BioCore
Exploring Scientific Community

International Journal of Dentistry and Oral Health

Review Article
ISSN 2471-657X

Green Dentistry

G. Saraswathy[*1], A. Sujatha[2], M.B. Aswath Narayanan[3], S.G. Ramesh Kumar[2], A. Leena Selvamary[2]

[1]*Postgraduate, Department of Public Health Dentistry, Tamil Nadu Government Dental College and Hospital, Chennai-600003, India*
[2]*Assistant Professor, Department of Public Health Dentistry, Tamil Nadu Government Dental College and Hospital, Chennai - 600003, India*
[3]*Professor and Head, Department of Public Health Dentistry Tamil Nadu Government Dental College and Hospital, Chennai-600003, India*

Abstract

Dentistry is a quintessential curative and foremost healing profession. Traditionally, Dentistry produces waste materials that may cause harm to the soil and to the biosphere. Extreme climate change, increased pollution, diminishing green spaces and vanishing plant and wildlife species are testaments to the need for a change in the environment. Dentistry as a profession has contributed to a heavy load of metallic waste on the environment and has over exploited the water and the electricity for various dental procedures, which specifically emphasize the thrust to move towards "green dentistry". Eco-friendly dentistry is an intellectual way of dental practice which is environment friendly and at the same time conserves money and time by reducing waste, decreasing pollution, and conserving energy with the use of latest techniques and procedures. This literature review article provides an insight on series of 'green' recommendations that dentists around the world can implement to become leading Stewards of the environment.

Keywords: Green, Dentistry, Dental waste, Herbs, Environment

Corresponding author: **G. Saraswathy**
Postgraduate, Department of Public Health Dentistry, Tamil Nadu Government Dental College and Hospital, Chennai-600003, India
Tel: 9962013227, **E-mail:** prabusaras@yahoo.com

Citation: G. Saraswathy et al. (2018), Green Dentistry. Int J Dent & Oral Heal. 4:9, 142-152

Received: September 15, 2018
Accepted: September 21, 2018
Published: September 29, 2018

Introduction

Environmental pollution is the flaming issue today in the world. Directly or indirectly, every individual is responsible for this, and Dentistry is not an exception[1]. Extreme climate change, increased pollution, diminishing green spaces and vanishing plant and wildlife species are testaments to the need for a change in the way we approach the environment[2]. Exposures to environmental pollution remain a major source of health risk throughout the world, though risks are generally higher in developing countries, where poverty, lack of investment in modern technology and weak environmental legislation combine to cause high pollution levels[3]. Global Warming is caused by a blanket of pollution that traps heat around the earth and has no boundaries. It enters the atmosphere, spreads across the globe and traps heat around the earth for 50-200 years after it is emitted. Hence, there is a need to reduce global warming pollution now[4]. The continuous rise in temperature of the planet is really upsetting. The root cause attributed for the continuous temperature rise is global warming. The major cause of global warming is the greenhouse gases. Greenhouse gases are the by-product of energy production and are a major threat to a healthy planet. In such a scenario, professional obligation and social responsibility of dentists makes it imperative to transform the practice of dentistry from a hazardous to a sustainable one, by adopting environmental-friendly measures or 'green dentistry'[5].

Traditionally, Dentistry produces waste materials that cause harm to the soil and to the biosphere. Dentistry is one of the fields that contribute to climate change and pollution of the environment. Though, the refused trash generated by the dentists is very less, but the accumulated waste that is produced can have marked deleterious effect on the environment[6]. The color green has healing power and is understood to be the most restful and relaxing color. Green can enhance vision, stability and endurance. Renewal, growth, and hope are related to this color and it indicates safety in the advertising of drugs and medical products. Green Dentistry is an approach to dentistry that combines dental practices and environment conservation[7]. Eco-dentistry association defines Green Dentistry as "A high-tech approach that reduces the environmental impact of dental practices and encompasses a service model for dentistry that supports and maintains wellness"[8].According to the Eco-dentistry Association, Green Dentistry reduces waste and pollution; saves energy, water, and money; incorporates high-tech innovations, and focuses on wellness and integrative practices within the offices that result in an eco-friendly environment[1].Green dentistry is a whole-Earth approach to tooth care that reduces the environmental impact of dentistry and creates a caring environment for patients. It is based on the model of four Rs, i.e., Rethink, Reduce, Reuse, and Recycle[9]. A green dental practice uses non-toxic products, reduces waste, reduces the carbon footprint,

saves energy, water, money, incorporates high tech innovations and focuses on wellness and integrative practices[7]. Eco dentistry is a new approach towards dentistry that supports dental practices by limiting the consumption of resources and waste. Waste disposal is also considered as an important part of the office. Alternatives that are eco-friendly should be executed in dental office[9].

Green dentistry is a relatively new term and an emerging concept in dentistry[10]. The article highlights the importance of social values, community care, engaging stakeholders, economic benefits, developing policy and providing leadership in converting the concept of green dentistry into a practised reality[11].

The prime intent behind this review article is to investigate the various environmental problems caused by the dental community and to equip the dentists with various environmental substitutes of the materials in use and to impart them with tier of "green" guidance which would invoke them to become leading stewards of the environment[12].

Components Of Green Dentistry

Green Dentistry includes four categories of green practice, providing a comprehensive, eco-friendly model for the dental office.

1. Waste reduction
2. Pollution prevention
3. Energy conservation
4. Water conservation[10].

Classification Of Waste

Non-hazardous waste

This constitutes about 85% of the waste generated in most healthcare set-ups. This includes waste comprising of food remnants, fruit peels, wash water, paper cartons, packaging material.

Hazardous waste

Potentially infectious waste

- Blood and blood products.
- Dressings and swabs contaminated with blood, pus and body fluids.
- Laboratory waste including laboratory culture stocks of infectious agents.
- Potentially infected animals used in diagnostic and research studies.
- Potentially injected material.
- Excised tumors and organs, extracted teeth etc.
- Sharps which include needle, syringes blades etc.

Potentially toxic waste

Chemical waste: It include disinfectants (hypochlorite, gluteraldehyde, iodophors, phenolic derivatives and alcohol based preparation), X-ray processing solutions, monomers and associated reagents, base metal debris (dental amalgam in extracted teeth).

Pharmaceutical waste: It includes anaesthetics, sedatives, antibiotics and analgesics etc.

Radioactive waste: It Includes waste contaminated with radionuclide[7].

Need for Green Dentistry

- Infrastructure of the clinic.
- Use of traditional radiography producing hazardous by-products like waste fixer, lead foils.
- Use of silver amalgam restorations.
- Excessive use of disposables for infection control.
- Use of chemical sterilization with toxic disinfectants.
- Wastage of resources like electricity, water, paper, etc.
- Improper disposal of Bio-Hazardous waste.
- Green Dentistry is safe for the patients
- Conservation of the environment
- Stronger, more natural restorations
- Less chemicals and disposables[13].

Eco-Friendly Recommendations

- An eco-friendly sterilization program should be implemented, which concurrently eliminates the need for disposable autoclave wraps and disposable patient bibs.
- Use a community's existing recycling program to separately recycle the paper and plastic halves of autoclave bags.
- Use a dry dental vacuum pump, instead of a wet one.
- If traditional x-rays are used, fixer and developer solutions should be recycled as well as lead foil from x-rays are to be recycled.
- Consider using less harmful surface disinfectants in dental offices, such as tea tree oil and thyme[2].

Use reusable and biodegradable laundries wherever possible

- Reusable operating room cotton towels instead of disposable plastic or paper patient bibs should be used
- Reusable stainless steel high- and low-volume, surgical/endodontic suction tips as an alternative to disposable plastic
- Reusable glass irrigation syringe as a substitute for disposable plastic
- Biodegradable disposable cups instead of regular paper cups
- Chlorine-free, high post-consumer recycled paper products instead of traditional paper products.
- Use stainless steel prophy cups instead of disposable prophy-containing cups. This means purchasing prophy paste in tubes or tubs. This also allows you to use only the amount of paste that is needed versus a predetermined amount, which is often more than you need, and thus wasteful and costly.
- Use disposable, plastic or paper barriers only as truly needed. An effective exercise would be for each office to do a one-day consumption analysis exclusively for barriers and then calculate how many barriers are used per week, month and year, and throughout one's dental career.
- Use an Energy Star washer and dryer, where applicable.
- Use fluorescent instead of halogen lighting, where practical.
- Use liquid crystal display (LCD) instead of cathode ray tube (CRT) computer monitors.
- Use linoleum, a more environmentally friendly choice for flooring.
- Use ultra-low volatile organic compound (VOC) paint[2].
- Use of CAD/CAM Systems to reduce greenhouse gases produced from patient and staff travel for multiple appointments
- Use of waterless vacuum system[14].

Eco-friendly dentistry uses a sustainable approach to encourage dentists to implement new strategies to try and reduce the energy being consumed and the large amount of waste being produced by the industry. Four R's is a strategy implemented by dental professionals for an easier transition to a more sustainable practice[15]. Dentistry can limit its burden on the environment by employing the "Four R's of Going Green," namely, "Re-think, Reduce, Reuse, and Recycle"[12].

S.NO	RETHINK	REDUCE	REUSE	RECYCLE
1	Environmentalism or environmental rights is a broad philosophy, ideology, and social movement regarding concern for environmental protection and improvement of the health of the environment	Packaging generates 33% of waste;It is recommended to purchase products with minimum packaging and use of reusable plastic container[9].	Use reusable sterilization items and patient barriers in the clinics and hospitals that are free from plastic.	Recycling is a viable way to reduce overall contamination of the environment
2	Mobile dental van should be considered as it is a desirable mode of clinical practice in an unconventional setup for the outreach programs	Tele Dentistry has the potential ability to provide better access to oral health care, improve its delivery system and lower its costs for the underserved population[7].	Use reusable stainless steel or compostable impression trays Switch to cloth sterilization bags and patient barriers. Reuse lab and shipping boxes[16].	Participation in an instrument recycling program that turns them into industrial metal.
3	Reduction of energy and water consumption[9].	Combining orders to reduce shipping waste. Buy in bulk; e.g., prophy paste and impression materials	Use a reusable face shield Wear cloth lab coats instead of paper ones[15].	Use sharp disposal service that recycles them into building materials
4		Set printers for double sided printing with single spaced printing[16].		Recycle copy paper and choose a medical shredding service that recycles the shredded paper.
5		Use steam sterilization eliminating the use of chemicals.		Provide recycling bins for staff break-room waste[17].
6		Implement digital technology for making impressions [15].		Collect and store all contact and noncontact scrap amalgam and send it to an approved recycler [10].

Alternative Therapeutics For Oral Diseases

Oral diseases continue to be a major health problem worldwide. Dental caries and periodontal disease are among the most important global oral health problems, although other conditions like oral and pharyngeal cancers and oral tissue lesions are also of significant concern. Oral health is integral to general wellbeing and relates to the quality of life that extends beyond the functions of the craniofacial complex. Herbs have been used for centuries to prevent and control dental disease. Herbal extracts are effective because they interact with specific chemical receptors within the body. Herbal medicines have less adverse effects in comparison with traditional medicines. Herbal products can vary in their potency.

The global need for alternative prevention and treatment options and products for oral diseases that are safe, effective and economical comes from the rise in disease incidence (particularly in developing countries), increased resistance of pathogenic bacteria to currently used antibiotics and chemotherapeutics, opportunistic infections in immune compromised individuals and financial considerations in developing countries. Despite several chemical agents being commercially available, these can alter oral micro biota and have undesirable side-effects such as vomiting, diarrhoea and tooth staining. Hence, the search for alternative products continues and natural phytochemicals isolated from plants used in traditional medicine are considered as good alternatives to synthetic chemicals. Herbal products are also being increasingly used as sedatives, or plaque reduction and healthy gums[18].

The established practices to prevent dental caries and periodontal diseases are the use of fluorides in different forms and mechanical plaque control in combination with professional care. However, in reality, a major bulk of the population may not have adequate dexterity and motivation that are necessary to maintain optimum oral hygiene. This is especially true in rural areas. Antimicrobial mouth rinses have also been suggested as adjuncts for mechanical plaque control methods. The most commonly used antiplaque agent is chlorhexidine gluconate. The use of chlorhexidine has some potential drawbacks like altered taste sensation, staining of teeth, and development of resistant bac-

teria that incapacitate its application on long-term basis. There exists a need to develop some innovative strategies that act against both dental caries and periodontal diseases simultaneously. One such strategy would be to explore the abundantly available medicinal plants in nature. The "naturally occurring" active ingredients in plant medicines restore health, with minimal harmful effects and maximum efficiency[19]. Aloe vera, Bloodroot, Caraway, Chamomile, Clove, Cranberry, Evening Primrose, Garlic, Ginger, Green Tea, Haritaki, Liquorice, Myrrh, Neem, Peppermint, Propolis, Purple Coneflower, Rosemary, Sage, Thyme, Turmeric, Tulsi, Triphala, and a summary of other herbs are useful in treatment of oral diseases. Herbs may be good alternatives to current preventive and curative treatments for oral health problems, but it is clear that we need more research[20].

S.NO	Herbs (Botanical names)	Mechanism of Action	Method of Application and Preparation
1.	Clove (Syzygium aromaticum)	Antimicrobial, analgesic and antiseptic	Clove gel can provide dentists with an alternative to benzocaine for topical anaesthesia in their daily practice, especially for use with children and in areas where cost and availability limit access to pharmaceutical topical anaesthetics. It is available as a tincture (1:5, 25% ethanol), lozenges and mouthwash[21].
2.	Aloe vera (Aloe barbadensis)	Analgesic, antibacterial, antifungal, antioxidant, Immune modulating, antiseptic, anti-inflammatory	Aloin, aloe-emodin posseses strong antibacterial action. They have polyphenolic structures, which inhibit protein synthesis by bacterial cells[22].
3.	Neem (Azadirachta indica)	Antimicrobial	The inhibitory effects of neem upon bacterial growth, adhesion to hydroxyapatite on tooth surfaces, and production of insoluble glucan, which may affect in vitro plaque formation. The twigs may be used as a toothbrush, the bark for healing gum disease, the oil for soap, and the leaves for medicine[21].
4.	Cranberry (Vaccinium oxycoccus)	Antimicrobial	It stops the bacteria sticking to surfaces, ensuring that plaque is never given the chance to form. The compounds also prevent acid formation and reduce the acid tolerance of the bacteria that cause decay hence preventing prevent tooth decay[21].
5.	Triphala Amalaki (Emblica officinalis), Haritaki (Terminalia chebula) Bahera (Terminalia belerica)	Antioxidant, Antimicrobial	It has free radical scavenging property thus aiding in the protection of gum cells effectively from free radicals produced by the microorganisms[20].
6.	Turmeric (Curcuma longa)	Anti-mutagenic, anti-carcinogenic	Massaging the aching teeth with roasted, ground turmeric[20].
7.	Greater burdock (Arctium Lappa)	Anti-carcinogenic, anti-fungal, diuretic, anti-oxidant anxiolytic action, anti-platelet HIV-inhibitory action.	Intracanal medication for 5 days in teeth infected with C. albicans, E. coli, L. Acidophylus, P. Aeruginosa and S. mutants inhibited microbial growth after 14 days[19].
8.	Grape Seed Extract (Vitis vinifera)	Antioxidant, Anti-inflammatory, antibacterial and	It has been reported to strengthen collagen based tissues by increasing collagen cross-links. Promising natural agent for non-invasive root caries therapy[19].
9.	Shield sun dew (Drosera peltata)	Antibacterial	Aerial parts of the plant Droserapeltata showed broad spectrum activity spectrum activity against numerous bacteria of the oral cavity, with greatest activity against S.mutans and S. sobrinus[21].
10.	Garlic (Allium sativum)	Antibacterial, antifungal, anti-helminthic, bacteriostatic.	It is chopped and held in the mouth for 5 minutes to sterilize the oral cavity, which is due to its strong antibacterial activity. Fresh garlic juice kills Streptococcus pyogenes and corynebacterium diphteriae in 2-3 minutes time[20].
11.	Papaine (Carica papaya)	Anti-inflammatory, bacteriostatic, bactericidal	It is present in latex of the leaves and fruits of the green adult papaya. An active ingredient acts on the predegraded collagen of the lesion, promoting its softening, without acting on healthy adjacent tissue and without causing pain, has made this technique an effective alternative for treatment of carious injuries[20].

Table 1: Herbs in Dental Caries

12.	Long pepper (Piper cubeba)	Anti-oxidant, anti-inflammatory anti-microbial	Acetone, Methanol and Ethanol extracts of P.cubeba has shown activity against Streptococcal species namely, S.aureus and S.mutans with an MIC of 50 mg/ml[23].
13.	White Mulberry (Morus alba)	Anti-diabetic Anti-helminthic, antimicrobial antioxidant, anxiolytic, hepatoprotective and nephroprotective	Good source of Ascorbic acid, Carotene, Vitamin B1, folic acid, isoquercetin, quercetin, tannins, flavonoids and saponins, which are good antioxidants. Antibacterial agent kuwanon G isolated from root bark has showed action against Streptococcus mutants at an MIC of 8.0 µg/ml. The bactericidal test showed that kuwanon G completely inactivated S. mutans at the concentration 20 µg/ml in 1 min[23].
14.	Ajwain (Trachyspermum ammi)	antimicrobial antihypertensive, anti-spasmodic, broncho-dilating, antilithiasis, carminative, antipyretic	Real-time RT-PCR analyses showed that 2- Isopropyl-5-methyl-phenol isolated from these seeds were found to significantly suppress of the genes involved in biofilm formation and thus affect the cariogenicity of S.mutans[23].
15.	Babul, kikar or Indian gum Arabic tree (Acacia nilotica)	Anti-carcinogenic, Anti- spasmodic, Antiinflammatory, Anti-oxidant and Anti-platelet Aggregatory properties. A. nilotica has Anti-plasmodial, Antifungal, Anti-microbial activity, inhibitory activity against HCV and HIV	Acacia nilotica stem bark extracts contain alkaloids, saponins, cardiac glycosides, tannins, flavonoids and anthraquinones which have high inhibitory activity against Streptococcus mutans with a MIC in the range of 9.75-313µg/ml[23].
16.	Green Tea (Camellia sinensis)	Antimicrobial, anti-inflammatory, Thermogenic, Probiotic and antioxidant.	The alkaloids are said to interfere with microbial cell division, whereas flavonoids possess anti – glucosyl transferase activity and inhibit bacterial adherence. Tannins, on the other hand, inhibit bacterial growth with their strong iron – binding capacity and also inhibit glucosyl transferase activity and bacterial adhesion[22].
17.	Pudina (Mentha piperita)	Antioxidant, Antimicrobial	Its menthol component is the biologically active antioxidant. Pudina leaf extract displays antimicrobial activity against planktonic cells of S mutans and plaque inhibition[22].

Table 1: Herbs In Dental Caries

S.NO	Herbs	Mechanism of action	Method of application
1	Cranberry Juice (Vaccinium Macrocarpon)	Anti-bacterial	Prevents adhesion of oral pathogens to surfaces and related phenomena, such as the production of glucans and fructans, and the formation of biofilms[23].
2	Neem (Azadirachta indica)	Anti-bacterial	Its anti-inflammatory action can be attributed to its ability to inhibit prostaglandin E and Serotonin and its antibacterial action can be explained by "Azadiachtin" that is known to destroy bacterial cell wall and thus inevitably inhibit the growth of bacteria. Extract the juice from a few neem leaves. Apply this juice on the gums and teeth, allow it to sit for 5 minutes and then rinse it off with warm water[24].
4	Common madder (Rubia Cordifolia)	Anti-inflammatory	The roots of this plant have been used in ayurvedic medicine. It also contains an organic compound known as Alizarin, which gives the red color to textile dyes. Mollugin, a major component of R. cordifolia has been shown to possess anti-inflammatory property[24].

Table 2: Herbs Used In Periodontal Disease

5	Sumac (Rhus coriaria)	Anti-inflammatory, antimicrobial, antioxidant	It has showed antioxidant activity against lipid peroxidation and free radicals in vitro Serum total oxidant status (TOS) and oxidative stress index (OSI) were significantly reduced in the sumac extract treated rats. Orally administered to reduce bone alveolar levels[24].
6	Maidenhair tree (Ginkbo Biloba)	Anti-inflammatory	Its purported biological effects include: Scavenging free radicals, lowering oxidative stress and anti-inflammation .In ligatur-induced periodontitis rat model, systemic administration of EGb (28-56 mg/kg/day) resulted in reduced osteoclastic counts, decreased inflammation and induced osteoblastic activity[24].
7	Piperine (Piper nigrum)	Antioxidant, anti-inflammatory	In an animal model, LPS stimulated mice when treated with piperine showed reductions in the nitrite level and lowered the TNF-a level. This study corroborates the free radical scavenging activity of piperine[24].
8	Guava (Psidium Guajava)	Anti-inflammatory anti-bacterial	Guava leaf extracts and essential oil from the stem have the ability to scavenge hydrogen peroxide, superoxide anion and inhibit the formation of hydroxyl radical. The decoction of the root bark is recommended as a mouthwash and decoction of leaves as an effective gargle for bleeding gums[24].
9	Green Tea (Camellia sinensis)	Anti-oxidant, anti-inflammatory	It prevents the adherence of P. gingivalis onto human buccal epithelial cells. Catechin present in green tea is also highly potent in suppressing the bone resorption mediated by an inflammatory response as seen in periodontal disease[25].
10	Aloe Vera (Aloe Barbadensis)	Anti-inflammatory, anti-bacterial	It destroys bacteria responsible for gingivitis. It also helps in speeding up of the process of healing. Massaging the aloe gel into the gums has many therapeutic benefits[24].
11	Gotu kola (Centella asiatica	Anti-inflammatory	If surgery is required, this botanical can be helpful in speeding recovery after laser surgery for severe periodontal disease. Dosage is based on triterpenic acid
12	Olive (Olea europaea)	Anti-inflammatory, Antioxidants.	Take a tablespoon of extra virgin olive oil and swish around your mouth for a couple of seconds and then spit. It will wash away all the toxins. Repeat three times a day for best results[25].
13	Clove (Syzygium aromaticum)	Anti-inflammatory	Rub the gums with clove oil or just chew a piece of clove[25].

Table 2: Herbs Used In Periodontal Disease

14	Frankincense extract (Bowsellia)	Anti-inflammatory antibacterial effects	The effect of Frankincense powder or extract in the treatment of gingivitis was studied by various authors and was found that administration of 0.1 g of Frankincense extract or 0.2 g of its powder led to a significant decrease in various gingival and plaque scores due to its anti-inflammatory and anti-bacterial effects. It was also preferred by patients due to its low cost and easy availability[22].
15	Ginger (Zingiber officinale)	Anti-inflammatory	It inhibits Arachidonic acid metabolism via the cyclooxygenase and lipoxygenase pathways[26].

Table 2: Herbs Used In Periodontal Disease

S.NO	Vitamins in Oral Cancer	Mechanism of action	Sources	Method of application
1	Provitamin A (Beta-carotene)	Antioxidant, Immunomodulating Inhibition of cancer cell growth.	Dark green, orange or yellowish fruits and vegetables, such as spinach, carrots, sweet potato, mango, papaya, and oranges.	Beta-carotene is also used for scavenging free radicals such as peroxyl and hydroxyl radicals in areas of low oxygen concentration. In various oral premalignant lesions and conditions, serum beta carotene levels are shown to be decreased and thus its supplementation (30 mg/day) has led to the regression of these lesions[27].
2	Vitamin C (L-ascorbic acid)	Chemotaxis, Phagocytosis, and Collagen synthesis. Inhibits nitrosamine formation. Anti-oxidising property	Citrus fruits such as kiwi, strawberries, papaya, and mango	L-AA has an antioxidizing property and reacts with the superoxide produced as a result of the cells' normal metabolic processes; It inhibits the formation of nitrosamines and avoid damage to the DNA and cellular proteins[27]
3	Vitamin E (α-tocoferol)	Antioxidant	Plant oil, margarine, and green leaves	Free radical scavenging. Maintenance of membrane integrity, immune function. Inhibition of cancer cell growth/differentiation. Cytotoxicity. It inhibits mutagenicity and nitrosamine formation. Prevents DNA, RNA, and protein synthesis in cancer cells[27].

Table 3: Herbs Used In Oral Cancer

S.NO	Herbs in Oral Cancer	Mechanism of action	Sources	Method of application
1	Spirulina (Arthrospira Platensis)	Antioxidant	An excellent source of protein, beta-carotene, gamma linolenic acid, B-vitamins, minerals, chlorophyll, sulfolipids, glycolipids, superoxide dismutase, phycocyanin, and enzymes	The nutrients present in Spirulina boost the immune system and enhance the body's ability to generate new blood cells to prevent disease and cancer[27].
2	Green tea (Camellia Sinensis)	Anti-carcinogenic, anti-oxidant	Dried leaves of camellia sininesis	EGCG (epigallocate-chin-3-gallate), which is the most biologically active catechin — is likely a result of inhibition of tumor initi-ation and promotion, thus retarding the growth and development of neoplasms [27].
3	Neem (Azadirachta indica)	Anti-inflammatory, anti-oxidant	Leaves ,fruits seed oil	Catechin can inhibit the pro-duction of metalloproteas-es, inducing the apoptosis It has anti-inflammatory effect by suppressive activation of nuclear factor κ-b (NFκ-b), which induces the apoptosis of cancer cells[27].
4	Lycopene (Lycopersicum)	Antioxidant	Tomatoes and other red fruits and vegetables, such as, red carrots, wa-termelons, and papayas	Lycopene can reduce the risk of oral cancer, as it has been shown to inhibit the prolif-eration of KB-1 human oral tumor cell by up regulation of connexin-43 (gap junction pro-tein) expressions, concomitant with enhanced gap-junctional communication[27].
5	Curcumin (Curcuma Longa)	Anti-carcinogenic, anti-tumour activity	Turmeric	Inhibit cell growth and induce apoptosis in oral cancer cells. It enhances the cancer-fighting power of the treatment with a tumor necrosis factor-relat-ed apoptosis-inducing ligand (TRAIL). A recommended daily dose of up to 10 g can suppress tumor initiation, pro-motion, and metastasis[27].
6	Mushrooms (Agaricus bisporus)	Mutagenic and Anticancer activity.	B vitamins, selenium, copper, potassium	It fights against cancer and im-prove the immune system be-cause of the presence of certain glucans and polysaccharide peptides (proteoglycans)[27].
7	Vata or Vada tree (Ficus Bengalensis Linn.)	Anti-tumor, antibacterial	Fruits	Fruit extracts of Ficus species were screened for bioactivity. F. Bengalensis and F. religiosa demonstrated activity in the brine shrimp test (Artemia sa-lina) which indicates toxicity. All the fruit extracts exhibited antitumor activity in the potato disc bioassay[28].

Table 3: Herbs Used in Oral Cancer

8	Nuna (Morinda citrifolia / Noni)	Antitumor	Leaves and Flowers	The roots, stems, leaves, barks and fruits of Morinda citrifolia plant are involved in anti-tumour activity. Mostly Morinda citrifolia is consumed in the form of juice[29].
9	Sitaphalam (Annona squamosa)	Anti-tumour	Leaves, seeds	A.squamosa seed extracts induce apoptosis in BC-8 tumour cells by inducing oxidative stress. It would be of interest to identify the active component(s) present in the seed extracts showing such promising anti-cancer activity[29].
10	Triphala	Anti-cancer	Phytochemicals	Selenium as glutathione peroxidase inhibits the replication of tumour viruses and prevents the malignant transformation of cells. Triphala and its three constituents have shown V content in range 1-2 ug/g, plays a vital role in treatment of cancer[29].

Table 3: Herbs Used In Oral Cancer

S.N	Herbs	**Mechanism of action**	**Method of preparation**
1.	Tulsi leaves (Ocimum sanctum)	Bio adsorbent	Tulsi is the only material that had shown a consistent Defluoridation capacity both with boiling (31% to 42%) and without boiling (24.4% to 28.2%). Tulsi leaves were sun dried for a week and the leaves were grinded in a flour mill to a fine powder. This reduction could be attributed majorly to the coagulant proteins in plant leaves[30].
2.	Wheatgrass (Triticum aestivum)	Bio adsorbent ,natural coagulant	Leaves were sun dried for a week and grind into fine powder. Wheatgrass has shown deflouridating capability on boiling[30].
3.	Drum Stick (Moringa Oleifera)	Bio adsorbent	The seeds of the drumstick tree (Moringa oleifera) adsorb fluoride from water[30].
4.	Vetiver (Vetiveria zizanoides)	Blood purifier, cooling agent and tonic	The roots were effective at defluoridation and could remove as much as 70% of the fluoride from a sample. The defluoridation efficiency is higher[31].
5.	Tamarind (Tamarindus indica)	Antidote for fluoride poisoning	Maximum defluoridation is achieved at pH of 7; post defluoridation pH adjustment is not required.Tamarind seeds, a kitchen waste, obtained at much cheaper[31].
6.	Peepal Leaf (Ficus religiosa)	Bio Adsorbent	Fresh leaves chosen based on their crude fibre content and tress were obtained from peepal tree. The fresh leaves were sun-dried for 3–4 days, put in a cotton jute bag and sieved into desired particle size. For peepal leaf powder, the 1/n value is ~ 0.72 (<1), which indicates a favorable sorption[32].

Table .4: Herbs In Dental Fluorosis

S.N	HERBS	MECHANISM OF ACTION	SOURCES	METHOD OF APPLICATION
1.	Karoo umathai (Datura metel Linn.)	Antibacterial	Fresh Leaves	The fresh leaves are boiled with gingelly oil and applied topically on Tempo-ro-mandibular joint swelling[33].

Table.5: Herbs In Temporomandibular Joint Disorders

• Baptisia tinctoria relieves rigid muscles of jaw and a flushed red face.
• Calcarea fluorica is a specific remedy for relieving hard swelling and jaw tension related to anxiety
• Sanguinaria Canadensis relieves neuralgia pain in the upper jaw along with shooting pain. It also relieves twitching of cheeks towards the eyes.
• Causticum relieves neuralgic, tearing and drawing pains and prevents paralysis.
• Symphytum officinale relieves inflammation of facial bones [34].

Barriers In Implementation Of Green Dentistry

Despite the many benefits offered by the eco-friendly approach, dentistry as a whole has been slow to catch on to the trend. It is still a work in progress and it meets certain barriers in its implementation. Few of the shortcomings in this regard are as follows:

1. The first and foremost barrier in the implementation of eco-friendly dentistry is the "UNAWARENESS" of the concept among the concerned professionals. Green dentistry being a new, budding notion, is still doing rounds just on the internet, and a very few have worked on the concept.

2. The consideration of building a "Green Office" is one of the prerequisites in green dentistry. But those already with a conventional dental clinic would give a difficult time in getting convinced to re-build their offices according to the guidelines of green dentistry because it would be a costly affair and high costs may also be a deterrent for some dentists. Moreover, it is a time consuming pursuit to switch from conventional practice to green practice.12 (Mohelay et al. 2016).

3. The most frequently identified barriers to implementation of eco-friendly dental offices strategies were cost and lack of incentives from the government. There is a need for creating awareness among dentist practitioners regarding eco-friendly dental practices through formal and continuing dental education.

4. Over-exploitation of the natural resources. Dental professionals have a responsibility to conserve natural resources and to eliminate/reduce toxic wastes from their practices that could harm human health and environment[35].

Conclusion

Eco-Friendly dentistry is a newly evolving practice of dentistry, which encompasses a simultaneous devotion to sustainability, prevention, precaution, and a minimally invasive patient-centric as well as global-centric treatment philosophy. The four processes responsible for most of the dental practice waste and pollution are (1) Placement and removal of mercury containing dental material. (2) Conventional X-ray systems. (3) Infection control methods including disposable barriers, sterilization items and toxic disinfectants. (4) Conventional vacuum saliva ejector systems. Saliva ejector systems, also known as dental vacuum systems, are a critical piece of machinery for any dental office. Unfortunately, these dental vacuum systems utilize tremendous amount of water leading to wastage and to water pollution. Hence, dry vacuum system should be considered[8].

The current review discussed here has only dented the surface of what is a very intricate line of scientific and engineering exploration. Global warming is a big hazard and appropriate measures must be taken to tackle this serious problem. Dentistry is the paramount and foremost therapeutic profession. In today's world, it is very necessary to understand the importance of being eco-friendly in every aspect of our lives, including dental practice which has a massive impact on the environment because of large amount of metallic waste that is produced by numerous dental procedures. Eco-friendly dentistry is not merely a "feel Good"Endeavor. There is over-whelming evidence of global climate changes and the finite capacity of our planet's ecosystem to absorb further depletion and degradation. If environmental degradation was a stock, the industrial nations would be the primary share-holders. Thus, it is an ethical duty for all the dentists in world to play a primary role in developing sustainable solutions. This will help to safeguard the patient and workers. This will ensure to protect our air, water and land from the detrimental effects of the waste disposal. To conclude we quote Ray Kroc "As long you are green, you are growing. As soon you are ripe, you start to rot." So let us go green today and save mother Earth from biohazards for a better tomorrow.

References

1. Sawant, PH., Vimala, N., Padhye, L., 2017. "Let's go green to get our globe clean: Green Dentistry". Journal of Operative Dentistry and Endodontics, 2(1), pp.19-24.

2.Adams E. Eco-friendly dentistry: not a matter of choice. Journal (Canadian Dental Association). 2007 Sep;73(7):581-4.

3. Briggs D. Environmental pollution and the global burden of disease. British medical bulletin. 2003 Dec 1;68(1):1-24.

4. Climate Energy. Available at: http://www.nrcm.org/projects/climate/global-warming-air-pollution. Accessed on 05/06/18 .

5. Ripah US. Global Warming: Causes,Effects and Solutions. Durreesamin journal Aug 2015;1(4):pg 1-5

6. Rathakrishnan M, Priyadarhini A. Green dentistry: The future. Journal of the International Clinical Dental Research Organization. 2017 Jul 1;9(2):59.

7. Srinivasan K, Chitra S. Green dentistry: A metamorphosis towards an eco-friendly dentistry: A review. International Journal of Information Research and Review. 2015 Oct 29;12:1521-5.

8. Rastogi V, Sharma R, YAdAV LA, Satpute P, Sharma V. Green dentistry, a metamorphosis towards an eco-friendly dentistry: A short communication. Journal of clinical and diagnostic research: JCDR. 2014 Jul;8(7):ZM01.

9. Eram P, Shabina S, Rizwana M, Rana N. eco dentistry: A new wave of the future dental practice. Annals of Dental Specialty. 2017 Jan

1;5(1):14-7.

10. Singla, N., Singla, R., 2017. Dentistry- A Revolution: A Review. Guident online

Dental Magazine.

11. Mulimani P. Green dentistry: the art and science of sustainable practice. British dental journal. 2017 Jun;222(12):954.

12. Mohelay N, Shravani GD, Dolly J, Rashmi L, Sen S,Chapekar J. Eco-Friendly Dentistry: A Green Business with Teeth. Int J Oral Health Med Res 2016;3(2):66-70.

13. Aggarwal VP, Kakkar A, Singh S. Go green: a new prospective in dentistry. MOJ Curr Res & Rev. 2017;1(1):7-10.

14. Avinash B, Avinash BS, Shivalinga BM, Jyothikiran S, Padmini MN. Going green with eco-friendly dentistry. The journal of contemporary dental practice. 2013 Jul 1;14(4):766.

15. Passi S, Bhalla S. Go green dentistry. J Educ Ethics Dent 2012;10-2

16. Rathakrishnan M, Priyadarhini A. Green dentistry: The future. Journal of the International Clinical Dental Research Organization. 2017 Jul 1;9(2):59.

17. Sachdev, R., Wazir, S.S., Garg, K. and Singh, G. Green Route Indeed a Need for Dental Practice: A Review. World Journal of Pharmaceutical Research.2017 Jun; 6(7): 1878-1884

18.Buggapati, L.Herbs in Dentistry. International Journal of Pharmaceutical Science Invention.2016; 5(6): 7-12.

19. Shekar BR, Nagarajappa R, Suma S, Thakur R. Herbal extracts in oral health care-A review of the current scenario and its future needs. Pharmacognosy reviews. 2015 Jul;9(18):87.

20. Anushri M, Yashoda R, Puranik MP. Herbs: A good alternatives to current treatments for oral health problems. dermatitis (from topical application). 2015;7:9-12.

21. Seal,M., Talukdar, P., Maniyar, R., Shivakumar, G., Sahana, S., and Verma,S.Role of Herbs in Dental Caries: A Reviving Age Old Concept. International Journal of Current Medical and Pharmaceutical Research.2016; 2(11):1040-1043.

22.Megalaa N, Kayalvizhi G, Silas AJ, Sajeev R, Saravana Kumar MS.Role of herbal leaves in caries prevention. International Journal of Contemporary Medical Research.2014; 1(2):71-78.

23.Adyanthaya, A., Ismail, S. and Sreelakshmi, N. Indian traditional medicinal herbs against dental caries–An unsung past to a bright future. Saudi J Oral Res.2016;1(1):1-6.

24. Ramesh A, Varghese SS, Doraiswamy JN, Malaiappan S. Herbs as an antioxidant arsenal for periodontal diseases. Journal of intercultural ethnopharmacology. 2016 Jan;5(1):92.

25. Kim MY, Park BY, Moon CH, Park EK, Kim KM, inventors; AngioLab Inc, assignee. Composition comprising Melissa leaf extract for anti-angiogenic and matrix metalloproteinase inhibitory activity. United States patent US 7,485,327. 2009 Feb 3.

25.Anand, B. Herbal Therapy in Periodontics: A Review. Journal of Research in Pharmaceutical Science.2016; 1(3):01-07.

26. Pandita V, Patthi B, Singla A, Singh S, Malhi R, Vashishtha V. Dentistry meets nature-role of herbs in periodontal care: A systematic review. Journal of Indian Association of Public Health Dentistry. 2014 Jul 1;12(3):148.

27. Danaraddi S, Koneru A, Hunasgi S, Ramalu S, Vanishree M. Natural ways to prevent and treat oral cancer. Journal of Oral Research and Review. 2014 Jan 1;6(1):34.

28. Mousa O, Vuorela P, Kiviranta J, Törnquist K, Vuorela H, Hiltunen F. Bioactivity of certain Egyptian Ficus species. Planta Medica (Germany). 1992.

29.Kaur , H., Gurjar , N., and Gill, R. A systematic review on anticancer potential and other health beneficial pharmacological activities. Journal of Medicinal Plants Studies.2018; 6(2):86-93.

30. RaMeSh MV, Naveenkumar PG, PRaShant GM, Sakeenabi B. Evaluation of Effect of Brushite-Calcite and Two Indigenous Herbs in Removal of Fluoride from Water. Journal of clinical and diagnostic research: JCDR. 2016 Jun;10(6):ZC83.

31. Manjula K. International Journal of Environmental Science and Technology. International Journal of Environmental Science and Technology. 2016;1(1):61-4.

32. Dwivedi S, Mondal P, Balomajumder C. Bioadsorption of fluoride by Ficus religiosa (Peepal leaf powder): Optimization of process parameters and equilibrium study. Research Journal of Chemical Sciences. 2014 Jul;4(7):52-60.

33. Arjun TN, Sudhir H, Saxena E, Dayma A, Raghuvanshi RS, Shah R. ROLE OF SIDDHA SYSTEM OF MEDICINE IN THE MANAGEMENT OF ORO-FACIAL DISEASES: A REVIEW.

34. Health and Herbs. Retrieved from http: // health herbs and nutrition .com / index .php /2018/03/19/tmd/. Accessed on 05/06/2018.

35. Chopra A, Raju K. Green dentistry: Practices and perceived barriers among dental practitioners of Chandigarh, Panchkula, and Mohali (Tricity), India. Journal of Indian Association of Public Health Dentistry. 2017 Jan 1;15(1):53.