neem Extract

Several pharmacological activities and medicinal applications of various parts of neem are well known. Biological activity of neem is reported with the crude extracts and their different fractions from leaf, bark, root, seed and oil. However, crude extract of different parts of neem have been used as traditional medicine for the treatment of various diseases.

Some of the medicinal attributes of various parts of neem<sup>[11]</sup> as mentioned in ayurveda<sup>[12],[13]</sup> have been summarized in **Table - 1**.

### Neem In Periodontics

Given its immunostimulant, antiulcerative, antifungal, antibacterial, antiviral, anticarcinogenic and antioxidant activity as well as its varying degrees of effect on central nervous system, Neem has been tried as an excellent microbial agent, pain reliever

Table – 1: Medicinal Uses Of Neem As Mentioned In Ayurveda

Part	Medicinal Use
Leaf	Leprosy, Eye Problem, Epistaxis, Intestinal Worms, Anorexia, Bilioussness, Skin Ulcer
Bark	Analgesic, Alternative And Curative Of Fever.
Flower	Bile Suppression, Elimination Of Intestinal Worms And Phlegm.
Fruit	Relieves Piles, Intestinal Worms, Urinary Disorder, Epistaxis, Phlegm, Eye Problem, Diabetes, Wounds And Leprosy.
Twig	Removing Plaque, Maintaining Oral Hygiene, Relieves Cough, Asthma, Piles, Phantom Tumour, Intestinal Worms, Spermatorrhoea, Obstinate Urinary Disorder, Diabetes.
Gum	Effective Against Skin Diseases Like Ringworms, Scabies, Wounds And Ulcers.
Seed Pulp	Leprosy And Intestinal Worms.
Oil	Leprosy And Intestinal Worms.
Root, Bark, Leaf, Flower And Fruit	Blood Morbidity, Biliary Afflictions, Itching, Skin Ulcer, Burning Sensation And Leprosy.

and tissue protector in Periodontics. Neem extracts are used to treat various skin diseases, as an antiseptic substance, against endo and ectoparasites or simply as a herbal mouthwash<sup>[14]</sup>. In test tubes, neem has been shown to have significant effects on both gram-positive and gram-negative organisms.

Extracts from neem sticks or bark have been shown to inhibit the growth of *Streptococcus mutans*. Some of the studies citing use of Neem in Periodontics have been enumerated in **Table - 2**.

### Turmeric (Curcuma Longa)

Turmeric or *Curcuma longa*, a perennial herb, is a member of the family Zingiberaceae (ginger). The plant grows to a height of three to five feet, and is cultivated extensively in India, China and other countries with a tropical climate. The rhizome is the portion of the plant used medicinally; it is usually boiled, cleaned, and dried, yielding a yellow powder.

In old Hindu Medicine, it was extensively used for the treatment of sprains and swelling caused by injury. In recent times, traditional Indian medicine uses turmeric powder for the treatment of biliary disorders, anorexia, hepatic disorders, rheumatism and sinusitis.

### Biological Activity of Turmeric and its derivative compounds

Turmeric powder, curcumin and its derivatives and many other extracts from the rhizomes were found to be bioactive. Some of the reported biological

Table – 2: Studies On Use Of Neem In Periodontics

Study	Study Design	Results
Patel and Venkatakrisna-Bhatt (1988) <sup>15</sup>	Study on Mango ( <i>Mangifera indica</i> ), Neem ( <i>Azadirachta indica</i> ; <i>Melia azadirachta</i> ), Ocimum ( <i>Ocimum basilicum</i> ), tea-dust ( <i>Camellia sinensis</i> ) and uncommonly <i>Murayya</i> , i.e., currey leaf ( <i>Murayya Koenigi</i> )	The herbs used showed potential efficacy as compared to commercially available dentifrices.
Wolinsky et al. (1996) <sup>16</sup>	Examined the inhibitory effects of aqueous extracts derived from the bark-containing sticks (Neem stick) of <i>Azadirachta indica</i> upon bacterial aggregation, growth, adhesion to hydroxyapatite, and production of insoluble glucan.	Neem stick extract reduced the ability of some streptococci to colonize tooth surface.
Bhuiyan et al. (1997) <sup>17</sup>	Evaluated the antibacterial activities of aqueous and acetonetic extracts of Neem bark (NBE) on agar plates by using <i>Streptococcus sobrinus</i> .	Neem bark constituents may have ability to suppress oral pathogens.
Vanka et al. (2001) <sup>18</sup>	Tested the antibacterial effect of Neem mouthwash against salivary levels of <i>Streptococcus mutans</i> and <i>Lactobacillus</i> over a period of 2 months. Also it's effect in reversing incipient carious lesions was assessed.	Neem mouthwash was effective in inhibiting <i>S. mutans</i> and reversing incipient carious lesions.
Pai et al. (2004) <sup>19</sup>	Developed a gel containing neem leaf extract and compared its antiplaque activity with a mouthwash containing chlorhexidine gluconate, a common ingredient in medicinal mouthwashes.	Neem extract gel proved useful for treating gingivitis and oral infections as it inhibited the formation of plaque and the growth of bacteria.
Subramaniam et al. (2005) <sup>20</sup>	Determined the influence of different concentrations of Neem leaves extract on the inhibition of <i>Streptococcus mutans</i> .	Neem leaves extract exhibited antibacterial effect towards <i>Streptococcus mutans</i> .
Lakshmi and Aravind (2010) <sup>21</sup>	Evaluated the antibacterial activity of ethanolic leaf extract of <i>Azadirachta indica</i> against selected acidogenic oral bacteria that causes dental plaque in fixed orthodontic appliance patients.	The extract exhibited significant antibacterial activity against <i>Streptococcus mitis</i> , <i>Streptococcus mutans</i> , <i>Streptococcus sanguis</i> & <i>Streptococcus salivarius</i> . Did not show antibacterial activity against <i>Lactobacillus acidophilus</i> .
Chatterjee et al. (2011) <sup>22</sup>	Carried out a double-blind, randomized, controlled trial to evaluate the antigingivitis and antiplaque effect of an <i>Azadirachta indica</i> (neem) mouthrinse on plaque induced gingivitis.	<i>A. indica</i> -based mouth rinse was equally efficacious with fewer side effects as compared to chlorhexidine and may be used as an adjunct therapy in treating plaque induced gingivitis.
Jainet al. (2012) <sup>23</sup>	Evaluated the efficacy of neem chip as an adjunct to scaling and root planing (SRP) in patients with periodontitis.	Neem chip may prove to be beneficial in the treatment of periodontal pockets.
Rathod et al. (2012) <sup>24</sup>	Assessed the susceptibilities from aqueous and ethanol extracts of Neem (leaves and bark) and Tulsi (leaves) against some clinically significant bacterial species.	The study indicated that Neem bark was found to possess more significant antibacterial activity than Neem leaves and Tulsi leaves against two Gram positive bacteria ( <i>Bacillus subtilis</i> and <i>Staphylococcus aureus</i> ) and two Gram negative bacteria ( <i>Klebsiella pneumoniae</i> and <i>Escherichia coli</i> ).
Verma and Dixit (2012) <sup>25</sup>	Assessed the influence of Chlorhexidine (CHX) and Neem Extract (NE) on Cultured Human Gingival Fibroblasts (hGF).	CHX beyond 1% concentration exhibited toxic effect on hGF at 1 minute time exposure. However, NE did not adversely affect the fibroblasts even up to 50% concentration showing less toxic effect in comparison with CHX on these cells. The cytoprotective, oral friendly quality of NE emphasize the superiority of NE over CHX.

activities<sup>[26]</sup> are as follows:

1. Anti-inflammatory, antioxidant, anti-bacterial, anti-HIV, anti-tumor and arthritis.
2. Anti-bacterial, anti-HIV, antitumor, anti-inflammatory and anti-diabetic action.
3. Anti-bacterial, anti-HIV, arthritis, antioxidant, antitumor, anti-inflammatory, snake bite and apoptosis.
4. Antioxidant, anticarcinogenic effect, snakebite and arthritis.
5. Antioxidant, Alzheimer's disease, anti-bacterial and hepatoprotective effects.
6. Antispasmodic, anti-inflammatory, arthritis, gastrointestinal and cardiovascular effects.
7. Antioxidant, anticarcinogenic effect, antifibrotic effect and effect on immunity.
8. Anti-rheumatic activity, antioxidant and anticarcinogenic effect.
9. Arthritis, Alzheimer's and anti-inflammatory.
10. Abolished cytotoxic activity and antioxidant.

Table – 3: Studies On Use Of Turmeric In Periodontics

Study	Study Design	Results
Suhag et al. (2007)27	Compared curcumin irrigation with commonly used irrigant chlorhexidine (0.2%).	1% curcumin solution caused better resolution of inflammatory signs (BOP and redness) and PPD reduction than chlorhexidine and saline irrigation as an adjunctive therapy.
Murakami et al. (2008)28	Curcumin and its reduced derivative tetrahydrocurcumin have been shown to exhibit chemopreventive activity.	Curcumin has both oxidant and antioxidant properties. A causal link between the anti-inflammatory activities and molecular properties of phenolic antioxidants was suggested.
Habiboallah et al. (2008)29	Compared the effects of Curcuma longa-ghee formulation and hyaluronic acid on gingival wound healing following surgery in an animal model.	The results suggested a positive potential therapeutic effect on surgical wound healing particularly improvement of periodontal treatment consequences after surgery.
Waghmare et al. (2011)30	Compared chlorhexidine gluconate and turmeric extract mouthwashes for dental and gingival health.	Concluded that turmeric mouthwash could be a good adjunct to mechanical plaque control. Both mouthwashes showed efficacy and reduction of inflammation and plaque count, with the CHX mouthwash scoring better on the plaque index.
Behal et al. (2011)31	Effect of experimental local-drug delivery system containing 2% whole turmeric (gel form) as an adjunct to scaling and root planing (SRP) with the effect achieved using SRP alone	The experimental local drug-delivery system containing 2% whole turmeric gel can be effectively used as an adjunct to scaling and root planing and was more effective than scaling and root planing alone in the treatment of periodontal pockets.
Kim (2011)32	Investigated the effects of curcumin on the production of interleukin-6 (IL-6)	Curcumin may contribute to blockade of the host-destructive processes mediated by IL-6 and appears to have potential therapeutic values in the treatment of inflammatory periodontal disease.
Lopez-Jomet et al. (2011)33	Carried out an experimental animal study to show the effect of topical curcumin for the healing of carbon dioxide laser skin wounds in mice.	Topical curcumin applied to CO2 laser-induced skin wounds may be useful, because improved re-epithelialization was observed after 7 days.
Singh et al. (2012)34	Analysed insulin-mediated mitogenesis on curcumin(CUR)-treated hGF cells and developed an in vitro model of wound healing.	The in vitro model for gingival wound healing established that insulin significantly enhanced wound filling faster than CUR-treated hGF cells over 48 h. Reinforced the pivotal role of insulin in supporting CUR-mediated wound repair.
Zhang et al. (2012)35	Investigated the effect of curcumin on growth and apoptosis of myofibroblasts derived from human oral mucosa.	Results demonstrated the antifibrotic effect of curcumin in vitro. It may therefore be a candidate for the treatment of OSF.
Kudva et al. (2012)36	Carried out a comparative in vitro and in vivo study to evaluate the adjunctive efficacy of turmeric, curcumin, and traditional nonsurgical methods for treating periodontal pockets.	Plaque index and gingival index scores showed significant improvement from baseline to the end of the study

11. Ovarian and bone cancers.
12. Inhibitors of 5-lipoxygenase, cyclooxygenase and antileukemic.
13. CAKI-1 23 (renal cancer) and MCF-7 (breast cancer).
14. Inhibitors of HIV-1 integrase activity.
15. Antioxidant activity and hypocholestermic.
16. Turmeric also acts as a digestive agent.

### Turmeric In Periodontics

Owing to its excellent anti-inflammatory, antimicrobial and wound healing properties use of turmeric and its derivatives has gained a momentum in the recent research in Periodontics. Some of the contemporary research with empirical evidence has been enumerated in **Table - 3**.

### Clove (Syzygium Aromaticum)

*Syzygium aromaticum*(Linn.) Merr. & L.M. Perry (Syn. *Eugenia aromatica*) Kuntze, *Eugenia caryophyllata* Thunberg, belongs to family Myrtaceae, commonly known as clove, is an aromatic tree, native to Indonesia and used as a spice in cuisines in many parts of the world<sup>[37]</sup>. It is grown naturally in Moluku Islands of Indonesia and cultivated in many parts of the world like Tanzania, Madagascar, Sri Lanka, India, China, Indonesia, Malaysia, Brazil, Malagasy Republic, Jamaica and Guinea<sup>[38],[39]</sup>. It is an ever-green plant of 10 to 20 m in height with spear-shaped leaves and racemiferous yellowish flowers, has a strong phenolic smell and sharp acrid taste, whereas, essential oil of clove is a colorless or light yellowish fluid extracted from dried flower buds.

### Clove In Periodontics

Although clove and clove oil have been used in dentistry as an analgesic from times immemorial and the use of eugenol, a derivative of clove has also a useful place in Endodontics, yet recent dental literature has shown empirical evidence of use of clove and its derivatives in periodontics. Some of the studies are enumerated in **Table - 4**.

### Tulsi (Ocimum Sanctum)

*Ocimum sanctum*L. (also known as *Ocimum tenuiflorum*, Tulsi or Basil) has been used for thousands of years in Ayurveda for its diverse healing properties. Tulsi, the Queen of herbs, the legendary 'Incomparable one' of India, is one of the holiest and most cherished of the many healing and healthy giving herbs of the orient. The sacred basil, Tulsi, is renowned<sup>[45]</sup> for its religious and spiritual sanctity, as well as for its important role in the traditional Ayurvedic and Unani system of holistic health and herbal medicine of the East.

Marked by its strong aroma and astringent taste, it is regarded in Ayurveda as a kind of 'elixir of life' and believed to promote longevity. Tulsi extracts are used in Ayurvedic remedies for common colds, headaches, stomach disorders, inflammation, heart disease, various forms of poisoning and malaria. Traditionally, *O. sanctum* is taken in many forms, as herbal tea, dried powder or fresh leaf<sup>[46]</sup>.

*Ocimum sanctum*L. (Tulsi) is an erect, much branched sub-shrub 30-60 cm tall, with simple opposite green or purple leaves that are strongly scented and hairy stems. Leaves have petiole and are ovate, up to 5 cm long, usually somewhat toothed.

### Tulsi In Periodontics

Given its excellent antimicrobial, anti-inflammatory, wound healing and immunoregulatory properties, Tulsi has always generated interest from dental community for use in treatment and protection against periodontal diseases. Some recent evidence regarding use of Tulsi in periodontics has been enumerated in **Table - 5**.

### Conclusion

Overview of use of herbs in periodontal practice revealed that although a lot of work to experimentally evaluate the efficacy of these herbs in clinical periodontics has been done and some

Table – 4: Studies On Use Of Clove In Periodontics

Study	Study Design	Results
Carrasco et al. (2009)40	-	Clove essential oil increased the total white blood cell count and enhanced the delayed-type hypersensitivity response in mice.
Mahadlek et al. (2010)41	The effects of clove oil and eugenol added into the prepared Zinc Oxide gel were studied.	The antimicrobial activity of the prepared gel was increased when the concentration of clove oil and eugenol was increased. The antimicrobial activity of systems comprising clove oil tended to be higher than that of eugenol.
Sikka, Dodwad and Chandrashekar (2011)42	Carried out a clinical study for a duration of four weeks and focused on two specific mouthwashes: HEXIDINE (0.2% chlorhexidine) and SEFDENT (a dual action mouthrinse with clove oil and sorbitol, sol isopropyl myristate, sodium saccharin)	Both the mouth-rinses studies turned out to be statistically significant but control group (HEXIDINE) showed significant improvement in plaque index, gingival scores, when compared to test group (SEFDENT). This showed that chlorhexidine remains a gold standard in improving the gingival status.
Moon et al. (2011)43	Evaluated clove oil and its major compounds, eugenol and $\beta$ -caryophyllene against oral bacteria, either alone or in combination with ampicillin or gentamicin,	The results suggested that the clove oil and eugenol could be employed as a natural antibacterial agent against cariogenic and periodontopathogenic bacteria. The antibacterial activity of the clove oil was higher than $\beta$ -caryophyllene but was similar to eugenol against all tested oral bacteria.
Kraivaphan and Amornchat (2012)44	Evaluated the efficacy of an essential oil (derived from clove) containing dentifrice on established plaque and gingivitis compared with a placebo dentifrice.	Essential oil containing dentifrice gave a 25.4% reduction ( $p < 0.001$ ) in supragingival plaque accumulation and a 19.5% reduction ( $p < 0.001$ ) in gingivitis compared to the placebo dentifrice.

Table – 5: Studies On Use Of Tulsi In Periodontics

Study	Study Design	Results
Singh et al. (2005)47	Assessed antibacterial activity of <i>Ocimum sanctum</i> L. fixed oil.	<i>Ocimum sanctum</i> fixed oil showed good antibacterial activity against <i>Staphylococcus aureus</i> , <i>Bacillus pumilus</i> and <i>Pseudomonas aeruginosa</i> , where <i>S. aureus</i> was the most sensitive organism.
Agarwal, Nagesh and Murlikrishnan (2010)48	Determined if Tulsi ( <i>Ocimum sanctum</i> ) extract has an antimicrobial activity against <i>Streptococcus mutans</i> .	At the 4% concentration of Tulsi extract, a zone of inhibition of 22 mm was obtained.
Agarwal and Nagesh (2011)49	Compared the effect of 0.2% Chlorhexidine mouth rinse, Listerine mouth rinse and 4% Tulsi extract mouth rinse on salivary <i>Streptococcus mutans</i> level.	Tulsi has stood the test and is as effective as Chlorhexidine and Listerine in reducing the salivary <i>S. mutans</i> levels.
Malhotra et al. (2011)50	Compared the efficacy of a commercially available herbal mouthrinse (Herboral) with that of chlorhexidine gluconate.	Herboral. Herbal mouthrinse was found to be a potent plaque inhibitor, though less effective than Chlorhexidine Gluconate.
Rodrigues-Holanda et al. (2012)51	Evaluated the antiplaque and antigingivitis effect of 3% <i>Ocimum gratissimum</i> gel in human gingivitis.	Indicated that 3% OCG gel associated to brushing showed antiplaque and antigingivitis effect, being important as an adjuvant to plaque-induced gingivitis treatment.

promising results have been shown, yet there is almost no practical use in clinical practice as yet. It is time now to substantiate the evidence obtained in preliminary studies and to carry out multicentric trials to prove the efficacy of these herbal remedies and to ensure that if they have any beneficial effect then they should get place in contemporary clinical use.

There is a need to build up a industry-laboratory relationship, despite having shown a better efficacy in experimental studies, if these experiments do not transform into medicinal products that can be used clinically then all this work would prove to be a sheer waste of

resources.

### References

1. Malhotra R, Grover V, Kapoor A, Saxena D. Comparison of the effectiveness of a commercially available herbal mouthrinse with chlorhexidine gluconate at the clinical and patient level. *Journal of Indian Society of Periodontology* 2011; 15(4); 349- 352.
2. Bhandari MM. *Flora of the Indian desert*. 1st ed. Dhrti printers, NewDelhi,1990.
3. Ismail MYM, Aseem NM, Zakriya M. *Botanicals Promoting Oral and Dental Hygiene: A Review*. RJPBS

2010; 1(2): 202-206.

4. Johri. M. *Neem: Rightly Called the 'Village Pharmacy'*, IST 2007 15:42:27.
5. Chitme HR, Chandra R, and Kaushik S, "Studies on antidiarrheal activity of *calotropis gigantea* R. Br. in experimental animals," *Journal of Pharmacy & Pharmaceutical Sciences*, 2003; 7: 70-75.
6. Cowan MM. "Plant products as antimicrobial agents," *Clinical Microbiology Reviews* 1999; 12(4): 564–582.
7. Kalembe D and Kunicka A. "Antibacterial and antifungal properties of essential oils. *Current Medicinal Chemistry* 2003; 10(10): 813-829.
8. Chopra, R. N., Nayer, S. L. and Chopra, I. C., *Glossary of Indian Medicinal Plants*, CSIR, New Delhi, 1956.
9. Kirtikar, K. R. and Basu, B. D., in *Medicinal Plants* (eds Blatter, E., Cains, J. F., Mhaskar, K. S.), Vivek Vihar, New Delhi, 1975, p. 536
10. Chatterjee, A. and Pakrashi, S. (eds), *The Treatise on Indian Medicinal Plants*, 1994, vol. 3, p. 76.
11. Ketkar, A. Y. and Ketkar, C. M., in *The Neem Tree: Source of Unique Natural Products for Integrated Pest Management, Medicine, Industry and Other Purposes* (ed. Schmutterer, H.), 1995, pp. 518–525.
12. Mitra CR. *Neem*, Dr M. S. Patel, Indian Central Oilseeds Committee, Hyderabad, 1963, pp. 69–94.
13. Varma, G. S., *Miracles of Neem Tree*, Rasayan Pharmacy, New Delhi, 1976.
14. Kukreja BJ, Dodwad V. *Herbal mouthwashes – a gift of nature*. *Int. J. Pharm. Bio Sciences* 2012; 3(2): 46-52.
15. Patel VK, Venkatakrishna-Bhatt H. *Folklore therapeutic indigenous plants in periodontal disorders in India* (review, experimental and clinical approach).. *Int J Clin Pharmacol Ther Toxicol*. 1988 Apr;26(4):176-84.
16. Wolinsky LE, Mania S, Nachnani S, Ling S. The Inhibiting Effect of Aqueous *Azadirachta indica* (Neem) Extract Upon Bacterial Properties Influencing in vitro Plaque Formation. *J. Dent. Res.* 1996; 75(2): 816-822.
17. Bhuiyan MM, Nishimura M, Matsumara S, Shimono T.

- Antibacterial effects of the crude Azadirachta indica bark extract on Streptococcus sobrinus. *Pediatric Dental J.* 1997; 7(1): 61-64.
18. Vanka A, Tandon S, Rao SR, Udupa N, Ramkumar P. The effect of indigenous Neem Azadirachta indica [correction of (Adirachta indica)] mouth wash on Streptococcus mutans and lactobacilli growth. *Indian J Dent Res.* 2001 Jul-Sep;12(3):133-44.
  19. Pai MR, Acharya LD, Udupa N. Evaluation of antiplaque activity of Azadirachta indica leaf extract gel—a 6-week clinical study. *J Ethnopharmacol.* February 2004;90(2-3):99-103.
  20. Subramaniam SK, Siswomihardjo W, Sunarintyas S. The effect of different concentrations of Neem (Azadirachta indica) leaves extract on the inhibition of Streptococcus mutans (In vitro). *Maj. Ked. Gigi. (Dent. J.)* 2005;38(4): 176–179.
  21. Lakshmi T, Aravinda Kumar S. Antibacterial evaluation of azadirachta indica ethanolic leaf extract against selected acidogenic oral bacteria causing dental plaque in fixed orthodontic appliance patients – an invitro study. *Journal of Bio-Technology and Research* 2010; 2(2): 1-7.
  22. Chatterjee A, Saluja M, Singh N, Kandwal A. To evaluate the anti-gingivitis and anti-plaque effect of an Azadirachta indica (neem) mouthrinse on plaque induced gingivitis: A double-blind, randomized, controlled trial. *J Indian Soc Periodontol* 2011;15:398-401
  23. Jain S, Kaur H, Brar S. To Evaluate The Efficacy Of Neem Chip As An Adjunct To Scaling And Root Planing (SRP) in patients with Periodontitis. *Ind. J. Dent. Sc.* 2012; 4(4) Suppl.: 042-045.
  24. Rathod GP, Kotecha BM, Sharma R, Amin H, Prajapati PK. In vitro Antibacterial study of two commonly used medicinal plants in Ayurveda: Neem (Azadirachta indica L.) and Tulsi (Ocimum sanctum L.). *International Journal of Pharmaceutical & Biological Archives* 2012; 3(3):582-586.
  25. Verma UP, Dixit J. Development of a human gingival fibroblast (HGF) cell line for the evaluation of a novel mouthwash from Azadirachta indica vis-à-vis chlorhexidine. *Int. J. Pharmacy and Pharmaceutical Sciences* 2012; 4(2): 217-221.
  26. Gupta SK, Lather A, Jaiswal V, Garg S, Jyoti, Kumar A. Phytochemistry of Curcuma longa – An overview. *JPBMS* 2010; 4(1): 1-8.
  27. Suhag A, Dixit J, Dhan P. Role of curcumin in periodontal disease. *Perio* 2007; 4(2): 115-121.
  28. Murakami Y, Ishii H, Takada N, Tanaka S, Machino M, Ito S, Fujisawa S. Comparative Anti-inflammatory Activities of Curcumin and Tetrahydrocurcumin Based on the Phenolic O-H Bond Dissociation Enthalpy, Ionization Potential and Quantum Chemical Descriptor. *Anticancer Res.* 2008; 28: 699-708.
  29. Habiboallah G, Nasroallah S, Mahdi Z, Nasser MS, Massoud Z, Ehsan BN, Mina ZJ, Heidar P. Histological evaluation of Curcuma longa-ghee formulation and hyaluronic acid on gingival healing in dog. *J Ethnopharmacol.* 2008 Dec 8;120(3):335
  30. Waghmare PF, Chaudhari AU, Karhadkar VM, Jamkhande AS. Comparative evaluation of turmeric and chlorhexidine gluconate mouthwash in prevention of plaque formation and gingivitis: A clinical and microbiological study. *J Contemp Dent Pract.* 2011;12(4):221-224.
  31. Behal R, Mali AM, Glida SS, Paradkar AR. Evaluation of local drug-delivery system containing 2% whole turmeric gel used as an adjunct to scaling and root planing in chronic periodontitis: A clinical and microbiological study. *J Indian Soc Periodontol.* 2011 Jan-Mar; 15(1): 35–38.
  32. Kim S-J. Curcumin suppresses the production of interleukin-6 in Prevotella intermedia lipopolysaccharide-activated RAW 264.7 cells. *J Periodontal Implant Sci* 2011;41:157-163
  33. López-Jornet P, Camacho-Alonso F, Jiménez-Torres MJ, Orduña-Domingo A, and Gómez-García F. Photomedicine and Laser Surgery. 2011; 29(12): 809-814.
  34. Singh N, Ranjan R, Zaidi D, Shyam H, Singh A, Lodha D, Sharma R, Verma U, Dixit J, Balapure AK. Insulin catalyzes the curcumin-induced wound healing: An in vitro model for gingival repair. *Ind. J. Pharmacol.* 2012; 44(4): 456-462.
  35. Zhang S-S, Gong Z-J, Li W-H, Wang X, Ling T-Y. Antifibrotic Effect of Curcumin in TGF- 1-Induced Myofibroblasts from Human Oral Mucosa. *Asian Pacific J Cancer Prev.* 2012; 13, 289-294
  36. Kudva P, Tabasum ST, Gupta S. Comparative evaluation of the efficacy of turmeric and curcumin as a local drug delivery system: a clinicomicrobiological study. *Gen Dent.* 2012 Sep-Oct;60(5):e283-7.
  37. Srivastava KC and Malhotra N. Acetyl eugenol, a component of oil of cloves (Syzygium aromaticum L.) inhibits aggregation and alters arachidonic acid metabolism in human blood platelets. *Prostaglandins Leukot Essent Fatty Acids.* 1991;42(1):73-81.
  38. Zheng GQ, Kenney PM and Lam LK. Sesquiterpenes from clove (Eugenia caryophyllata) as potential anticarcinogenic agents. *J Nat Prod.* 1992;55(7):999-1003
  39. Baytop T. Therapy with Medicinal Plants in Turkey. 2nd ed. Nobel Medical Bookstore: stanbul-Turkey; 1999
  40. Carrasco FR, Schmidt G, Romero AL, Sartoretto JL, Caparroz-Assef SM, Bersani-Amado CA, Cuman RK. Immunomodulatory activity of Zingiber officinale Roscoe, Salvia officinalis L. and Syzygium aromaticum L. essential oils: evidence for humor- and cell-mediated responses. *J Pharm Pharmacol.* 2009 Jul;61(7):961-7.
  41. Mahadlek J, Charoenteeraboon J, Phaechamud T. Zinc Oxide Gels for Periodontitis Treatment. *Journal of Metals, Materials and Minerals* 2010; 20(3): 159-163.
  42. Sikka G, Dodwad V, Chandrashekar KT. Comparative Anti-plaque and Anti-gingivitis Efficacy of Two Commercially Available Mouthwashes - 4 Weeks Clinical Study. *J Oral Health Comm Dent* 2011;5(3)110-112
  43. Moon SE, Kim HY, Cha JD. Synergistic effect between clove oil and its major compounds and antibiotics against oral bacteria. *Arch Oral Biol.* 2011 Sep;56(9):907-16.
  44. Kraivaphan P, Amornchat C. Effect of an essential oil-containing dentifrice on established plaque and gingivitis. *Southeast Asian J Trop Med Public Health* 2012; 43(1): 243-248.
  45. Warriar PK. In: Longman O, editor. *Indian Medicinal Plants.* New Delhi,

- CBS publication, 1995. p. 168.
46. Biswas NP, Biswas AK. Evaluation of some leaf dusts as grain protectant against rice weevil *Sitophilus oryzae* (Linn.). *Environ Ecol* 2005;23:485-8.
47. Singh S, Malhotra M, Majumdar DK. Antibacterial activity of *Ocimum sanctum* L. fixed oil. *Indian J Exp Biol*. 2005 Sep;43(9):835-7.
48. Agarwal P, Nagesh L, Murlikrishnan. Evaluation of the antimicrobial activity of various concentrations of Tulsi (*ocimum sanctum*) extract against streptococcus mutans: An in vitro study . *Indian Journal of Dental Research* 2010; 21; 3357-359
49. Agarwal P, Nagesh L. Comparative evaluation of efficacy of 0.2% Chlorhexidine, Listerine and Tulsi extract mouth rinses on salivary Streptococcus mutans count of high school children--RCT. *Contemporary Clinical Trials* 2011; 32(6): 802-808.
50. Malhotra R, Grover V, Kapoor A, Saxena D. Comparison of the effectiveness of a commercially available herbal mouthrinse with chlorhexidine gluconate at the clinical and patient level. *J Indian Soc Periodontol*. 2011 Oct-Dec; 15(4): 349-352.
51. Rodrigues Holanda J, de Santiago Dutra C, Moreira de Olinda T, do Nascimento Gomes K, Lima V, Goes P. Antiplaque and antigingivitis effect of ocimum gratissimum gel: a randomized double-blinded clinical trial. *Braz. J. Periodontol*. 2012; 22(3): 70-74.

Source of Support : Nil, Conflict of Interest : None declared