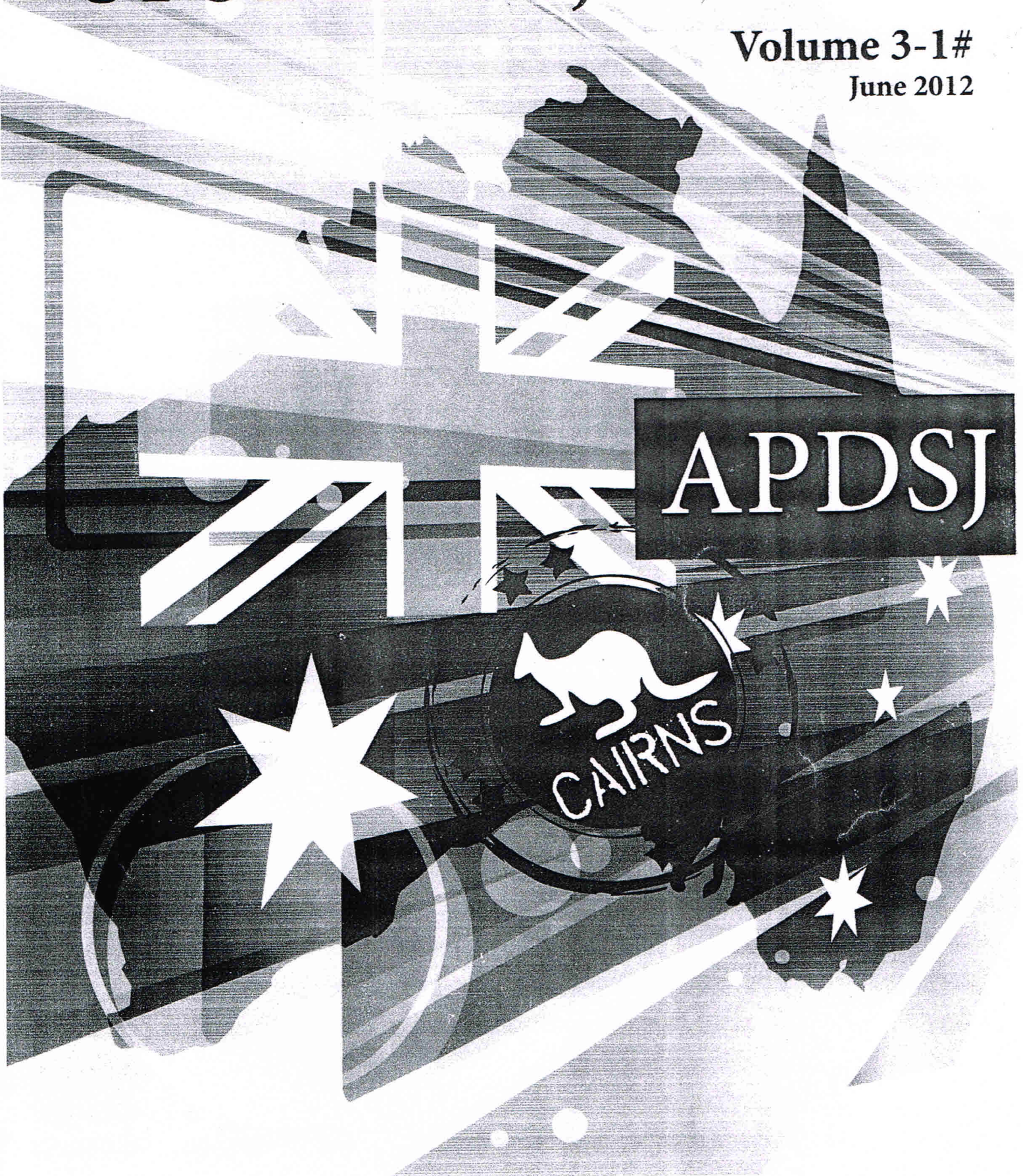


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ABSTRACT

Background: Oil pulling is an ancient medicine mentioned that is a widely recommended procedure in Ayurveda. In many countries, it has been used extensively as a traditional folk remedy to strengthen the gums, and to prevent and to treat decay, oral malodor, loose gums, bleeding of the gums, swollen lips and loosened teeth. **Purpose:** The aim of this study was to assess the mechanism of oil pulling therapy in improving gingival health. **Methods:** This is a complementary and alternative medicine using primarily olive oil as a natural product which because the products of spices used are natural. The oil pulling therapy with olive oil was used for one of it. The olive oil was shown to inhibit COX-2 enzyme which protects cavity from infection and inflammation by its antioxidant property. COX-2 is expressed in inflammatory cells and plays a key role in the tissue repair process. The olive oil also contains a main phenolic compound called Hydroxytyrosol which has anti-oxidative properties with powerful antioxidant activity and can inhibit the reactive oxygen species (ROS). The oil pulling therapy may significantly reduced plaque scores. The viscosity of the oil may inhibit bacterial adhesion and plaque co-aggregation. The bacteriosid effect of oil was shown as it may reduce *Porphyromonas gingivalis* count in plaque and saliva after oil pulling therapy. **Conclusion:** oil pulling therapy may be beneficial in non surgical phase of periodontal therapy as it may modulate the detrimental host responses. We suggest to conduct a further scientific research and evaluation of this ancient health practice as an adjunct in periodontal therapy and host modulatory agent.

Keywords: oil pulling therapy, gingivitis, COX-2 enzymes

INTRODUCTION

Ayurvedic medicine, or Ayurveda, is one of the ancient medical system that originated in India. The term "Ayurveda" consists of the Sanskrit words *ayur* (life) and *veda* (science/knowledge), then Ayurveda means "the science of life" or "the knowledge for long life".^{1,2} In some countries, for example the United States, Ayurveda is considered as a complimentary and alternative medicine that is offered as herbs, massage and specialized diets.² Furthermore, its treatments rely heavily on herbs and other plants, including oils and common spices.²

Ayurveda traditionally uses certain oils for oil pulling, such as sesame oil, coconut oil, almond oil, vegetable oil and other organic and cold-pressed oils for this purpose. Numerous studies had revealed that oil pulling therapy has the ability to improve oral hygiene and reduce plaque and gingivitis.³ Olive oil is also a kind of good quality oil that can be used in oil pulling therapy in dentistry. In vitro microbiological experiments were conducted to examine the effect of olive oil, it is resulted that there are significant plaque inhibition and the decreasing of bacterial growth and adhesion.⁴

The aim of this literature review is to discuss about the Olive oil (*Olea europeae L.*) as alternative natural, safe and effective material in oil pulling therapy for reducing gingival inflammation, increasing oral hygiene and avoiding of periodontal disease.

Oil Pulling Therapy

Many people believe that the therapeutic effects and the science behind oil pulling is the effects caused by the absorption of toxins and chemicals through blood vessels in the mouth and tongue, as well as sublingual/transmucosal absorption of the fatty acids in the oils used for pulling.⁶ Oil pulling is one of the alternative medicine treatments that is a widely recommended procedure in dentistry. It has been used extensively as a traditional remedy for gingivitis, tooth aches, and the prevention of decay, oral bleeding, gum disease, cracked lips, and loose fixed loosened teeth. The method of oil pulling consists of swishing a small amount of vegetable oil in the mouth for 15 to 20 minutes. It is done by pulling the oil through the mouth for a period of 15 to 20 minutes. It is done 1 to 2 times a day on an empty stomach. The best time to do it is before eating breakfast, but it can be done before any meal. The oil is drawn into the mouth and rinsed out with water. The oil is never swallowed because it is loaded with bacteria, toxins, and pus.⁶ The therapy is also claimed to cure about 30 systemic diseases ranging from headache, diabetes, asthma, skin conditions, allergies, oral bacterial infections, gum problems and more.

Oil pulling has a very powerful detoxifying effect. Mouths are the home to billions of bacteria, viruses, fungi and other parasites and their toxins. *Candida* and *Streptococcus* are common residents in the mouths. It is these types of germs and their toxic waste products that cause gum disease and tooth decay and contribute to many other health problems including arthritis and heart disease. Immune system is constantly fighting these troublemakers. If the immune system becomes overloaded or burdened by excessive stress, poor diet, environmental toxins and such, these organisms can spread throughout the body causing secondary infections and chronic inflammation, leading to any number of health problems.³

Olive Oil

Olive is native to Mediterranean basin, wild olives from the trees were collected by Neolithic peoples in the early of 8th millenium BC.⁹ The wild olive tree originated in Asia Minor in modern Greece.¹⁰ The earliest surviving olive oil amphorae date to 3500 BC (Early Minoan times), though the production of olive oil is assumed to have started before 4000 BC. An alternative view retains that olives extracted into oil by 4500 BC by Canaanites in present-day Israel.¹¹

Olive oil is a fundamental ingredient that is used in Mediterranean diet. Over the past few years, its diffusion and consumption have spread outside the Mediterranean basin. The growing interest in olive oil lies on its taste and nutritional properties. Besides as food, olive oil also has been used for religious rituals, as a fuel in oil lamps, soap-making, skin care application and medicines. There is a wealth of epidemiological evidence showing that Mediterranean populations who consume large volumes of olive oil in their daily diets (about 25–50 ml/day) have reduced risk for certain chronic diseases (such as atherosclerosis, cardiovascular disease, particular types of cancer, and extended life expectancy compared with other geographic populations.^{12-14,39} Furthermore, studies (including human, animal, in vivo and in vitro) have shown that olive oil phenolics have beneficial effects on certain physiological parameters, such as plasma lipoproteins, oxidative damage, inflammatory markers, platelet and cellular function, antimicrobial activity, and bone health.^{15,16}

Olive oil is an extraction product from the fruit of *Olea europaea* L., and is composed of about 90-99% glycerol fraction and 0,4-5% non-glycerol fraction.¹⁷ Olive oil is mainly composed of triacylglycerides, glycerol and contains small quantities of free fatty acids, glycerol, phospholipids, pigments, polyphenolic compounds, other minor components (waxes, tocopherols, hydrocarbons, etc.).¹⁸ Olive oil contains 70-80% of the fatty acid content in olive oil. Triacylglyceride contains two components glycerol and fatty acids. Fatty acids are hydrocarbons with a carboxylic acid group varying in length between 16 and 24 carbon atoms in olive oil.

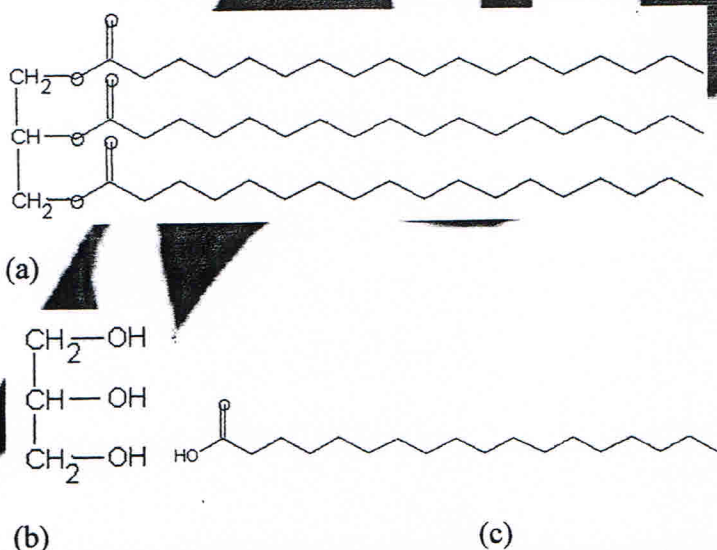


Figure 1. Chemical structure of olive oil (a) tryglycerides (b) glycerol (c) fatty acids.²⁰

The beneficial effects of olive oil could be due to its components, such as phenolic compounds, α -tocopherol, carotenoids and to the high unsaturated/ saturated fatty acid ratio with oleic acid (MUFA).^{21,22} Monounsaturated fatty acids in olive oil showed a healthy impact on plasma cholesterol level.²³ Olive oil also has been shown to have relation with a better quality of life, longevity, and a lower incidence of cardiovascular disease, cancer, and cognitive degeneration.²⁴ The oleic acid and other non-glycerol fraction, such as phenol and tocopherols, exhibit a high nutritional status and biological value.¹⁹ In various studies (in vivo and in vitro), the polyphenols in olive oil have been

described and demonstrated as the main components that attributed the anti-inflammatory, anti-microbial and anti-oxidant properties.^{22,25,26}

The olive oils also have a bactericidal activities against microorganisms. Various experiments showed that olive oil can act as bacteriostatic in formulas of some products for oral hygiene which contains an average content of olive oil (1-60% of the formula).²⁷ Most of foodborne pathogens did not survive after 1-hour contact with olive oils.²⁸ It also reduced the population of bacteria present in the buccal cavity and bacterial plaque, both supra-and infra-gingival with a significant improvement of periodontal health (reduction of cavities, gingivitis and improvement in periodontitis), like *Streptococcus mutans*, *Staphylococcus aureus*, *Porphyromonas gingivalis*, and also the other anaerobic and gram-negative species bacteria, microorganisms that mostly cause the occurrence of dental diseases and halitosis.²⁷

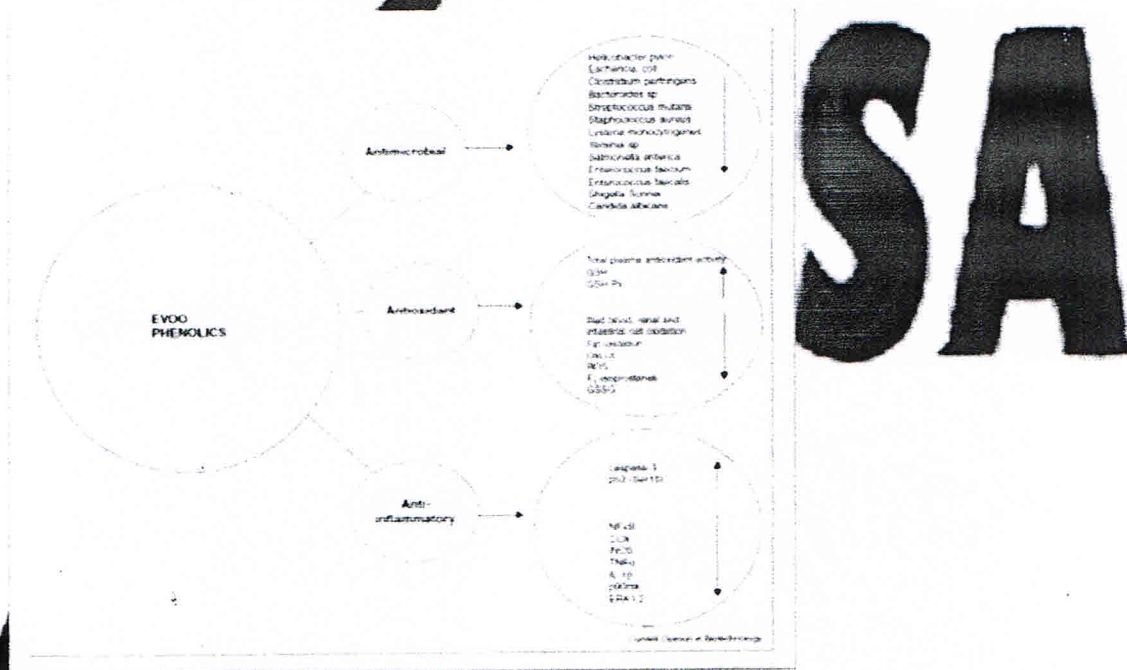


Figure 2. Overview of the antimicrobial, antioxidant and anti-inflammatory activities of extra virgin olive oil (EVOO) phenolic compounds.²²

Up to 36 phenolic compounds have been identified in olive oil.¹⁵ Phenolic compounds found in extra virgin olive oil, including the dialdehydic form of decarboxymethyl oleuropein, aglycon, oleocanthal, hydroxytyrosol and tyrosol, have been shown to possess potent activity against several strains of bacteria.^{22,29} Additional beneficial effects on oxidation also have been demonstrated by olive oil phenolics in vitro. Olive oil phenolics have been found to decrease reactive oxygen species (ROS) production and elicit significant free-radical scavenging effects.^{30,31} In vivo and in vitro research

also has reported the phenolics may attenuate inflammatory responses in the body and reduce the risk of chronic inflammatory disease development.^{22,32}

OleochantL compound possesses an antiinflammatory ability, a relatively similar chemical structure than ibuprofen, due to its dose-dependent ability to inhibit cyclooxygenase (COX) enzymes, both COX-1 and COX-2, which are involved in the prostaglandin biosynthesis (inflammatory) pathway.³⁹

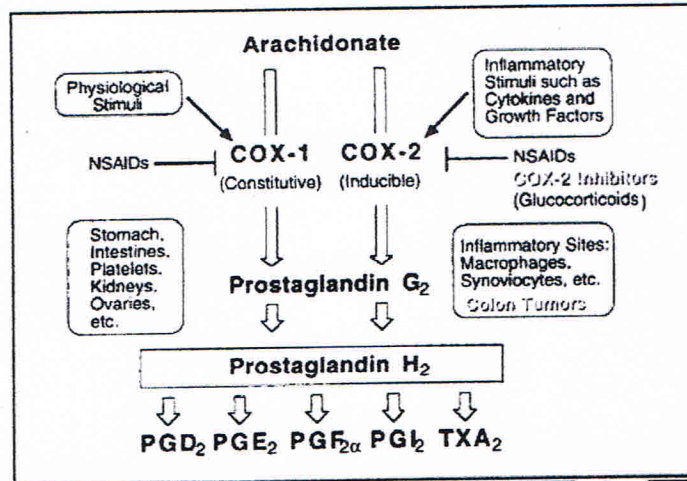


Figure 3. Arachidonate metabolism pathway of prostaglandin synthesis. Cyclooxygenase enzyme COX1 and COX2 are found in olive oil act as the NSAIDs. NSAIDs inhibit COX-1 and COX-2.

Besides, Oleocanthal has also been found to escape hydrolysis under stomach-simulated conditions and is effective in inhibiting the growth of *Helicobacter pylori* bacteria, which have been associated with peptic ulcers and gastric cancer development.⁴² The anti-inflammatory actions of oleocanthal reported most recently, conclude that this compound has potent pharmacological actions in attenuating inflammatory mediators such as inducible nitric oxide synthase (iNOS) which plays a role in the pathogenesis of joint degenerative disease.⁴³

In vitro has shown that oleuropein aglycone, one of the olive oil phenolics, inhibits tumour necrosis factor alpha (TNF α) induced matrix metalloproteinase 9 (MMP-9) in a monocyte cell line, and this has implications for health as monocytes along with the molecules they express play a significant role in inflammation-based disease development.⁴⁵

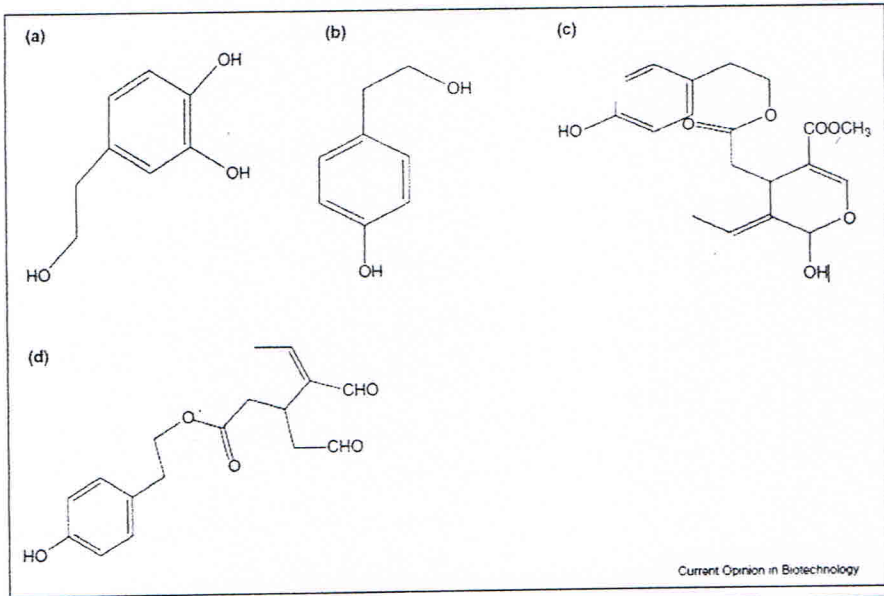


Figure 4. Much research has been conducted to investigate the health-promoting properties of hydroxytyrosol, (b) tyrosol, and (c) polyphenolic compounds. Tyrosol has been shown to have antioxidant and phenolic of much interest. Tyrosol has been shown to have a potent antioxidant activity.

Tyrosol and Hydroxytyrosol are phenolic compounds that have been shown to have antioxidant effects. Hydroxytyrosol differs from tyrosol by having an additional hydroxyl group at position 3 on the phenyl ring. Tyrosol has been shown to conduct protective effects against oxidative injuries in cell systems. It showed a high protective effect in GSH and reduced intracellular antioxidant defences.⁴⁵ Hydroxytyrosol also shows cardioprotective effects, preventing oxidative stress-induced endothelial dysfunction⁴⁸, inhibiting lipid and protein oxidation in human plasma⁴⁹, a wide range of antitumor effects, inhibiting proliferation and promoting apoptosis in several human tumour-cell lines through several mechanisms.⁵⁰

Gingivitis

Gingivitis is diagnosed by the presence of redness, swelling, and increased edema of the gingival tissues. There may be increased pocket depth without attachment loss caused by gingival enlargement, and bleeding on probing is a hallmark of gingivitis and periodontitis. Epidemiological research show that there is a near relation between amount of supragingival plaque and chronic gingivitis, so that clinically research has been proved that supragingival plaque as a main etiology of gingival inflammation³³.

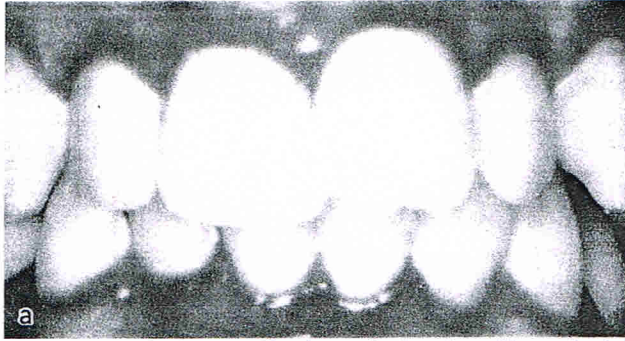


Figure 5. Typical generalized marginal and papillary gingivitis³⁴

Gingival bleeding varies in severity, duration, and ease of provocation. Bleeding on probing is easily detected clinically and therefore is of value for the early diagnosis and prevention of more advanced gingivitis. It has been shown that bleeding on probing appears earlier than a change in color. Other signs of inflammation, in addition, the use of bleeding rather than color to detect early inflammation is advantageous that bleeding is a more subjective sign that requires subjective estimation by the examiner. Increased gingival bleeding on probing indicates an inflammation in both the gingiva and the connective tissue. It exhibits specific histological differences from many gingivitis. Even though gingival bleeding may be a good diagnostic indicator for inflammation, attachment loss is not an excellent negative predictor for periodontal loss³⁶. Score and index for gingival index (GI) were as follows:

- 0 = Normal gingiva.
- 1 = Mild inflammation: slight change in color and slight edema no bleeding on probing.
- 2 = Moderate inflammation: redness, edema, and Glazing, bleeding on probing.
- 3 = Severe inflammation: Marked redness and edema; ulceration; tendency to spontaneous bleeding.

The most common cause of abnormal gingival bleeding on probing is chronic inflammation. The bleeding is chronic or recurrent and is provoked by mechanical irritation (e.g., from toothbrushing, toothpicks, or food impaction) or by biting into solid foods such as apples.³⁵

The severity of bleeding and the ease of its provocation depend on the intensity of the inflammation. Subgingival plaque (plaque below the gum line) is associated with periodontitis, an inflammatory disease characterized by the irreversible destruction of the epithelium, connective tissue, and bone supporting the teeth. Gingivitis is associated with a mixture of gram-positive (56%) and gram-negative species(44%), as well as facultative(59%) and anaerobic species(41%).³⁵ Dominant Gram-positive species consist of *S. Sanguins*, *S. Mitis*, *S. Intermedius*, *S oralis* *A. Viscosius*, *A. Naeslundii*, *Peptostreptococcus micros*. Dominant gram-negative species consist of *F nucleatum*, *Prevotella Intermedia*, *V. Parvula*, *Haemophilus influenzae*, *Captocyphaga*, *Campylabacter*.³⁷

Gingivitis can be a preamble to periodontal diseases and involves anaerobic bacteria commonly found in supragingival plaque, for example, *Porphyromonas gingivalis*, *Fusobacterium nucleatum* and *Prevotella intermedia*³⁷. The general view is that not all gingivitis leads to periodontal disease but that infectious periodontal disease usually follows gingivitis. Chronic gingivitis often results in mild bleeding from the gums during tooth brushing, which is generally only a minor inconvenience unless underlying blood dyscrasias or bleeding disorders exist.³⁵

DISCUSSION

From over the years oil pulling users all over the world are giving enough evidence that by oil pulling they were getting benefit. Mouth is normally teeming with bacteria and saliva also is a key defense against bacteria and viruses. It contains enzymes that destroy bacteria in different ways, but harmful bacteria can sometimes grow out of control and lead to periodontitis, a serious gum infection.⁴

The phenolic compounds found in olive oil including oleocanthal, oleocanthal aldehyde, and oleocanthal diol. Oleocanthal is a dihydrochalcone, a type of flavonoid. It is a natural anti-inflammatory compound. Oleocanthal has been shown to possess anti-inflammatory activity against several strains of bacteria. Oleocanthal is one of olive oil phenolic compounds that is considered to be a natural benefit product. This compound possesses anti-inflammatory activity, similar to ibuprofen, but with a different structure than ibuprofen. It is a natural anti-inflammatory compound. Oleocanthal inhibits COX (COX) enzymes, COX-1 and COX-2, which are involved in the prostaglandin biosynthesis (the cyclooxygenase pathway). Some studies have shown that oleocanthal inhibits the production of prostaglandins, which are mediators of inflammation in human breast and prostate cancer lines. Therapeutic activities have also been shown by oleocanthal in the treatment of Alzheimer's disease.⁴¹

Tyrosol and hydroxytyrosol are phenolic compounds obtained from olive extract with antioxidant properties. Tyrosol penetrates and accumulates in macrophages and improves the intracellular antioxidant defence systems. Besides, in vitro hydroxytyrosol has been reported to attenuate the TNF- α , iNOS, and COX-2 in LPS-induced human monocytic (THP-1) cells. Hydroxytyrosol also displays anti-inflammatory effect, it inhibited the production of nitric oxide and prostaglandin E (PGE) and decreased secretion of cytokines and chemokines, reduced the expression of genes, and inhibited PGE synthase in murine macrophages.^{46,47} Hydroxytyrosol phenolic antioxidants reduced generation of ROS (Reactive Oxygen Species), which plays key role in many physiological and pathogenic processes, including signal transduction, inflammation, aging, neurodegeneration and atherosclerosis.⁵¹ H₂O₂ is an ubiquitous ROS main product which can activate signaling processes, induce cytotoxicity in many cells, then lead to oxidative damage.⁵²

Pathological changes on gingiva because of microorganism adhesion at the tooth surface or surrounding gingival sulcus is called gingivitis. This gingival inflammation is happened because the present of microorganism product had activated monocytes and macrophages then yields some inflammation mediators like PGE2, INF, TNF, and IL-2. At this study, olive oil pulling functionate as therapeutic because it could decrease plaque even reducing gingivitis. The mechanism of olive oil phenolics as antimicrobial activities inhibit gingival bacteria for example, *Streptococcus mutans*, *Streptococcus*

aureus and *Porphyromonas gingivalis*. Oleocanthal and hydroxytyrosol possess potent activities against several strains of bacteria and attenuate inflammatory responses in the body and also decrease reactive oxygen species (ROS) production.^{22,29-32} Oleocanthal also inhibits cyclooxygenase (COX) enzymes, both COX-1 and COX-2, which are involved in the prostaglandin biosynthesis (inflammatory) pathway in gingiva without attachment.⁶

Another research is also conducted to evaluate the effectiveness of bacterial plaque elimination and in the bleeding decrease in gingivitis. Sixty samples were divided into three groups with 20 persons for each group. The first group being required to use water for tooth-brushing, second group were to use olive oil and the third group were to use sunflower oil. The result showed that the group who used olive oil obtained a smaller bleeding index and greater bacterial plaque elimination than the others. It concluded that olive oil is a suitable substance for achieving total elimination of plaque and combating gingivitis as the first sign of periodontal pathology.²⁷

The pathological events leading to the destruction of the periodontium during inflammatory periodontal diseases are likely to represent complex interactions involving an imbalance in enzymic and non-enzymic degradative mechanisms. This paper also to review the increasing body of evidence implicating reactive oxygen species (ROS), derived from many metabolic sources, in the pathogenesis of periodontal tissue destruction. ROS are generated predominantly by polymorphonuclear leukocytes (PMN) during an inflammatory response and are regarded as being highly destructive in nature. The detection of ROS oxidation products, the elevation of iron and copper ions, which catalyse the production of the most reactive radical species, and the identification of an imbalance in the oxidant/antioxidant activity within periodontal pockets, suggests a significant role for ROS in periodontal tissue destruction. In vitro studies have shown that ROS are capable of degrading a number of extracellular matrix components including proteoglycans, resulting in the modification of amino acid functional groups, leading to fragmentation of the core protein, whilst the constituent glycosaminoglycan chains undergo limited depolymerisation. The identification and characterisation of connective tissue metabolites in gingival crevicular fluid (GCF) resulting from the degradation of periodontal tissues, notably alveolar bone, provides further evidence for a role for ROS in tissue destruction associated with inflammatory periodontal diseases.⁵³

It is concluded that oil pulling therapy may be beneficial in non surgical phase of periodontal therapy as it may modulate the detrimental host responses. We suggest to conduct a further scientific research and evaluation of this ancient health practice as an adjunct in periodontal therapy and host modulatory agent.

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