

Evaluation Of Surface Tension And Antioxidant Properties Of Essential Oils

Research Article

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Abstract

Aim: The aim of the study was to assess the antioxidant property and surface tension of oils used during instrument retrieval.

Materials And Methods: Four solutions were prepared: corn oil, soya oil, orange oil and liquid EDTA. 100 ml of each solution was prepared and assessed for antioxidant activity and surface tension property.

For antioxidant property - DPPH assay was used. In different test tubes the respective oils were mixed with ethanol solution at different concentrations (10–50 µg/ml) Then 0.8 ml of 100 mM tris HCl buffer was added to them and pH was adjusted to 7.4. Then DPPH (500 mM in 1.0 ml ethanol) solution was added to the above mixtures.

Absorbance of the resulting solution was measured at 517 nm UV-Visible Spectrophotometer

The surface tension of four liquids was measured using a goniometer.

Results: Orange oil showed more surface tension when compared with Corn Oil, EDTA & Soya Oil. EDTA showed the highest antioxidant property compared to corn oil, soya oil, orange oil.

Conclusion: Within the limitations of the study it was seen that EDTA has better antioxidant property compared to other three groups. Orange oil has more surface tension when compared to other three groups. However, more clinical trials need to be done to get conclusive results.

Keywords: Surface Tension; Antioxidant Activity; DPPH Assay; Corn Oil; EDTA; Orange Oil; Soya Oil.

Introduction

Oxygen is an essential element which is important for life and it plays an important role in promotion and deterioration of human health. Gershan's free radical theory of oxygen toxicity in 1954 threw light on the toxicity of oxygen due to its partially reduced form[1]. When cells use oxygen to generate energy in the form of ATP in the mitochondria, free radicals are created [1, 2]. A free radical is defined as “any species capable of independent existence that contains one or more unpaired electrons. They are a family of highly reactive and diverse species, capable of extracting electrons and thereby oxidizing a variety of bio molecules vital to cell and tissue function, which not only includes oxygen free radicals, but also nitrogen and chlorine species[1, 3].

In recent years, the term “reactive oxygen species” (ROS) has

been adopted to include molecules such as hydrogen peroxide (H₂O₂), hypochlorous acid (HOCl) and singlet oxygen (O₂), which though, not radical in nature, are capable of radical transformation in the extra- and intracellular environments[1-4]

Antioxidants are defined as “those substances which when present at low concentrations, compared to those of an oxidizable substrate, will significantly delay or inhibit oxidation of that substrate[5].

Oxidative stress is defined as “disturbance in the pro oxidant - antioxidant balance in favour of former, leading to potential damage”[6]. It has been implicated in the pathogenesis of various chronic and degenerative conditions including cancer, arthritis, aging, autoimmune disorders, cardiovascular and neurodegenerative diseases[6, 7].

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Antioxidants are capable of deactivating free radicals before they attack human cells. Humans do generate highly complex antioxidant systems (enzymatic and non enzymatic), which work synergistically and in combination with each other to prevent cells or organs against free radical[6-8].

Another important aspect of root canal treatment is disinfection which involves mechanical preparation of the canal along with chemical debridement. This includes irrigation of the canal[9]. Irrigation of the canal involves various properties of the irrigant such as nature of the irrigant, viscosity, surface tension and various other flow characteristics. Irrigants must be used with the aim of complete debridement of the canal. To achieve this, the irrigant must be in contact with the dentinal wall[10]. The intimacy of this contact is dependent on the wettability of the irrigant which is solely a subvariant of surface tension. The surface tension is defined as “the force between molecules that produces a tendency for the surface area of a liquid to decrease”[11]. The irrigants for endodontic use should have very low surface tension. By improving the wettability, an irrigant solution could enhance better antimicrobial activity by increasing its protein solvent capability even in the uninstrumented areas of the root canal[12].

Liquid EDTA is normally used in a concentration of 17% and is frequently used as an irrigant in root canal treatment. Its main activity is toward smear layer removal because of its chelating power which makes it effective in removing the inorganic component of dentin[13]. But it is ineffective in removing the smear layer and also has high surface tension and it is unable to reach bacteria in the depth of the dentinal tubules. A quaternary ammonium bromide has been added to EDTA solutions to reduce surface tension and increase penetrability of the solution[14].

Natural products have shown reliable outcomes in various aspects of endodontic therapy. They have been gaining popularity due to their lower immunogenicity, easy availability and less harmful effects. One of such many natural products are corn oil and orange oil[15].

Orange oil, Corn oil is said to have superior antioxidant property due to the presence of flavonoids. The surface tension of the oil changes with the amount of heat applied to the oil[16]. Warming of the liquid decreases the viscosity and thereby increases the surface tension. Soya bean oil is rich in Vitamins A,E which are antioxidants[17]. Hence soya bean oil and corn oil being natural products and also potent antioxidants can be employed as irrigants[18]. The purpose of this study is to assess the surface tension and antioxidant property of soya bean oil, Orange oil, Liquid EDTA and corn oil used as lubricants during instrument retrieval. Previously our team has a rich experience in working on various research projects across multiple disciplines [19–33]. Now the growing trend in this area motivated us to pursue this project.

Materials And Methods

Sample Preparation

Four oils namely : corn oil, soya oil, orange oil and liquid EDTA were taken. 100 ml of each solution was used and assessed for antioxidant activity and surface tension property.

DPPH Assay

In different test tubes the respective oils were mixed with ethanol solution at different concentrations (10–50 µg/ml) Then 0.8 ml of 100 mM tris HCl buffer was added to them and pH was adjusted to 7.4. Then DPPH (500 mM in 1.0 ml ethanol) solution was added to the above mixtures.

Contact Angle Goniometer

The surface tension of four liquids was measured using a goniometer. In goniometer contact angle is observed and measured from the 2-D side view image of drops on the solid surface using ossilla software.

Statistical Analysis

Results were expressed as mean \pm S.E.M. There was no statistically significant difference between different oils - ANOVA, with 95% confidence intervals. p value was more than 0.05.

Results And Discussion

The surface tension values exhibited by the different essential oils and EDTA are as follows:

Orange oil-718.1 N/m

EDTA- 692.1 N/m

Soya oil- 677.6 N/m

Corn oil- 616.3 N/m

Orange oil showed more surface tension when compared with EDTA, Corn Oil & Soya Oil .

EDTA showed the highest antioxidant property compared to corn oil, soya oil, orange oil. Corn oil and soya oil contain polyphenols as flavonoids which are important for antioxidant activity. Orange oil contains ascorbic acid which is a potent antioxidant. EDTA activates antioxidant enzymes and reduces the activity of reactive oxygen species

Irrigation is an important aspect of endodontic therapy. The use of proper irrigants enable to clean those parts of the canal space which are inaccessible to clean via mechanical debridement such as isthumi, accessory canals, fins and so on[34]. Properties of irrigants such as viscosity, surface tension, density influence the flow of irrigant into the canal space. The irrigant must be in contact with the dentinal wall in order to exert its function. This depends on the surface tension of the liquid[35].

Surface tension is defined as the force between molecules that produces a tendency for the surface area of a liquid to decrease. Surface tension of the liquid limits the ability of the irrigant to penetrate into the intricacies of the canal space. The efficiency of the irrigant depends on the lower surface tension[35, 36].

Another important property of the irrigant is its antioxidant property. Antioxidant activity is mainly due to its free radical scavenging ability[37]. This property ensures thorough debridement of the canal space. Antioxidant activity is determined by various assays and one such being DPPH assay[38].

Figure 1. This graph depicts the percentage of DPPH radical scavenging action. Results are expressed as Mean±SEM. There was no statistically significant difference between different oils - ANOVA, with 95% confidence intervals. p value was more than 0.05.

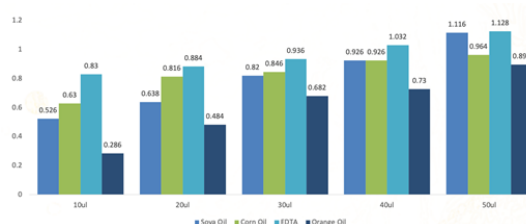
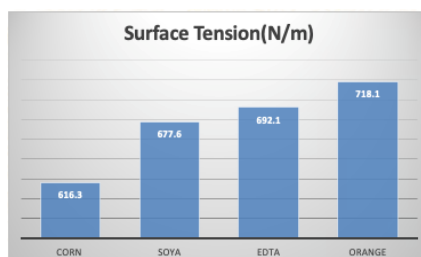


Figure 2. Bar graph depicts the surface tension assay results. Results are expressed as newtons/meters. Orange Oil had the highest surface tension value 718 N/m, Corn Oil had the least value 616 N/m.



The results of the present study showed that EDTA showed the highest antioxidant property compared to corn oil, soya oil, orange oil. Corn oil and soya oil contain polyphenols as flavonoids which are important for antioxidant activity. Orange oil contains ascorbic acid which is a potent antioxidant. EDTA activates anti-oxidant enzymes and reduces the activity of reactive oxygen species.

The results of surface tension measured by the goniometer showed that orange oil showed the greatest surface tension values compared to other essential oils. The least value was shown by corn oil. An irrigant efficacy is determined by its lower surface tension. The lower the surface tension the higher is its ability to penetrate into the canal walls and clean the inaccessible areas[39]. From the above results it can be inferred that corn oil has the lowest surface tension activity compared to other essential oils while EDTA exhibited highest antioxidant activity.

The above properties of the irrigants help the clinician mainly during instrument retrieval. The lower surface tension of the irrigant displaces the instrument from the canal and allows the instrument to wiggle which helps in easy retrieval of the instrument and high antioxidant property will reduce the bacterial load. Our institution is passionate about high quality evidence based research and has excelled in various fields [40–50].

Conclusion

Within the limitations of the study it was seen that EDTA has better antioxidant properties compared to other three groups. Orange oil has more surface tension when compared to other three groups. However, more clinical trials need to be done to get conclusive results.

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