


*The pathogenic potential of waterborne black yeasts
in cold-blooded animals*

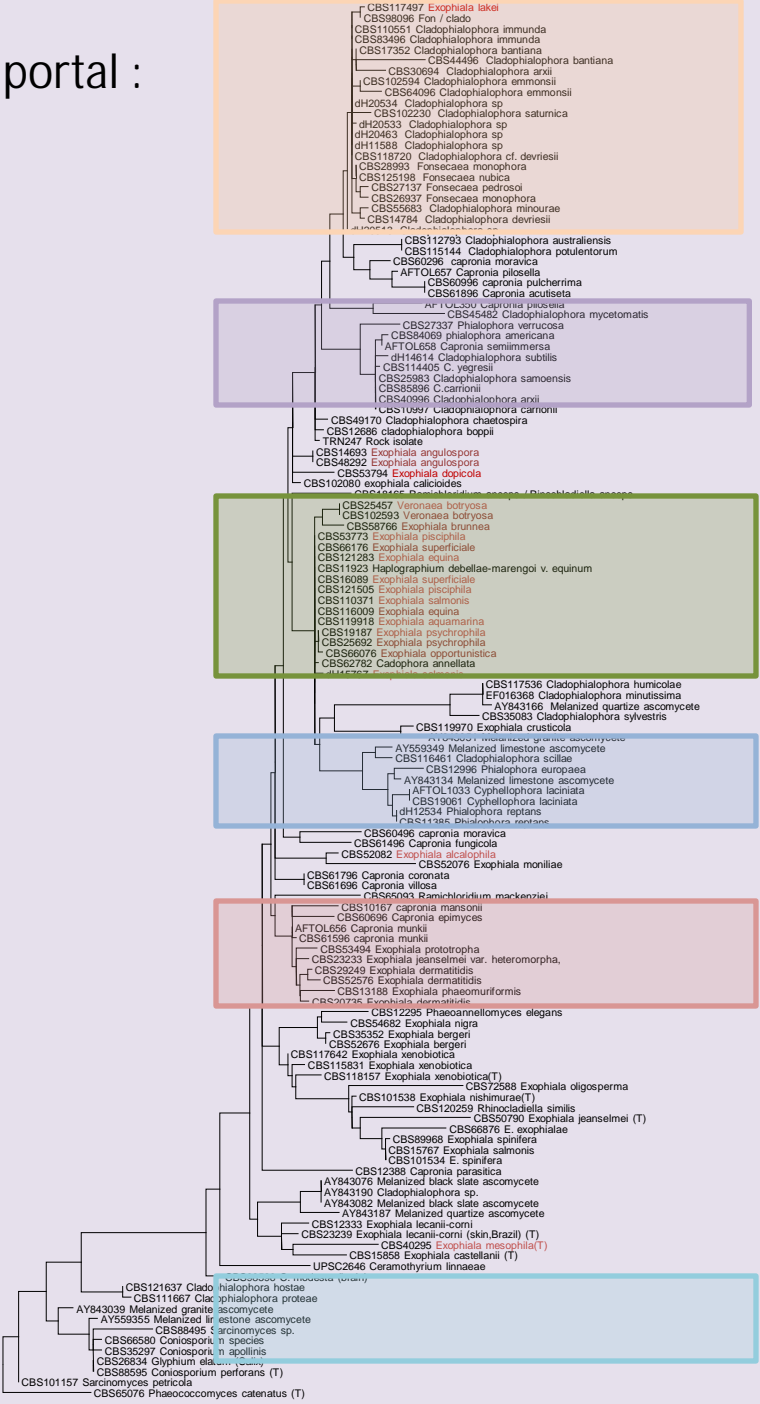


**Seyedmojtaba Seyedmousavi Tasieh
(Amir)**

1- CBS – KNAW Fungal Biodiversity Centre, Utrecht, The Netherlands.

2- Faculty of Medicine and Medical Sciences, Islamic Azad University, Ardabil Branch, Iran

SSU RaxML ver.7.0.4 in cypress portal :
 order *Chaetothyriales*



bantiana clade

carrionii clade

salmonis clade

europaea clade

dermatitidis clade

rock clade

0.005

Different pathogenic potentials in clades of Chaetothyriales:

	Invertebrates	Vertebrates				
		Fish	Amphibian	Reptile	Bird	Mammal
<i>bantiana clade</i>	-	-	-	-	-	+++
<i>carrionii clade</i>	-	-	-	-	-	+++
<i>salmonis clade</i>	+	+++	+++	-	-	+
<i>europaea clade</i>	-	-	-	-	-	+
<i>dermatitidis clade</i>	-	-	-	-	-	+++
<i>rock clade</i>	-	-	-	-	-	+

Different pathogenic potentials in clades of Chaetothyriales:

	Invertebrates	Fish	Amphibian	Vertebrates		Human
				Reptile	Bird	
<i>bantiana clade</i>	-	-	-	-	-	+++
<i>carrionii clade</i>	-	-	-	-	-	+++
<i>salmonis clade</i>	+	+++	+++	-	-	+
<i>europaea clade</i>	-	-	-	-	-	+
<i>dermatitidis clade</i>	-	-	-	-	-	+++
<i>rock clade</i>	-	-	-	-	-	+

Different pathogenic potentials in clades of Chaetothyriales:

	Invertebrates			Reptile	Bird	Mammal
		Fish	Amphibian			
<i>bantiana clade</i>	-	-	-	-	-	+++
<i>carrionii clade</i>	-	-	-	-	-	+++
<i>salmonis clade</i>	+	+++	+++	-	-	+
<i>europaea clade</i>	-	-	-	-	-	+
<i>dermatitidis clade</i>	-	-	-	-	-	+++
<i>rock clade</i>	-	-	-	-	-	+

Different type of infections in clades of Chaetothyriales:

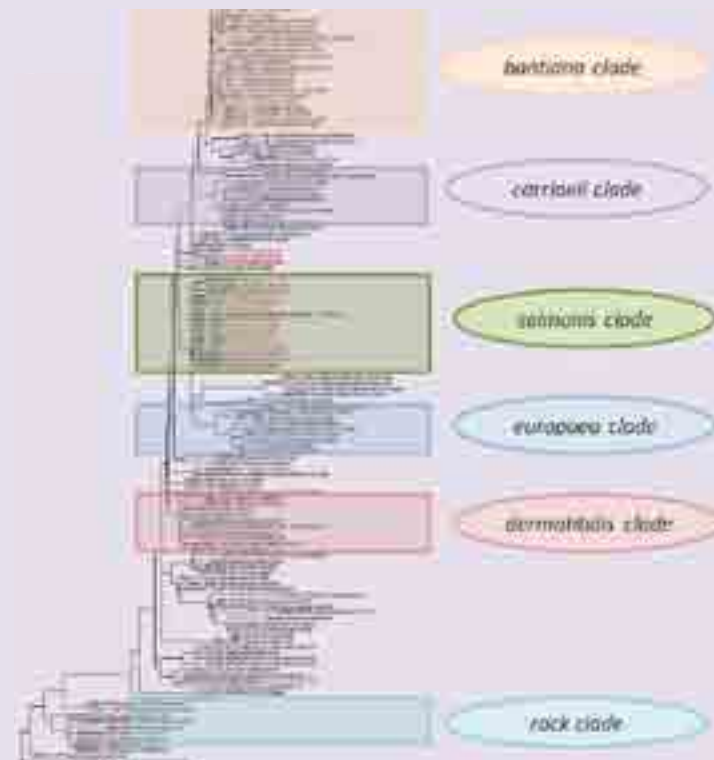
	Invertebrates	Vertebrates				
		Fish	Amphibian	Reptile	Bird	Mammal
<i>bantiana clade</i>	-	-	-	-	-	disseminated infection
<i>carrionii clade</i>	-	-	-	-	-	disseminated infection
<i>salmonis clade</i>	disseminated infection	disseminated infection	disseminated infection	-	-	superficial infection
<i>europaea clade</i>	-	-	-	-	-	superficial infection
<i>dermatitidis clade</i>	-	-	-	-	-	disseminated infection
<i>rock clade</i>	-	-	-	-	-	superficial infection

Contents

- Pathogenicity of *Chaetothyriales*:
 - reptiles and birds are not susceptible
- Possible virulence factors:
 - Temperature
 - Melanin
 - Skin moisture
 - Alkyl benzenes
 - Immune system

Maximum growth temperature between different clades in the order *Chaetothyriales*:

	Maximum growth temperature
<i>bantiana clade</i>	37-40
<i>carrionii clade</i>	36-37
<i>salmonis clade</i>	27-33(36)
<i>europaea clade</i>	37
<i>dermatitidis clade</i>	36-42
<i>rock clade</i>	?



SSU RaxML ver.7.0.4 in cipres portal :

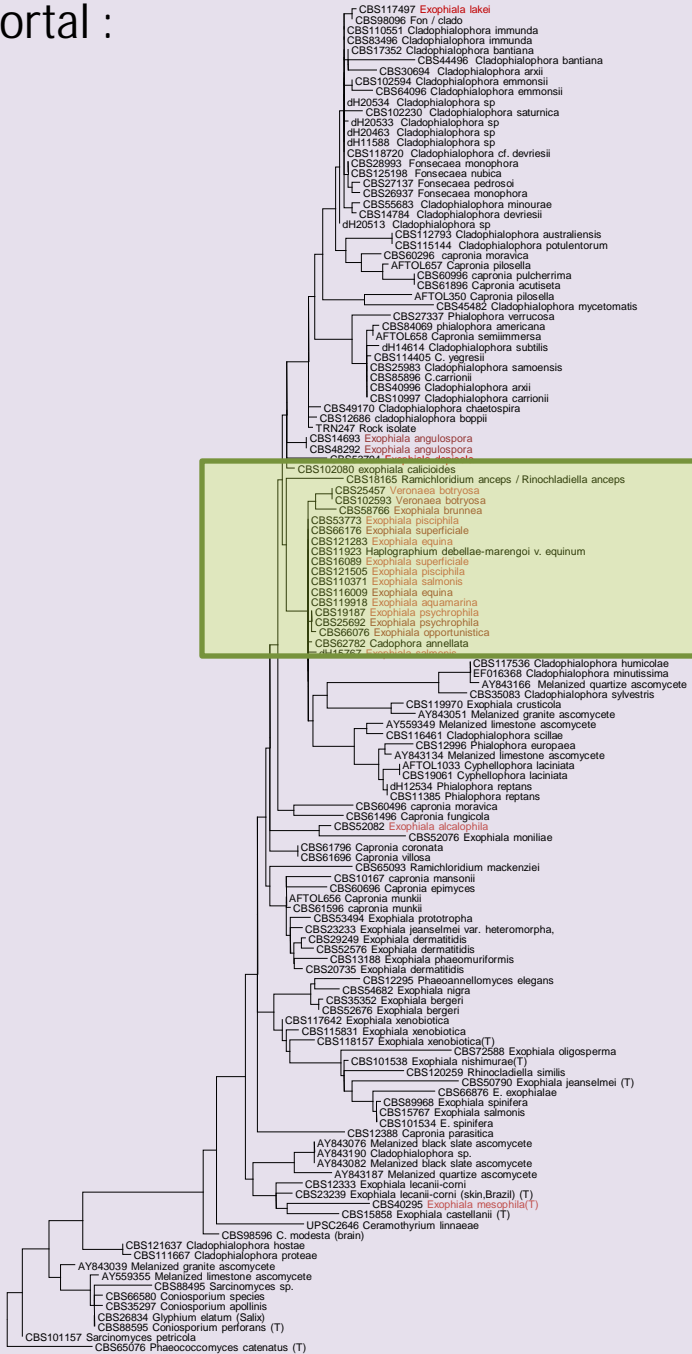
order *Chaetothyriales*

Waterborne clade



salmonis clade:

- E. angulospora*
- E. halophila*
- E. alcalophila*
- E. pisciphila*
- E. aquamarina*
- E. equina*
- E. superficiale*
- E. salmonis*
- E. opportunistica*
- E. psychrophila*
- E. cancerae*
- V. botryosa*



Temperature

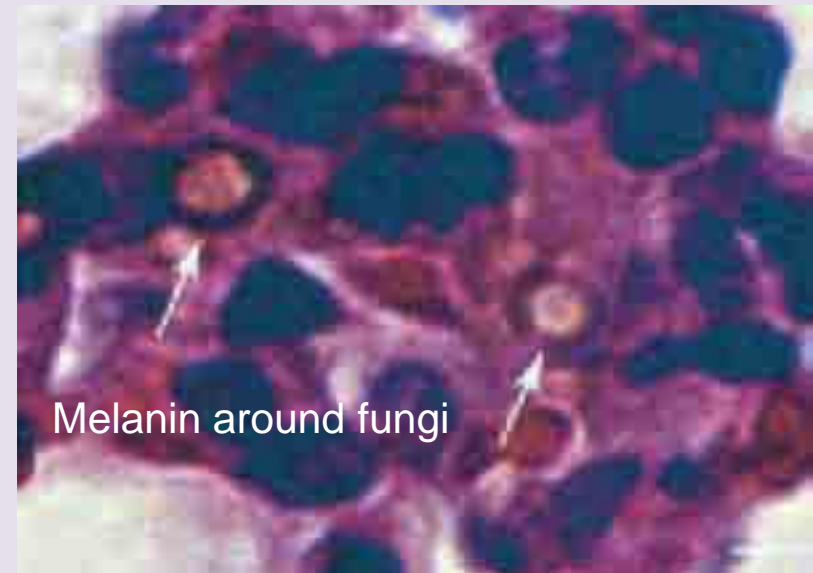
Characteristics of *salmonis* clade:

Temperature

Waterborne clade	Maximum growth temperature	Ecology	Infections in Animal Kingdom					Human
			Crab	Fish	Amphibian	Reptile	Bird	
			disseminated	disseminated	disseminated	-	-	
<i>E. angulospora</i>	30-33°C	cold drinking water, sea water aquaria and fish nurseries	-	sea dragon, marine lumpfish	-	-	-	-
<i>E. halophila</i>	30-33°C	salty water	-	-	-	-	-	human
<i>E. alcalophila</i>	36-40 °C	soil on a minimal medium ,bath water	-	-	-	-	-	human
<i>E. pisciphila</i>	30-33°C	freshwater , seawater	-	channel catfish, captive marine plaice, dog fish,	frog	-	-	human
<i>E. aquamarina</i>	33-36°C	sea aquarium	-	sea dragon, winter flounder, tunny fish	-	-	-	-
<i>E. equina</i>	33-36°C	drinking and waste water	-	-	-	-	-	horse, human
<i>E. superficiale</i>	30-33°C	skin of patients with diabetes	-	-	-	-	-	human
<i>E. salmonis</i>	30-33°C	cold water with temperature range of 12-14 °C	-	trout cod, atlantic salmon	frog	-	-	human
<i>E. opportunistica</i>	27-30 °C	drinking water	-	fish	-	-	-	-
<i>E. psychrophila</i>	24-27°C	cold water with temperature range of 12-14 °C	-	atlantic salmon	-	-	-	-
<i>E. cancerae</i>	30-33°C	brazilian coast	mangrove crabs	-	green toad	-	-	human
<i>V. botryosa</i>	33-36°C	sansa olive slag, wood treated	-	-	-	-	-	human

Synthesis of melanin within cell walls

- Protection against oxygen radicals that produce by phagocytic cells
- Synthesis of melanin in *Chaetothyriales* is consistent
- One of the general virulence factor

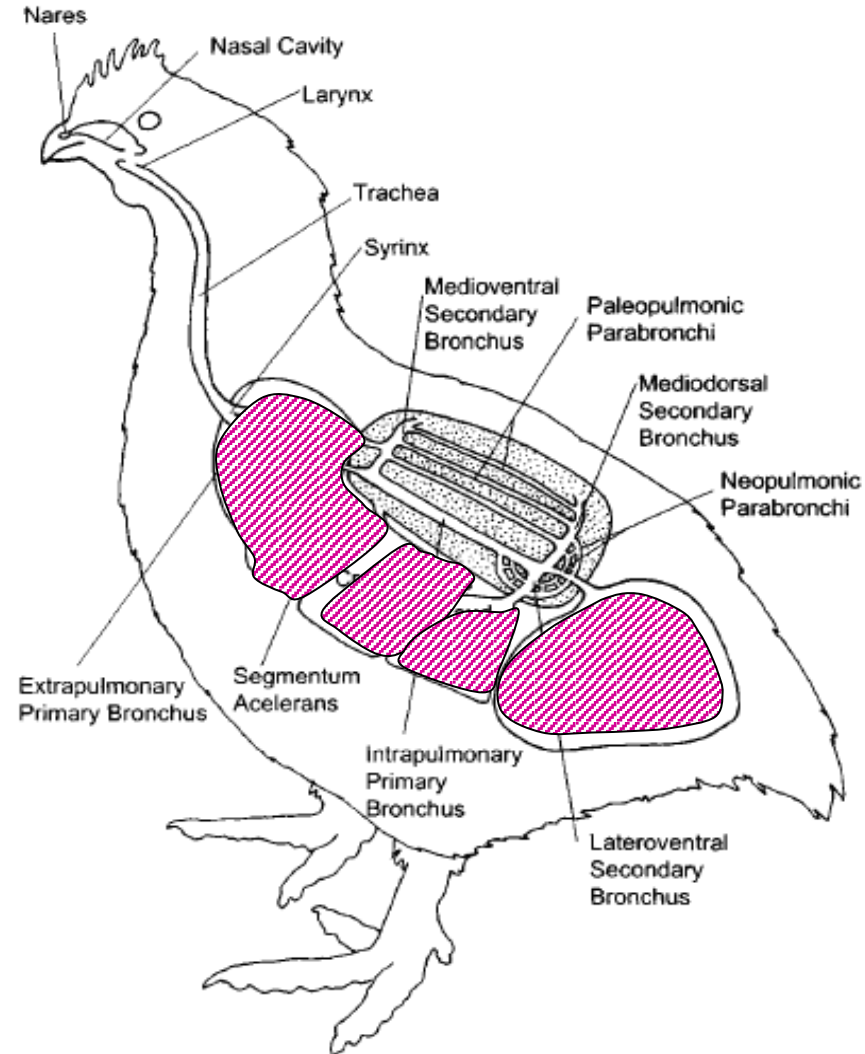


Anatomy, physiology and immunology of birds

- Endothermic (40-42°C body temperature)
- Good level of immune response
- Birds do not have sweat glands: **Dry skin**

Different pathogenic potentials in clades of Chastothyrtales:

	Invertebrates	Reptile		Bird		Mammal
		Fish	Amphibian			
<i>bartonii</i> clade	+	+	+	+	+	+++
<i>carriani</i> clade	+	+	+	+	+	+++
<i>salmonis</i> clade	+	+++	+++	+	+	+
<i>europaea</i> clade	+	+	+	+	+	+
<i>dermatitidis</i> clade	+	+	+	+	+	+++
<i>rock</i> clade	+	+	+	+	+	+



Anatomy, physiology and immunology of reptiles

- Ectothermic
- Reptiles, unlike mammals, do not have lymph nodes, but have a lymphatic system.
- Few/no glands in skin: **Dry skin**
- Thick stratum corneum with modifications to epidermal scales or shell.

Different pathogenic potentials in clades of Chactothyrals:

	Invertebrates	Reptile		Bird		Mammal
		Fish	Amphibian			
bantiana clade	++	++	++	++	++	+++
corriani clade	++	++	++	++	++	+++
salmonii clade	+	+++	+++	++	++	++
europaea clade	++	++	++	++	++	+
dermatitidis clade	++	++	++	++	++	+++
rock clade	++	++	++	++	++	++



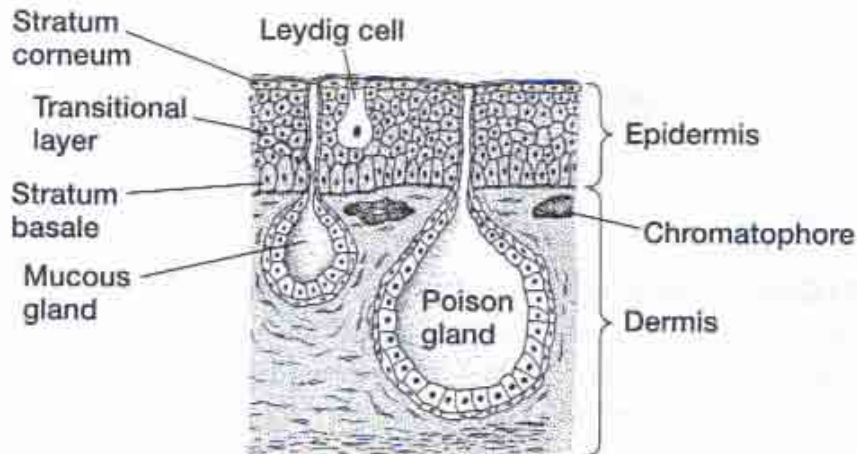
Anatomy, physiology and immunology of fish

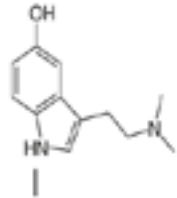
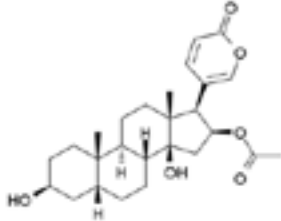
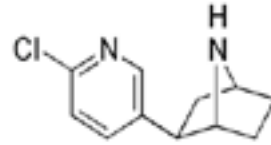
- Ecto-thermic
- True lymphoid organs are absent
- No stratum corneum
- The outer body of many fish is covered with scales in a protective layer of slime (mucus) producing by many unicellular **Moist skin**



Anatomy, physiology and immunology of amphibians

- They have stratum corneum
- Loses dermal scales
- **Moist skin**
- Epidermal multicellular **glands** abundant: all toads have large poison glands located behind the eyes on the top of the head that contain **toxins**



Chemical structure of toxin glands in amphibiansBufoteninBufotalinEpibatidine

Epibatidine: $C_{11}H_{13}N_2Cl$

0021-0144/99/0130
The Journal of Neurochemistry and Synaptology
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Vol. 42, No. 1, pp. 31-45, 1994
Printed in U.S.A.

Original Article

Molecular Anatomy of a Skin Gland: Histochemical and Biochemical Investigations on the Mucous Glands of *Xenopus laevis*¹

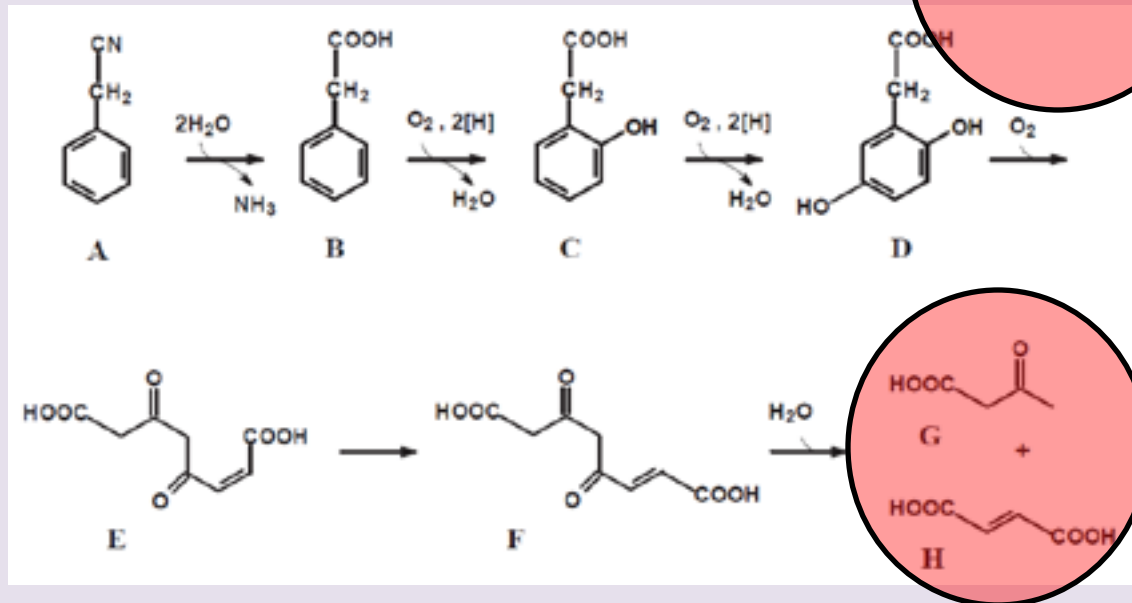
UDO SCHUMACHER,² ELIZABETH ADAM, FRANK HAUSER, JOSEPH C. PROBST,
and WERNER HOFFMANN

Department of Human Morphology, University of Southampton, Southampton, United Kingdom (U.S.A.) and
Max Planck Institute for Psychiatric, Abteilung Neurochemie, Marburg, Germany (FRG/CEFT).



Biodegradation of aromatic hydrocarbons by fungi

- Co-metabolic nature of fungi
- Metabolisation of aromatic hydrocarbons and cleave them to aromatic ring



March 2002
DOI: 10.1007/s10267-001-0014-4

FUNGAL MICROBIOLOGY

Isolation and Identification of Black Yeasts by Enrichment on Atmospheres of Monoaromatic Hydrocarbons

Jingjun Zhao · Jingxi Zeng · G. Sybren de Hoog ·
Dorlene Amor-Angelis · Francesc X. Prenafeta-Boldú

Volume 4 Number 11 November 2002

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Available online at www.kluweronline.com
DOI: 10.1007/s10267-002-0014-4

Characterisation of the substrate specificity of the nitrile hydrolyzing system of the acidotolerant black yeast *Xerophilala oligosperma* R1

J. Kubicek · A. C. de Vries · M. A. S. de Vries · G. M. de Vries

Volume 4 Number 11 November 2002
Available online at www.kluweronline.com
DOI: 10.1007/s10267-002-0014-4

Fungi growing on aromatic hydrocarbons: biotechnology's unexpected encounter with biohazard?

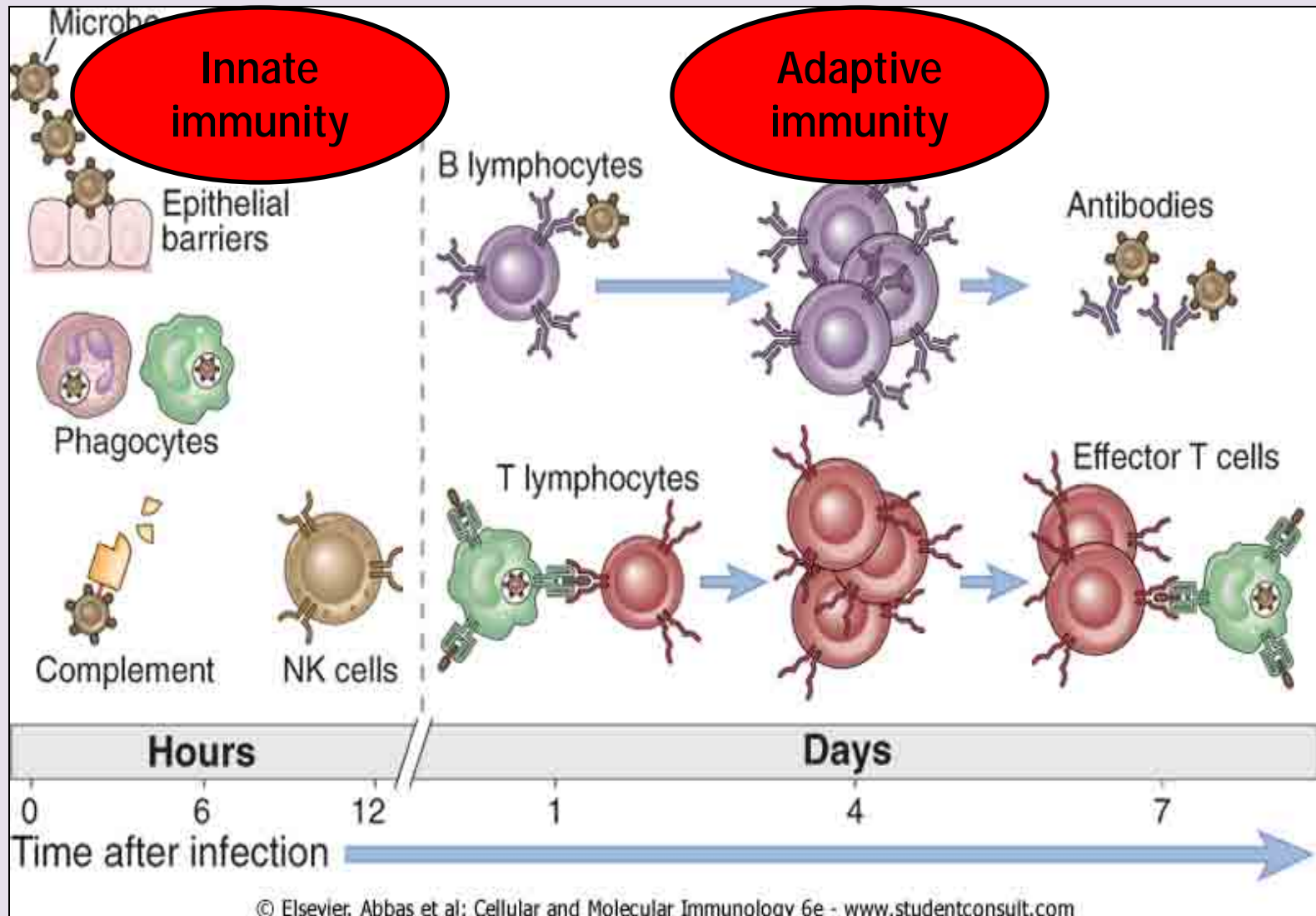
Francesc X. Prenafeta-Boldú, Richard Summerbell & G. Sybren de Hoog

Centraalbureau voor Schimmcultures, Utrecht, The Netherlands

Evolution of immune system

Animal kingdom		Examples	Immune system		Type of infection
			Innate	Adaptive	
Major phyla of the vertebrate	Mammal	a liver transplant recipient	*****	*****	superficial infection
	Bird	-	****	****	-
	Reptile	-	***	***	-
	Amphibian	toads	**	**	disseminated infection
	Fish	atlantic salmon	*	*	disseminated infection
Major phyla of the invertebrate	Crustaceae	mangrove crabs	*	-	disseminated infection

Comparison of vertebrate and invertebrate immune system

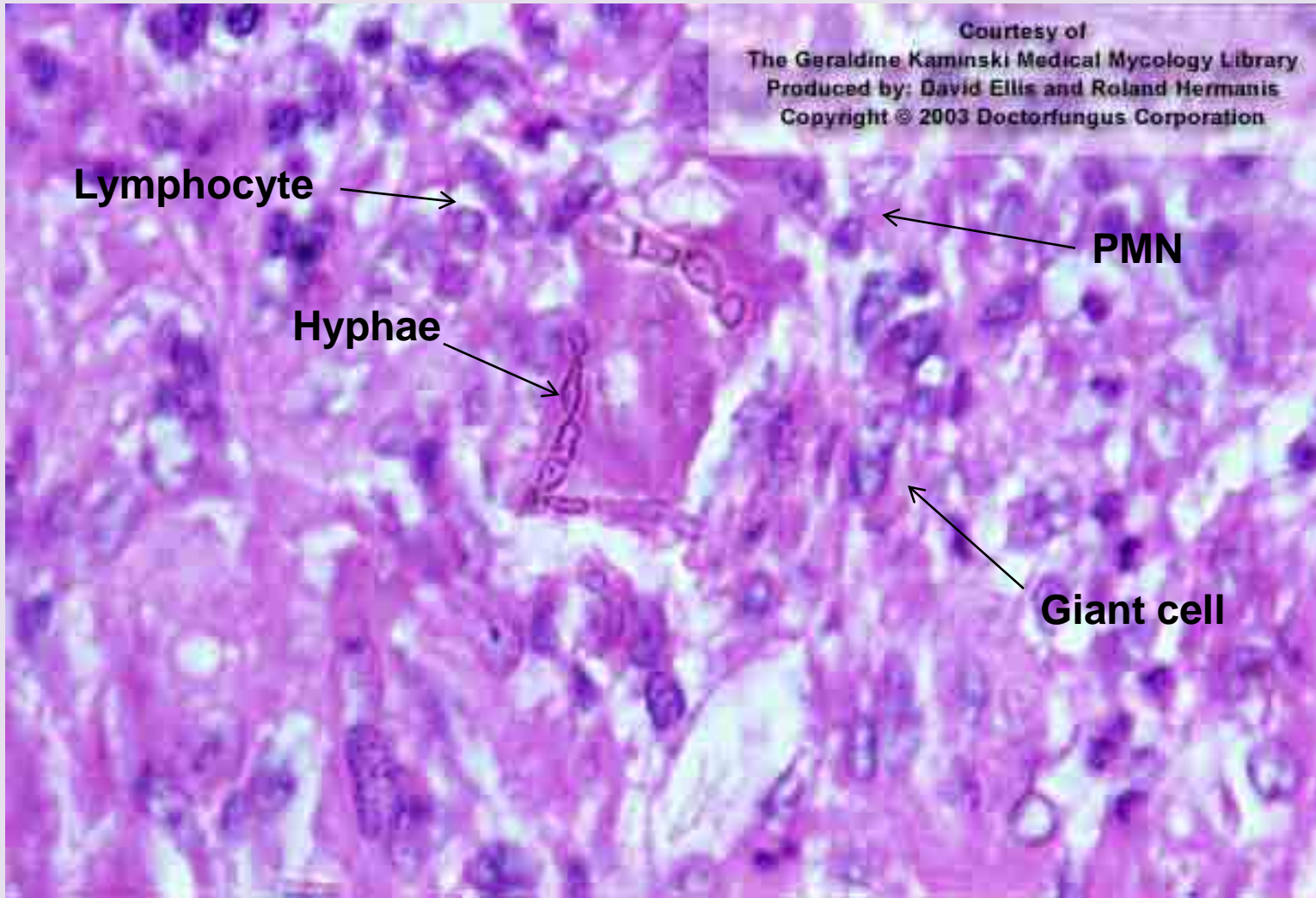


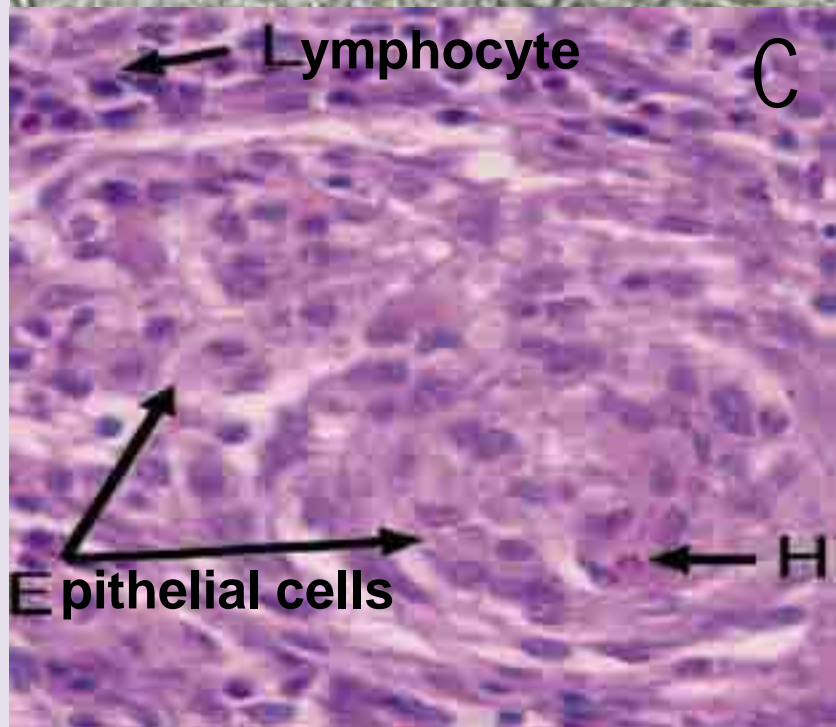
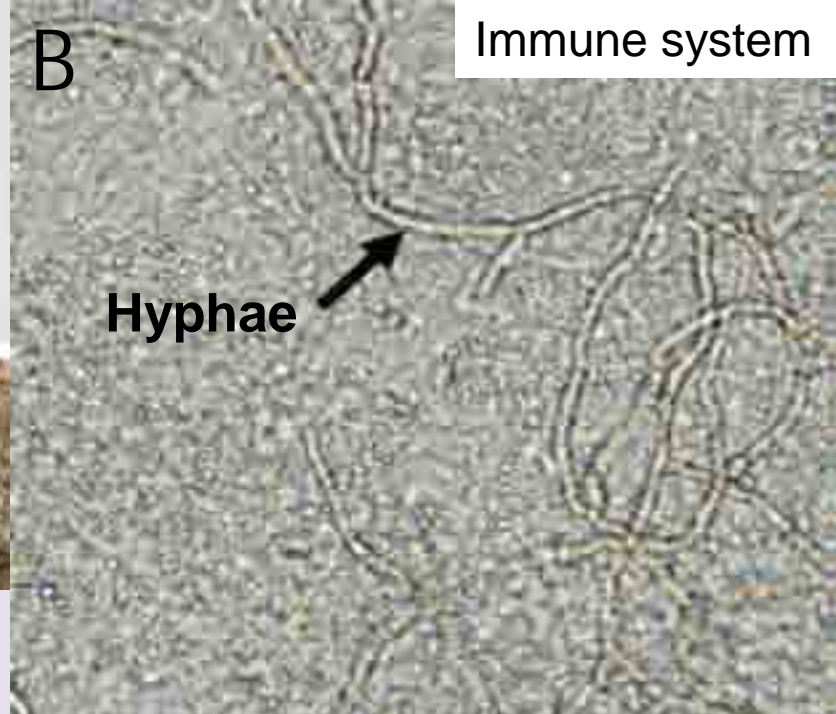
Evolution of immune system

Animal kingdom		Examples	Immune system		Type of infection								
			Innate	Adaptive									
Major phyla of the vertebrate	Mammal	a liver transplant recipient	+	+	+	+	+	+	+	+	+	+	superficial infection
	Bird	-	+	+	+	+	+	+	+	+	-		
	Reptile	-	+	+	+	+	+	+	-				
	Amphibian	toads	+	+	+	+	disseminated infection						
	Fish	atlantic salmon	+	+	+	disseminated infection							
Major phyla of the invertebrate	Crustaceae	mangrove crabs	+	-	disseminated infection								

Phaeohyphomycosis in human with *Exophiala jeanselmei*

Complete level of inflammatory reaction

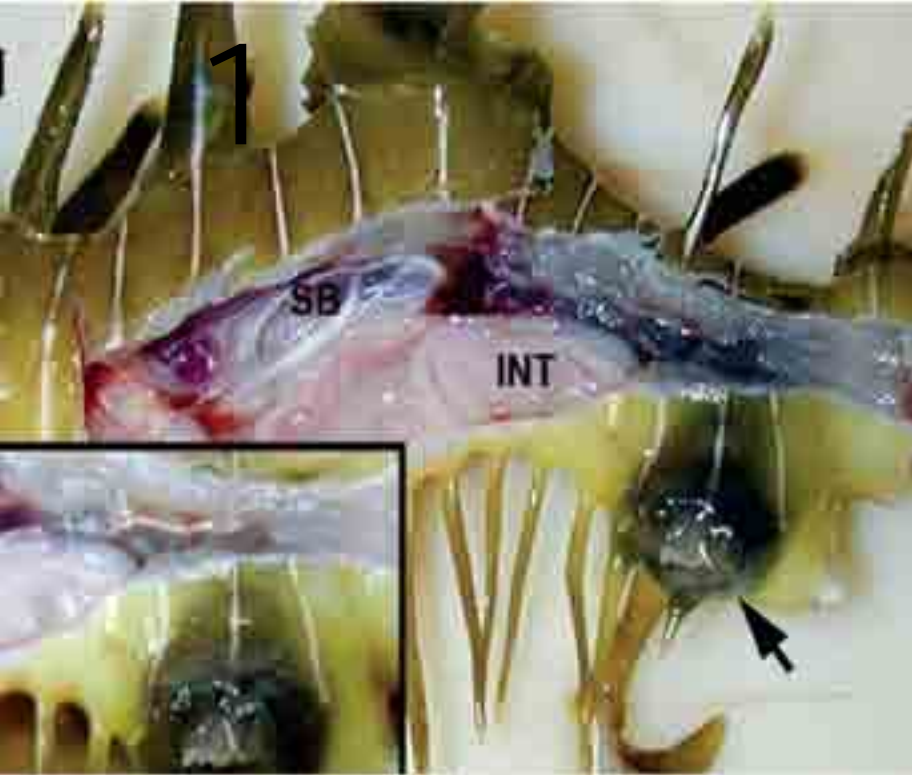




Primitive level of inflammatory reaction

Novel *Exophiala* Infection Involving Ulcerative Skin Lesions in Japanese Flounder *Paralichthys olivaceus*

Osamu Kurata^{1*}, Chutharat Munchan¹, Shinpei Wada¹, Kishio Hatai¹, Yasuyuki Miyoshi² and Yutaka Fukuda²



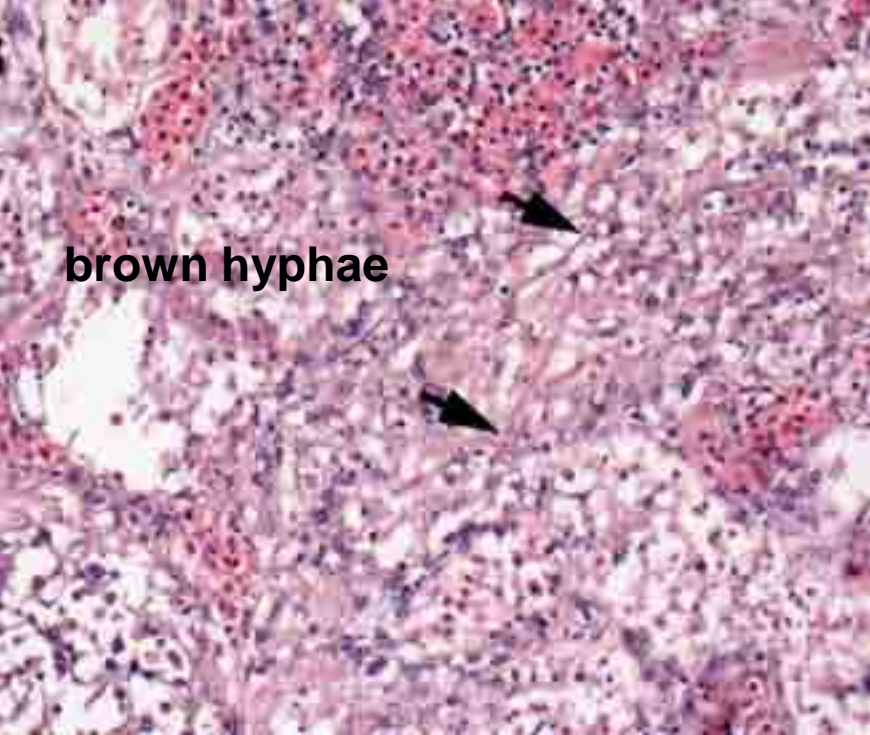
Primitive level of inflammatory reaction

J Vet Diagn Invest 21:69-79 (2009)

Disseminated phaeohyphomycosis in weedy seadragons (*Phyllopteryx taeniolatus*) and leafy seadragons (*Phycodurus eques*) caused by species of *Exophiala*, including a novel species

Akinyi Nyaoko, E. Scott Weber, Charles Innis, Donald Stremme, Cynthia Dowd, Lynn Hinckley, Timothy Gorton, Brian Wickes, Deanna Sutton, Sybren de Hoog, Salvatore Frasca Jr.¹

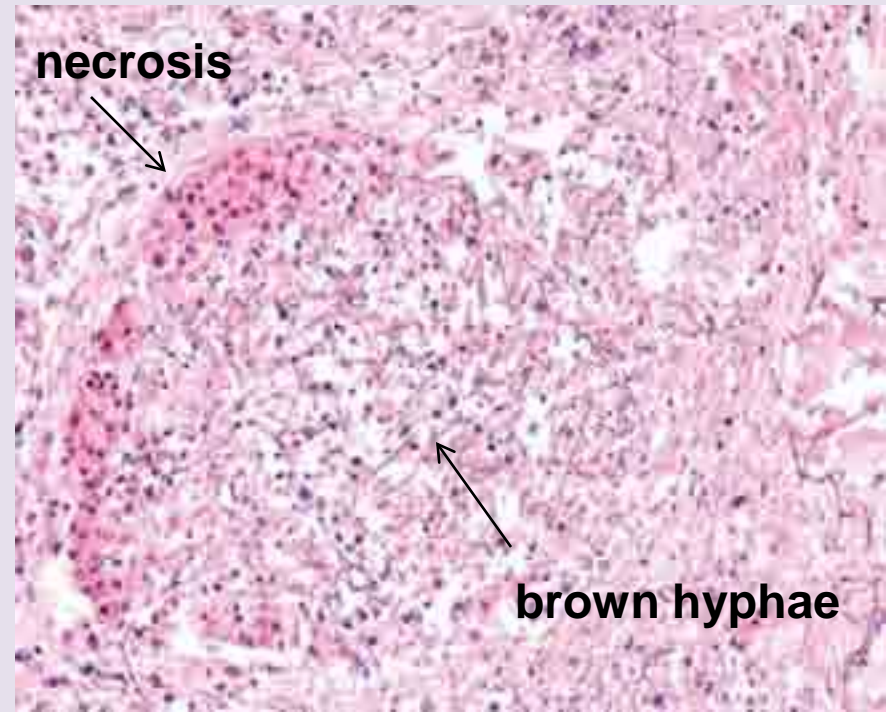




brown hyphae

← Filamentous brown fungal hyphae
in necrotic tubules of kidney

The absence of granuloma formation



necrosis

Intact brown fungal hyphae

filamentous brown fungal
hyphae in blood vessels →

brown hyphae

The absence of granuloma formation



brown hyphae

Mem Inst Oswaldo Cruz, Rio de Janeiro, Vol. 100(2): 161-167, April 2005 161

Lethargic crab disease: multidisciplinary evidence supports a mycotic etiology

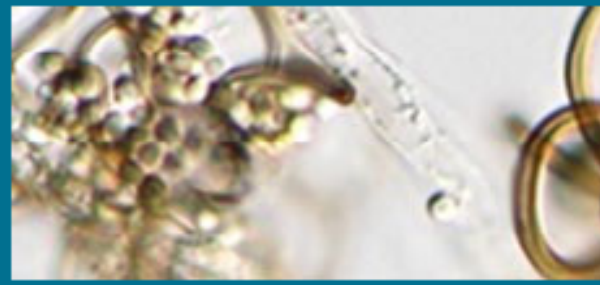
Walter A Boeger¹*, Marcio R Pie, Antonio Ostrensky*, Luciana Patella

Grupo Integrado de Aqüicultura e Estudos Ambientais (GIA), Departamento de Zoologia, *GIA, Departamento de Zootecnia, Universidade Federal do Paraná, Caixa Postal 19073, 81531-990 Curitiba, PR, Brasil



Conclusion

- Thermo-tolerance determines the choice of host
- Consistent presence of melanin is a general virulence factor for *Chaetothyriales*
- Hosts (reptiles, birds) with dry skin are not susceptible to black yeast infection
- The presence of alkyl benzenes may enhance infection
- Complexity of immune system determines the type of tissue response



ISHAM NEWS! (30-03-2010)

ISHAM Working Group on Veterinary Mycology

An initiative has been taken to start a **Working Group on Veterinary Mycology** under the auspices of ISHAM. This area covers very different practical and fundamental areas, such as development of vaccines in agriculture, mycoses in poultry, equines and other farm animals, mycotoxins, pet care, companion and wild animals, and research on fish and amphibian epidemics. Those who are interested to organize international networks for mutual support and exchange are requested to contact Seyed Mojtaba Seyed Mousavi Tasieh, mosavim@yahoo.com. Suggestions on priority topics are welcome.

Aknowlegement: CBS Black Yeast Group

üProf.Dr.Sybren.de.Hoog

üBert

üKasper

üMarlene

üVania

üHamid

üJavad

üSun

üLu

üDeng

üStephanie

üMarjon

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And



Thank You
For Your
Attention