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Antimicrobial activity of some essential oils against oral multidrug-resistant *Enterococcus faecalis* in both planktonic and biofilm state

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PEER REVIEW

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Comments

This study evaluated some EOs in treatment of intractable oral infections, principally caused by biofilm of multidrug-resistant *E. faecalis*. The results of this study is useful for *E. faecalis* infection treatment. The high yield and strong antimicrobial activity of three Algerian medicinal plants EOs used in eradication of MDR pathogens from oral ecosystem may contribute to the medical treatment for oral intractable infections caused by *E. faecalis*.

Details on Page 471

ABSTRACT

Objective: To evaluate some essential oils in treatment of intractable oral infections, principally caused by biofilm of multidrug-resistant *Enterococcus faecalis* (*E. faecalis*), such as persistent endodontic infections in which their treatment exhibits a real challenge for dentists.

Methods: Ten chemically analyzed essential oils by gas chromatography–mass spectrometry were evaluated for antimicrobial activity against sensitive and resistant clinical strains of *E. faecalis* in both planktonic and biofilm state using two methods, disk diffusion and broth micro-dilution.

Results: Studied essential oils showed a good antimicrobial activity and high ability in *E. faecalis* biofilm eradication, whether for sensitive or multidrug-resistant strains, especially those of *Origanum glandulosum* and *Thymbra capitata* with interesting minimum inhibitory concentration, biofilm inhibitory concentration, and biofilm eradication concentration values which doesn't exceed 0.063%, 0.75%, and 1.5%, respectively.

Conclusions: Findings of this study indicate that essential oils extracted from aromatic plants can be used in treatment of intractable oral infections, especially caused by biofilm of multidrug-resistant *E. faecalis*.

KEYWORDS

Bacterial infections, Biofilm, *Enterococcus faecalis*, Essential oils, Multidrug-resistance

1. Introduction

Enterococci are commensal Gram-positive bacteria that inhabit in oral cavity, gastrointestinal tract, and vagina of humans and animals[1]. These bacteria can cause a wide

variety of diseases in humans, especially, nosocomial infections and they now rank among the leading causative pathogens in the world[2]. *Enterococcus faecalis* (*E. faecalis*) is responsible for up to 90% of human enterococcal infections[3], its pathogenicity ranges from life threatening

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diseases in compromised individuals to less severe conditions particularly due to many virulence factors[4]. Enterococci are multidrug-resistant (MDR) bacteria to most antimicrobial drugs used to treat human infections which exhibit a considerable therapeutic challenges[5].

In oral cavity, *E. faecalis* is not considered to be part of the normal oral microbiota[6]. *E. faecalis* is mainly responsible for several oral pathologies, particularly, dental caries[7], dental abscess[8], periodontal infections[9], apical periodontitis[10], and persistent endodontic infections, also known as post-treatment endodontic diseases, in which *E. faecalis* is the etiological causative agent and responsible for serious complications[11,12]. This can be explained by the fact that this bacterium possesses not only many virulence factors, but also an endogenous resistance to extreme ecological conditions and antimicrobials[8], allowing *E. faecalis* to tolerate harsh environmental conditions in some sites within oral cavity, especially in root canal[11].

The resistance of microorganisms to harsh conditions is due to biofilm formation[13], a complex of lifestyle that allowing bacteria displaying specific properties, including an increase in resistance to antibiotics and antiseptic chemicals[14]. In fact, formation of these sessile communities and their inherent resistance to biocides are the origin of many persistent and chronic bacterial infections[15]. In dental root canal, eradication of *E. faecalis* with chemo-mechanical preparations and using antiseptics is difficult[11]. Even the most used antiseptics in endodontic treatments, sodium hypochlorite and chlorhexidine showed low ability to eliminate *E. faecalis*[16].

The lack of strategies for *E. faecalis* biofilm elimination requires trying other substances except antiseptics and antibiotics, such as secondary metabolites of plants, especially, essential oils (EOs) one of the most important

bioactive substances in medicinal plants[17]. Possessing a good antimicrobial activity[18], EOs can replace treatments with antibiotics and disinfection using antiseptics. Furthermore, EOs have many interesting medicinal properties which can contribute to the treatment of intractable oral infections such as anti-inflammatory[19,20], anti-oxidant and stimulating the immune system response activities[21,22].

Treatment of oral infections by plant preparations, such as decoctions and infusions, is very popular among Arab peoples. Major reason of using those herbs extracts is their effectiveness and availability. In Algeria, many herbs especially from Lamiaceae family are widely used in treatment of oral diseases such as candidiasis, dental caries and periodontal diseases. Present principally in wild, species of thyme, lavender, oregano and rosemary are even applied by local population as antiseptics and for oral cavity aromatization because of their refreshing scent.

In the lack of studies that evaluate EOs as treatments of intractable oral infections, such as persistent endodontic infections, the aim of this study was to evaluate some Algerian EOs as natural antiseptics and antimicrobials against MDR *E. faecalis*, one of the principal oral pathogens, in both planktonic and biofilm state.

2. Materials and methods

2.1. Plant material

We have selected ten medicinal plants for this study which are presented in Table 1. The choice of plant species is based on their use by the local population against oral infections, such as periodontal infections and dental caries. All species have been harvested from the region of

Table 1

Data on the studied plant material.

Scientific name	Family	Studied organs	Harvest station			Harvest date
			Name (Municipality)	Location	Altitude (m)	
<i>Ammi visnaga</i> (L.) Lam.	Apiaceae	Leaves, Stems, Flowers & Seeds	Bouhannak (Mansoura)	+34°88'19" -1°37'07"	711	Jul-11
<i>Ammoides verticillata</i> (Desf.) Briq.	Apiaceae	Leaves, Stems, Flowers & Seeds	Atar (Mansoura)	+34°88'51" -1°37'75"	980	Jul-11
<i>Artemisia arborescens</i> (Vaill.) L.	Asteraceae	Leaves, Stems & Flowers	Sidi Yahyia (Sidi Medjahed)	+34°46'45" -1°38'12"	380	Jul-11
<i>Dittrichia graveolens</i> (L.) Greuter	Asteraceae	Leaves, Stems & Flowers	Bouhannak (Mansoura)	+34°88'14" -1°36'38"	725	Aug-11
<i>Lavandula dentata</i> L.	Lamiaceae	Leaves, Stems & Flowers	Sidi Yahyia (Sidi Medjahed)	+34°88'14" -1°36'38"	580	Jul-11
<i>Lavandula multifida</i> L.	Lamiaceae	Leaves, Stems & Flowers	Bouhannak (Mansoura)	+34°88'51" -1°37'75"	700	Oct-11
<i>Mentha piperita</i> L.	Lamiaceae	Leaves, Stems & Flowers	Ouled charef (Maghnia)	+34°49'57" -1°42'4"	400	May-12
<i>Origanum vulgare</i> subsp. <i>glandulosum</i> (Desf.) letsw.	Lamiaceae	Leaves, Stems & Flowers	Atar (Mansoura)	+34°88'51" -1°37'75"	980	Jun-11
<i>Rosmarinus eriocalyx</i> Jord. & Fourr.	Lamiaceae	Leaves, Stems & Flowers	Honaine	+34°88'14" -1°36'38"	100	Jun-11
<i>Thymbra capitata</i> (L.) Cav.	Lamiaceae	Leaves, Stems & Flowers	El Koudia	+34°53'59" -1°21'55"	690	Jul-11

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