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SPICY ANTIFUNGAL

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There has constantly been increasing the search for alternative and efficient compounds for fungal treatment, aiming a partial or total replacement of antifungal chemical additives. Inhibitory activity of spices and derivatives on the growth of yeasts and fungi has been well reported, so they could be used in treatment of skin diseases as main or as adjuvant compounds in order to prevent fungal growth.

Keywords : Antifungal; Skin disease; Spices.

Spices in general are the products of tropical and subtropical trees, shrubs or vines and are characterized by highly pungent odours and flavours. The earliest literary record in India on spices is the Rig Veda (around 6000 BC), one of the ancient Hindu scriptures, lists more than a thousand healing plants and herbs (bark, fragrant leaves, roots , flowers and stem of certain plants of temperate region).

Despite the contrasting opinion of different experts who insisted on their indications, spices used as medicines, there is a little evidence of any specific benefit from most spices. Many pungent spices are unattractive to animals and they do have some antimicrobial properties, however there is lack of uniformity in findings. In general, it is claimed that garlic, onion, coriander, capsicum were found to be the best all round bacterial killer - the most potent antibacterial and antifungal agents; followed by cinnamon, cumin - which kill up to 80% of bacteria. Capsicum, including chilies and other hot peppers are in the middle of the antimicrobial pack- killing/inhibiting up to 75% of bacteria, while pepper of the white or black variety inhibits 25% of bacteria as do ginger, anise seed and the juices of lemon and limes.

Antimicrobial activity of spices depends on kind of spice; composition and concentration of spice; microbial species and its occurrence level: substrate composition and processing conditions and storage.

Spices include leaves (mint, coriander, bay), flowers (clove), bulbs (garlic, onion), fruits (cumin, red chilies, black pepper) and other plant parts.

Pathogenic Fungi - Although the vast majority of fungi are saprophytic, some 50 species are opportunists, i.e., they can cause disease in man when introduced in to the body under the right conditions. The pathogenic fungi are of two general types; (a) those causing generalized or systemic infection of deep tissues, often fatal and (b) those affecting only superficial tissues; *i.e.* skin, nails and hairs. The fungi of second group are collectively called dermatophytes i.e. skin fungi. Infections by any fungi are collectively called mycoses[1].

Antifungal activity - Antifungal activity of spices and derivatives has been studied regarding viable cells count, mycelial growth and mycotoxins synthesis. Karapinar[2] analyzed the inhibitory effect of various concentrations of mint, sage, bay, anise and pepper (0.5, 1.0, 2.0, 4.0, 8.0, 16.0 % w/v) on the growth of *Aspergillus parasiticus* and its aflatoxin production and reported that only thyme presented significant delay on the fungal growth up to ten days at 2.0 % and up to 30 days at 4.0, 8.0 and 16.0 %. Thyagaraja and Hosono[3] assayed the ability of chili, coriander, pepper, cumin and asafoetida on *Rhizopus azygosporus, Mucor dimorphosphorus, Penicillium commune, Fusarium solani.* Asafoetida showed promising results in inhibiting the fungal growth, among the ethanolic and aqueous asafoetida extract, only ethanolic fraction showed antifungal property. Abel-Hafez and El-Said[4] analyzed the effect of garlic and onion extract and reported effectiveness of garlic extract up to 0.25% v/v to inhibit the growth of *Aspergillus flavus, A. fumigatus, A. niger, A. ochraceus, A. terreus, Penicillium chrysogenum, P. citrinum* and *Rhizopus stolonifer*. Onion extract at all assayed concentrations (0.625, 0.250 and 0.125 % v/v) did not present significant inhibitory effect when compared to the controlled assay. Adam *et al.*[5] analyzed the antifungal activity of essential oil from sage and mint on human pathogenic fungi and found prominent inhibition on *Malassezia furfur* and *Trychophyton ruburum.* Arora and Kaur[6] assayed the sensitivity of yeasts to spices aqueous extract and found that garlic and clove extract were able to inhibit *Candida acutus, C. albicans, C. apicola* and *Trichosporum beigelii* with minimum inhibitory

Table 1. Top 16 spices with Antimicrobial properties:

• Garlic (*Allium sativa)*	• Tumeric (*Curcuma longa)*
• Onion (*Allium cepa)*	• Mint (*Mentha longifolia)*
• Cinnamon (*Cinnamomum zeylanicum)*	• Fennel (*Foeniculum vulgare)*
• Cumin (*Cuminum cyminum)*	• Coriander (*Coriandrum sativum*)
• Clove (*Syzygium aromaticum*)	• Dill (*Anethum graveolens*)
• Asafoetida (*Ferula asafetida*)	• Cardamom (*Elettaria cardamomum*)
• Mustard (*Brassica compestris*)	• Pepper (*Piper nigrum*)
• Saffron (*Crocus sativus*)	• Ginger (*Zingiber officinale*)

Table 2. Examples of Human Mycoses.

Disease	Foci of Infection	Causative Fungus
I. Systemic Mycoses:		
Candidiasis	Lungs, mucous membrane	*Candida albicans*
Coccidiodomycosis	Lungs	*Coccidioides immitis*
Blastomycosis	Lungs	*Blastomyces dermatidis*
Aspergillosis	Lungs	*Aspergillus fumigatus*
Cryptococosis	Lungs, meninges	*Cryptococcus neoformans*
II. Dermal Mycoses:		
Ring worm	Scalp,face	*Microsporum audouini*
Athlete's foot	Toe webs, feet	*Epidermophyton floccosum*
Barber's itch	Bearded area of face	*Trichophyton sp.*

concentration and lethal minimum inhibitory concentration of 0.25% and 1.0% v/v. Minimum Inhibitory concentration (MIC) was understood as the lower essential oil concentration that cause the total inhibition of the fungal growth, while the lethal minimum inhibitory concentration was understood as the lower essential oil concentration that killed the fungi inoculum detected by viable cells count[6]. Juglal *et al.*[7] studied the effectiveness of nine essential oils to control the growth of mycotoxins producing moulds and noted that clove, cinnamon were able to prevent the growth of *Aspergillus parasiticus* and *Fusarium moniliforme*. Benkeblia[8] observed the inhibitory effect of onion essential oil at concentration 50, 100, 200, 300 and 500 ml/liter on *Fusarium oxysporum, Aspergillus niger and Penicillium cyclopium.*

In general, inhibitory action of spices on fungi and moulds involve cytoplasm granulation, cytoplasmic membrane rupture and inactivation and / or inhibition of intracellular and extra cellular enzymes. Many authors have emphasized that the antifungal effect of essential oil constituents has been dependent on their hydrophobicity and partition in the microbial plasmatic membrane. Effect of specific ions due to their addition in / on plasmatic membrane had great effect on the protons motive force, intracellular ATP content and overall activity of these cells including turgor pressure, solutes transport and metabolism regulations[9-11].

Fifty years of increasing use of chemo- antifungal

have created a situation leading to an ecological imbalance and enrichment of multiple multi-resistant pathogenic microorganisms. The successful story of microbial chemo control lies in the continuous search for new antifungal substances to control the challenges posed by resistant strains. Spices with antifungal properties notably have obtained emphasis for possible application in topical preparations in order to prevent fungal growth. Spices are characterized for a wide range of volatile compounds, which are important quality factors and are generally recognized as safe (GRAS). Systematic screening of biological interaction between fungi and spices has been valuable source of new and effective microbial ingredient which could have different ways on/in the fungal cell when compared to other conventional antifungal substances.

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References

1. Frobisher M, Hindsill D Ronald, Crabtree T Koby and Goodheart R Clyde, *Fundamentals of Microbiology.* 9th Edn. W.B. Saunders Company, U.S.A., p 171.
2. Karapinar M 1985, The effects of citrus oils and some Turkish spices on growth and aflotoxin production by *Aspergillus parasiticus* NRRl 2999. *Inter. J. Food Micro.* **12** 239-245.
3. Thyagaraja N and Hosono A 1996, Effect of spice extract on fungal inhibition. *Lebensmittel Wissenchaft und-Tech.* **29** 286-288.
4. Adbel-Hafez S I I and El-Said A H M 1997, Effect of garlic, onion and sodium benzoate on the mycoflora of pepper, cinnamon and rosemary in Egypt. *Inter. Biodeterioratio Biodegradation 39 67-77.*
5. Adam K, Sivropoulus A, Kokkini S, Lanaras T and Arsenakis M 1998, Antifungal activities of *Origanum vulgare* subsp. *Hirtum, Mentha spicata, Lavandula angustifolia* and *Salvia fructicosa* essential oils against human pathogenic fungi. *J. Agri. and Food Chem.* **46** 1739-1745.
6. Arora D and Kaur J 1999, Antimicrobial activity of spices. *Inter. J. Anti. Agents* **12** 257-262.
7. Juglal S, Govinden R and Odhav B 2002, Spices oils for the control of co-occuring mycotoxin producing fungi. *J. Food Prot.* **65** 638-687.
8. Benkeblia N 2004, Antimicrobial activity of essential oils of various onions (*Allium cepa*) and garlic (*Allium sativum*). *Lebensmittel wissenchaftund-Tech.* **37** 263-268.
9. Cowan M M 1999, Plants products as antimicrobial agents. *Clinical Micro. Review* **12** 564-582.
10. Notermans S and Hoogenboon- Verdegaal A 1992, Existing and emerging food borne diseases. *Inter. J. Food Micro.* **15** 205.
11. Newberne P, Smith R L, Doull J and Feron V J 2000, GRAS flavoring substances. *Food Tech.* **54** 66-83.