International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 3 Number 3 (2014) pp. 937-944**
http://www.ijcmas.com

Original Research Article

Antifungal Activities of *Cuminum cyminum* and *Pimpinella anisum* Essential Oils

A.H.M.El-Said* and El-Hady Goder

Botany Department, Faculty of Science, South Valley University, Qena, Egypt
**Corresponding author*

Keywords

Essential oils, antifungal activity, anise oil, cumin oil.

A B S T R A C T

Investigations were conducted to evaluate the antifungal activity of anise and cumin essential oils on mycelia growth of 90 isolates of fungi. The agar-well diffusion method was used to evaluate fungal growth inhibition at a concentration of 100%. Cumin oil was highly effective against all the isolates of tested fungi. It was completely inhibited mycelial growth of all fungi when added to solid medium. Anise oil had no inhibition, partial inhibition and completely inhibition against fungal isolates. Fifty-five isolates (61.1% of total isolates) were shown no inhibition, twenty-six isolates (28.9% of total isolates) were inhibited with different degrees and nine isolates (10% of total isolates) were completely inhibited by anise oil.

Introduction

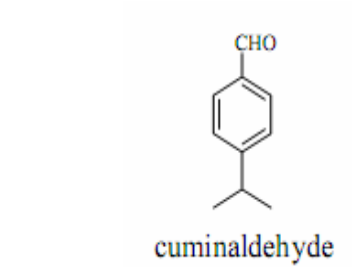
Spices are aromatic or pungent vegetable substances used in minute quantities to enrich, alter or mask the flavour of food (Al-Mofleh, 2010). Spices have been traditionally used since ancient time for the preservation of food product as they have been reported to have antiseptic and disinfectant properties (Dawar *et al*., 2008; Hashem and Alamri, 2010). They prolong the storage life of foods by preventing rancidity and oxidation of lipids (kelen and Tepe, 2008) or through bacteriostatic or bactericidal activity (Nazef *et al*., 2008) and they perform the antifungal activity (Kotzekidou *et al*., 2008). Spices and their extracts were had various medicinal properties (Ayodele *et al*., 2009), they are affect digestion processes differently. Most of them stimulate the secretion of saliva. Curcuma, cayenne pepper, ginger, anis, mint, onions, fenugreek, and cumin enhance the synthesis of bile acids in the liver and their excretion in bile, what beneficially effects the digestion and absorption of lipids. Most of the prelisted spices stimulate the function of pancreatic enzymes (lipases, amylases and proteases), some also increase the activity of digestive enzymes of gastric mucosa (Srinivasan, 2005). Besides the effect on bile synthesis and enzyme activity, extracts from herbs

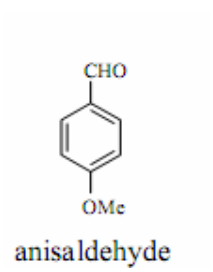
and spices accelerate the digestion and shorten the time of feed/food passage through the digestive tract (Suresh and Srinivasan, 2007).

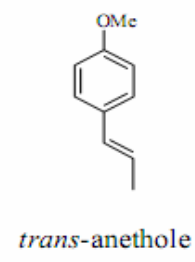
Each spice has a unique aroma and flavor, which derive from compounds known as phytochemicals or secondary compounds (because they are secondary to the plant's basic metabolism). These chemicals evolved in plants to protect them against herbivorous insects and vertebrates, fungi, pathogens, and parasites (Walker, 1994).

Anise oil (Anisi aetheroleum) is the essential oil obtained by steam distillation from dry ripe fruits of anise (*P. anisum* L.) or star anise (*Illicum verum* Hook. fil.) (European Pharmacopoeia, 2001). Essential oil of anise fruits contains from 80 to 95%, or more, *trans*-anethole as the main compound, followed by chavicol methyl ether (estragole), anisaldehyde and *cis*-anethole (Hansel *et al*., 1999; Tyler *et al.*, 1988). Oil is used as an expectorant and carminative, especially in pediatrics, in cough mixtures and as a flavouring and spice. The important phenylpropanes, such as *trans*-anethole and chavicol methyl ether (estragole), have a stabilizing influence on the autonomous nervous system. Anise oil has been used in Iranian folk medicine for the treatment of some diseases, including seizures and epilepsy (Pourgholami *et al*., 1999). Anise has mild estrogenic effects, which explains the use of this plant in folk medicine for increasing milk secretion (Czygan, 1992) and for amenorrhea. Products that contain anise fruits extracts or anise essential oil may cause contact dermatitis, probably due to their anethole content (Martindale, 2002).

Composition of the cumin seed oil was extensively investigated many years ago. In 1981, Takahashi *et al*. (1981) reported that cumin oil contained mint sulfide as a trace constituent. Twelve years later, Anon (1993) and Shaath and Azzo (1993) reported that the main constituents of Egyptian cumin seed oil were cumin aldehyde, b-pinene, g-terpinene, r-mentha-1,3- dien-7-al, r-mentha-1,4-dien-7-al and p-cymene. Composition of the cumin seed oil of Turkish origin was investigated by (Baser *et al*. 1992; Borges and Pino 1993) who found that Turkish cumin seed oil was characterized by high amount of cumin aldehyde, p-mentha-1,3-dien-7-al, p-mentha-1,4- dien-7-al, g-terpinene, p-cymene, b-pinene and perilla aldehyde.







Several studies have been shown that essential oils of spices and herbs demonstrate antifungal effects as reported by several researchers (Gulcin *et al*., 2003; Angioni *et al*., 2004; Lopez *et al*., 2005; Rasooli *et al*., 2006; Cruz *et al*., 2007; Chen *et al*., 2008; Mekawey *et al*., 2009; Skrinjar *et al*., 2009). This work was conducted to investigate the antifungal activity of anise oil and cumin oil on the growth of fungi.

Materials and Methods

The fungal strains used in this study that isolated from spices (anise and cumin) samples.

Inculation

The strains (eighty-seven species and 3 species varieties belonging to 32 genera) were cultivated on Czapek's agar medium for about ten days at 28°C until they were well sporulated, then by a sterile cork borer with 10 mm in diameter cut one disk from the pure culture and inoculated into 100 ml Erlenmeyer flask contained 50 ml sterilized distillated water to make spore suspension.

Antifungal screening:

The modified Collins *et al*. (1995) agar-well diffusion method was employed to determine the antifungal activity of oils; these essential oils were obtained from Quss factory.

Agar-well diffusion method

Using modified Collins *et al*. (1995), one ml of spore suspension poured into sterile plate, 20 ml of sterile Czapek's medium poured into a sterile culture plate and allowed to set at room temperature for about 30 minutes, with a sterile cork borer, three bores about 10 mm in diameter were punched on the plates, 0.5 ml of essential oil was poured into each bore and the plates were incubated at 28° C for ten days.

Results and Discussion

The study reported here deals with the inhibitory effects of two spices essential oils on the growth of various fungi that isolated from anise and cumin seeds (90 isolates).

The data presented in (Table 1), clearly show that cumin oil was highly effective against all the isolates of fungi tested. It is completely inhibited mycelial growth of all fungi when added to solid medium. Anise essential oil showed variable effects on fungal growth ranging from complete inhibition in case of sensitive isolates to limit or no inhibition on resistant isolates.

Nine isolates (10% of total isolates) were completely inhibited with anise oil and these were: *Chaetomium oblatum*, *Drechslera erythrospila*, *D. euphorbiae*, *Epicoccum purpurascens*, *Fusarium sulphureum*, *Gibberella tricincta*, *Scopulariopsis brevicaulis*, *Setosphaeria rostrata* and *Stemphylium solani*.

Twenty-six isolates (28.9% of total isolates) were inhibited by anise oil but with different effects and these were: *Aspergillus clavatus*, *A. sydowii*, *A. ustus*, *A. versicolor*, *Botryotrichum piluliferum*, *C. funicola*, *Circinella muscae*, *Cladosporium musae*, *Curvularia brachyspora*, *Emericella nidulans* var. *lata*, *Eurotium chevalieri*, *Fusarium oxysporum*, *Memnoniella subsimplex*, *Myrothecium verrucaria*, *Nectria haematococca*, *Paecilomyces carneus*, *Penicillium aurantiogriseum*, *P. brevicompactum*, *P. duclauxii*, *P. funiculosum*, *P. spinulosum*, *Stachybotrys* state of *Melanopsamma pomiformis*, *Syncephalastrum racemosum*, *Trichoderma hamatum*, *T. viride* and *Ulocladium chartarum*. The remaining fungal isolates (55 isolates) were not inhibited by anise oil.

Several studies have shown that essential oils of anise and cumin seeds and other

Table.1 Inhibition effect of essential oils (anise and cumin oils) on the growth of various fungal isolates, (diameter of inhibition zone in mm).

Fungal isolates	Inhibation zone in mm	Inhibation zone in mm
	Anise oil	Cumin oil
Acremonium furcatum	N.I	C.I
A. kiliense	N.I	C.I
A. rutilum	N.I	C.I
A. strictum	N.I	C.I
Alternaria alternata	N.I	C.I
A. brassicicola	N.I	C.I
A. chlamydospora	N.I	C.I
A. raphani	N.I	C.I
Aspergillus candidus	N.I	C.I
A. clavatus	14	C.I
A. flavus	N.I	C.I
A. fumigatus	N.I	C.I
A. niger	N.I	C.I
A. ochraceus	N.I	C.I
A. sulphureus	N.I	C.I
A. sydowii	30	C.I
A. tamarii	N.I	C.I
A. terreus var. *aureus*	N.I	C.I
A. ustus	17	C.I
A. versicolor	17	C.I
Botryotrichum piluliferum	20	C.I
Chaetomium anguipilium	N.I	C.I
C. atrobrunneum	N.I	C.I
C. citrinum	N.I	C.I
C. crispatum	N.I	C.I
C. dreyfussii	N.I	C.I
C. funicola	39	C.I
C. globosporum	N.I	C.I
C. globosum	N.I	C.I
C. jabalpurense	N.I	C.I
C. spiralotrichum	N.I	C.I
C. oblatum	C.I	C.I
C. subspirilliferum	N.I	C.I
C. uniporum	N.I	C.I
Circinella muscae	15	C.I
Cladosporium cladosporioides	N.I	C.I
C. musae	23	C.I
C. sphaerospermum	N.I	C.I
C. variabile	N.I	C.I
Cochliobolus lunatus	N.I	C.I
C. spicifer	N.I	C.I
C. tuberculatus	N.I	C.I
Cunninghamella echinulata	N.I	C.I
Curvularia brachyspora	26	C.I
C. lunata var. *aeria*	N.I	C.I

C. pallescens	N.I	C.I
Drechslera australiensis	N.I	C.I
D. erythrospila	C.I	C.I
D. euphorbiae	C.I	C.I
*D.*state of *Trichometasphaeria pedicellata*	N.I	C.I
Emericella nidulans var. *lata*	33	C.I
Epicoccum purpurascens	C.I	C.I
Eurotium chevalieri	20	C.I
Fusarium dimerum	N.I	C.I
F. merismoides	N.I	C.I
F. oxysporum	22	C.I
F. semitectum	N.I	C.I
F. sulphureum	C.I	C.I
Gibberella fujikuroi	N.I	C.I
G. tricincta	C.I	C.I
Memnoniella subsimplex	33	C.I
Monographella nivalis	N.I	C.I
Mucor circinelloides	N.I	C.I
M. hiemalis	N.I	C.I
M. racemosus	N.I	C.I
Myrothecium verrucaria	14	C.I
Nectria haematococca	16	C.I
Paecilomyces carneus	35	C.I
Penicillium aurantiogriseum	23	C.I
P. brevicompactum	19	C.I
P. chrysogenum	N.I	C.I
P. citrinum	N.I	C.I
P. corylophilum	N.I	C.I
P. duclauxii	15	C.I
P. funiculosum	31	C.I
P. purpurogenum	N.I	C.I
P. spinulosum	17	C.I
Phoma eupyrena	N.I	C.I
Rhizopus stolonifer	N.I	C.I
Scopulariopsis brevicaulis	C.I	C.I
S. sphaerospora	N.I	C.I
Setosphaeria rostrata	C.I	C.I
Stachybotrys state of *Melanopsamma pomiformis*	26	C.I
Stemphylium solani	C.I	C.I
Syncephalastrum racemosum	50	C.I
Trichoderma hamatum	36	C.I
T. viride	16	C.I
Ulocladium alternariae	N.I	C.I
U. botrytis	N.I	C.I
U. chartarum	18	C.I

C.I= completely inhibition, N.I= No inhibition.

spices demonstrate antifungal effects. Matan and Matan (2008) studied the antifungal activities of anise oil, lime oil, and tangerine oil against molds identified from rubberwood surfaces (*Aspergillus niger*, *Penicillium chrysogenum*, and *Penicillium* sp.) and determined the minimal inhibitory concentration (MIC) and minimal fungicidal concentration (MFC). Anise oil was the strongest inhibitor with the MIC and MFC of 40 $\mu l ml^{-1}$ against *Penicillium* sp. and *A. niger* and 60 $\mu l ml^{-1}$ against *P. chrysogenum*. Lime oil and tangerine oil were also effective against those molds at higher concentrations of 100–180 $\mu l ml^{-1}$.

Skrinjar and Nemet (2009) studied the antimicrobial activity of essential oils extracted from garlic, mustard, cinnamon, cumin, clove, bay, thyme, basil, oregano, pepper, ginger, sage, rosemary etc., against most common bacteria and fungi that contaminate food. Fungi tested includes *Aspergillus* and *Cladosporium* species. It was found that cinnamon, cloves and mustard have very strong antimicrobial potential. Oils from cumin, oregano, sage, thyme and rosemary show medium inhibitory effect, and spices such as pepper and ginger have weak inhibitory effect.

Naeini *et al*. (2009) studied the anti-*Candida albicans* activity by the essential oils of 16 Iranian medicinal plants. They found that essential oils of *Zataria multiflora*, *Thymus kotschyanus*, *Cuminum cyminum* and *Plargonium graveolens* showed significant activity against *C. albicans* ($P < 0.05$).

References

Al-Mofleh I.A. 2010. Spices, herbal xenobiotics and the stomach: Friends or foes? World Journal of Gastroenterology, 1622: 2710-2719.

Angioni A., Barra A., Cereti E., Barile D., Coisson D. J., Arlorio M., *et al*. 2004. Chemical composition, plant genetic differences, antimicrobial and antifungal activity investigation of the essential oil of *Rosmarinus officinalis* L. Journal of Agricultural and Food Chemistry, 5211: 3530–3535.

Anon A. 1993. Analytical methods of committee. Application of gas-liquid chromatography to analysis of essential oils Part XVI. Monography for five essential oils. Analyst, 118: 1089–1098.

Ayodele S.M., Llondu E.M. and Onwubolu N.C. 2009. Antifungal properties of some locally used spices In Nigeria against some rot fungi. African Journal of Plant Science, 3 6: 139-141.

Baser K.H.C., Kurkcuoglu M. and Ozek T. 1992. Composition of the Turkish cumin seed oil. J. Ess. Oil Res., 4: 133-138.

Borges P. and Pino J. 1993. The isolation of volatile oil from cumin seeds by steam distillation. Nahrung, 2: 123–126.

Chen N., Chang C. C., Ng C. C., Wang C. Y., Shyu Y. T. and Chang T. L. 2008. Antioxidant and antimicrobial activity of Zingiberaceae plants in Taiwan. Plant Foods for Human Nutrition, 63 1: 15-20.

Collins C.H., Lynes P.M. and Grange J.M. 1995. Microbiological Methods. 7thEdn. Butterwort-Heinemann Ltd., Britain, 175-190.

Cruz M. C. S., Santos P. O., Barbosa A. M., de M'elo D. L. F. M., Alviano C. S., Antoniolli A. R., *et al*. 2007. Antifungal activity of Brazilian medicinal plants involved in popular treatment of mycoses. Journal of

Ethnopharmacology, 111: 409-412.
Czygan F.C. 1992. Anis Anisi fructus DAB 10 – *Pimpinella anisum*, Z. Phytother. 13: 101-106.
Dawar S., Abbas S., Tariq M. and Zaki M.J. 2008. In vitro fungicidal activity of spices against root infecting fungi. Pak. J. Bot., 40 1: 433-438.
European Pharmacopoeia, 4th ed, Council of Europe, Strasbourg 2001, pp. 93-99.
Gulcın I., Oktay M., Kırecci E. and Ku frevıog Lu O.I. 2003. Screening of antioxidant and antimicrobial activities of anise *Pimpinella anisum* L. seed extracts. Food Chem., 83: 371-82.
Hansel R., Sticher O. and Steinegger E. 1999. Pharmakognosie-Phytopharmazie, 6th ed., Springer-Verlag, Berlin, pp. 692-695.
Hashem M. and Alamri S. 2010. Contamination of common spices in Saudi Arabia markets with potential mycotoxin-producing fungi. Saudi Journal of Biological Sciences, 17: 167-175.
Kelen M. and Tepe B. 2008. Chemical composition, antioxidant and antimicrobial properties of the essential oils of three Salvia species from Turkish flora. Bioresour. Technol., 99: 4096-4104.
Kotzekidou P., Giannakidis P. and Boulamatsis A. 2008. Antimicrobial activity of some plant extracts and essential oils against food-borne pathogens in vitro and on the fate of inoculated pathogens in chocolate. LWT, 41: 119-127.
Lopez P., Sanchez C., Batlle R. and Nerin C. 2005. Solid- and vapor-phase antimicrobial activities of six essential oils: Susceptibility of selected foodborne bacterial and fungal strains. J. Agr. Food Chem. 53: 6939-6946.
Matan N. and Matan N. 2008. Antifungal activities of anise oil, lime oil, and tangerine oil against molds on rubberwood *Hevea brasiliensis*. International Biodeterioration & Biodegradation, 62: 75-78.
Martindale: The Complete Drug Reference Ed. S. Sweetman, Electronic version, Edition 2002, Pharmaceutical Press, London 2002.
Mekawey A.A.I., Mokhtar M.M. and Farrag R.M. 2009. Antitumor and Antibacterial Activities of [1-2-Ethyl, 6-Heptyl Phenol] from *Cuminum Cyminum* Seeds. Journal of Applied Sciences Research, 5 11: 1881-1888.
Naeini A., Khosravi A.R., Chitaz M., Shokri H. and Kamlnejad M. 2009. Anti-Candida albicans activity of some Iranian plants used in traditional medicine. Journal De Mycologie Medicale. Mycmed., 190: 1-5.
Nazef L., Belguesmia Y., Tani A., Prevost H. and Drider D. 2008. Identification of lactic acid bacteria from poultry feces: Evidence on anti-*Campylobacter* and anti-*Listeria* activities. Poultry Science, 872: 329-334.
Pourgholami M.H., Majzoob S., Javadi M., Kamalinejad M., Fanaee G.H.R. and Sayyah M. 1999. The fruit essential oil of *Pimpinella anisum* exerts anticolvusant effects in mice, J. Ethnopharmacol, 66: 211-215.
Rasooli I., Rezaei M.B. and Allameh A. 2006. Growth inhibition and morphological alterations of Aspergillus niger by essential oils from *Thymus* eriocalyx and *Thymus x-porlock*. Food Control. 17: 359-364.
Shaath N.A. and Azzo N.R. 1993. Essential oil of Egypt. In G. Charalambous Ed., Food flavor ingredients and composition pp. 591–603. Amsterdam: Elsevier Sci. Pub.
Skrinjar M.M. and Nemet N.T. 2009.

Antimicrobial effects of spices and herbs essential oils. Apteff, 40: 1-220.

Srinivasan K. 2005. Spices as influencers of body metabolism: an overview of three decades of research. Food Research International, 38: 77-86.

Suresh D. and Srinivasan K. 2007. Studies on the in vitro absorption of spice principles – curcumin, capsaicin and piperine in rat intestines. Food and Chemical Toxicology, 45: 1437-1442.

Takahashi K., Muraki S. and Yoshida T. 1981. Synthesis and distribution of _-mint sulfide a novel sulfur-containing sesquiterpene.Agro. Bio. Chem., 45: 129-131.

Tyler V.E., Brady L.R. and Robbers J.E. 1988. Pharmacognosy, 9th ed., Lea and Fabiger, Philadelphia, p. 125.

Walker J.R.L. 1994. Antimicrobial compounds in food plants. Pages 181–204 in Dillon VM, Board RG, eds. Natural Antimicrobial Systems and Food Preservation. Wallingford UK: CAB International.