

## PERSPECTIVES ON THE USE OF GERANIUM ESSENTIAL OIL: PELARGONIUM GRAVEOLENS AND PELARGONIUM ROSEUM, IN DENTAL MEDICINE

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### ABSTRACT

This review aims to present the latest research news and current research directions in the field of dental medicine of geranium essential oil. Geranium is native to South Africa, belonging to the Geraniaceae family, owning more than 300 species, this study will include the species of Pelargonium graveolens and Pelargonium Roseum. Due to current medical and pharmacological studies, geranium essential oil has been shown to have special actions in the spectrum of dental medicine and multidisciplinary, presenting pharmacological action as well as benefits in the field of oral health: Antimicrobial, antiviral, anti-inflammatory, antifungal, tissue regeneration, air fresheners of the oral cavity, astringent, scarring, painkillers, anti-tumor and antioxidants. Due to the increased concentration of citronellol, but also the lower amounts of limonene,  $\alpha$ -pimenum and  $\beta$ -pimenum in geranium essential oils, it has superior antifungal and antibacterial actions. Due to these actions, we want to study in depth and design of toothpastes, mouthwashes or controlled cesarean preparations used in the spectrum of the oral cavity. We propose these research directions due to the early research and lack of products obtained from geranium essential oils in the spectrum of dental medicine.

**Keywords:** essential oil, geraniol, nanocapsules, oral pathology

### 1. INTRODUCTION

Origin and characteristics: Geranium is native to South Africa and belongs to the Geraniaceae family. Geranium has more than 300 species, and they have the possibility to vary and differ depending on the design of the plant and the special appearance of the flowers, this study will include the species of Pelargonium graveolens and Pelargonium Roseum. [1, 2].

Geranium species are divided into 2 categories, thus describing perennial species

and annual species. The flowers of the species in the spectrum of the geranium plant exhibit coloristic diversity, for example red, purple, pink or white, their development can be achieved both in bouquets and in bunches. The leaves of the geranium plant are found in most species in lobate forms, presenting a coloristic diversity, including special colors such as silver, green, or dark-toned colors. [3,4].

Geranium oil obtained from the bitcata pelargonium graveolens has long been used in general medicine as well as dental medicine, having a special history and with an impact on the quality of life of patients due to its antiviral, antibacterial, antifungal, cellular regeneration, astringent properties. sedatohipnotic, scarring, pain reliever, antitumor and antioxidant. [5,6,7]

In the literature there are few studies showing the implication of geranium oils in the treatment of diseases of oral pathology (infections of the oral cavity, gum inflammation, oral burning syndrome, and pain associated with pathology). [8, 9]

Geranium oil, also known as pink geranium, originated in South Africa and has been used in medicine for hundreds of years because of its therapeutic and cosmetic properties.

The history of this species pelargonium roseum is similar to the other species in the geranium branch. Their use in the past is considered to have been flavoring baths but also for medicinal purposes by both Egyptians and Romans. [9,10,11]

In the 17th century the geranium plant was introduced to Europe and soon became very popular for its outstanding qualities in cosmetics and perfumery. Pelargonium Roseum in recent years managed to attract attention due to its medical, sedatohipnotic, therapeutic and cosmetic properties. [10.11]

In the literature are described calming and relaxing properties of the essential oil of pelargonium roseum, it can reduce stress and anxiety levels, precisely because of this it can be used in aroma therapy. In the cosmetic industry, the essential oil of pelargonium roseum has the ability to moisturize and regenerate tissues and skin. [12,13]

The latest studies have highlighted the special properties of pelargonium roseum oil, which are antimicrobial. These directions need further research because current studies

are only carried out in vitro and in vivo only on laboratory animals. [14, 15]

## 2. PHARMACOLOGICAL ACTION, PROPERTIES AND BENEFITS OF GERANIUM OIL IN THE FIELD OF ORAL HEALTH

Geranium oil is an oil with a fruity, floral scent and a distinguished taste. This oil has been used for hundreds of years in traditional medicine due to its favorable characteristics, both in health and in cosmetics. [16, 17]

Geranium oil is obtained by steam distillation of leaves and flowers of pelargonium graveolens, pelargonium roseum, the temperatures of obtaining geranium oil by this method are lower than the boiling point, so the therapeutic properties of the essential oil are not influenced or distorted by the oil production process (figure 1 and figure 2). [16, 17, 18]



Figure 1. Geraniu, Pelargonium roseum Willd



Figure 2. Culture at maturity

The geranium plant (*Pelargonium graveolens*, *Pelargonium roseum*) is currently cultivated around the world, although it was originally cultivated only in South Africa. [16, 17, 18].

Geranium essential oil is also used in various respiratory diseases, nervous system and dermatological conditions. Geranium essential oil can be used in various pharmaceutical forms including inhalation, topical applications, oral use in various concentrations. [9, 12]

The properties and benefits of geranium essential oil are as follows: Antibacterial, antiviral, anti-inflammatory, antifungal, cellular regeneration, astringent, sedative-hypnotic, scarring, analgesics, antioxidants and antitumoral, these last two are found only in preliminary studies. [[16, 17, 18, 19, 20, 21].

### 2.1 Antimicrobial properties and benefits

Pharmacologically, the most important action is the antibacterial action, which has been highlighted on the following strains: *Bacillus subtilis*, *Staphylococcus aureus*, *Listeria monocytogenes*, *Pseudomonas aeruginosa*. The antibacterial action is supported by several phytoconstituents of the monoterpene class: Citronellol, limonene,  $\alpha$ -pinenum,  $\beta$ -pinenum (Table 1) [22, 23]

So far, in consultation with specialized literature, we have not found studies on anaerobic bacterial strains that cause pathogenesis of periodontal diseases. Geranium essential oil has special antimicrobial properties, and they have the ability to combat different types of potentially pathogenic bacteria: *Escherichia coli*, *Staphylococcus aureus*. [8, 24]

The antimicrobial benefits of geranium essential oil include the special capacities to inhibit growth and multiplication of microorganisms, but also the ability to reduce the risk of infection and accelerate processes of tissue regeneration. In the study we propose, we will also analyze the action of geranium oil, in nosocomial infections with *Clostridium difficile*. [25]

Also, these essential oils can be used for dermatological purposes with potential in cleansing and cleansing the skin and are beneficial in treating acne and of course other microbial diseases. Geranium essential oil for cosmetic/dermatological purposes has recommendations for dilution in a potential carrier oil: Jojoba oil or coconut oil, it is contraindicated to use without dilution in contact with the skin. [13]

### 2.2 Antiviral properties and benefits

On the antiviral effect the vast majority of studies have been directed to viruses in the group responsible for viral respiratory infections A (H1N1, H3N2) [22]. The effect of aqueous solutions of *Pelargonium siddoides* on the immunodeficiency virus has also been examined and significant anti-HIV1 action (Table 1). There are several studies and research that have examined the effectiveness of geranium essential oil in fighting certain viruses. Most studies have focused on the antiviral efficacy of geranium essential oil, on respiratory infection-causing viruses, and only a few specific studies have been conducted in the context of oral health.

Studies show 2 antiviral benefits of geranium oil: Direct antiviral activity and immune system stimulation. A study published in the journal *Molecules* in 2022 noted that geranium essential oil inhibited replication of influenza type A virus and other respiratory aprate viruses. [6, 22, 26]

Geranium oil stimulates the immune system, supporting it in the fight against certain viruses, including viruses that act on the oral cavity. In terms of the latest research, geranium oil (*pelargonium graveolens*, *pelargonium roseum*) has been shown to have an increased antiviral effect, but research in this field is in the early stages and requires further research, with limited clinical trials on human patients. [22, 26]

### **2.3 Anti-inflammatory properties and benefits**

The anti-inflammatory action has been highlighted on edema generated in mice with croton oil and appears to be caused by the reduction of 2.2 diphenyl picrihydrazil radicals (Table 1). Geranium oil decreases inflammation in the body due to components present in geranium oil, such as geraniol and citronelol. [22,25,26]

Among the anti-inflammatory benefits of geranium oil are the decrease in inflammation and discomfort associated with diseases such as tendonitis, rheumatoid arthritis and sprains. By decreasing inflammation, geranium essential oil lowers the level of joint pain and at the same time leads to increased mobility of the affected joints. [22,27]

Geranium oil can also be used in dermatological conditions such as dermatitis, leading to reduced erythema, itching and hastening healing of affected tissues. [22,26,27].

### **2.4 Antifungal properties and benefits**

The antifungal action was highlighted on the following strains: *Candida albicans*, *Candida glabra*, *Candida kefir*, *Candida lusitaniae* *Criptococcus neoformans*. Among

the phytoconstituents it seems that the most important antifungal action is given by citronellol, followed by geraniol, isomentone, geranyl formate, citronellyl formate (Table 1). [22,27]

Geranium essential oil holds antifungal properties, inhibiting the growth and multiplication of fungi such as *Candida albicans* or dermatophytes. [6,22]

Thus, geranium essential oil can be beneficial and useful in the treatment of mycosis, onychomycosis [28] or other US dermatological conditions caused by fungi. [22,29]

A research study found that geranium essential oil is active against several species of candida. In such conditions, geranium oil can be used with caution diluted or undiluted in allergic patients, use will be performed on a small portion of the skin because the essential oil of geranium can cause irritation to certain persons. [30,31,32,33]

### **2.5 Properties and benefits of cell regeneration**

Studies have found that geranium essential oil helps to proliferate healthy cells and increase blood circulation locally, thus increasing the supply of oxygen and nutrients to the affected tissues, and this phenomenon acts by accelerating the processes of tissue healing and regeneration. [19,33,34]

Geranium essential oil can be used for cutting injuries, burns, wounds or other skin conditions in the spectrum of the oral cavity, leading to accelerated healing and of course the ability to minimize scar tissue formation. [19,33,34]

Geranium essential oil has indications of topical application on affected areas or diluted in a carrier oil before topical applications on extended areas , before topical application on extended areas it is recommended to perform allergy tolerance tests. [19,33,34]

### **2.6 Astringent properties and benefits**



Geranium essential oil has astringent properties, these properties provide the essential oil's ability to tone and tighten tissues, thus decreasing the ability of glandular secretion, beneficial in excess glandular excretion. [35]

Due to its astringent properties, geranium essential oil can be used in the case of gingival bleeding leading to the formation of a protective layer over the affected region, used mainly in children and adolescents. [35]

## 2.7 Properties and benefits of oral cavity odorization

But its most expel action is the odorizing action caused by geraniol, respectively its esters (Geranyl tiglat, geranyl formate, geranyl acetate, geranyl propionate) and rose-oxide. Geranium oil is the most important oil used in the perfumery industry, successfully replacing rose oil (with incomparably higher costs). In addition to the use of geranium oil in the perfumery and cosmetic industries, it is also used in the food industry as an additive (aromatizing and taste correction) without side effects. The most important producers in the geranium oil market are still China, Egypt, Algeria and Morocco, with the price of essential oil ranging from \$ 55-155 / kg-1 (Table 1). [23]

Because essential geranium oil has a pleasant smell, due to the fact that it can neutralize unpleasant odors in the oral cavity can be used in the composition of toothpaste, mouthwash, or other dental products used for refreshing oral breath. Along with geranium oil, other oils with similar properties may be used, such as basil oil. [ 36 ]

## 2.8 Sedative-hypnotic properties and benefits

The anxiolytic action appears to be due to a possible involvement of serotonin transmission and appearance tested on Swiss albinotic sores [37]. For the hypnotic action, studies have been initiated on two species of

ornamental aquarium fish (*Scianochromis fryrieri* and *Labidochromis caeruleus*), proving the anesthetic potential of essential oils of *Pelargonium graveolens*. [38]

From the point of view of the mechanism of action, the anxiolytic action is given by phytoconstituents of the monoterpene class (linalool, geraniol, limonene, terpineol) that act on olfactory receptors at the limbic level having a calming effect (Table 1) [22].

In the literature, geranium essential oil is noted for its aromatic therapeutic and sedato-hypnotic properties, creating capacities to induce beneficial effects on mental and emotional states. The benefits of aromo therapy and sedato-hypnotic seem to be the following: Relaxation and lowering stress levels. Anxiety and high levels of stress can be reduced due to the special smell of geranium essential oil in dental practices. [22, 37, 38]

The limbic system can be stimulated in the brain by inhaling the scent of geranium, and this type of inhalation and stimulation of the limbic system leads to decreased emotions, anxiety toward the dentist and creates a positive mood. [22, 37, 38]

The energizing and refreshing effects of geranium essential oil can be beneficial to your overall health, leading to fatigue and lethargy. The floral aroma of geranium essential oil can improve the patient's energy level and mood both in the waiting room and during dental practice. [22, 37, 38]

The ability to reduce discomfort and the calming effect in the dental office: there is a high percentage of patients with anxiety and discomfort during dental procedures, and inhalation of geranium essential oil by aromo therapy can create a state of relaxation and calm of patients, providing the possibility of reducing associated discomfort. [22, 37, 38]

## 2.9 Healing properties and benefits

According to studies, geranium essential oils help heal lesions, so they can be applied topically to ulcers and wounds in the oral cavity, in a concentration of 100% or diluted, leading to accelerated healing of lesions in the oral cavity. [6]

### **2.10 Analgesic properties and benefits**

The analgesic action of geranium oil obtained by distillation of the species *Pelargonium graveolens* was also highlighted in the clinical study conducted on patients with stomatitis. The effect of the product "Geranium oil topical gel 1%" proved to be significantly superior to those induced by a placebo effect gel (Table 1). [22] The anti-inflammatory and analgesic action of the active principles extracted from plants, similar to geranium oil, is recognized. [39,40]

Geranium essential oil due to its antialgic and anti-inflammatory action can lead to pain relief from various oral cavity conditions such as gingivitis, stomatitis or injuries resulting from various causes. [22]

### **2.11 Antitumor properties and benefits (at the stage of preliminary studies)**

Geranium oil prevents the proliferation of T24 cells in prostate cancer, linalool in concentrations of 20, 40 and 80  $\mu\text{m}$  respectively, causing damage to cancer cells. In breast cancer, however, citonellol is the key compound, having antimetastatic action and anti-angiogenesis. In cervical cancer, geranium oil causes DNA damage (Table 1) [22].

Research in the field of dentistry in terms of antitumor effects is in the early

stages. However, there are some studies that evoke the properties of geranium essential oil to inhibit the growth of malignant cells. [41,42]

A study published in the Journal of Oral Medicine in 2018 showed observations of geranium essential oil. That it can inhibit multiplication and cause death of malignant cells in the oral cavity. It is important to remember that the study was not performed on human patients and only on cell cultures. [42,42]

Because research in this field is in its early stages, the treatment of tumors in the mouth is not yet recommended to use geranium essential oil, recommending standardized clinical, therapeutic approaches such as radiotherapy, surgery and chemotherapy.

### **2.12 Antioxidant properties and benefits (at the stage of preliminary studies)**

Geranium essential oil contains products such as vitamin E and polyphenol that help reduce oxidative stress and neutralize free radicals. Thus, the use of geranium oil in the dental spectrum can help maintain the overall health of the oral cavity. [43,44]

In dental medicine, geranium essential oil is used in a smaller proportion compared to the use of other substances with antioxidant properties containing coenzyme Q10 or vitamin E. [43,44]

**Table 1 Pharmacological action of pelargonium species**

No. crt.	Pharmacological action	Strains involved/ Studies performed	Phytoconstituents responsible for pharmacological action / Mechanism
1.	<i>Antibacterial action</i>	Bacillus subtilis, Staphylococcus aureus, Listeria monocytogenes, Pseudomonas aeruginosa	Citronellol, limonene, $\alpha$ -pimen, $\beta$ -pimenul
2.	<i>Antifungal action</i>	Candida albicans, Candida glabra, Candida kefyr, Candida lusitanae, Cryptococcus neoformans	Citronellal, geraniol, isomethone, geranyl formiate, citronelil formiate
3.	<i>Antiviral</i>	SARS-COV2, Influenzae virus, Yellow fever	Ace2 inhibition and activation of TMPRS2 receptors in SARS-COV2
4.	<i>Anti-inflammatory and antioxidant</i>	Action on edema induced with croton oil in yarrow (a 73-88% reduction in inflammation is observed)	Geranium oil has antioxidant and anti-inflammatory properties due to the reduction of radicals 2.2 diphenyl picrihydral directly proportional to the dose
5.	<i>Sedate-hypnotic action, Antidepressant</i>	Welds regarding the inhalation of geranium oil in the first phase of labor (calming action)	The anxiolytic action is given by monoterpenes: linalool, geraniol, limonene, terpineol which acts on the olfactory receptors at the limbic level with calming effect
6.	<i>Antitumor action</i>	Studies on the treatment with geranium oil in the mammary neoplasm	Linalool (in prostate cancer) Citonelol (recent studies recommend it as an alternative treatment in breast cancer)
7.	<i>Calming action</i>	Geranium oil topical gel studies 1%	Polyphenols, tannins, flavonoids, citronellol, geraniol, limonene
8.	<i>Air freshener action</i>	It is found in numerous soaps, shampoos, body lotions, crème, toothpastes, perfumes	Geraniol, geranyl tigate, geranyl formiate, geranyl acetate, geranyl propionate, rose-oxide

### 3. NEW PERSPECTIVES ON ITS USE IN DENTISTRY OF GERANIUM OIL

Due to the increased concentration of citronellol, but also the presence in smaller amounts of limonene,  $\alpha$ -pimenum and  $\beta$ -pimenum in geranium essential oils, it has superior antifungal and antibacterial actions. [22, 23]

Due to these actions, we want during the doctorate the detailed study and the conception of some toothpaste, mouthwash, or preparations with controlled yield: liposomes, microcapsules, nanocapsules, etc, used in the spectrum of the oral cavity in periodontal bags. [44,45,46,47,48,49]

Due to the effects of geranium oil to prevent the proliferation of T24 cells in

prostate cancer, linalool in concentrations of 20, 40 and 80  $\mu$ m causes damage to cancer cells. Citonellol is the key compound, having anti-metastatic and anti-angiogenesis action. In cervical cancer, geranium oil causes destruction in THE DNA. These research directions require further studies and the development of cancer prevention products in the mouth. [22]

Studies have shown that anxiety and high levels of stress can be reduced due to the special smell of geranium essential oil in dental practices, but also due to the special sedato-hypnotic capacity of geranium essential oil. These directions are not exploited in dental practices because the conditions for creating aromatherapy are

more difficult to meet. This research direction should be developed and created aromatherapy areas for patients in dental medicine offices and beyond. [22, 37, 38,49]

We propose these research directions due to the early research and lack of products obtained from geranium essential oils in the spectrum of dental medicine.

#### 4 .CONCLUSIONS

Geranium essential oil has been shown to have special actions in the spectrum of dental medicine as well as multidisciplinary, presenting pharmacological action as well as benefits in the field of oral health: Antimicrobial, antiviral, anti-inflammatory, antifungal, tissue regeneration, air fresheners of the oral cavity, astringent, scarring, painkillers, anti-tumor and antioxidants.

Pharmacologically, the most important action is the antibacterial action, which has been highlighted on the following

strains: *Bacillus subtilis*, *Staphylococcus aureus*, *Listeria monocytogenes*, *Pseudomonas aeruginosa*. The antibacterial action is supported by several phytoconstituents of the class of monoterpenes: citronellol, limonene,  $\alpha$ -pimenum,  $\beta$ -pimenum.

Geranium oil prevents the proliferation of T24 cells in prostate cancer, with linalool in concentrations of 20, 40 and 80  $\mu$ m respectively causing damage to cancer cells. In breast cancer, however, citronellol is the key compound, having anti-metastatic action and anti-angiogenesis. In cervical cancer, geranium oil causes destruction in THE DNA.

The current special research of geranium essential oils is mainly limited to studies on membranes and laboratory animals, and in the spectrum of dental medicine the formulation of controlled yield products are only at the beginning of the road.

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