

Fungal Skin Infection

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Objectives

1. Recognize Fungal skin infections:

Superficial mycoses, Cutaneous & Mucocutaneous mycoses

Subcutaneous mycoses

2. Explain these mycoses in these following items;

2.1 Causative agents, habitat, general characters

2.2 Pathogenesis and pathology

2.3 Clinical diagnosis

2.4 Lab diagnosis : causative agents' characteristics

Tissue form, Saprophytic (parasitic) form

3. Recognize prevention and treatment: antifungal drugs

References

1. Hoog de GS and J Guarro. 1994. Atlas of Clinical Fungi from Centraalbureau voor Schimmelcultures, Baarn, The Netherlands. CBS publications
2. Kwon-Chung KJ and JE Bennett 1992. Medical Mycology Lea & Febiger
3. Kidd S, Halliday HA, Alexiou H, Ellis D. Descriptions of medical fungi, 3rd ed. Adelaide: Newstyle Printing, 2016:v-vi
4. <http://www.mycology.adelaide.edu.au/mycoses>
5. <https://www.isham.org/>
[ISHAM | The International Society for Human & Animal Mycology](#)

Etc.

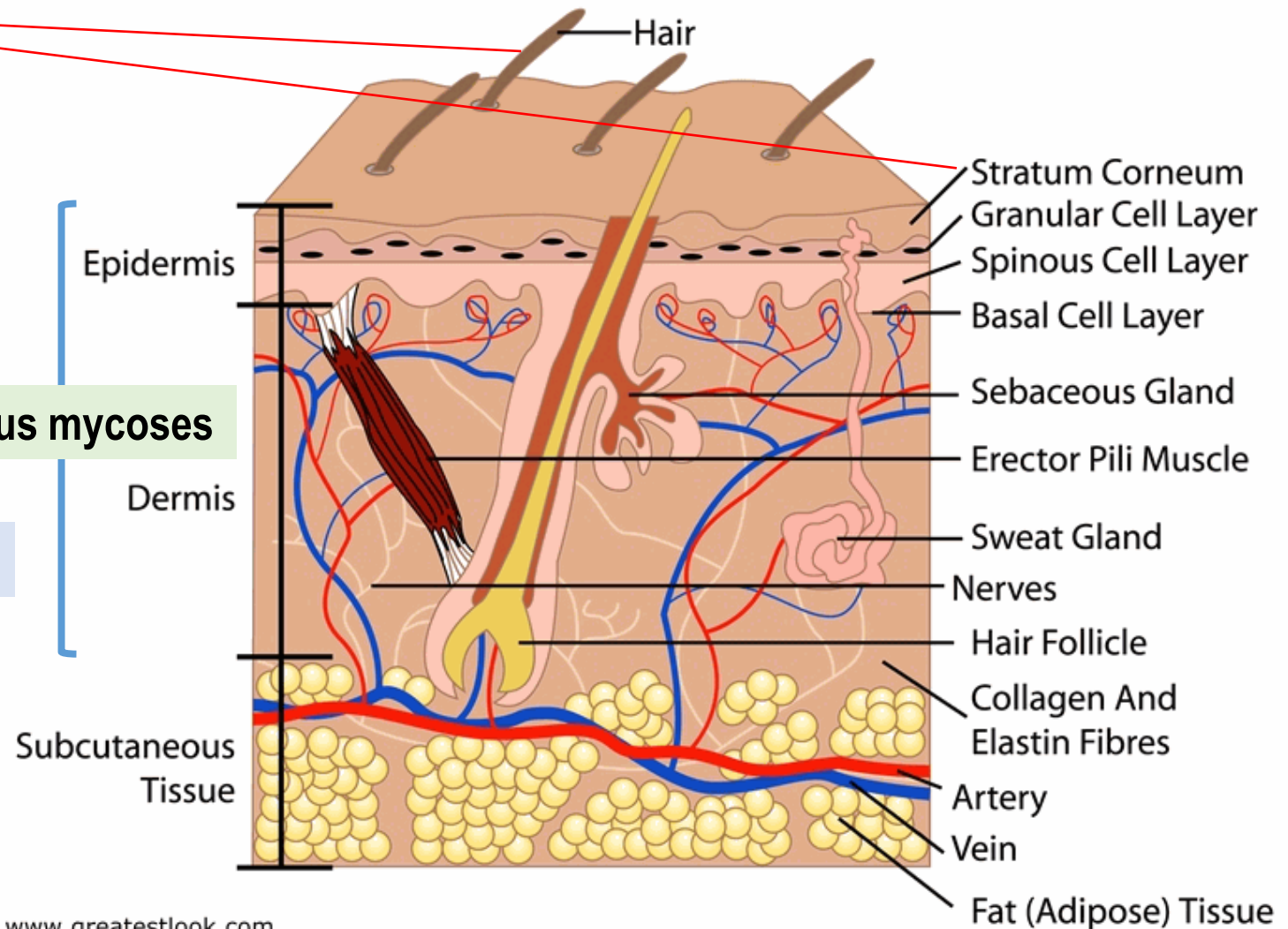
Pathology

Superficial mycoses

Cutaneous mycoses

Subcutaneous mycoses

Anatomy of the Skin



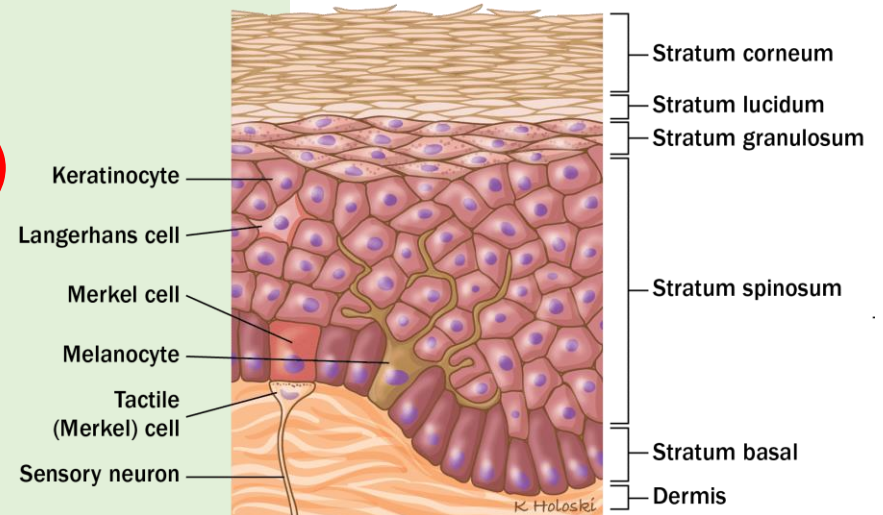
Superficial and Cutaneous mycoses

Superficial layer: Stratum corneum, hair shaft

Tinea versicolor or Pityriasis versicolor)

Tinea nigra

Piedra



Superficial, epidermis and dermis

Dermatophytosis (Tinea or Ringworm)

Candidiasis: Cutaneous infection

Mucocutaneous infection

https://thangguide.org/wp-content/uploads/2019/04/61_epidermis-20190410.png

Tinea versicolor (Pityriasis versicolor)

Causative agent: *Malassezia* ; *M. furfur*, *M. sympodialis*, *M. globosa* etc.

Basidiomycetes: Budding yeast cells,

“Lipophilic yeast”

Source : Normal flora ; human and animal skin

Predisposing factors: heat, humidity, immunodeficiency, oily skin,
application of oily lotion and cream etc.

Pathogenesis: colonize stratum corneum
hyperkeratosis, acantosis, interfere melanin production?

Signs & Symptoms : Non-inflammatory lesions
Hypopigmented type, Hyperpigmented type, Erythematous type

Treatment: topical application; clotrimazole, sodium thiosulfate etc.

Hypopigmented type



<https://staticg.sportskeeda.com/editor/2023/07/1af43-16893270689411-1920.jpg>

Hyperpigmented type



https://images.squarespacecdn.com/content/v1/5eb88cc7c7eb587825bc2263/1648321057138-KBR9V29WUQ296K72QUHU/IMG_4245.jpg

Hypopigmented type



https://encrypted-tbn0.gstatic.com/images?q=tbn:ANd9GcQMt5T5Z6jj9qRDyppZwMqTZA9QTL7C-SkCmX_FkpYcAk8KfVEFVeUf5WogGIEHCCrAuYM&usqp=CAU

Erythematous type



<https://www.researchgate.net/publication/233989900/figure/fig2/AS:293951383851047@1447094879861/Tinea-versicolor-of-neck-and-trunk-appears-as-confluent-fawn-colored-patches-Habif.png>

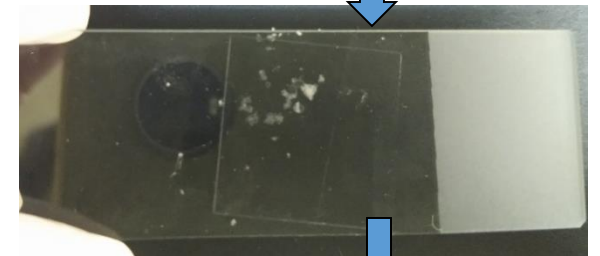
Lab. Diag. : specimens; skin scrapings

1. Direct examination: **KOH-preparation**

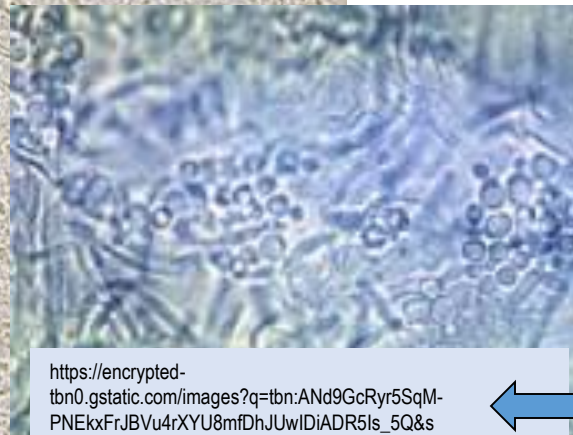
Wet mount with 10% KOH



Skin scraping



40X



Tissue form: budding yeast cells and short hyphae

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https://encrypted-tbn0.gstatic.com/images?q=tbn:ANd9GcRyr5SqM-PNEkxFrJBVu4rXYU8mfDhJUwIDiADR5ls_5Q&s

<https://img.medscapestatic.com/pi/meds/ckb/66/43166tn.jpg>

Lab. Diag. : specimens; skin scrapings (cont.)

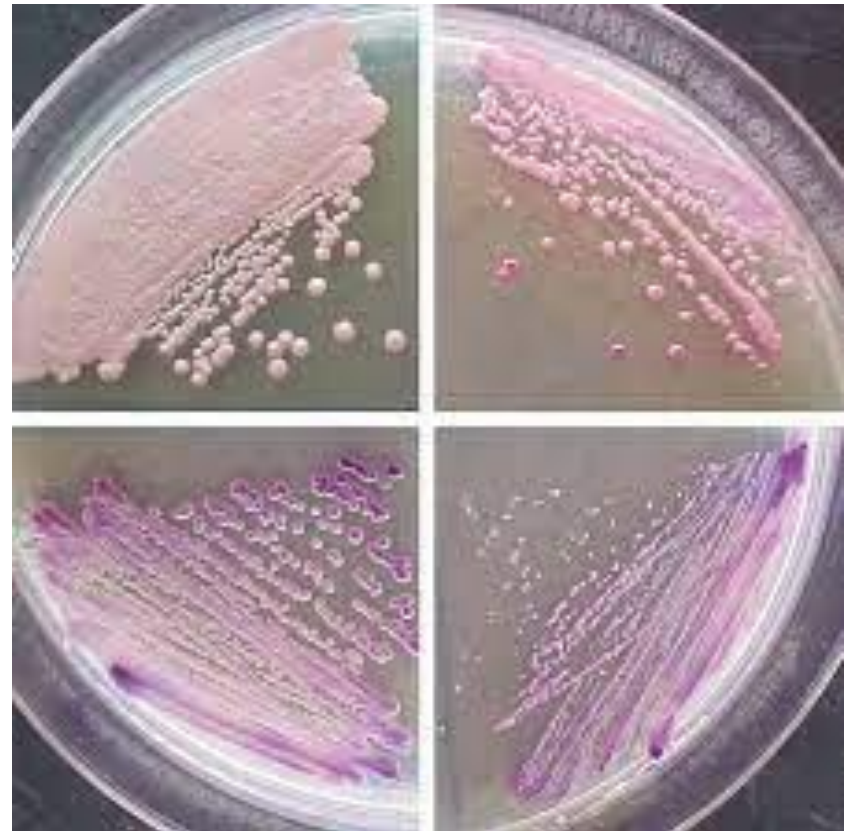
2. Culture: Saprophytic form; SDA + oil, 25oC: budding yeast cells conventional or molecular identification



<https://multimedia.elsevier.es/PublicationsMultimediaV1/item/multimedia/S1130140619300750:gr1.jpeg?xkr=ue/lmdikolMrs.JoerZ+w997EogCnBdOOD93cPFbanNcq2nO4tiu3xsxzm9tFSvJ8smtWCzeY6QL1kFNV4pd/h5x2DDo/xJlFFkcJf3vFIF8Npkg5eldhMo+SVpYlcG22wVdcwyAnv7mhMcZRPT6nC3Hr1il54oQLyu3EVdGaeQVhHOR2YzAKHu2olhUbUT49TEGh7nc3l/FkHYAd/BGJxrhhlhWGmwGE6W0RvYpKNc9T/YbXtRbnweXjXkLKG4YFh/rVv4VJbsZ+76UASxsF5AJB/CinksphlcFyKRPFe4=>



<https://www.medical-labs.net/wp-content/uploads/2015/03/Malassezia-furfur-under-microscope.jpg>



Malassezia spp. on LNCHROM, Clockwise from 12 o'clock:
***M. pachydermatis*, *M. slooffiae*, *M. sympodialis*, *M. furfur*.**

<https://encrypted-tbn0.gstatic.com/images?q=tbn:ANd9GcT8pPSSumMFPkq09CFH2ymawwsiiysgzfJVLY4p3xu9qQEraHvvW8T4GrcQ2ALEi2SVoE&usqp=CAU>

Tinea nigra

Causative agent : *Hortaea werneckii*

Black yeast : produce melanized septate hyphae, annelloconidia and yeast cells

Sources: saprophyte; soil, compose, humus, salt pan “Halotolerance”

Pathogenesis: colonize stratum corneum at hand or foot
brown or black macules, non-inflammatory and non-scaling

Treatment : Whitfield's ointment or topical imidazole



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https://i0.wp.com/images-prod.healthline.com/hlcmsresource/images/Image-Galleries/tinea-nigra/4300-What_Is_Tinea_Nigra-642x361-tinea_nigra-slide1.jpg?w=1155

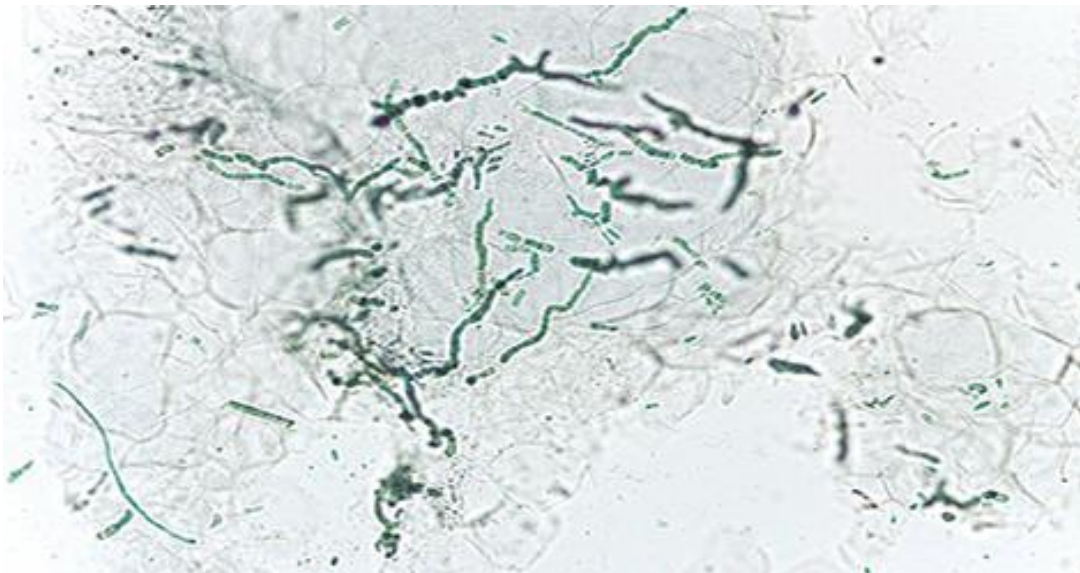


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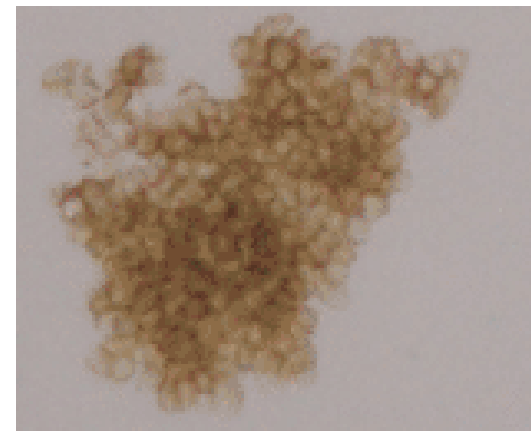
Lab. Diag. : specimens; skin scraping

1. Direct examination: Tissue form; KOH-preparation

Melanized septate hyphae, melanized yeast cells



<https://www.scielo.cl/img/revistas/rcp/v89n4//0370-4106-rcp-00404-gf3.jpg>



<https://www.researchgate.net/publication/343612207/figure/fig1/AS:1029155634282497@1622381232896/Hortaea-verneckii-culture-on-SDA-from-PDE-on-day-3-a-and-day-20-b-with-septated.png>

Lab. Diag. : specimens; skin scraping (cont.)

2. Culture: Saprophytic form; SDA, 25oC

Black yeast colony



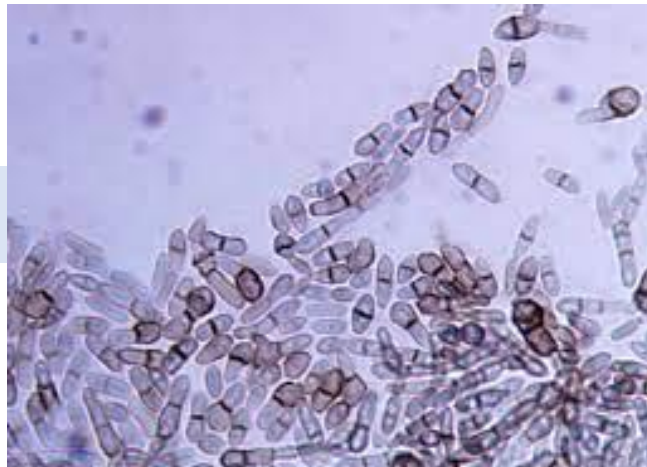
https://3.bp.blogspot.com/-wAAuS5GPcF0/U0rT3hx622I/AAAAAAAAJKI/FkbWP8W_24w/s1600/01-+Hortaea+werneckii+SAB.jpg

Melanized septate hyphae

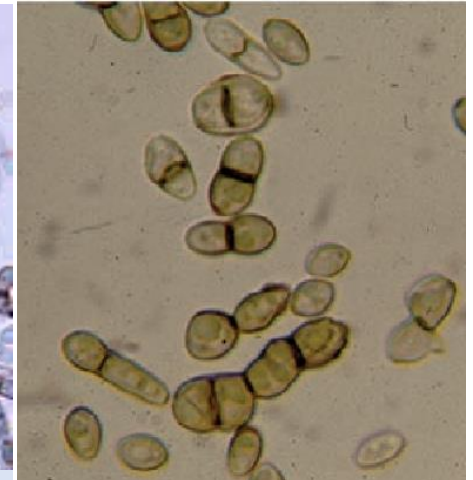


<https://onlinelibrary.wiley.com/cms/asset/40a692b8-f8d3-4080-b862-6bbcdc44b398/jde12830-fig-0003-m.jpg>

Yeast cells with annelloconidia



<https://encrypted-tbn0.gstatic.com/images?q=tbn:ANd9GcRNYSMJV6E2-cYleOZtERIDZaVkCrvV-3K7zCYBJUryboYp91fPdspcyASmpHcKrpYiQLI&usqp=CAU>



<https://d3i71xaburhd42.cloudfront.net/32418c29bbe9bb448fc12d20efcf922621a883ad/6-Figure4-1.png>

Piedra

Black Piedra : hard black nodules on hair shafts;

scalp, beard, moustache, pubic

Causative agent : *Piedraia hortae* ; Ascomycetes fungi, soil saprophyte

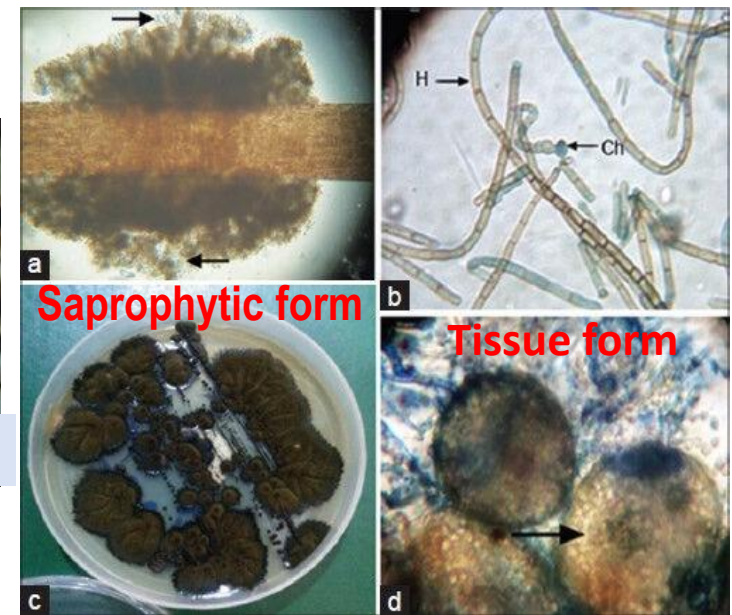
White Piedra : soft greyish-white nodules, 1-1.5 mm, along hair shafts,
axilla, scalp, pubic

Causative agents : *Trichosporon beigellii*, *T asahii* etc. ; Basidiomycetes
human skin normal flora

Predisposing factors : poor hygiene, immunosuppressed patient

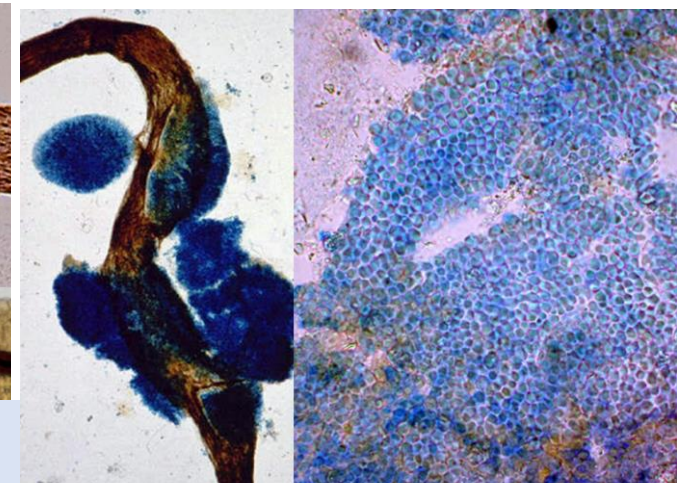
Treatments: shaving hair, topical imidazole for re-infection

Black Piedra: *Piedraia hortae*



(a) 10% KOH: black colored nodule of filamentous hyphae, spore at the edges of the nodule (←), (b) **brown dematiaceous closely septate hyphae (H)** with **few chlamydoconidia (Ch)**. (c) SDA blackish conical colonies with velvety surface. (d) globus ascus (→) with ascospores

White Piedra: *Trichosporon beigelii*



https://www.adelaide.edu.au/mycology/sites/default/files/styles/ua_image_landscape/public/media/images/2021-09/whitepiedra-cult.jpg?h=c4dd2c7b&itok=Tk6lbBsb

Dermatophytosis or Ringworm or Tinea

Causative agents : Dermatophytes “**keratinophilic fungi**” ; 3 genera

Trichophyton : *T. rubrum*, *T. mentagrophyte* etc.

Microsporum : *M. gypseum*, *M. canis* etc.

Epidermophyton : *E. floccosum*

Sources : human and animal skin flora, soil saprophyte

Predis. factors : warm climate, poor hygiene, immunocompromised

Pathogenesis : colonize stratum corneum,
keratinase, metabolites induce allergy and inflammation

Signs & Symptoms : skin ; ring-shaped rash with itchy, scaly,
slightly raised “**inflammatory lesion**”
hair & nail infection

Disease's name :

Skin area : Tinea capitis, Tinea corporis, Tinea cruris, Tinea barbae,
Tinea faciei, Tinea pedis, Tinea manuum, Tinea unguium

Pathology : Tinea favosa, Tinea imbricata

Tinea corporis



<https://cdn.lecturio.com/assets/Tinea-corporis.jpg>

Tinea capitis



https://www.shutterstock.com/shutterstock/photos/1415776412/display_1500/stock-photo-treated-tinea-capitis-or-fungal-infection-on-scalp-of-southeast-asian-burmese-two-years-old-child-1415776412.jpg

Tinea cruris



https://encrypted-tbn0.gstatic.com/images?q=tbn:ANd9GcQv1hIP4YVsk5KwOHS_PR3E96itOTJRwZmpNaljD_kA6lemkpM7SyZCAduEKY0MvoqJZFk&usqp=CAU

Tinea barbae



<https://o.quizlet.com/ekNZXkyCMLaaVssHTL8VEg.png>

Tinea faciei



<https://healthjade.net/wp-content/uploads/2019/08/tinea-faciei.jpg>

Tinea cruris & corporis



https://www.pcds.org.uk/imager/gallery/clinical/tinea-corporis-body-cruris-groin-and-incognito-steroid-exacerbated/13170/Fig_13_CORPORIS-EXTENSIVE_fee391183f15cb4d62773032fe0be92d.jpg

Tinea pedis



Tinea manuum



Tinea unguium





<https://upload.wikimedia.org/wikipedia/commons/thumb/3/3c/Favus.jpg/800px-Favus.jpg>



https://dermnetnz.org/assets/Uploads/favus__ProtectWyJQcm90ZWNOlIO_FocusFillWzI5NCwyMjlsInkiLDg1XQ.JPG



https://phil.cdc.gov/phil_images/20030116/11/PHIL_2936_lores.jpg

Tinea favosa or Favus : severe form of Tinea capitis

Signs : inflammation with yellowish, circular, cup-shaped crusts,
extensive hair loss, scars

Causative agents : *T. schoenleinii* (95%), *M. canis*, *T. verrucosum* etc.

<https://www.ncbi.nlm.nih.gov/books/NBK559024/>

Tinea imbricata : lesions are often lamellar
at torso and limbs

Causative agent : *Trichophyton concentricum*

People ; southwest Polynesia, SEA, India
autosomal recessive trait?

“กลากหนุมาน”



<https://papuaposnabire.com/images/news/0222/L-07-02-22-Kaskado.JPG>



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<https://pbs.twimg.com/media/D17Dk60UcAATy8i.jpg>

Lab. Diag. : specimens; Skin scraping, crusts

1. Direct exam. : KOH-prep

Tissue form : branching septate hyphae, arthrospores

2. Culture : Saprophytic form

SDA : mold ; microconidia, macroconidia

Morphological identification

Trichophyton : micro- & pencil-shaped macro-

Microsporum : micro- & spindle shaped macro-

Epidermophyton : clubbed shaped macro-, aggregated

3. Molecular identification : DNA sequencing

Treatment : topical clotrimazole, oral itraconazole, terbinafine etc.

Tissue form : Branching septate hyphae, arthrospores

KOH preparation: skin scraping



KOH preparation: nail

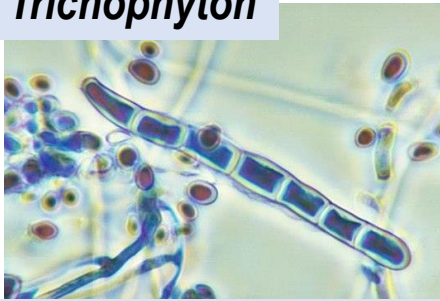


<https://www.researchgate.net/publication/316767443/figure/fig3/AS:494614815936513@1494936769197/Na-il-clippings-on-KOH-mount-original-magnification-X-400-branching-fungal-hyphae-in.png>

KOH preparation: skin scraping



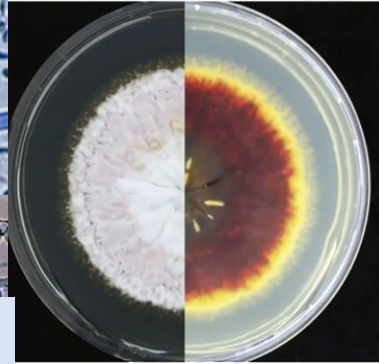
Trichophyton



https://upload.wikimedia.org/wikipedia/commons/thumb/a/a2/Trichophyton_rubrum_var_rodhaini.jpg/640px-Trichophyton_rubrum_var_rodhaini.jpg



https://www.adelaide.edu.au/mycology/sites/default/files/styles/ua_image_landscape/public/media/images/2021-09/trich-rub-micro2.jpg?h=cfa2f048&itok=ptwMTUEc



<https://www.creative-biolabs.com/drug-discovery/therapeutics/images/Trichophyton-Rubrum-2.png>

Microsporum



https://upload.wikimedia.org/wikipedia/commons/4/4b/Microsporum_gypseum-003.JPG



<https://www.researchgate.net/publication/13426624/figure/fig3/AS:601784015941671@1520487898841/Microscopy-of-Microsporum-gypseum-Courtesy-of-Dr-Michael-R-McGinnis-Medical-Mycology.png>



https://encrypted-tbn0.gstatic.com/images?q=tbn:ANd9GcTVXuZKeL4EXRj25PssBXb_UvFNluZyLe6OzA&usqp=CAU

Epidermophyton



https://phil.cdc.gov/PHIL/Images/2937/2937_lores.jpg



https://2.bp.blogspot.com/-~1wtQtjsxu8/VggRcym0ihI/AAAAAAAAAKho/1eJi9xICyw/s1600/25-%2BE_floccosum%2B1000X.jpg



https://phil.cdc.gov/PHIL/Images/14588/14588_lores.jpg

Candidiasis or Candidosis

Causative agents : *Candida* ; *C. albicans* (BSL2), *C. tropicalis*, *C. parapsilosis* etc.
human normal flora ; skin, GI

Predisposing factors : immunocompromised conditions,

Pathogenesis : colonization, endogenous infection,
opportunistic infection

Pathogenicity : **proteinase, phospholipase?, lipase?**

Signs & Symptoms :

1. Cutaneous candidiasis "Candidal intertrigo";

Skin : axillae, groin, inter- & sub-mammary folds, inter-gluteal folds,
interdigital spaces, umbilicus

Nail : Paronychia & Onychomycosis

2. Muco-cutaneous; Oral candidiasis; thrush

Vulvovaginal candidiasis : inflammation, itching, burning,
creamy white, curd-like discharge

Balanitis : erythema, itching & vesiculopustules at penis



Cutaneous candidiasis “Candidal intertrigo” : reddish–brown rash with small bumps, itching, stinging and/or burning



Nail infection

Onychomycosis



Paronychia



Oral candidiasis “Thrush” : white patches, redness, soreness

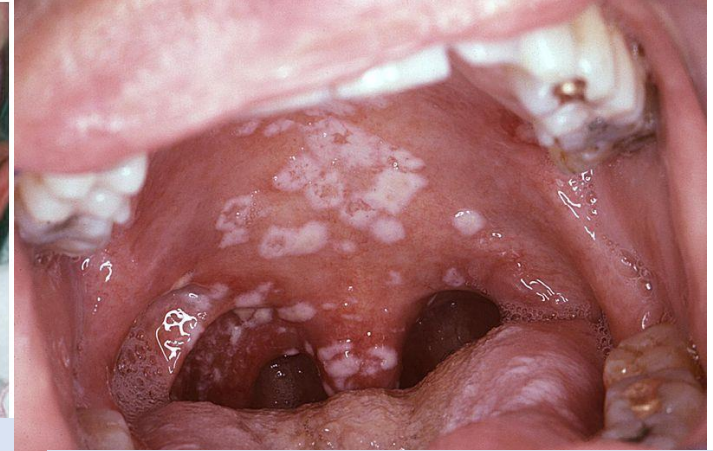


<https://dftbskindeep.com/wp-content/uploads/2020/08/D130-oral-candidiasis-1024x1024.jpg>



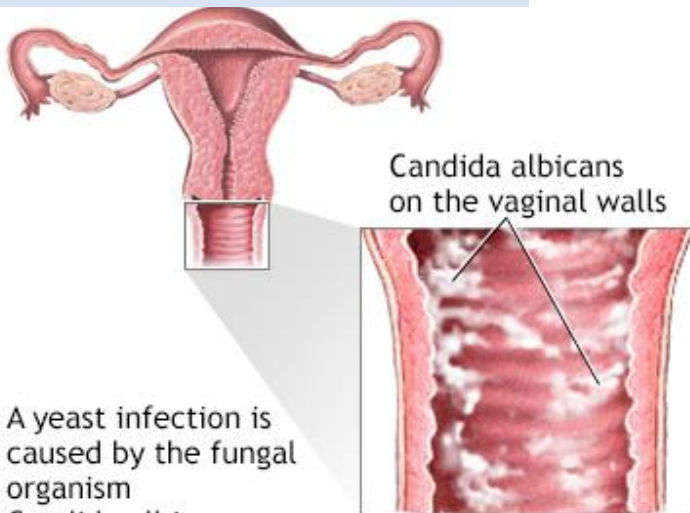
https://s3.amazonaws.com/HMP/c360/imported/transfer/Screenc_Shot_2013-03-22_at_1.45.04_PM.png

otherwise healthy 3-month-old girl. No diaper rash was noted.



<https://www.healthcarethai.com/wp-content/uploads/candidiasis-of-oral-cavity.jpg>

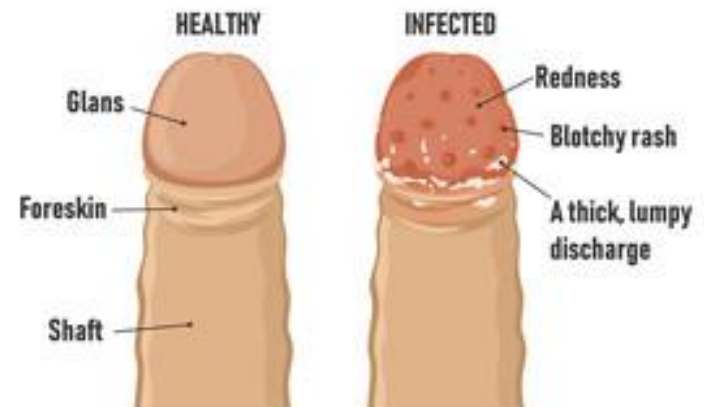
Vulvovaginal candidiasis



A yeast infection is caused by the fungal organism *Candida albicans*

<https://ssl.adam.com/graphics/images/en/17141.jpg>

CANDIDA BALANITIS



<https://metromaleclinic.com/wp-content/uploads/2022/03/candida-balanitis-faqs.jpg>

Lab. diag : Specimens : Skin scrapings, nail, vaginal swab, swab etc.

1. Direct exam. : KOH-prep, wet mount, Gram stain

Tissue form : budding yeast cells, hyphae, pseudohyphae

2. Culture : SDA, PDA, BA

Saprophytic form : yeast colony,

Yeast-like colony

Species ident. :

Conventional methods : germ tube formation,
chlamydospore production,
sugar assimilation, Chrome agar

Molecular methods : MALDI-TOF (Protein), DNA sequencing

Treatment

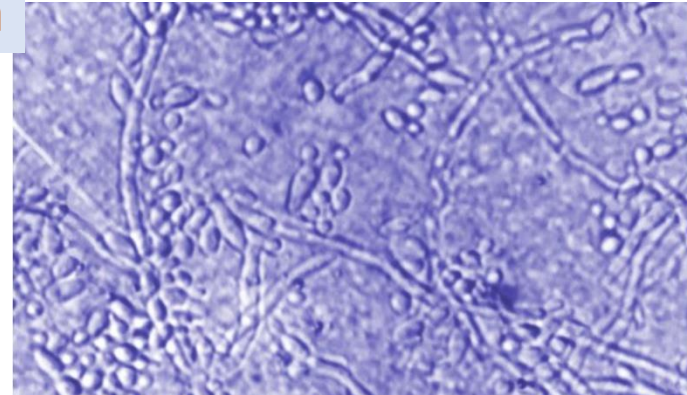
Cutaneous candidiasis : topical clotrimazole, miconazole, nystatin,
oral fluconazole

Thrush : clotrimazole, miconazole

Vulvovaginal candidiasis, balanitis : clotrimazole, miconazole

Tissue form : Budding yeast cells and septate hyphae, pseudohyphae

KOH preparation



<https://cdn.lecturio.com/assets/Photomicrograph-of-Candida-albicans-demonstrating-budding-yeast-cells-and-hyphae.jpg>



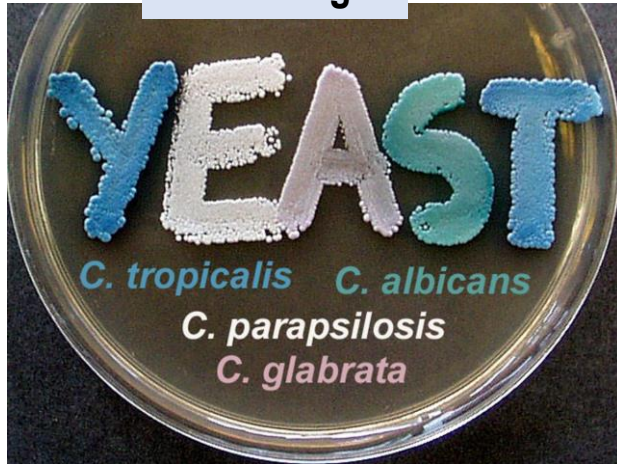
Gram stain



<https://www.researchgate.net/publication/221821747/figure/fig1/AS:763976094846976@1559157503493/The-Candida-hyphae-along-with-budding-yeast-cells-under-the-electron-microscope.png>

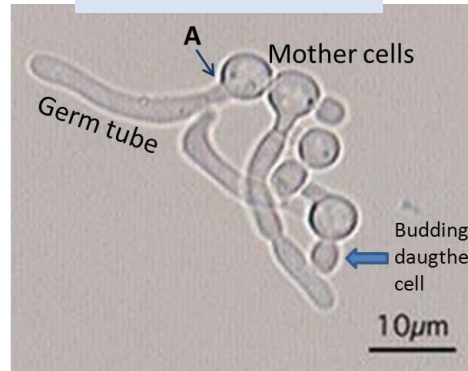
Saprophytic forms

Chrome agar



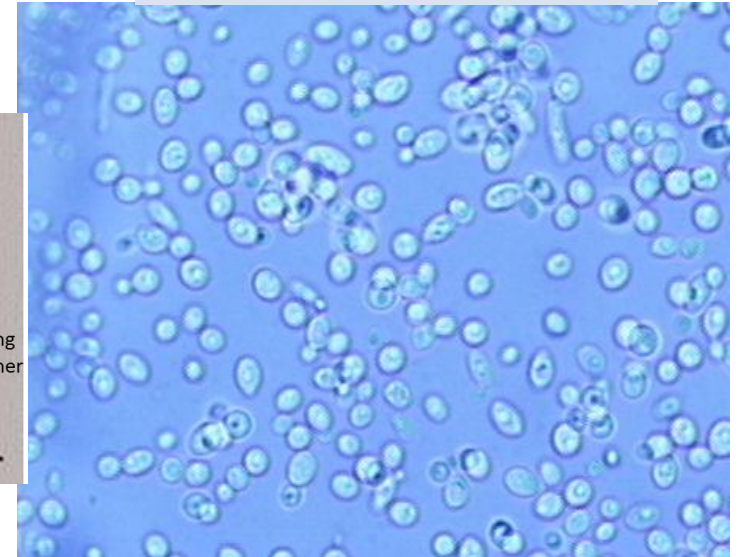
https://www.adelaide.edu.au/mycology/sites/default/files/styles/ua_image_landscape/public/media/images/2021-09/yeastid1.jpg?h=c4dd2c7b&itok=9tMe7-iw

Germ tube test

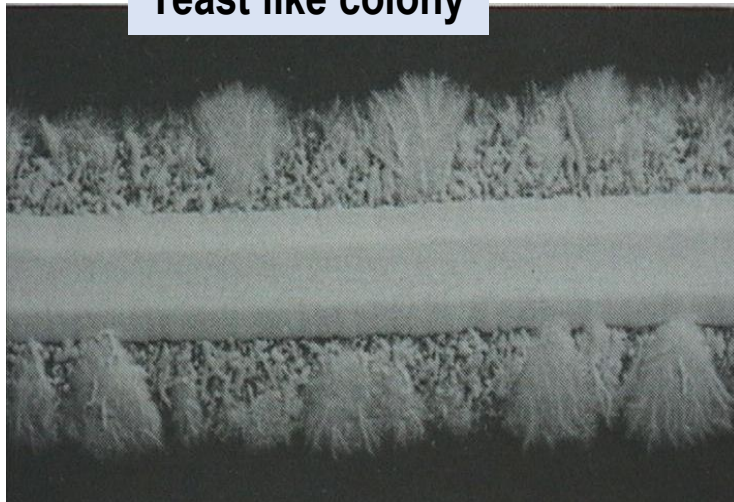


<http://yeastinfectioncause.net/2015/12/30/candida-albicans-koh-test-7/>

Budding yeast cells , germ tubes



Yeast like colony

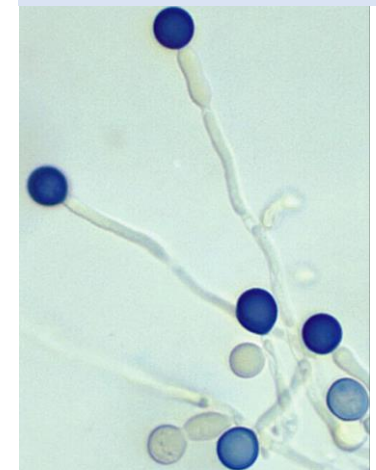


Sugar assimilation



https://www.researchgate.net/publication/365843089/figure/fig4/AS:11431281103648488@1669768517239/Sugar-fermentation-patterns-of-Candida-spp_W640.jpg

Chlamydospores



https://www.adelaide.edu.au/mycology/sites/default/files/styles/ua_image_landscape/public/media/images/2021-09/yeastid3.jpg?h=c4dd2c7b&itok=wAylY06l

Subcutaneous Mycoses

Pathology: Superficial to Subcutaneous tissues

Trauma implantation of causative agents
via wound; cut, puncture, abrasion

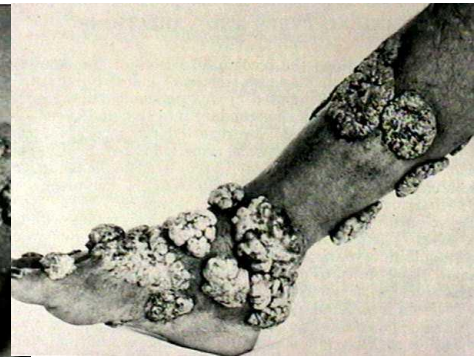
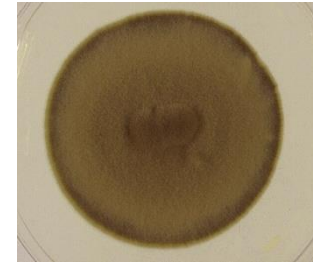
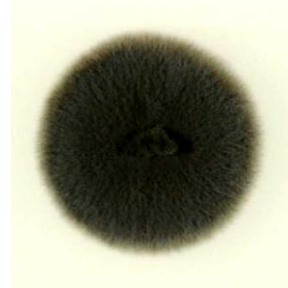
**Chromoblastomycosis, Eumycotic mycetoma,
Sporotrichosis, Phaeohyphomycosis,
Subcutaneous zygomycoses**

etc.

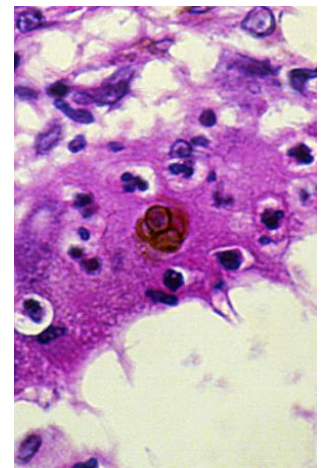
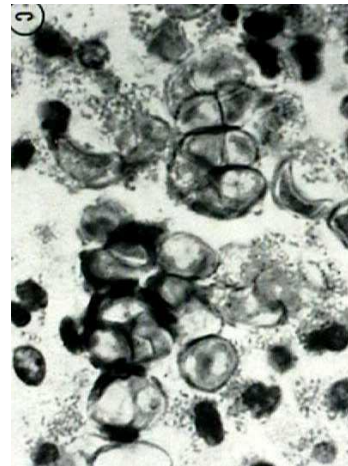
Chromoblastomycosis

Black fungi “dematiaceous fungi”: cell wall with melanin: brown or gray septate hyphae, soil saprophyte

Phialophora verrucosa,
Fonsecaea species complexes
Cladophialophora carrionii



Tissue form
“**Sclerotic bodies**”



Eumycotic mycetoma

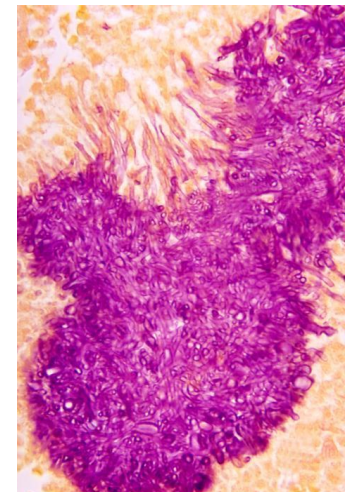
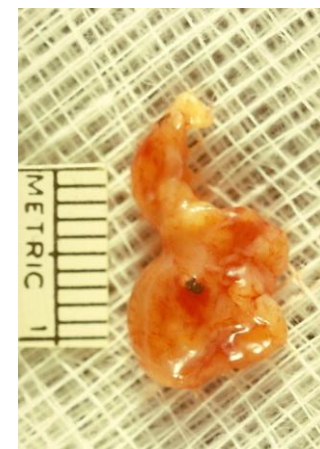
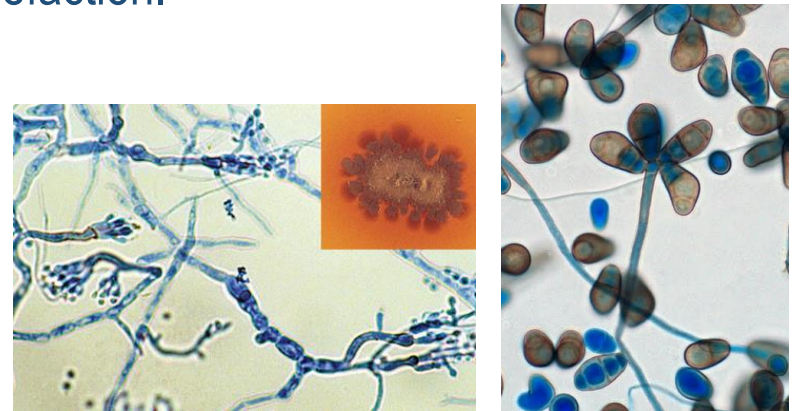
Madurella, Acremonium, Pseudallescheria, Exophiala, Leptosphaeria, Curvularia, Fusarium, Aspergillus etc.

Signs & Symptoms: chronic, suppurative infection of subcutaneous tissue and contiguous bone

“triad”: draining sinuses, granules(grains) and tumefaction.

Tissue form: Granules; vary in size & color,
soft or hard

Saprophytic form: melanised or hyaline
septate hyphae, conidia



Sporotrichosis

Soil saprophytes: *Sporothrix schenckii* *S. globose* etc.

Rose bushes “rose handler’s disease”

S. schenckii : dimorphic fungus;

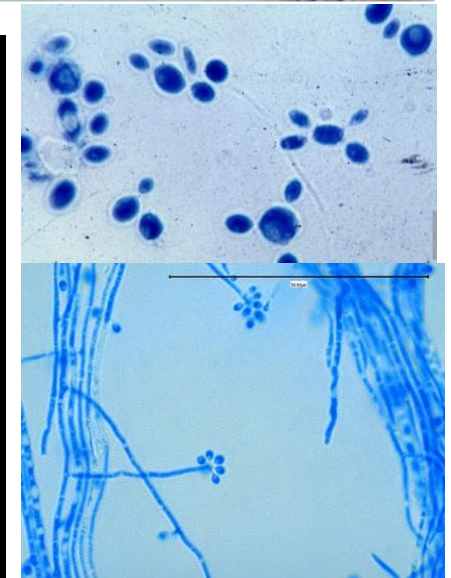
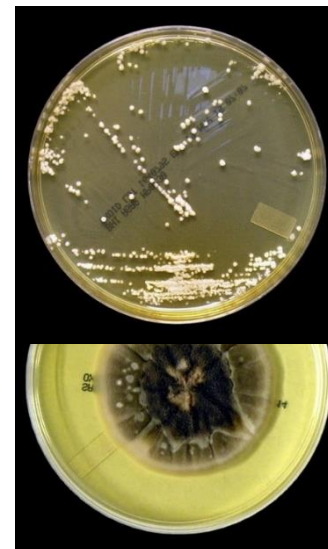
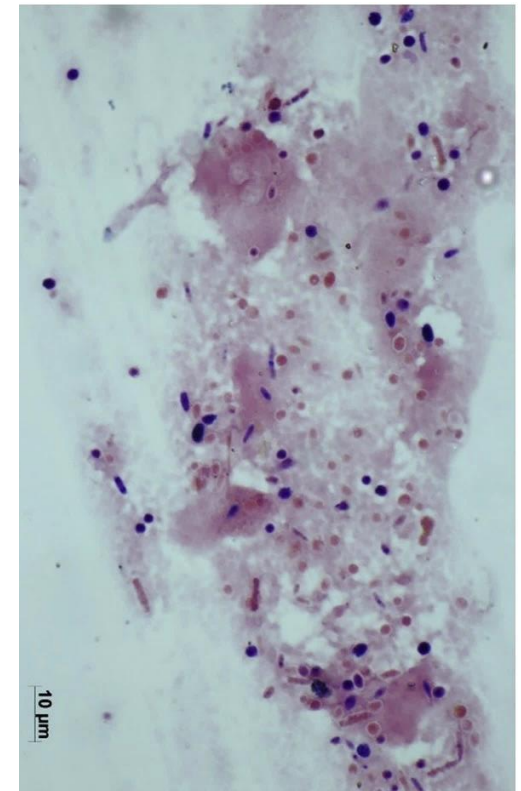
mold at 25°C,

budding yeast form at 37°C

Signs & Symptoms: Painless nodular, suppurate, ulcerate,
discharging a serous or purulent fluid
spread to articular surfaces, rare to bone and muscle,

Tissue form: budding yeast cells, round to “cigar shaped”

Saprophytic form: hyaline branching septate hyphae, conidia,



Phaeohyphomycosis

Causative agents; Dematiaceous fungi,

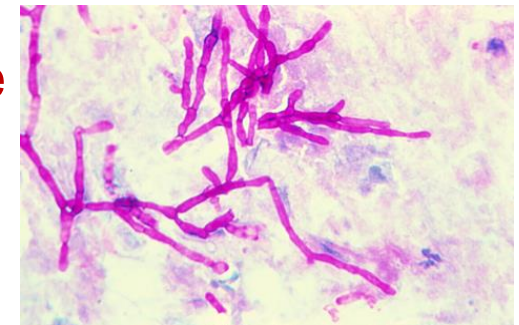
Common environmental airborne contaminants

Exophiala, Phialophora, Bipolaris, Exserohilum, Cladophialophora, Aureobasidium, Cladosporium, Curvularia and Alternaria etc.

71 species (39 genera)

(Ajello L and R.J. Hay. 1997. Medical Mycology Vol 4 Topley & Wilson's Microbiology and Infectious Infections. 9th Edition, Arnold London)

Tissue form: branching melanized (brown, gray) septate hyphae



Zygomycosis

Chronic inflammatory, granulomatous disease, restricted to the subcutaneous tissue

Aetiologic agents: coenocytic hyphae fungi producing zygospore

Basidiobolus ranarum : Intestines of vertebrates; amphibians

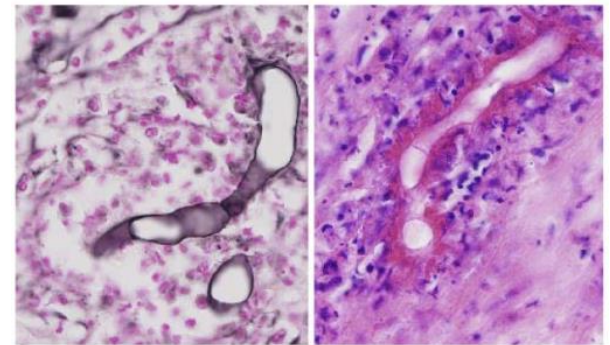
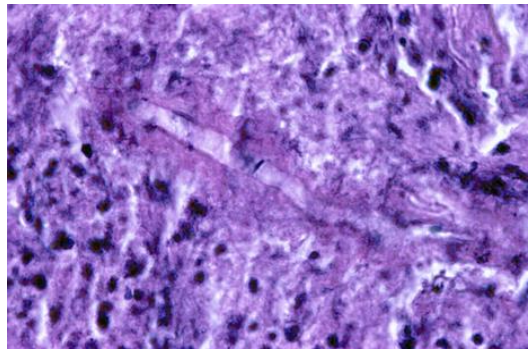
- Subcutaneous nodules, massive, firm, indurated, painless swellings, freely movable over the muscle attached to skin, hyperpigmented, not ulcerated
- Limbs, chest, back, buttocks, children or males

Conidiobolus coronatus: Pathogen of termites, other insects, spiders

- Nasal submucosa, perinasal regions, subcutaneous nodules, and facial swelling,

Clinical variants; pulmonary and systemic infections, nasal obstruction, drainage and sinus pain.

Tissue form: broad, infrequently septate, thin-walled hyphae, often show focal bulbous dilations and irregular branching



A fatal pseudo-tumour: disseminated basidiobolomycosis.

van den Berk GE, Noorduyt LA, van Ketel RJ, van Leeuwen J, Bemelman WA, Prins JM - [BMC Infect. Dis. \(2006\)](#)