

**MINI REVIEW**

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## **Dermatophytoses and prospectives of their cure by plant products**

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The review article deals with the dermatophytes and the symptomology as well as etiology of dermatophytoses. The role of different therapeutic agents has been discussed. Besides, the prospectives of higher plant products for cure of the disease has been focused in the light of recent reports on some plant products.

**Key words :** Dermatophytes, dermatomycosis, plant products

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### **INTRODUCTION**

Dermatophytic fungi are worldwide in distribution. Their occurrence is more prevalent in countries of tropical and subtropical regions (Dasgupta and Majumdar, 1960; Srivastava, 1985). The type of severity of these infections depends on the immune state of the host as well as to the strain and species of the organism causing infection. The number of recognized dermatophyte's is now 37, as reviewed by Ajello (1968). These include one species in the genus *Epidermophyton*, 15 in *Microsporum* and 21 in *Trichophyton*.

### **SOURCE OF INFECTION**

The source of infection of dermatophytes to human beings may be animal to man (zoophilic), or soil to man (geophilic) or man to man (anthrophilic). *Trichophyton concentricum* is passed from mother to child soon after birth. Infection of entire population of children in schools and institutions during epidemics of *Microsporum audouinii* has been recorded.

It has been pointed out that several domestic animals act as reservoir for human dermatophytosis. Zoophilic dermatophyte infections are particularly common in rural areas. Fungi from domestic animals such as dogs and cats may initiate as epidemic among children. The infected hairs shed from these animals may be a source of human infection. The infections of *M. canis* on cats, pigs and sheep, *M. audouinii* on dogs and monkeys, *T. mentagrophytes* on cattle have been frequently recorded as a source of human infection.

### CLINICAL DISEASE

Many species of dermatophytes elicit a number of well defined clinical syndromes. Various terms of clinical dermatophytoses are tabulated below. The external morphological differences between these dermatophytoses are apparent but histopathologic changes are fundamentally the same.

### IMMUNOLOGY OF DERMATOPHYTOSIS

Clinical records indicate that, in a large series of children treated for *Tinea capitis*, secondary infection could not take place. Similar findings were observed in agricultural workers infected with *T. verrucosum* (Leavell and Tucker, 1966). Their observations are interpreted to mean that there was increased resistance to reinfection as a result of the initial infections. On the other hand, multiple episodes of *Tinea pedis* (caused by *T. mentagrophytes*) occur and reinfection is common with patients of the disease. Repeated *tinea carporis* (caused by *T. rubrum*) and *Tinea capities* (caused by *M. audouinii*) are also common and each episode differs a little from the initial infection (Desai and Bhat, 1963). Thus acquired resistance to reinfection to the dermatophytosis differs with patients as well as with the dermatophytes. Intradermal infection of this substance elicit either a delayed or immediate response. Purification and chemical analysis of trichophytin shows it to be a galactomannan peptide (Barker and Trotter, 1960). Degradation studies indicate that the immediate reaction is associated with the carbohydrate fraction (galactomannan) and delayed reactivity with the peptide moiety. Attempts to conclusively demonstrate this in human disease have as yet been unsuccessful, although the work of Jones and Reinhardt (1973), is suggestive. Trichophytin; as presently prepared is not species specific and is common to almost all dermatophytes from which it is derived. Trichophytin like substances have been isolated from species of *Aspergillus* and *Penicillium* as well as dermatophytes. The development of species specific antigens would greatly aid in the understanding of dermatophyte disease.

Dermatophytid or id-reactions are secondary eruptions occurring in sensitized patients as a result of circulation of allergenic products from a primary site of infection. Id-reaction is frequently observed in case of infection of *Tinea pedis* and *Tinea capitis*.

### CHEMOTHERAPY OF THE DERMATOPHYTOSIS

During the latter-half of this century some effective synthetic antifungal drugs have been discovered for cure of dermatophytosis. Griseofulvin is an effective antifungal antibiotics commonly obtained from *Penicillium* species (Dekker, 1978). Many polyene antibiotics produced by *Streptomyces* species have shown potential clinical usefulness for the control of such diseases. However, at present Amphotericin-B and Nystatin are commonly used as chemotherapeutic agents but these also exhibit some side effects.

Such side effects are believed to be nil or even much less with the medicines of herbal origin. The traditional medicines have been attracted researchers from all parts of the globe. Hence, a worldwide interest is created in the field of ethnomedicines for finding out new substitute herbal drugs. For this an intensive research in scientific disciplines like ethnomedicine, ethnopharmacology and ethnopsychiatry is needed (Brahma, 1992).

According to WHO (Franz, 1989) about 80% of inhabitants of the world rely chiefly on traditional medicines for their primary health care and the major part of traditional therapy

involves the use of plant extracts or their active principles. In addition, the total world annual turnover of the pharmaceutical industry utilizing medicinal plants has been recently estimated to be at least US\$ 20,000 millions (Franz, 1989). The WHO has brought out an inventory of about 16,000 medicinal plants widely used in 99 countries of the world based on the Pharmacopoeias of these countries.

**Table 1.** Symptomatology of Dermatophytoses

Clinical disease	Parts affected	Fungi involved	Symptomatology and characteristics
Tinea capitis	Scalp, Eyebrow, eyelashes	<i>M. audouinii</i> <i>T. mentagrophytes</i> <i>M. gypseum</i> <i>M. canis</i> <i>T. violaceum</i>	Infection begins as small erythematous papule around hairs shaft, within a few days it pales and becomes scaly and hairs become greyish weakened and breakoff. Itching may become severe and ulcerative lesions may develop. Dermatophytid (id) reaction may occur.
Tinea favosa	Scalp, glabrous skin	<i>T. schoenleinii</i>	Yellowish cup shaped crusts called scutula are formed, after some time, atrophy skin may develop.
Tinea corporis	Glabrous skin of the body	<i>T. mentagrophytes</i> <i>T. rubrum</i> <i>E. floccosum</i>	Usually the margin of the lesions remain red (sometimes swollen) while central area becomes scaly.
Tinea imbricata	Most of the part of the body	<i>T. concentricum</i>	Numerous concentrically arranged rings and formed covering most of body.
Tinea cruris	Groin	<i>T. mentagrophytes</i> <i>E. floccosum</i>	The central portion of the lesions are brownish to red in colour, covered with thin scales.
Tinea unguium	Nail	<i>T. mentagrophytes</i> <i>T. rubrum</i>	The infected nail becomes brown or black and cracked.
Tinea barbae	Face and neck	<i>T. mentagrophytes</i> <i>T. rubrum</i>	There is central scaling of lesions and shedding of hairs.
Tinea manuum	Palm	<i>T. mentagrophytes</i> <i>T. rubrum</i> <i>E. floccosum</i>	Hyperkeratosis of palm is most common, (id) reactions also occurs.
Tinea pedis	Feet	<i>T. mentagrophytes</i> <i>T. rubrum</i> <i>E. floccosum</i>	Maceration and fissuring of skin take place. Infected portion becomes pale to white in colour.

Although there are some review articles and monographs on fungitoxic plants and the products vis-a-vis plant pathogenic fungi (Nickell, 1959; Mahadevan, 1982; Dixit *et al.*, 1984; Dubey *et al.*, 1984), there is still no compiled account of the work done on antifungal activity of higher plants and their products against dermatophytes.

Crudes of different plants have been tested against some dermatophytes. Most of the testings remained confined to *in vitro* conditions. However, the extracts of *Juglans regia* (Ahmad *et al.*, 1973), *Perlargonium roseum* (Wellman *et al.*, 1973), *Allium sativum* (Tansey and Appleton, 1975), *Curcuma Zedoaria* (Venkitaraman *et al.*, 1977), *Ipomoea purpurea* (Singh and Bhatt, 1979), *Vinca rosea* (Chile *et al.*, 1981), *Adenocalymna allicea* (Rao and Rao, 1985), *Cassia alata* (Palanichamy and Nagrajan, 1990) have shown promising efficacy in inhibition of growth of different species of *Microsporum* and *Trichophyton*. Similarly the active principles of some plants have been isolated and

standardized as antidermatophyte. The essential oils of *Psoralea drupacea* (Band Cirenko *et al.*, 1972), *Allium sativum*, *Ammomum subulatum*, *Azadirachta indica*, *Syzygium aromaticum* (Thind and Dahiya, 1977), *Aegle marmelos* (Jain, 1977), *Curcuma angustifolia* (Banerjee and Nigam, 1977), *Cyperus scariosus* and *Ocimum basilicum* (Lahariya and Rao, 1979), *Hypericum perforatum* (Khosa and Bhatia, 1982), *Cymbopogon martinii*, *Eucalyptus globulus* and *Thuja orientalis* (Deshmukh *et al.*, 1982), *Juniperus virginiana* (Mall *et al.*, 1985), *Ageratum conyzoides* (Singh *et al.*, 1986), *Trachysperum ammi* (Singh *et al.*, 1986), *Eupatorium cannabinum*, *E. capillifolium* (Mall, 1987), *Eucalyptus citriodora* (Mishra *et al.*, 1990), *Amomum subulatum* (Mishra and Dubey, 1990), *Piper betle* (Garg and Jain, 1992) have been isolated to exhibit fungitoxic property against ringworm. Similarly tomatidine from *Lycopersicon esculentum* (Chamisso, 1957), 5-hydroxy-1,4-naphthoquinone from *Juglans regia* and *J. seibodiana* (Tetsuro *et al.*, 1967), Sanguinarin from *Sanguinaria canadensis* (Adgina, 1970), 6-6, dihydroxythiobinupharidine from *Nuphar* sp. (Cutten and Lalonde, 1973), Alantolactone, Isolanto-lactone from *Inula racemosa* (Tripathi *et al.*, 1978), Tryptanthrin from *Isatis tinctoria* and *Polygonum tinctorium* (Honda *et al.*, 1979), Alantolactone from *Inula racemosa* (Wahab *et al.*, 1981), protoanemonin from *Ranunculus bulbosus* (Mares, 1987), saponin from *Solidago virgaurea* (Bader *et al.*, 1987) Quinones from *Chimaphilla unbellata* and *C. maculata* (Haused and Schiedermaier, 1988), Triterpene glycosides from *Sanicula europaea*, *Astrantia major*, *Solidago virgaurea*, *Solidago caanadensis*, *Bellis perennis* (Bader, 1991) have been found to be strongly toxic against the dermatophytes. Some investigators have worked out the therapeutic efficacy of the plant products against the induced dermatomycosis to animals. It is encouraging that many plant products have been found effective in cure of induced dermatomycosis and the ointments occupy an important place in modern medicine. Solamangine and solasonine isolated from *Solanum laciniatum* were found effective against experimentally induced ringworm on rabbit caused by *Microsporum canis* and *Trichophyton mentagrophytes* (Alkiewicz *et al.*, 1966). Vichkanova and Kuznetsova (1967) reported the essential oil of *Trapaolum majus* to cure the dermatomycosis caused by *Microsporum lanosum*. Plant extracts of *Euphorbia thymifolia* and *E. prostrata* were found effective against experimentally induced dermatomycosis by *Trichophyton mentagrophytes* and *T. simmii* in goat and rabbit (Pal and Gupta, 1978). Amer *et al.* (1980) reported extracts of *Allium sativum* to provide complete healing of dermatomycosis within 17 days on guinea pigs and rabbits. Chloroform extracts of *Leucas aspera* and *Curcuma longa* were effective in the treatment of *T. verrucosum* infection in cattle and *E. cannabinum* checked the ringworm disease of Guinea pigs within 21 days without any strong adverse effect to treated skin (Mall, 1987). In a detailed study on induced dermatomycosis on guinea pigs (Kishore *et al.*, 1993) reported the ointment of the oils of *Artemisia nelagrica*, *Chenopodium ambrosioides*, *Caesulia axillaris* and *Cymbopogon citratus* prepared in petroleum jelly efficacious to cure the dermatomycosis on guinea pigs within 12 days. Amongst these *Artemisia* oil was found to be most effective.

Thus many of the products of higher plant origin are more efficacious than the prevalent antimycotic drugs. Because of their long history of harmless nature such plant products may constitute an effective chemotherapeutant for dermatomycosis. The volatile plant products should be tested for their detailed clinical and pharmacognostic properties and if found effective these may be prescribed as aromatherapy for cure of deep mycosis as Aspergillosis. Thus higher plants are untapped reservoirs of valuable chemotherapeutants which may be effectively exploited for cure of dermatomycoses in animals and human beings.

## REFERENCES

- Adgina, V.V. (1970). Antifungal activity of Sanguinarin *in vitro*. Mater. Vses. Konf. Issled. Lek. Rast. Perspet. Ikh. Isl'zprovizvod. prep. p. 221-223.
- Ahmed, S., Wahid, M.A. and Bukhari, A.Q.S. (1973). Fungistatic action of juglans. *Antimicrobial agents and chemotherapy*, **3** : 436-438.
- Ajello, I. (1968). A taxonomic review of the dermatophytes and related species. *Sabouraudia*, **6** : 147-159.
- Alkiewicz, J., Henryk, G., Kamysek, F., Kowalewski, Z. and Moderski (1966). The *in vitro* and *in vivo* action of the glycoalkaloid of *Solanum laciniatum*, *Solamargin solasonine*, on some strains of dermatophytes. *Diss. Pharm. Pharmacol.* **18** : 553-559.
- Amer, M., Toha, M. and Tosson, Z. (1980). The effect of aqueous garlic extract on the growth of dermatophytes. *Inter. J. Dermatol.* **19** : 285-287.
- Bader, Gerd (1991). Biological activity of Triterpene saponins with special regards to antifungal activity. *Wiss z humboldt Univ Berl Reithe Math Naturwiss* **40(1)** : 91-94.
- Bader, G., Binder, K., Hiller and Ziegler Bohme, H. (1987). Antimycotic activity of triterpenoid saponins from *Solidago virgaurea*. *Pharmazie* **42(2)**: 140.
- Band Cirenko, A.S., Aizanman, B. Ya., Prykhod, V.O., Mesheherya, KO, Kov, A.O., Skorobanat, KO and Mishenkovea, Ye. L. (1972). Antibiotic properties of *Psoralea drupacea* Bge essential oil *Mikrobiol. Z. (KYYJV)*, **34** : 612-616.
- Banerjee, A. and Nigam, S.S. (1977). Antifungal activity of the essential oil of *Curcuma angustifolia*. *Indian J. Pharm.* **39** : 143.
- Barker, S.A. and Trotter, M.D. (1960). Isolation of purified trichophytin. *Nature*, **188** : 232-233.
- Chamisso, P. (1957). Fungistatic activity of some derivatives of salasodine. *Anal. Ass. Quim. Arq.* **45** : 113-120.
- Chile, S.K., Saraf, M. and Barde, A.K. (1981). Efficacy of *Vinca rosea* extract against human pathogenic strain of *Trichophyton rubrum* Sab. *Indian Drugs Pharm. Ind.* **16** : 31-33.
- Cutten, W.P. and Lalonde, R.T. (1973). Isolation and *in vitro* antifungal activity of 6-6 dihydroxythiobinuharidine *J. Pharm. Sci.* **62** : 826-827.
- Dasgupta S. N. and Majumdar, S.S. (1960). Medical mycology in India. *Mycopath.* **13** : 339-376.
- Dekker, J. (1978). Antibiotics. In: Fungicides on Advance Treatises Vol. III, Ed. D.C. Torgerson, Academic Press, New York and London, 580-625.
- Desai, S.C. and Bhat, M.L.A. (1963). Biology of *Trichophyton rubrum* infections. *Indian Med. Res.* **51** : 233-243.
- Deshmukh, S.K., Gupta, D.K. and Tiwari, O.P. (1982). Sensitivity of some dermatophytes. *Indian Drugs* **19** : 404-405.
- Dixit, S.N., Dubey, N.K. and Tripathi, N.N. (1983). Fungitoxic essential oils vis-a-vis disease control. In: Recent Advances in Plant Pathology. Eng. Husain, A., Singh, B.R., Singh, K. and Agnihotri, V.P., Print House, Lucknow, India, pp. 248-251.
- Dubey, N.K., Tripathi, N.N. and Dixit, S.N. (1984). Higher plants a promising source of antifungal constituents. In : Recent Trends in Botanical Researchers. Ed. R.P. Sinha, Murlidharr Printers, Patna, pp. 221-228.
- Franz, C. (1989). Domestication of wild growing medicinal plants. *Plant Research and Development.* **37**: 101-111.
- Garg, S.C. and Jain, R. (1992). Biological activity essential oil of Piper betle L. *Journal of Essential Oil research* **4(6)** : 601-606.
- Hausen, B.M. and Schiedermaier, I. (1988). The sensitizing capacity of chinaphilin, a naturally occurring

- quinone. *Contact dermatitis* **19**(3) : 180-183.
- Honda, G., Tosirisnk, V. and Tabata, M. (1979). Isolation of an antidermatophytic Trypanthrin from Indigo plants, *Polygonum tinctorium* and *Isatis tinctoria* *Plants Medica* **38** : 276-276.
- Jain, N.K. (1977). Antifungal activity of essential oil of *Aegle Marmelos*, correa (Rutaceae). *Indian Journal of Microbiology* **17**(1) : 51.
- Jones, H.E., and Reinhardt, J.H. (1973). A clinical mycological and immunological survey for dermatophytosis. *Arch. Dermatol.* **108** : 61-65.
- Khosa, R.L. and Bhatia, N. (1992). Antifungal effect of *Hypericum perforatum*. *J. Sci. Res. Plant Med.* **3** : 49-50.
- Kishore, N., Mishra, A.K. and Chansouria, J.P.N. (1993). Fungitoxicity of essential oils against dermatophytes. *Mycoses* **36** : 211-215.
- Lahariya, A.K. and Rao, J.T. (1979). *In vitro* antimicrobial studies of the essential oil of *Cyperus scariosus* and *Ocimum basilicum*. *Indian Drugs* **16** : 150-152.
- Leavell, U.W. and Tucker, E. (1966). Blue dot infection of the scalp in two brother. *J. Ky. Med. Assoc.* **64** : 1107-1110.
- Mahadevan, A. (1982) Biochemical aspects of plant disease resistance, Part I Performed Inhibitory substanceprohibitions. Today and Tomorrow's Printers and publication, New Delhi, pp. 15-60.
- Mall, H.V., Asthana, A., Dubey, N.K. and Dixit, S.N. (1985). Toxicity of cedar wood oil against some dermatophytes. *Indian Drugs* **22** : 296-298.
- Mall, H.V. (1987). Evaluation of some green plants against ringworm fungi. Ph.D. Thesis, Gorakhpur University, Gorakhpur, India.
- Mares, D. (1987). Antimicrobial activity of protoanemonin, a lactone from vanunculaceous plants. *Mycopathologia* **98** (3) : 133-140.
- Mishra, A.K. and Dubey, N.K. (1990). Fungitoxicity of essential oil of *Amomum subulatum* against *Aspergillus flavus*. *Econ. Bot.* **44** : 530-533.
- Mishra, D.N., Mishra, A.K. and Dixit, V. (1990). Mycotoxic properties of the essential oil of Eucalyptus against some dermatophytes. *Vegetos* **3** (2) : 182-185.
- Nickell, L.G. (1959). Antimicrobial activity of vascular plants. *Eco. Bot.* **13** : 281-318.
- Pal, S. and Gupta, I. (1979). Antifungal activity of 'Choti dudhi plant' (*Euphorbia prostrata* and *Euphorbia thymifolia* Linn.) against certain dermatophytes II. *Indian Veterinary Journal* **58** (5) : 367-369.
- Palanichammy, S. and Nagrajan, S. (1990). Antifungal activity of *Cassia alata* leaf extract. *Journal of Ethnopharmacology* **29** (3) : 337-340.
- Rao, M. and Venkata Rao, E. (1985). Antimicrobial activity of the leaf extract of *Adenocalymna alliaccum* *Indian Drug* **22** : 354-365.
- Singh, K.V. and Bhatt, S.K. (1979). *Ipomoea purpurea*. *Indian Drug* **17** : 84.
- Singh, S.P., Shukla, H.S., Singh, R.S. and Tripathi, S.C. (1986). Antifungal properties of essential oil of *Ageratum conyzoides* L. *Nat. Acad. Sci. Letters* **9**: 97-99.
- Srivastava, O.P. (1985). Ecology of human pathogenic fungi progress in Microbial Ecology. Prof. J.N. Rai Festschrift ed. K.G. Mukerji, U.P. Agnihotri and R.P. Singh, Print House (India), Lucknow, pp. 375-390.
- Tansey, M.R. and Appleton, J.A. (1975). Inhibition of fungal growth by garlic extract. *Mycologia* **67** : 409-413.
- Tetsuro, Ikekawa, E. Lin Wang, Mass Hamada, Tomic Takeuchi and Hamao Umezawa (1967). Isolation and identification of the antifungal active substance in walnuts. *Chem. Pharm. Bull.* **15** : 242-245.
- Thind, T.S. and Dahiya, M.S. (1977). Inhibitory effects of essential oils of our medicinal plants against

- some keratinophylic fungi. *East Pharm.* **20**: 147-148.
- Tripathi, S.C., Srivastava, H.S. and Dixit, S.N. (1978). A fungitoxic principle from the leaves of *Lawsonia inermis* Lam. *Experientia* **34** : 51-52.
- Venkitaraman, S., Agnihotri, R.J., Verma, R.R. and Venkataraghavan (1977). Antifungal activity of single and compound indigenous medicinal preparation on experimental study (*in vitro*) and clinical evaluation. *J. res. Indian Med. Yoga Homoeopathy* **12** : 25-28.
- Vichkanova, S.A. and Kuznetsova, S.M. (1967). Antifungal activity of the essential oil from tall annual nasturtium (*Trapaeolum Majus*) seeds. *Naukdunka Kiev* **IB 515** : 117-180.
- Wahab, S., Tondon, R.N., Jacob, Z., Sagar, P. and Srivastava, O.P. (1981). *In vitro* activity of a phytochemical, alantolactone from *Inula racemosa* Hook F. against some pathogenic and opportunistic fungi. *J. Indian Bot. Soc.* **60** : 278-281.
- Wellmann, H., Habicht, G., Lan, I. and Schulz (1973). Some properties of the essential oil of *Pelargonium roseum* from domestic cultivation. *Pharmazie* **28** : 56-58.

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