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MELBOURNE

FOOD20006

Food Microbiology & Safety

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Microbial responses to stress_Sporulation

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Ray and Bhunina Ch 8



Intended learning outcomes

Distinguish between spores of molds, yeasts and bacteria

Describe the process of bacteria sporulation, dormancy, activation and germination

Discuss the importance of spores in food

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Spores

For bacteria, sporulation is a response to an unfavourable environment

For moulds and yeast, sporulation can occur through sexual and asexual reproduction

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Spores are more resistant to environmental conditions than vegetative cells

Bacterial spores are much more resistant than mould or yeast spores

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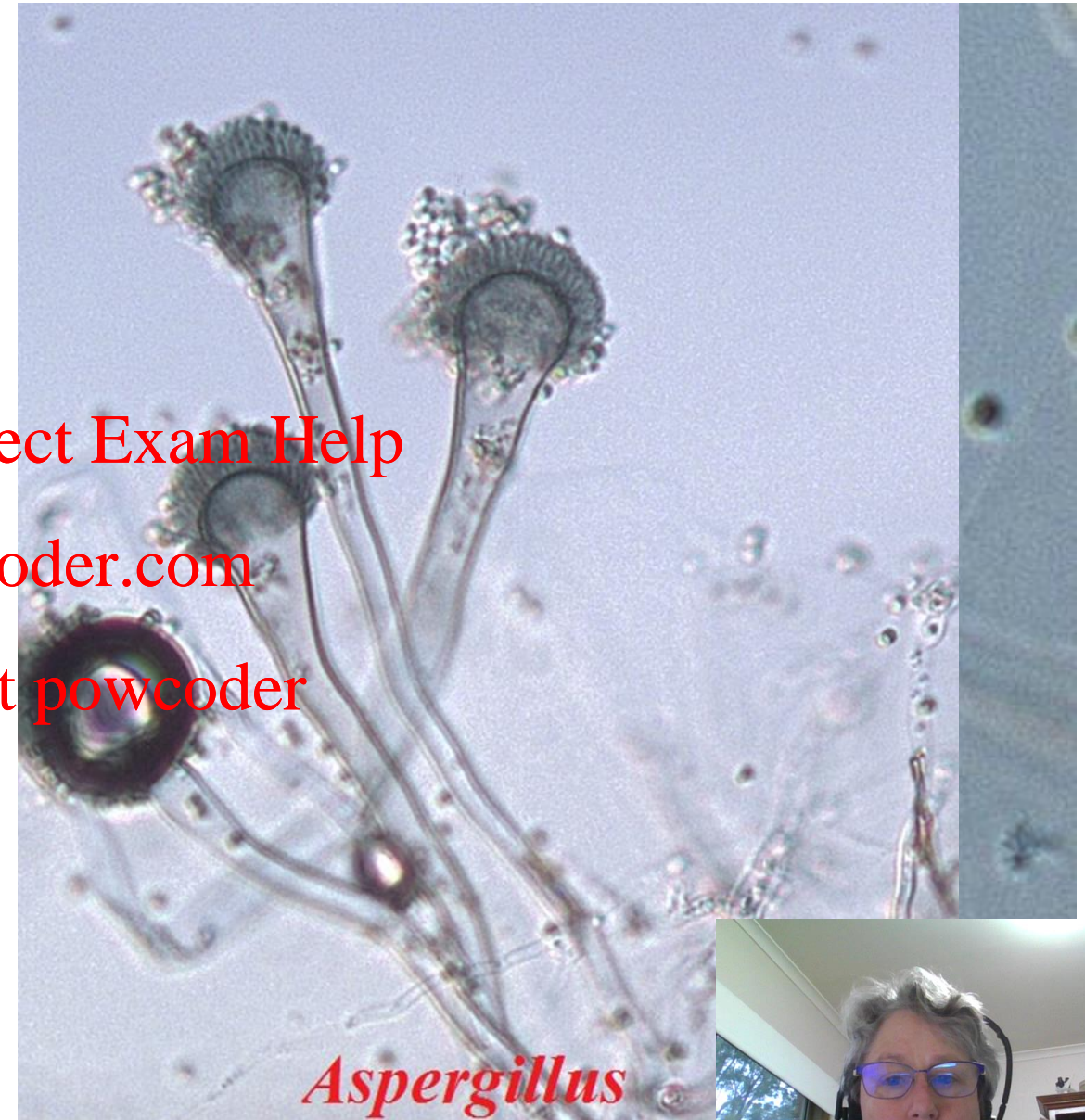
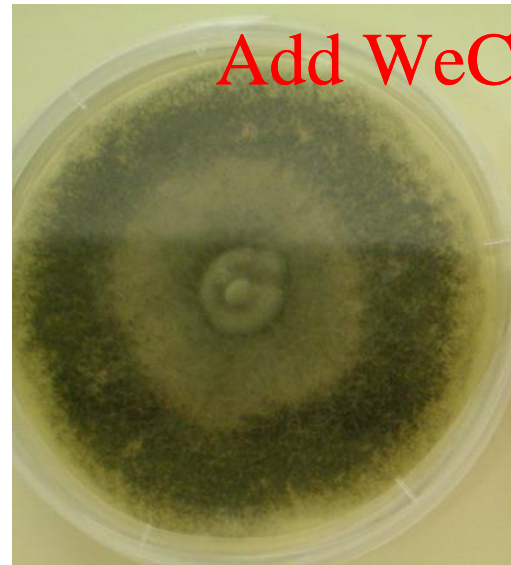
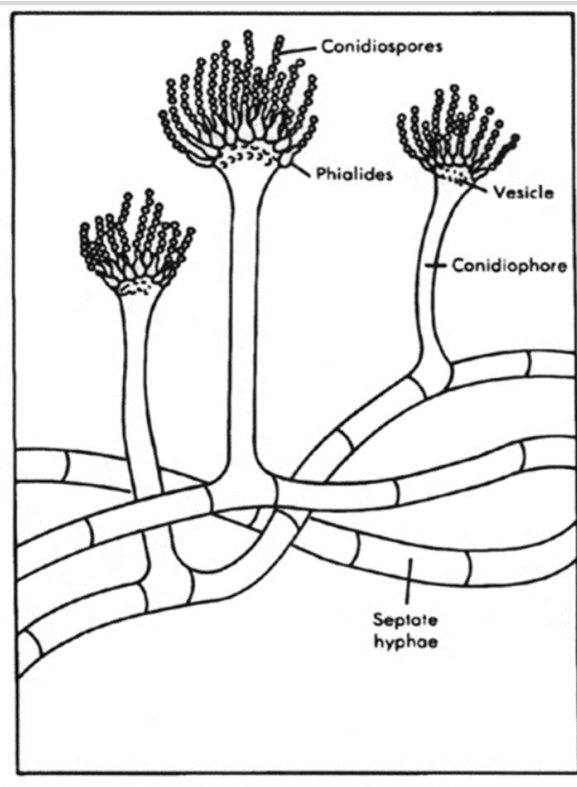
For convenience, we refer to bacterial spores as endospores. Refer back to earlier lectures on different sorts of mould spores; sporangiospores (with sac) and conidiospores (without sac)



Mould spores

Mould form large numbers of spores

- Conidiospores (conidia)
 - *Aspergillus* and *Penicillium* species form conidia



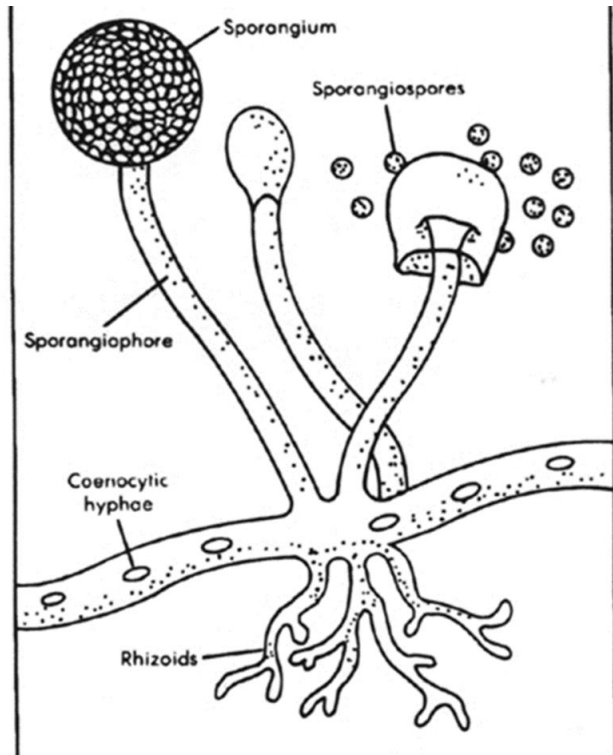
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Mould spores

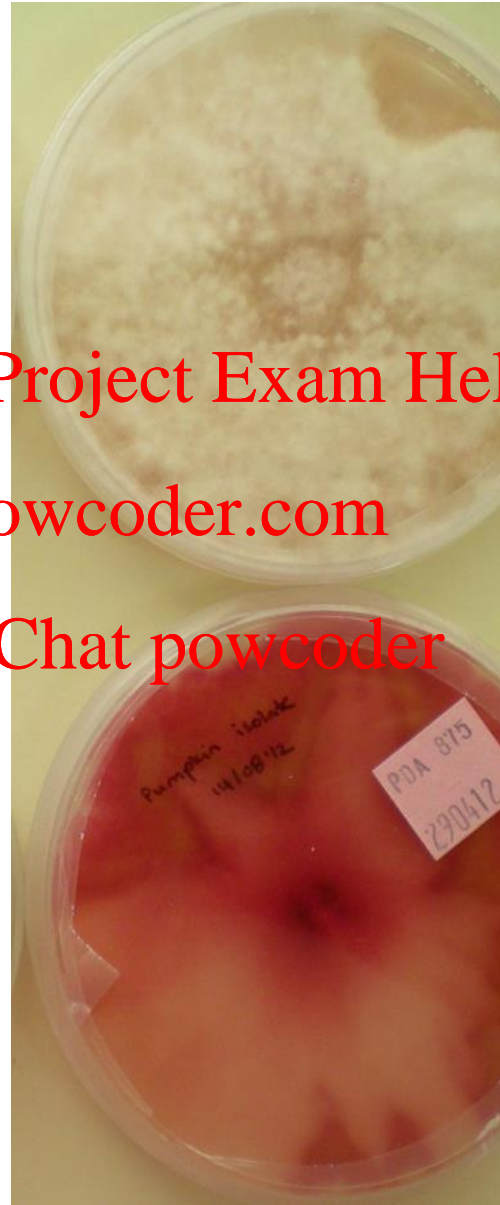
- Sporangiospores
 - *Mucor* and *Rhizopus* form sporangiospores



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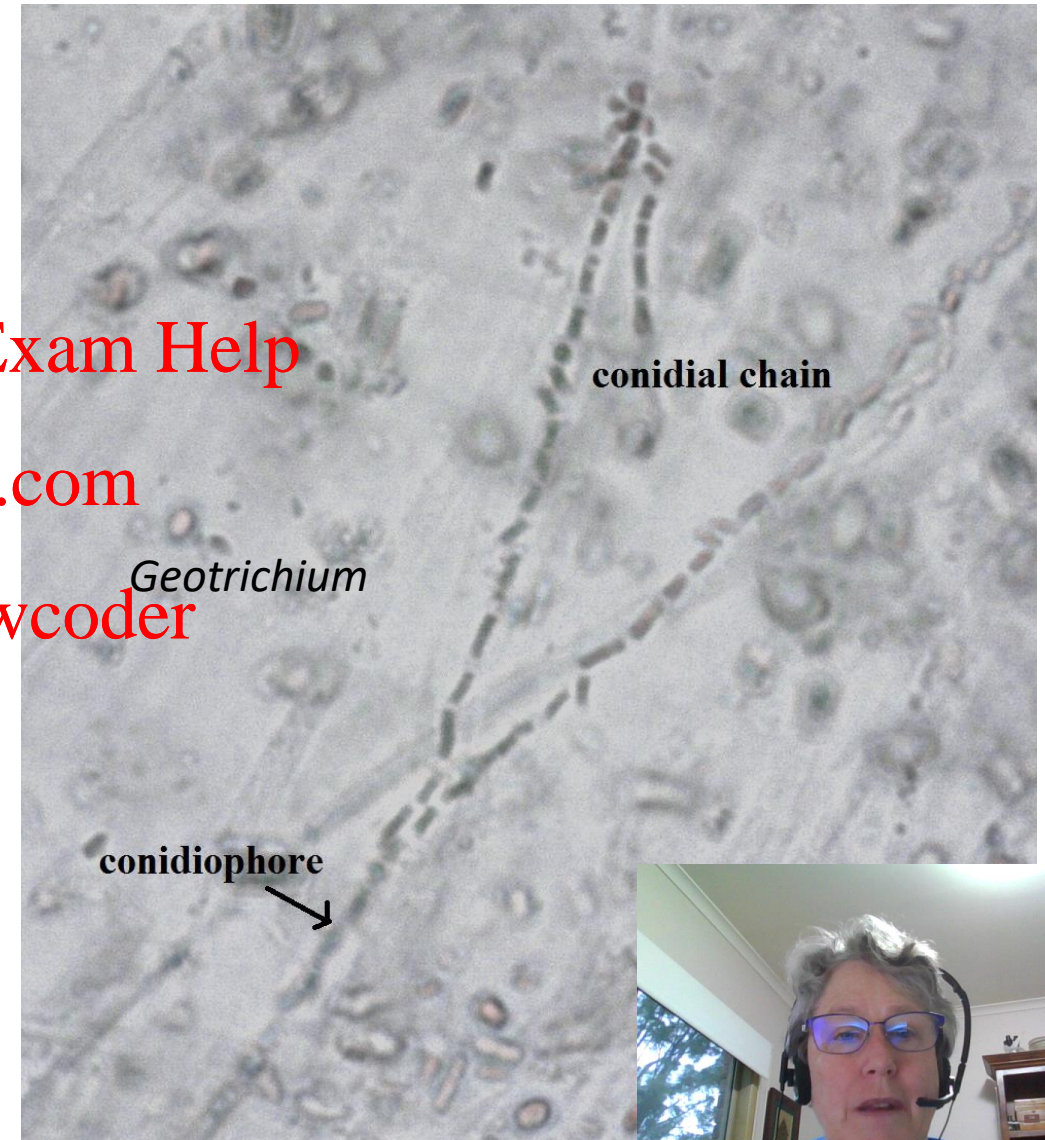
Mould spores

- Arthrospores
 - *Geotrichium* and *Pestalotiopsis* for arthrospores
 - Arthrospores are a primitive version of spores formed by breaking up of fungal mycelium

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Yeast spores

Yeasts that are important in food can be divided into two groups

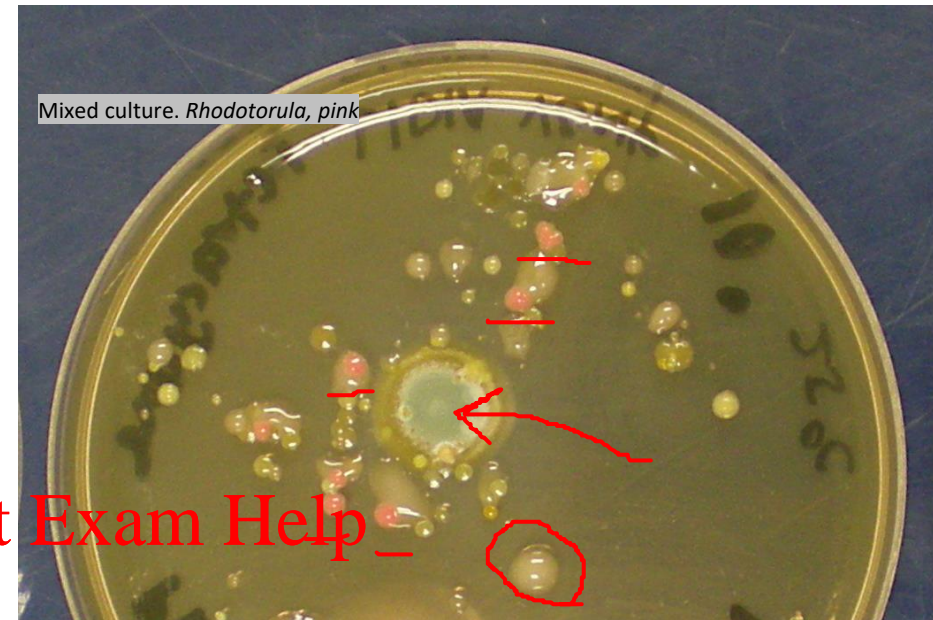
1. Those that do not form spores (false yeasts)

Examples: *Candida*, *Rhodotorula*

2. Yeasts that produce sexual ascospores (true yeasts)

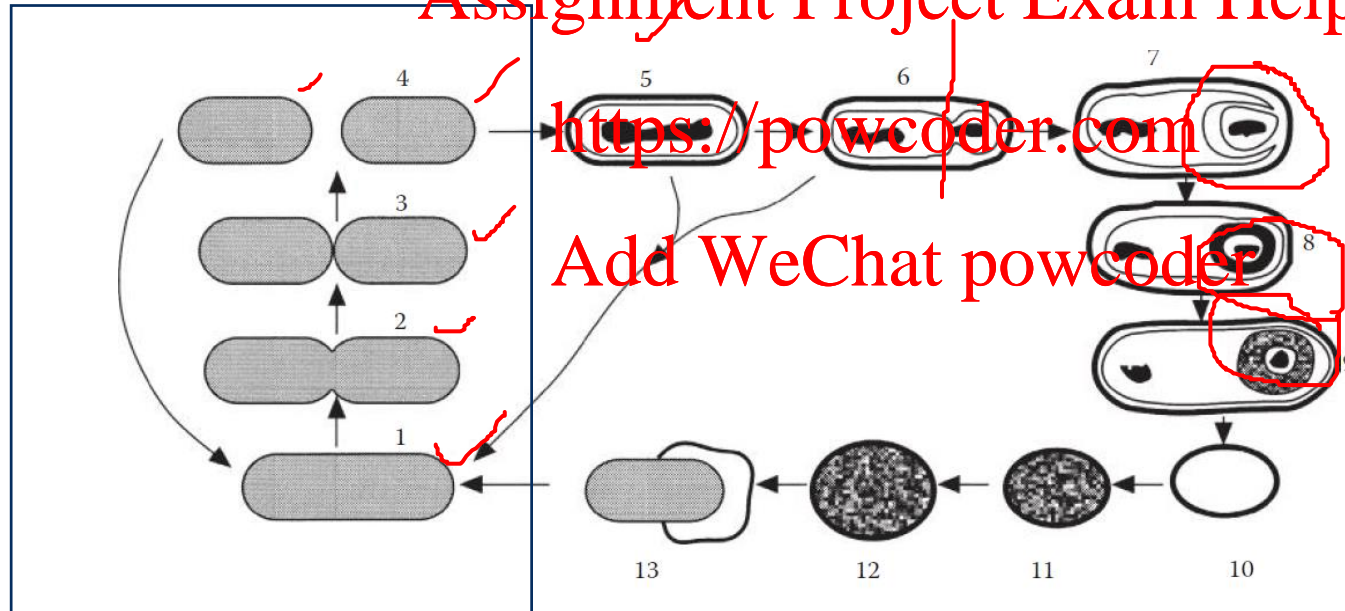
Examples: *Saccharomyces*, *Pichia*, *Hansenula*

Sexual reproduction is rarely observed in yeast which are important in food



Bacterial spores

- The ability to form spores is confined to few gram-positive bacterial genera including *Bacillus* and *Clostridium* and a few gram-negative species
- Bacteria form endospores (inside cell, one spore per cell)



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Activation and germination

Bacterial spores remain dominant when environmental conditions are unfavourable for growth

Bacterial spores are very resistant to extreme environmental conditions and they are essentially metabolically inactive (dormant)

Bacterial spores can be activated by

- Sublethal heat treatment
- Radiation
- Exposure to extreme pH
- Treatment with high-pressure
- Sonication (soundwaves)

Bacterial spores which are activated undergo structural changes as they emerge from the dormant state and entered germination. This process is irreversible once it has started

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Important of spores in food

Spores are able to survive for a long time and spread easily by dust and in air

This enables spores to contaminate food and if the food environment is suitable spores germinate, grow and produce undesirable effects such as spoilage

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Moulds and yeasts

- spores can be readily destroyed by heat treatments
- Germination of spores can only happen in air. The growth can be prevented by storing foods in the absence of air

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Bacteria

- Species of *Bacillus* and *Clostridium* are associated with food spoilage and foodborne disease
- Bacterial spores have high heat resistance
- Special effort is made to prevent germination and outgrowth





Prevention of spore germination

Spores are a major concern in the canning of low acid foods

Very high heat treatment is employed to achieve commercial sterility that kills spores of pathogenic bacteria

Spore germination can be inhibited with

- Nitrite (processed meats such as salami)
- Low pH (acid products)
- Low-water activity
- High salt

If a combination of different measures is used to prevent a food safety problem we called this Hurdle technology.

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Hurdles



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