Secondary cutaneous mycosis: Indicator of lethal disease

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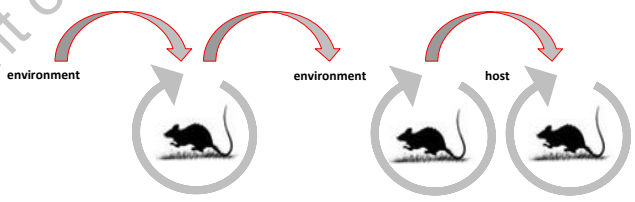
Contents

Contents

Transmissible



Environmental pathogen:
Indirect transmission
(e.g. *Histoplasma capsulatum*)

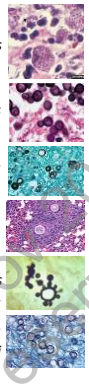
Zoophilic pathogen / commensal:
Direct transmission
(e.g. anthropophilic dermatophytes)

de Hoog et al. – Emerg. Epizoot Fungal Inf. 2018

Onygenales: systemic pathogens (Ajellomycetaceae)

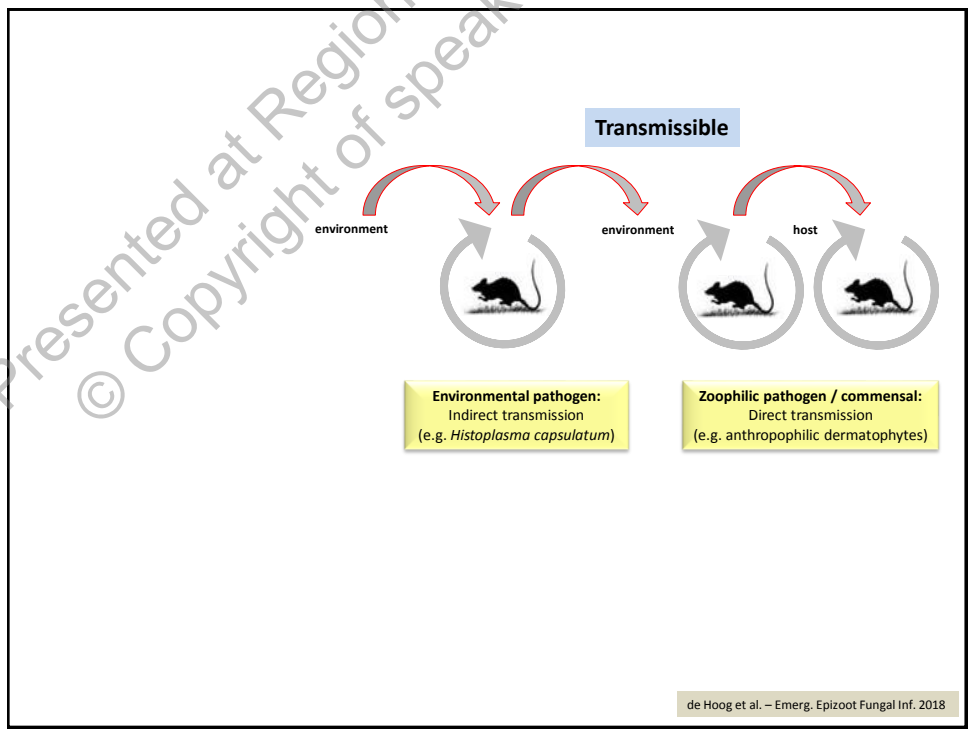
Inhalation
↓
Pulmonary colonization
↓
Mild pneumonia
↓
Dormancy
↓
Endogenous reactivation
↓
Environment

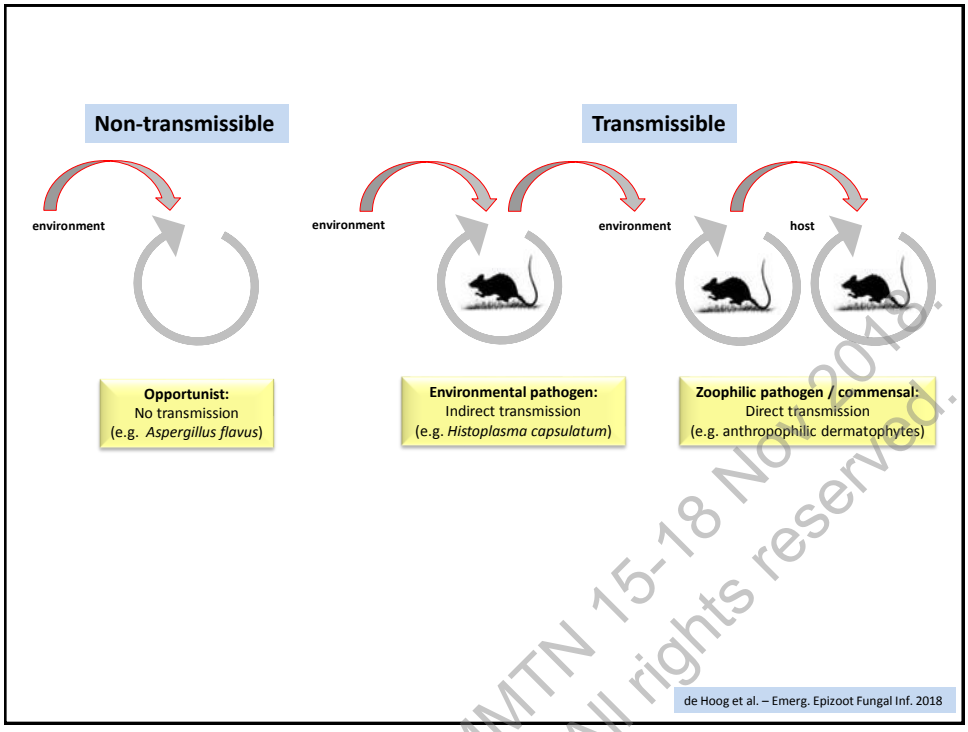
specialized tissue forms:

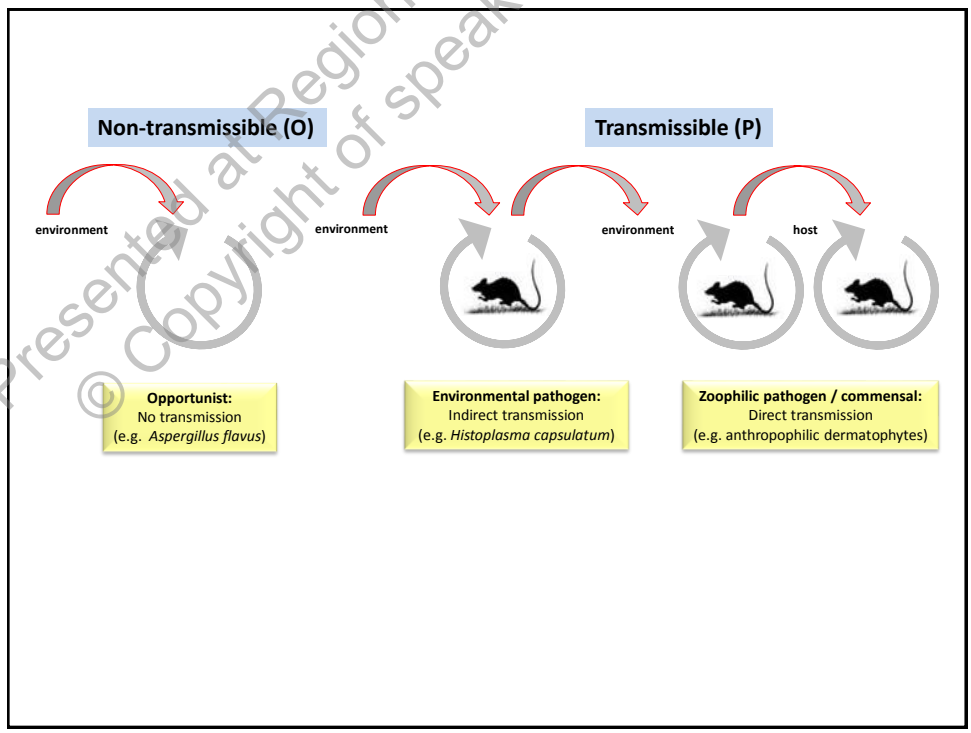


Disseminated, secondary cutaneous by pathogens

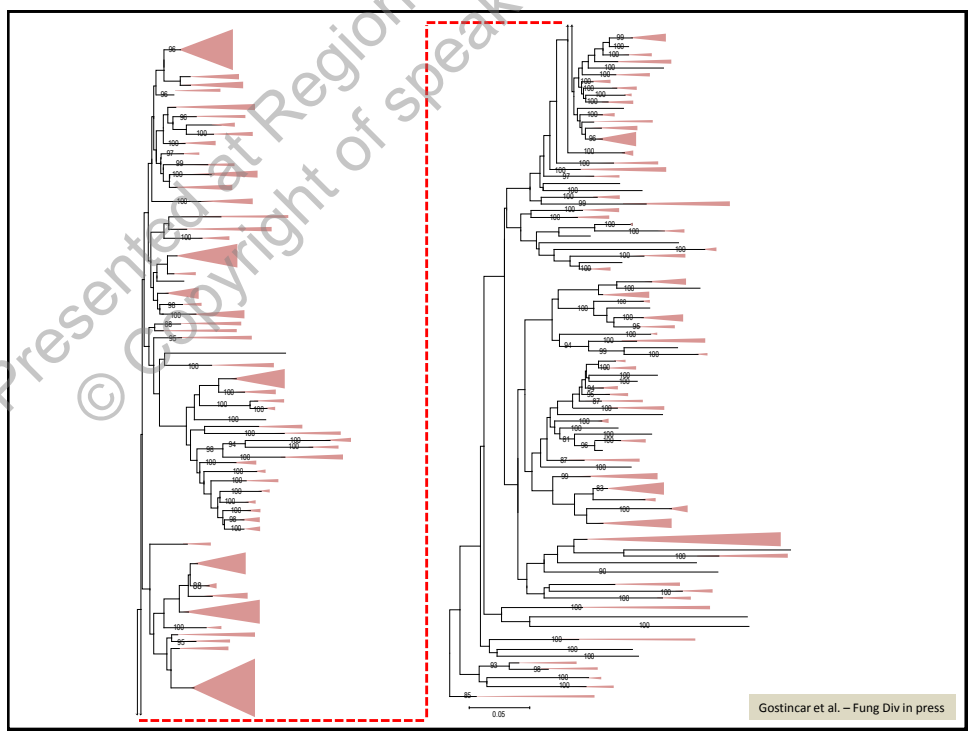
Emergomyces ***Histoplasma*** ***Blastomyces*** ***Talaromyces***

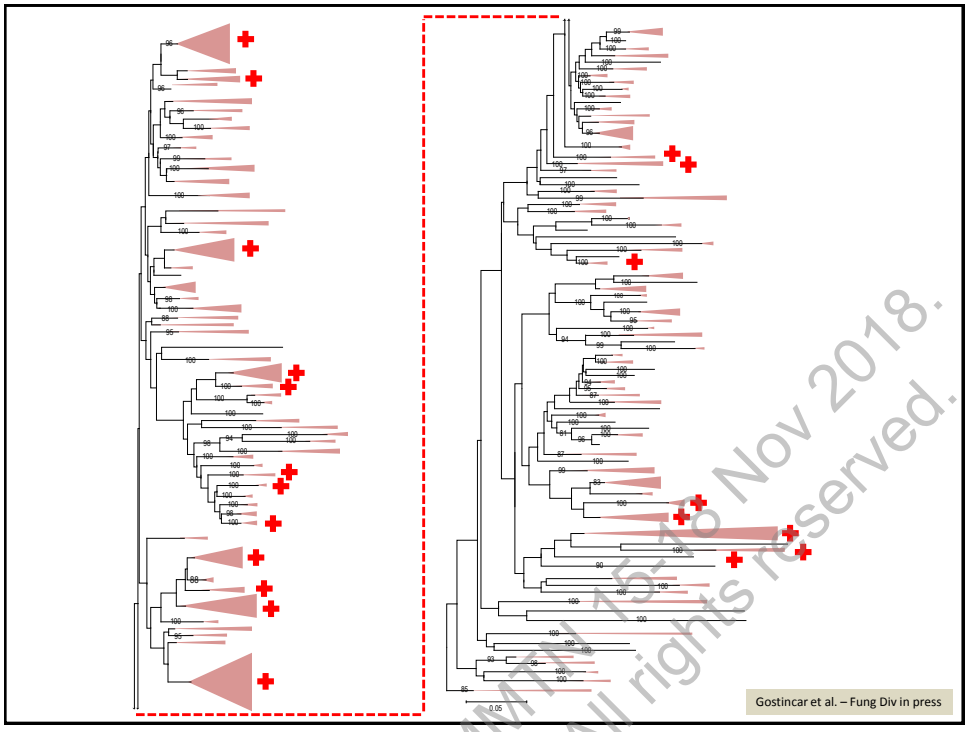


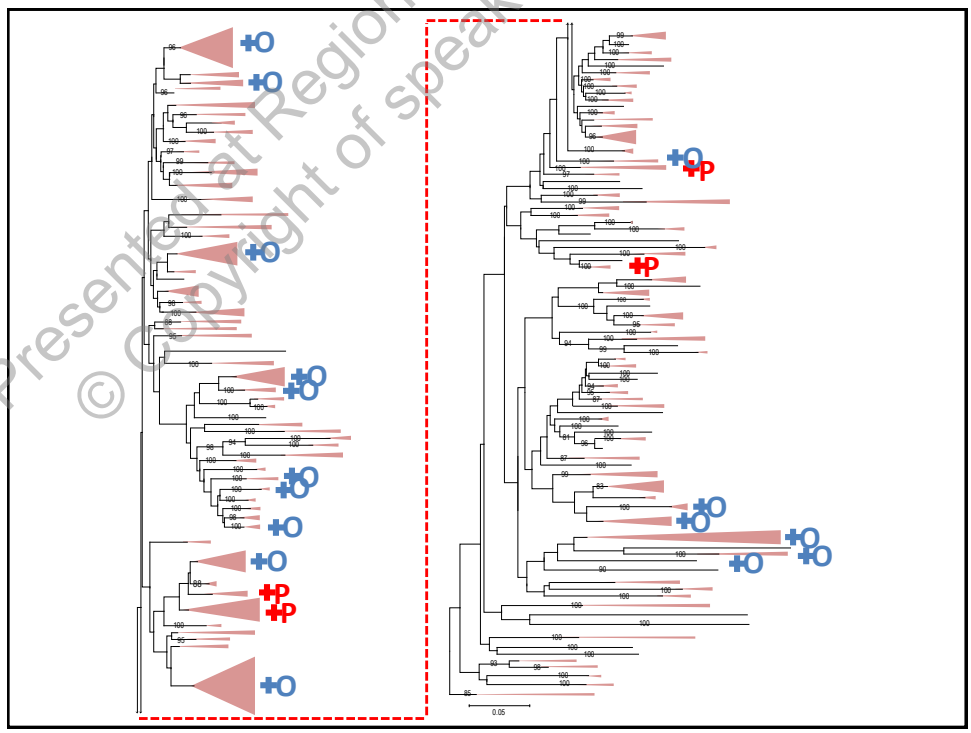




Contents





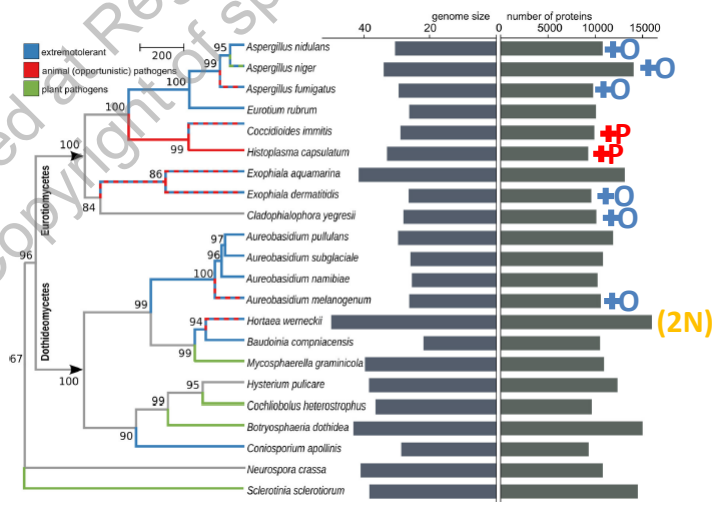


Repeated infection in 21 out of 140 orders:
7.1% Basidiomycota
18.8% Ascomycota

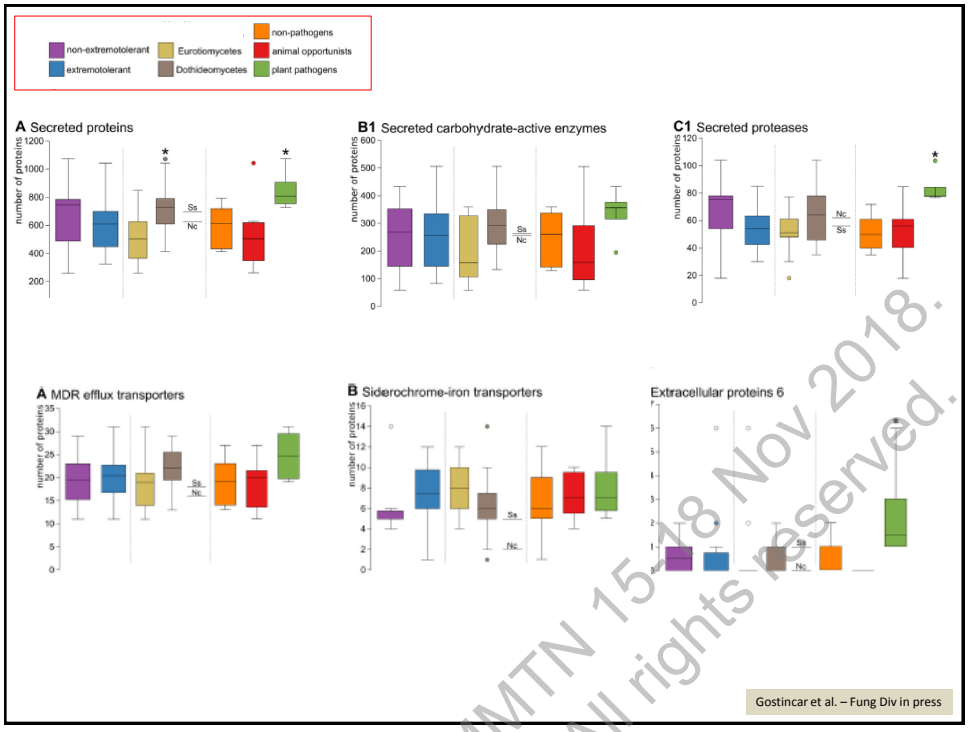
Association with life styles:
Thermotolerance (100%)
Psychrotolerance (p=0.0043)
Extremotolerance (p=0.0001):
- osmotolerance
- pH
- oligotrophism (nutrient scavenging)

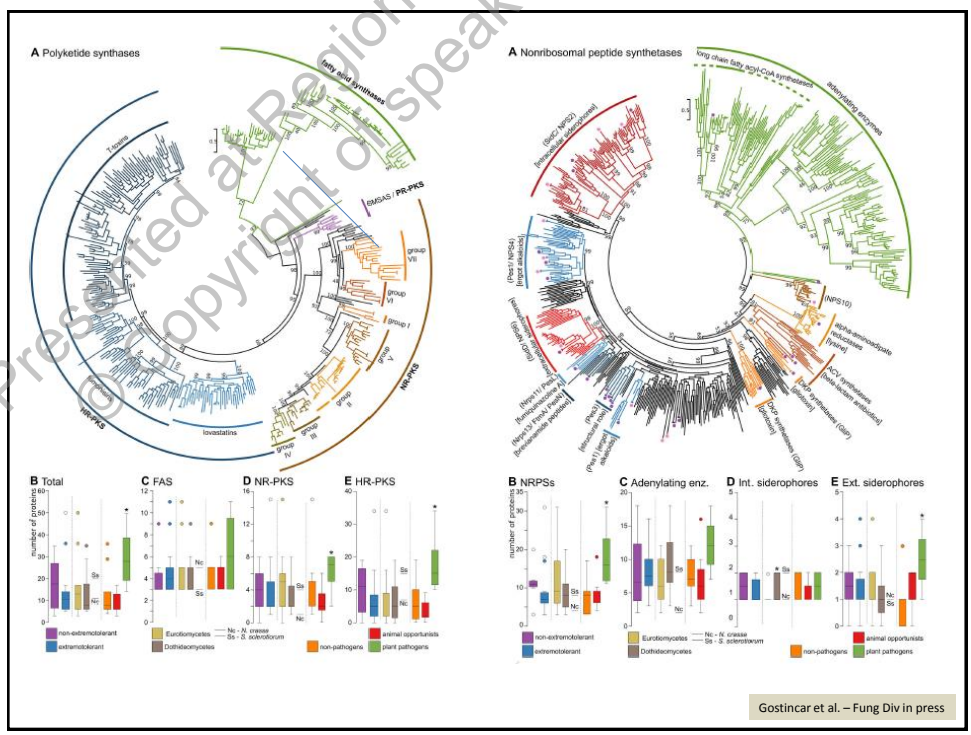
No significant association with plant pathogenicity

Genome sizes



Gostincar et al. – Fung Div in press





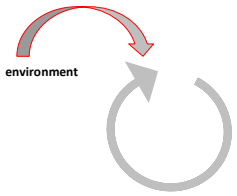
Genome:

Trehalose, choline	**Extremotolerance**
Alcohol & aldehyde dehydrogenases	
CAZY GH32 invertases (energy storage / recovery)	
Melanin	

Extremotolerance determines opportunism

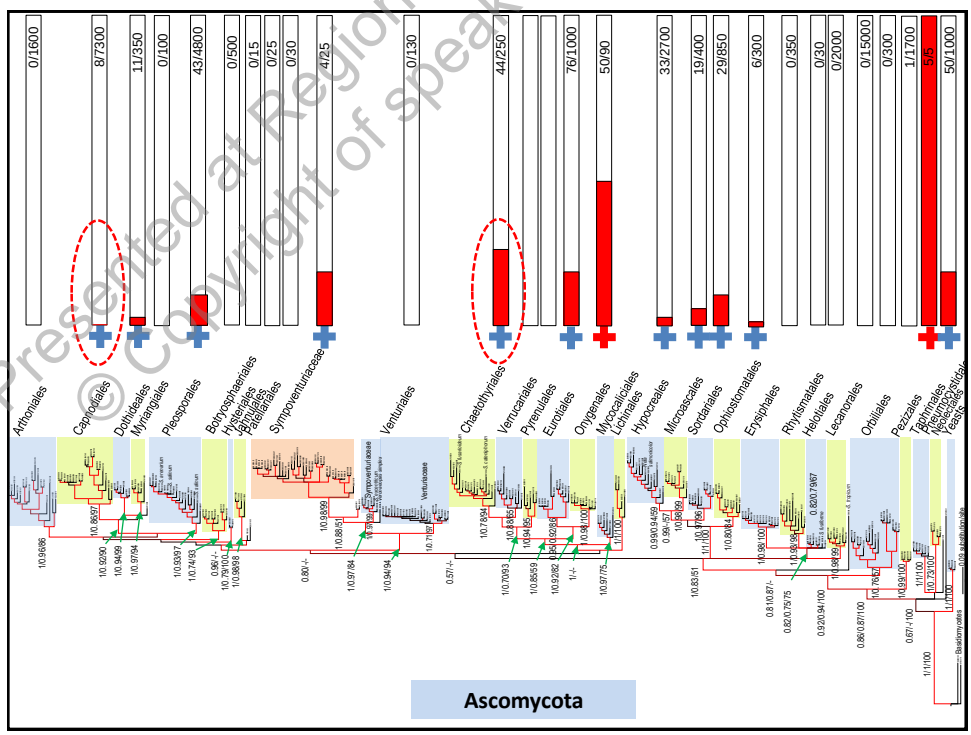
Contents

Non-transmissible (O)

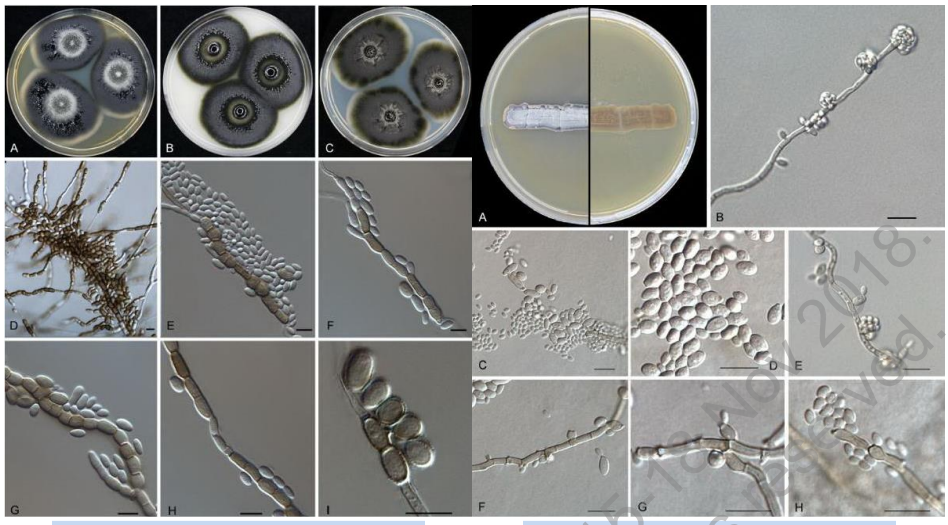


Opportunist:
No transmission

Some are much more 'successful' (frequent) than others



Focus organisms



Aureobasidium (*Capnodiales*)

Exophiala (*Chaetothyriales*)

Polymorphic black yeasts colonizing bathrooms

Capnodiales:	
Cutaneous	- traumatic
Catheter-related	- compromised

Chaetothyriales:	
Cutaneous, keratitis	- traumatic
Chromoblastomycosis	- traumatic
Mycetoma	- traumatic
Subcutaneous cyst	- traumatic
Pulmonary colonization (CF)	- inhalation
Disseminated, sec. cutaneous	- inhalation
Primary cerebral	- inhalation
Primary cutaneous, sec. cerebral	- traumatic
Systemic in cold-blooded	- ingestion?

Chaetothyriales:
Systemic / disseminated + secondary cutaneous:
Several hundreds of cases globally
90% prevalence in males
About 50% in healthy appearing humans
Fatality rate up to 80%

Veronaea botryosa

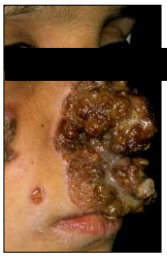
China: inhalation

Mexico: inhalation

Exophiala spinifera

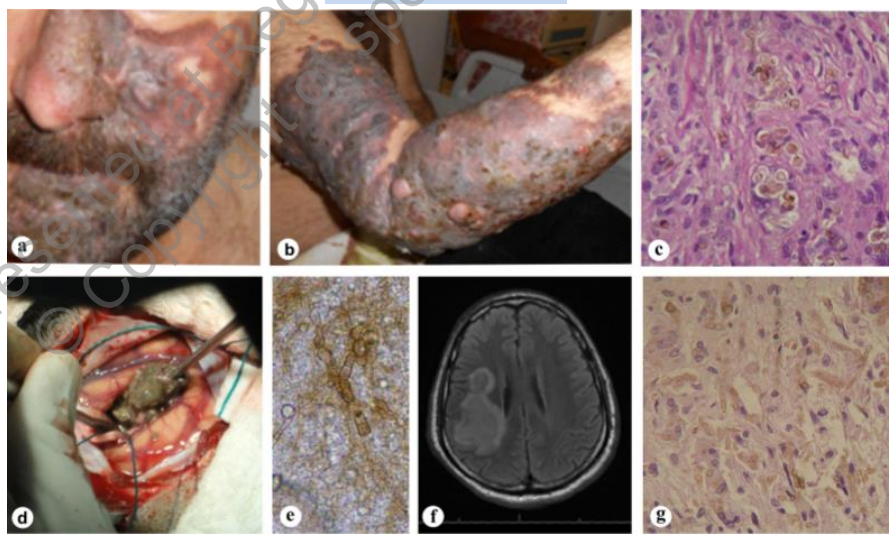
China: inhalation

Phialophora tarda



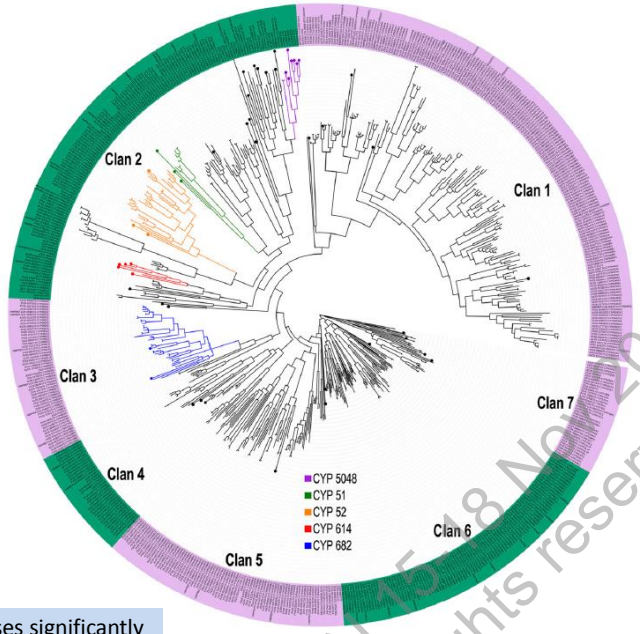
Libya: inhalation

Fonsecaea pugnacius



Primary cutaneous: dissemination from chromoblastomycosis

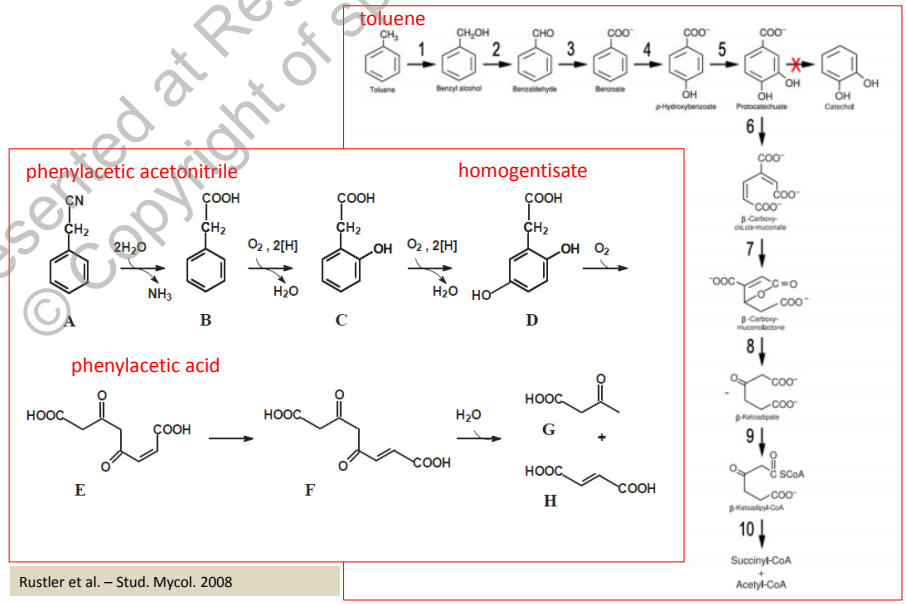
Gomes et al. – JCM 2015



Cytochrome oxidases significantly enriched in Chaetothyriales

Moreno et al. – G3 2018

Hydrocarbon degradation via homogentisate pathway



Rustler et al. – Stud. Mycol. 2008

Moreno et al. – G3 2018

Contents

Genome:

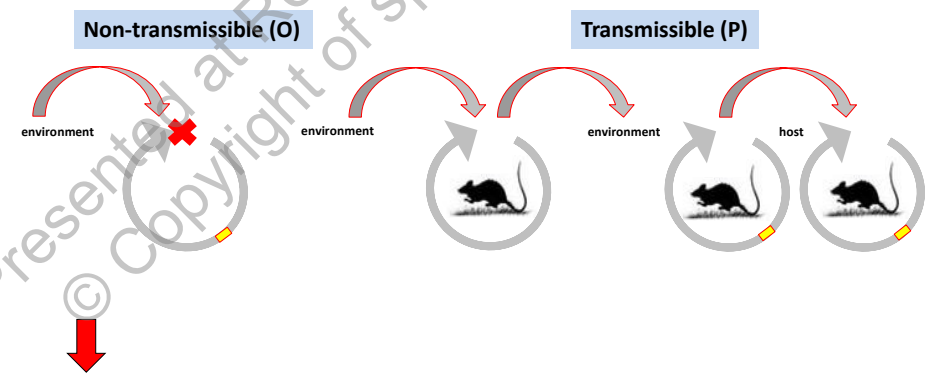
Tyrosine, choline	**Extremotolerance**
Alcohol & aldehyde dehydrogenases	
CAZY GH32 invertases (energy storage / recovery)	
Melanin	
Transporters, secretory proteins	**Toxin management**
Laccases, cytochromes for hydrocarbon scavenging	
Hydrocarbon degradation pathways, opening benzene rings	

Polyextremotolerance determines invasive potential of Chaetothyriales

Associated with genetic disorders of innate immunity (*CARD9, STAT1*)

NB Pathogens: associated with impaired acquired immunity

Contents



Opportunists are unlikely to evolve towards increased pathogenicity

Acknowledgements

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