

Dermatophytes

# dermatophytosis

- Cutaneous mycoses include infections caused by dermatophytic fungi (dermatophytosis)
- The term dermatophytosis refers to a complex of diseases caused by filamentous fungi in the genera
  - Trichophyton,
  - Epidermophyton
  - Microsporum

# the dermatophytes

- These fungi are known collectively as the dermatophytes, and all possess the ability to cause disease in humans and/or animals.
- All have in common the ability to invade the skin, hair, or nails. In each case, these fungi are keratinophilic and keratinolytic and so are able to break down the keratin surfaces of these structures.
- In the case of skin infections, the dermatophytes invade only the upper outermost layer of the epidermis, the stratum corneum.
- hair and nails, being part of the skin, only the keratinized layers are invaded.

# Classification of Dermatophytes According to Ecologic Niche

Ecologic Niche	Species	Principal Hosts	Geographic Distribution	Prevalence	
<b>Anthropophilic</b>	<i>Epidermophyton floccosum</i>		Worldwide	Common	
	<i>Microsporum audouinii</i>		Worldwide	Common	
	<i>M. ferrugineum</i>		Africa, Asia	Endemic	
	<i>Trichophyton concentricum</i>		Asia, Pacific Islands	Endemic Rare	
	<i>T. megnini</i>		Europe, Africa	Endemic	
	<i>T. mentagrophytes</i> var. <i>interdigitale</i>		Worldwide	Common	
	<i>T. rubrum</i>		Worldwide	Common	
	<i>T. schoenleinii</i>		Europe, Africa	Endemic	
	<i>T. soudanese</i>		Africa	Endemic	
	<i>T. tonsurans</i>		Worldwide	Common	
	<i>T. violaceum</i>		Europe, Africa, Asia	Common	
	<b>Zoophilic</b>	<i>M. canis</i>	Cat, dog, horse	Worldwide	Common
		<i>M. gallinae</i>	Fowl	Worldwide	Rare
<i>M. nanum</i>		Swine	Worldwide	Rare	
<i>M. persicolor</i>		Vole	Europe, United States	Rare	
<i>T. equinum</i>		Horse	Worldwide	Rare	
<i>T. mentagrophytes</i> var. <i>mentagrophytes</i>		Rodent	Worldwide	Common	
var. <i>erinacei</i>		Hedgehog	Europe, New Zealand, Africa	Occasional	
var. <i>quinckeanum</i>		Mouse	Worldwide	Rare	
<i>T. simii</i>		Monkey	India	Occasional	
<i>T. verrucosum</i>		Cow	Worldwide	Common	
<b>Geophilic</b>	<i>M. gypseum</i> complex		Worldwide	Occasional	
	<i>T. vanbreuseghemii</i>		Worldwide	Rare	

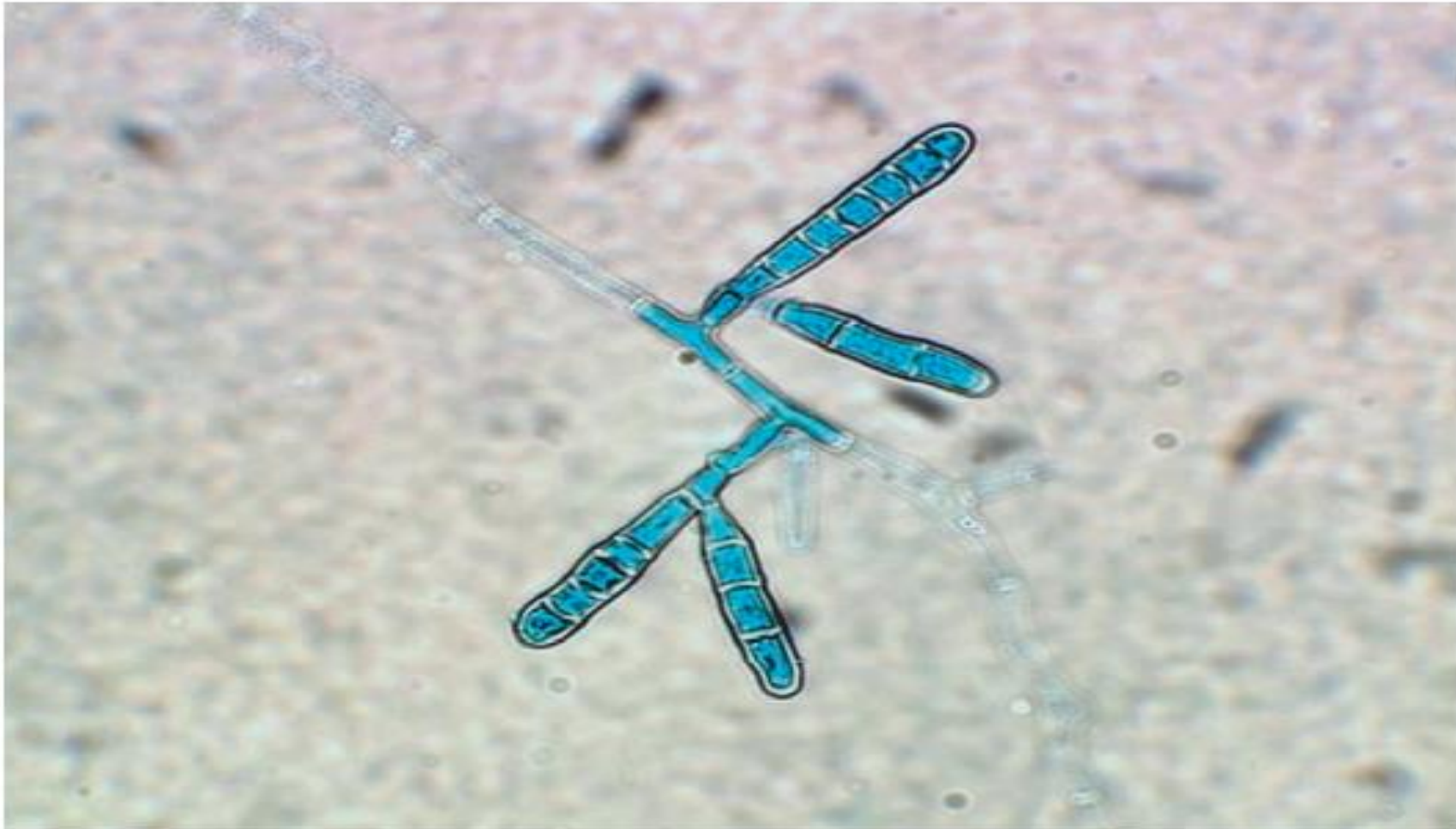
- various forms of dermatophytosis are referred to as tineas or “ringworm.” Clinically, the tineas are classified according to the anatomic site or structure affected:
  - (1) tinea capitis of the scalp, eyebrows, and eyelashes
  - (2) tinea barbae of the beard
  - (3) tinea corporis of the smooth or glabrous skin
  - (4) tinea cruris of the groin
  - (5) tinea pedis of the foot
  - (6) tinea unguium of the nails (also known as onychomycosis).
- The clinical signs and symptoms of dermatophytosis vary according to the etiologic agents, host reaction, and site of infection.

# Morphology

- Each genus of dermatophytic mold is characterized by a specific pattern of growth in culture and by the production of macroconidia and microconidia .
- Further identification to species level requires consideration of colony morphology, spore production, and nutritional requirements in vitro.

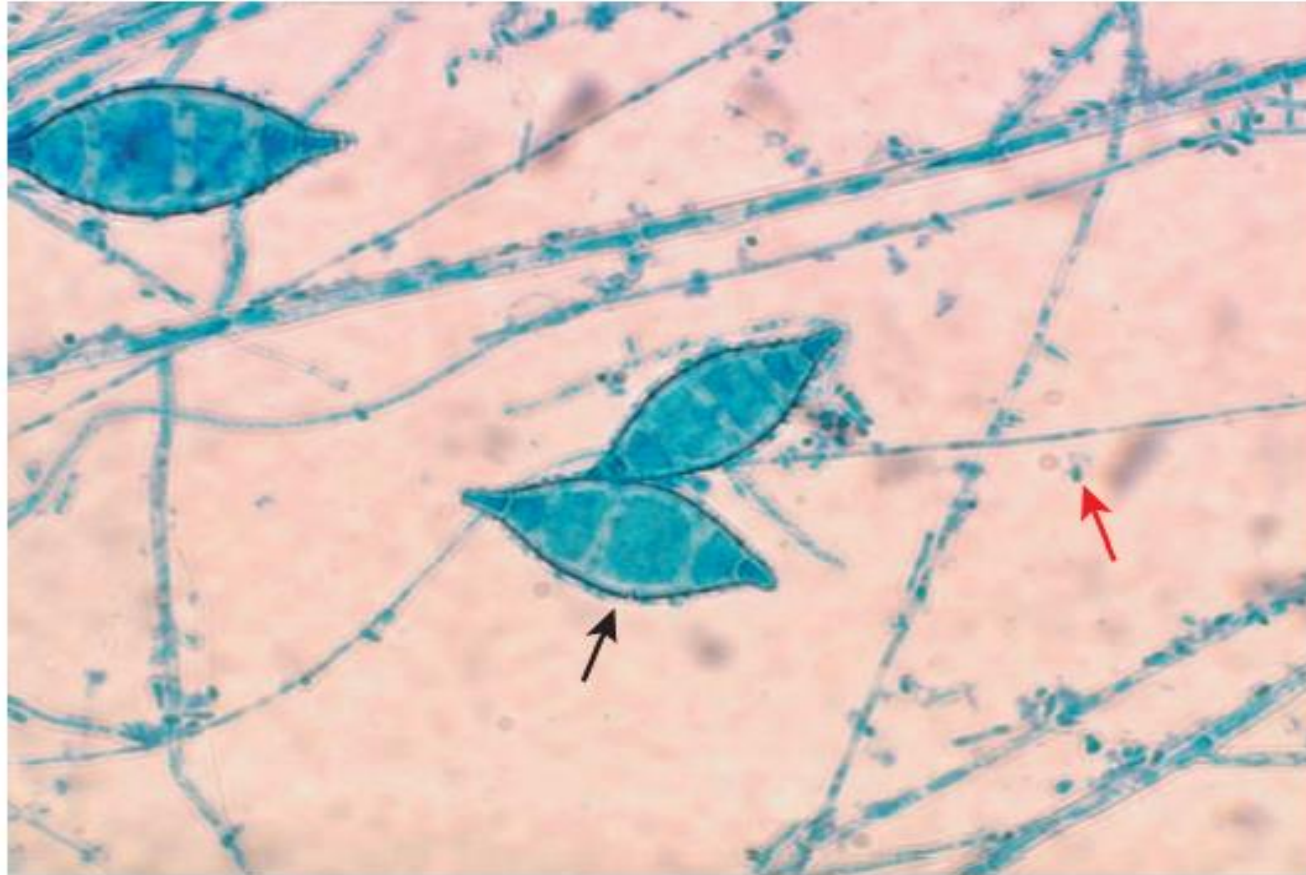
- Microscopically, the genus *Microsporum* is identified by observation of its macroconidia
- microconidia are the characteristic structures of the genus *Trichophyton* .
- *Epidermophyton floccosum* does not produce microconidia, but its smooth-walled macroconidia borne in clusters of two or three are quite distinctive .
- *Microsporum canis* produces characteristic large, multicellular (five to eight cells per conidium), thick- and roughwalled macroconidia .  
*Trichophyton rubrum* produces microconidia that are teardrop or peg shaped.

Epidermophyton floccosum. Lactophenol cotton blue showing smooth-walled macroconidia

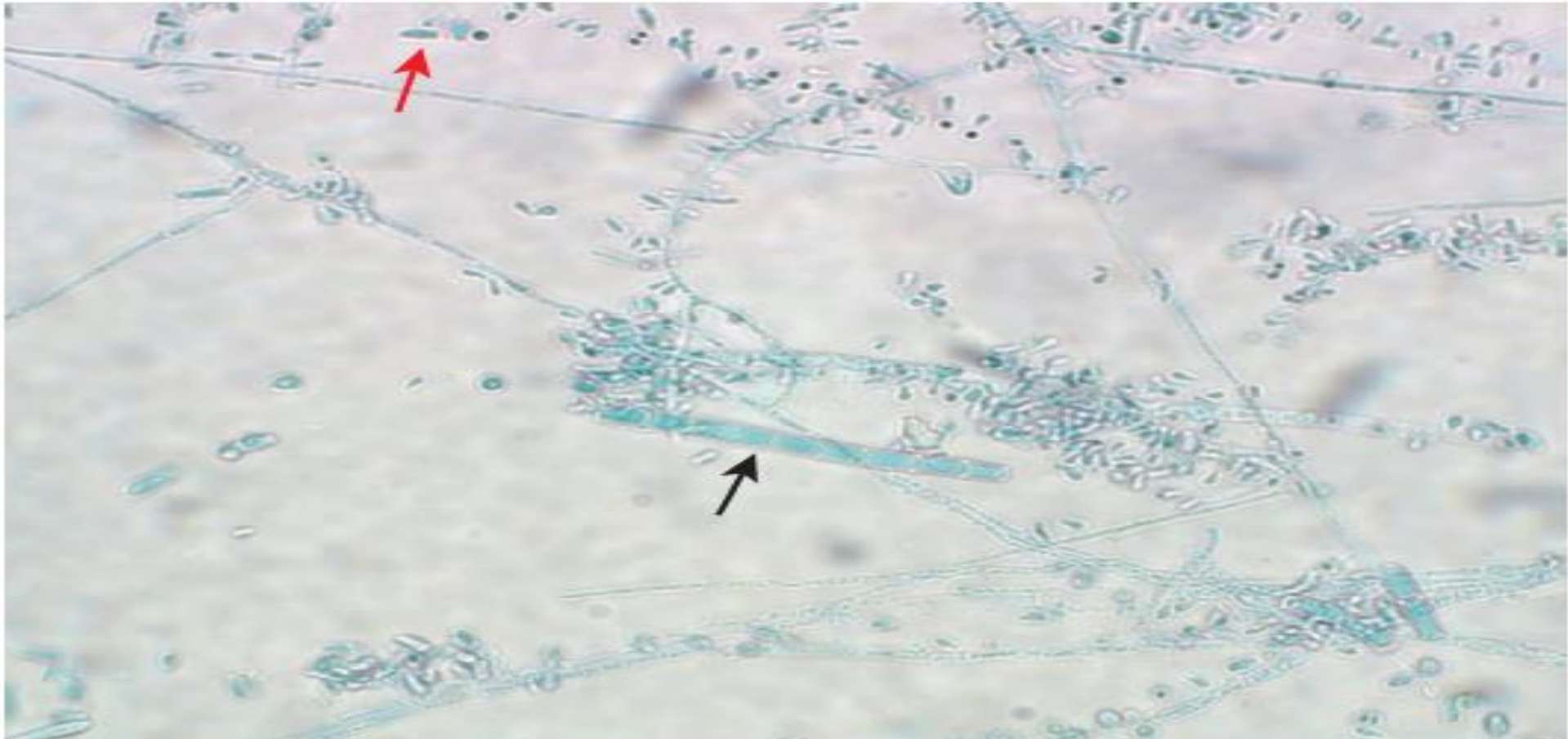




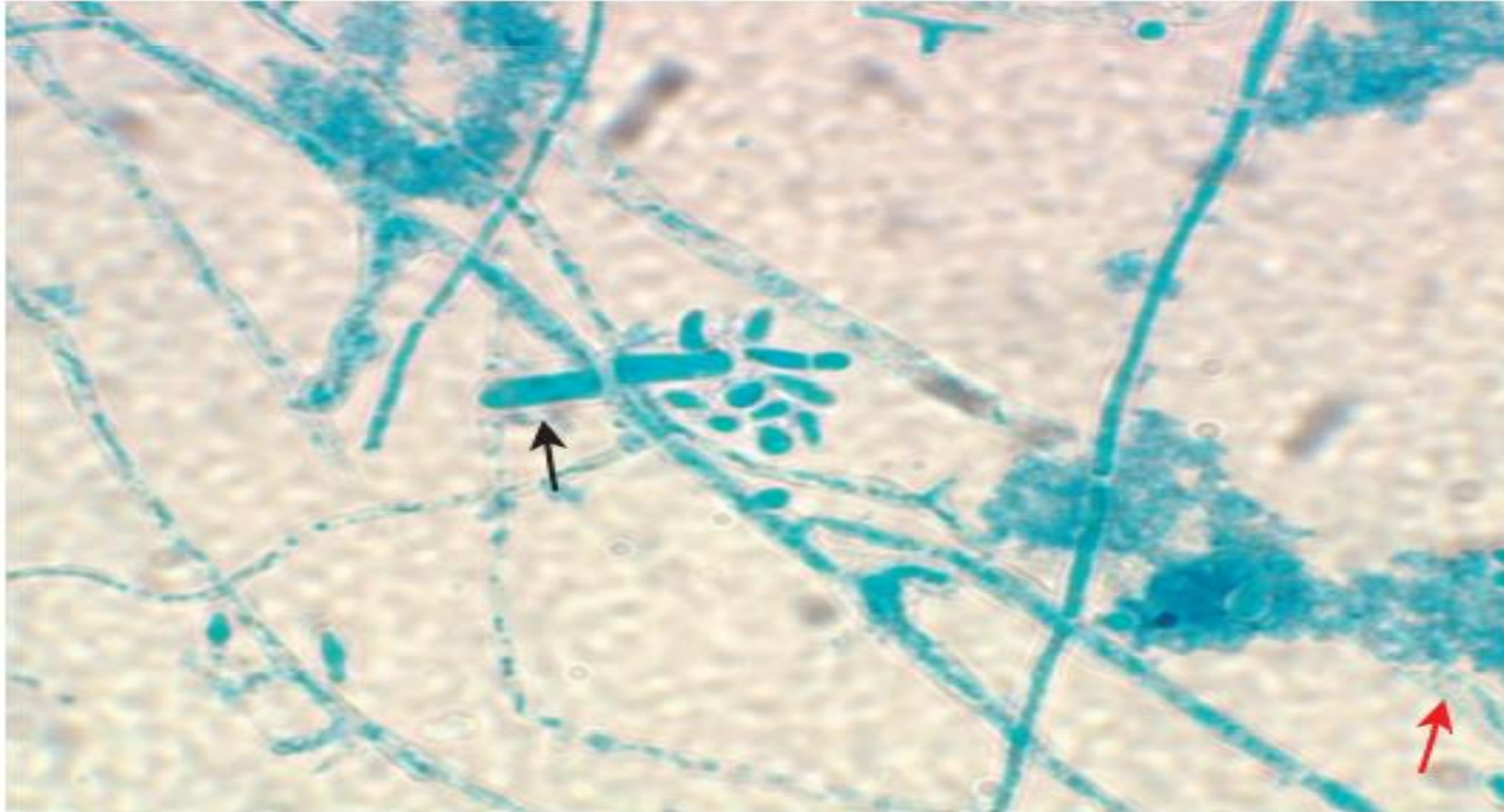
*Microsporium canis*. Lactophenol cotton blue showing rough-walled macroconidia (black arrow) and microconidia (red arrow)



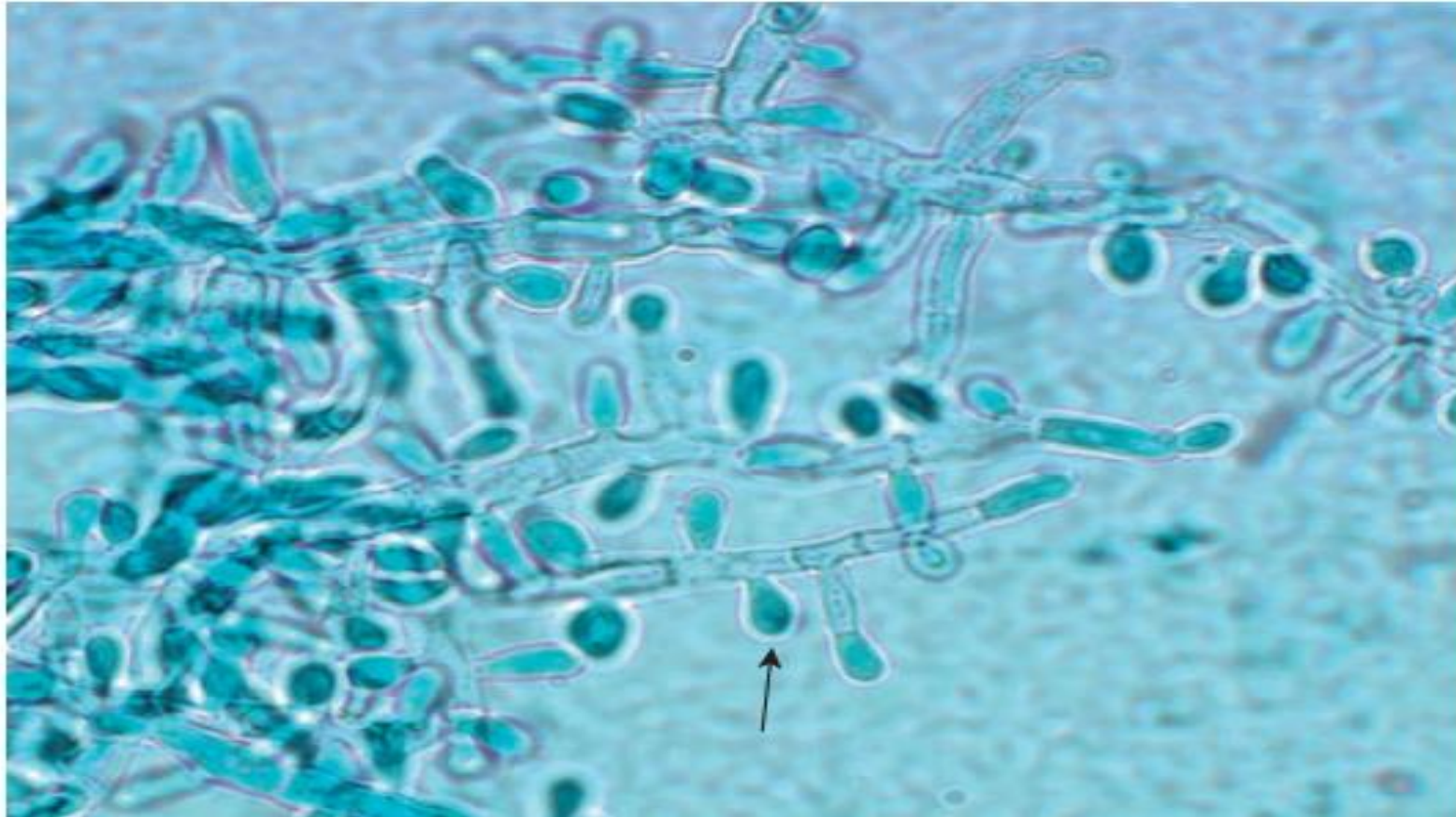
Trichophyton rubrum. Lactophenol cotton blue showing multicelled macroconidia (black arrow) and teardrop- and peg-shaped microconidia (red arrow)



Trichophyton mentagrophytes. Lactophenol cotton blue showing cigar-shaped macroconidia (black arrow) and grapelike clusters of microconidia (red arrow)

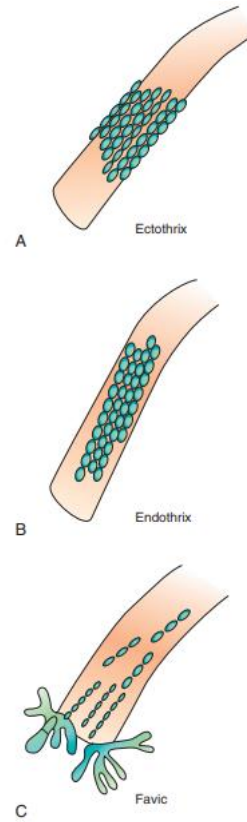


Trichophyton tonsurans. Lactophenol cotton blue showing microconidia (black arrow).



- In skin biopsies, all dermatophytes are morphologically similar and appear as hyaline septate hyphae, chains of arthroconidia, or dissociated chains of arthroconidia that invade the stratum corneum, hair follicles, and hairs.
- When the hair is infected, the pattern of fungal invasion can be either ectothrix, endothrix, or favic depending on the dermatophytic species . Septate hyphae may be seen within the hair shaft in all three patterns.
- In the ectothrix pattern, arthroconidia are formed on the hair
- in the endothrix pattern, arthroconidia are formed inside the hair
- in the favic pattern, hyphae, arthroconidia, and empty spaces resembling air bubbles (“honeycomb” pattern) are formed inside the hair .
- The dermatophytes can usually be seen on H&E stain; however, they are best visualized with special stains for fungi, such as Gomori methenamine silver (GMS) and PAS .

Schematic of (A) ectothrix hair infection, (B) endothrix hair infection, and (C) favic hair infection



# Ecology

- Dermatophytes can be classified into three different categories based on their natural habitat :
  - (1) geophilic
  - (2) zoophilic
  - (3) anthropophilic.
- Species of dermatophytes that are considered anthropophilic tend to cause chronic, relatively noninflammatory infections that are difficult to cure.
- In contrast, the zoophilic and geophilic dermatophytes tend to elicit a profound host reaction, causing lesions that are highly inflammatory and respond well to therapy.
- In some instances, these infections may heal spontaneously.

# Epidemiology

- The dermatophytes are worldwide in distribution , and infection may be acquired from the transfer of arthroconidia or hyphae, or keratinous material containing these elements, from an infected host to a susceptible uninfected host.
- Dermatophytes may remain viable in desquamated skin scales or hair for long periods, and infection may be either by direct contact or indirect via fomites. Individuals of both sexes and all ages are susceptible to dermatophytosis; however, tinea capitis is more common in prepubescent children, and tinea cruris and tinea pedis are primarily diseases of adult males.
- individual dermatophyte species may vary in their geographic distribution and in their virulence for humans



Tinea capitis caused by *Microsporum canis*.



# Onychomycosis caused by *Trichophyton rubrum*



# Clinical Syndromes

- Dermatophytoses manifest a wide range of clinical presentations that may be affected by factors such as the species of dermatophytes, inoculum size, site of infection, and immune status of the host.
- The classic pattern of dermatophytosis is the “ringworm” pattern of a ring of inflammatory scaling with diminution of inflammation toward the center of the lesion. Tineas of hairbearing areas often present as raised circular or ring-shaped patches of alopecia with erythema and scaling or as more diffusely scattered papules, pustules, vesicles, and kerions (severe inflammation involving the hair shaft) .
- Hairs infected with certain species (e.g., *M. canis*, *M. audouinii*, *Trichophyton schoenleinii*) often fluoresce yellow-green when exposed to a Wood light.

- Infections of smooth skin commonly present as erythematous and scaling patches that expand in a centripetal pattern with central clearing.
- Dermatophytoses of the foot and hand may often become complicated by onychomycosis , in which the nail plate is invaded and destroyed by the fungus. Onychomycosis (tinea unguium) is caused by a variety of dermatophytes and is estimated to affect approximately 3% of the population in most temperate countries. It is a disease seen mostly in adults, with toenails affected more commonly than fingernails. The infection is usually chronic, and the nails become thickened, discolored, raised, friable, and deformed

# Laboratory Diagnosis

- By direct microscopy of skin, hair, or nail samples and the isolation of organisms in culture.
- Specimens are mounted in a drop of 10% to 20% KOH on a glass slide and examined microscopically.
- Filamentous hyaline hyphal elements characteristic of dermatophytes may be seen in skin scrapings, nail scrapings, and hairs.
- Cultures are always useful and can be obtained by scraping the affected areas and placing the skin, hair, or nail clippings onto standard mycologic media such as Sabouraud agar, with and without antibiotics, or dermatophyte test medium. Colonies develop within 7 to 28 days.
- Their gross and microscopic appearance and nutritional requirements can be used in identification.
- More recently, molecular and proteomic methods have been used to provide rapid and specific means of identifying those unusual isolates that are difficult to identify using conventional phenotypic approaches

# Treatment

- Topical agents include azoles (miconazole, clotrimazole, econazole, tioconazole, and itraconazole), terbinafine, and haloprogin. Whitfield ointment (benzoic and salicylic acids) is an optional agent for dermatophytosis, but responses are usually slower than those seen with agents with specific antifungal activity.
- Oral antifungal agents with systemic activity against dermatophytes include griseofulvin, itraconazole, fluconazole, and terbinafine. The azoles and terbinafine are more rapidly and broadly efficacious than griseofulvin, especially for treatment of onychomycosis.