

FUNDAÇÃO OSWALDO ARANHA

CENTRO UNIVERSITÁRIO DE VOLTA REDONDA

PRÓ-REITORIA DE PESQUISA E PÓS-GRADUAÇÃO

MESTRADO PROFISSIONAL EM ENSINO EM
CIÊNCIAS DA SAÚDE E DO MEIO AMBIENTE

DIGITAL ATLAS OF ONYCHOMYCOSIS

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ENGLISH



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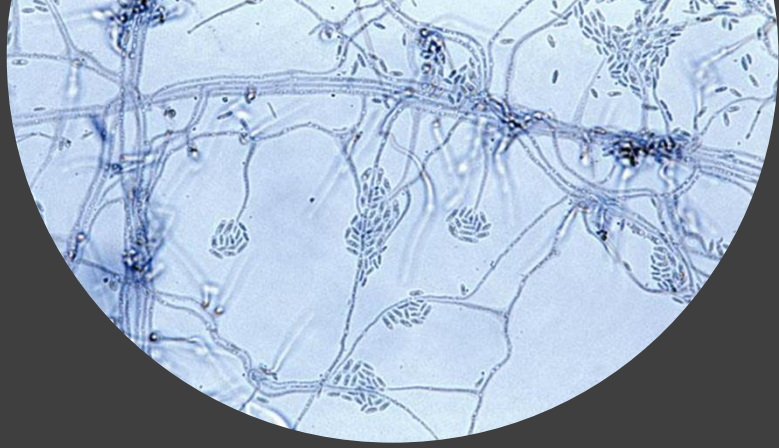
[Scopulariopsis sp.](#)

[Scytalidium hyalinum](#)

[Trichophyton mentagrophytes](#)

[Trichophyton rubrum](#)

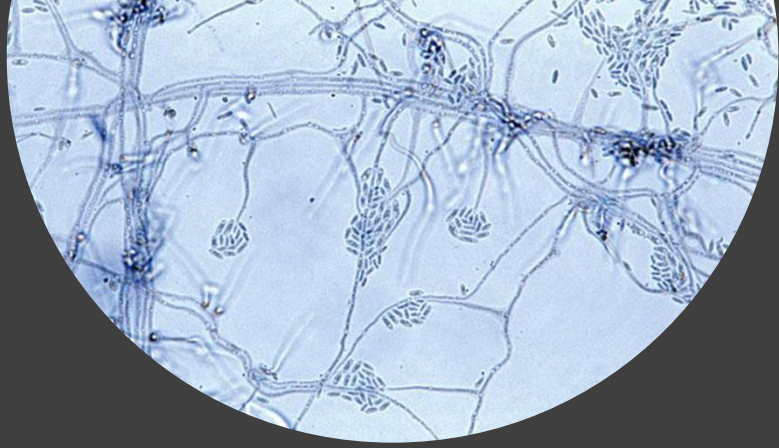
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OBJETIVOS

Utilizando-se de tecnologia digital como recurso de ensino sobre o diagnóstico laboratorial de onicomicose, mais especificamente o exame micológico direto e a cultura para fungos, esperamos auxiliar na capacitação dos profissionais que façam estes exames. Dessa forma, esperamos também proporcionar uma potencial mudança na execução desses exames e na interpretação de seus resultados, através do aprimoramento das técnicas utilizadas pelos profissionais executantes.

Como consequência, auxiliaríamos no diagnóstico laboratorial de onicomicose. Impactando positivamente no diagnóstico dessa patologia, haverá também impacto em seu tratamento, possibilitando que ele seja direcionado para o agente etiológico identificado, evitando-se, assim, tratamentos empíricos e/ou inadequados.



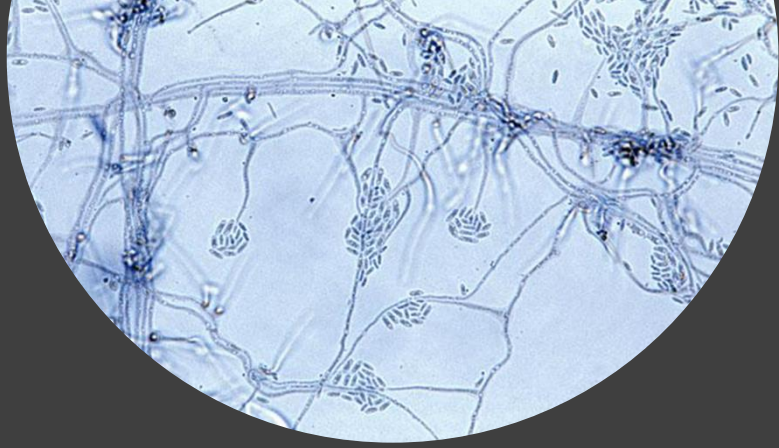
OBJETIVOS

Além disso, este recurso tecnológico poderá igualmente contribuir para dermatologistas e médicos pós-graduandos em dermatologia a aprimorarem seus conhecimentos sobre onicomicose e as técnicas mais corriqueiras para seu diagnóstico.

Este Atlas tem como conteúdo breve revisão teórica sobre onicomicose, vídeos e fotos que mostram o passo a passo da coleta do material da unha com suspeita clínica de onicomicose, a correta execução do exame micológico direto e da cultura para fungos e como devem ser interpretados seus resultados.

Esperamos que tenha um bom aprendizado!



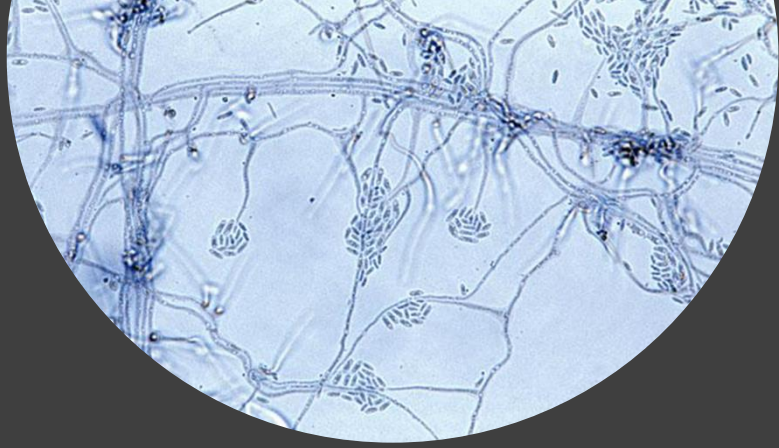


APARELHO UNGUEAL

O aparelho ungueal maduro (Figura 1) compreende a matriz ungueal, o leito ungueal, onde deita a lâmina, a lâmina ungueal e a prega ungueal. Os principais constituintes da lâmina ungueal são filamentos paralelos de queratina, que lhe conferem estabilidade mecânica, minerais, colesterol e cerca de 7% de água. A lâmina ungueal é mil vezes mais permeável à água do que a pele intacta e também pode ser um local onde substâncias exógenas são depositadas, como medicamentos²⁸.



Figura 1. Aparelho ungueal.

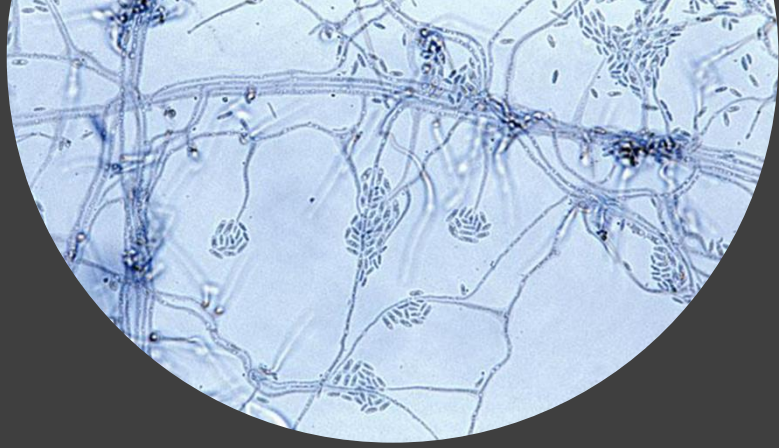


ONICOMICOSE

DEFINIÇÃO E CARACTERÍSTICAS

A infecção fúngica das unhas é uma micose superficial e acomete a lâmina, o leito e a matriz da unha. Durante o desenvolvimento da infecção, há uma colonização inicial com invasão subsequente do leito e lâmina ungueal, que causa alterações na cor, textura e forma da unha²⁶.

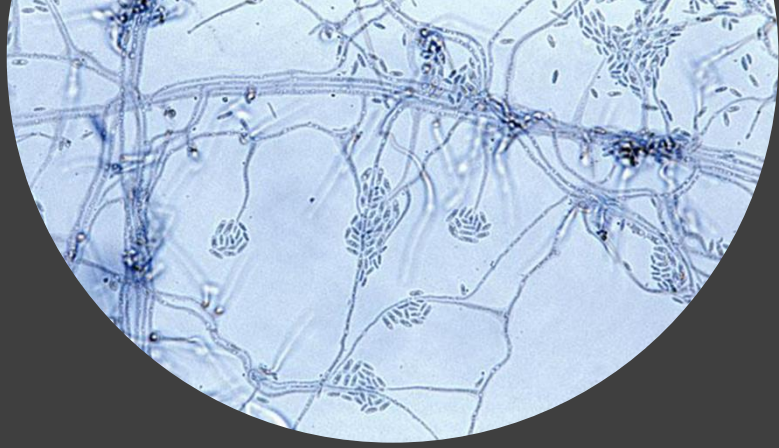
As doenças fúngicas das unhas são contagiosas e a transmissão entre os membros de uma família é a via mais comum¹⁶, se não forem tratadas¹. Os portadores da doença funcionam, portanto, como fonte de infecção e, potencialmente, podem contaminar as áreas comuns⁵. A fonte mais comum de infecção é o banho¹⁶.



ONICOMICOSE

NOMENCLATURA

Denomina-se onicomicose quando a infecção da lâmina ungueal é causada por fungo filamentoso não-dermatófito⁶. Já quando o agente causal é um fungo dermatófito, denomina-se tinea unguium, que é a forma plural. Quando apenas uma unha é afetada, diz-se tinea unguis²⁸. Entretanto, de forma genérica, todas as infecções das unhas por fungos são denominadas onicomicose. Aqui, adotaremos o termo genérico.

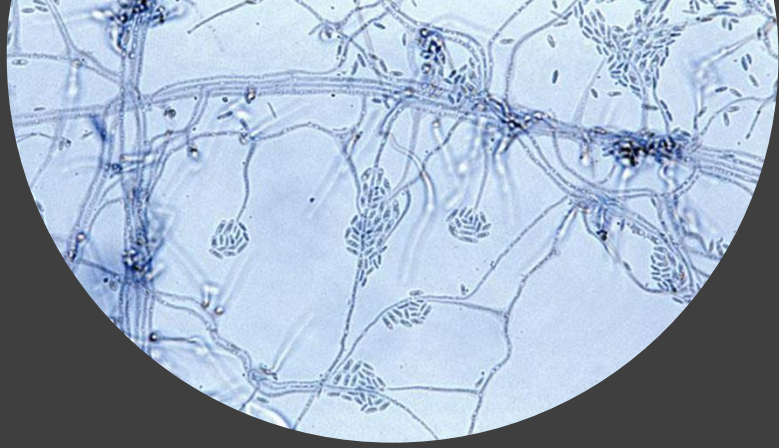


ONICOMICOSE

AGENTES ETIOLÓGICOS

Os agentes etiológicos da onicomicose são fungos dermatófitos, leveduras e fungos filamentosos não-dermatófitos⁴, sendo estes últimos hialinos ou demáceos.

Os fungos dermatófitos são responsáveis por 60%¹² a 85% das infecções². Os fungos filamentosos não-dermatófitos e leveduras também podem acometer as unhas, sendo ambos responsáveis por 30 a 40% das onicomicoses. Fungos filamentosos não-dermatófitos são responsáveis por 20% das infecções fúngicas ungueais²³.

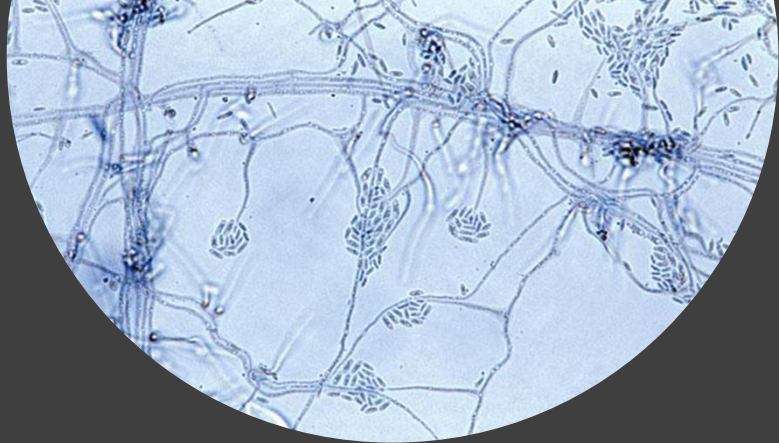


ONICOMICOSE

AGENTES ETIOLÓGICOS

a) Fungos Dermatófitos

De forma geral, os fungos dermatófitos são compostos pelos gêneros *Microsporum*, *Trichophyton* e *Epidermophyton*¹⁷. Devido à sua afinidade aos tecidos queratinizados, são os mais identificados como patogênicos das unhas o *Trichophyton rubrum*, seguido do *Trichophyton mentagrophytes*^{9, 17, 22, 28} em mais de 50% e cerca de 20% dos casos, respectivamente¹².



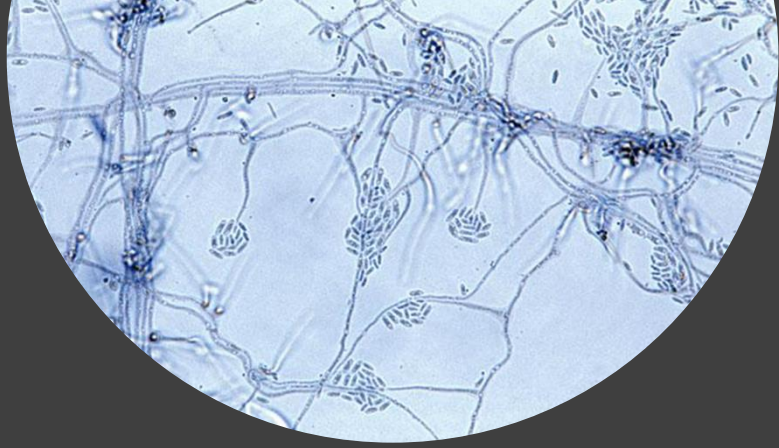
ONICOMICOSE

AGENTES ETIOLÓGICOS

b) Fungos Filamentosos não-Dermatófitos

Os principais agentes envolvidos nesta classe são: *Scopulariopsis brevicaulis*, *Aspergillus spp*, *Acremonium*, *Fusarium spp*, *Alternaria alternata* e *Neoscytalidium*²³. Eles são mais comuns em pessoas com idade entre 40 e 60 anos, em pacientes com dermatoses que afetam as unhas e em pacientes imunocomprometidos¹⁰.

Com exceção das espécies de *Neoscytalidium*, os fungos filamentosos não-dermatófitos não são queratinolíticos. O diagnóstico de onicomicose por fungos filamentosos não-dermatófitos é mais complexa em relação ao diagnóstico de onicomicose por dermatófitos, pois, ao invés de patógenos primários da lâmina ungueal, são frequentemente contaminantes comuns das unhas e do laboratório de micologia⁴, agentes colonizadores, invasores secundários, que acometem unhas previamente doentes ou traumatizadas¹.

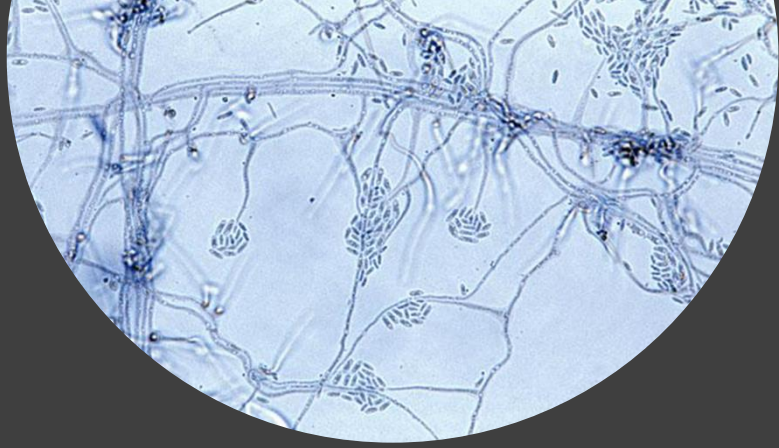


ONICOMICOSE

AGENTES ETIOLÓGICOS

c) Fungos Leveduriformes

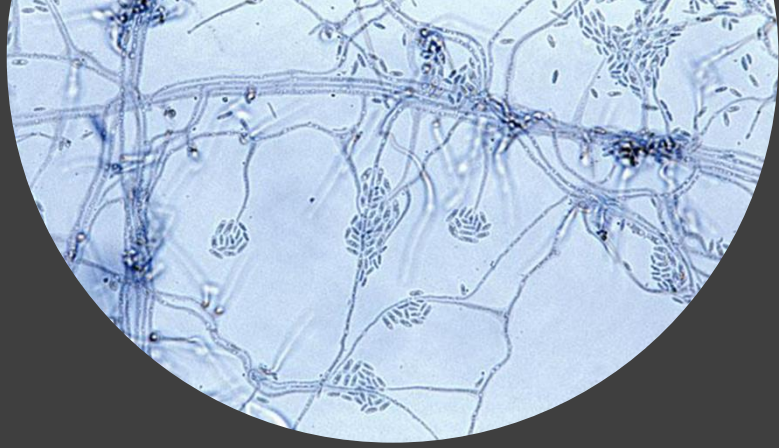
As espécies de *Candida* são responsáveis por 10% a 20% dos casos de onicomicose¹⁵. A onicomicose causada por *Candida sp.* geralmente é acompanhada de paroníquia e ocorre mais frequentemente nas unhas das mãos¹.



ONICOMICOSE

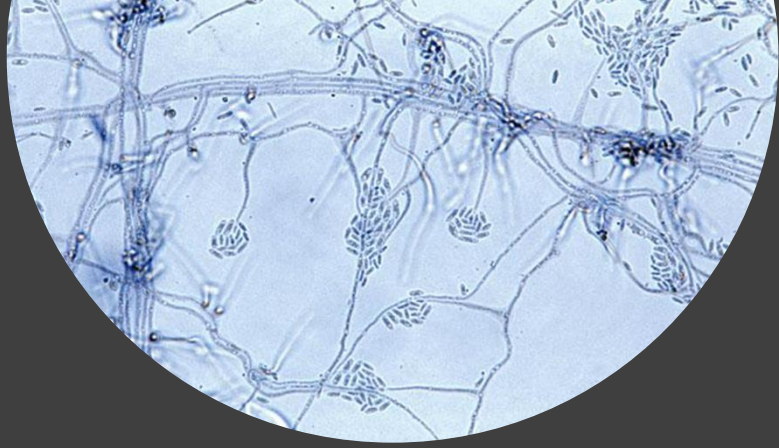
EPIDEMIOLOGIA

A onicomicose é doença cosmopolita frequente e recalcitrante, que acomete aproximadamente entre 5,5%¹² a 10% da população geral, com frequências que variam em diferentes partes do mundo^{2,19}, e continua a se espalhar e persistir². É mais frequente em homens que mulheres, em uma razão 1,5:1² e muito menos frequente em crianças²⁸. De todas as doenças que acometem as unhas, a onicomicose é a mais comum, sendo responsável por metade das afecções ungueais^{3,8,11,14,17}. Essa frequência tem sido relatada como crescente em crianças e também em adultos e idosos, o que pode ser justificado por alguns fatores, como imunossupressão, mudanças no estilo de vida, características ambientais e envelhecimento da população, já que a prevalência da onicomicose aumenta com a idade^{1,25}.



ONICOMICOSE

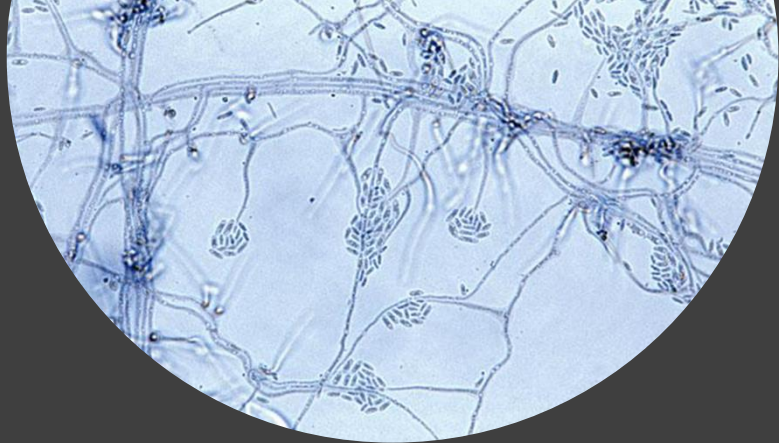
As unhas dos pés são até sete vezes mais acometidas que as unhas das mãos⁵. Isso pois os pés estão em contato direto com reservatórios em que os dermatófitos comumente colonizam; devido ao crescimento da lâmina ungueal dos pododáctilos ser mais lento; pela presença de doenças vasculares subjacentes²⁸; por serem muitas vezes confinados ao ambiente úmido dentro dos calçados e por causa de trauma causado por estes ^{24,27}. O hálux e o quinto pododáctilo são os mais frequentemente acometidos^{1,5}, provavelmente pois os calçados provocam mais danos nestes. O acometimento do hálux ocorre em cerca de 70%².



ONICOMICOSE

FATORES PREDISPOONENTES

Algumas condições podem ser implicadas como fatores predisponentes, ou são associados a uma maior incidência ou prevalência de onicomicose. Estas condições podem ser externas ou internas do indivíduo.

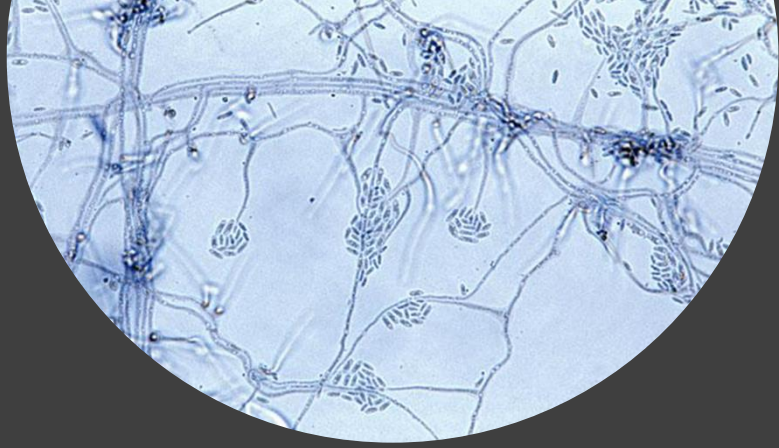


ONICOMICOSE

FATORES PREDISPONENTES

1. Fatores Externos

Os fatores que estão relacionados a um aumento da incidência de onicomicose são clima tropical e úmido, condições de pobreza e superlotação de moradias, traumatismo nas unhas, aumento da exposição a trabalho úmido, andar descalço, frequência de viagem, uso de calçados inadequados e de piscinas comerciais⁵, tipo de ocupação individual, como atletas ou esportistas. Nestes últimos, o aumento da incidência da doença provavelmente ocorre por aumento do trauma ungueal, da transpiração¹ e pelo uso de materiais sintéticos que retêm suor^{13,24}.

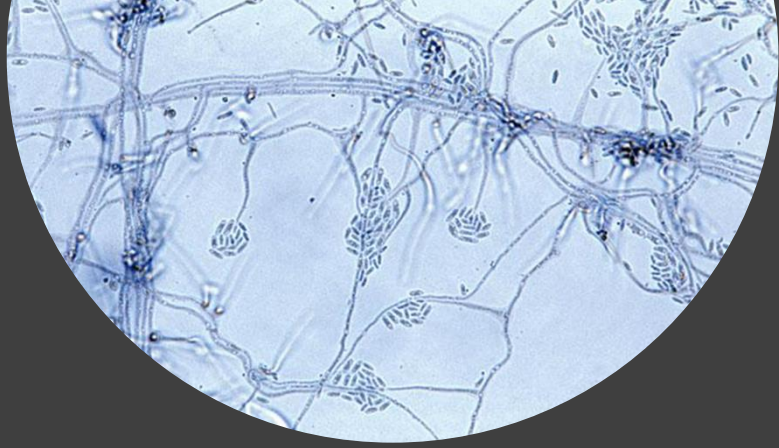


ONICOMICOSE

FATORES PREDISPONENTES

2. Fatores Internos

Consideram-se fatores internos relacionados ao aparecimento de onicomicose as seguintes comorbidades: psoríase ungueal, hiperidrose, imunossupressão, neuropatia periférica, insuficiência vascular periférica, síndrome de Down^{3,12,26,28}. Além desses, são considerados também como fatores predisponentes os que seguem: tinea pedis, idade avançada, diabetes mellitus, infecção pelo HIV e história familiar.



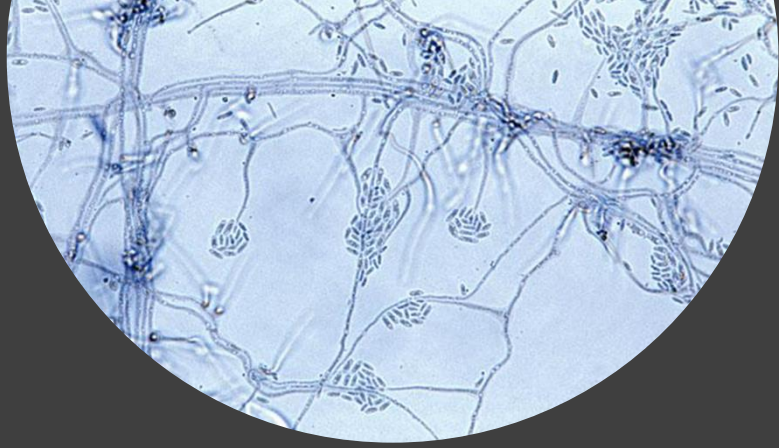
ONICOMICOSE

FATORES PREDISPONENTES

2. Fatores Internos

a. Tinea Pedis

A tinea pedis pode ser considerada como fator predisponente para o desenvolvimento de onicomicose, estando a onicomicose associada a ela em até um terço dos casos¹.



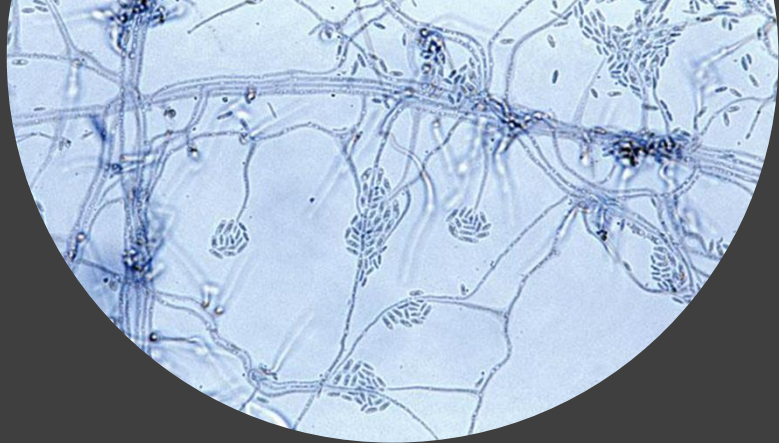
ONICOMICOSE

FATORES PREDISPONENTES

2. Fatores Internos

b. Idade Avançada

Justifica-se a idade avançada como sendo fator predisponente de onicomicose por uma série de fatores, como a diminuição da circulação periférica, inatividade, estado imunitário sub-ótimo, diabetes, crescimento mais lento da lâmina ungueal, dificuldade no cuidado com as unhas e na manutenção da higiene dos pés, lesão frequente nas unhas e aumento da exposição a doenças predisponentes à infecção fúngica¹.



ONICOMICOSE

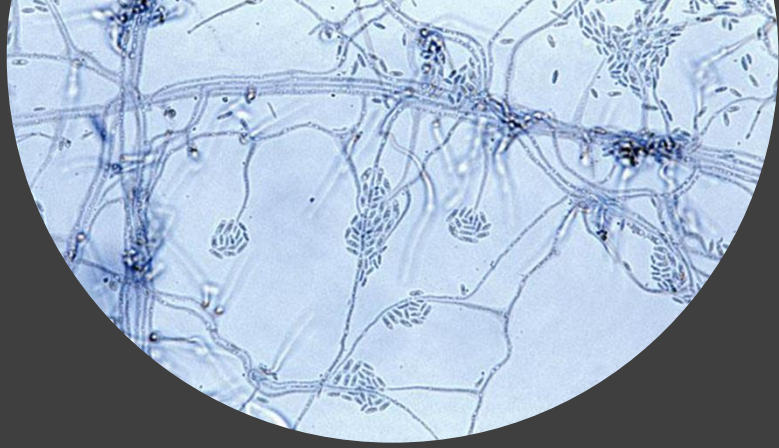
FATORES PREDISPONENTES

2. Fatores Internos

c. Diabetes Mellitus

O diabetes mellitus é um fator de risco importante. Um terço dos pacientes com diabetes são acometidos pela onicomicose. Nestes pacientes, há agravantes com relação à onicomicose, já que a unha doente tem potencial de ferir a pele adjacente, o que pode passar despercebido devido a neuropatia sensorial, e isso pode predispor a osteomielite, úlceras diabéticas⁵ e erisipela.





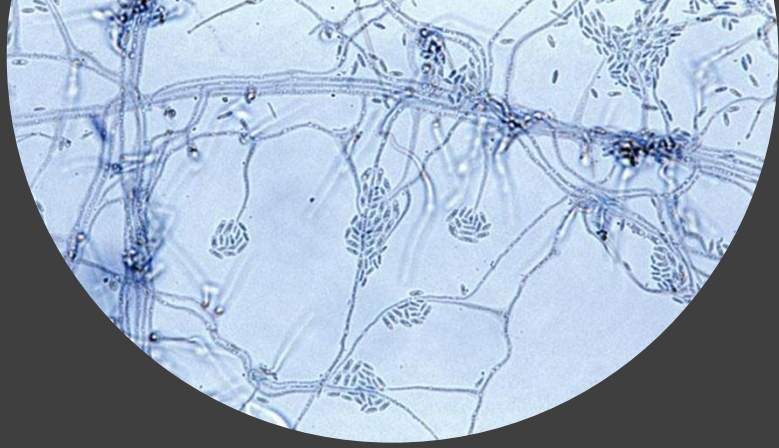
ONICOMICOSE

FATORES PREDISPOONENTES

2. Fatores Internos

d. História Familiar

História familiar de onicomicose também é considerada fator de risco, uma vez que alguns estudos sugerem uma base genética para a suscetibilidade à onicomicose. Vários estudos destacaram risco aumentado para o desenvolvimento de onicomicose em indivíduos em que pelo menos um dos pais tinha onicomicose. Além disso, a infecção por *Trichophyton rubrum* mostrou um padrão familiar de herança autossômica dominante⁷.



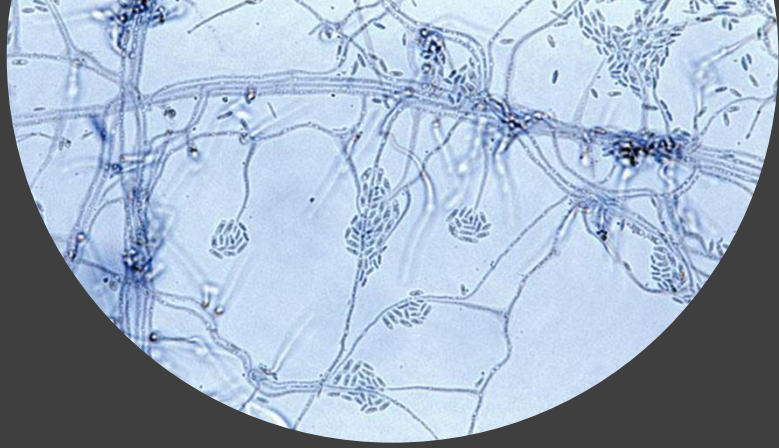
ONICOMICOSE

FATORES PREDISPOONENTES

2. Fatores Internos

e. Infecção pelo HIV

Indivíduos infectados pelo HIV têm um risco aumentado de desenvolver onicomicose quando sua contagem de linfócitos T é tão baixa quanto 400 células mm^3 . A onicomicose, nesses indivíduos, tende a ser mais espalhada⁷.

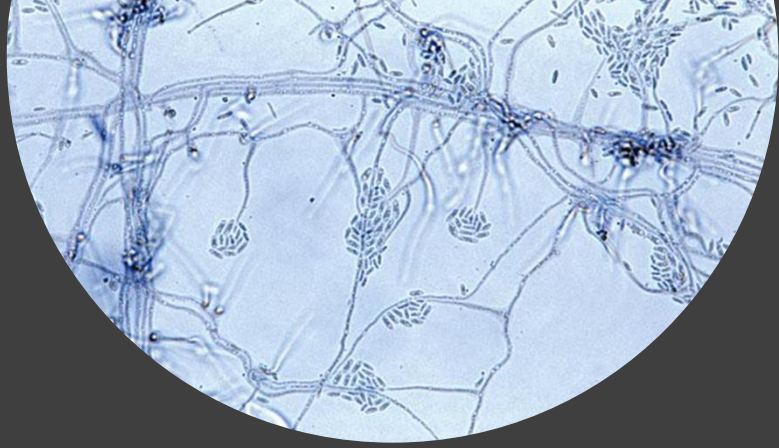


ONICOMICOSE

QUADRO CLÍNICO

a. Onicomiose Subungueal Distal e Lateral

A forma mais frequente é a subungueal distal e lateral ^{1,2,12,24}. Neste tipo, o fungo invade a unha e o leito ungueal ao penetrar as margens distal ou lateral da unha¹. Afeta principalmente o hioníquio e as bordas laterais, vai progredindo proximalmente e causa hiperqueratose subungueal, descoloração da lâmina ungueal, espessamento ungueal e onicólise².

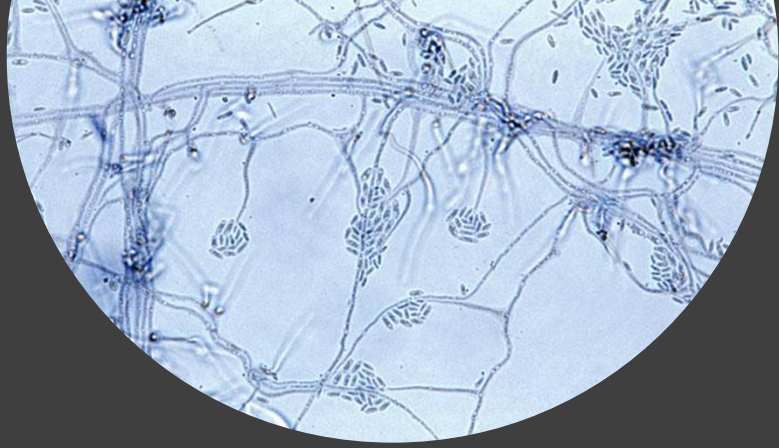


ONICOMICOSE

QUADRO CLÍNICO

b. Onicomicose Subungueal Proximal

A infecção subungueal proximal se desenvolve quando o fungo invade a partir da superfície inferior da dobra ungueal proximal¹². A porção distal da lâmina permanece normal, até que a doença progrida distalmente. Geralmente ocorre nos pododáctilos¹. Está relacionada à imunossupressão¹², acometendo geralmente pacientes com diabetes mellitus, transplantados, pacientes em tratamento hemodialítico, podendo, algumas vezes, ser um indicador de infecção por HIV¹ ou síndrome da imunodeficiência adquirida (SIDA). O principal agente etiológico continua a ser o *Trichophyton rubrum*⁷, entretanto, outros agentes frequentemente encontrados nessa forma clínica são o *Trichophyton schoelleinii* e o *Trichophyton tonsurans*.

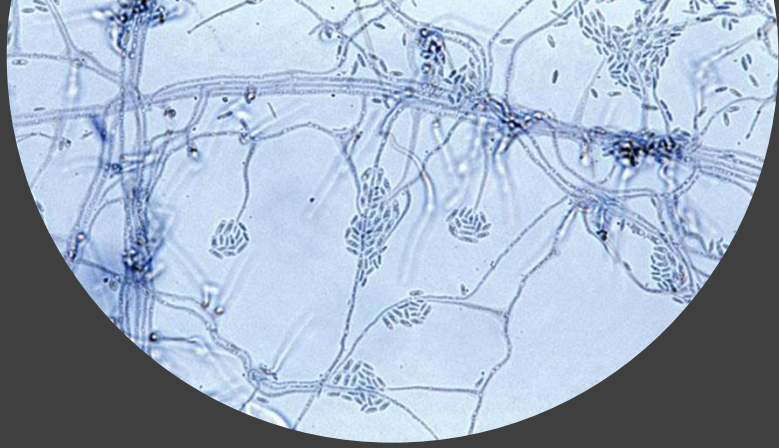


ONICOMICOSE

QUADRO CLÍNICO

c. Onicomicose Superficial Branca

Nesse tipo, a infecção geralmente tem início na camada superficial da lâmina ungueal e se espalha para as camadas mais profundas. Manchas brancas que surgem gradualmente progridem até que toda a lâmina ungueal esteja envolvida¹. Este tipo clínico afeta principalmente o hálux em pequenas áreas ou toda a lâmina ungueal². Ocorre principalmente em crianças¹ e pode, ocasionalmente, estar relacionada à imunossupressão. O agente mais comumente encontrado neste tipo é o *T. mentagrophytes var. interdigitale*^{1,7}.



ONICOMICOSE

QUADRO CLÍNICO

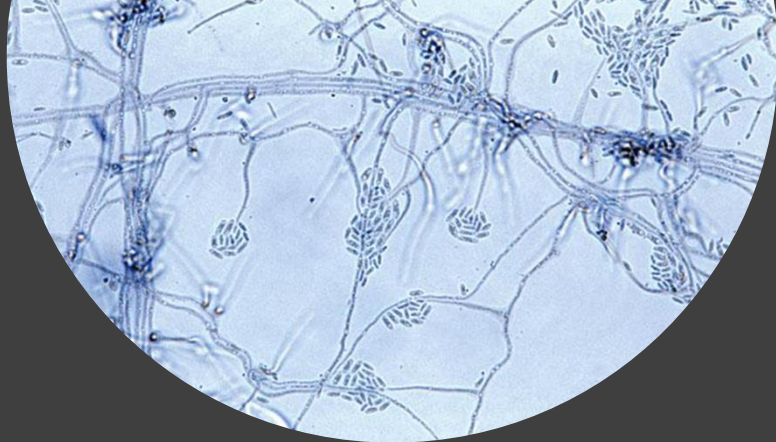
d. Onicomiose Distrófica Total

O tipo distrófica total é a forma mais severa, em que a lâmina ungueal está quase completamente destruída¹. Geralmente representa a evolução do tipo subungueal distal lateral², podendo qualquer forma clínica, entretanto, evoluir para a distrofia total¹.



MENU BIBLIOGRAFIA



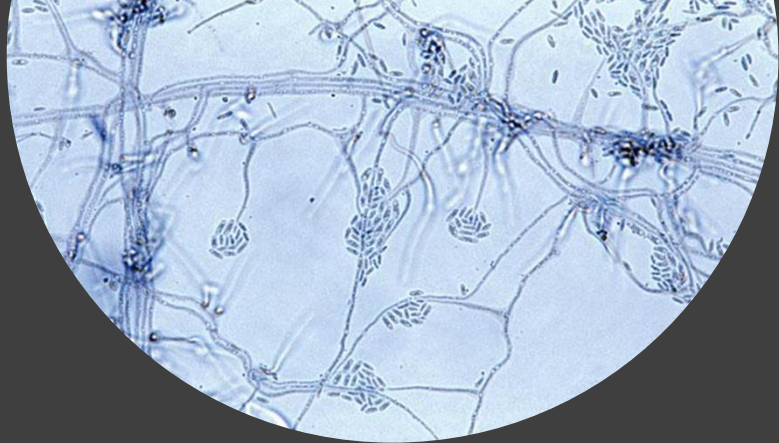


COLETA DO MATERIAL

ORIENTAÇÕES GERAIS

Os pacientes devem ser orientados a remover o esmalte antes do exame¹².

As amostras devem ser coletadas antes de iniciadas terapias antifúngicas locais ou sistêmicas, de forma a evitar resultados falso-negativos. Assim, deve-se aguardar duas semanas sem o uso de antifúngico tópico, ou dois meses em caso de uso de antifúngico sistêmico²⁰.



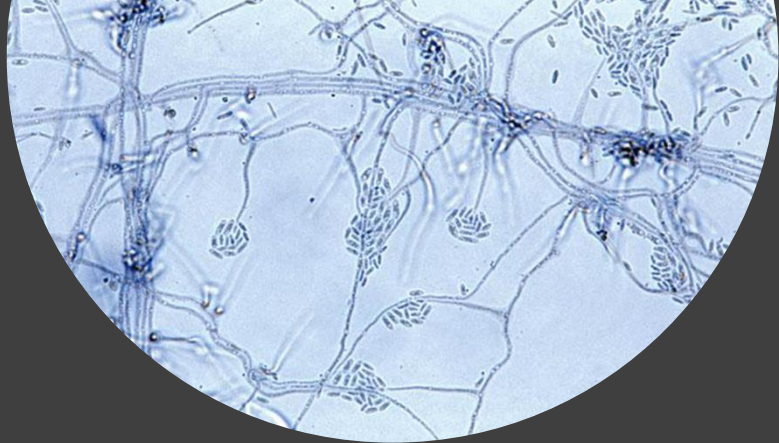
COLETA DO MATERIAL

LOCAL DA COLETA

A forma clínica de apresentação da onicomicose determinará o local da coleta do material¹²:

- Forma subungueal distal: a amostra deve ser coletada na área afetada, na região mais proximal da unha;
- Forma superficial branca: o material deve ser coletado de raspado da superfície clinicamente alterada da unha;
- Forma subungueal proximal: a placa ungueal deve ser suavemente desbridada para coletar os debris de unha subjacentes²¹.





COLETA DO MATERIAL

MÉTODO

- Limpar a lâmina ungueal e a pele ao redor com gaze embebida em álcool etílico 70º⁵. Esse cuidado é realizado para se diminuir o risco de bactérias ou fungos saprófitas contaminantes nas amostras⁶;
- Colher os debris subungueais da região limítrofe entre unha alterada e unha sadia, ou seja, a localização mais proximal, que corresponde à área ativa da lesão¹⁸. Apenas nos casos de suspeita de onicomiose superficial branca, o raspado deve ser feito da superfície da lâmina ungueal, onde está a leuconiquia;
- Debris subungueais distais não devem ser submetidos à cultura porque, muitas vezes, carregam bactérias ou fungos saprófitas contaminantes, que podem facilmente ultrapassar o crescimento dos dermatófitos nos meios de cultura⁸;
- Colher o material por raspagem, com instrumento estéril (utilizamos o esculpador Lecron);
- Quantidade suficiente de material deve ser coletada. Muitas vezes, amostras inadequadas de unhas, em quantidade ou qualidade, levam ao fracasso diagnóstico⁸;
- O material coletado deve ser dividido em duas partes: uma para o exame micológico direto, a outra para a cultura para fungos⁵.

COLETA DO MATERIAL

MATERIAL:

- Esculpidor Lecron
- Álcool 70º
- Gaze
- Luvas



Figura 2. Material para coleta.

COLETA DO MATERIAL

ESCULPIDOR LECRON

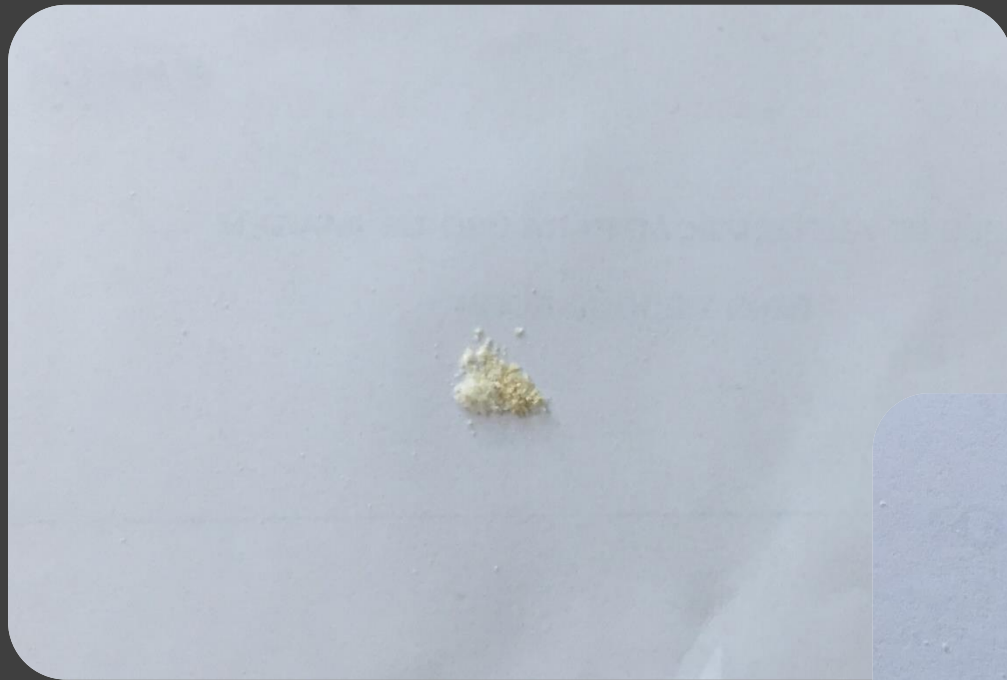


Figura 3. Esculpidor Lecron.

MENU



COLETA DO MATERIAL



MATERIAL COLETADO

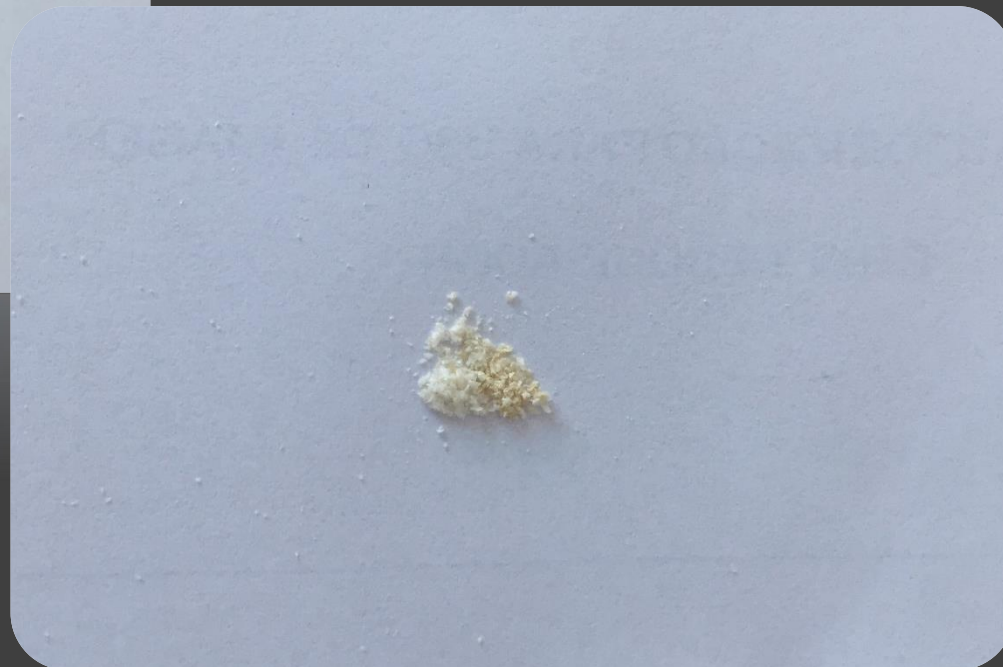
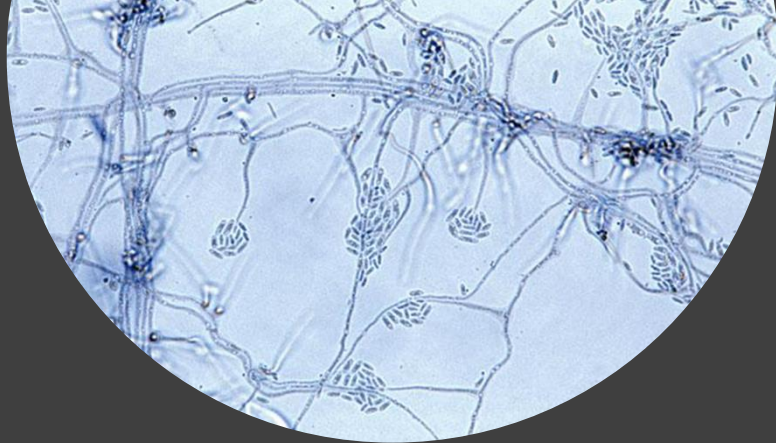


Figura 4. Material coletado.

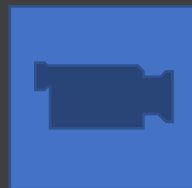
MENU





COLETA DO MATERIAL

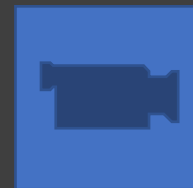
VÍDEOS DE ASSEPSIA



Vídeo 1.



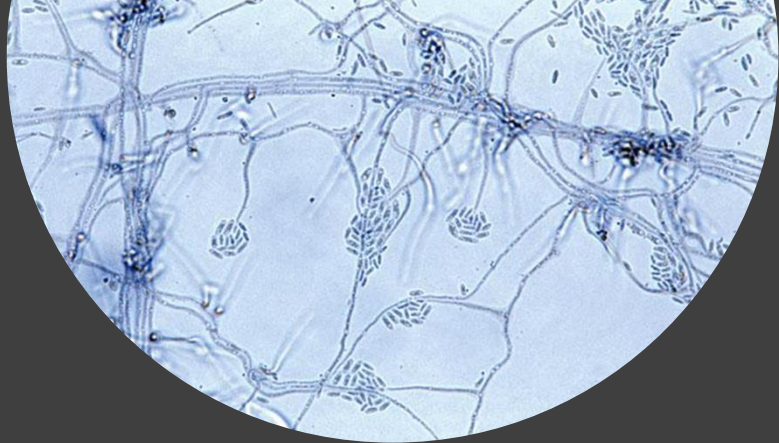
Vídeo 2.



Vídeo 3.

MENU





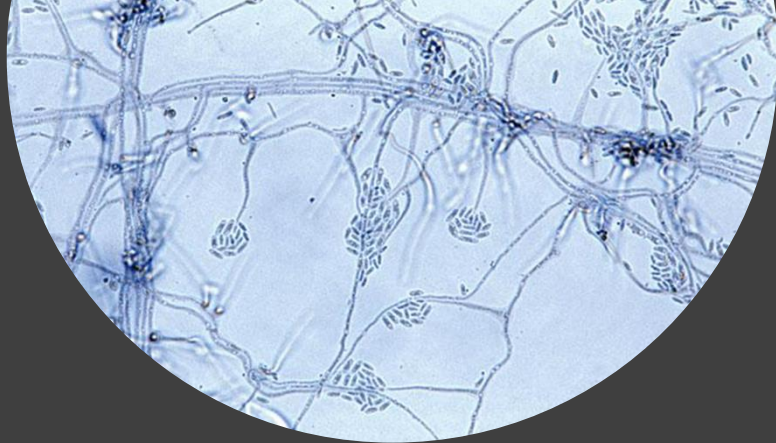
COLETA DO MATERIAL



Vídeo 1. Assepsia.

MENU





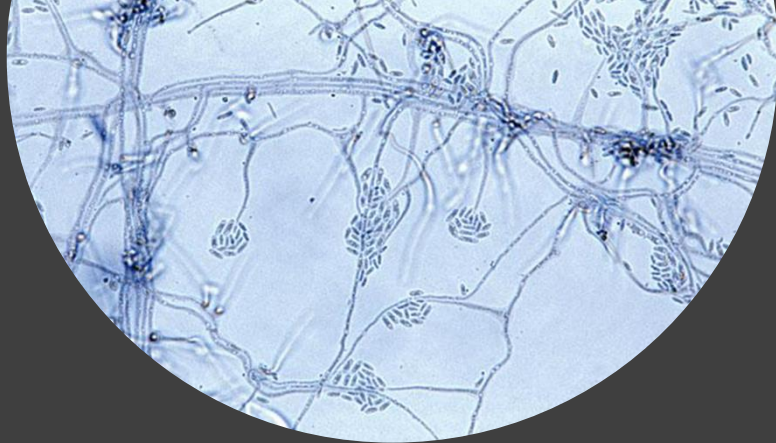
COLETA DO MATERIAL



Vídeo 2. Assepsia.

MENU





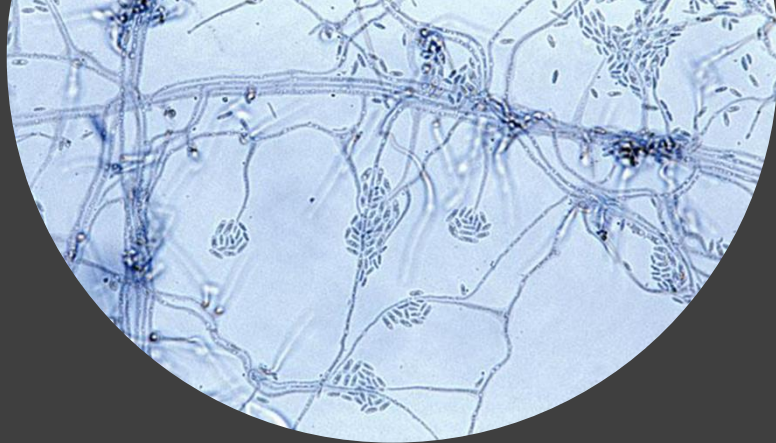
COLETA DO MATERIAL



Vídeo 3. Assepsia.

MENU





COLETA DO MATERIAL

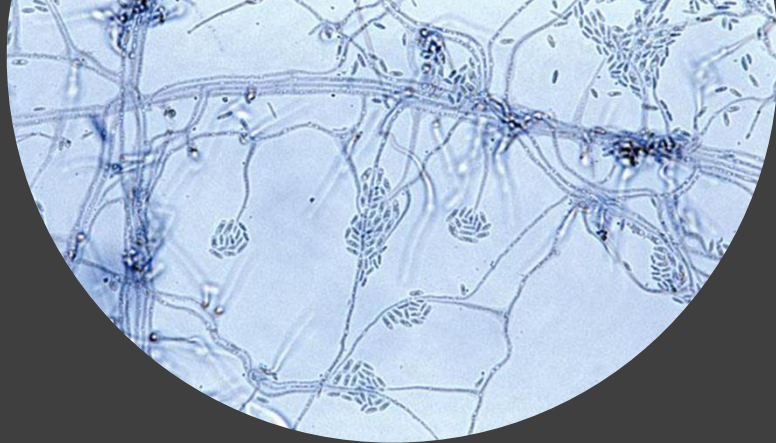
VÍDEOS DE COLETA DO MATERIAL



Vídeo 4.



Vídeo 5.



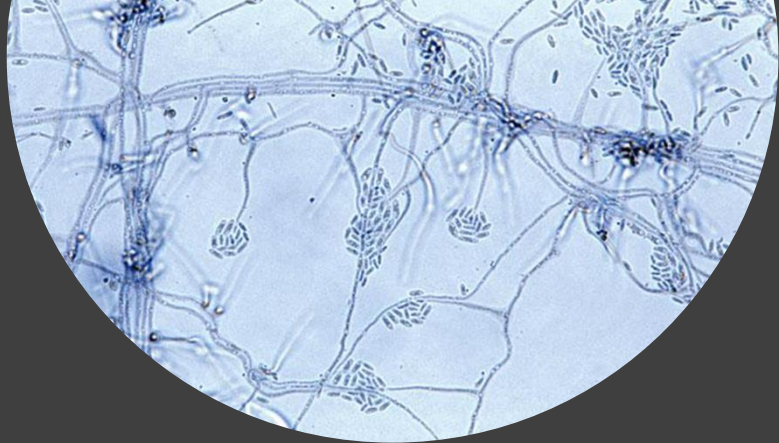
COLETA DO MATERIAL



Vídeo 4. Coleta do material.

MENU



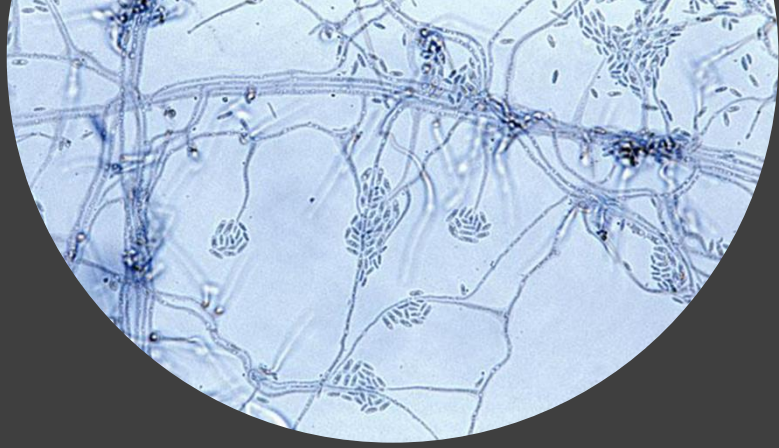


COLETA DO MATERIAL



Vídeo 5. Coleta do material.

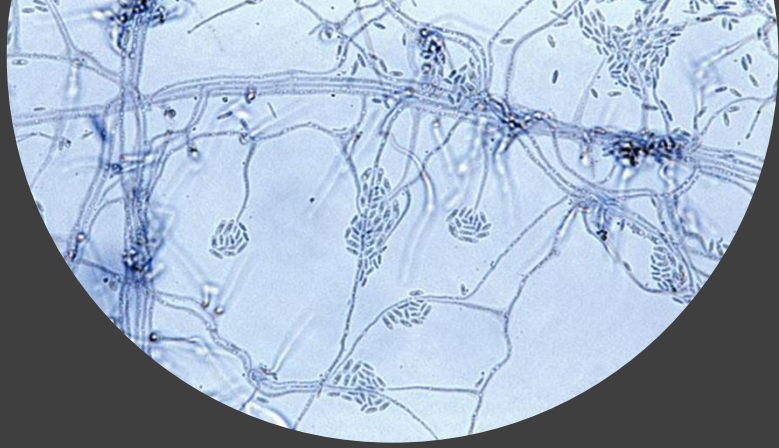




EXAME MICOLÓGICO DIRETO

CARACTERÍSTICAS

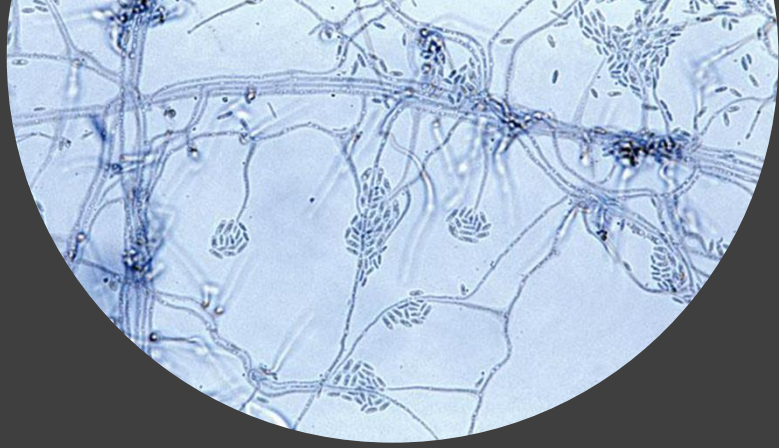
- Barato;
- Viabiliza rapidamente o resultado;
- Permite ao examinador observar hifas indicando que o paciente está infectado por um fungo, mas sem a elucidação etiológica do mesmo;
- A viabilidade fúngica não pode ser determinada. Portanto, os resultados positivos podem ser enganosos se usados para avaliação de cura⁸;
- O resultado do exame direto pode variar consideravelmente, a depender do examinador¹². Considera-se, pois, que há uma subjetividade na microscopia para a identificação;
- Fatores que podem interferir nos resultados são a possibilidade de haver artefatos, contaminantes ambientais, ou em alguns casos, o baixo grau de parasitismo da amostra. Foi relatada alta taxa de falso-negativos, variando entre 5% e 40% em diferentes estudos, devido à baixa visibilidade e distribuição esparsa de hifas na lâmina⁶;
- Parte do material colhido da unha em estudo deve ser destinado para a realização do exame direto. Sua acurácia depende de boa coleta de amostras, preparação e experiência do examinador⁸.



EXAME MICOLÓGICO DIRETO

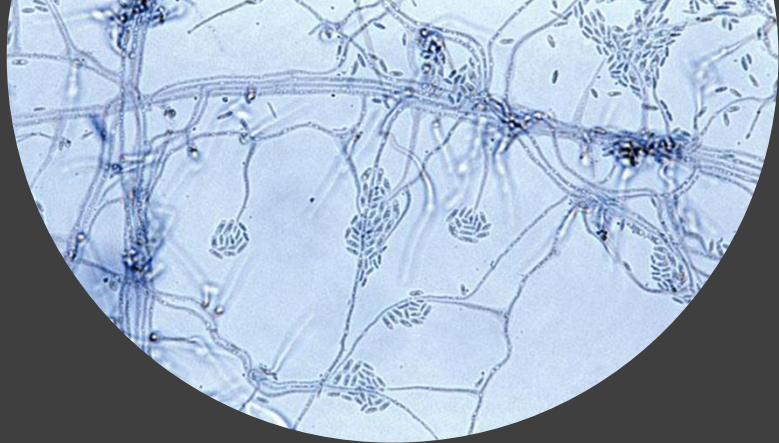
PREPARO DA LÂMINA

- O material coletado é colocado em lâmina e clarificado com uma gota de hidróxido de potássio (KOH) a 10% ou 20%, ou lactofenol de Amann. Isso facilita a visualização dos elementos fúngicos devido à degradação da queratina²⁶;
- A clarificação por KOH é simples e barata, entretanto a análise do material deve ser feita rapidamente, já que a queratina é irreversivelmente degradada;
- O uso do lactofenol de Amann é útil quando o exame direto não será imediatamente realizado²;
- Após a clarificação do material, coloca-se a lamínula e está finalizado o preparo da lâmina, que será analisada em microscópio óptico².

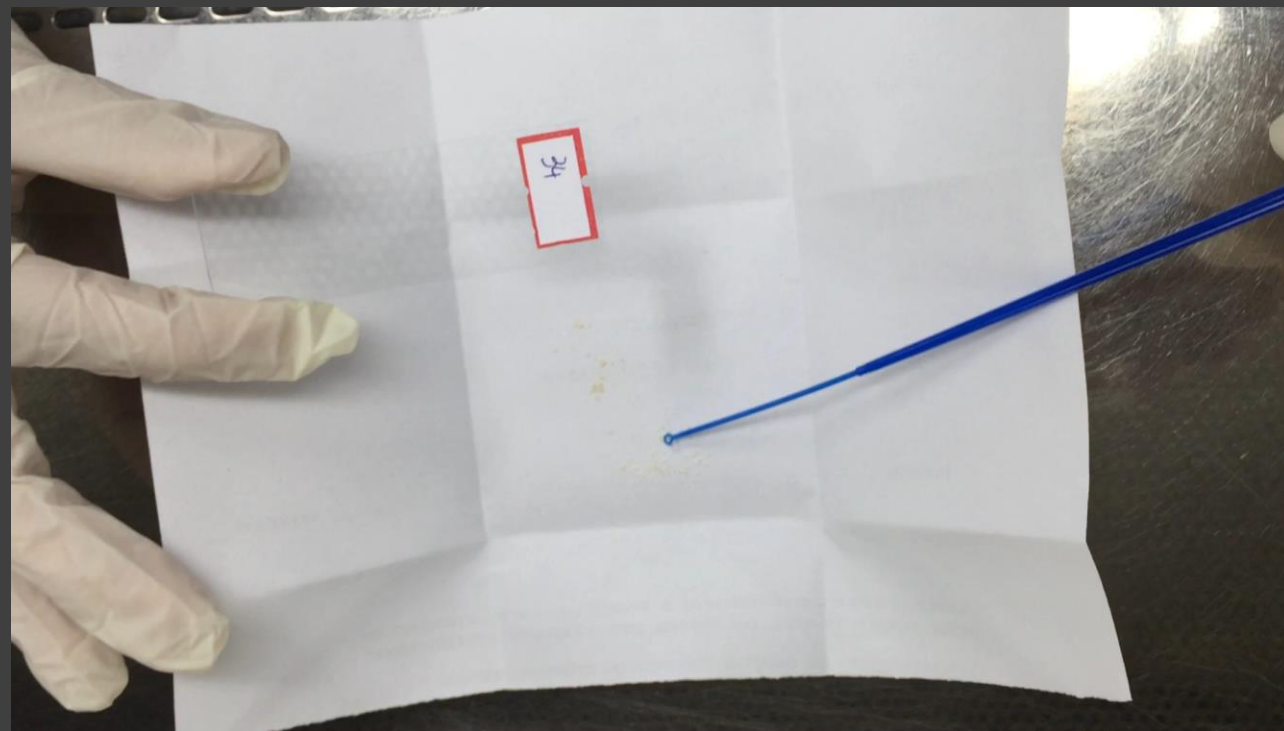


EXAME MICOLÓGICO DIRETO

- O branco de calcoflúor é um agente fluorescente que é misturado com KOH a fim de corar a quitina da parede celular do fungo, tornando elementos fúngicos mais facilmente visíveis sobre o fundo de material celular do hospedeiro;
- Ele se liga aos polissacáridos beta 1-3 e beta 1-4 em celulose e quitina e fluoresce quando exposto à radiação ultravioleta⁸;
- A sensibilidade relacionada ao teste de KOH tradicional é superado usando o calcofluor branco, se um espécime adequado é coletado, embora ambas as técnicas tenham demonstrado eficácia semelhante. No entanto, a necessidade de um microscópio de fluorescência para a utilização desse corante pode ser, muitas vezes, uma barreira para seu uso.



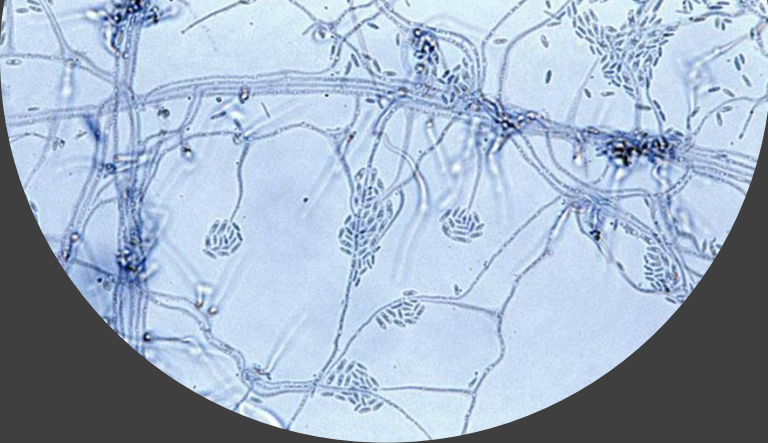
EXAME MICOLÓGICO DIRETO PREPARO DA LÂMINA



Vídeo 6. Preparo da lâmina

MENU





EXAME MICOLÓGICO DIRETO PREPARO DA LÂMINA

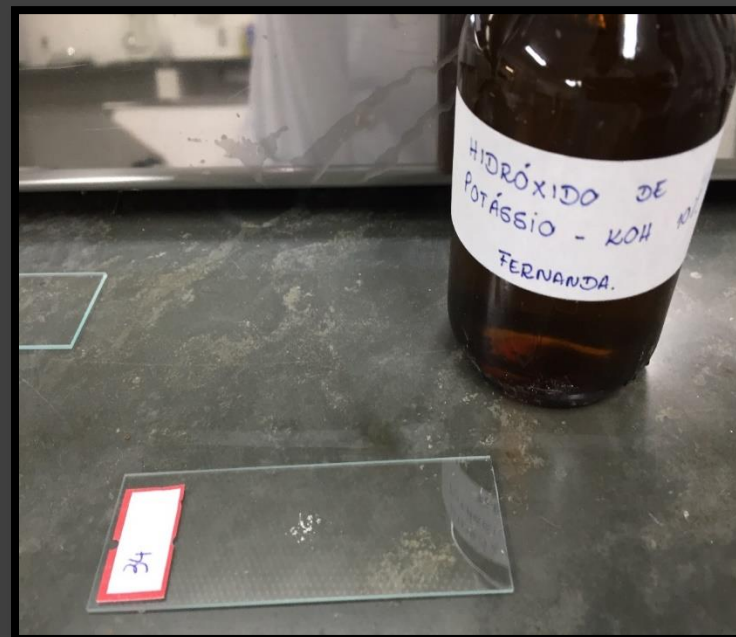


Figura 5. Material colocado na lâmina.

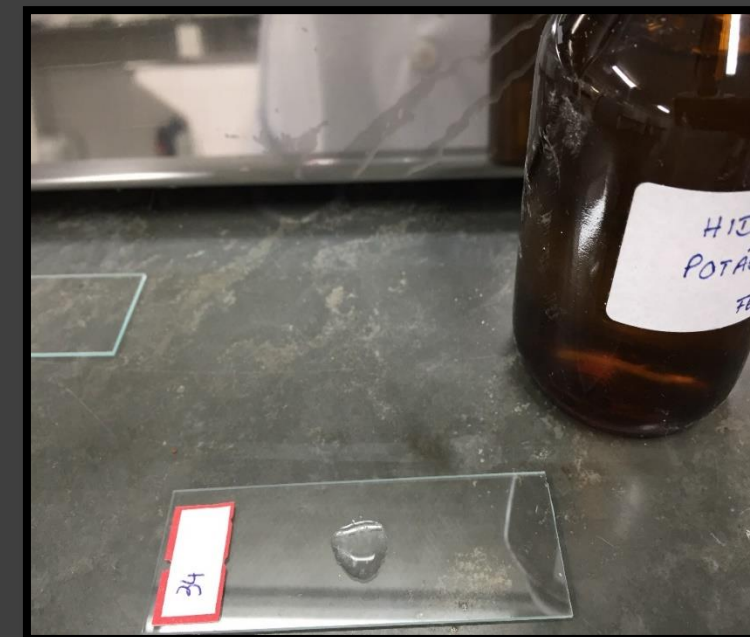
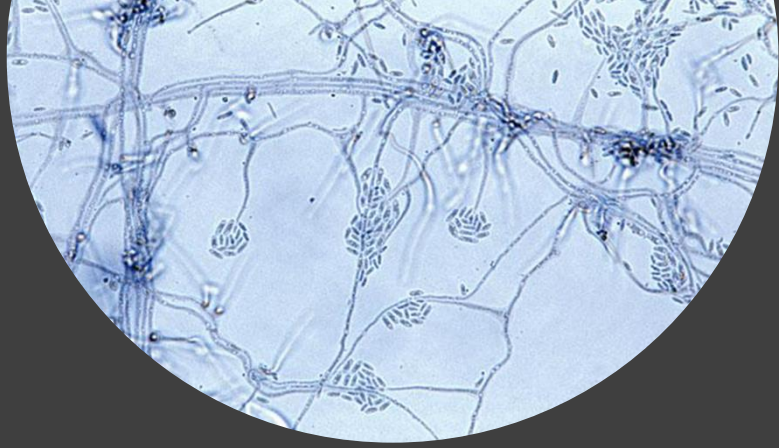


Figura 6. Colocada uma gota de KOH sobre o material. Após esta etapa, colocar a lamínula sobre a lâmina.

MENU

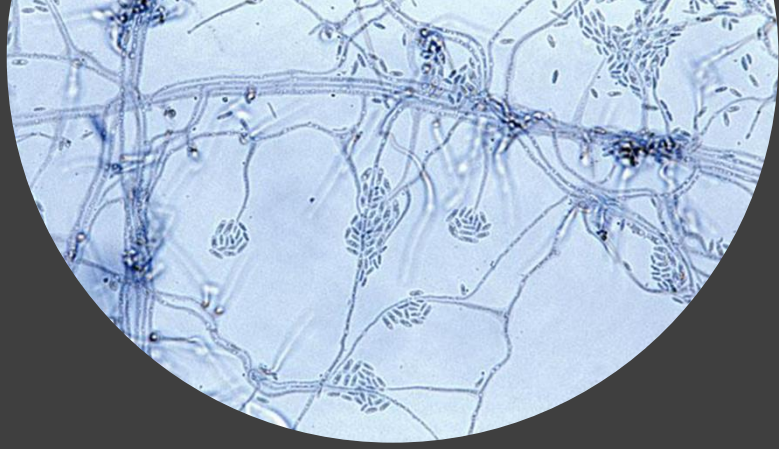




EXAME MICOLÓGICO DIRETO

DIAGNÓSTICO

- A presença de hifas no exame direto confirma o diagnóstico de onicomicose. Além disso, características morfológicas das hifas podem auxiliar no diagnóstico;
- O exame direto dos fungos dermatófitos caracteriza-se pela presença de hifas hialinas, septadas, ramificadas e artroconídios;
- Hifas acastanhadas são características de fungos demáceos. Fungos filamentosos não-dermatófitos apresentam hifas irregulares (ASZ-SIGAL; TOSTI; ARENAS, 2016);
- Exame direto de candidíase caracteriza-se pela presença de hifas hialinas, septadas, pseudo-hifas e blastoconídios.



EXAME MICOLÓGICO
DIRETO

FOTOS DE EXAME DIRETO

MENU



EXAME MICOLÓGICO DIRETO

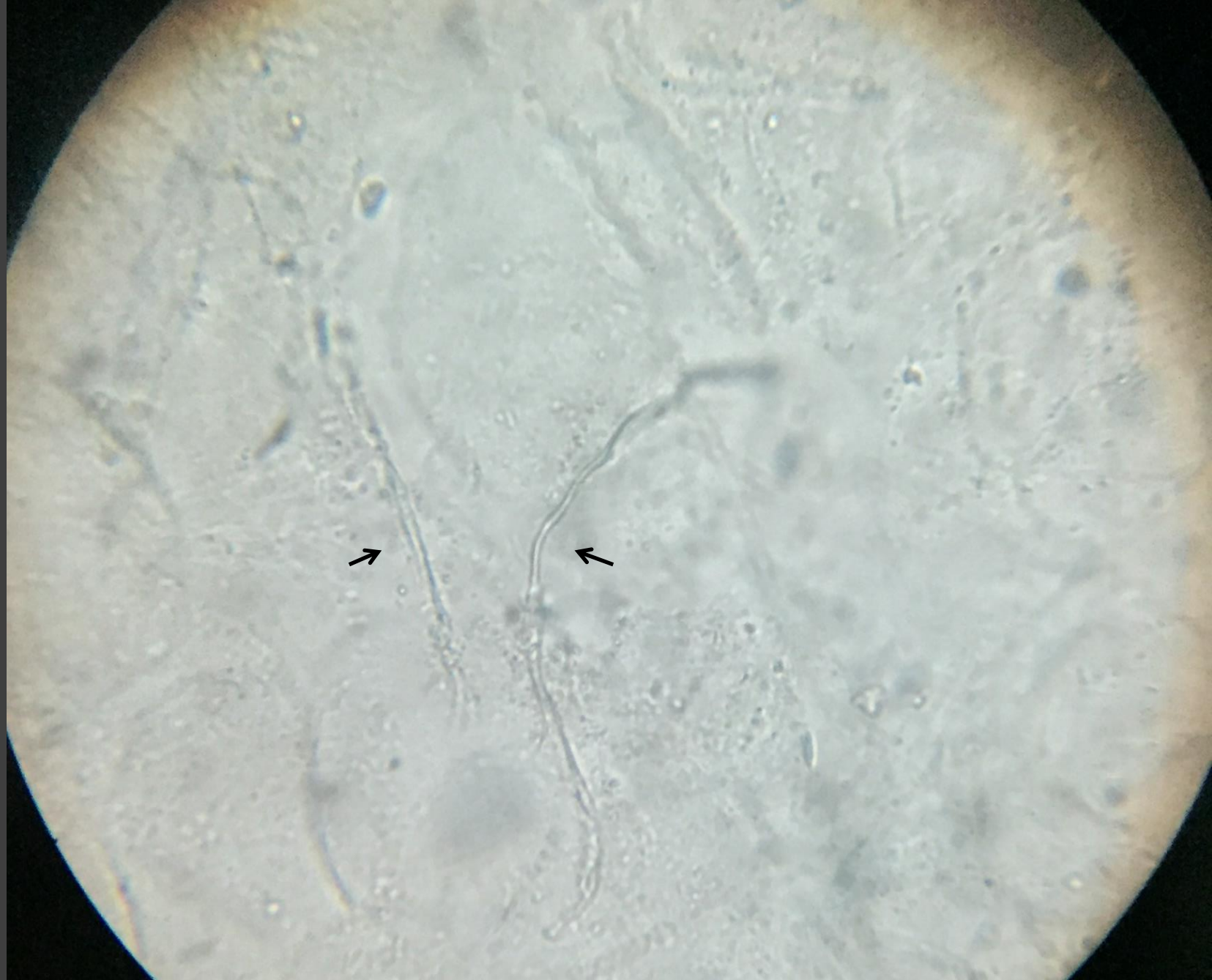


Figura 7. Exame direto de dermatófito: hifas hialinas, septadas, ramificadas e artroconídios.

MENU



EXAME MICOLÓGICO
DIRETO

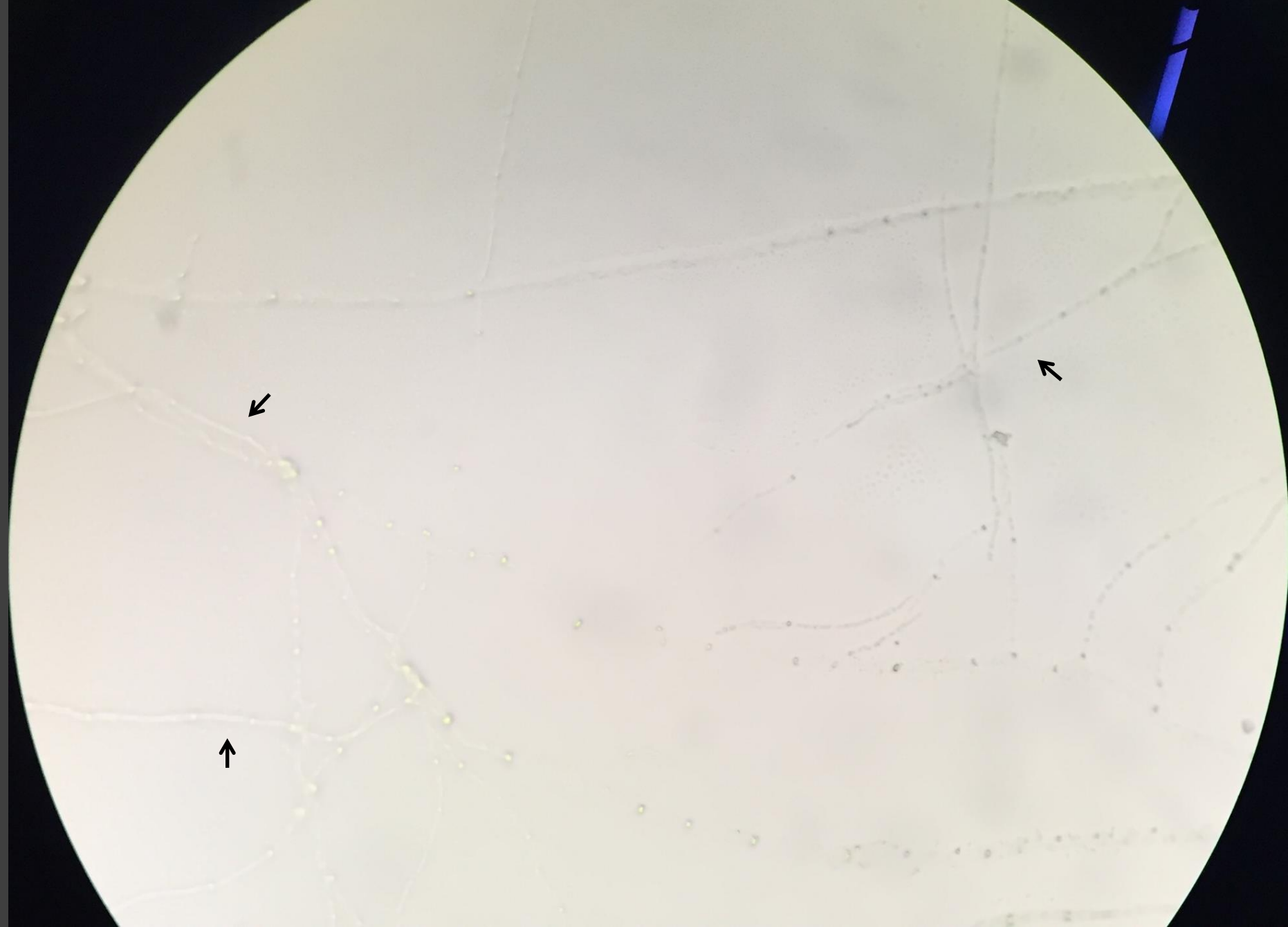


Figura 8. Exame direto de dermatófito: hifas hialinas, septadas, ramificadas e artroconídios.

MENU



EXAME MICOLÓGICO DIRETO

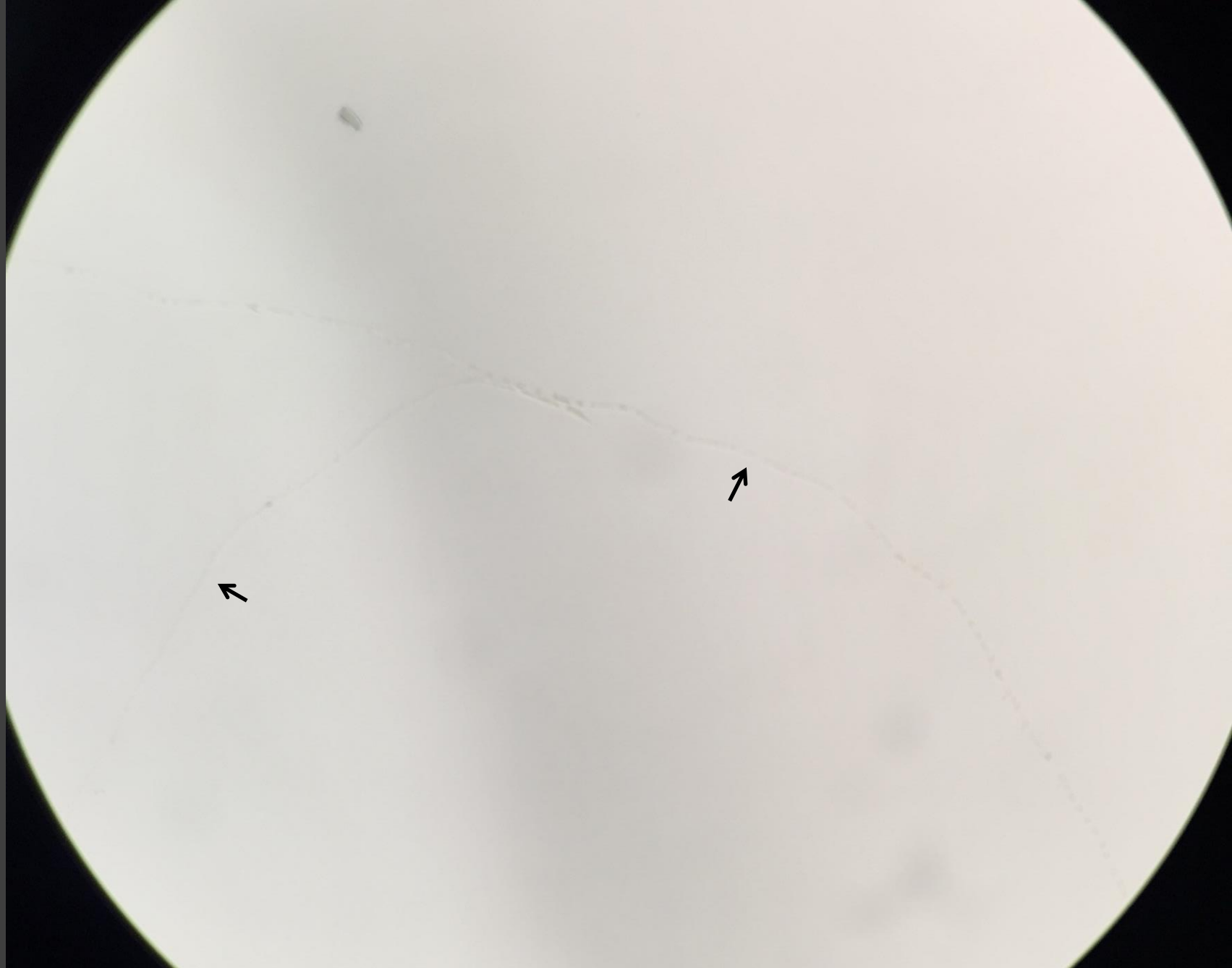


Figura 9. Exame direto de dermatófito: hifas hialinas, septadas, ramificadas e arthroconídios.

MENU



EXAME MICOLÓGICO DIRETO



Figura 10. Exame direto de dermatófito: hifas hialinas, septadas, ramificadas e artroconídios.

MENU



EXAME MICOLÓGICO DIRETO



Figura 11. Exame direto de dermatófito: hifas hialinas, septadas, ramificadas e artroconídios.

MENU



EXAME
MICOLÓGICO
DIRETO



Figura 12. Exame direto de dermatófito: hifas hialinas, septadas, ramificadas e arthroconídios.

MENU



EXAME MICOLÓGICO DIRETO



Figura 13. Exame direto de dermatófito: hifas hialinas, septadas, ramificadas e artroconídios.

EXAME MICOLÓGICO DIRETO

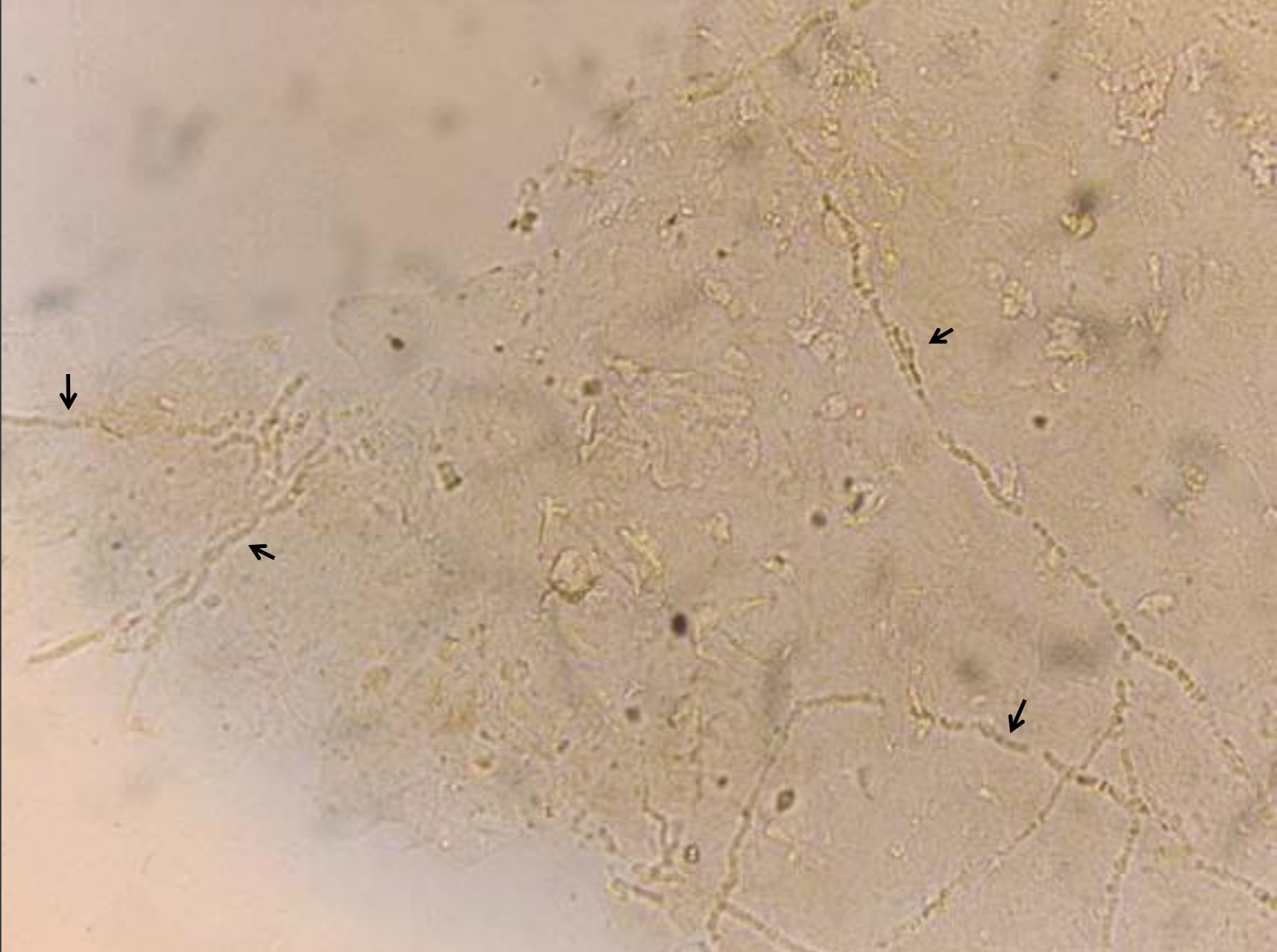


Figura 14. Exame direto de dermatófito: hifas hialinas, septadas, ramificadas e artroconídios. Foto gentilmente cedida pela professora Claudia Maria Pena Dias.

EXAME MICOLÓGICO
DIRETO



Figura 15. Exame direto de dermatófito: hifas hialinas, septadas, ramificadas e artroconídios.

EXAME MICOLÓGICO DIRETO

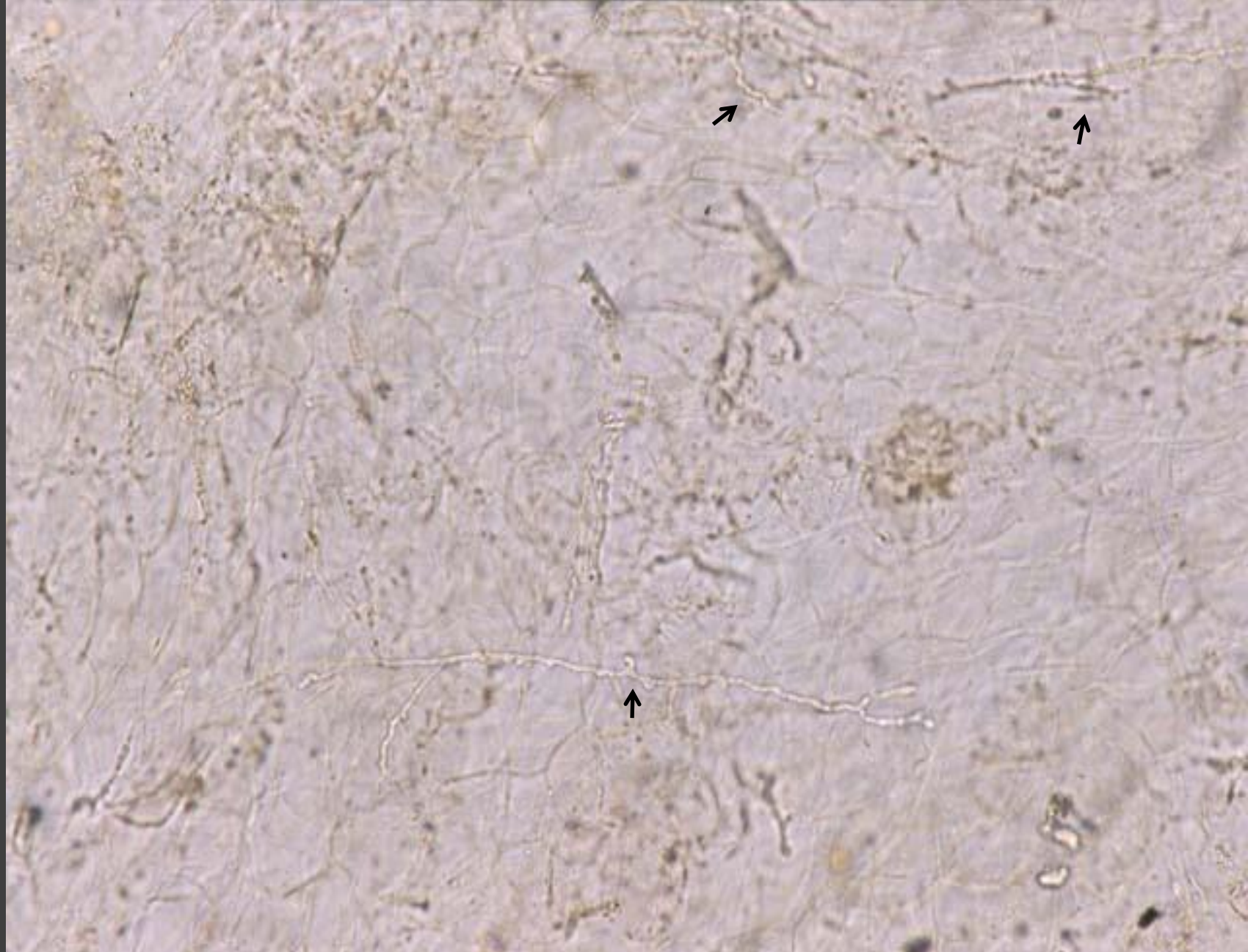


Figura 16. Exame direto de dermatófito: hifas hialinas, septadas, ramificadas e arthroconídios. Foto gentilmente cedida pela professora Cláudia Maria Pena Dias.

MENU



EXAME MICOLÓGICO DIRETO



Figura 17. Exame direto de dermatófito: hifas hialinas, septadas, ramificadas e artroconídios. Foto gentilmente cedida pela professora Claudia Maria Pena Dias.

MENU



EXAME MICOLÓGICO DIRETO

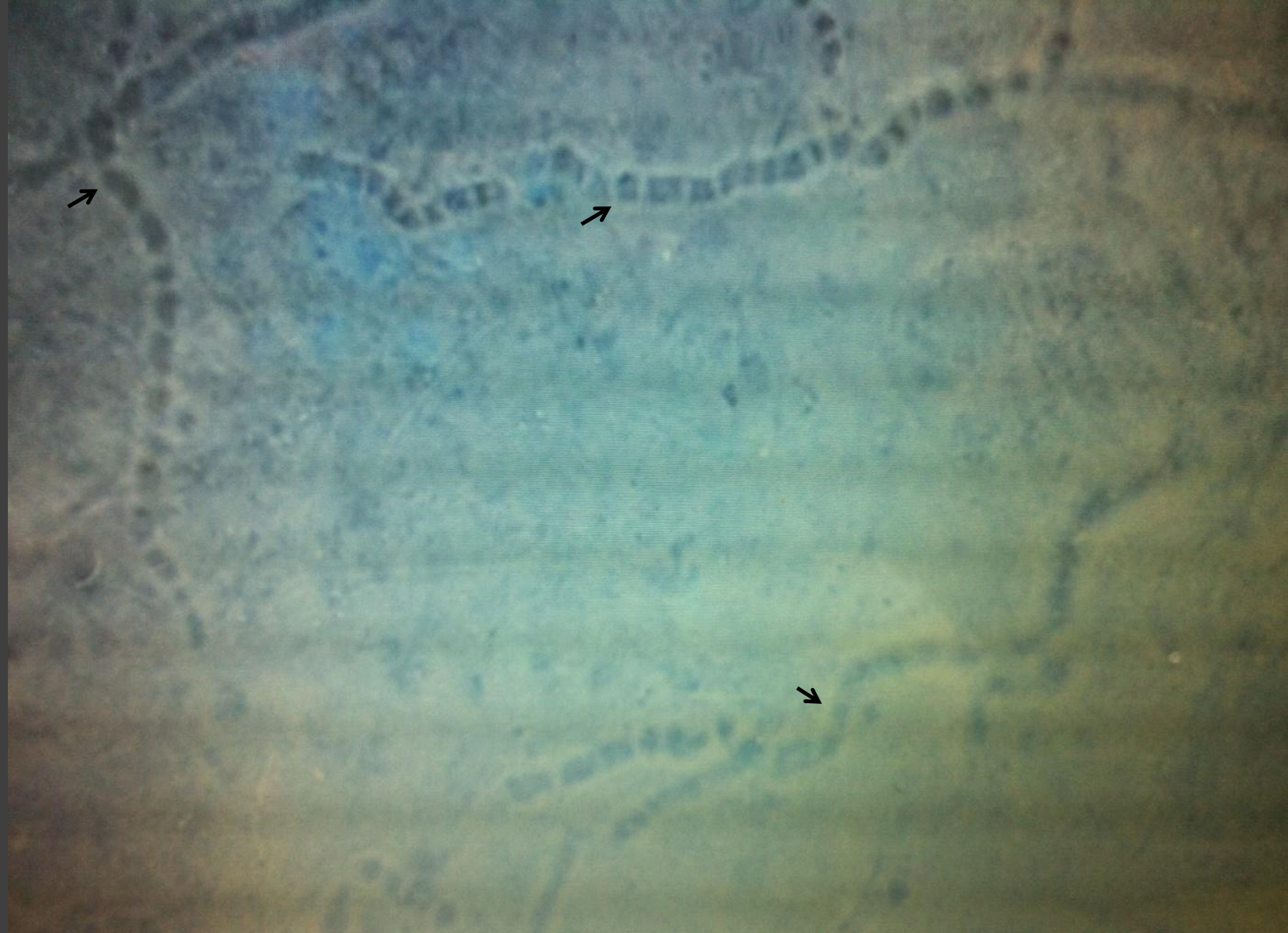


Figura 18. Exame direto de dermatófito: hifas hialinas, septadas, ramificadas e artroconídios. Foto gentilmente cedida pela professora Claudia Maria Pena Dias.

MENU



EXAME MICOLÓGICO DIRETO

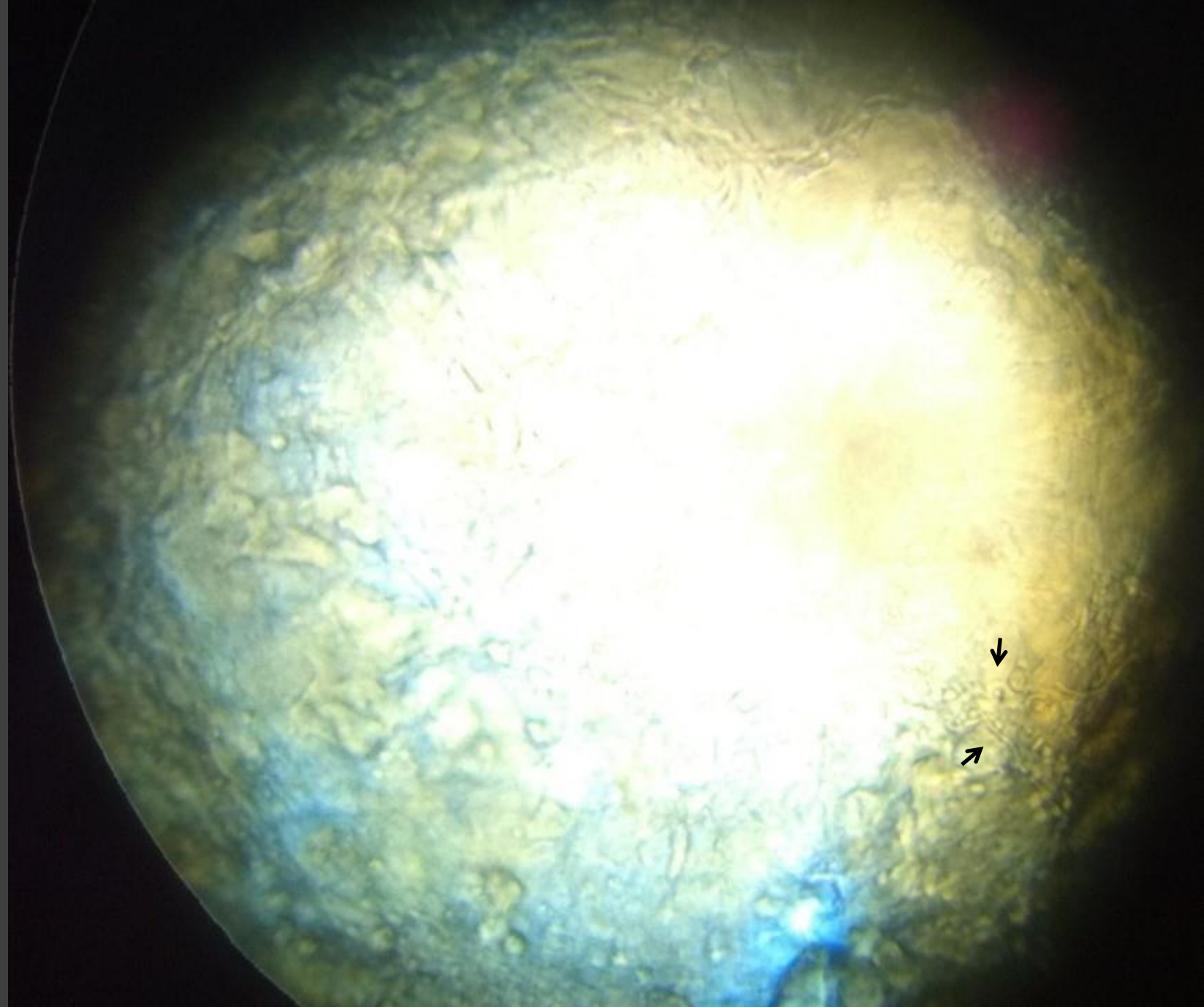


Figura 19. Exame direto de candidíase: hifas hialinas, septadas, pseudo-hifas e blastoconídios.

MENU



EXAME MICOLÓGICO
DIRETO

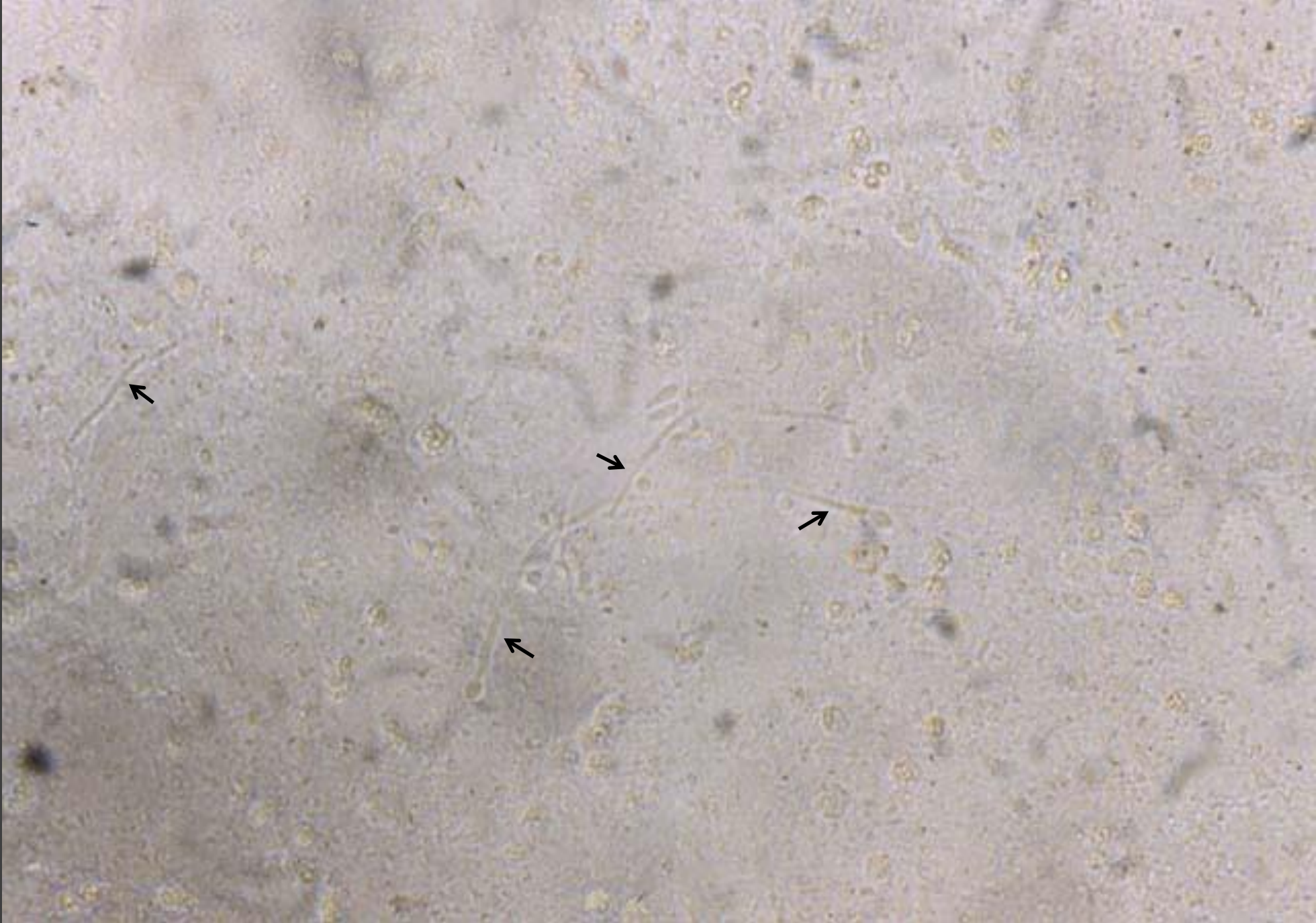
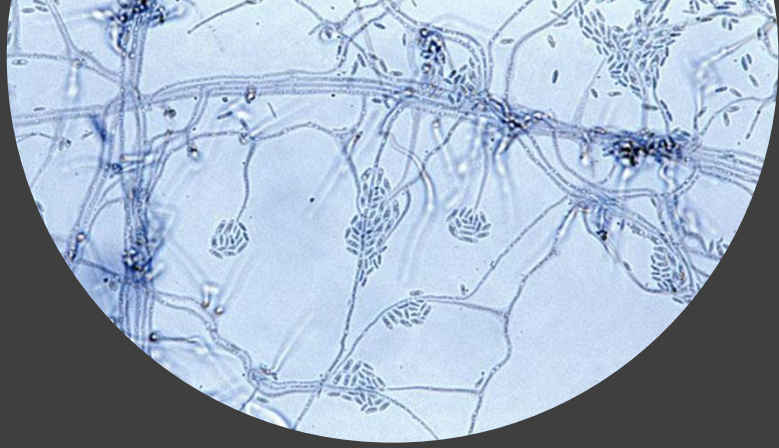


Figura 20. Exame direto de candidíase: hifas hialinas, septadas, pseudo-hifas e blastoconídios.

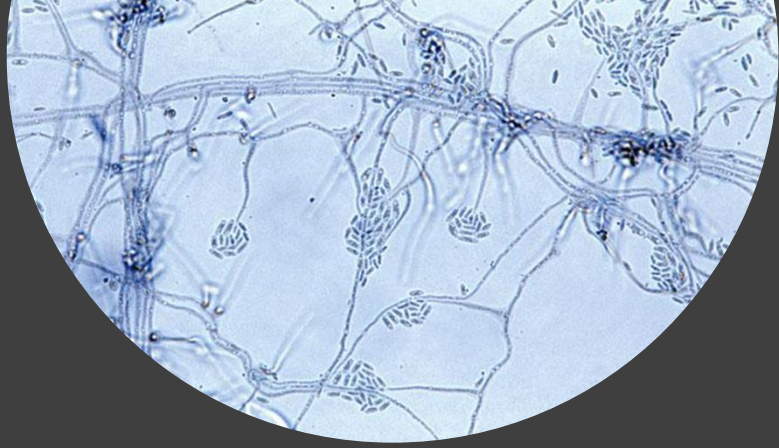




CULTURA PARA FUNGOS

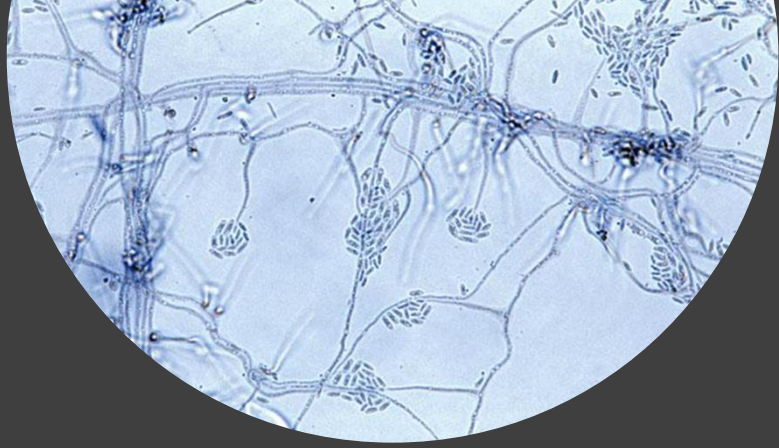
ASPECTOS GERAIS

- Padrão ouro no diagnóstico de onicomicose⁸;
- Necessária para a identificação da espécie de fungo envolvida, sendo um complemento importante tanto para o exame micológico direto, quanto para o exame histopatológico;
- É, atualmente, o único que pode definitivamente identificar o organismo etiopatogênico e sua viabilidade¹²;
- Demorada, requer examinador experiente;
- Estima-se que mais de 30 a 40% sejam falso-negativos²;
- Requer meios adequados, condições de temperatura e fungos viáveis³;
- Quando a suspeição clínica é alta e a cultura for negativa, deve-se repetir este exame⁵.



CULTURA PARA FUNGOS

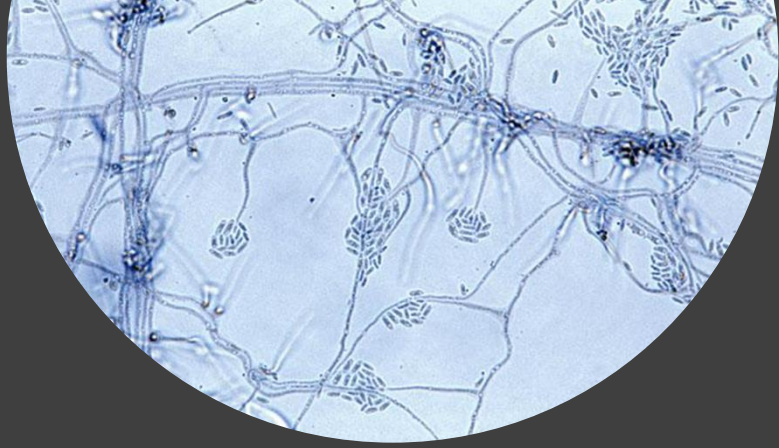
- Podem ocorrer divergências entre os resultados dos exames direto e cultura. Muitas vezes, exames diretos positivos são seguidos de culturas negativas;
- Resultados falso-negativos:
 - amostragem insuficiente;
 - pouco tempo de incubação do material nos meios de cultura;
 - acondicionamento dos meios em temperatura inadequada;
 - uso de antifúngicos antes da coleta do material (redunda em hifas não viáveis, que são observadas nos exames diretos, entretanto que não crescem no meio de cultura);
 - presença de contaminantes no meio, que impedem o crescimento da colônia.



CULTURA PARA FUNGOS

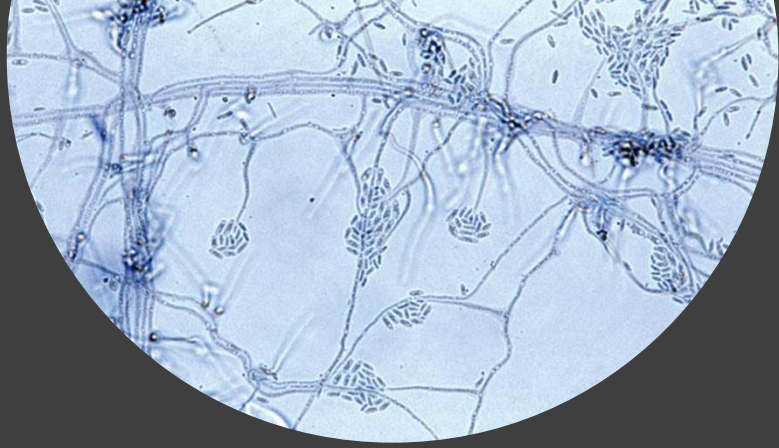
MEIOS DE CULTURA

- Os mais comumente utilizados são o ágar Sabouraud com cloranfenicol ou ágar Sabouraud com cloranfenicol e ciclo-heximida (Mycosel);
- Cloranfenicol: papel de evitar o crescimento de bactérias contaminantes;
- O meio com ciclo-heximida evita o crescimento de fungos saprófitas e fungos filamentosos não dermatófitos e favorece o crescimento de fungos dermatófitos;
- O meio sem a ciclo-heximida favorece o crescimento de fungos filamentosos não-dermatófitos⁶;
- A contaminação da amostra por fungos oportunistas ou bactérias pode comprometer o correto diagnóstico³.



CULTURA PARA FUNGOS

Quando for identificado na cultura fungo filamentosos não-dermatófito, como *Fusarium sp.*, *Aspergillus sp.*, *Penicillium sp.* e *Alternaria sp.*, devem ser realizadas, no mínimo, três culturas repetidas, sendo o material coletado em momentos distintos, para que seja confirmada onicomicose por fungo não dermatófito.



CULTURA PARA FUNGOS

SEMEADURA, ACONDICIONAMENTO DO MEIO DE CULTURA E LEITURA
DOS RESULTADOS

MENU



CULTURA PARA FUNGOS

- O material reservado para a cultura deverá ser coletado com alça estéril e colocado com suave afundamento no meio e, outra parte, deixado na superfície;
- Acondicionar os meios em temperatura de 20-25°C;
- O tempo de espera para se verificar o crescimento de colônia fúngica é de até quatro semanas, sendo que o tempo de 17 dias já é suficiente para o diagnóstico de fungos dermatófitos nas culturas²⁰;
- A leitura do resultado é realizada através da análise da macromorfologia e micromorfologia da colônia, que são características para cada espécie;
- A identificação morfológica das espécies de dermatófitos em culturas é por vezes difícil ou incerta, pois há variações de um fungo isolado para outro, e sobreposição de caracteres entre as espécies.

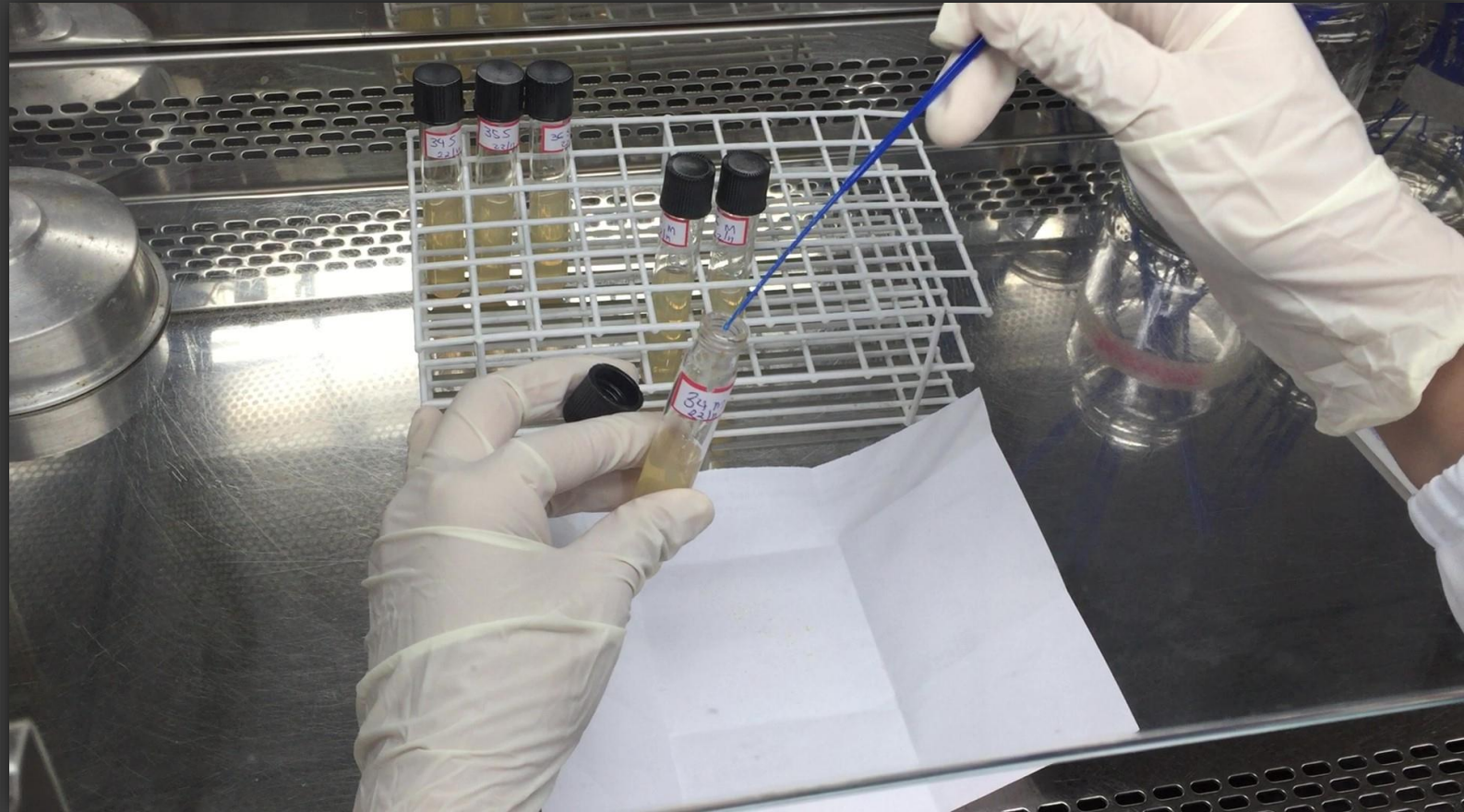
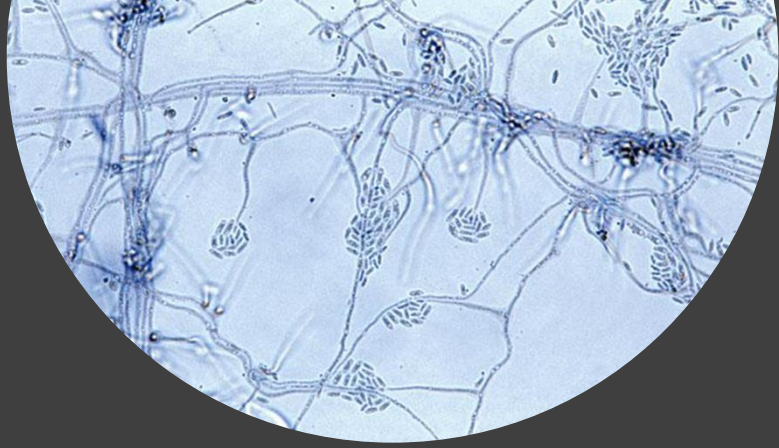


Figura 21. Semeadura do meio de cultura.



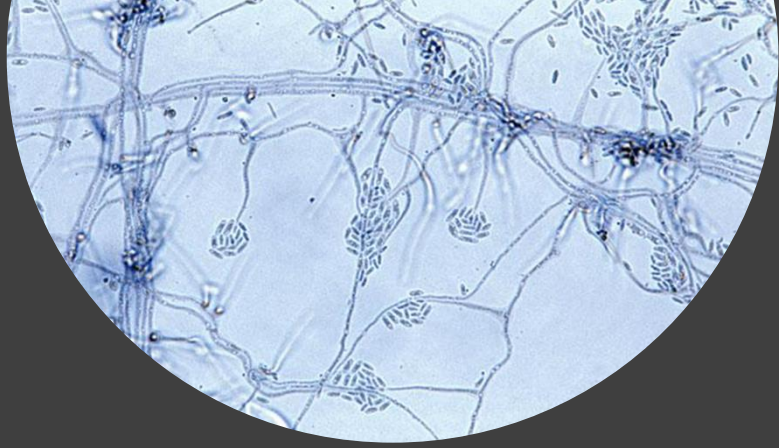
CULTURA PARA FUNGOS

MACROMORFOLOGIA

- Os aspectos macromorfológicos da colônia são utilizados para a identificação da espécie de fungo envolvida.

MICROMORFOLOGIA

- Coletar uma porção pequena da cultura e colocar sobre lâmina;
- Corar com uma gota de Azul de Algodão ou Azul de Toluidina;
- Cobrir com lamínula;
- Observar no microscópio óptico as características micromorfológicas da colônia.



CULTURA PARA FUNGOS

CULTURAS

MENU



CULTURA PARA FUNGOS

Acremonium sp

MACROMORFOLOGIA DA COLÔNIA

A colônia de *Acremonium sp.* caracteriza-se por micélio aéreo membranoso, bege, com superfície ligeiramente pregueada, com espículas centrais, verso incolor.



Figura 22. Colônia de *Acremonium sp.*

CULTURA PARA FUNGOS

Acremonium sp

MICROMORFOLOGIA DA COLÔNIA

Caracteriza-se por hifas hialinas, septadas e ramificadas, com conidióforo longo disposto na hifa. Conídios alongados, fusiformes, se agrupam no ápice do conidióforo.

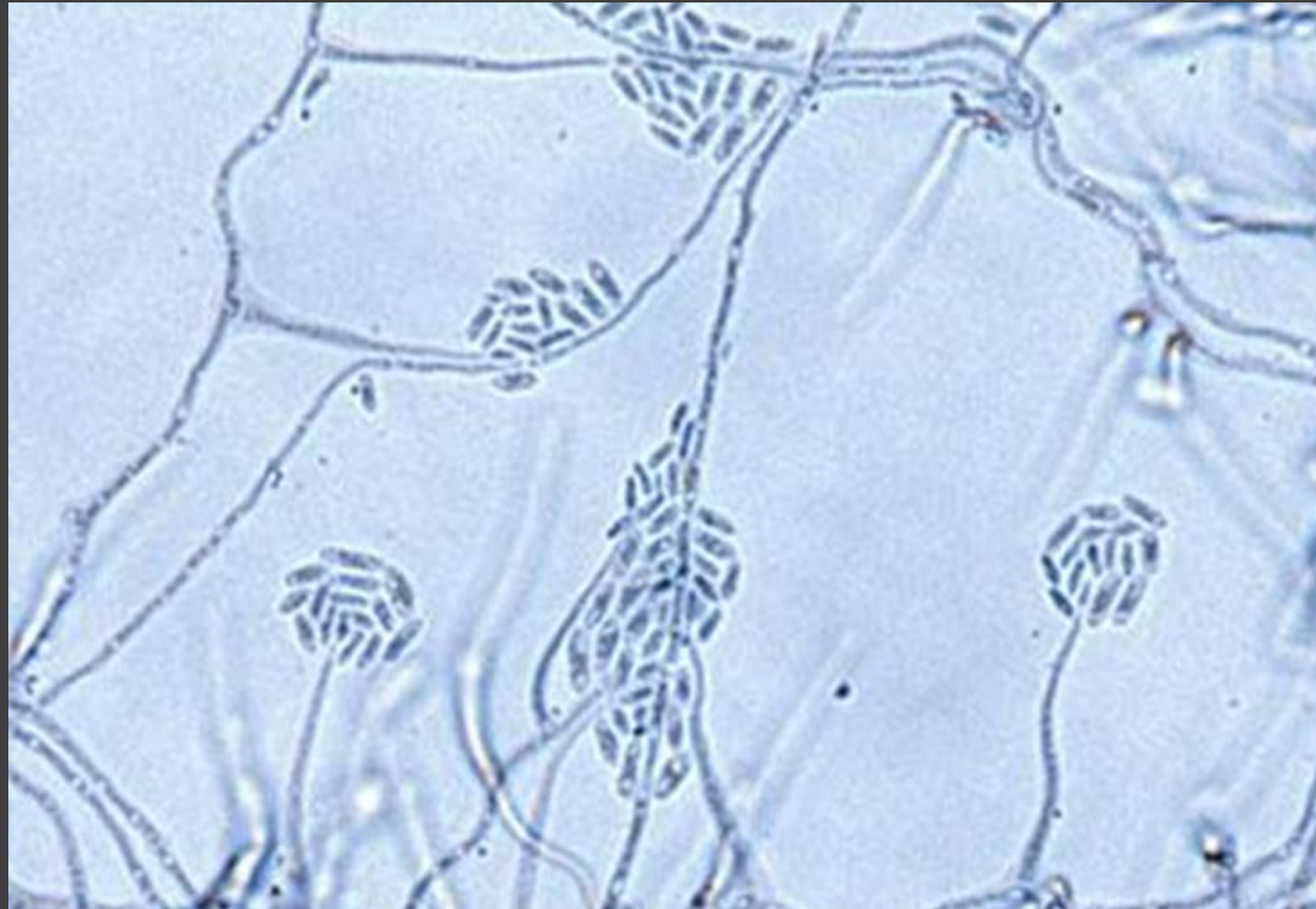


Figura 23. *Acremonium sp.*, micromorfologia da colônia.

CULTURA PARA FUNGOS

Aspergillus flavus

MACROMORFOLOGIA DA COLÔNIA

A colônia de *Aspergillus flavus* caracteriza-se por micélio aéreo grosseiramente granuloso, esverdeado, verso incolor.



Figura 24. Colônia de *Aspergillus flavus*.

CULTURA PARA FUNGOS

Aspergillus flavus

MICROMORFOLOGIA DA COLÔNIA

Caracteriza-se por hifas hialinas, septadas, ramificadas, com conidióforo composto por vesícula, de onde partem as fiálides. Das fiálides partem cadeias de conídios redondos.

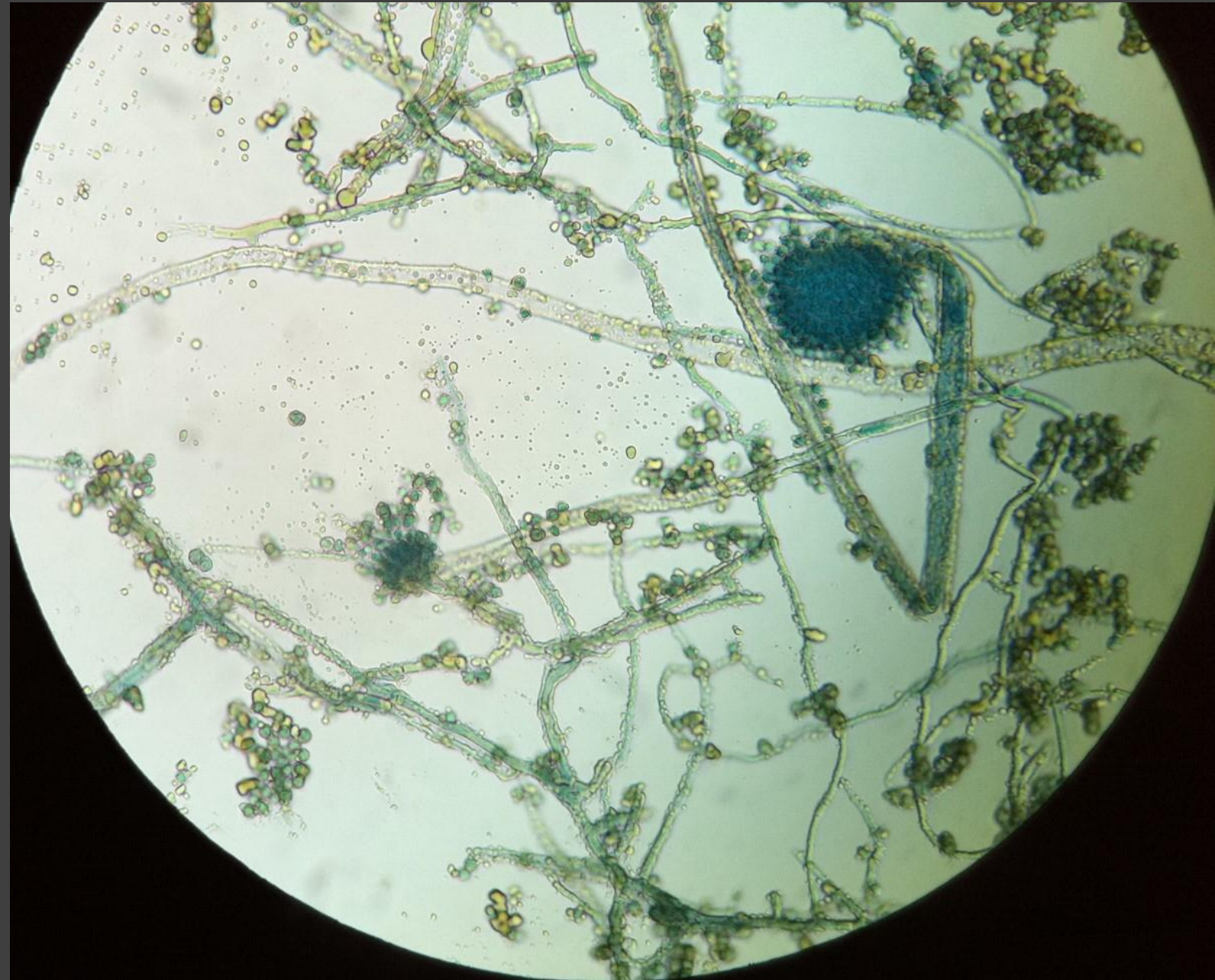


Figura 25. *Aspergillus* sp., micromorfologia da colônia.

MENU



CULTURA PARA FUNGOS

Candida sp.

MACROMORFOLOGIA DA COLÔNIA

Caracteriza-se por superfície cremosa, leveduriforme, bege, lisa ou finamente rugosa, com ou sem filamentos visíveis no meio de cultura, opaca, semelhante a “pingo de vela”.

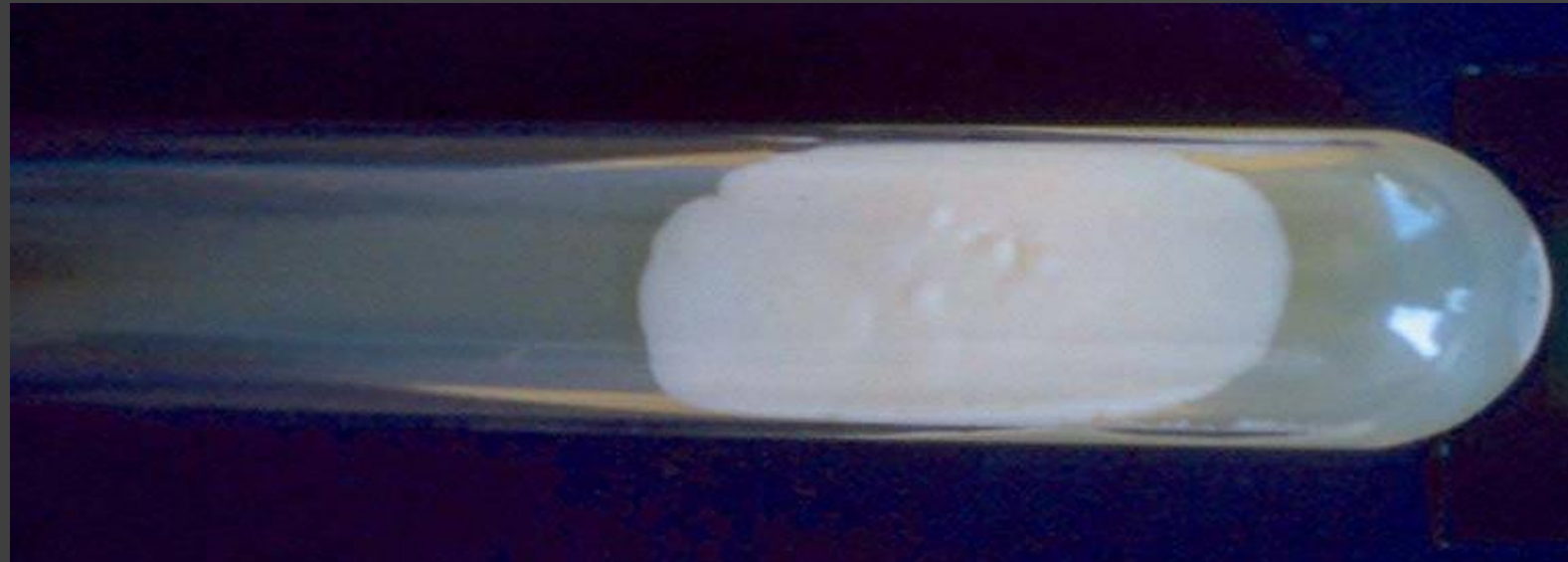


Figura 26. Colônia de *Candida sp.* Foto gentilmente cedida pela professora Claudia Maria Pena Dias.



Figura 27. Colônia de *Candida sp.*

CULTURA PARA FUNGOS

Epidermophyton floccosum

MACROMORFOLOGIA DA COLÔNIA

Caracteriza-se por micélio aéreo finamente granuloso, acastanhado, verso amarelado-verdeado, emite filamentos paralelos à superfície a partir do centro. Pode recobrir-se por micélio aéreo cotonoso, branco (pleomorfismo).



Figura 28. *Epidermophyton floccosum*, colônia. Foto gentilmente cedida pela professora Claudia Maria Pena Dias.

CULTURA PARA FUNGOS

Epidermophyton floccosum

MICROMORFOLOGIA DA COLÔNIA

Caracteriza-se por hifas hialinas, septadas, ramificadas, com clamidoconídios intercalares. Sem microconídios. Macroconídios claviformes, de parede fina, com dois a cinco septos, agrupados no conidióforo.

MAIS FOTOS

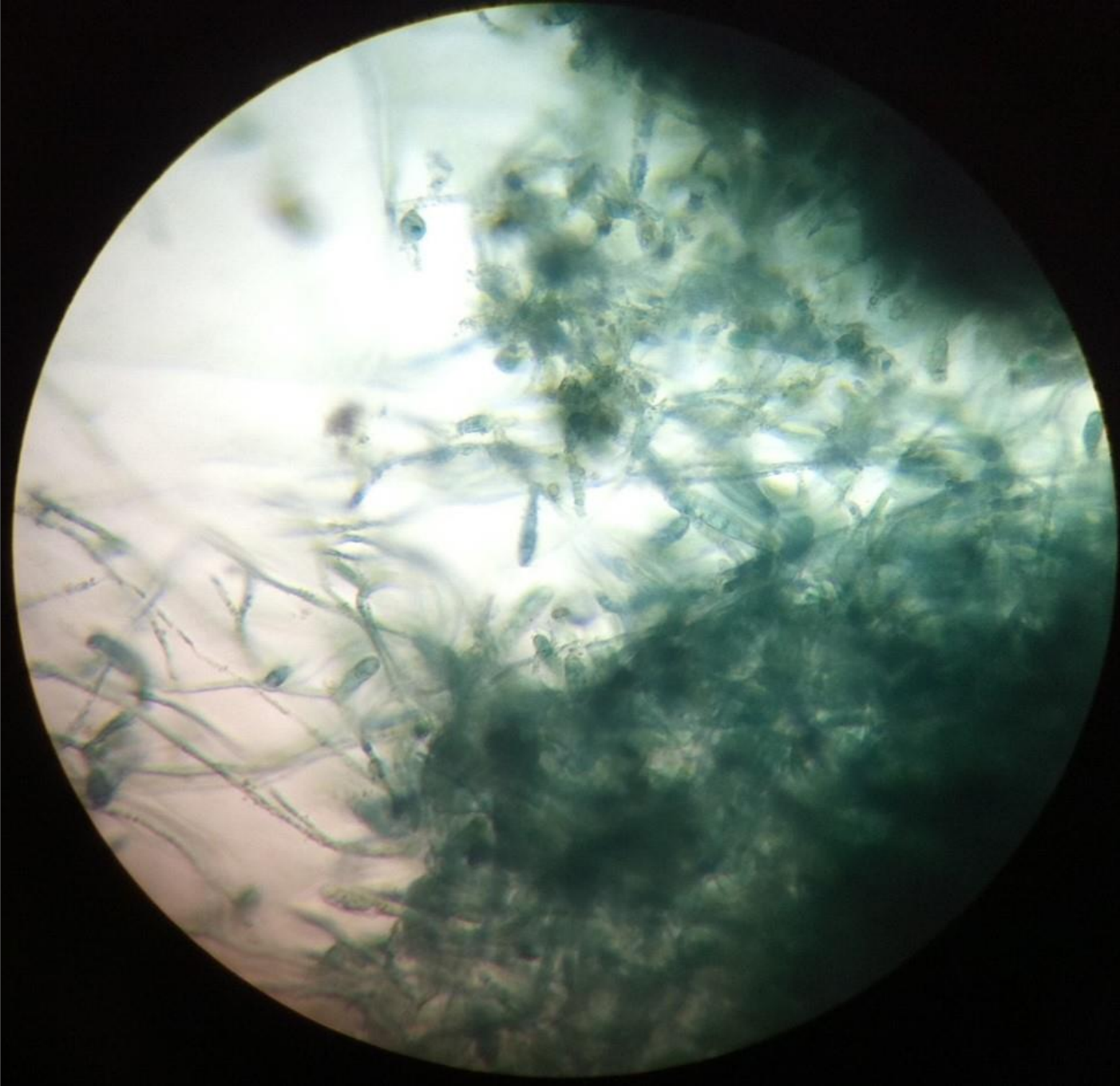


Figura 29. *Epidermophyton floccosum*, micromorfologia da colônia.

MENU



CULTURA PARA FUNGOS

Epidermophyton floccosum

MICROMORFOLOGIA DA COLÔNIA

Caracteriza-se por hifas hialinas, septadas, ramificadas, com clamidoconídios intercalares. Sem microconídios. Macroconídios claviformes, de parede fina, com dois a cinco septos, agrupados no conidióforo.

MAIS FOTOS

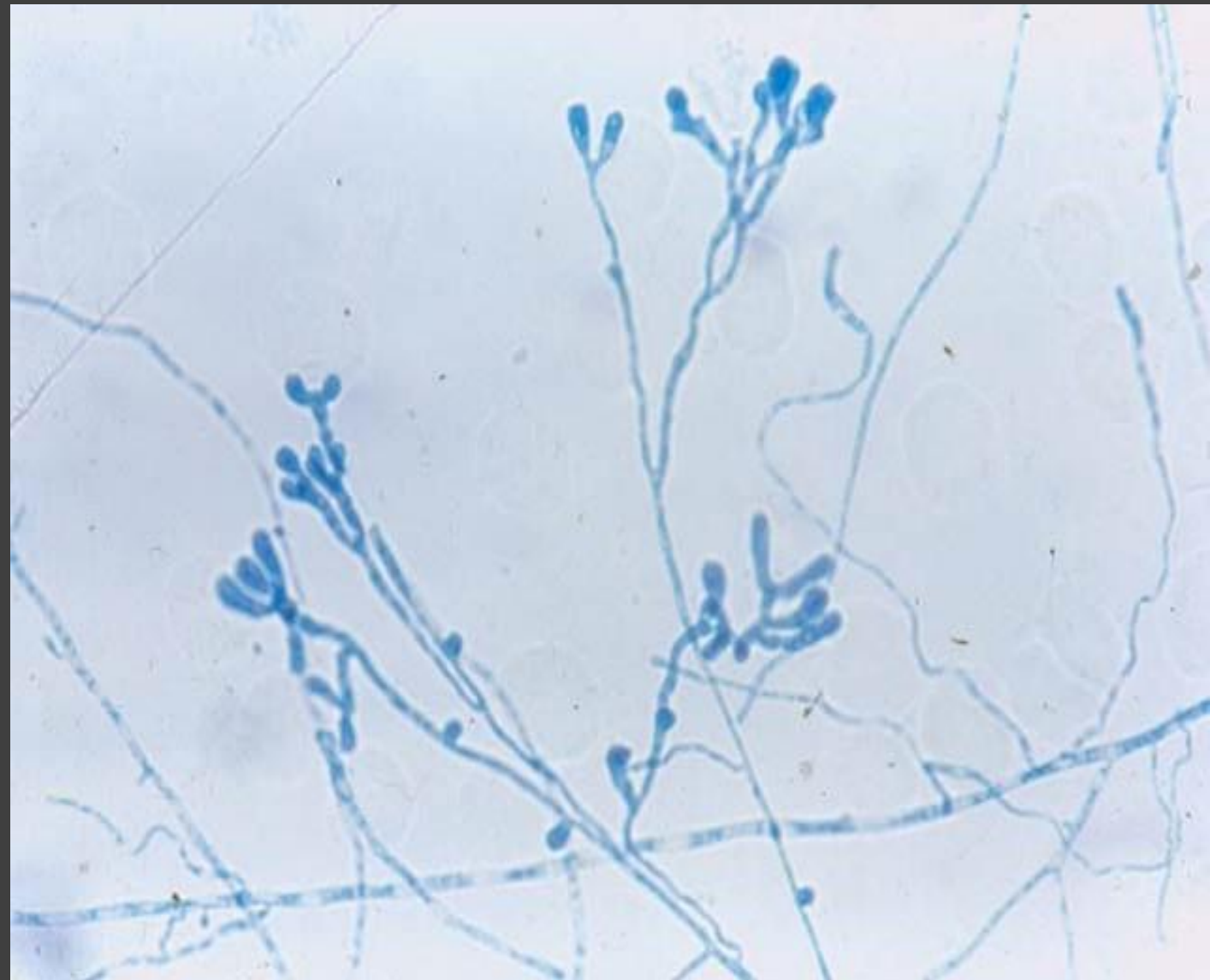
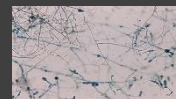
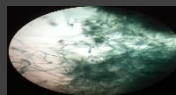


Figura 30. *Epidermophyton floccosum*, micromorfologia da colônia. Fotografia gentilmente cedida pela professora Claudia Maria Pena Dias.

MENU



CULTURA PARA FUNGOS

Epidermophyton floccosum

MICROMORFOLOGIA DA COLÔNIA

Caracteriza-se por hifas hialinas, septadas, ramificadas, com clamidoconídios intercalares. Sem microconídios. Macroconídios claviformes, de parede fina, com dois a cinco septos, agrupados no conidióforo.

MAIS FOTOS

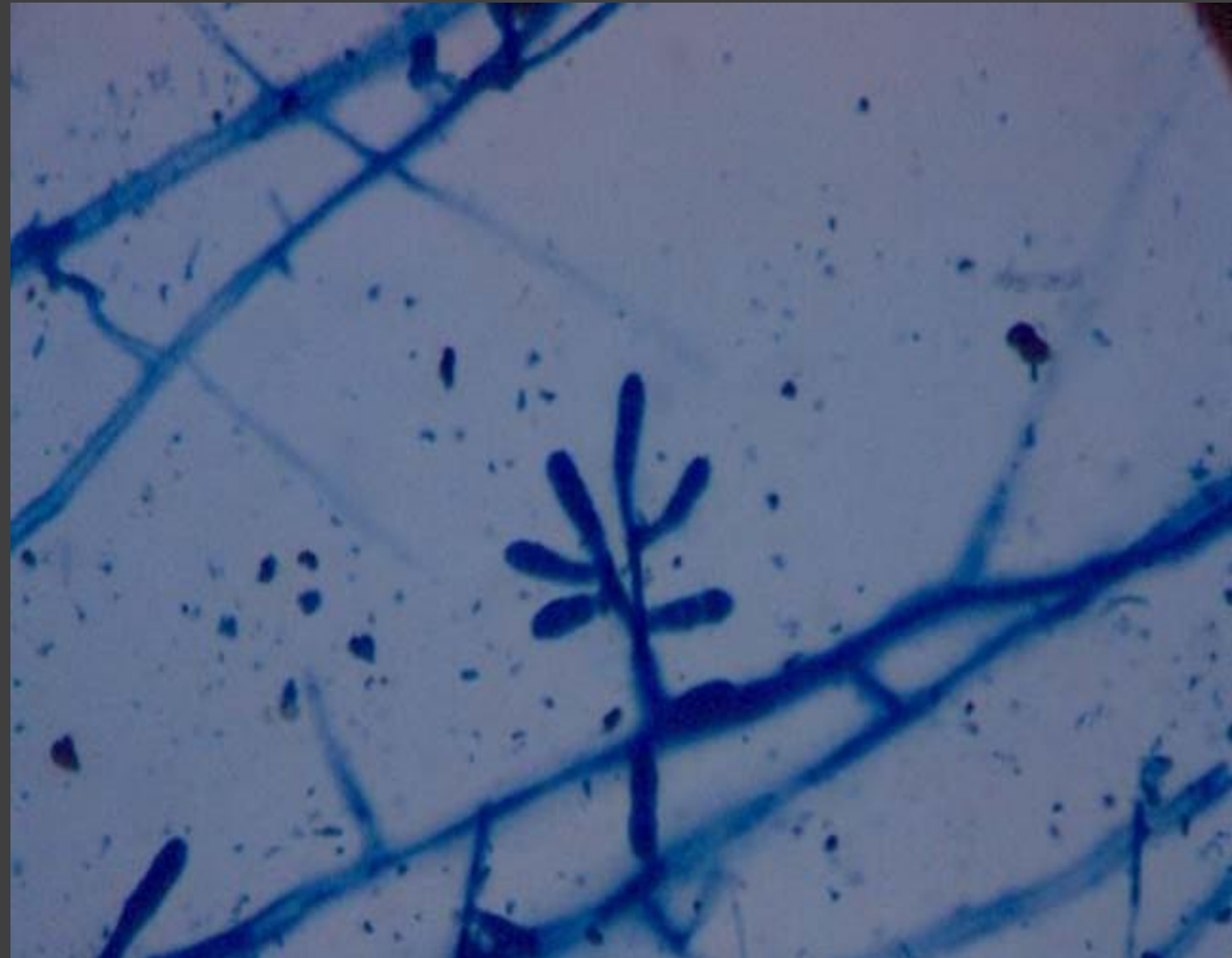
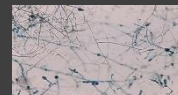
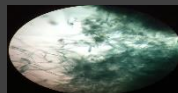


Figura 31. *Epidermophyton floccosum*, micromorfologia da colônia. Fotografia gentilmente cedida pela professora Claudia Maria Pena Dias.

MENU



CULTURA PARA FUNGOS

Epidermophyton floccosum

MICROMORFOLOGIA DA COLÔNIA

Caracteriza-se por hifas hialinas, septadas, ramificadas, com clamidoconídios intercalares. Sem microconídios. Macroconídios claviformes, de parede fina, com dois a cinco septos, agrupados no conidióforo.

MAIS FOTOS

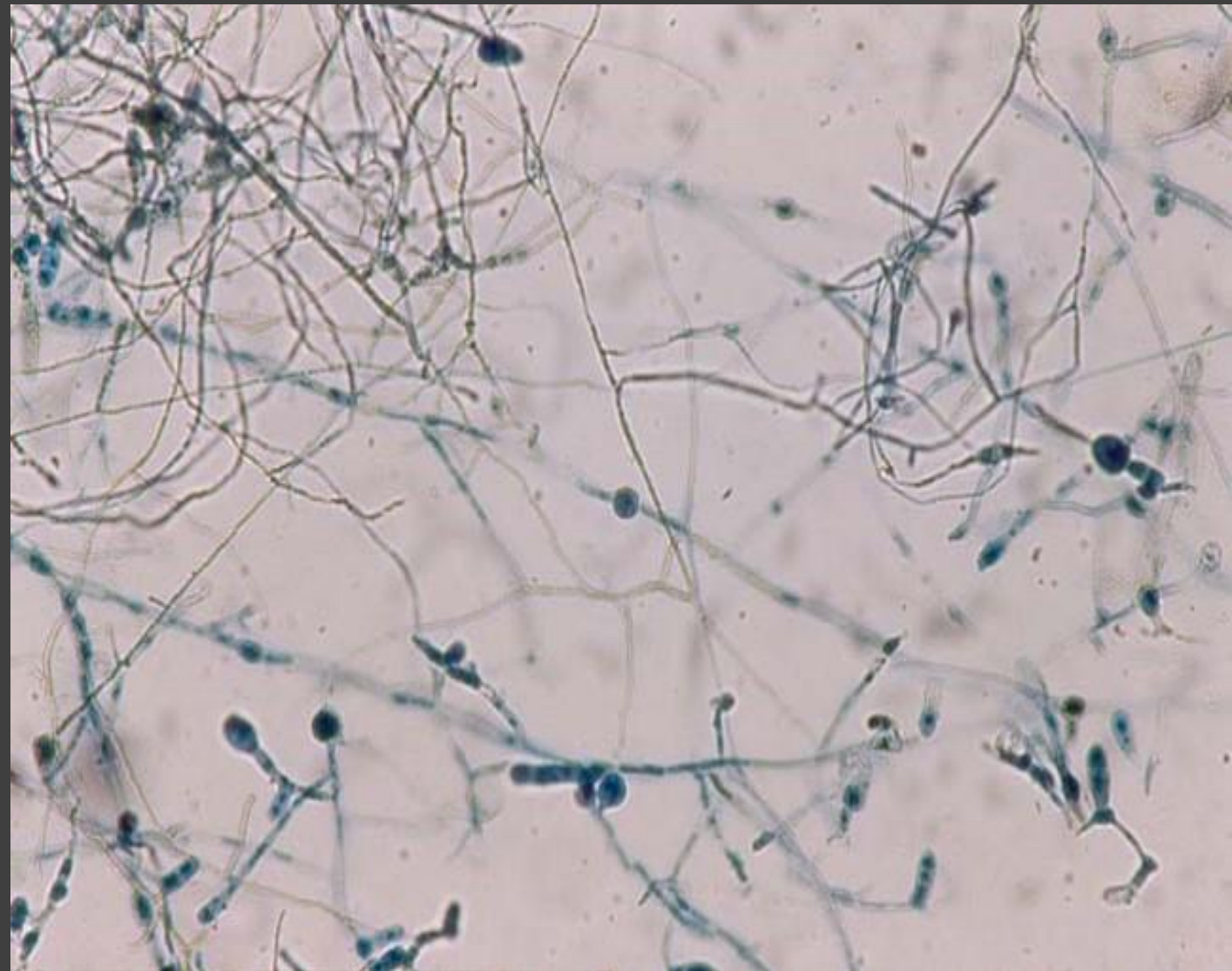
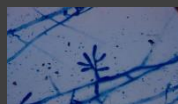
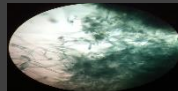


Figura 32. *Epidermophyton floccosum*, micromorfologia da colônia. Fotografia gentilmente cedida pela professora Claudia Maria Pena Dias.

MENU



CULTURA PARA FUNGOS

Fusarium sp.

MACROMORFOLOGIA DA COLÔNIA

Caracteriza-se por micélio aéreo cotonoso, branco, desorganizado. Verso violáceo, podendo ser incolor, amarelado ou acastanhado.



Figura 33. Colônia de *Fusarium sp.*

MAIS FOTOS



MENU



CULTURA PARA FUNGOS

Fusarium sp.

MACROMORFOLOGIA DA COLÔNIA

Caracteriza-se por micélio aéreo cotonoso, branco, desorganizado. Verso violáceo, podendo ser incolor, amarelado ou acastanhado.



Figura 34. Colônia de *Fusarium sp.* Foto gentilmente cedida pela professora Claudia Maria Pena Dias.

CULTURA PARA FUNGOS

Fusarium sp.

MICROMORFOLOGIA DA COLÔNIA

Caracteriza-se por hifas hialinas, septadas e ramificadas, arthroconídios fusiformes, encurvados, com um a três septos. Microconídios alongados, sem septo.



Figura 35. *Fusarium sp.* Micromorfologia da colônia. Foto gentilmente cedida pela professora Claudia Maria Pena Dias.

CULTURA PARA FUNGOS

Microsporium canis

MACROMORFOLOGIA DA COLÔNIA

Caracteriza-se por superfície branca, cotonosa, com micélio aéreo fino, brilhoso, penugento e verso amarelo vivo.

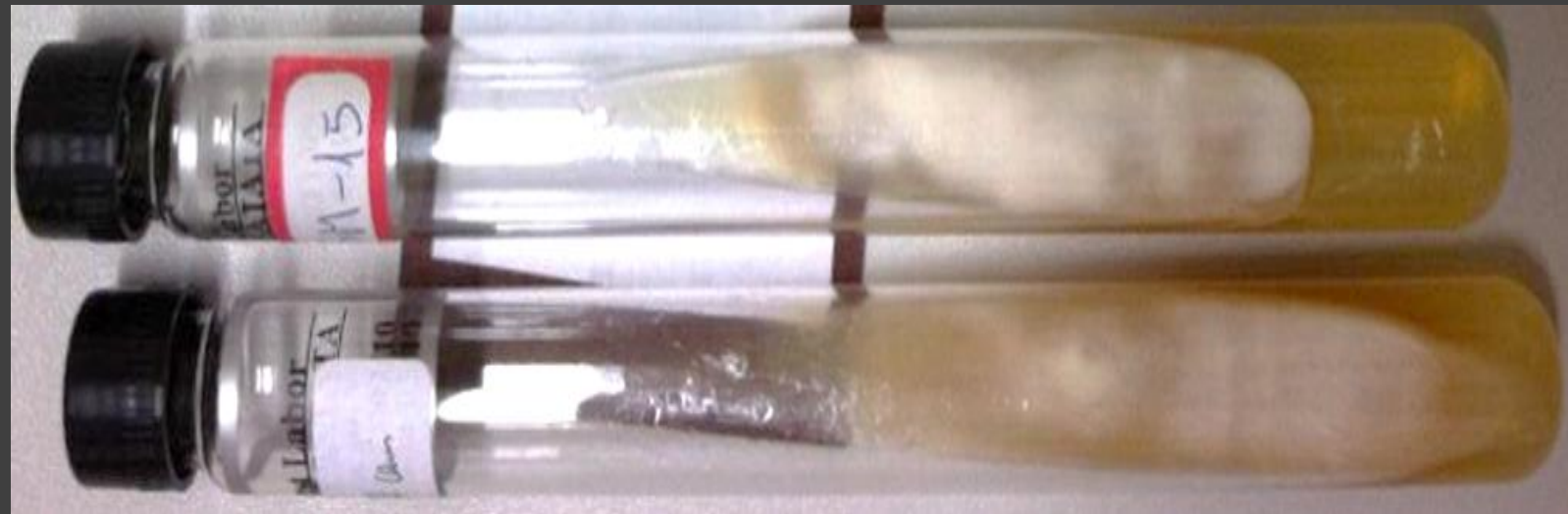
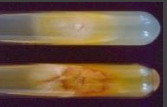


Figura 36. Colônia de *Microsporium canis*.

MAIS FOTOS



MENU



CULTURA PARA FUNGOS

Microsporum canis

MACROMORFOLOGIA DA COLÔNIA

Caracteriza-se por superfície branca, cotonosa, com micélio aéreo fino, brilhoso, penugento e verso amarelo vivo.

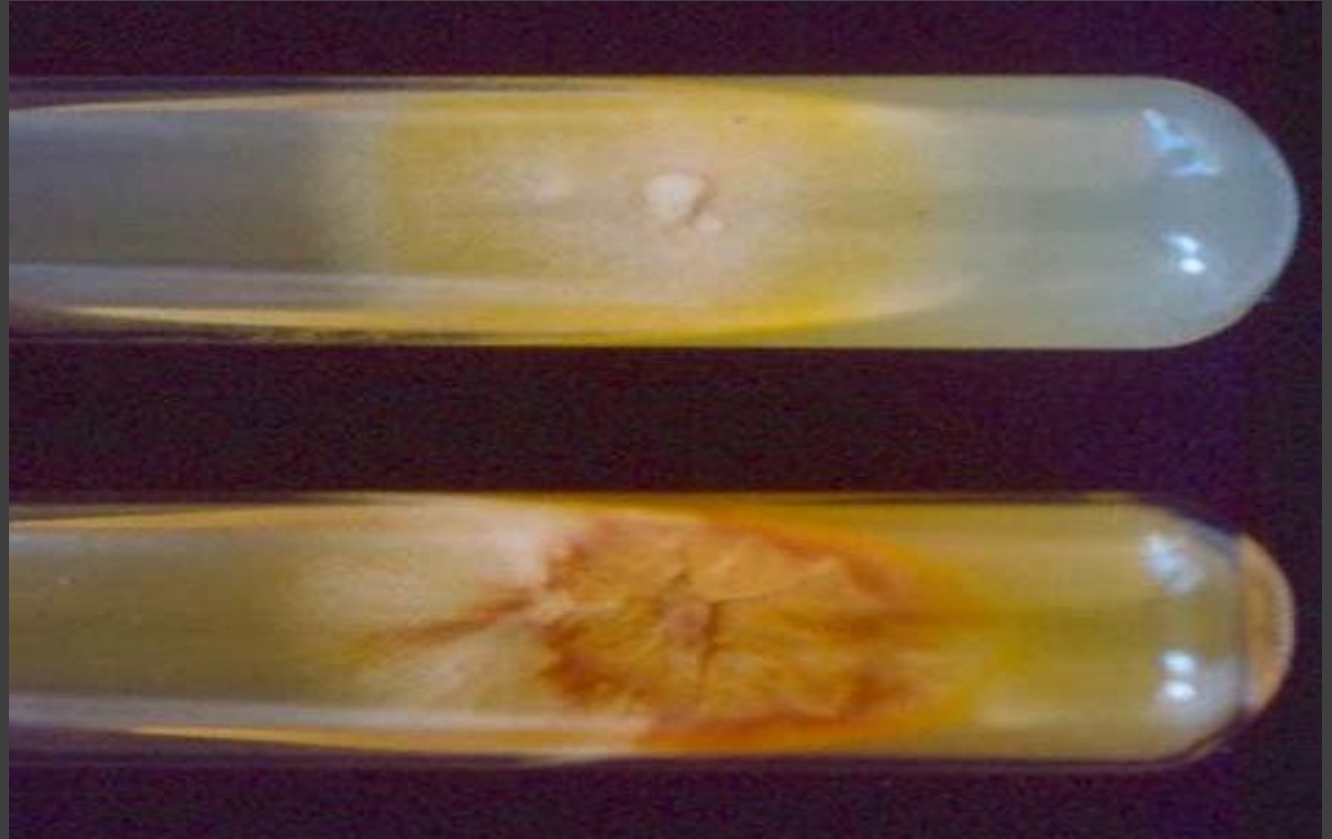


Figura 37. Colônia de *Microsporum canis*. Foto gentilmente cedida pela professora Claudia Maria Pena Dias.

CULTURA PARA FUNGOS

Microsporium canis

MICROMORFOLOGIA DA COLÔNIA

Caracteriza-se por hifas hialinas, septadas, ramificadas, macroconídios fusiformes com extremidade afilada, de parede espessa, com septos que variam de 5 a 7 e microconídios ausentes ou raros. Pode apresentar clamidoconídios.

MAIS FOTOS

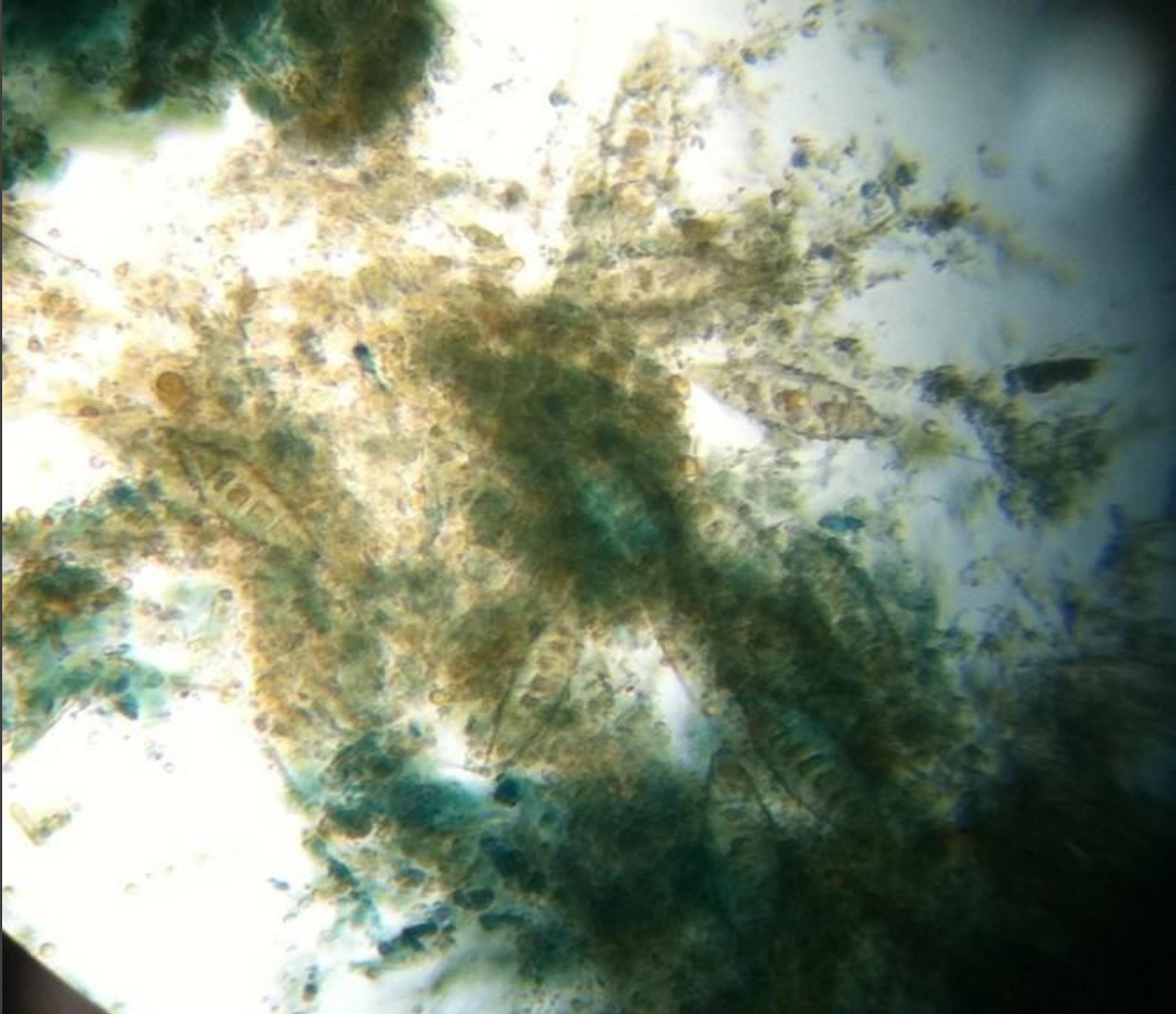


Figura 38. Micromorfologia da colônia de *Microsporium canis*.

MENU



CULTURA PARA FUNGOS

Microsporium canis

MICROMORFOLOGIA DA COLÔNIA

Caracteriza-se por hifas hialinas, septadas, ramificadas, macroconídios fusiformes com extremidade afilada, de parede espessa, com septos que variam de 5 a 7 e microconídios ausentes ou raros. Pode apresentar clamidoconídios.



Figura 39. Micromorfologia da colônia de *Microsporium canis*. Foto gentilmente cedida pela professora Claudia Maria Pena Dias.

CULTURA PARA FUNGOS

Microsporium gypseum

MACROMORFOLOGIA DA COLÔNIA

Caracteriza-se por micélio aéreo grosseiramente granuloso, de coloração bege, verso incolor, acastanhado, ou castanho-avermelhado.



Figura 40. Colônia de *Microsporium gypseum*.

MAIS FOTOS



MENU



CULTURA PARA FUNGOS

Microsporium gypseum

MACROMORFOLOGIA DA COLÔNIA

Caracteriza-se por micélio aéreo grosseiramente granuloso, de coloração bege, verso incolor, acastanhado, ou castanho-avermelhado.



Figura 41. Colônia de *Microsporium gypseum*. Foto gentilmente cedida pela professora Claudia Maria Pena Dias.

CULTURA PARA FUNGOS

Microsporium gypseum

MICROMORFOLOGIA DA COLÔNIA

Caracteriza-se por hifas hialinas, septadas, ramificadas, macroconídios de paredes finas, extremidades arredondadas, com septos que variam de 3 a 5 e microconídios piriformes.

MAIS FOTOS

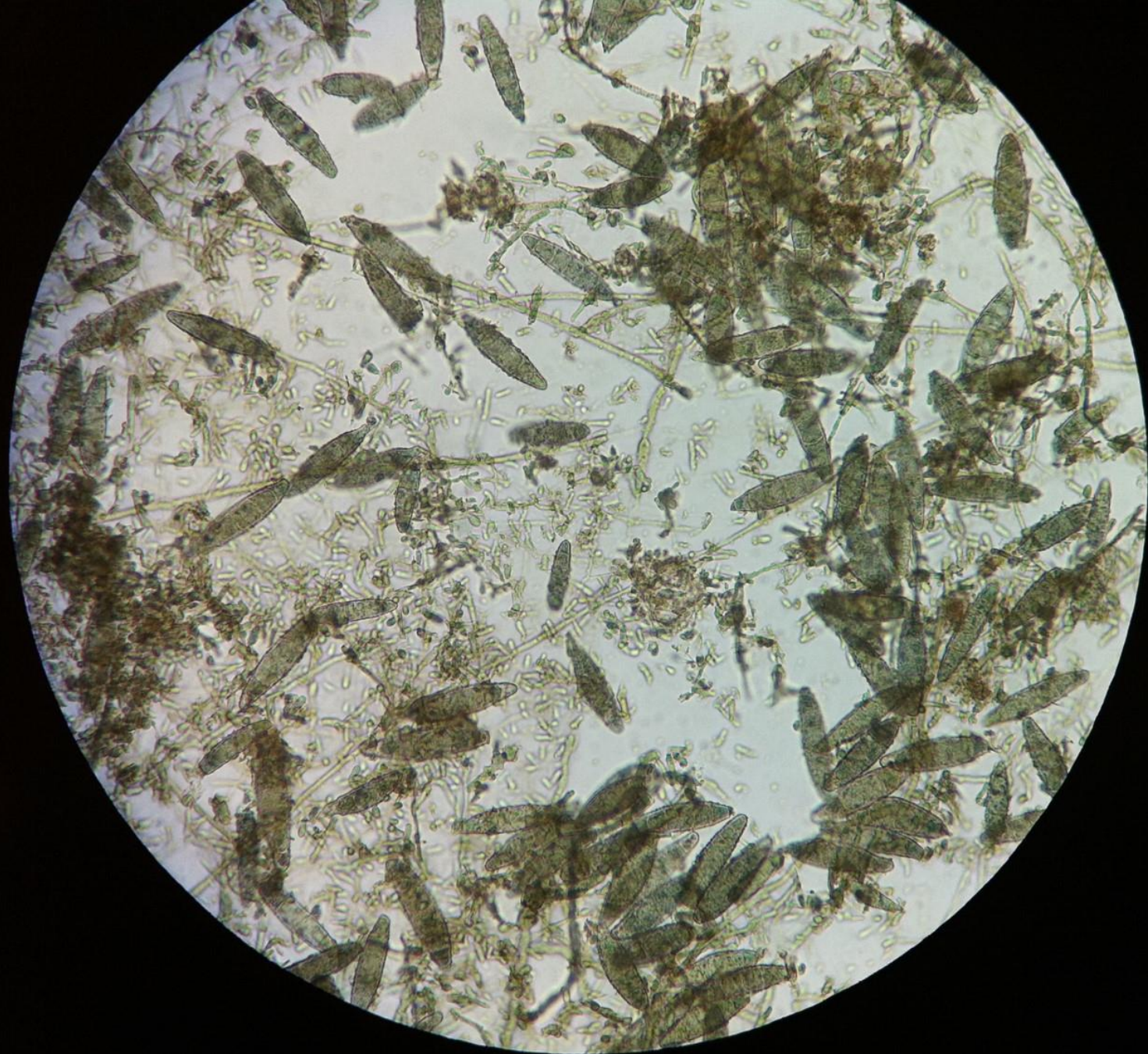


Figura 42. *Microsporium gypseum*, micromorfologia da colônia.

MENU



CULTURA PARA FUNGOS

Microsporium gypseum

MICROMORFOLOGIA DA COLÔNIA

Caracteriza-se por hifas hialinas, septadas, ramificadas, macroconídios de paredes finas, extremidades arredondadas, com septos que variam de 3 a 5 e microconídios piriformes.



Figura 43. *Microsporium gypseum*, micromorfologia da colônia.

CULTURA PARA FUNGOS

Neoscytalidium dimidiatum

MACROMORFOLOGIA DA COLÔNIA

A colônia de *Neoscytalidium dimidiatum* caracteriza-se macroscopicamente por micélio aéreo cotonoso, acinzentado ou negro, desorganizado, abundante, verso negro, corando o meio de cultura.



Figura 44. Colônia de *Neoscytalidium dimidiatum*.

CULTURA PARA FUNGOS

Neoscytalidium dimidiatum

MICROMORFOLOGIA DA COLÔNIA

Caracteriza-se por hifas acastanhadas, septadas e ramificadas; e hifas hialinas, septadas e ramificadas. Artroconídios dispostos em cadeia na hifa, sem septo ou com um septo.

MAIS FOTOS

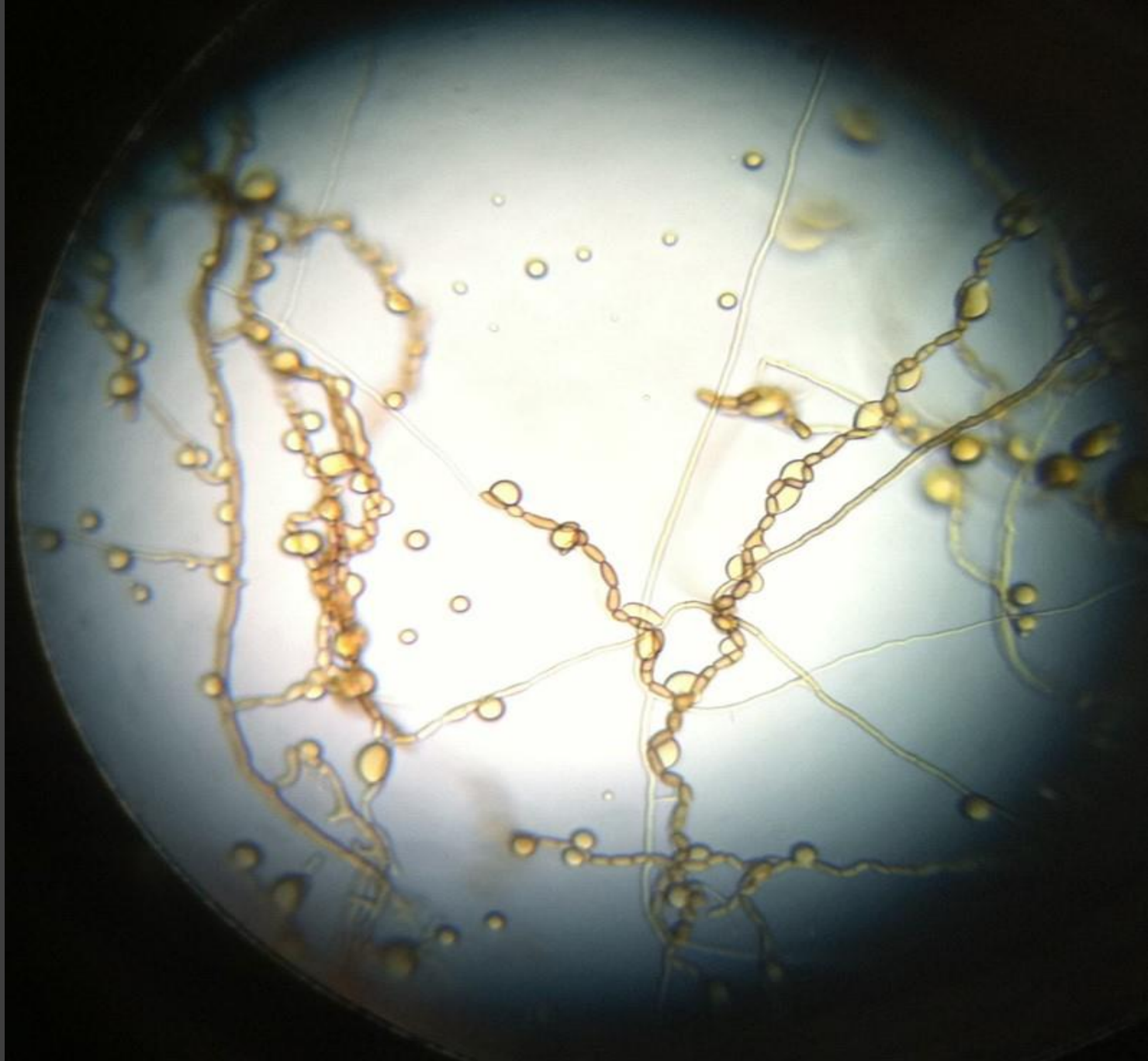
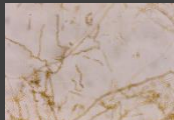


Figura 45. *Neoscytalidium hyalinum*, micromorfologia da colônia.

MENU



CULTURA PARA FUNGOS

Neoscytalidium dimidiatum

MICROMORFOLOGIA DA COLÔNIA

Caracteriza-se por hifas acastanhadas, septadas, ramificadas; e hifas hialinas, septadas, ramificadas. Artroconídios dispostos em cadeia na hifa, sem septo ou com um septo.

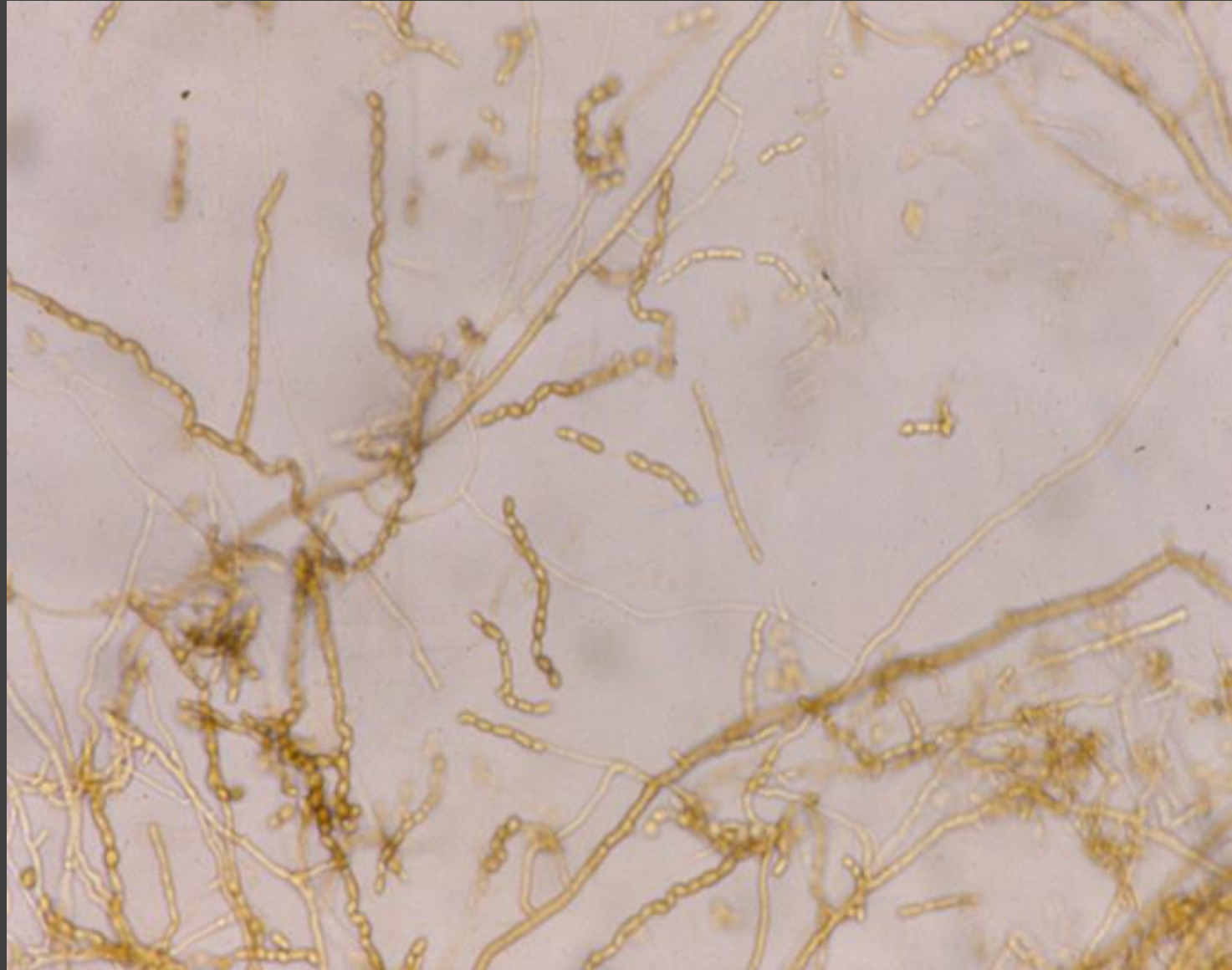


Figura 46. *Neoscytalidium dimidiatum*, micromorfologia da colônia. Foto gentilmente cedida pela professora Claudia Maria Pena Dias.

CULTURA PARA FUNGOS

Scopulariopsis sp.

MACROMORFOLOGIA DA COLÔNIA

A macromorfologia da colônia de *Scopulariopsis sp.* caracteriza-se por micélio aéreo cotonoso, de superfície pregueada, coloração bege a castanho, verso incolor.



Figura 47. Colônia de *Scopulariopsis sp.*

CULTURA PARA FUNGOS

Scytalidium hyalinum

MACROMORFOLOGIA DA COLÔNIA

A macromorfologia da colônia de *Scytalidium hyalinum* caracteriza-se por micélio aéreo cotonoso, branco, desorganizado, verso acastanhado.



Figura 48. Colônia de *Scytalidium hyalinum*.

MAIS FOTOS



MENU



CULTURA PARA FUNGOS

Scytalidium hyalinum

MACROMORFOLOGIA DA COLÔNIA

A macromorfologia da colônia de *Scytalidium hyalinum* caracteriza-se por micélio aéreo cotonoso, branco, desorganizado, verso acastanhado.



Figura 49. Colônia de *Scytalidium hyalinum*. Foto gentilmente cedida pela professora Claudia Maria Pena Dias.

CULTURA PARA FUNGOS

Scytalidium hyalinum

MICROMORFOLOGIA DA COLÔNIA

Caracteriza-se por hifas hialinas, septadas e ramificadas, artroconídios em cadeia dispostos na hifa, com um ou sem nenhum septo.



Figura 50. *Scytalidium hyalinum*, micromorfologia da colônia.

CULTURA PARA FUNGOS

Trichophyton mentagrophytes

MACROMORFOLOGIA DA COLÔNIA

- Variante granulosa

Caracteriza-se por micélio aéreo finamente granuloso, de coloração bege, brancacenta ou pardacenta, verso acastanhado, ou castanho-avermelhado.



Figura 51. Colônia de *Trichophyton mentagrophytes* variante granulosa.

MAIS FOTOS



MENU



CULTURA PARA FUNGOS

Trichophyton mentagrophytes

MACROMORFOLOGIA DA COLÔNIA

- Variante granulosa

Caracteriza-se por micélio aéreo finamente granuloso, de coloração bege, brancacenta ou pardacenta, verso acastanhado, ou castanho-avermelhado.



Figura 52. Colônia de *Trichophyton mentagrophytes* variante granulosa.
Foto gentilmente cedida pela professora Claudia Maria Pena Dias.

CULTURA PARA FUNGOS

Trichophyton mentagrophytes

MICROMORFOLOGIA DA COLÔNIA

Caracteriza-se por hifas hialinas, septadas, ramificadas, hifas em gavinha (espiraladas), hifas em raquete e clamidoconídios. Macroconídios em forma de charuto, microconídios arredondados e agrupados em cachos.

MAIS FOTOS

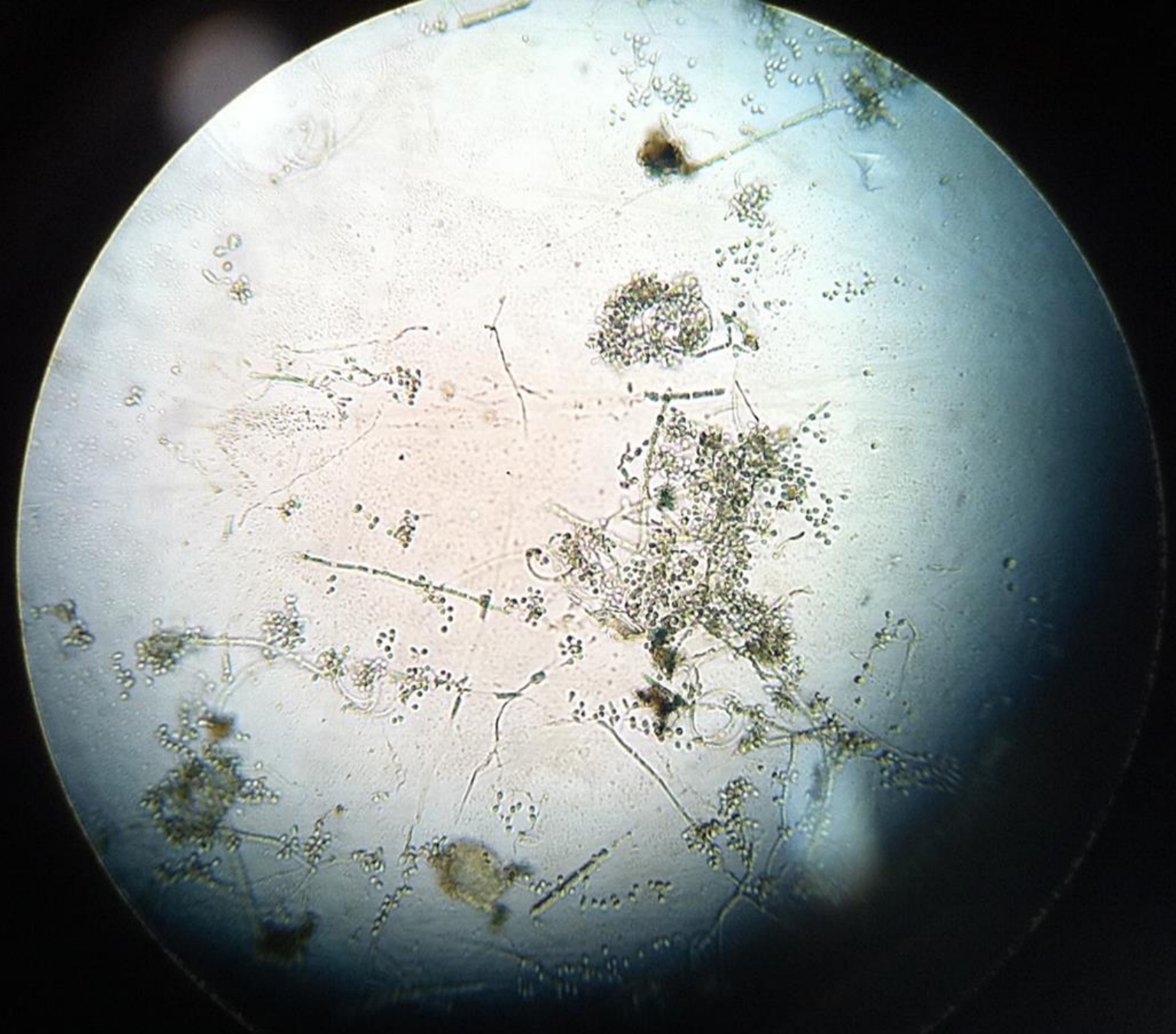
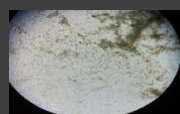
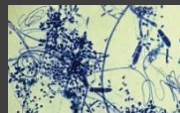


Figura 53. *Trichophyton mentagrophytes*, micromorfologia da colônia.

MENU



CULTURA PARA FUNGOS

Trichophyton mentagrophytes

MICROMORFOLOGIA DA COLÔNIA

Caracteriza-se por hifas hialinas, septadas, ramificadas, hifas em gavinha (espiraladas), hifas em raquete e clamidoconídios. Macroconídios em forma de charuto, microconídios arredondados e agrupados em cachos.

MAIS FOTOS

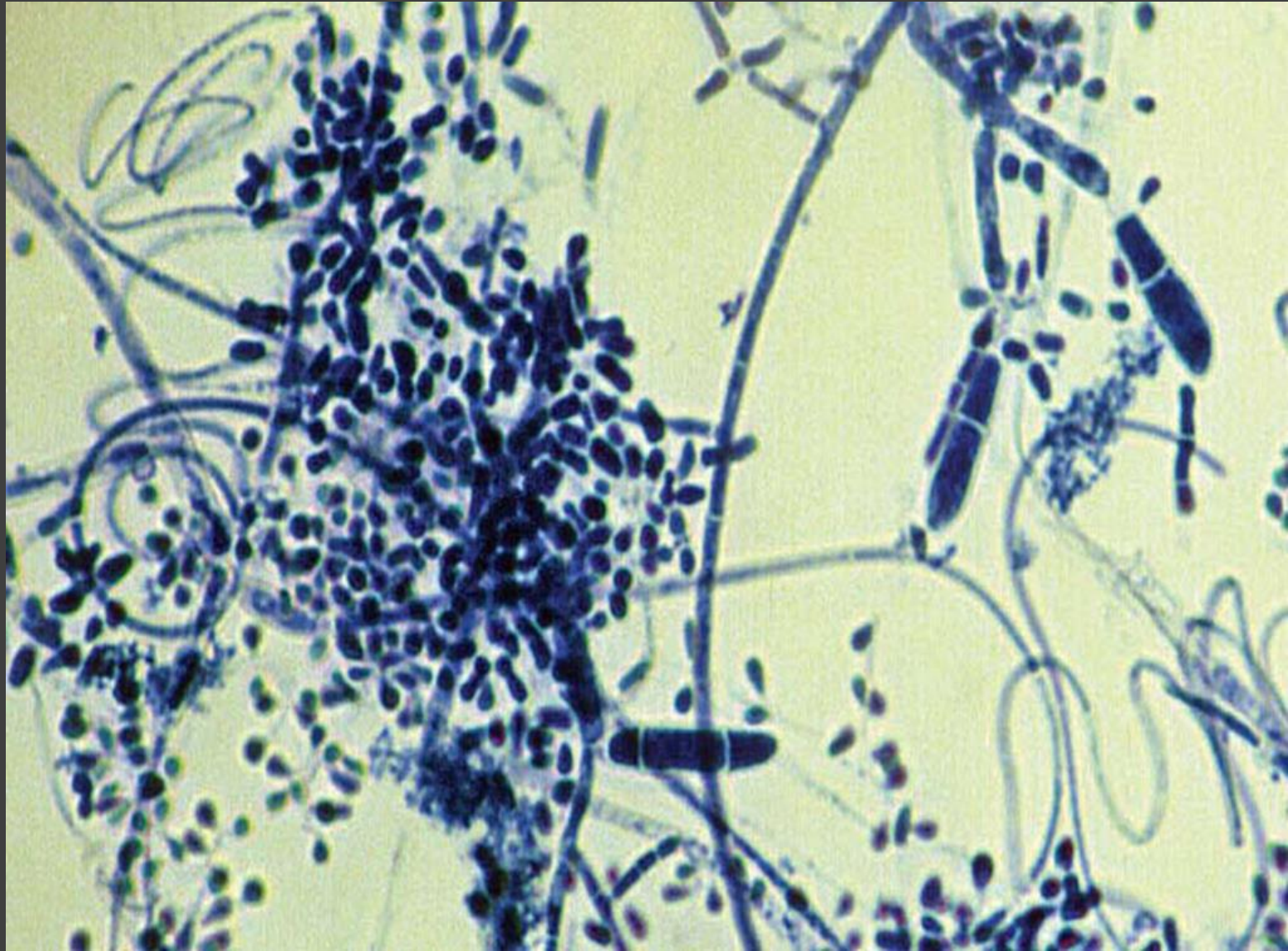
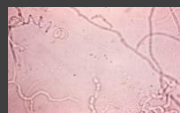


Figura 54. *Trichophyton mentagrophytes*, micromorfologia da colônia. Foto gentilmente cedida pela professora Claudia Maria Pena Dias.

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CULTURA PARA FUNGOS

Trichophyton mentagrophytes

MICROMORFOLOGIA DA COLÔNIA

Caracteriza-se por hifas hialinas, septadas, ramificadas, hifas em gavinha (espiraladas), hifas em raquete e clamidoconídios. Macroconídios em forma de charuto, microconídios arredondados e agrupados em cachos.

MAIS FOTOS

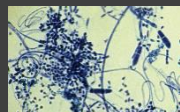


Figura 55. *Trichophyton mentagrophytes*, micromorfologia da colônia. Foto gentilmente cedida pela professora Claudia Maria Pena Dias.

MENU



CULTURA PARA FUNGOS

Trichophyton mentagrophytes

MICROMORFOLOGIA DA COLÔNIA

Caracteriza-se por hifas hialinas, septadas, ramificadas, hifas em gavinha (espiraladas), hifas em raquete e clamidoconídios. Macroconídios em forma de charuto, microconídios arredondados e agrupados em cachos.

MAIS FOTOS

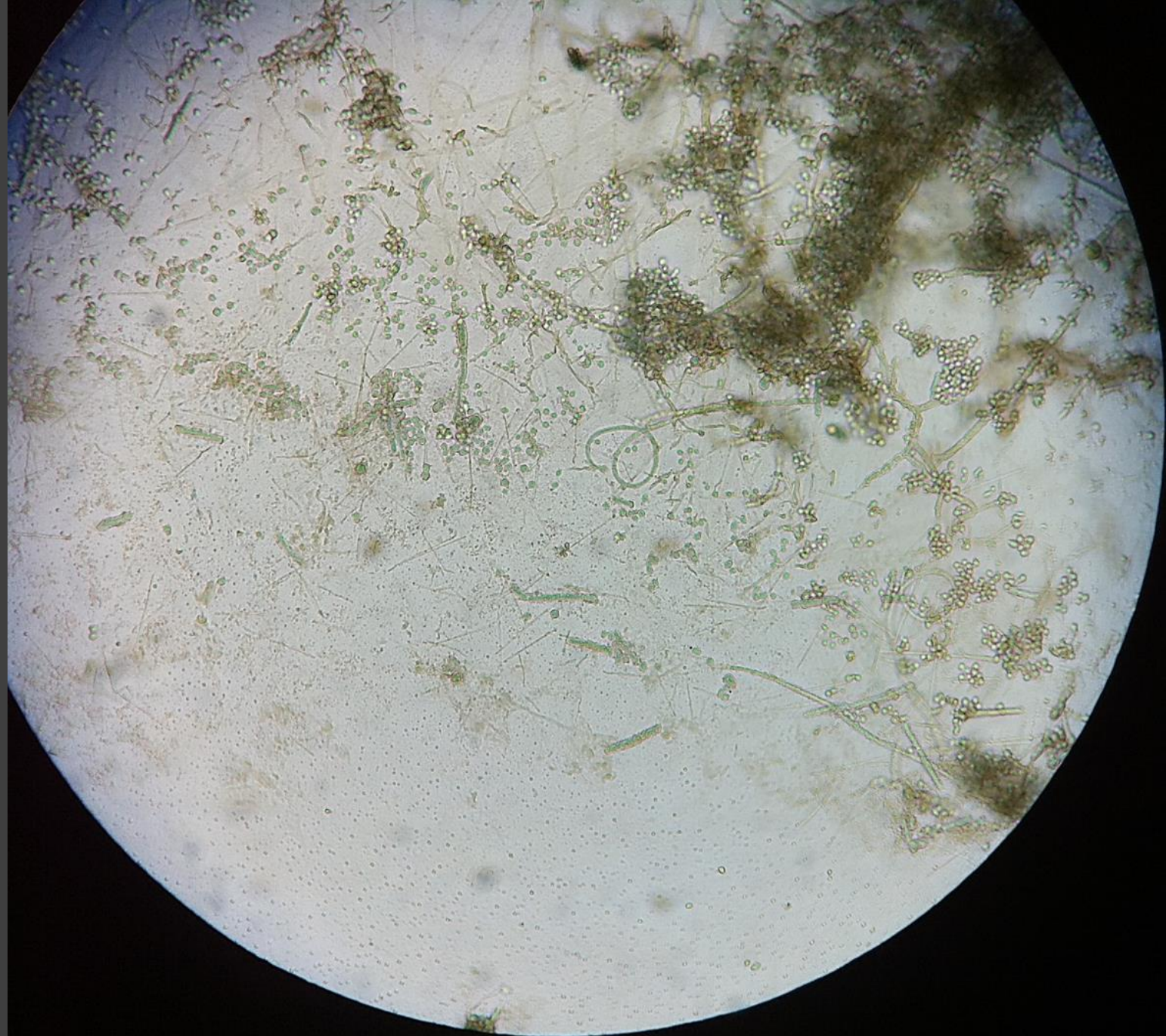
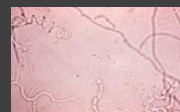
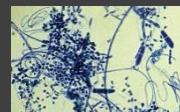
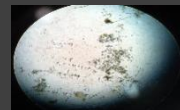


Figura 56. *Trichophyton mentagrophytes*, micromorfologia da colônia.

MENU



CULTURA PARA FUNGOS

Trichophyton rubrum

MACROMORFOLOGIA DA COLÔNIA

Caracteriza-se por micélio aéreo cotonoso, branco e verso vermelho.

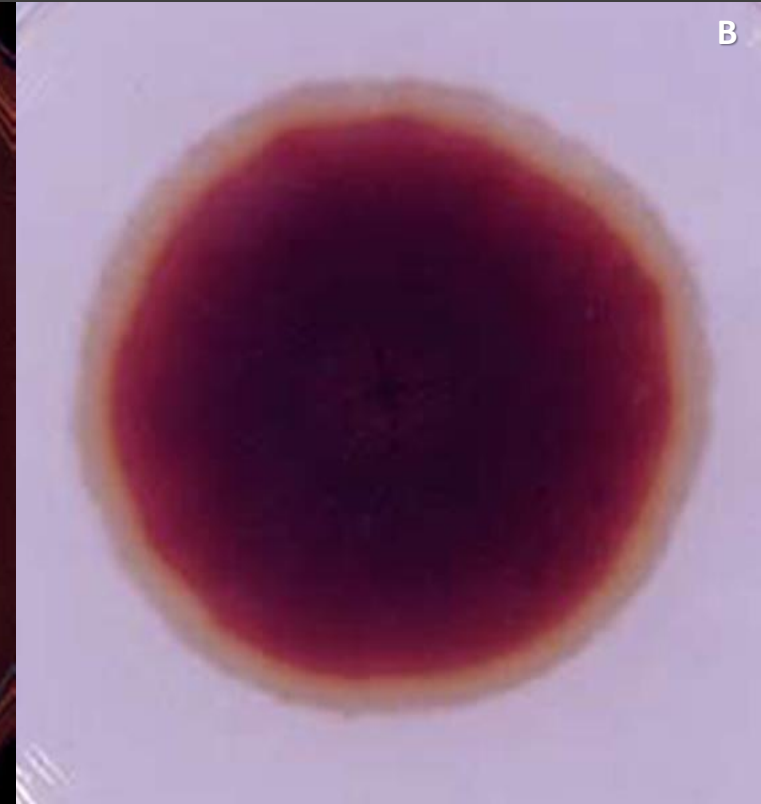
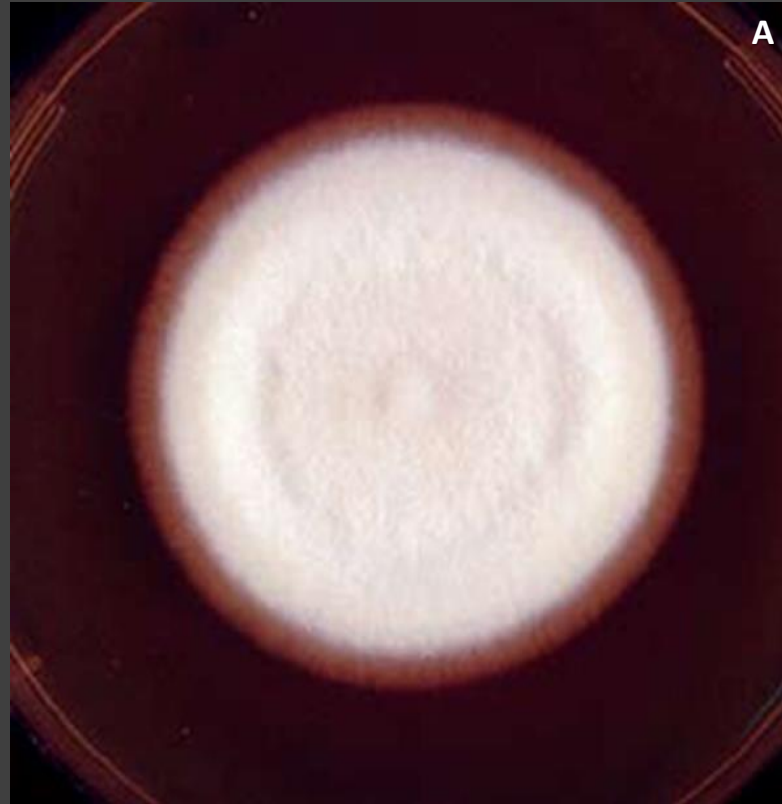
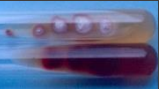


Figura 57. *Trichophyton rubrum*, colônia. A: face anterior. B: verso. Foto gentilmente cedida pela professora Claudia Maria Pena Dias.

MAIS FOTOS



MENU



CULTURA PARA FUNGOS

Trichophyton rubrum

MACROMORFOLOGIA DA COLÔNIA

Caracteriza-se por micélio aéreo cotonoso, branco e verso vermelho.

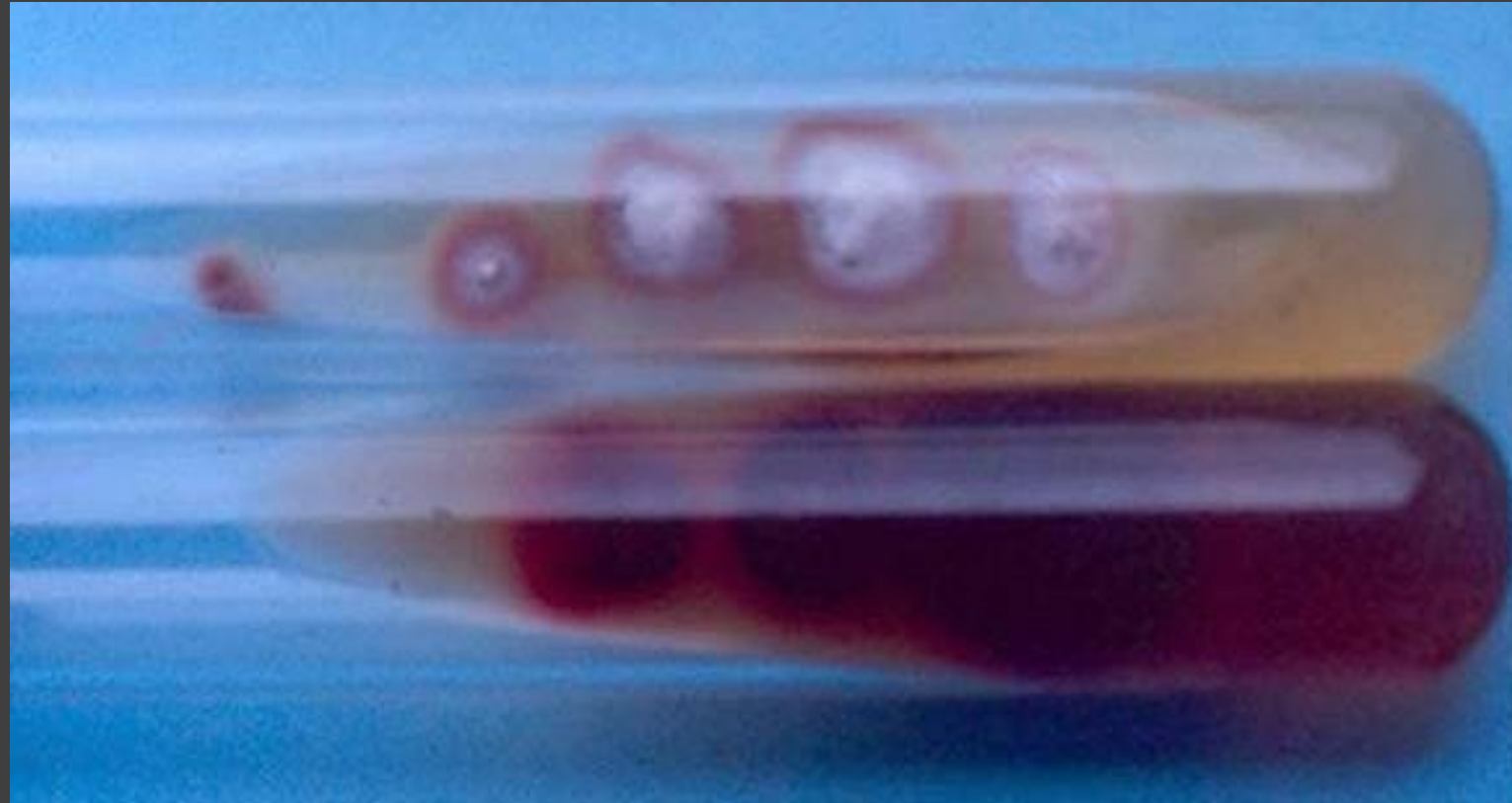


Figura 58. *Trichophyton rubrum*, colônia. A: face anterior. B: verso. Foto gentilmente cedida pela professora Claudia Maria Pena Dias.

CULTURA PARA FUNGOS

Trichophyton rubrum

MICROMORFOLOGIA DA COLÔNIA

Caracteriza-se por hifas hialinas, septadas, ramificadas e delicadas, macroconídios cilíndricos, com dois a nove septos e microconídios piriformes dispostos paralelamente na hifa.

MAIS FOTOS

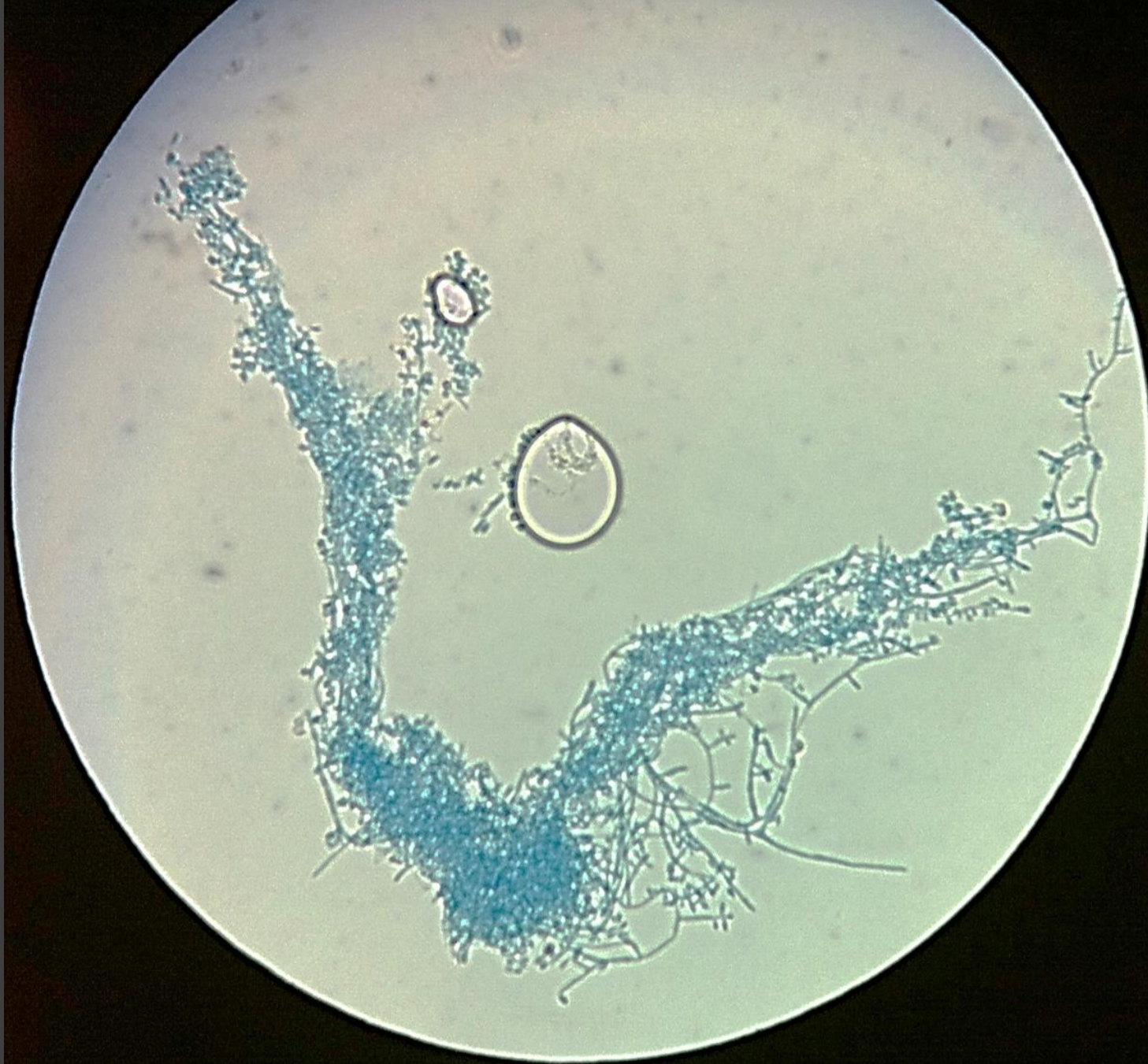
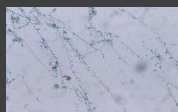


Figura 59. *Trichophyton rubrum*, micromorfologia da colônia.

MENU



CULTURA PARA FUNGOS

Trichophyton rubrum

MICROMORFOLOGIA DA COLÔNIA

Caracteriza-se por hifas hialinas, septadas, ramificadas e delicadas, macroconídios cilíndricos, com duas a nove septos e microconídios piriformes dispostos paralelamente na hifa.

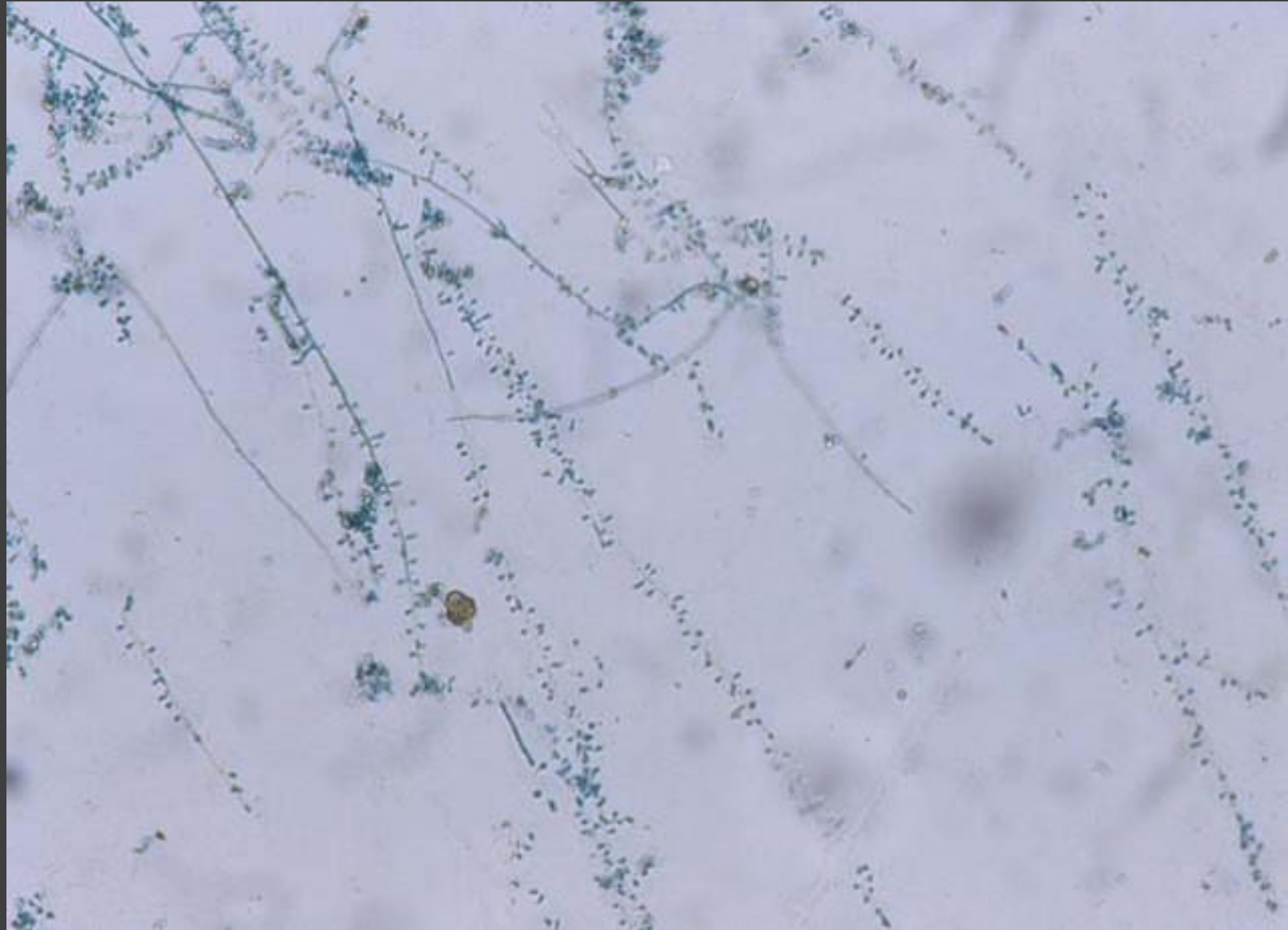


Figura 60. *Trichophyton rubrum*, micromorfologia da colônia. Foto gentilmente cedida pela professora Claudia Maria Pena Dias.

MENU



CULTURA PARA FUNGOS

Trichosporon sp.

MACROMORFOLOGIA DA COLÔNIA

O *Trichosporon sp.* caracteriza-se por colônia cremosa, leveduriforme, de superfície cerebriforme, bege e verso incolor.



Figura 61. Colônia de *Trichosporon sp.* Foto gentilmente cedida pela professora Claudia Maria Pena Dias.

MENU



CULTURA PARA FUNGOS

Trichosporon sp.

MICROMORFOLOGIA DA COLÔNIA

Caracteriza-se pela presença de hifas, pseudo-hifas, artroconídios e blastoconídios.

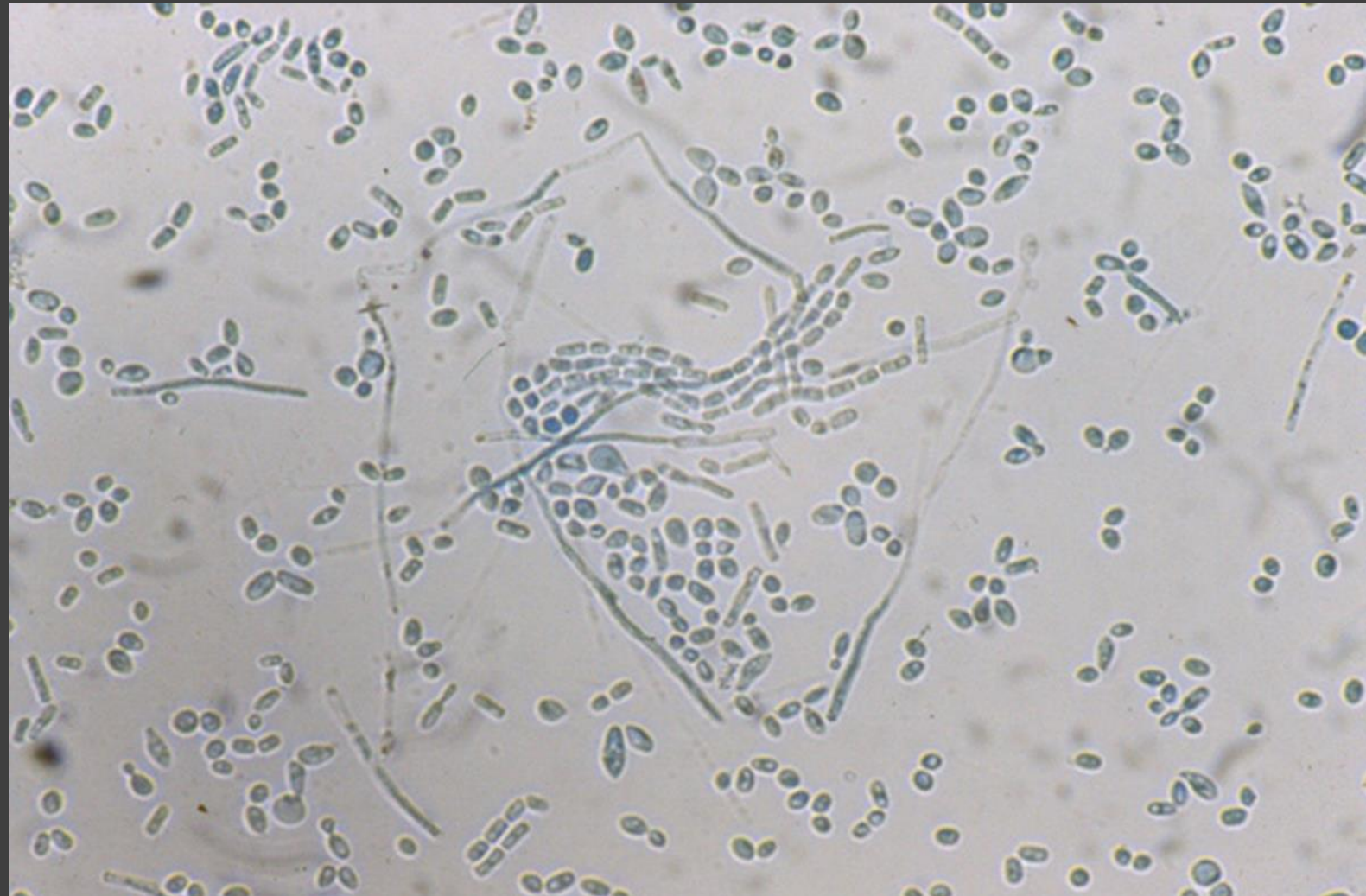
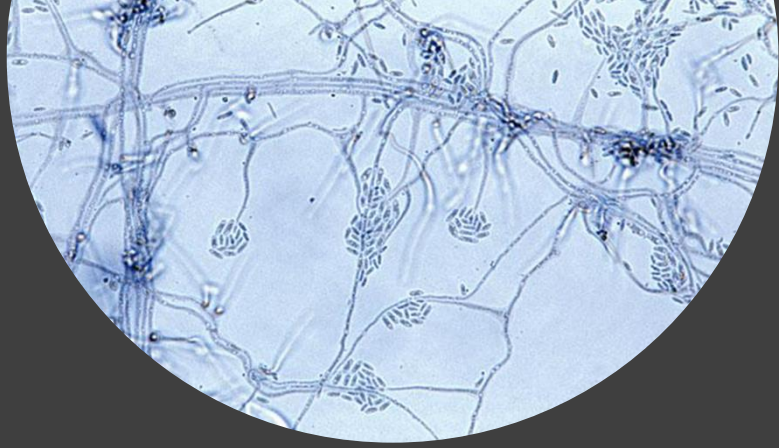


Figura 62. *Trichosporon sp.* Micromorfologia da colônia. Foto gentilmente cedida pela professora Claudia Maria Pena Dias.





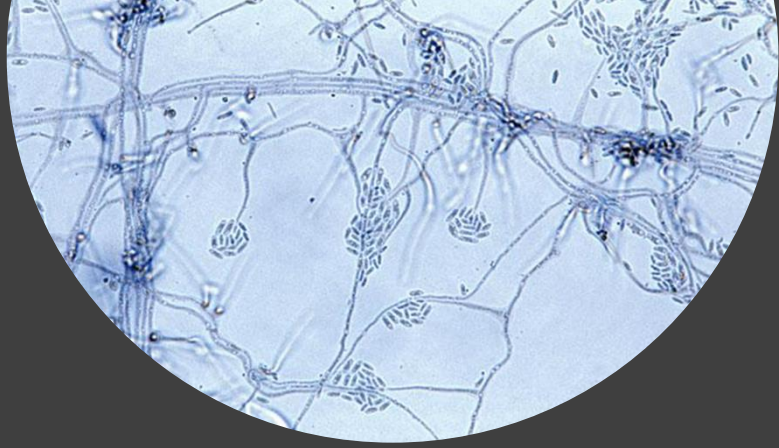
CONTATO



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MENU



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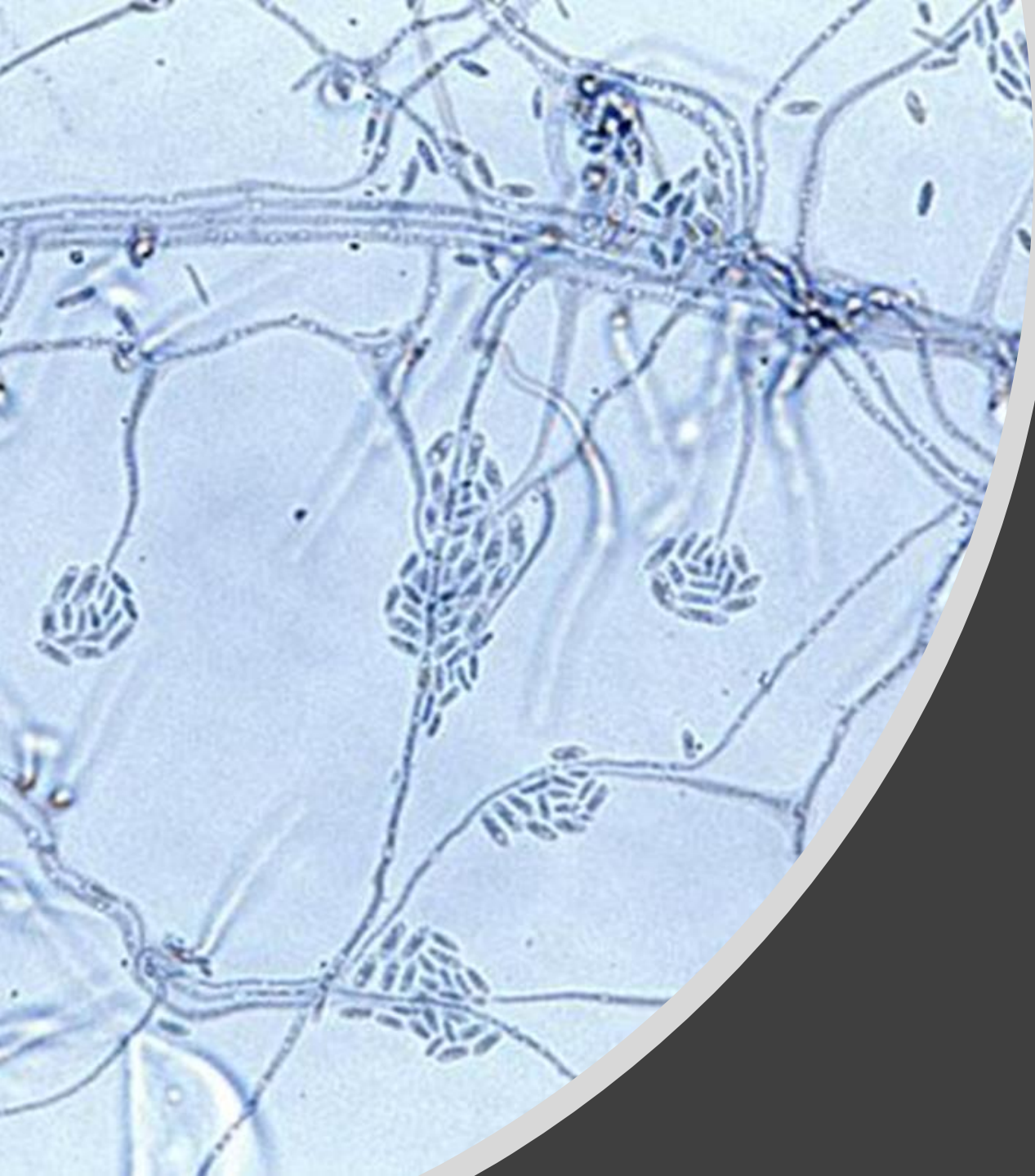


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MENU





OSWALDO ARANHA FOUNDATION

VOLTA REDONDA UNIVERSITY CENTRE

PRO-RECTORY OF RESEARCH AND POST-GRADUATION

PROFESSIONAL TEACHING MASTERS'S PROGRAM
IN HEALTH AND ENVIRONMENT SCIENCES

ONYCHOMYCOSIS INTERACTIVE ATLAS

AUTHORS:

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CARLOS ALBERTO SANCHES PEREIRA, PHD.

PORTUGUÊS



PRESS PLAY





MAIN MENU

- ▶ OBJECTIVES
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- ▶ ONYCHOMYCOSIS
- ▶ SAMPLE COLLECTION
- ▶ DIRECT MYCOLOGICAL EXAMINATION
- ▶ FUNGAL CULTURE
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- ▶ NOMENCLATURE
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- ▶ EPIDEMIOLOGY
- ▶ PREDISPOSING FACTORS
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The background of the slide is a microscopic image of plant tissue, showing a network of thin, branching structures. A dark diagonal band runs from the top right towards the bottom left, partially obscuring the image. The text is overlaid on the left side of the slide.

▶ MAIN MENU

SAMPLE COLLECTION

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FUNGAL CULTURE

- ▶ GENERAL ASPECTS
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- ▶ CULTURES OF FUNGI:

[Acromonium sp.](#)

[Aspergillus flavus](#)

[Candida sp.](#)

[Epidermophyton floccosum](#)

[Fusarium sp.](#)

[Microsporium canis](#)

[Microsporium gypseum](#)

[Neoscytalidium dimidiatum](#)

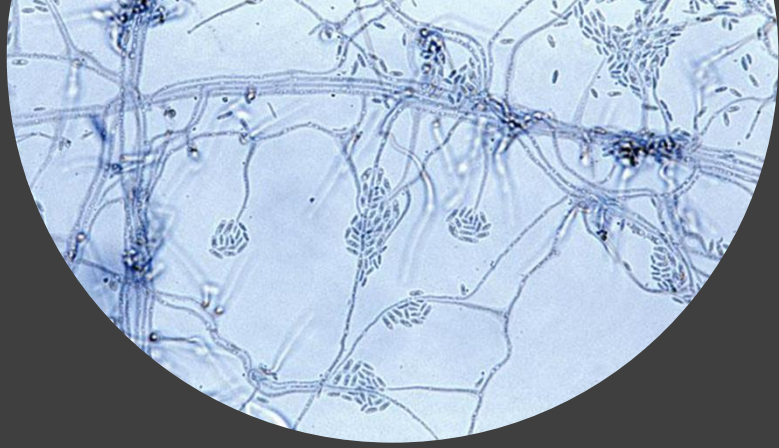
[Scopulariopsis sp.](#)

[Scytalidium hyalinum](#)

[Trichophyton mentagrophytes](#)

[Trichophyton rubrum](#)

[Trichosporon sp.](#)

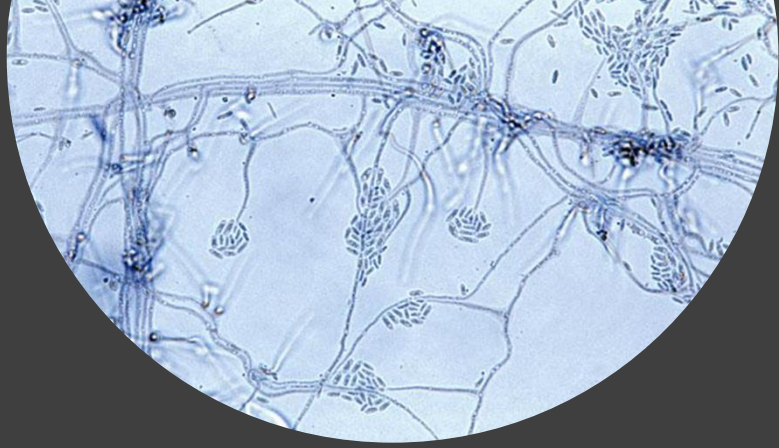


OBJECTIVES

By using digital technology as a teaching instrument of the laboratory diagnosis of onychomycosis, specifically the direct mycological examination and fungal culture, we hope to help capacitate professionals who perform such examinations. This way, we also hope to provide a potential change in the execution of these examinations and in the interpretation of their results by honing the techniques used by the professionals who execute them.

As a consequence, we would help with the laboratorial diagnosis of onychomycosis. Positively impacting the diagnosis of such pathology, there will also be an impact in its treatment, allowing it to be directed to the identified etiologic agent, avoiding empirical or inappropriate treatments.





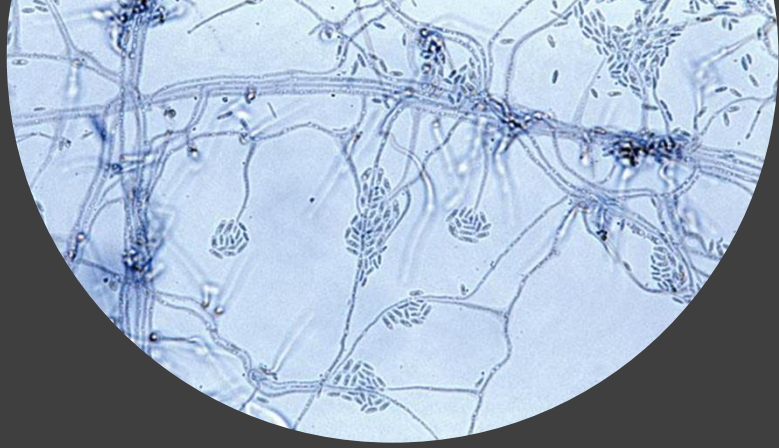
OBJECTIVES

Besides, this technologic tool will be able to equally contribute to dermatologists and postgraduate doctors in dermatology to improve their knowledge about onychomycosis and the most common diagnostic techniques.

This file has a brief theoretical revision about onychomycosis, videos and pictures that show the step-by-step process of material collection from the nail with clinical suspicion of onychomycosis, the correct preparation of the direct mycological examination and the fungal culture and how the results should be interpreted.

We hope you have a good learning!



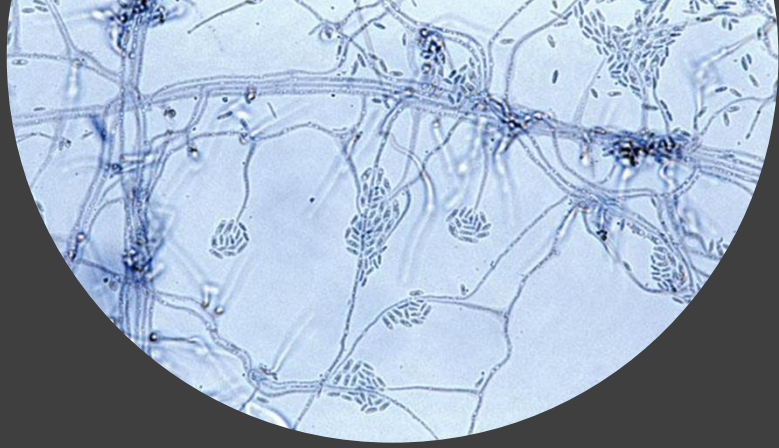


NAIL APPARATUS

The mature nail apparatus (Figure 1) includes the nail matrix, the nail bed, where the nail plate lies, and the nail fold. The main constituents of the nail plate are parallel keratin filaments, which give it mechanical stability, minerals and cholesterol, and around 7% of water. The nail bed is a thousand times more permeable to water than the full skin and it also can be a place where exogenous substances are deposited, such as medications.



Figure 1: nail apparatus.

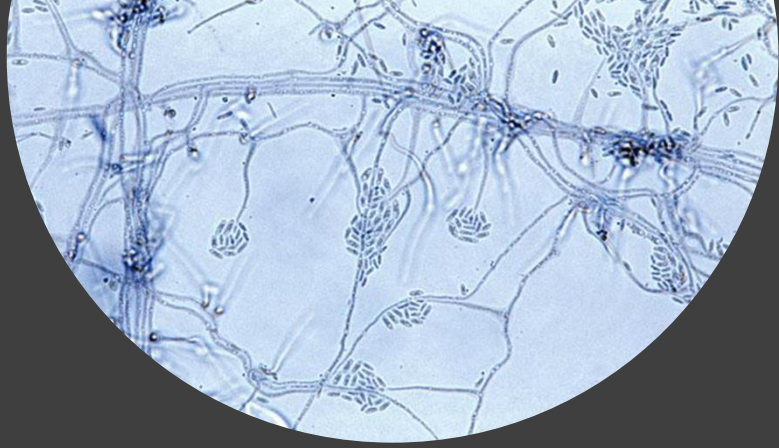


ONYCHOMYCOSIS

DEFINITION AND CHARACTERISTICS

The fungal infection of the nails is a superficial mycosis, and it affects the nail plate, the nail bed and the nail matrix. During the development of the infection, there is an initial colonization with subsequent invasion of the nail bed and plate, which causes color, texture and shape alterations in the nail .

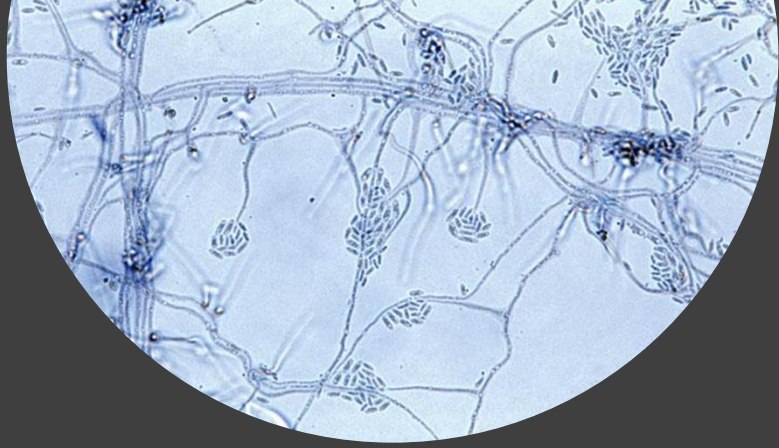
Nail fungal diseases are contagious and the transmission between family members is the most common route, being able to spread to other family members if not treated. The carriers of the disease work as an infection source and, potentially, can contaminate common areas. The most common source of infection is the shower.



ONYCHOMYCOSIS

NOMENCLATURE

The disease is called onychomycosis when non-dermatophyte filamentous fungi cause the infection of the nail plate. However, when the agent is a dermatophyte fungus, it is called tinea unguium, which is the plural form. When only one nail is affected, it is said tinea unguis. Although, in a generic way, all infections caused by fungi on nails are called onychomycosis. Here we will adopt this generic term.

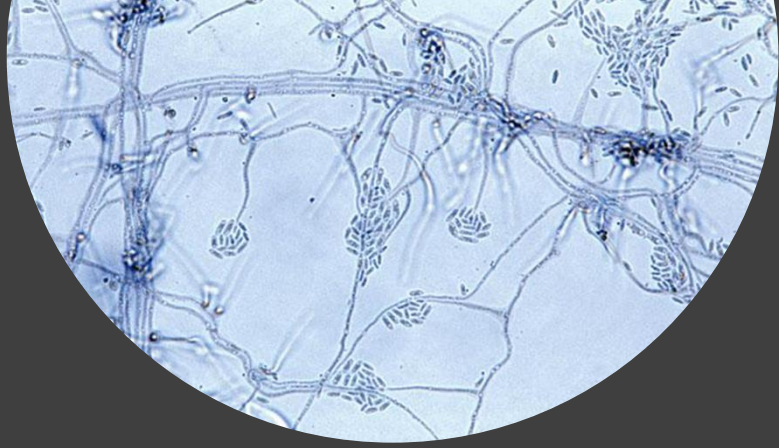


ONYCHOMYCOSIS

ETIOLOGIC AGENTS

The etiologic agents of onychomycosis are dermatophyte fungi, yeast and non-dermatophyte filamentous fungi, the last ones can be hyaline fungi or dematiaceous fungi.

Dermatophyte fungi are responsible for 60 to 85% of the infections. Non-dermatophyte filamentous fungi and yeast can also affect nails, and both are responsible for 30 to 40% of onychomycosis. Non-dermatophyte filamentous fungi are responsible for 20% of nail fungal infections.

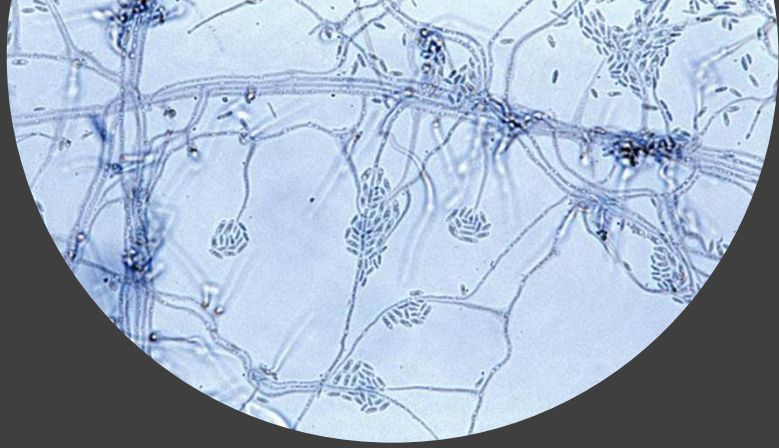


ONYCHOMYCOSIS

ETIOLOGIC AGENTS

a) Dermatophyte Fungi

Generally, dermatophyte fungi are composed by the genus *Microsporum*, *Trichophyton* e *Epidermophyton*. Due to their affinity to keratinized tissues, *Trichophyton rubrum* and *Trichophyton mentagrophytes* are identified as the most pathogenic fungi of nails, in more than 50% of cases and approximately 20% of cases respectively.



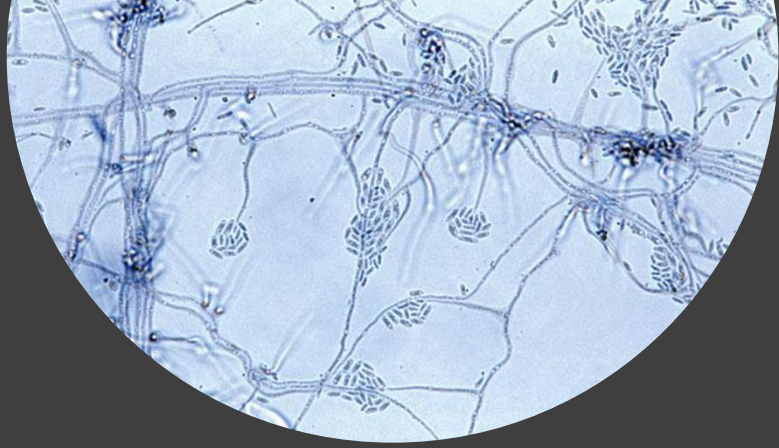
ONYCHOMYCOSIS

ETIOLOGIC AGENTS

b) Non-dermatophyte Fungi

The main agents involved from this class are *Scopulariopsis brevicaulis*, *Arpergillus* spp, *Acremonium*, *Fusarium* spp, *Alternaria alternate* e *Neocystalidium*. They are the most common in people who are between 40 and 60, in patients with dermatosis that affect the nails and in immunocompromised patients.

Except for the species of *Neocystalidium*, non-dermatophyte filamentous fungi are not keratinolytic fungi. Onychomycosis diagnostic by non-dermatophyte filamentous fungi is more complex than the onychomycosis diagnostic by dermatophyte fungi because, instead of primary pathogens of the nail plate, the first are frequently common contaminants of the nails and of the mycology laboratory, and colonizing agents, secondary invaders, affecting previously sick or traumatized nails.

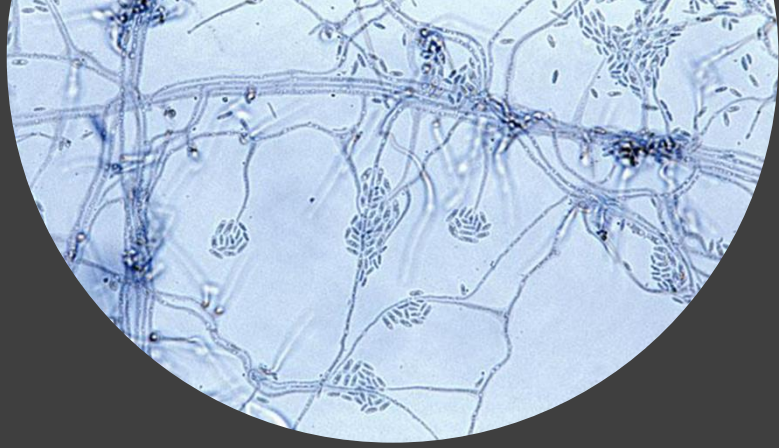


ONYCHOMYCOSIS

ETIOLOGIC AGENTS

c) Yeast-like Fungi

Candida species are responsible for 10 to 20% of onychomycosis. Onychomycosis caused by *Candida* sp. are generally followed by paronychia and happen more frequently in the nails of the hand.

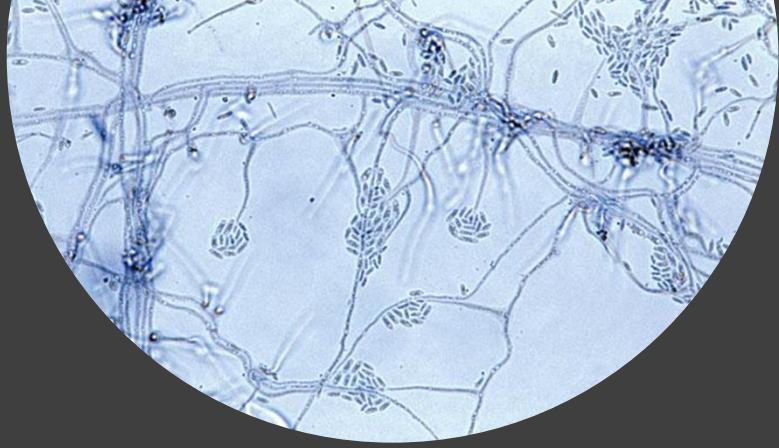


EPIDEMIOLOGY

Onychomycosis is a cosmopolitan disease which is frequent and recalcitrant, and affects approximately among 5,5 to 10% of the general population, with frequencies that vary in different parts of the world, and continues to spread and persist. It is more frequent in man than in women, in a ratio of 1.5 to 1, and it is much less frequent in children. From all the diseases that affect nails, onychomycosis is the most frequent, being responsible for half nail affections. This frequency has been related as growing in children and also in adults and elderly people, which can be justified by some factors such as immunosuppression, changes in life style, environmental characteristics and population aging, since onychomycosis prevalence increases with age.

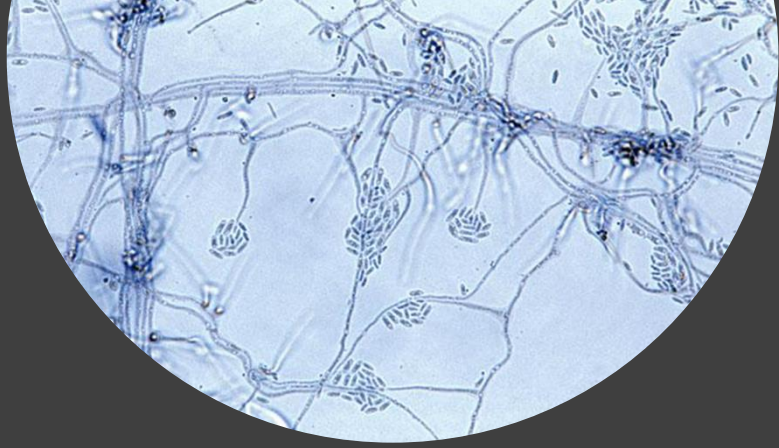
ONYCHOMYCOSIS





ONYCHOMYCOSIS

Toenails are seven times more affected than fingernails. This happens because the feet are in direct contact with reservoirs, in which the dermatophytes commonly colonize, as they are confined to a humid environment inside the shoes, because of a trauma caused by the shoes, due to the slower growth of the nail plate of the toes, and by the presence of vascular subjacent diseases. The hallux and the fifth toe are the most frequently affected, probably because shoes cause more damage to these toes. The involvement of hallux happens in around 70% of times.

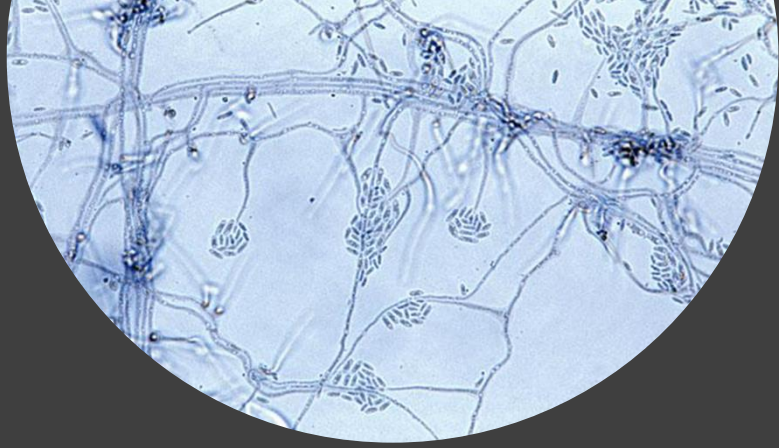


ONYCHOMYCOSIS

PREDISPOSING FACTORS

Some conditions can be implied as predisposing factors, or are associated to a higher tendency or prevalence of onychomycosis, and they also might be external or internal conditions of the subject.



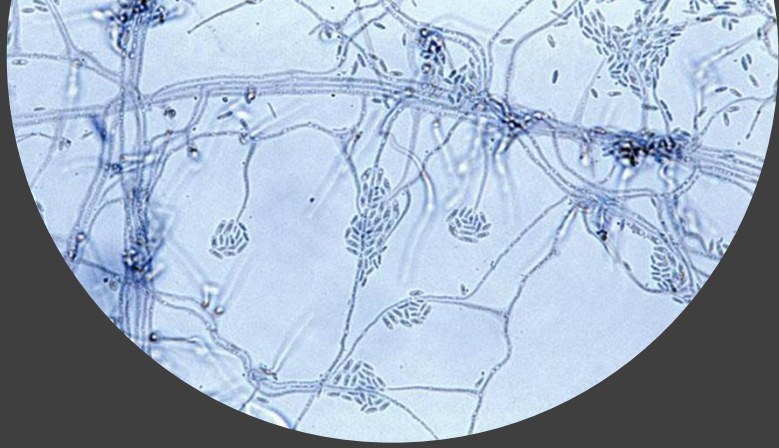


ONYCHOMYCOSIS

PREDISPOSING FACTORS

1. External Factors

The factors that are related to an increase in the incidence of onychomycosis are tropical and humid climate, poverty conditions and over crowded residences, nail trauma, increased exposure to wet work, walking barefoot, travelling frequency, wearing inappropriate shoes, going to public swimming pools, and type of individual occupation, such as athletes and sportspeople. In these, the increase of the disease's incidence probably occurs because of the increase of the nail trauma, the increase in sweat, the use of synthetic materials that retain sweat, and the higher incidence of tinea pedis in this group of individuals.

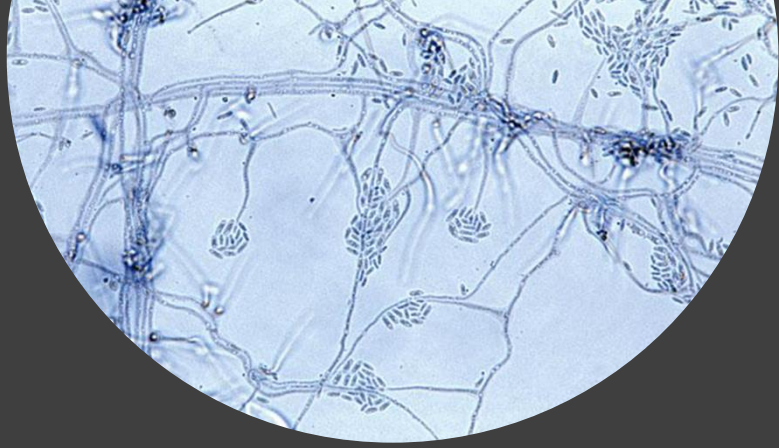


ONYCHOMYCOSIS

PREDISPOSING FACTORS

2. Internal Factors

The following diseases are considered internal factors related to the appearance of onychomycosis: nail psoriasis, hyperhidrosis, immunosuppression, peripheral neuropathy, peripheral vascular insufficiency and Down Syndrome. Besides these, the following are also considered predisposing factors: tinea pedis, advanced age, diabetes mellitus, family history, HIV infection.



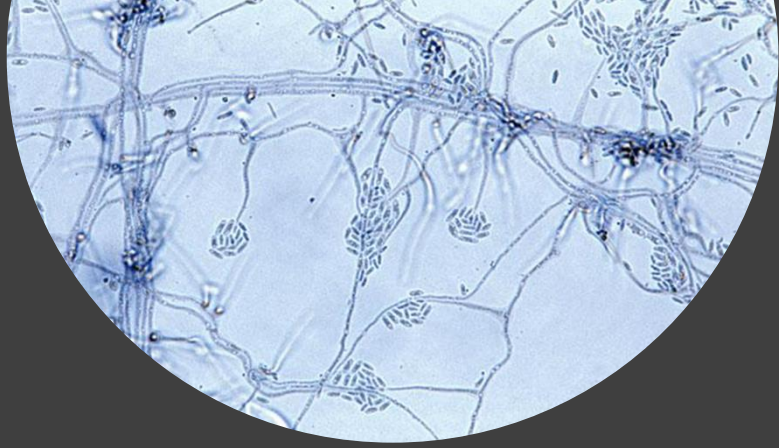
ONYCHOMYCOSIS

PREDISPOSING FACTORS

2. Internal Factors

a. Tinea Pedis

Tinea pedis can be considered a predisposing factor to onychomycosis once this is associated to tinea pedis in up to one third of the cases.



ONYCHOMYCOSIS

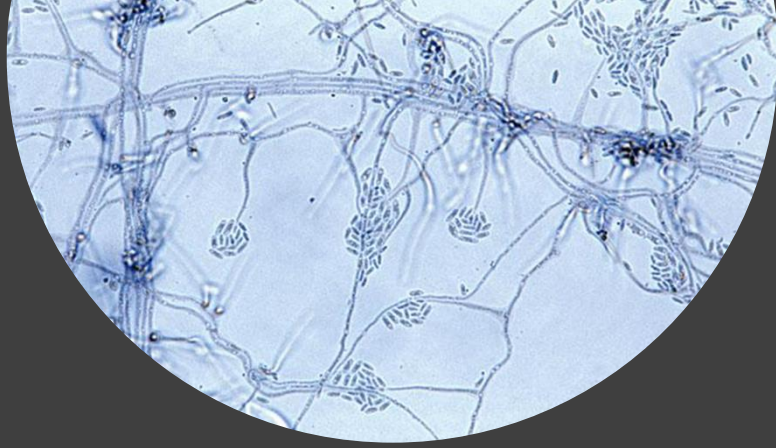
PREDISPOSING FACTORS

2. Internal Factors

b. Advanced Age

Advanced age is justified as a predisposing factor to onychomycosis because of a series of factors, such as the decrease of the peripheral circulation, inactivity, suboptimal immune state, diabetes, slower growth of the nail plate, difficulty in the care of nails and maintenance of feet hygiene, frequent lesion to the nails and increase in the exposition to predisposing diseases to fungal infection.

ONYCHOMYCOSIS

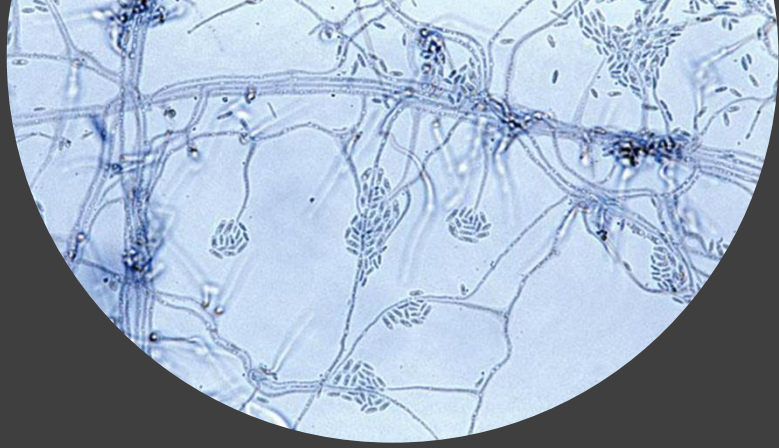


PREDISPOSING FACTORS

2. Internal Factors

c. Diabetes Mellitus

Diabetes mellitus is an important risk factor. One third of the patients with diabetes are affected by onychomycosis. In these patients there are aggravating factors in regard to onychomycosis, since the sick nail has the potential of hurting the adjacent skin, which can go by unnoticed due to sensorial neuropathy, and this can predispose to osteomyelitis and diabetic ulcers.



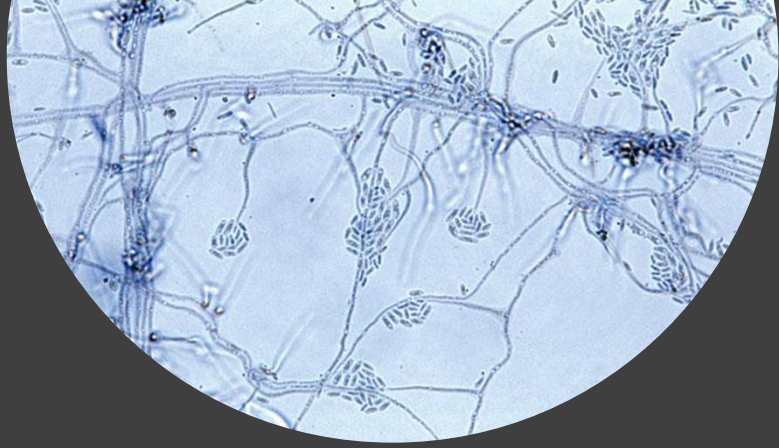
ONYCHOMYCOSIS

PREDISPOSING FACTORS

2. Internal Factors

d. Family History

Onychomycosis family history is also considered a risk factor, once some studies suggest that a genetic basis for onychomycosis susceptibility. Several studies have highlighted increased risk to the development of onychomycosis in subjects who had at least one parent who had had onychomycosis. Besides that, the infection by *Trichophyton rubrum* has showed a familiar pattern of autosomal dominant inheritance.



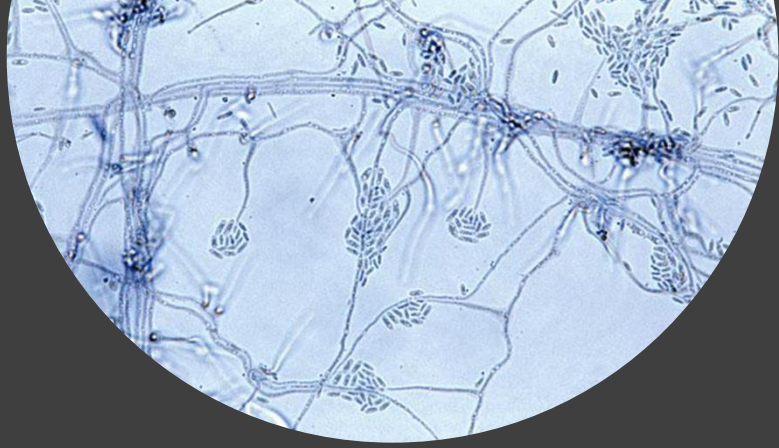
PREDISPOSING FACTORS

2. Internal Factors

e. HIV Infection

Subjects infected by HIV have an increased risk of developing onychomycosis when their T cells count is as low as 400 cells per mm^3 , and onychomycosis in these people tends to be more widespread.

ONYCHOMYCOSIS

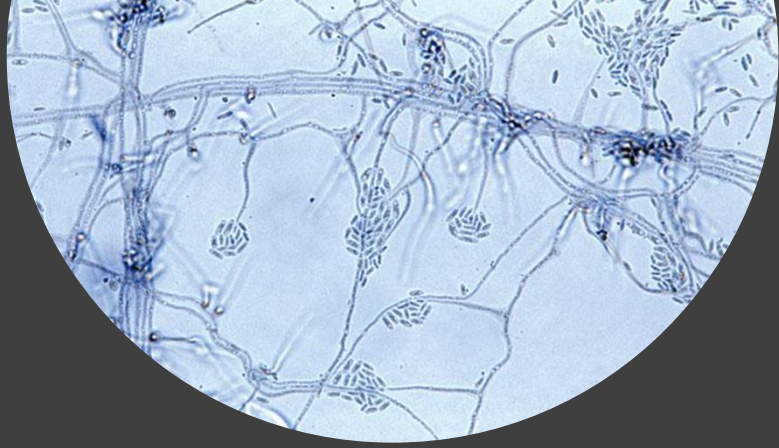


ONYCHOMYCOSIS

CLINICAL CONDITION

a. Distal and Lateral Subungual Onychomycosis

The most frequent form of onychomycosis are the distal and lateral subungual types. In these types, the fungus invades the nail and the nail bed while it penetrates the distal or lateral borders of the nail. It affects mainly the hyponychium and the lateral borders, progresses towards the proximal portion and causes subungual hyperkeratosis, nail plate discoloration, nail thickening and onycholysis.



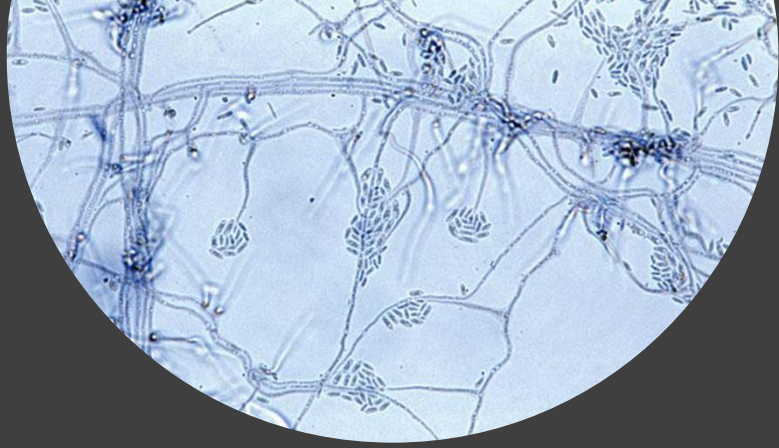
CLINICAL CONDITION

b. Proximal Subungual Onychomycosis

The proximal subungual infection is developed when the fungus invades from the lower surface of the proximal nail border, and the distal portion of the nail plate remains normal until the disease progresses towards the distal portion. Generally it occurs in the toes. It is related to immunosuppression, usually affecting patients with diabetes mellitus, transplant patients, patients undergoing hemodialysis treatment, and sometimes being an indicator of HIV infection or Acquired Immunodeficiency Syndrome (AIDS). The main etiologic agent is still *Trichophyton rubrum*; however, other frequently found agents in this clinical condition are *Trichophyton schoelleinii* and *Trichophyton tonsurans*.

ONYCHOMYCOSIS



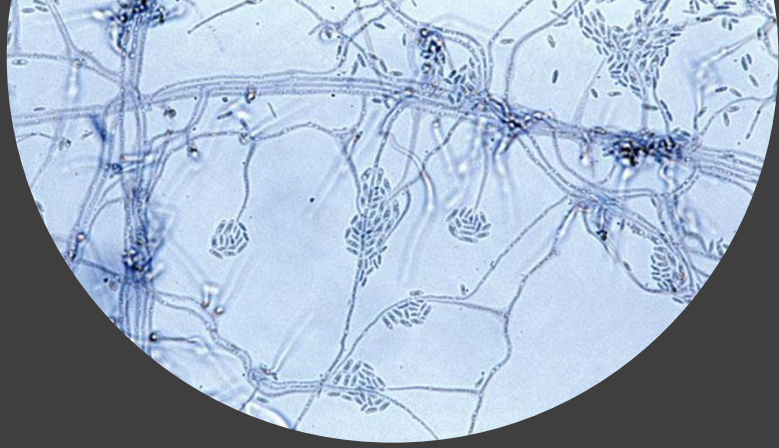


ONYCHOMYCOSIS

CLINICAL CONDITION

c. White Superficial Onychomycosis

In the white superficial type, the infection usually starts in the superficial layer of the nail plate, and it spreads itself until all the nail plate is involved. This clinical type affects mainly the hallux in small areas or all the nail plate. It occurs mainly in children and it can, occasionally, be related to immunosuppression. The most common agent found in this type is *T. mentagrophytes var. interdigitale*.



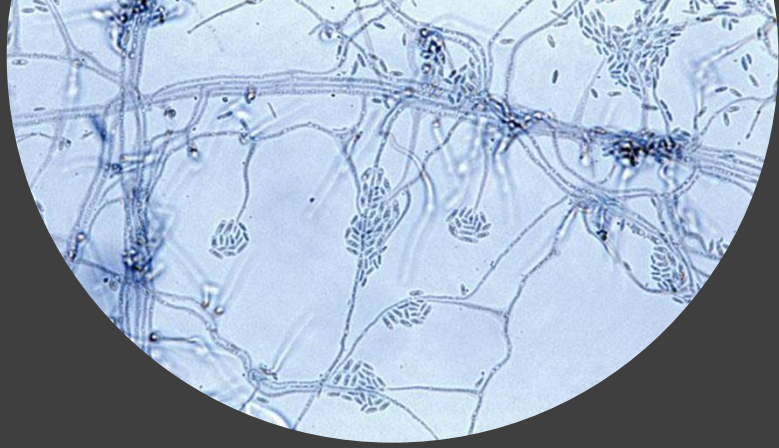
ONYCHOMYCOSIS

CLINICAL CONDITION

d. Total Dystrophic Onychomycosis

Total dystrophic type is the most severe form, in which the nail plate is almost completely destroyed. It generally represents the evolution of the distal and lateral subungual type; however, any other clinical type can evolve to the total dystrophic type.



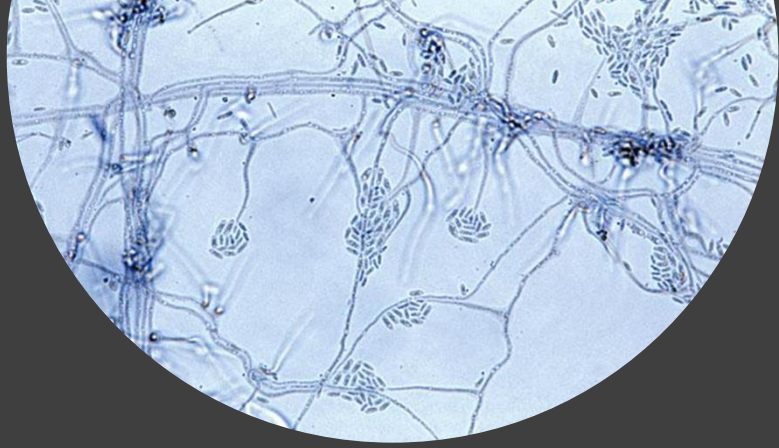


SAMPLE COLLECTION

GENERAL ORIENTATIONS

The patients must be oriented to remove any nail polish they may have on their nails before the examination.

The samples must be collected before the beginning of any local or systemic antifungal therapy, so that false-negative results can be avoided. Therefore, patients must not use any topical antifungal drug for two weeks, or any systemic drug for two months.

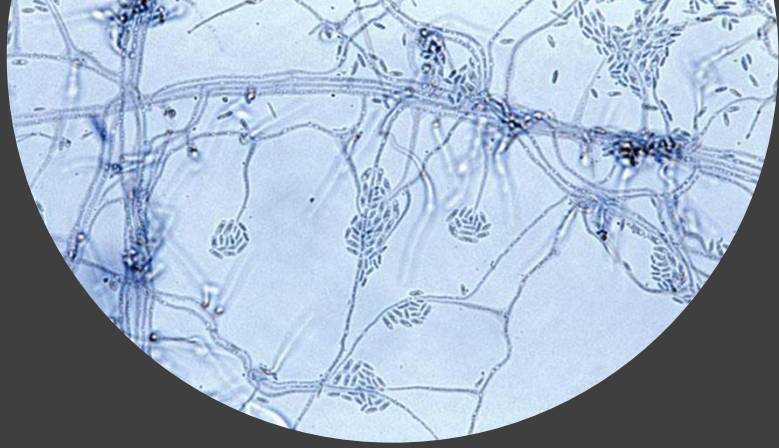


SAMPLE COLLECTION

PLACE OF THE COLLECTION

The clinical presentation of onychomycosis will determine the location of the material collection :

- Distal Subungual Type: the sample must be collected from the most proximal region to the affected area;
- White Superficial Type: the material must be collected from scraping the clinically altered surface of the nail;
- Proximal Subungual Type: the nail plate must be softly unbridled to collect subjacent nail debris.



SAMPLE COLLECTION

METHOD

- Cleaning the nail plate and the skin around with 70% ethyl alcohol-soaked gauze. This care is taken in order to reduce the risk of saprophytic bacteria or fungi to contaminate the samples;
- Collect the subungual debris from the borderline region between affected nail and healthy nail, which means the closest region that corresponds to the active area of the lesion. Only in the cases of suspect of white superficial onychomycosis the scraping must be done on the surface of the nail plate, where the leukonychia is;
- Distal subungual debris must not be submitted to culture because many times they carry contaminant saprophytic bacteria or fungi which can easily surpass the growth of the dermatophyte fungi in the culture medium;
- Collect the material by scrapping, with sterile instrument (Lecron carver was used);
- Sufficient quantity of material must be collected. Many times, inadequate samples (in quantities or quality) lead to diagnostic failure;
- The material collected must be divided in two parts: one for the direct mycological examination, and the other for fungal culture.



SAMPLE COLLECTION

MATERIAL:

- Lecron carver
- 70% alcohol
- Gauze
- Disposable gloves



Figure 2. Material for sample collection.

SAMPLE COLLECTION

LECRON CARVER

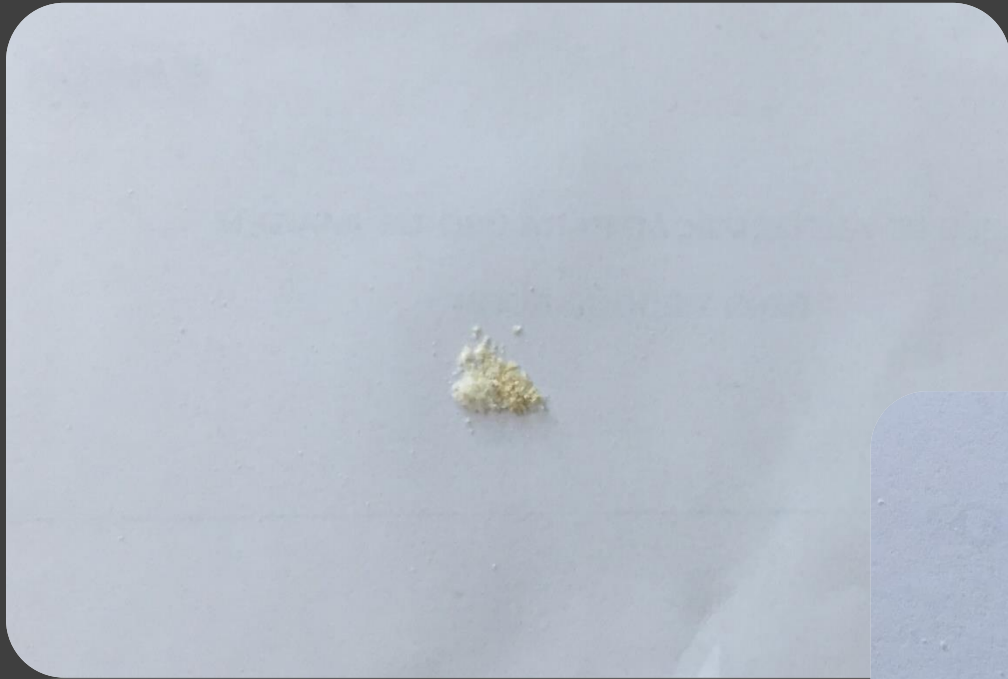


Figure 3. Lecron carver.

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SAMPLE COLLECTION



COLLECTED SAMPLE

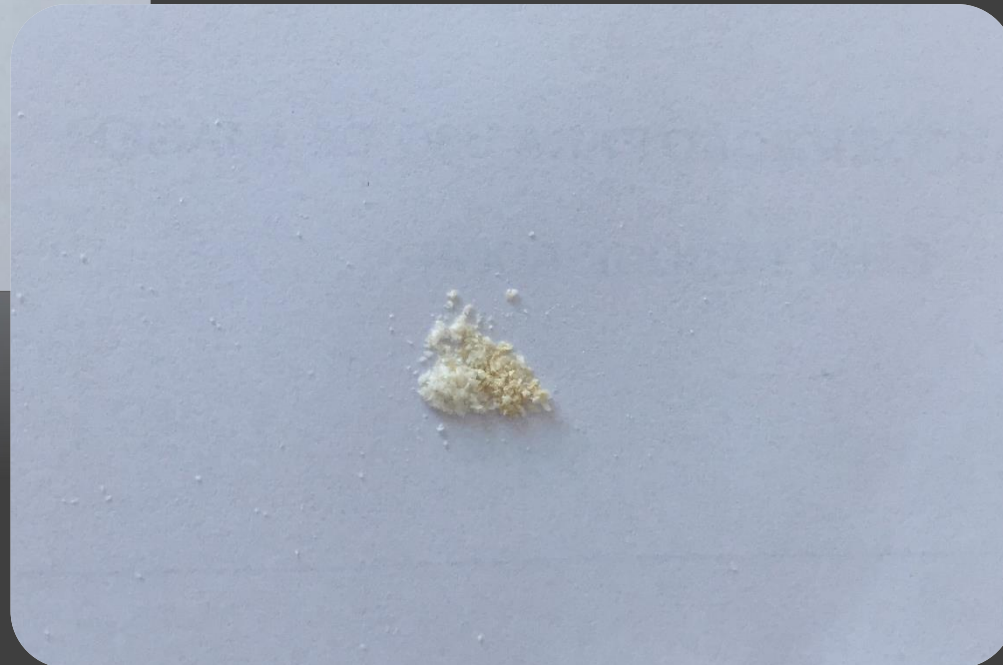
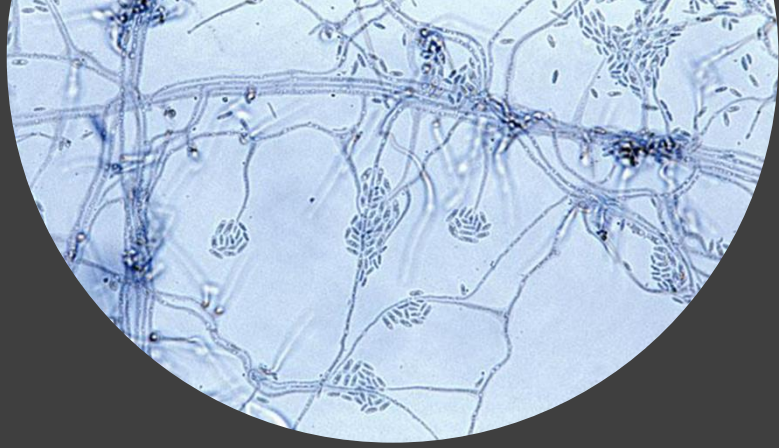


Figure 4. Collected sample.

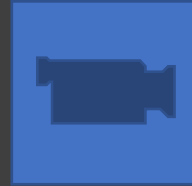
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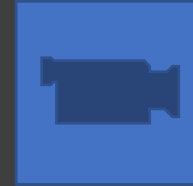


SAMPLE COLLECTION

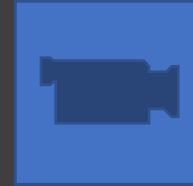
ASSEPSIS VIDEOS



Video 1.



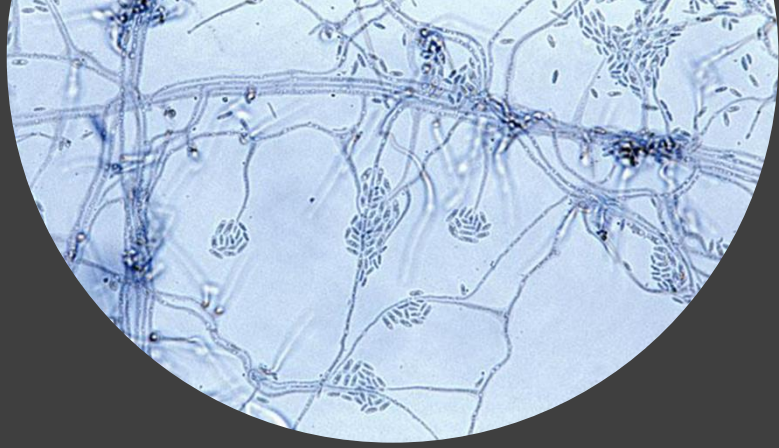
Video 2.



Video 3.

MAIN
MENU





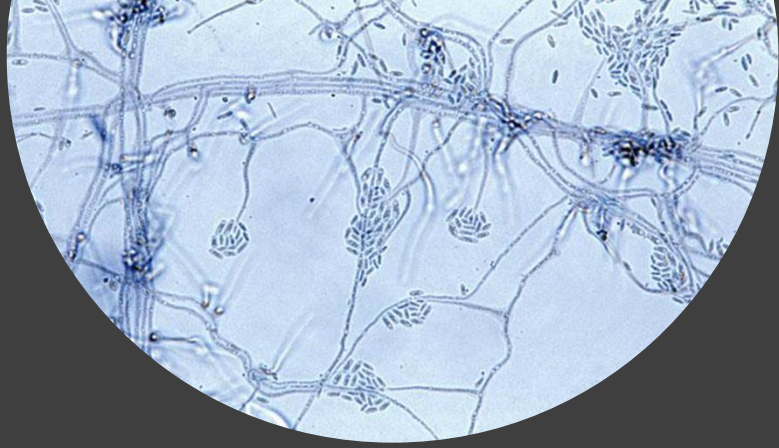
SAMPLE COLLECTION



Video 1. Assepsis.

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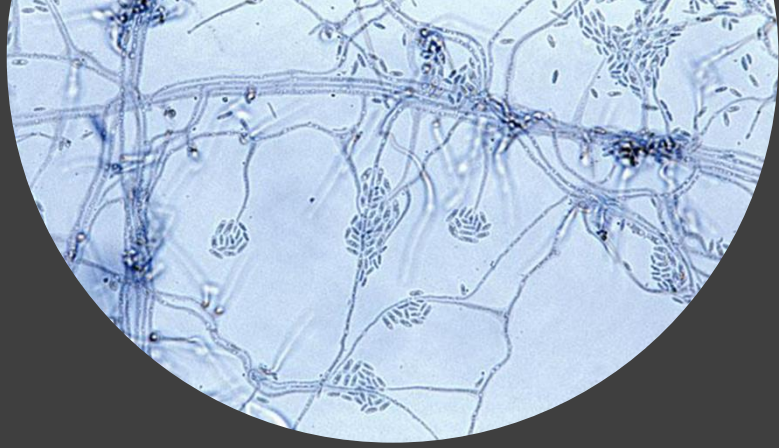
SAMPLE COLLECTION



Video 2. Assepsis.

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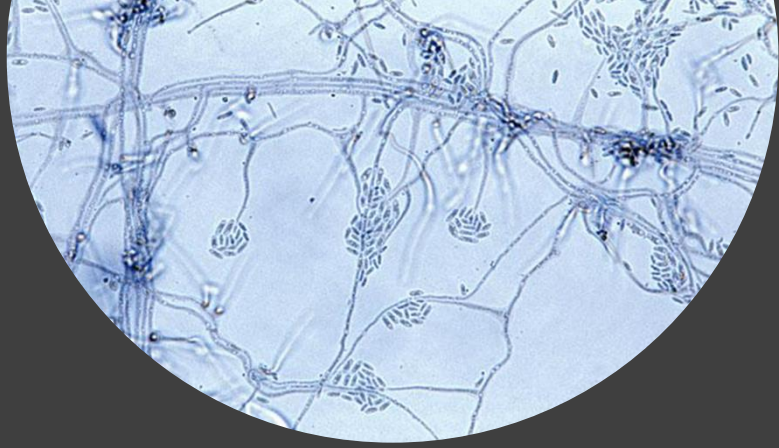
SAMPLE COLLECTION



Video 3. Assepsis.

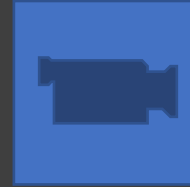
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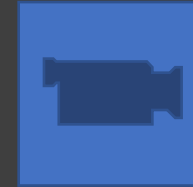


SAMPLE COLLECTION

SAMPLE COLLECTION VIDEOS



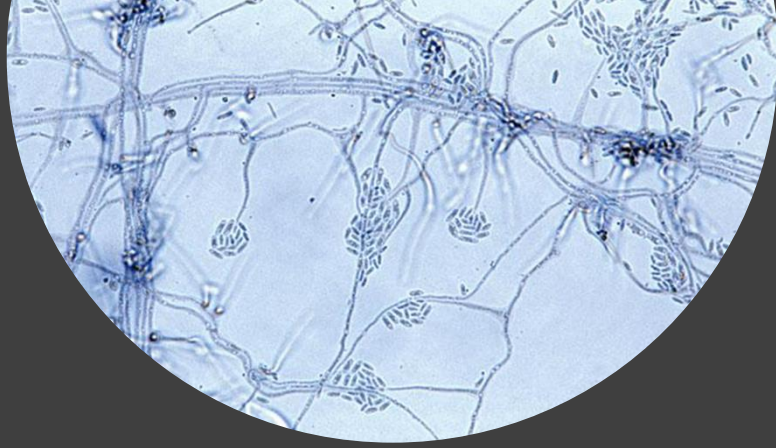
Video 4.



Video 5.

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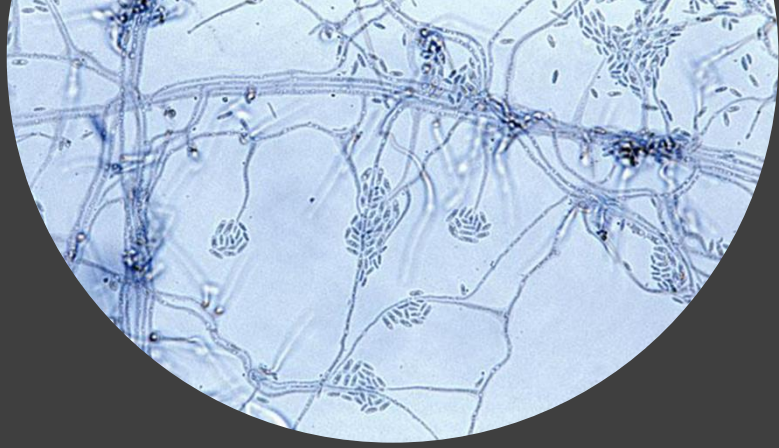
SAMPLE COLLECTION



Video 4. Sample collection.

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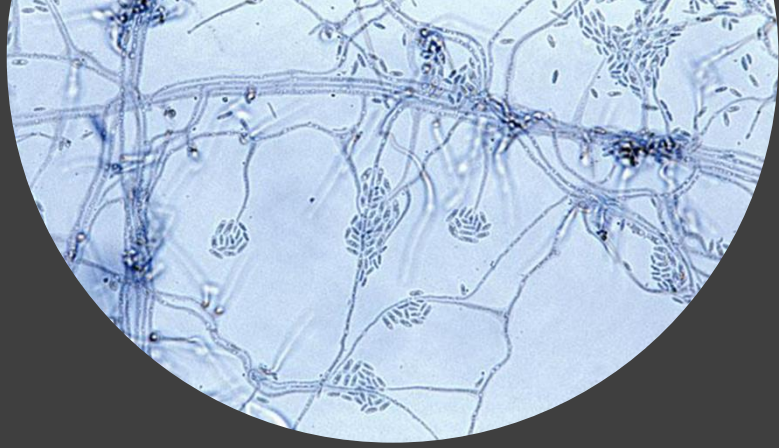
SAMPLE COLLECTION



Video 5. Sample collection.

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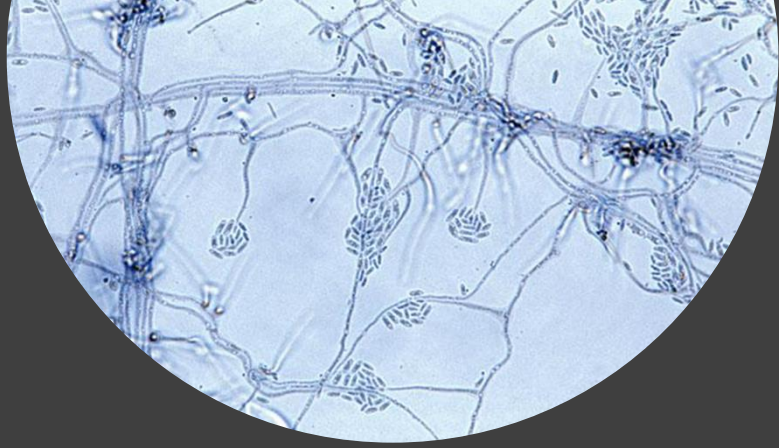




DIRECT MYCOLOGICAL EXAMINATION

CHARACTERISTICS:

- Cheap;
- Quickly enables results;
- Allows the examiner to observe hyphae, indicating that the patient is infected by a fungus, but without its etiologic elucidation;
- Fungal viability cannot be determined. Therefore positive results might be misleading if used to healing determination;
- The result of the direct examination can vary considerably, depending on the examiner. Therefore, subjectivity in the microscopic identification is considered;
- Other factors that can interfere with results are the possibility of artifacts, environmental contaminants, or in some cases, low level of parasitism in the sample. A high rate of false-negatives, varying from 5 to 40% in different studies, due to low visibility and sparse distribution of hyphae on the microscope slide;
- Part of the material collected in the nail to be studied must be assigned to perform the direct examination. Its accuracy depends on a good sample collection, preparation and examiner's experience.

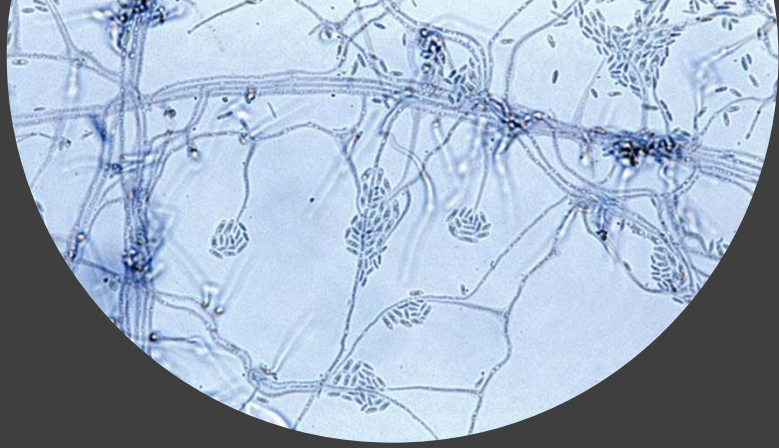


DIRECT MYCOLOGICAL EXAMINATION

MICROSCOPE SLIDE PREPARATION

- The material collected is placed on a microscope slide and clarified with a drop of potassium hydroxide (KOH) 10 or 20%, or lactophenol blue solution. This facilitates the visualization of fungal elements due to the degradation of keratin;
- The clarification by KOH is simple and cheap, however, the analysis of the material must be done quickly, since keratin is irreversibly degraded;
- The use of lactophenol blue solution is useful when the direct examination will not be immediately performed;
- After the clarification of the material, the coverslip is put on top of it and the preparation of the slide, which will be analyzed on the microscope, is finished.

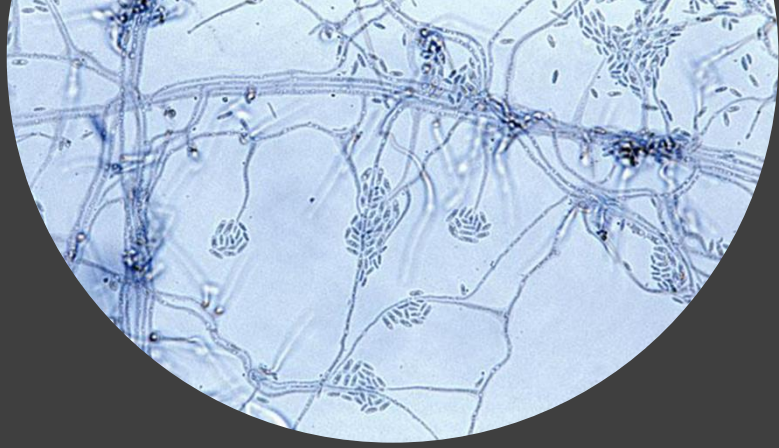




DIRECT MYCOLOGICAL EXAMINATION

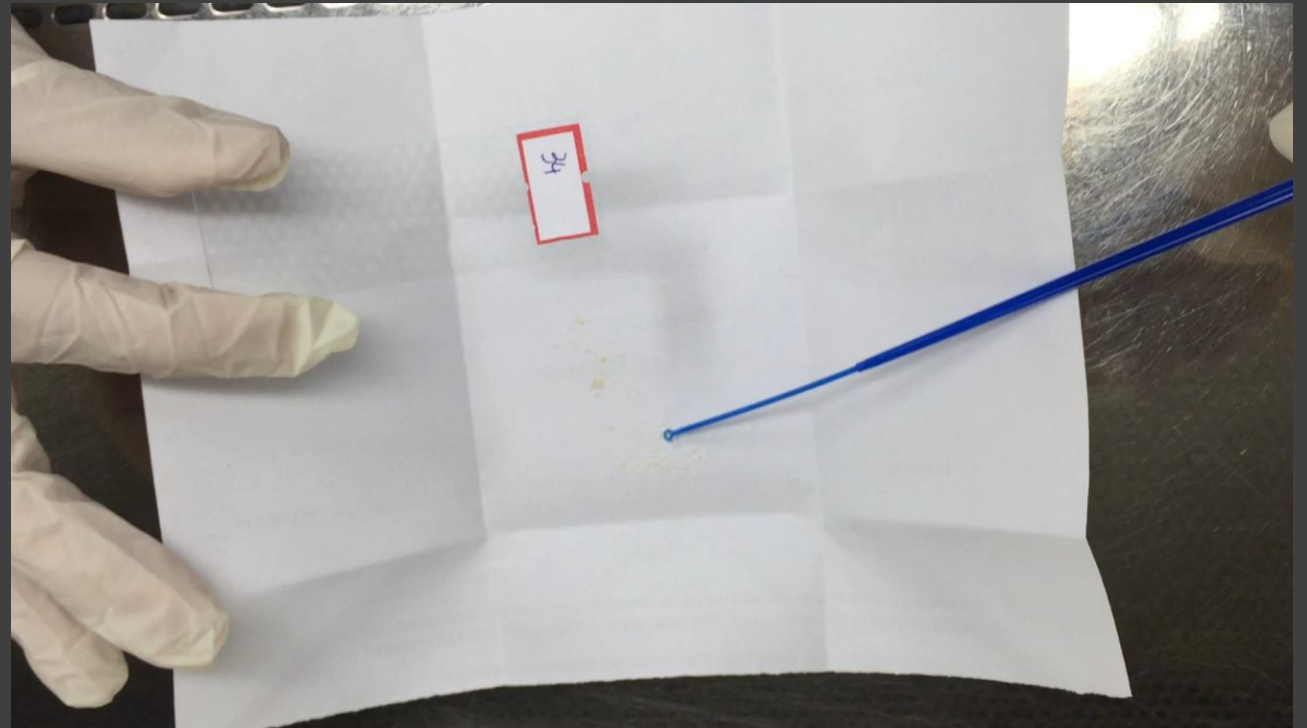
- Calcofluor-white is a fluorescent agent which is mixed with KOH in order to color the chitin on the fungus cell wall, making fungal elements more easily visible on the background of host cellular material;
- It bonds to beta 1-3 and beta 1-4 polysaccharides in cellulose and chitin and fluoresce when exposed to UV radiation;
- The sensibility associated to the traditional KOH test is overcome when calcofluor-white is used, if an appropriate specimen is collected, even though both techniques have demonstrated similar efficiency. Although, the need for a fluorescence microscope to use this dye can often be a barrier to its use.





DIRECT MYCOLOGICAL EXAMINATION

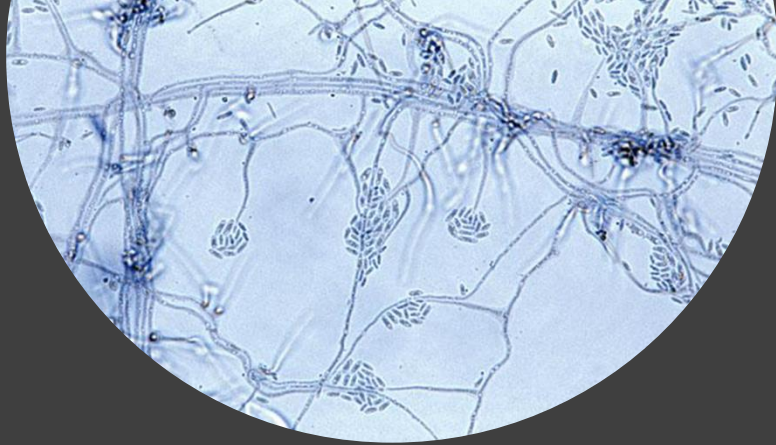
MICROSCOPE SLIDE PREPARATION



Video 6. Microscope slide preparation.

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DIRECT MYCOLOGICAL EXAMINATION

MICROSCOPE SLIDE PREPARATION

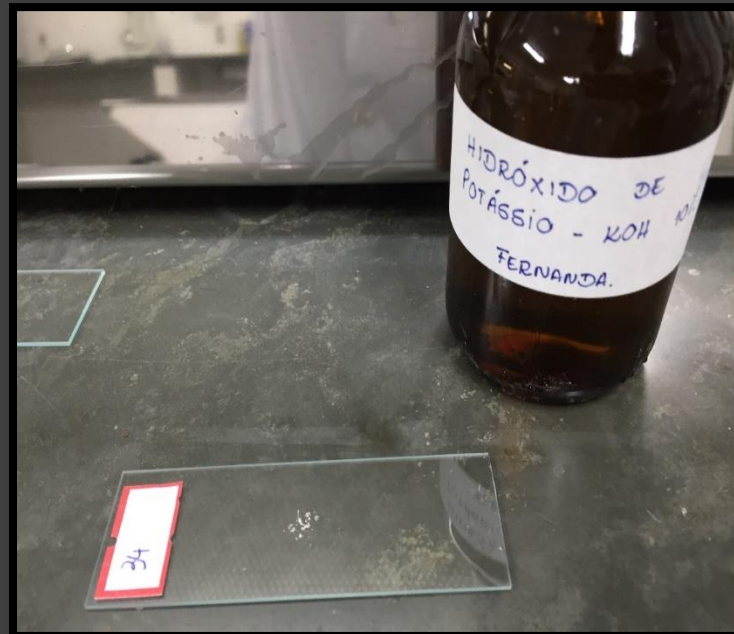


Figure 5. Sample placed on microscope slide.

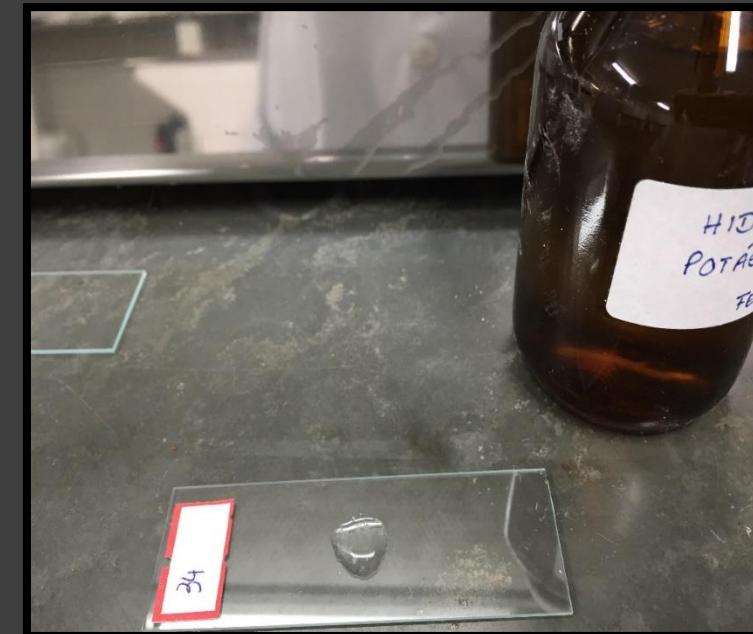
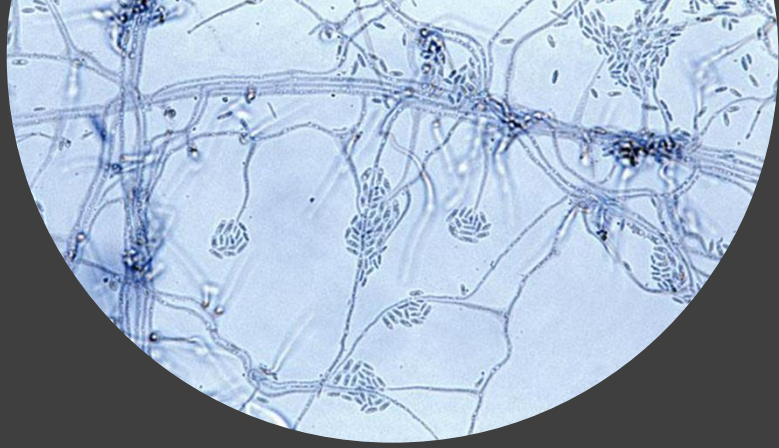


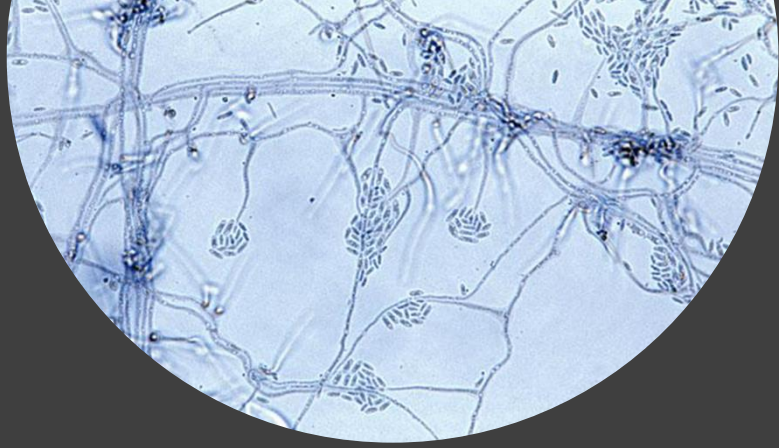
Figure 6. One drop of KOH was placed over the material. After this step, put the coverslip on top of the slide.



DIRECT MYCOLOGICAL EXAMINATION

DIAGNOSTIC:

- The presence of hyphae in the direct examination confirms the onychomycosis diagnostic. Besides, morphologic characteristic of the hyphae can help in the diagnostic;
- The direct examination of dermatophyte fungi is characterized by the presence of: hyaline, septate and branched hyphae and arthroconidia;
- Brownish hyphae are characteristics of dematiaceous fungi. Non-dermatophyte filamentous fungi have irregular hyphae (ASZ-SIGAL; TOSTI; ARENAS, 2016);
- Candidiasis direct examination: hyaline, septate hyphae, pseudo-hyphae and blastoconidia.



DIRECT
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**DIRECT MYCOLOGICAL
EXAMINATION FIGURES**

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DIRECT MICROLOGICAL
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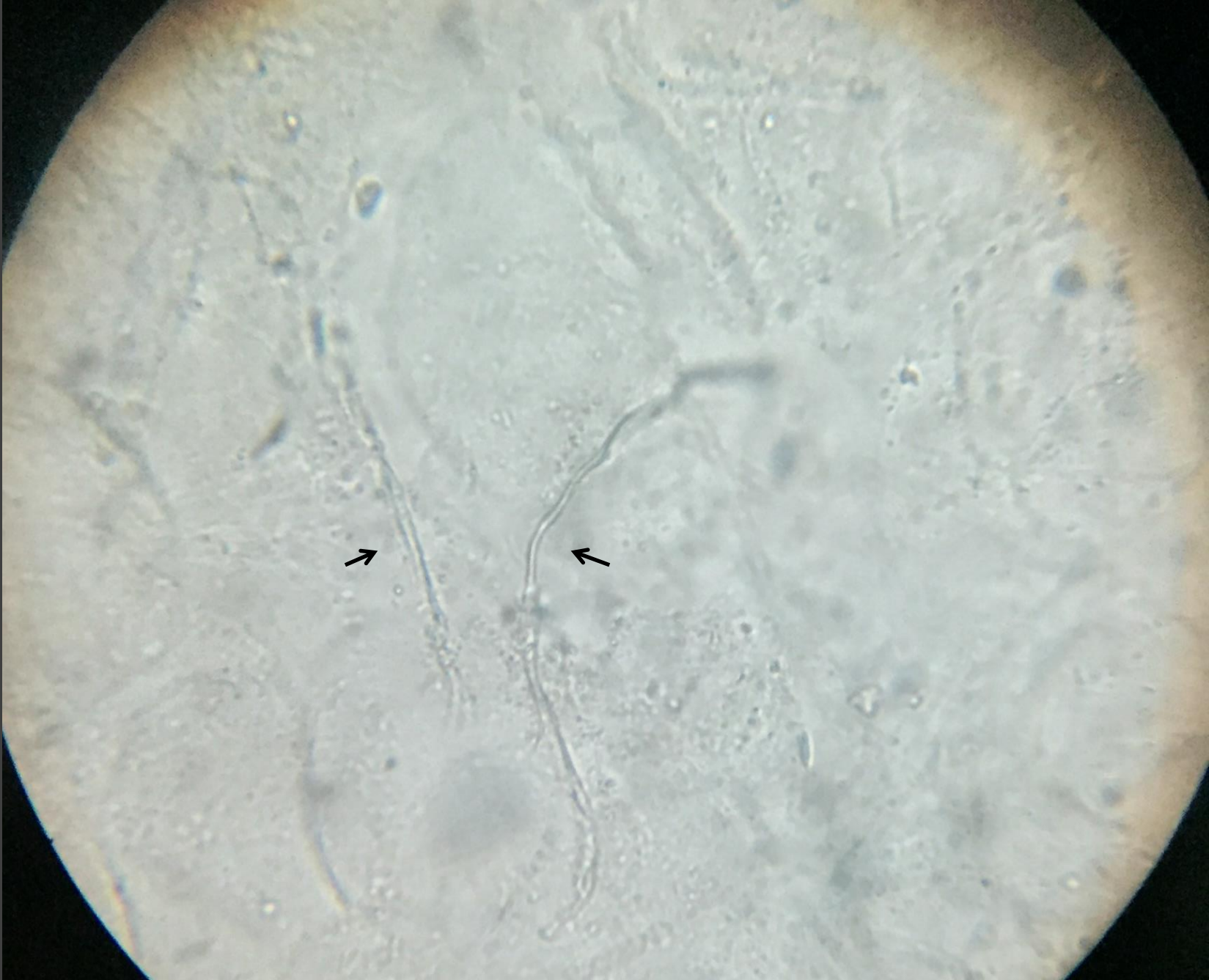


Figure 7. Dermatophyte Direct Examination: hyaline, septate, branched hyphae and arthroconidia.



DIRECT MICROLOGICAL EXAMINATION

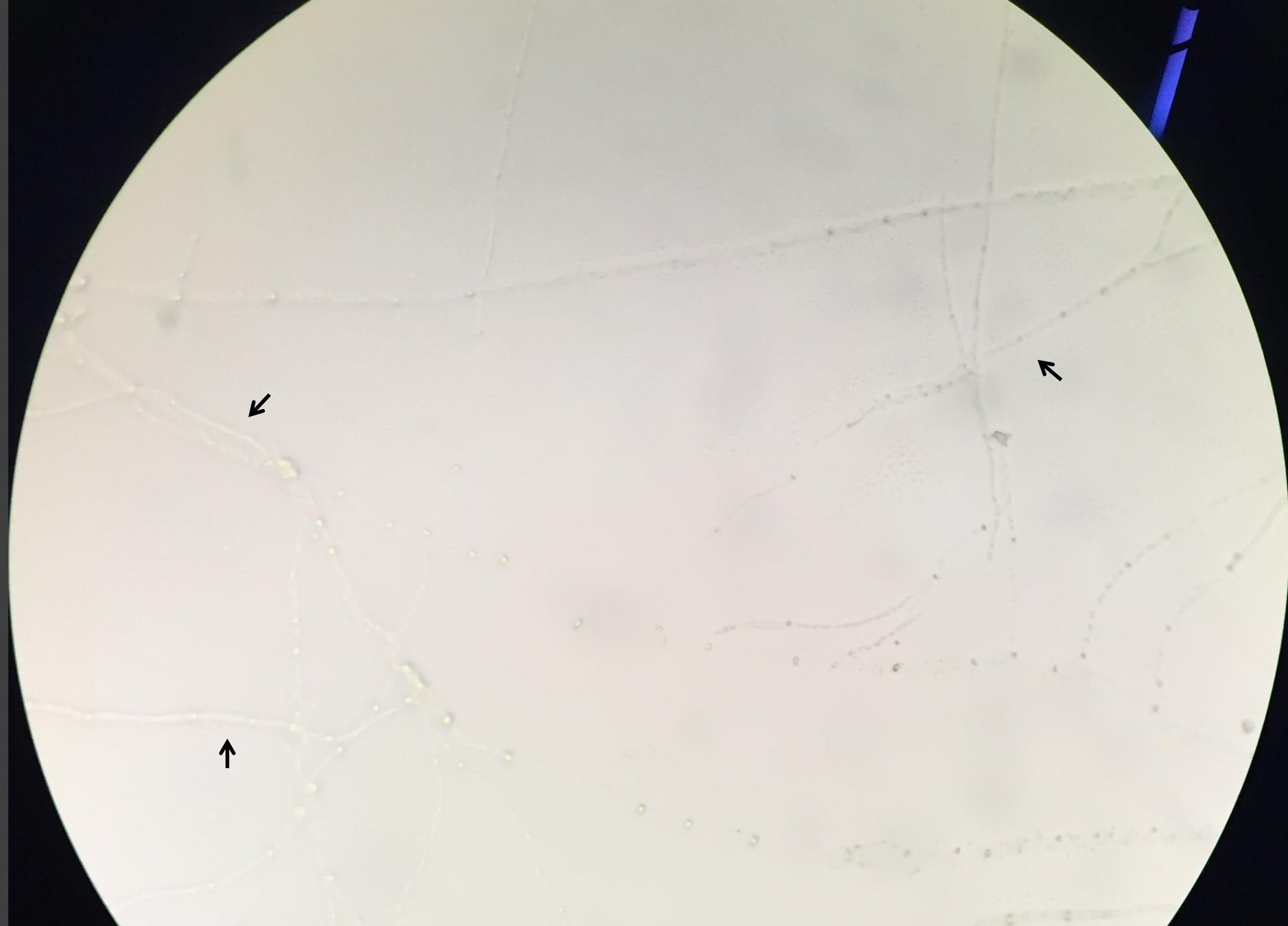


Figure 8. Dermatophyte Direct Examination: hyaline, septate, branched hyphae and arthroconidia.

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DIRECT MICROLOGICAL EXAMINATION

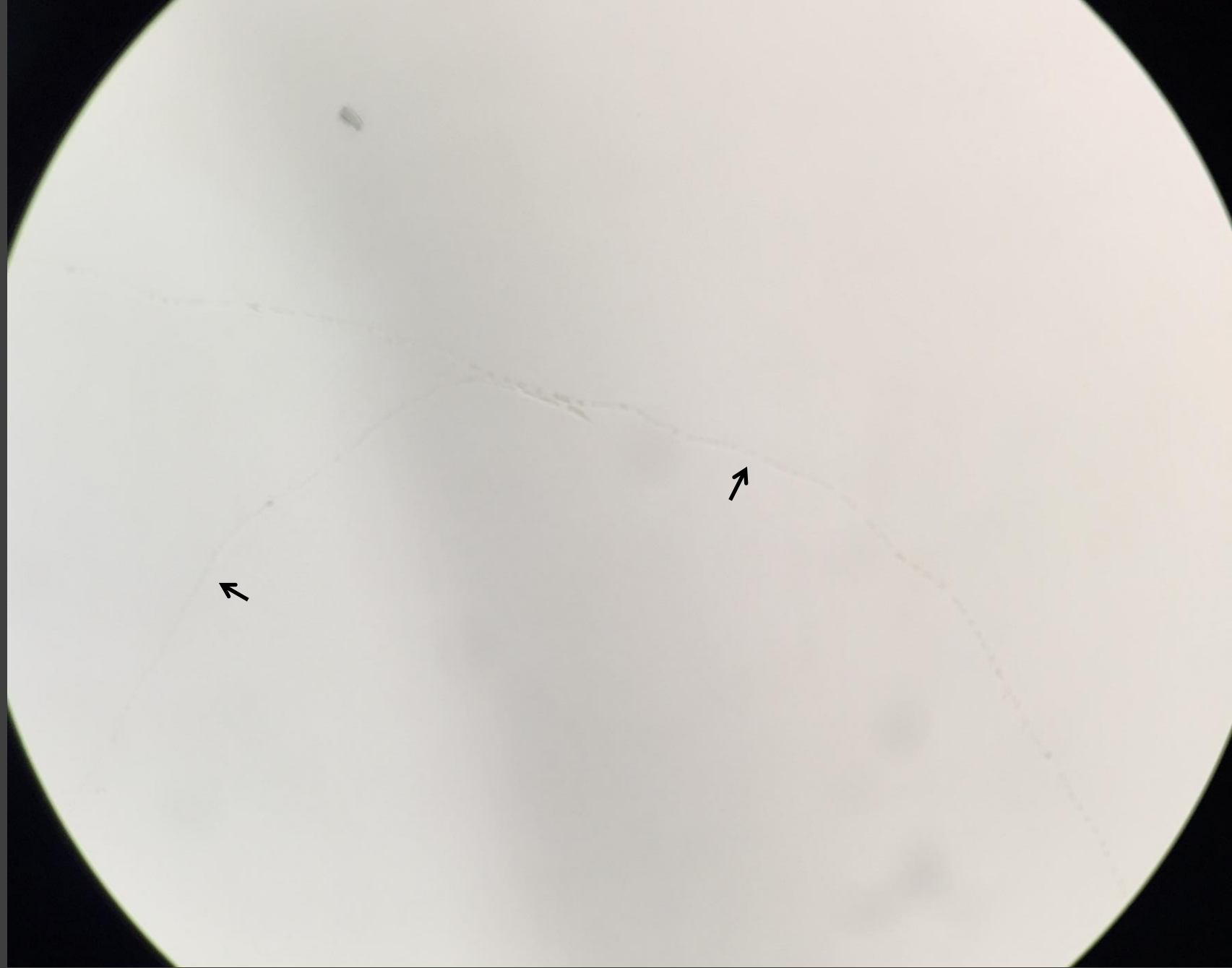


Figure 9. Dermatophyte Direct Examination: hyaline, septate, branched hyphae and arthroconidia.

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DIRECT MICROLOGICAL EXAMINATION



Figure 10. Dermatophyte Direct Examination: hyaline, septate, branched hyphae and arthroconidia.

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DIRECT MICROLOGICAL EXAMINATION



Figure 11. Dermatophyte Direct Examination: hyaline, septate, branched hyphae and arthroconidia.

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DIRECT
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Figure 12. Dermatophyte Direct Examination: hyaline, septate, branched hyphae and arthroconidia.

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DIRECT MICROLOGICAL EXAMINATION

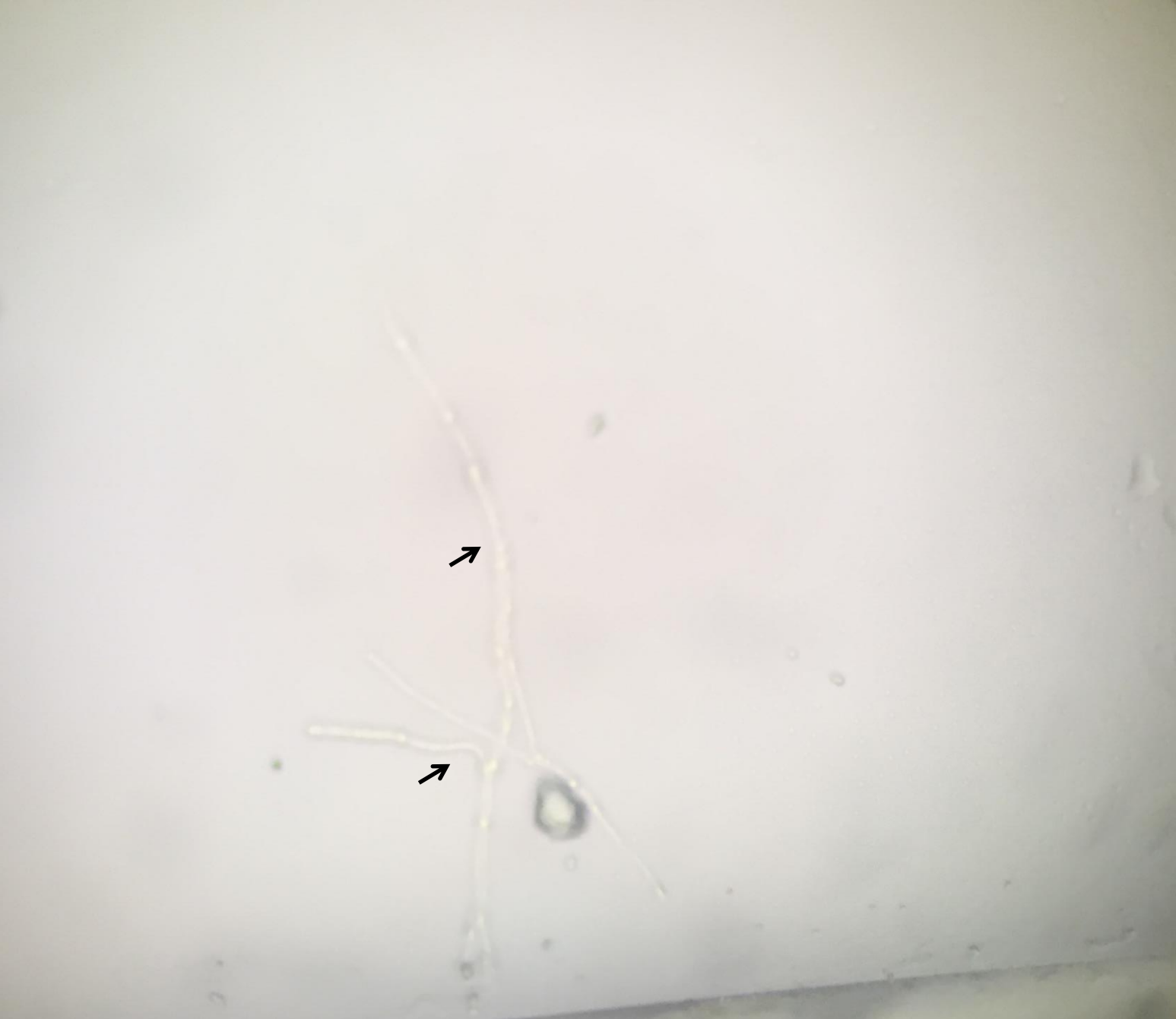


Figure 13. Dermatophyte Direct Examination: hyaline, septate, branched hyphae and arthroconidia.



DIRECT MICROLOGICAL EXAMINATION

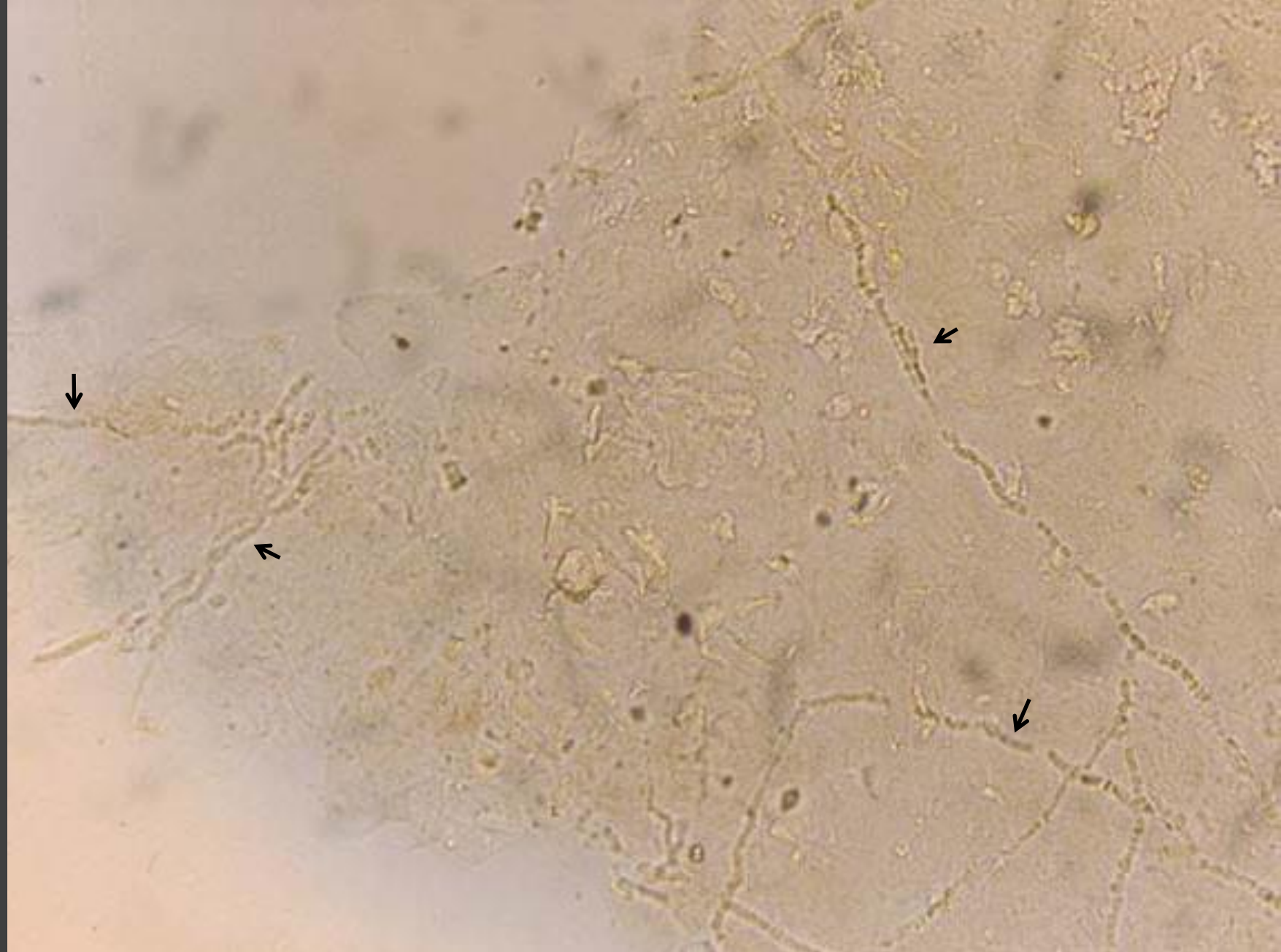


Figure 14. Dermatophyte Direct Examination: hyaline, septate, branched hyphae and arthroconidia. Photo courtesy of Professor Claudia Maria Pena Dias.

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Figure 15. Dermatophyte Direct Examination: hyaline, septate, branched hyphae and arthroconidia.

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DIRECT MICROLOGICAL EXAMINATION

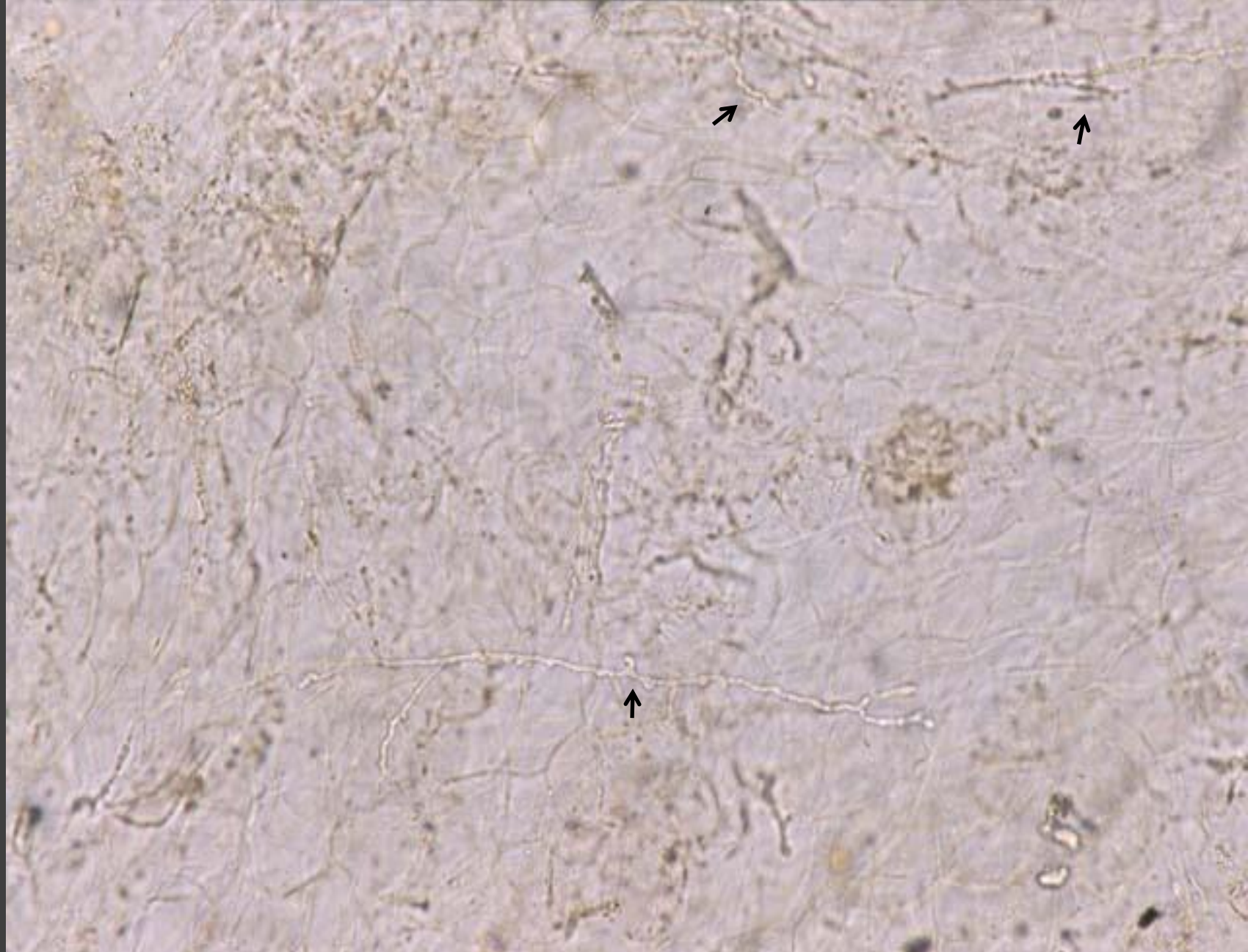


Figure 16. Dermatophyte Direct Examination: hyaline, septate, branched hyphae and arthroconidia. Photo courtesy of Professor Claudia Maria Pena Dias.

DIRECT MICROLOGICAL EXAMINATION



Figure 17. Dermatophyte Direct Examination: hyaline, septate, branched hyphae and arthroconidia. Photo courtesy of Professor Claudia Maria Pena Dias.

DIRECT MICROLOGICAL EXAMINATION

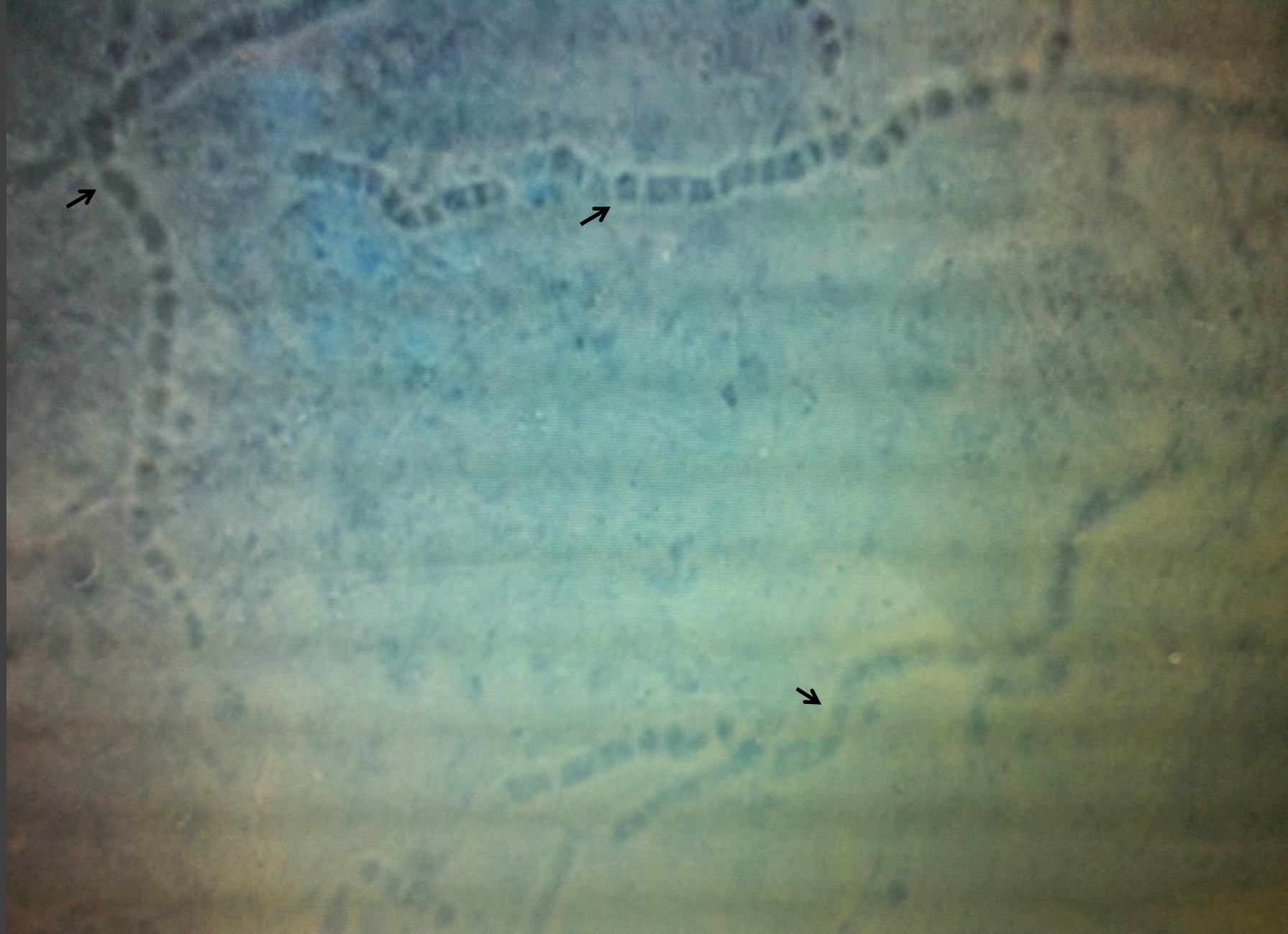


Figure 18. Dermatophyte Direct Examination: hyaline, septate, branched hyphae and arthroconidia. Photo courtesy of Professor Claudia Maria Pena Dias.

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DIRECT MICROLOGICAL EXAMINATION

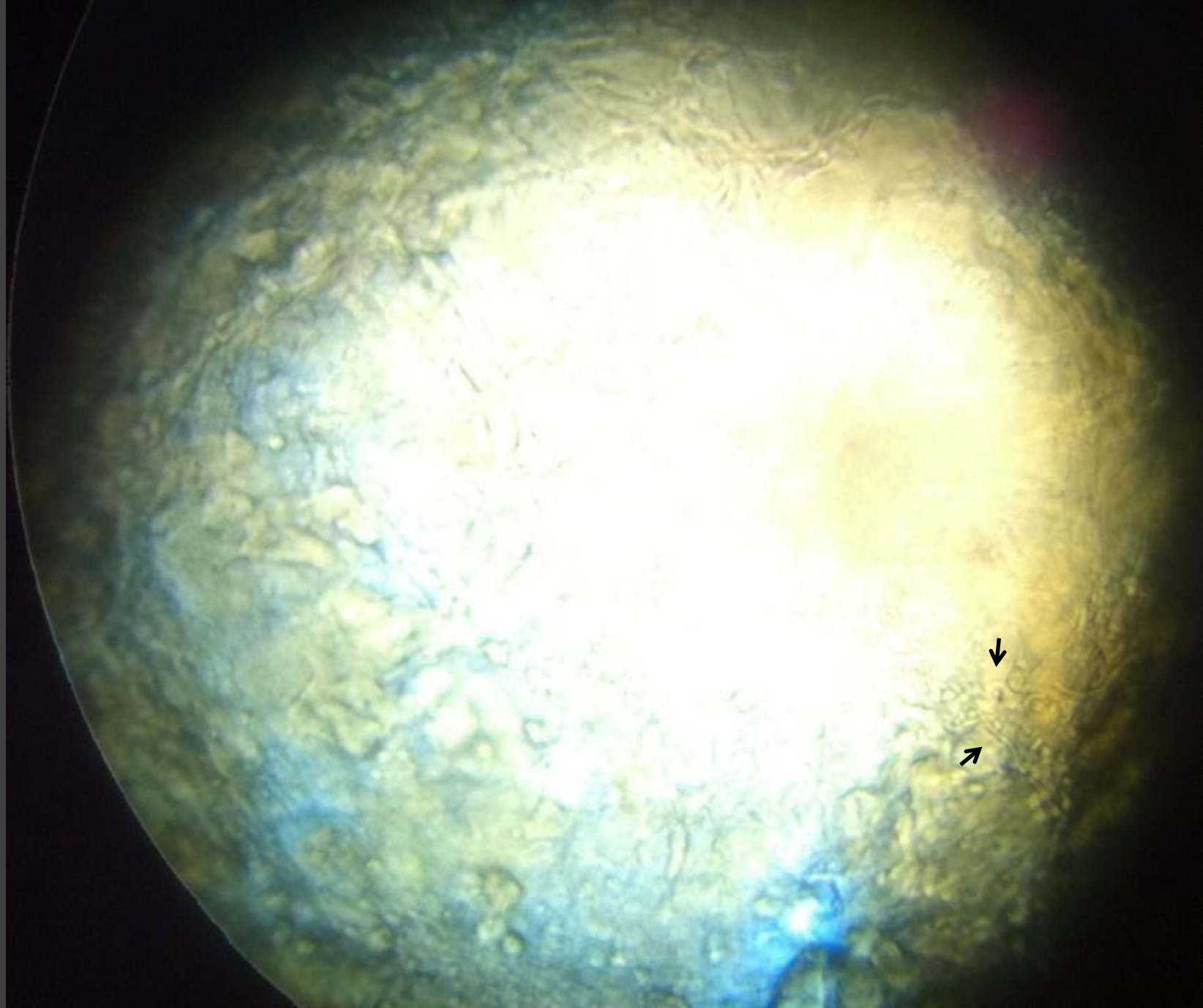


Figure 19. Candidiasis direct examination: hyaline, septate, branched hyphae and blastoconidia.

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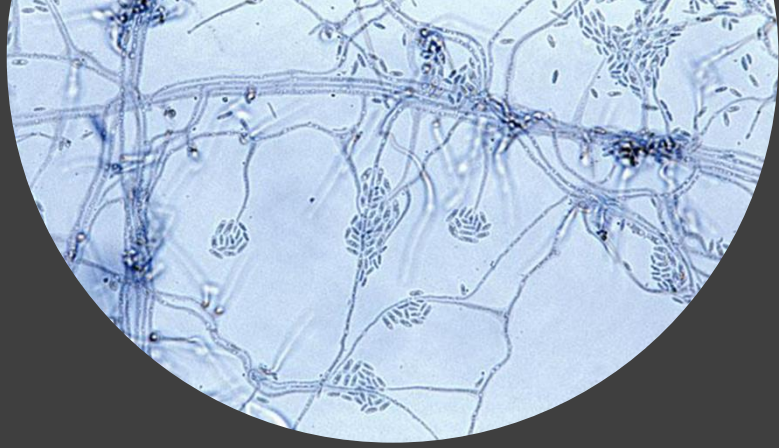


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Figure 20. Candidiasis direct examination: hyaline, septate, branched hyphae and blastoconidia.

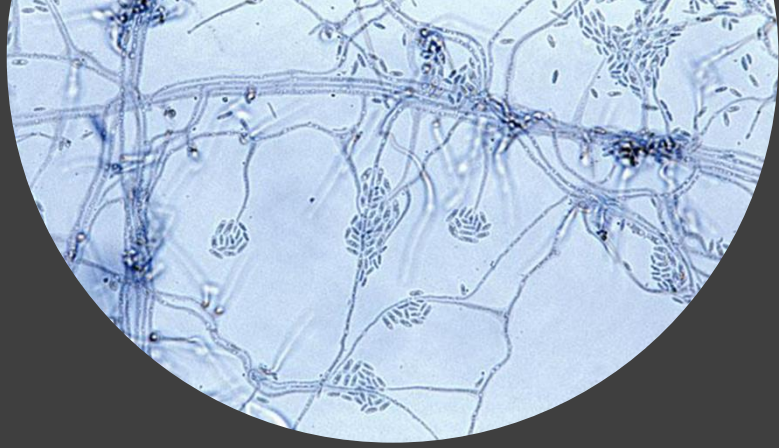




CULTURE FOR FUNGI

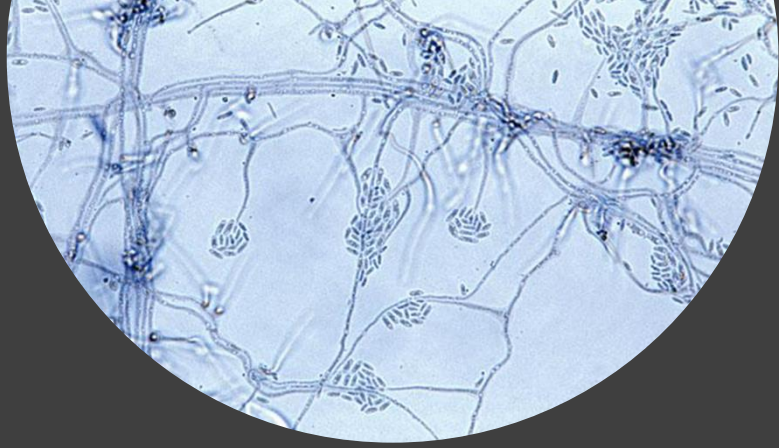
GENERAL ASPECTS

- Golden standard in the diagnostic of onychomycosis;
- Necessary for the identification of the fungal species involved, being an important complement for both the direct mycological examination and the histopathological examination;
- It is currently the only one that can definitely identify the etiopathogenic organism and its viability;
- It is long and requires an experienced examiner and it is estimated that more than 30 to 40% of tests are false-negatives;
- It requires adequate mediums, temperature conditions and viable fungi;
- When the clinical suspicion is high and the culture is negative, the test must be repeated.



CULTURE FOR FUNGI

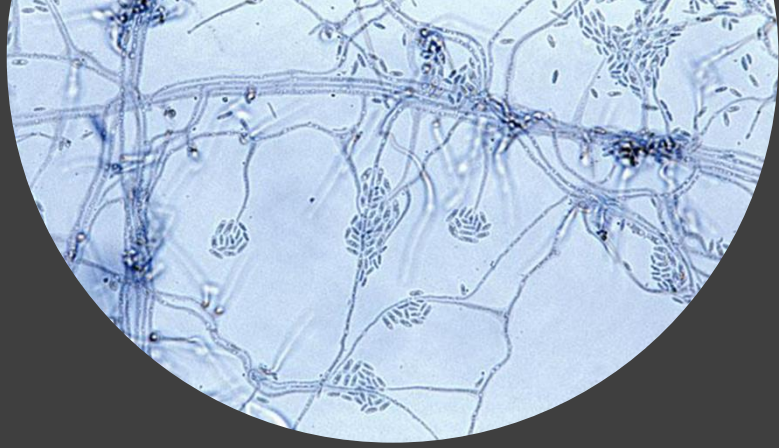
- Divergences between the results of the direct examination and the fungi culture may occur. Many times, positive direct examinations are followed by negative cultures;
- False negative results:
 - Insufficient sampling;
 - Insufficient incubation time of the material in the culture mediums;
 - Antifungal drugs use before the collection of the material (round up on non-viable hyphae, which are observed in the direct examinations, however they have not grown in the culture mediums);
 - Presence of contaminants in the medium, which prevent colony growth.



CULTURE FOR FUNGI

CULTURE MEDIUMS

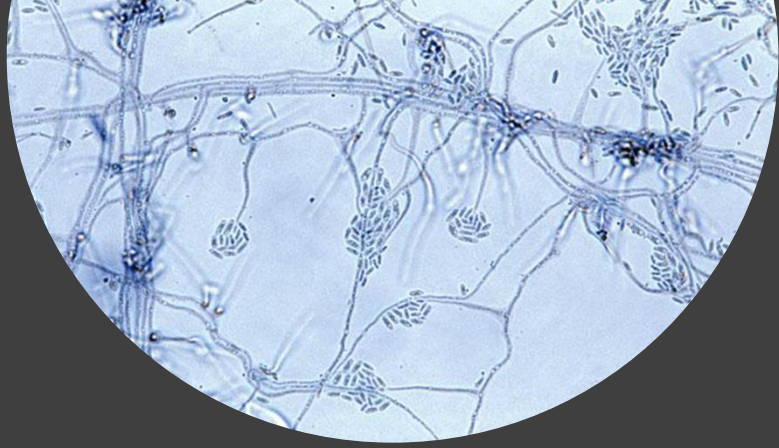
- The most commonly used mediums are Sabouraud agar with chloramphenicol or Sabouraud agar with chloramphenicol and cycloheximide (Mycosel);
- Chloramphenicol: avoids the growth of contaminant bacteria;
- The medium with cycloheximide avoids the growth of saprophyte and non-dermatophyte filamentous fungi and favors the growth of dermatophyte fungi;
- The medium without cycloheximide favors the growth of non-dermatophyte filamentous fungi;
- The contamination of the sample by opportunistic fungi or bacteria may compromise the correct diagnostic.



CULTURE FOR FUNGI

When a non-dermatophyte filamentous fungus is identified in the culture, such as *Fusarium* sp., *Aspergillus* sp., *Penicillium* sp., and *Alternaria* sp., at least three repeated cultures must be done, and the material must be collected in different moments so that onychomycosis by non-dermatophyte fungus is confirmed.





CULTURE FOR FUNGI

SEEDING, CULTURE MEDIUM PACKAGING AND READING OF RESULTS

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CULTURE FOR FUNGI

- The material reserved for culture must be collected with a sterile inoculation loop and placed with gentle sinking in the middle, and the other part, left on the surface;
- Condition the mediums in temperatures between 20 and 25°C;
- Waiting time to verify fungal colony growth is up to four weeks, and 17 days is already enough for the diagnostic of dermatophyte fungi in the cultures;
- The reading of the result must be done through the macromorphology and micromorphology of the colony, which are characteristics of each species;
- The morphological identification of the species of dermatophytes in cultures is sometimes difficult or uncertain, since there are variations from one isolated fungus to another, and overlapping of characteristics between species.

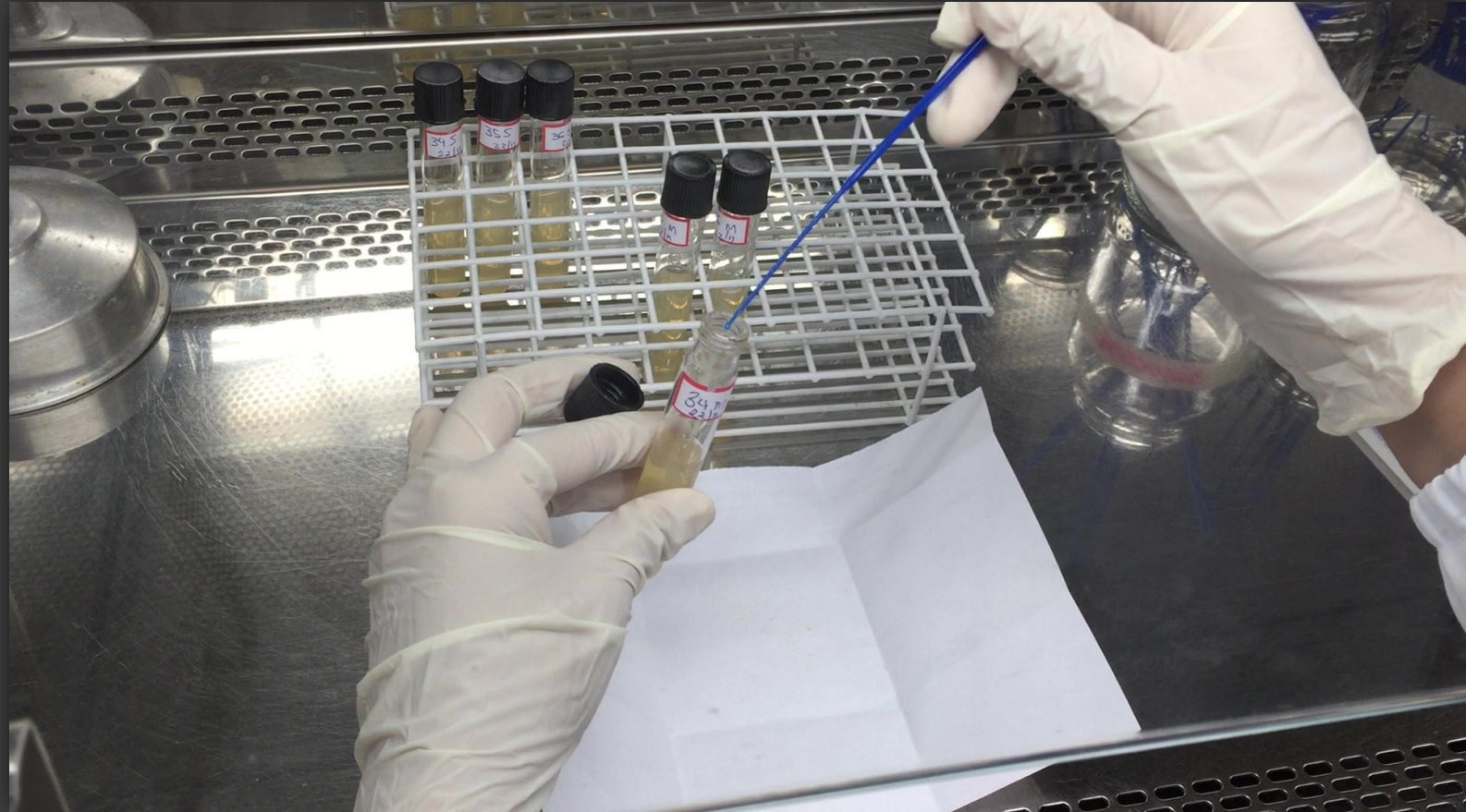
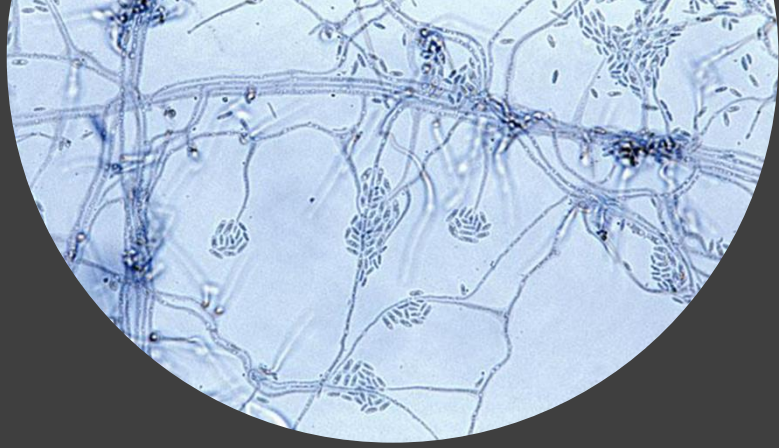


Figure 21. Seeding of culture medium.



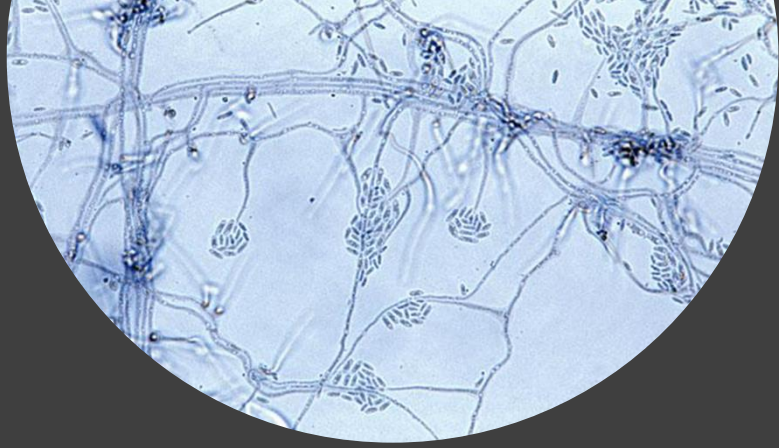
CULTURE FOR FUNGI

MACROMORPHOLOGY

- The macromorphological aspects of the colony are used to identify the fungi species involved.

MICROMORPHOLOGY

- Collect a small portion of the culture and place it over the microscope slide;
- Color it with a drop of Cotton Blue or Toluidine Blue stain;
- Cover it with a coverslip;
- Observe at the optical microscope the micromorphological characteristics of the colony.



CULTURE FOR FUNGI

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CULTURE FOR FUNGI

Acremonium sp

MACROMORPHOLOGY OF THE COLONY:

The colony of *Acremonium* sp. is characterized by an aerial membranous beige mycelium with a slightly pleated surface, with central spicules and colorless back.



Figure 22. Colony of *Acremonium* sp.

CULTURE FOR FUNGI

Acremonium sp

MICROMORPHOLOGY OF THE COLONY:

It is characterized by hyaline, septate and branched hyphae, with long conidiophore arranged in the hypha. Spindle-shaped, long conidia that cluster at the apex of the conidiophore.

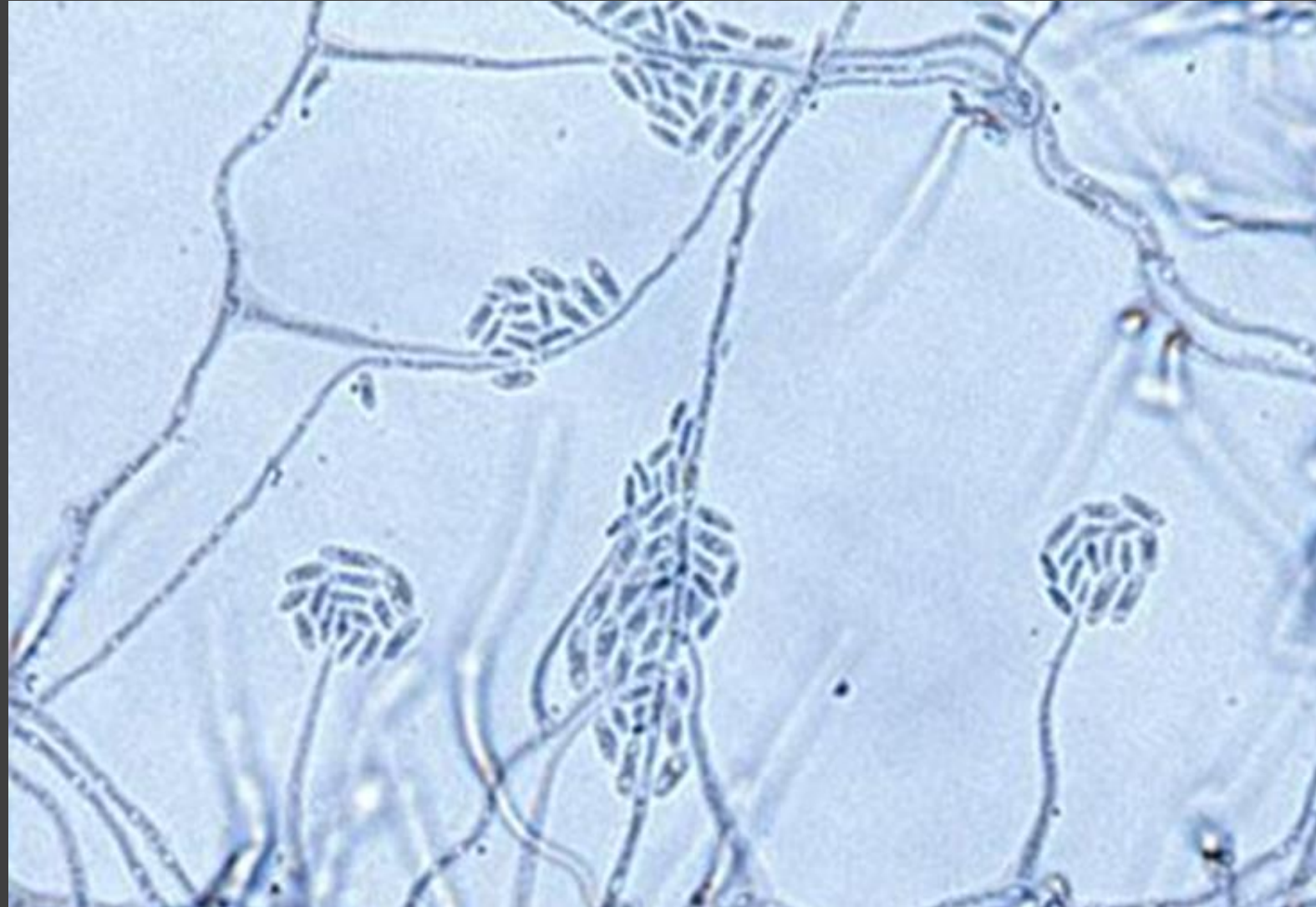


Figure 23. *Acremonium sp.*, micromorphology of the colony.

CULTURE FOR FUNGI

Aspergillus flavus

MACROMORPHOLOGY OF THE COLONY:

The colony of *Aspergillus flavus* is characterized by aerial mycelium roughly granular, greenish, with colorless back.



Figure 24. Colony of *Aspergillus flavus*.

CULTURE FOR FUNGI

Aspergillus flavus

MICROMORPHOLOGY OF THE COLONY:

It is characterized by hyaline, septate, branched hyphae with conidiophore composed by a vesicle, from where phialides come from. From the phialides, round conidia chains come from.

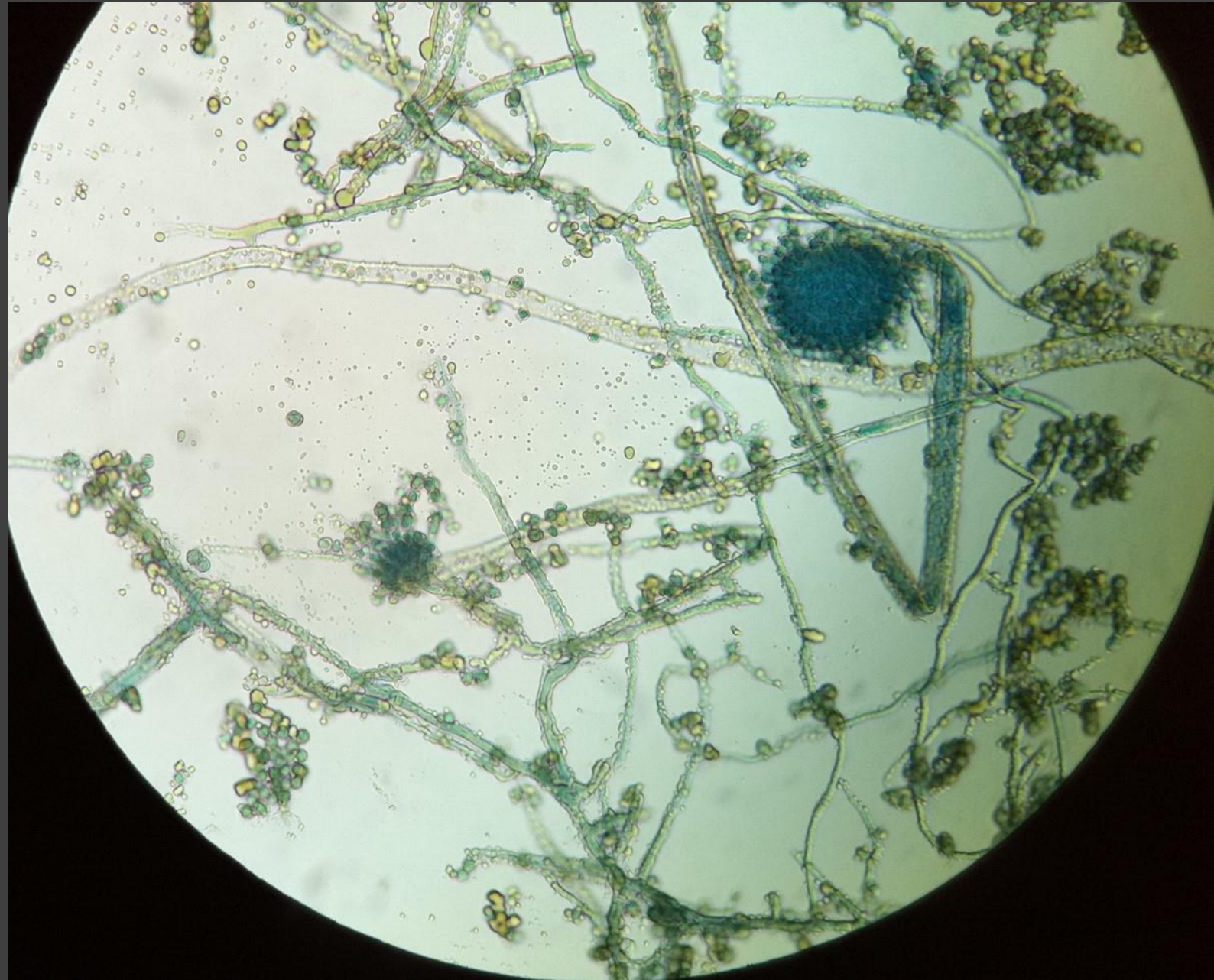


Figure 25. *Aspergillus* sp., micromorphology of the colony.

CULTURE FOR FUNGI

Candida sp.

MACROMORPHOLOGY OF THE COLONY:

It is characterized by creamy, yeast-like, smooth or finely rough, beige surface, with or without opaque visible filaments in the culture medium, similar to a “drop of a candle”.

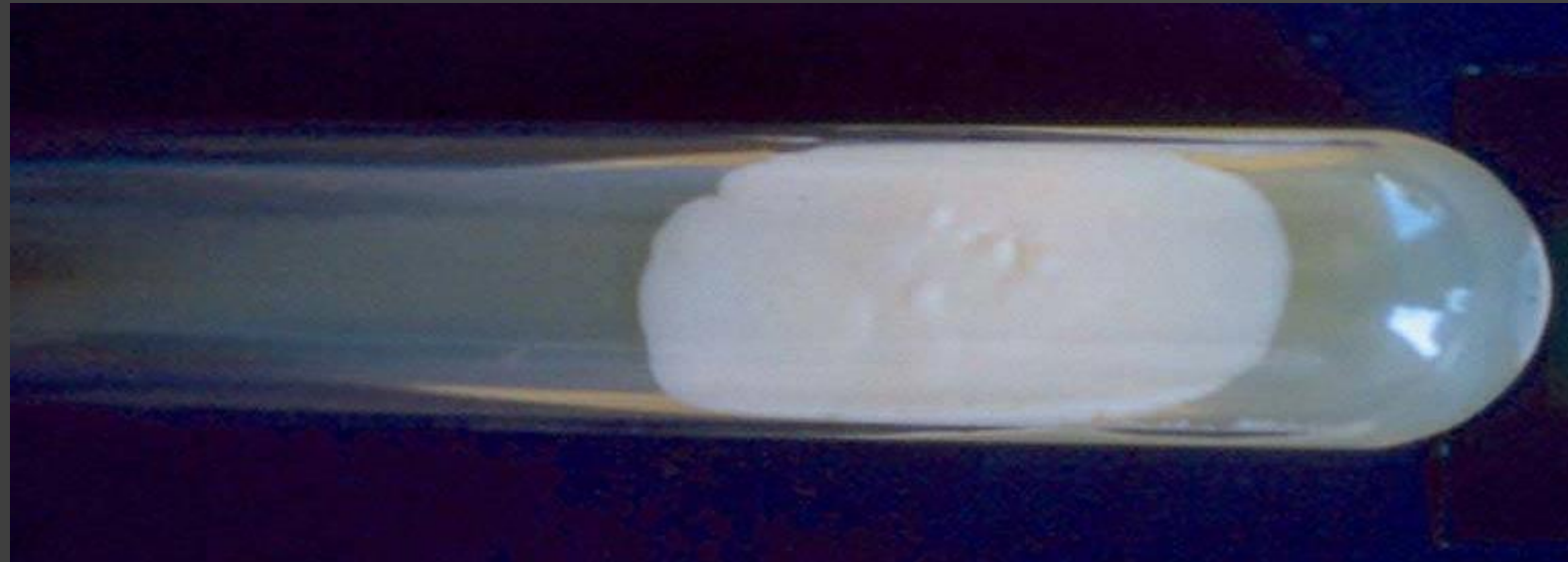


Figure 26. Colony of *Candida sp.* Photo courtesy of Professor Claudia Maria Pena Dias.



Figure 27. Colony of *Candida sp.*

CULTURE FOR FUNGI

Epidermophyton floccosum

MACROMORPHOLOGY OF THE COLONY:

It is characterized by aerial, finely granular, brownish mycelium, with greenish yellow back, emitting filaments parallel to the surface from the center. It can be covered by aerial cottony white (pleomorphism) mycelium.



Figure 28. Colony of *Epidermophyton floccosum*. Photo courtesy of Professor Claudia Maria Pena Dias.

CULTURE FOR FUNGI

Epidermophyton floccosum

MICROMORPHOLOGY OF THE COLONY:

It is characterized by hyaline, septate, branched hyphae, with intercalary chlamydoconidia, without microconidia. Thin-walled claviform macroconidia, with two to five septa, grouped in the conidiophore.

OTHER FIGURES

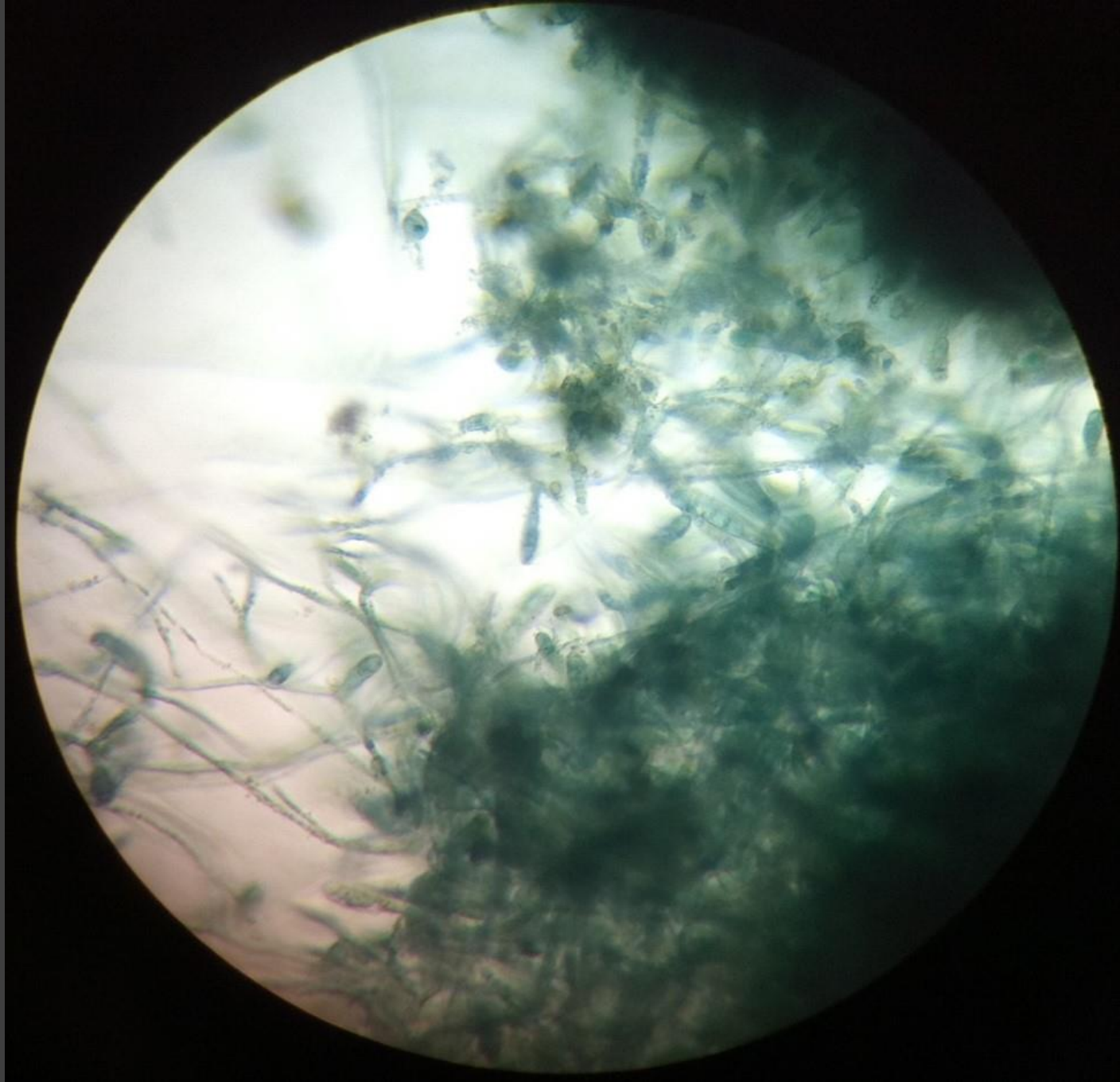


Figure 29. *Epidermophyton floccosum*, micromorphology of the colony.

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CULTURE FOR FUNGI

Epidermophyton floccosum

MICROMORPHOLOGY OF THE COLONY:

It is characterized by hyaline, septate, branched hyphae, with intercalary chlamydoconidia, without microconidia. Thin-walled claviform macroconidia, with two to five septa, grouped in the conidiophore.

OTHER FIGURES

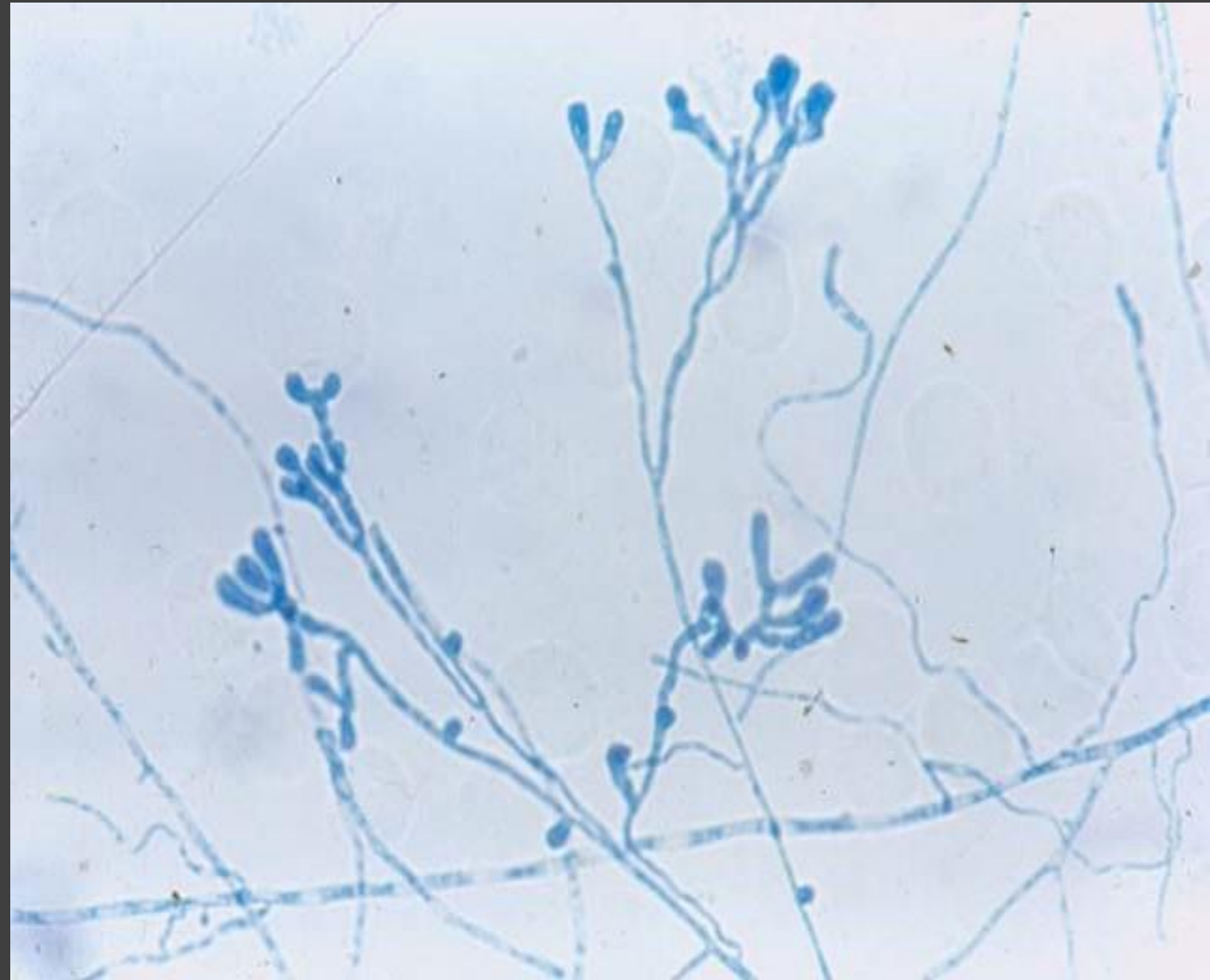
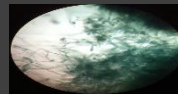


Figure 30. *Epidermophyton floccosum*, micromorphology of the colony. Photo courtesy of Professor Claudia Maria Pena Dias.



CULTURE FOR FUNGI

Epidermophyton floccosum

MICROMORPHOLOGY OF THE COLONY:

It is characterized by hyaline, septate, branched hyphae, with intercalary chlamydoconidia, without microconidia. Thin-walled claviform macroconidia, with two to five septa, grouped in the conidiophore.

OTHER FIGURES

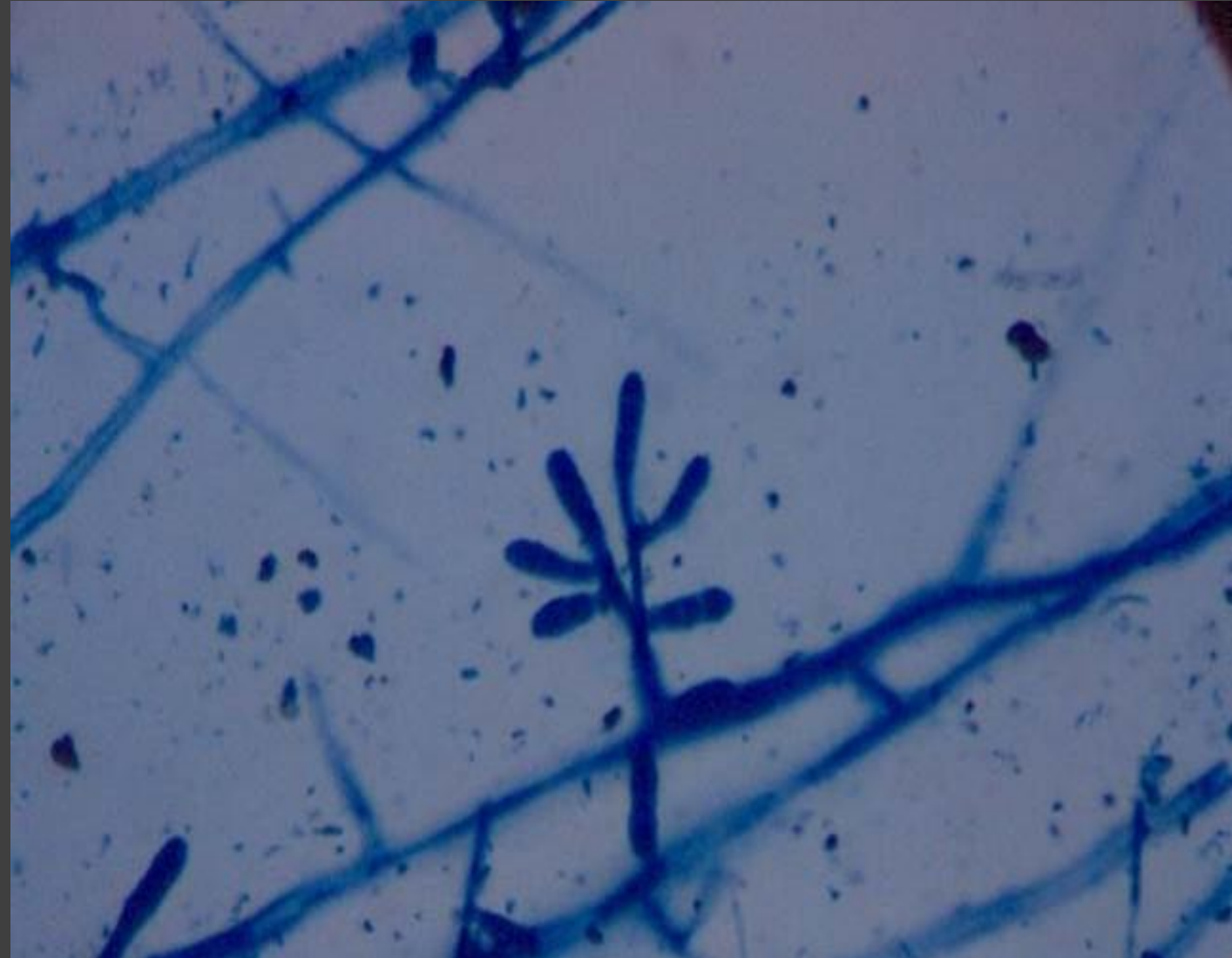
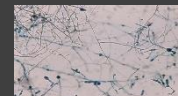
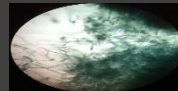


Figure 31. *Epidermophyton floccosum*, micromorphology of the colony. Photo courtesy of Professor Claudia Maria Pena Dias.

CULTURE FOR FUNGI

Epidermophyton floccosum

MICROMORPHOLOGY OF THE COLONY:

It is characterized by hyaline, septate, branched hyphae, with intercalary chlamydoconidia, without microconidia. Thin-walled claviform macroconidia, with two to five septa, grouped in the conidiophore.

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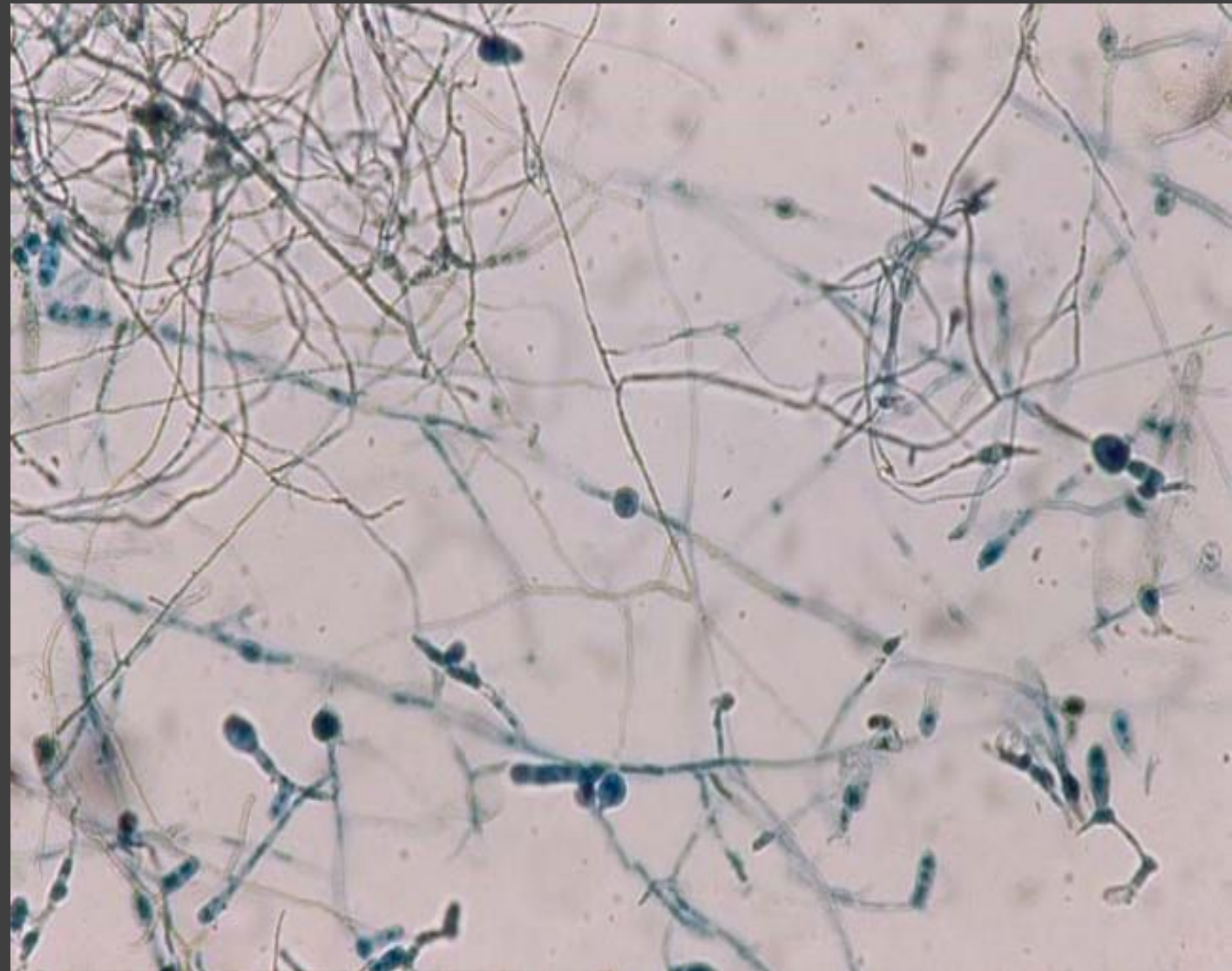
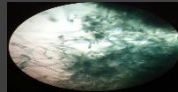


Figure 32. *Epidermophyton floccosum*, micromorphology of the colony. Photo courtesy of Professor Claudia Maria Pena Dias.

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CULTURE FOR FUNGI

Fusarium sp.

MACROMORPHOLOGY OF THE COLONY:

It is characterized by aerial, cottony, disorganized white mycelium, with violaceous back, which can also be colorless, yellowish or brownish.



Figure 33. Colony of *Fusarium sp.*

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CULTURE FOR FUNGI

Fusarium sp.

MACROMORPHOLOGY OF THE COLONY:

It is characterized by aerial, cottony, disorganized white mycelium, with violaceous back, which can also be colorless, yellowish or brownish.



Figure 34. Colony of *Fusarium sp.* Photo courtesy of Professor Claudia Maria Pena Dias.

CULTURE FOR FUNGI

Fusarium sp.

MICROMORPHOLOGY OF THE COLONY:

It is characterized by hyaline, septate, branched hyphae, with spindle-shaped, incurved arthroconidia, with one to three septa. Elongated microconidia, without septum.



Figure 35. *Fusarium sp.*, micromorphology of the colony. Photo courtesy of Professor Claudia Maria Pena Dias.



CULTURE FOR FUNGI

Microsporum canis

MACROMORPHOLOGY OF THE COLONY:

It is characterized by cottony white surface, with fine, shiny, fuzzy aerial mycelium, and bright yellow back.

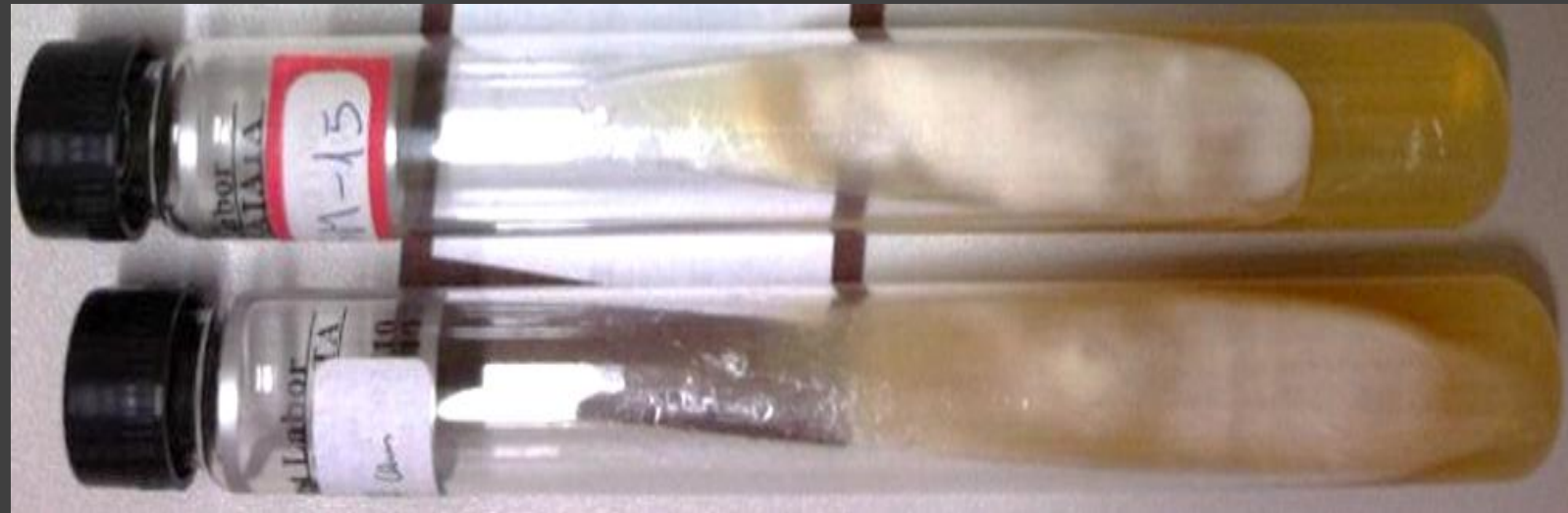
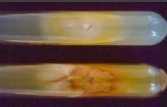


Figure 36. Colony of *Microsporum canis*.

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CULTURE FOR FUNGI

Microsporum canis

MACROMORPHOLOGY OF THE COLONY:

It is characterized by cottony white surface, with fine, shiny, fuzzy aerial mycelium, and bright yellow back.

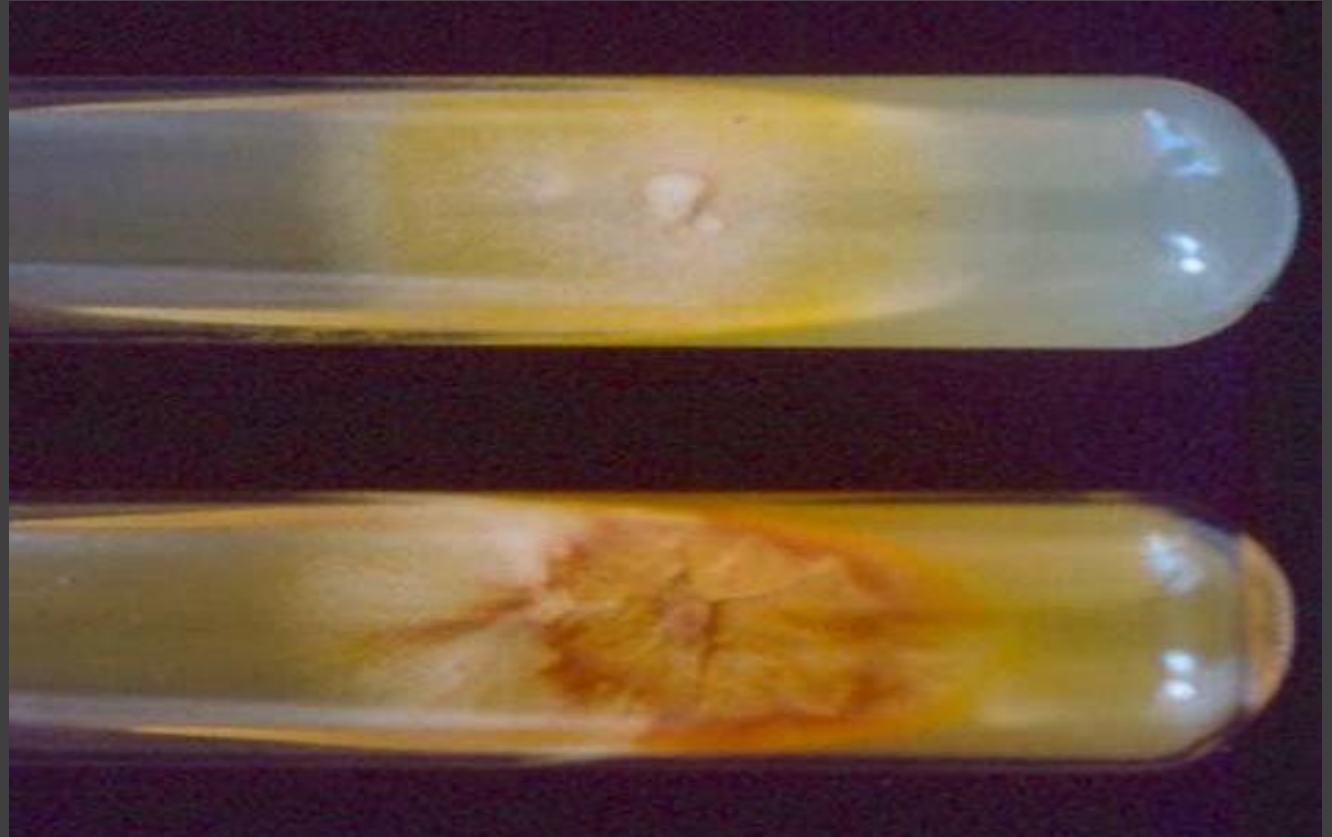


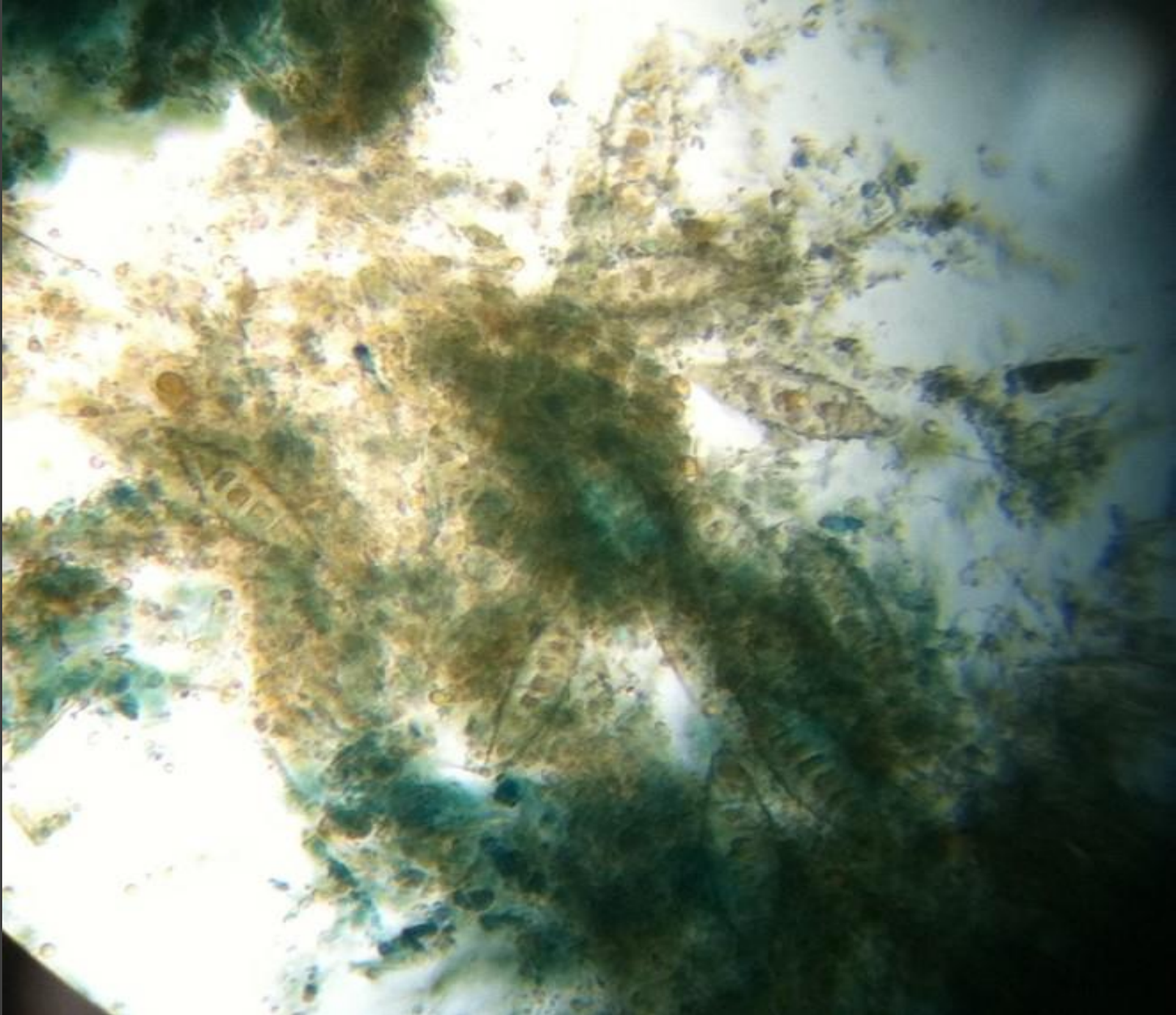
Figure 37. Colony of *Microsporum canis*. Photo courtesy of Professor Claudia Maria Pena Dias.

CULTURE FOR FUNGI

Microsporum canis

MICROMORPHOLOGY OF THE COLONY:

It is characterized by hyaline, septate, branched hyphae, spindle-shaped macroconidia with tapered end, thick-walled with septa that vary from 5 to 7 and rare or absent microconidia. It can present chlamydoconidia.



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Figure 38. *Microsporum canis*, micromorphology of the colony.

CULTURE FOR FUNGI

Microsporium canis

MICROMORFOLOGIA DA COLÔNIA

It is characterized by hyaline, septate, branched hyphae, spindle-shaped macroconidia with tapered end, thick-walled with septa that vary from 5 to 7 and rare or absent microconidia. It can present chlamydoconidia.

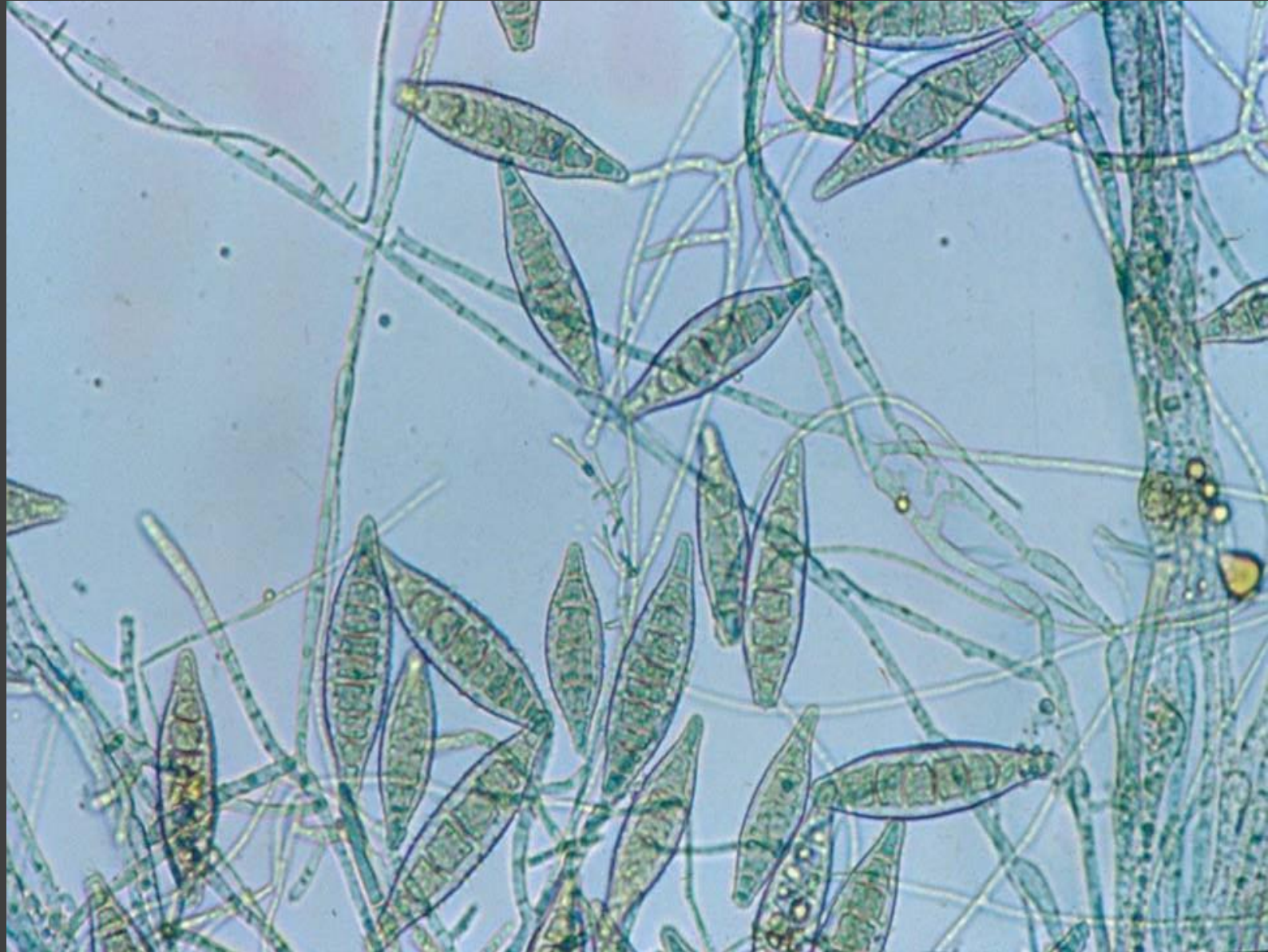


Figure 39. *Microsporium canis*, micromorphology of the colony. Photo courtesy of Professor Claudia Maria Pena Dias.

CULTURE FOR FUNGI

Microsporium gypseum

MACROMORPHOLOGY OF THE COLONY:

It is characterized by roughly granular aerial beige mycelium, with colorless, brownish or reddish-brown back.



Figure 40. Colony of *Microsporium gypseum*.

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CULTURE FOR FUNGI

Microsporium gypseum

MACROMORPHOLOGY OF THE COLONY:

It is characterized by roughly granular aerial beige mycelium, with colorless, brownish or reddish-brown back.



Figure 41. Colony of *Microsporium gypseum*. Photo courtesy of Professor Claudia Maria Pena Dias.

CULTURE FOR FUNGI

Microsporium gypseum

MICROMORPHOLOGY OF THE COLONY:

It is characterized by hyaline, septate, branched hyphae, thin-walled macroconidia, and rounded ends, with septa that vary from 3 to 5 piriform microconidia.

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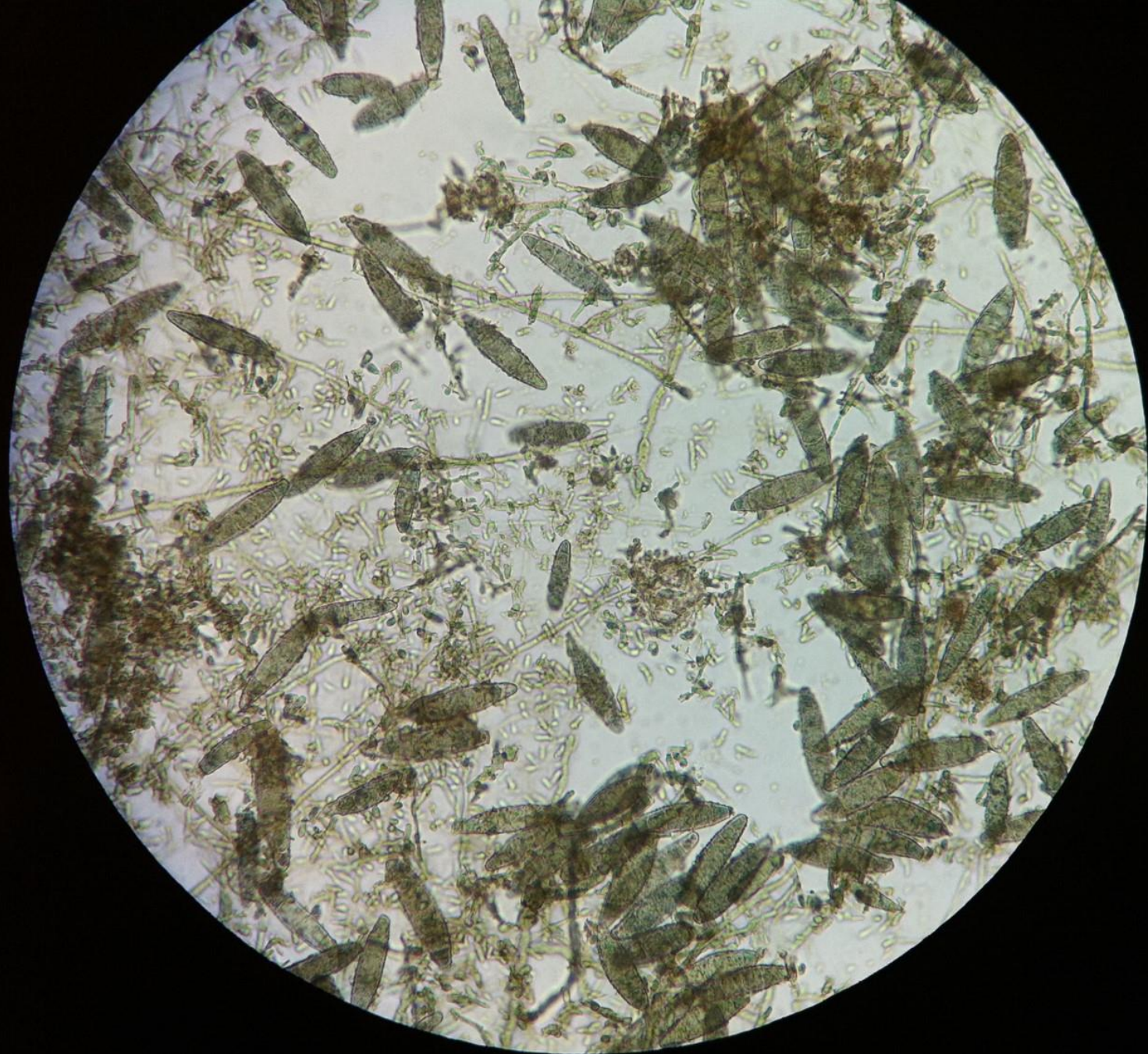


Figure 42. *Microsporium gypseum*, micromorphology of the colony.

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CULTURE FOR FUNGI

Microsporium gypseum

MICROMORPHOLOGY OF THE COLONY:

It is characterized by hyaline, septate, branched hyphae, thin-walled macroconidia, and rounded ends, with septa that vary from 3 to 5 piriform microconidia.



Figure 43. *Microsporium gypseum*, micromorphology of the colony.

CULTURE FOR FUNGI

Neoscytalidium dimidiatum

MACROMORPHOLOGY OF THE COLONY:

The colony of *Neoscytalidium dimidiatum* is macroscopically characterized by aerial cottony, disorganized, abundant, grayish or black mycelium that colors the medium of culture.



Figure 44. Colony of *Neoscytalidium dimidiatum*.

CULTURE FOR FUNGI

Neoscytalidium dimidiatum

MICROMORPHOLOGY OF THE COLONY:

It is characterized by hyaline, septate, branched, brownish hyphae. Chain-arranged arthroconidia in the hypha, with or without septum.

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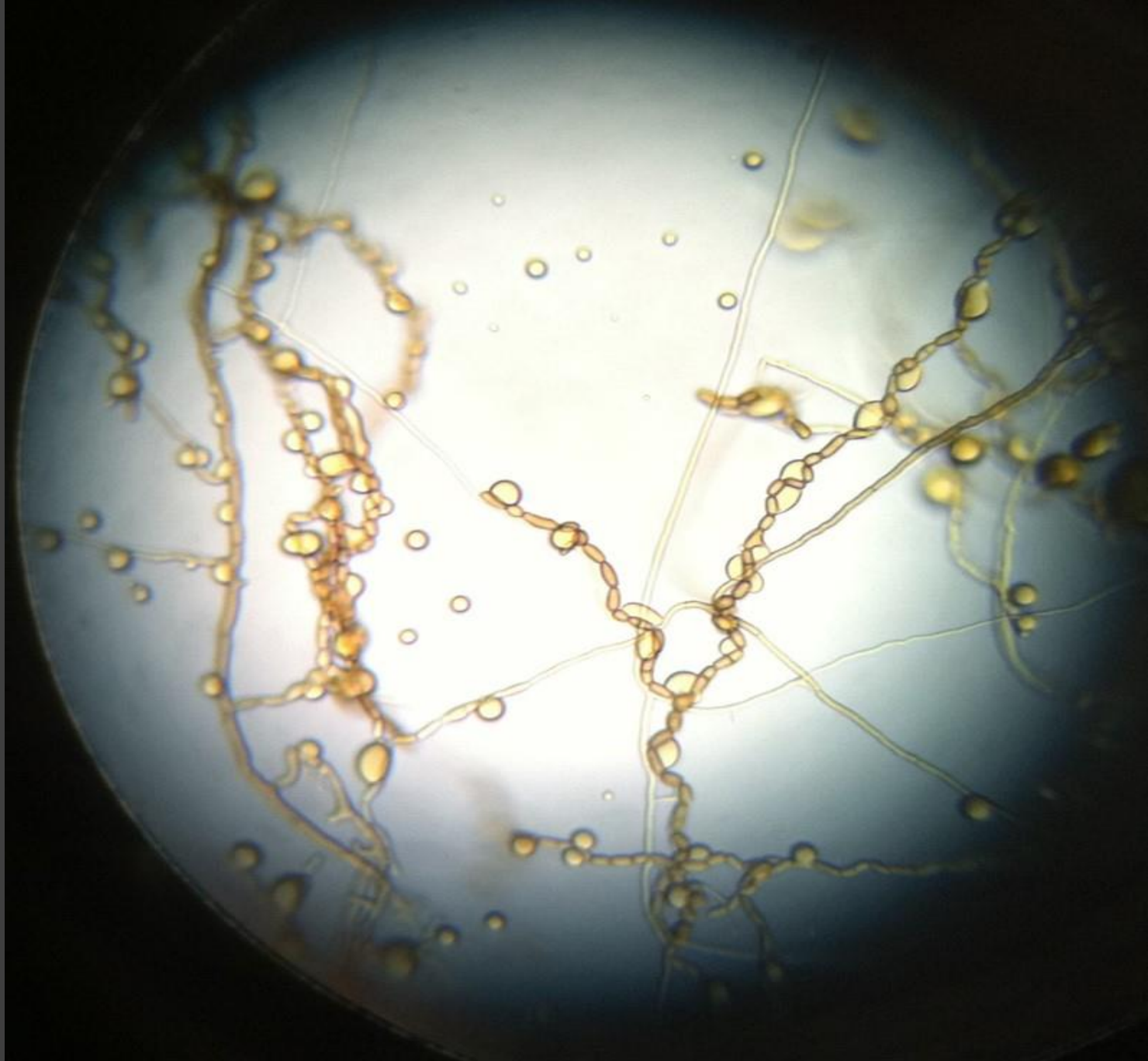
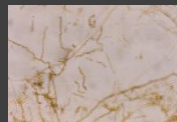


Figure 45. *Neoscytalidium hyalinum*, micromorphology of the colony.

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CULTURE FOR FUNGI

Neoscytalidium dimidiatum

MICROMORPHOLOGY OF THE COLONY:

It is characterized by hyaline, septate, branched, brownish hyphae. Chain-arranged arthroconidia in the hypha, with or without septum.

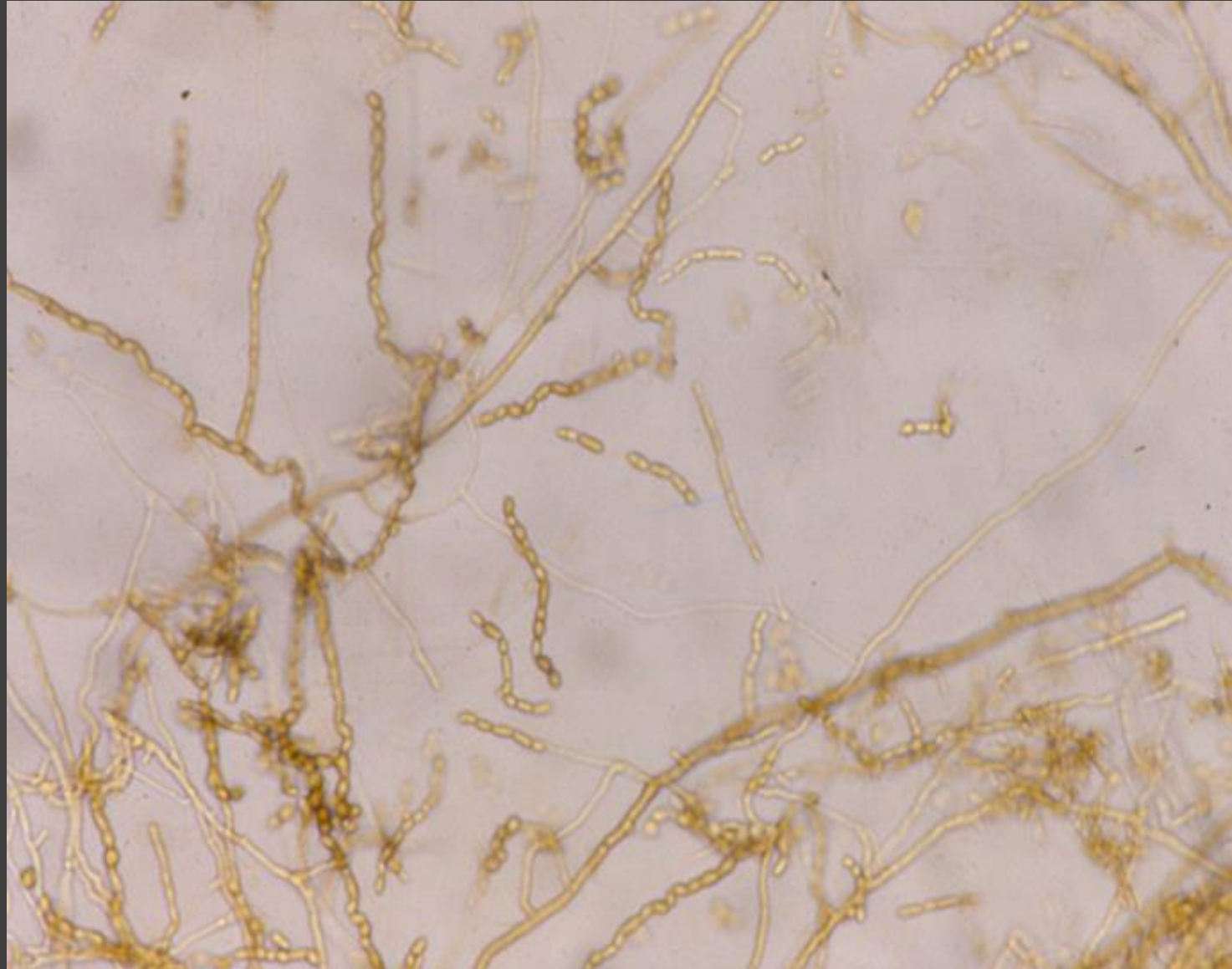


Figure 46. *Neoscytalidium dimidiatum*, micromorphology of the colony. Photo courtesy of Professor Claudia Maria Pena Dias.

CULTURE FOR FUNGI

Scopulariopsis sp.

MACROMORPHOLOGY OF THE COLONY:

The macromorphology of the colony of *Scopulariopsis* sp. is characterized by aerial, cottony mycelium with pleated, beige to brown surface and colorless back.



Figure 47. Colony of *Scopulariopsis* sp.

CULTURE FOR FUNGI

Scytalidium hyalinum

MACROMORPHOLOGY OF THE COLONY:

The macromorphology of the colony of *Scytalidium* sp. is characterized by aerial, cottony, disorganized, white mycelium with brown back.



Figure 48. Colony of *Scytalidium hyalinum*.

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CULTURE FOR FUNGI

Scytalidium hyalinum

MACROMORPHOLOGY OF THE COLONY:

The macromorphology of the colony of *Scytalidium* sp. is characterized by aerial, cottony, disorganized, white mycelium with brown back.



Figure 49. Colony of *Scytalidium hyalinum*. Photo courtesy of Professor Claudia Maria Pena Dias.

CULTURE FOR FUNGI

Scytalidium hyalinum

MICROMORPHOLOGY OF THE COLONY:

It is characterized by hyaline, septate, branched hyphae, chain arthroconidia arranged in the hyphae, with or without any septum.



Figure 50. *Scytalidium hyalinum*, micromorphology of the colony.

CULTURE FOR FUNGI

Trichophyton mentagrophytes

MACROMORPHOLOGY OF THE COLONY:

•Granular variation:

It is characterized by aerial, finely granular, white, beige or brown mycelium, brownish or reddish-brown back.



Figure 51. Colony of *Trichophyton mentagrophytes*, granular variation.

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CULTURE FOR FUNGI

Trichophyton mentagrophytes

MACROMORPHOLOGY OF THE COLONY:

- Granular variation:

It is characterized by aerial, finely granular, white, beige or brown mycelium, brownish or reddish-brown back.



Figure 52. Colony of *Trichophyton mentagrophytes*, granular variation.
Photo courtesy of Professor Claudia Maria Pena Dias.

CULTURE FOR FUNGI

Trichophyton mentagrophytes

MICROMORPHOLOGY OF THE COLONY:

It is characterized by hyaline, septate, branched, tendril (spiral) hyphae, racket hyphae, chlamydoconidia. Cigar-shaped macroconidia, rounded and cluster-like microconidia.

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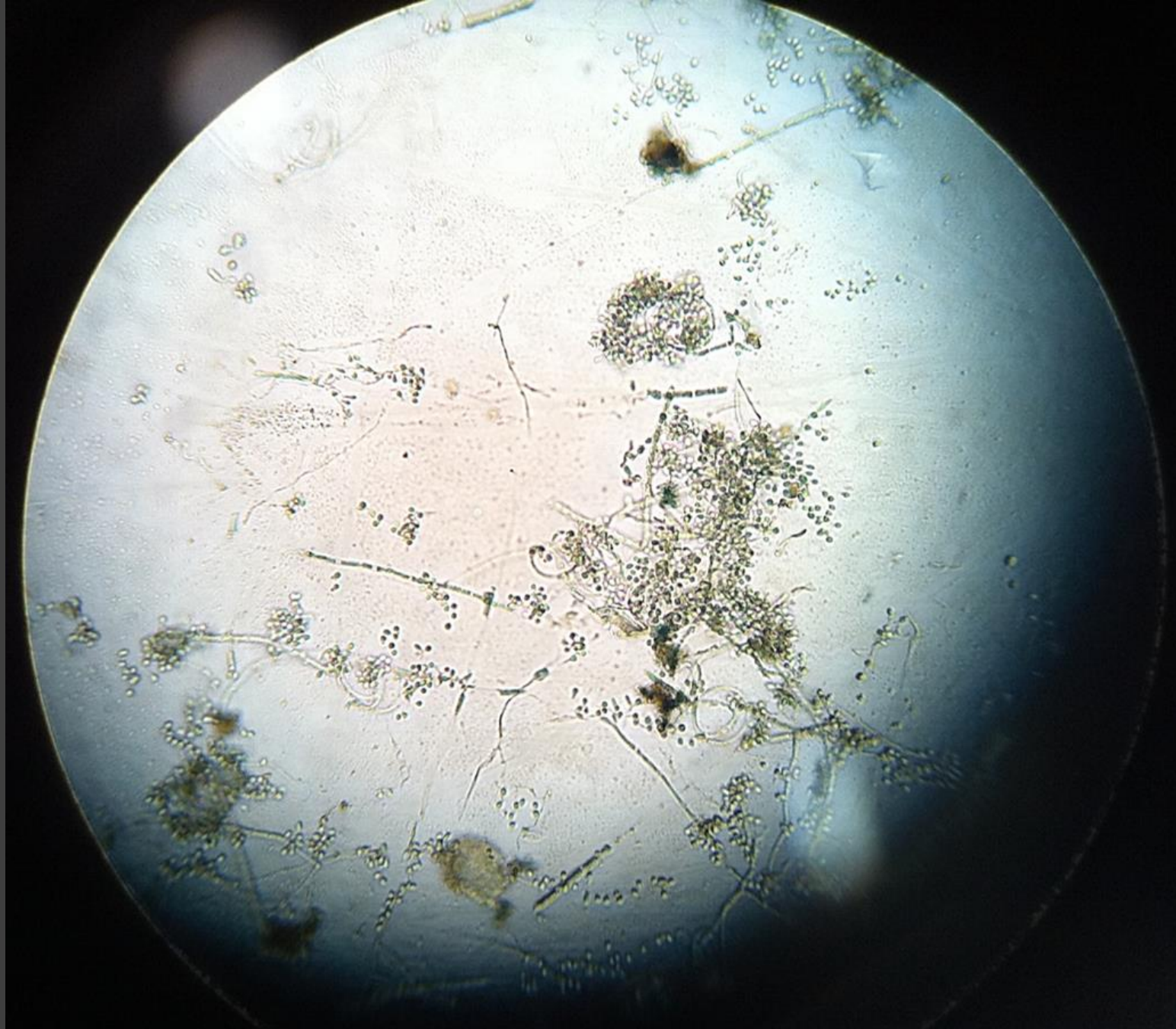
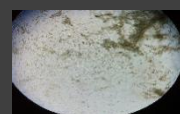
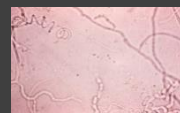
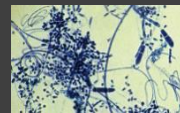


Figure 53. *Trichophyton mentagrophytes*, micromorphology of the colony.

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CULTURE FOR FUNGI

Trichophyton mentagrophytes

MICROMORPHOLOGY OF THE COLONY:

It is characterized by hyaline, septate, branched, tendril (spiral) hyphae, racket hyphae, chlamydoconidia. Cigar-shaped macroconidia, rounded and cluster-like microconidia.

OTHER FIGURES

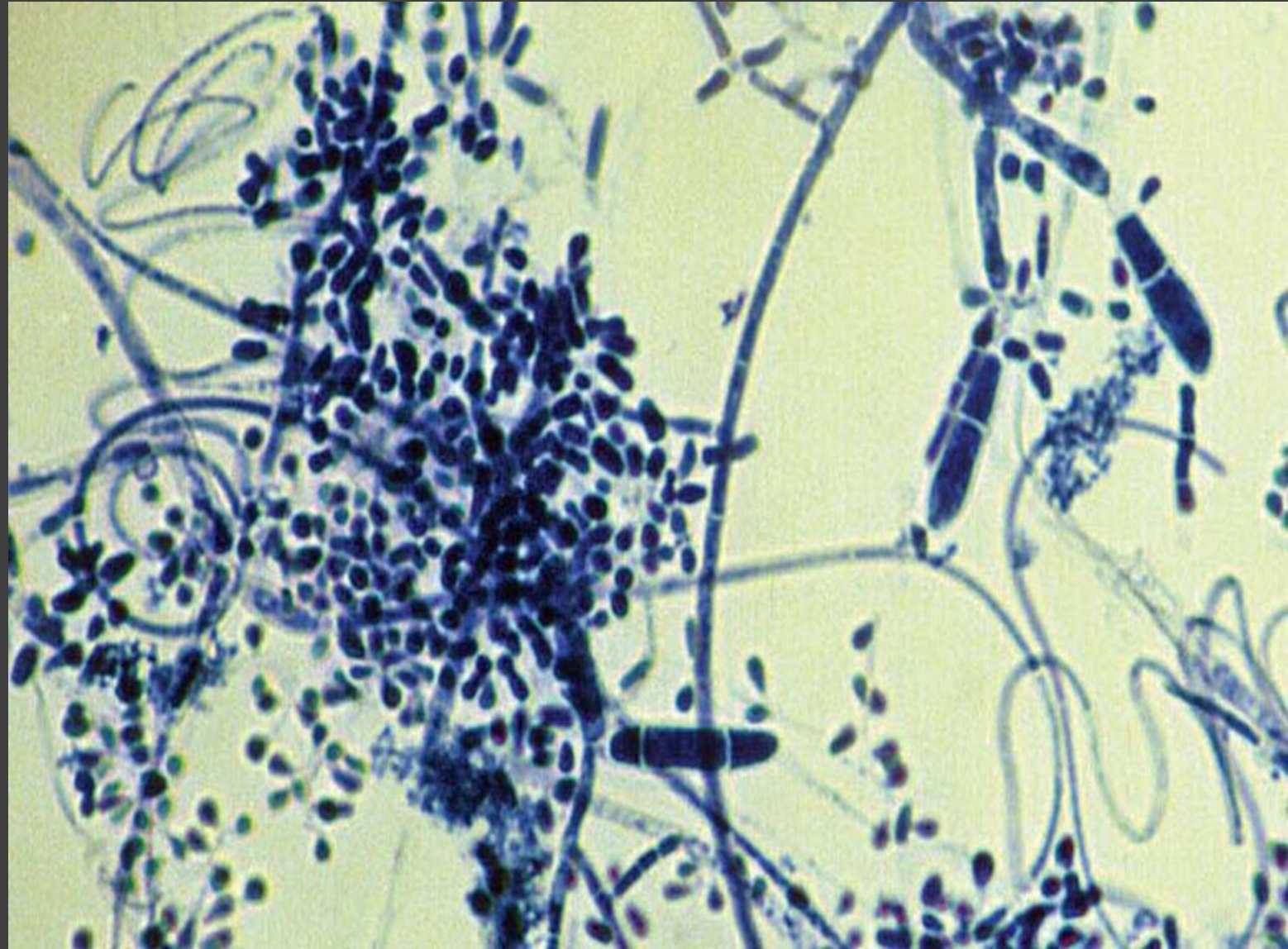
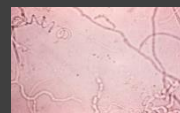
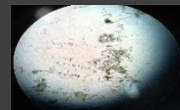


Figure 54. *Trichophyton mentagrophytes*, micromorphology of the colony. Photo courtesy of Professor Claudia Maria Pena Dias.

CULTURE FOR FUNGI

Trichophyton mentagrophytes

MICROMORPHOLOGY OF THE COLONY:

It is characterized by hyaline, septate, branched, tendril (spiral) hyphae, racket hyphae, chlamydoconidia. Cigar-shaped macroconidia, rounded and cluster-like microconidia.

OTHER FIGURES

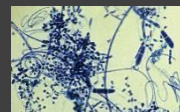
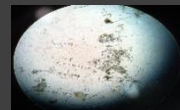


Figure 55. *Trichophyton mentagrophytes*, micromorphology of the colony. Photo courtesy of Professor Claudia Maria Pena Dias.

CULTURE FOR FUNGI

Trichophyton mentagrophytes

MICROMORPHOLOGY OF THE COLONY:

It is characterized by hyaline, septate, branched, tendril (spiral) hyphae, racket hyphae, chlamydoconidia. Cigar-shaped macroconidia, rounded and cluster-like microconidia.

OTHER FIGURES

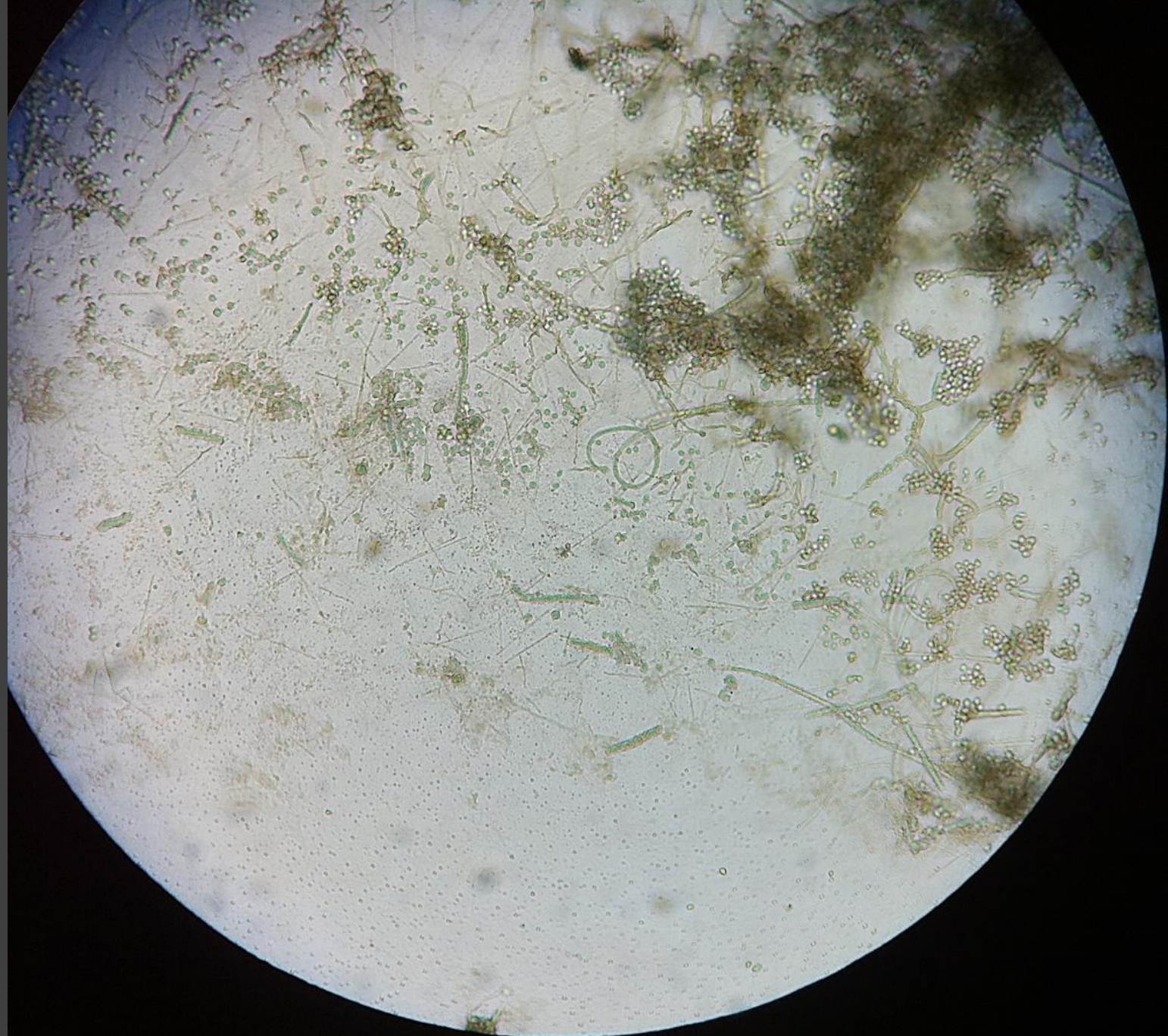
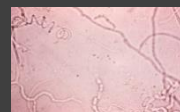
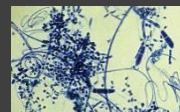
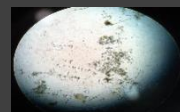


Figure 56. *Trichophyton mentagrophytes*, micromorphology of the colony.

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CULTURE FOR FUNGI

Trichophyton rubrum

MACROMORPHOLOGY OF THE COLONY:

It is characterized by aerial, cottony, white mycelium and red back.

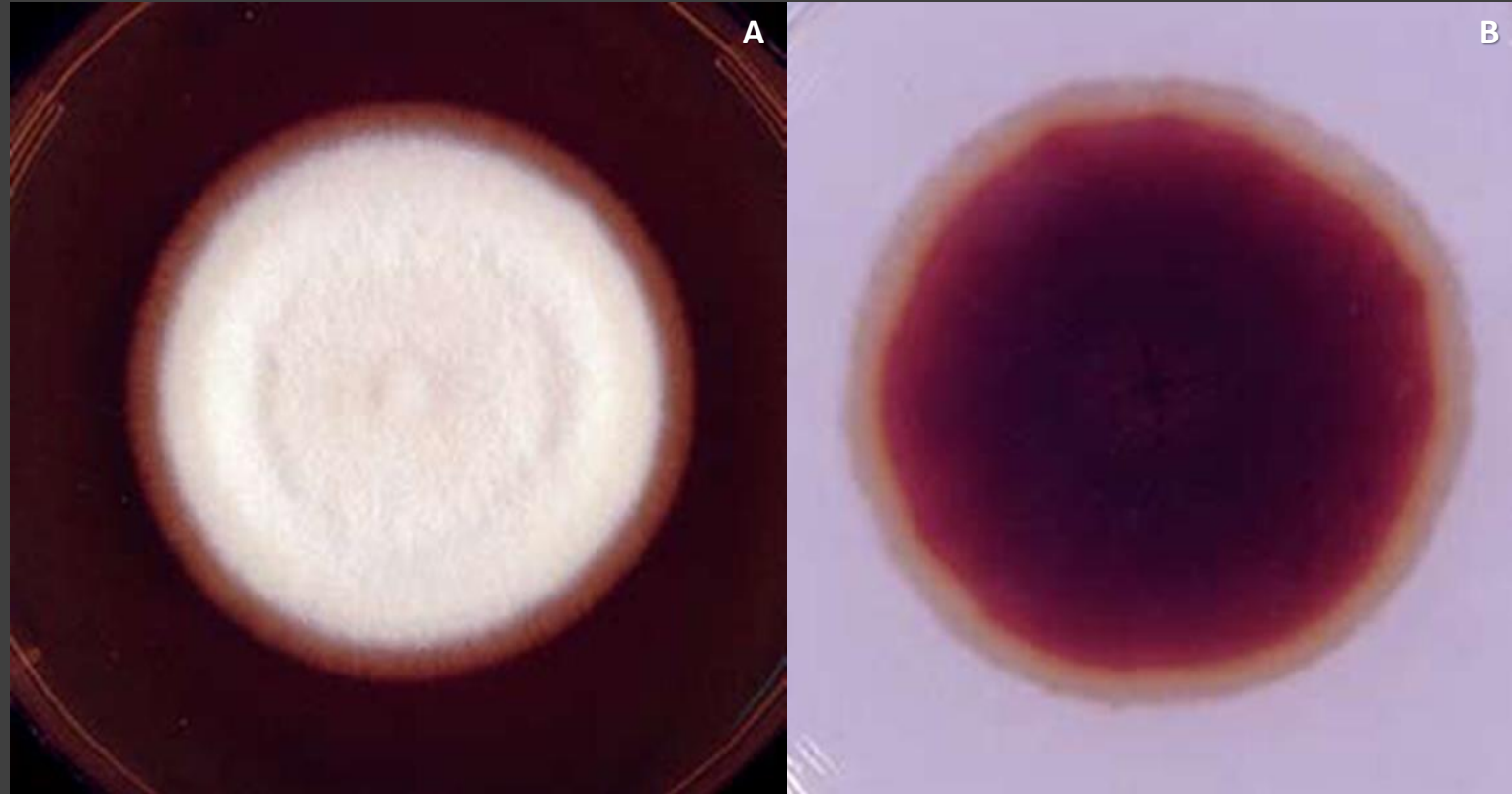


Figure 57. Colony of *Trichophyton rubrum*. A: front side. B: back. Photo courtesy of Professor Claudia Maria Pena Dias.



CULTURE FOR FUNGI

Trichophyton rubrum

MACROMORPHOLOGY OF THE COLONY:

It is characterized by aerial, cottony, white mycelium and red back.

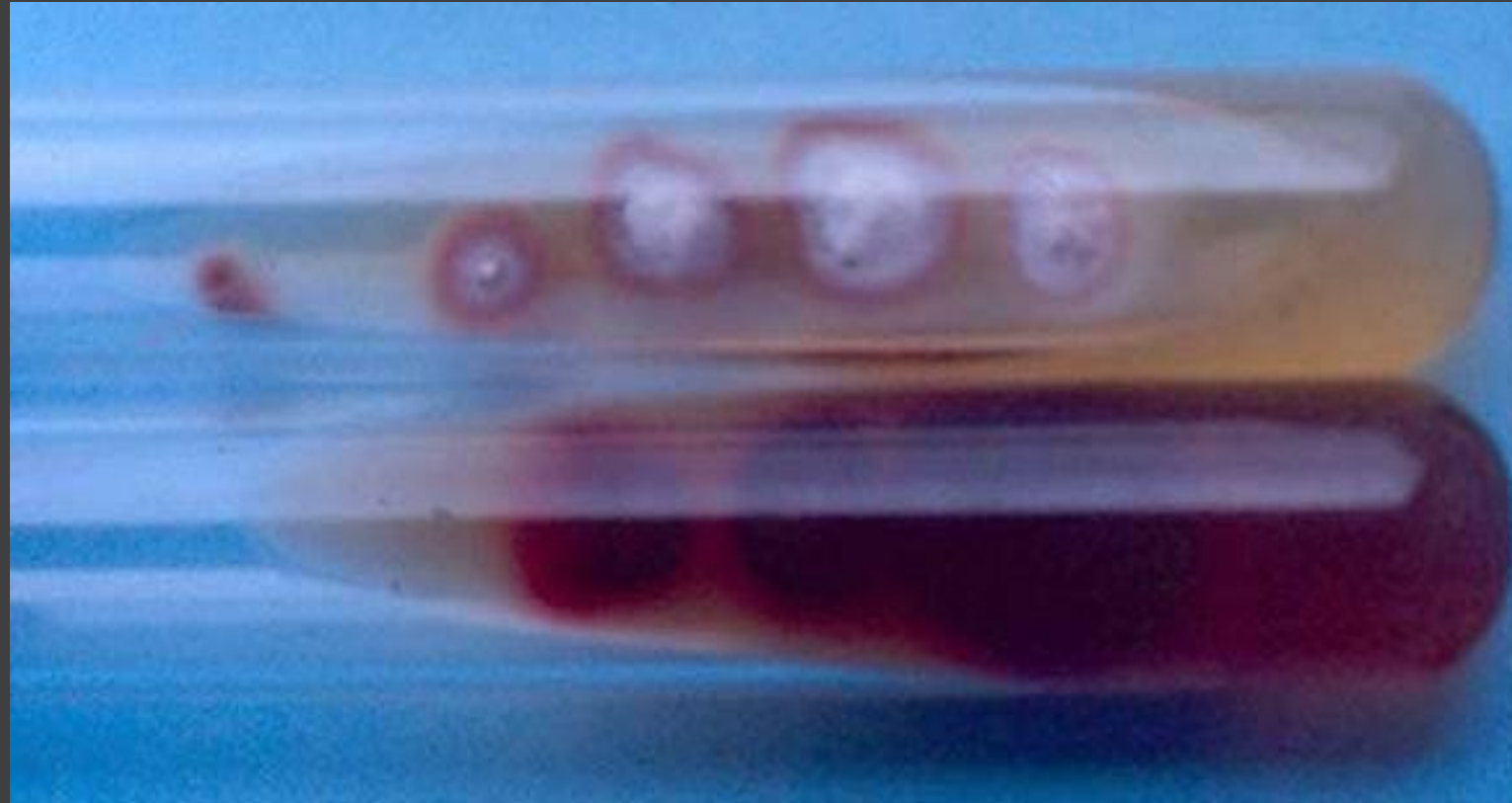


Figure 58. *Trichophyton rubrum*, colônia. A: front side. B: back. Photo courtesy of Professor Claudia Maria Pena Dias.

CULTURE FOR FUNGI

Trichophyton rubrum

MICROMORPHOLOGY OF THE COLONY:

It is characterized by hyaline, septate, branched and delicate hyphae, cylindrical macroconidia, with two to nine septa, piriform microconidia, in parallel in the hypha.

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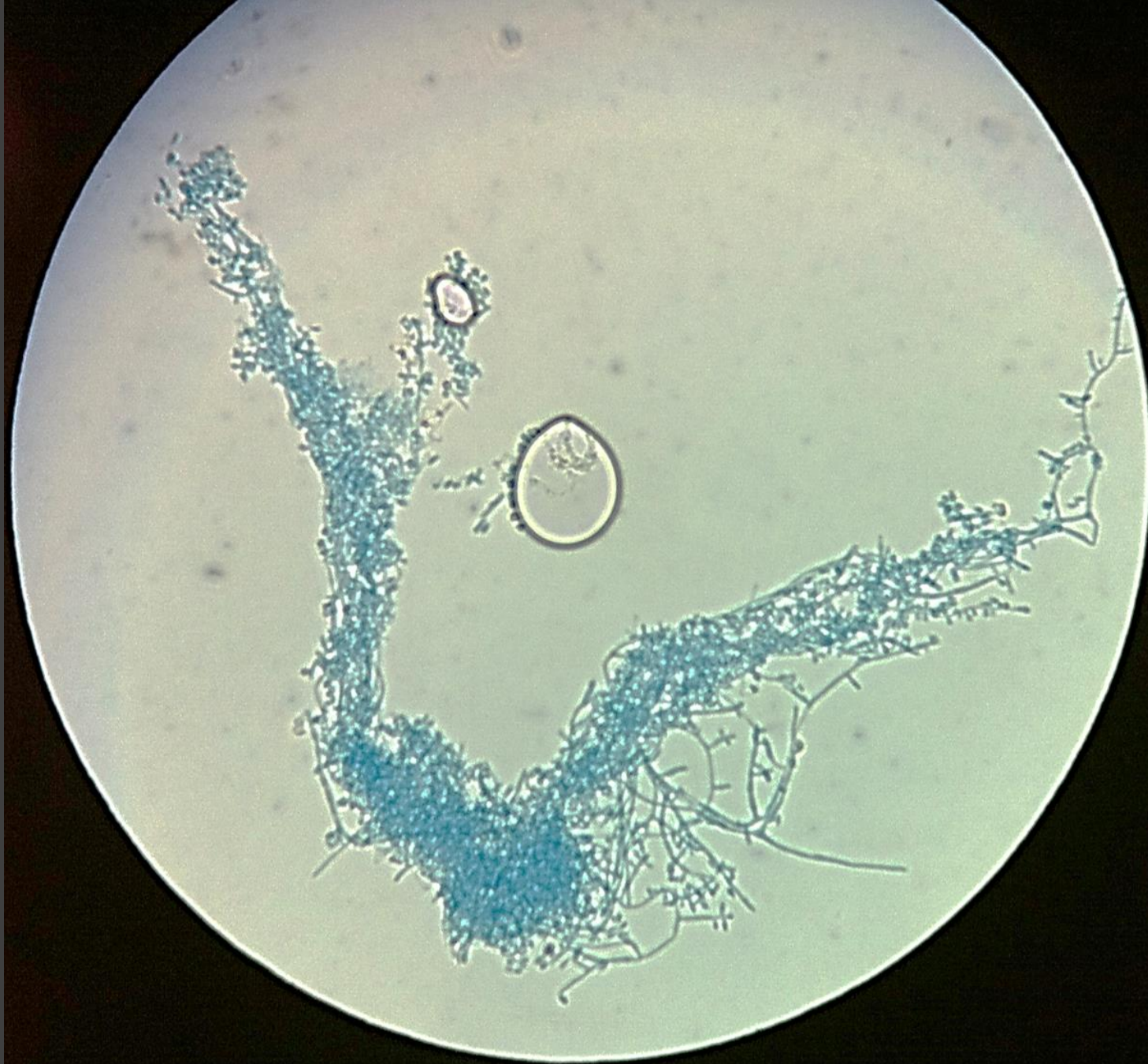
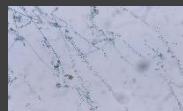


Figure 59. *Trichophyton rubrum*, micromorphology of the colony.

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CULTURE FOR FUNGI

Trichophyton rubrum

MICROMORPHOLOGY OF THE COLONY:

It is characterized by hyaline, septate, branched and delicate hyphae, cylindrical macroconidia, with two to nine septa, piriform microconidia, in parallel in the hypha.

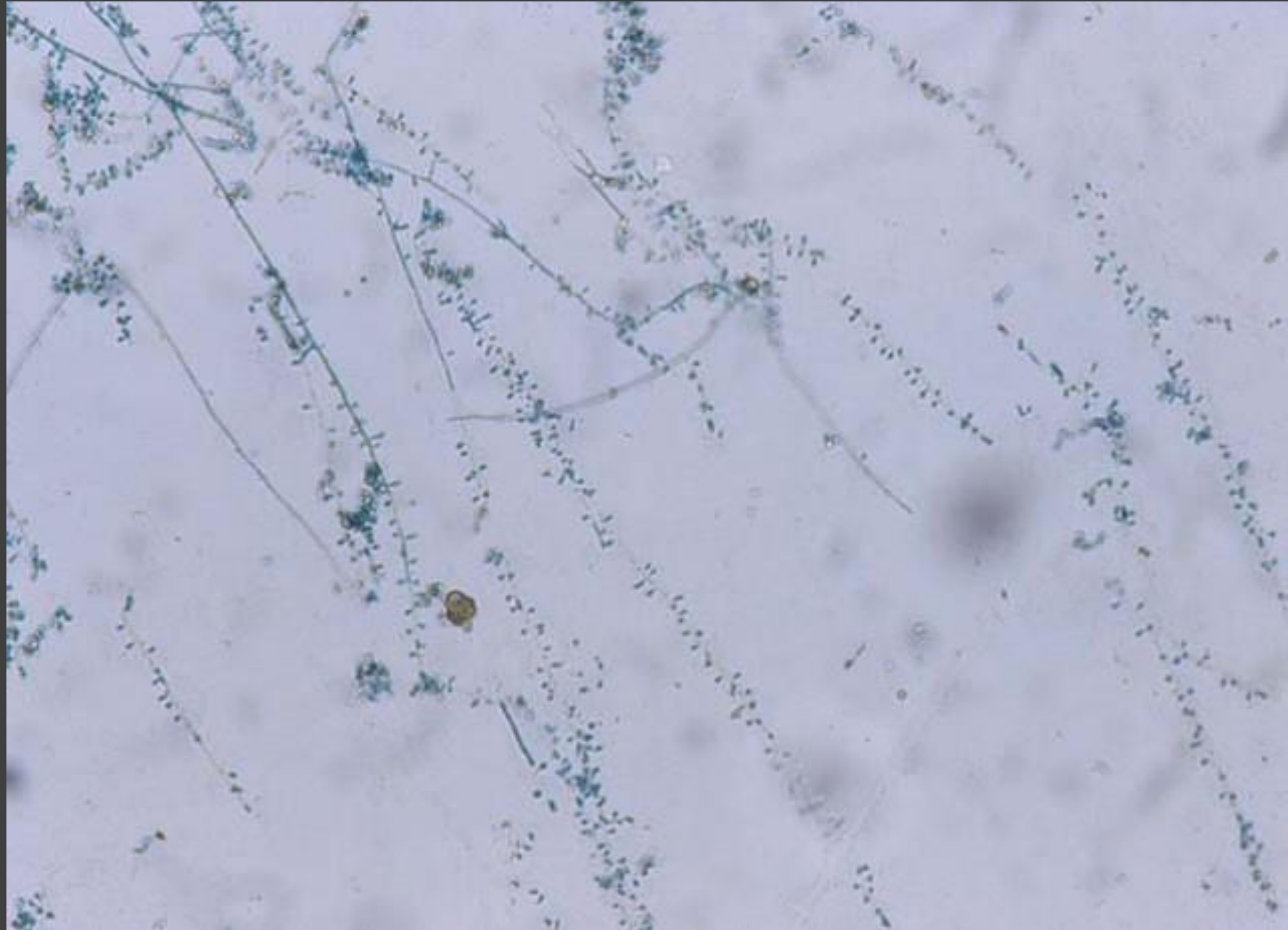


Figure 60. *Trichophyton rubrum*, micromorphology of the colony. Photo courtesy of Professor Claudia Maria Pena Dias.



CULTURE FOR FUNGI

Trichosporon sp.

MACROMORPHOLOGY OF THE COLONY:

Trichosporon sp. is characterized by creamy, yeast-like colony, with cerebriform, beige surface and colorless back.



Figure 61. Colony of *Trichosporon* sp. Photo courtesy of Professor Claudia Maria Pena Dias.

CULTURE FOR FUNGI

Trichosporon sp.

MICROMORPHOLOGY OF THE COLONY:

It is characterized by the presence of hyphae, pseudo-hyphae, arthroconidia and blastoconidia.

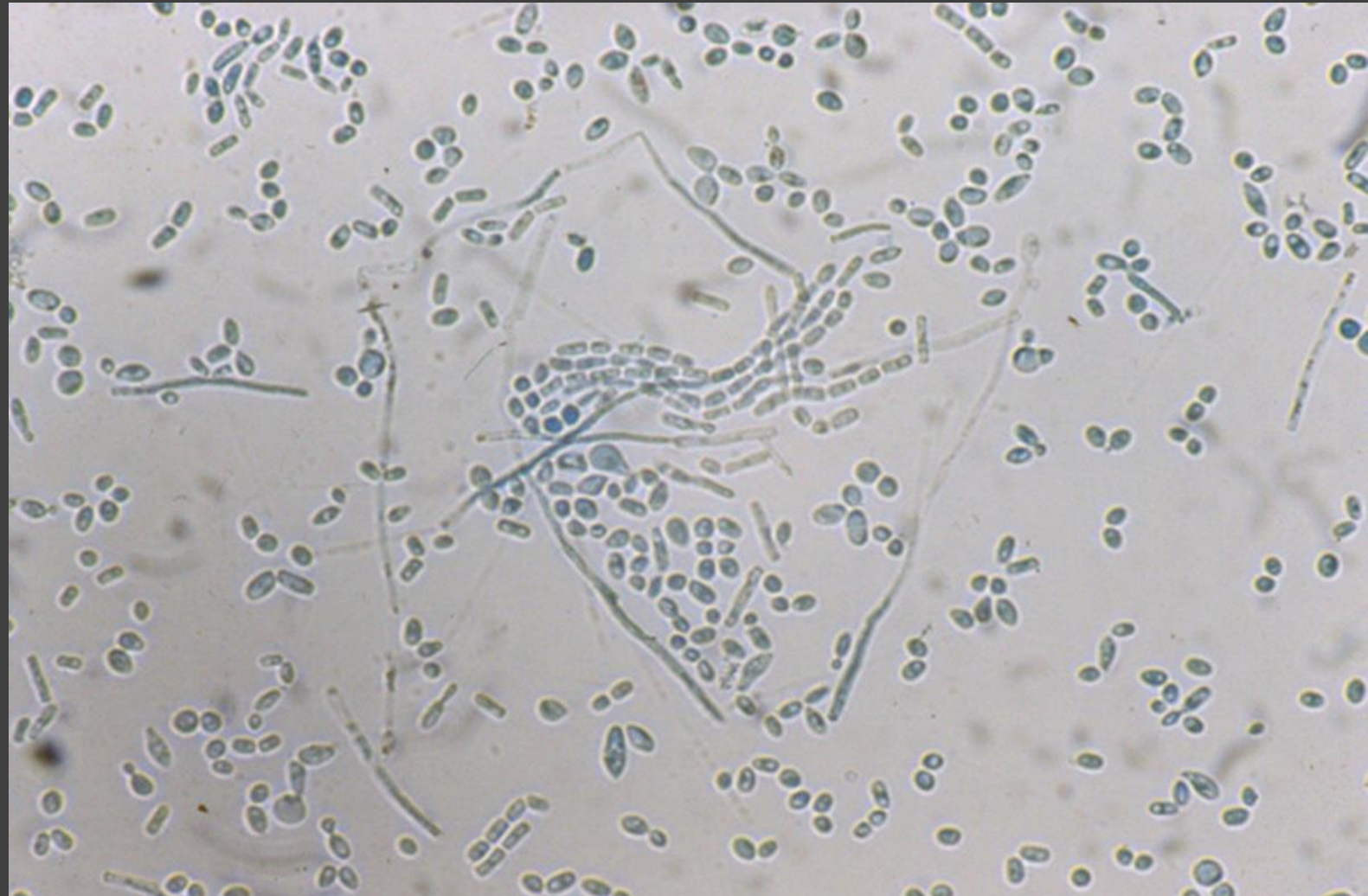
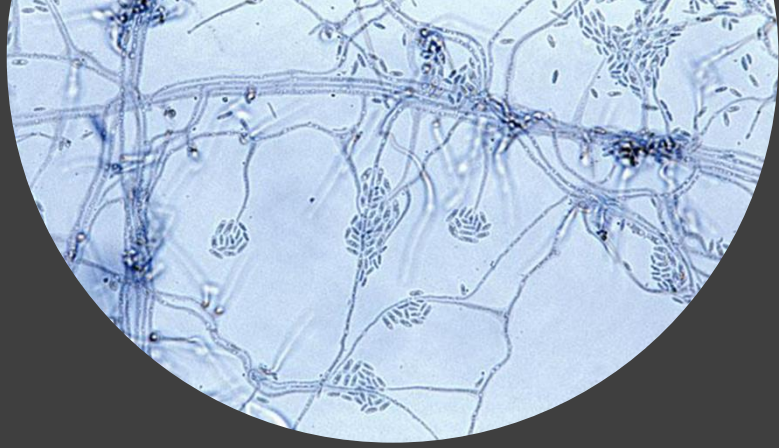


Figure 62. *Trichosporon sp.* micromorphology of the colony. Photo courtesy of Professor Claudia Maria Pena Dias.





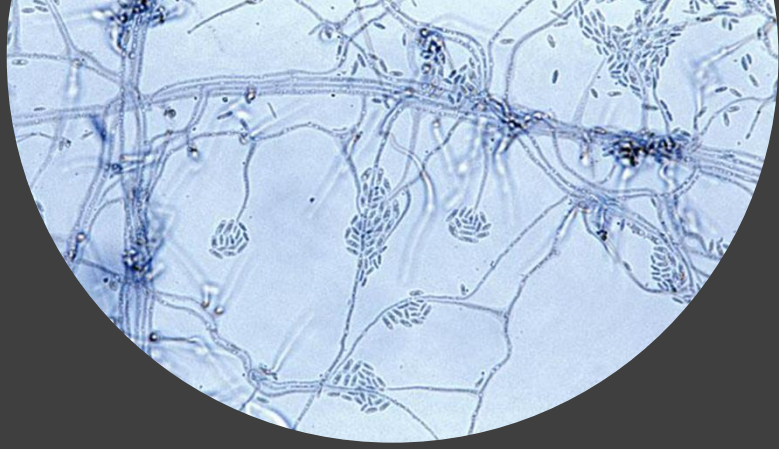
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