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ORIGINAL ARTICLE/ARTICLE ORIGINAL

The comparative study of antifungal activity of *Syzygium aromaticum*, *Punica granatum* and nystatin on *Candida albicans*; An in vitro study

L'étude comparative de l'activité antifongique de Syzygium aromaticum, Punica granatum *et nystatine sur* Candida albicans ; *étude in vitro*

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KEYWORDS
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Syzygium aromaticum;
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Antifungal agents;
Oral candidiasis

Summary
Aim. — Candida species are opportunistic fungi, among which, *Candida albicans* is the most important species responsible for infections in immunocompromised patients with invasive fungal disease. Resistance of *Candida* species to antifungal drugs has led scientists to pay more attention to traditional medicine herbs. Due to the limitations in the treatment of fungal diseases such as shortages, high prices, antifungal side effects and drug resistance or reduced susceptibility to fungal drugs we decided to study the antifungal effects of herbal extracts of *Syzygium aromaticum* and *Punica granatum*.
Methods. — Twenty-one isolates of oral *C. albicans* in patients with denture stomatitis referred to prosthesis department, Dental faculty of Tehran University of Medical Sciences were prepared and cultured. Plant extracts were prepared from the herbs market. Tests on patient samples and standard strains 5027ATCC (PTCC10231) yeast *C. albicans* were performed via well diffusion method. In addition, nystatin and methanol were used as positive and negative control,

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respectively. Finally, the antifungal effect of extracts using Statistical Repeated measurement ANOVA test was investigated.
Results. — Both *S. aromaticum* and *P. granatum* showed noticeable antifungal activity in well method. *Syzygium aromaticum* showed better anti candida activity than nystatin ($P < 0.001$).
Conclusion. — Due to increasing problems with fungal diseases, these findings suggest that the plant extracts of *S. aromaticum* and *P. granatum* showed good antifungal effects (*P*-value < 0.001). *S. aromaticum* (inhibition zone diameter: 29.62) showed better antifungal effects than nystatin (inhibition zone diameter: 28.48).

MOTS CLÉS
Candida albicans ;
Nystatine ;
Syzygium aromaticum ;
Punica granatum ;
Antifongiques ;
Candidose buccale

Résumé
Objectif. — Les espèces de *Candida* sont des champignon opportunistes, parmi lesquels, *Candida albicans* est l'espèce la plus importante chez les patients immunodéprimés exposés aux maladies fongiques invasives. La résistance de certaines espèces de *Candida* aux médicaments antifongiques a conduit les scientifiques à accorder plus d'attention à des herbes de la médecine traditionnelle. En raison des limitations dans le traitement des maladies fongiques telles que les pénuries, les prix élevés, les effets secondaires et la résistance ou une sensibilité réduite aux médicaments fongiques, nous avons décidé d'étudier les effets antifongiques des extraits à base de plantes, *Syzygium aromaticum* et *Punica granatum*.
Méthodes. — Vingt et un isolements de *C. albicans* oraux chez les patients avec stomatite sur prothèse adressés au département prothèses, à la faculté dentaire de l'université de Téhéran des sciences médicales ont été préparés et mis en culture. En outre, les extraits de plantes ont été préparés à partir des herbes du marché. Des tests sur les échantillons des patients et sur des souches de référence de *C. albicans* : 5027ATCC (PTCC10231) ont été réalisés par la méthode de diffusion en puits. En outre, la nystatine et le méthanol ont été utilisés comme contrôle positif et négatif, respectivement. Enfin, les résultats de l'effet antifongique d'extraits ont été soumis à l'analyse statistique Anova.
Résultats. — *S. aromaticum* et *P. granatum* ont montré une notable activité antifongique par la méthode des puits. *S. aromaticum* a montré une meilleure activité anti-candidosique que la nystatine ($p < 0{,}001$).
Conclusion. — Face à l'augmentation des maladies fongiques, ces résultats suggèrent que les extraits de plantes *S. aromaticum* et *P. granatum* ont de bons effets antifongiques ($p < 0{,}001$). *S. aromaticum* (diamètre de la zone d'inhibition : 29,62) a un effet antifongique supérieur à celui de la nystatine (diamètre de la zone d'inhibition : 28,48).

Introduction

Denture stomatitis is an oral pathology of multifactorial etiology that affects a large number of patients using complete or partial dentures. The main etiologic factors related to denture stomatitis are trauma, poor oral hygiene and infection with Candida species [4,14,17]. Patients often complain of pain and edema in the inflamed areas [3,18]. Chronic inflammation in the area may lead to an increase in bone resorption beneath the denture [20].

Candida-associated denture stomatitis (CADS) is a very common inflammatory process affecting about 60% of the subjects carrying a prosthesis [9]. *Candida albicans* seems to be the major pathogen involved in the oral candidiasis. However, the presence of other species of *Candida* such as *C. dubliniensis*, *C. parapsilosis*, *C. krusei*, *C. tropicalis* and *C. glabrata* in the pathogenesis of the oral candidiasis has been proven in previous studies [7]. This pathogenicity might be due to the ability of these species to adhere and proliferate through the hard and soft tissues of the oral cavity and making a biofilm [24]. *Candida* associated denture stomatitis would embark on local and systemic condition changes of the host. These conditions include diabetes, deficiency of nutritional factors, kidney affections, xerostomia, traumas, saliva components, pH of the oral cavity, permeability of acrylic resin and presence of microbial plaque [24].

The use of herbal extracts for treatment of various human diseases has a long history. According to an investigation conducted by the World Health Organization (WHO), more than 80% of the world's population relies on traditional medicine for their primary healthcare needs [16]. It had been recently proposed that laboratory purified components of herbal extracts may cause some side effects and if they accompanied other components found in the extract, these side effects would disappear [19].

Antibacterial and antifungal activity of *Punica granatum* (pomegranate) has been assessed in previous studies [4]. *Syzygium aromaticum* is a plant with a wide range of use including detergent, analgesic activity especially for tooth pain and antimicrobial activity [5]. Treatment of oral candidiasis includes improvement of oral hygiene, avoiding use of denture during nights, prosthesis correction, prosthesis soaking in antibacterial solutions and antifungal medications.