



# Atlas of Food Microbiology LAB

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*Microorganisms including: Bacteria, Molds & Yeast*

Describes in pictures the Microorganisms that can be isolated from food, giving brief characteristics of the isolated ones in our lab.

**University of Baghdad – College of Science – Department of Biology**

**Forth Classes**

**2019/2020**

**6<sup>th</sup>. Electronic Edition – for Limited use only**

# Preface

*“Science knows no country, because knowledge belongs to humanity, and is the torch which illuminates the world. Science is the highest personification of the nation because that nation will remain the first which carries the furthest the works of thought and intelligence”.*

**Louis Pasteur**

*Science always unites students whatever their specialization was, or their age is... As I was a student once, I've been inspired by my Teachers who taught me much & till now, how to learn from the simple things in life, recording notes, keep on trying despite the difficulties, searching the new scientific trends, but the most important thing that I've learned is to document the results to put the knowledge in the hands of those who need, to continue the never ending trip of science....*

*To prevail the benefits, preparing this Atlas was an important thing to work on, that included some of Lab results obtained during the hard work with the undergraduate students, and some of the important results related to the Food Microbiology Lab, collected from scientific references, besides the help of the Web services, in hope that it would be useful to all who read it.*

*Since no work can ever be done alone....*

*I would like to Thank ....*

*The Former Head of Biology Department Professor Doctor **Sabah N. Alwachi** at the year of publishing for all the support to encourage such a scientific work that would help our students...*

*The Current Head of Biology Department Professor Doctor **Hula Younis** for all the support she showed in a remarkable time...*

*And my colleagues of Food Microbiology LAB in Biology Department...*

**Msc. Teacher Assistant  
Lina A. Omar-Zahid**

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# Bacteria

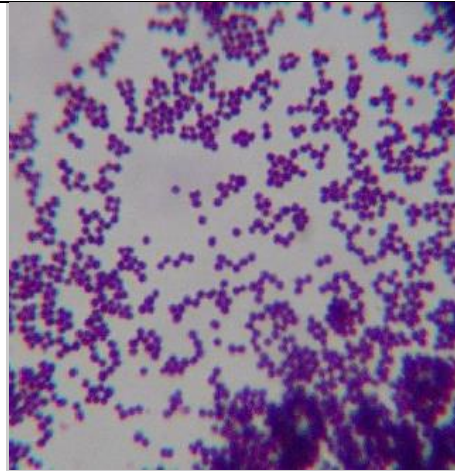


# 1-Gram Positive Bacteria

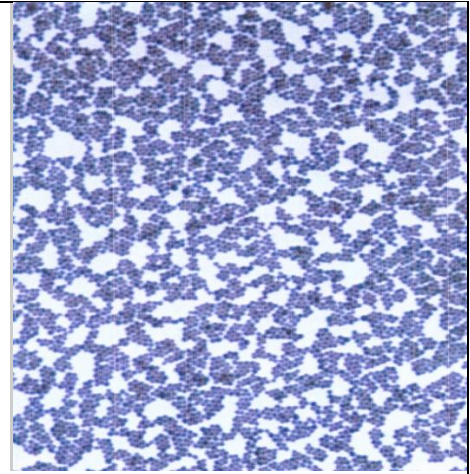
## 1.1 *Staphylococcus*



**A. Electron Microscope.**



**B. Light Microscope.**



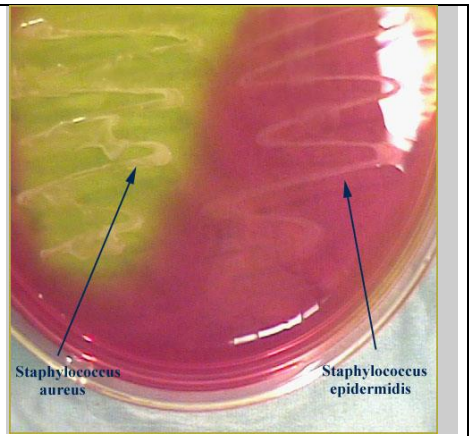
**C. Light Microscope.**



**D. Colonies of *S.epidermidis* on Nutrient Agar.**



**E. Colonies of *S.aureus* on Nutrient Agar.**



**F. Colonies on Mannitol Salt Agar.**

### Microscopic Characteristics

G+ve, cocci, non-spore former, irregular clusters.

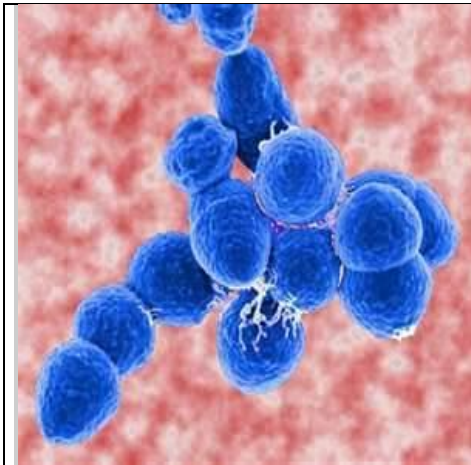
### Macroscopic Characteristics

*S. aureus* Small colonies, smooth, cocci, golden color colony, appear as yellow colonies on Mannitol Salt Agar.

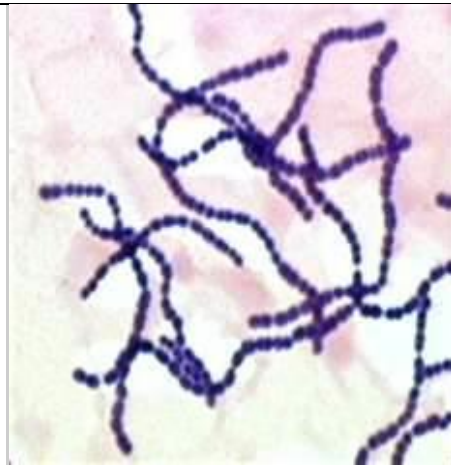
*S. epidermidis* Very small colonies, smooth, cocci, white color colony, appear as red colonies on Mannitol Salt Agar.

# Gram Positive Bacteria

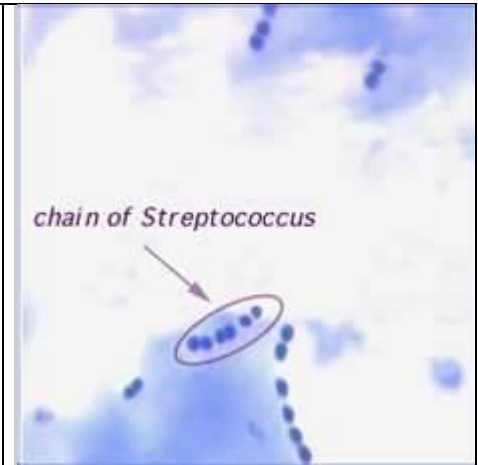
## 1.2 *Streptococcus*



A. Electron Microscope.



B. Light Microscope (Gram Stain).



C. Light Microscope (Methylene Blue).



D. Colonies of *Streptococcus* on Nutrient Agar.



E. Colonies of *Streptococcus* on Blood Agar.



F. Colonies of *Streptococcus* on Blood Agar showing different types of hemolysis.

### Microscopic Characteristics

G+ve, cocci, non-spore former, appear in chains.

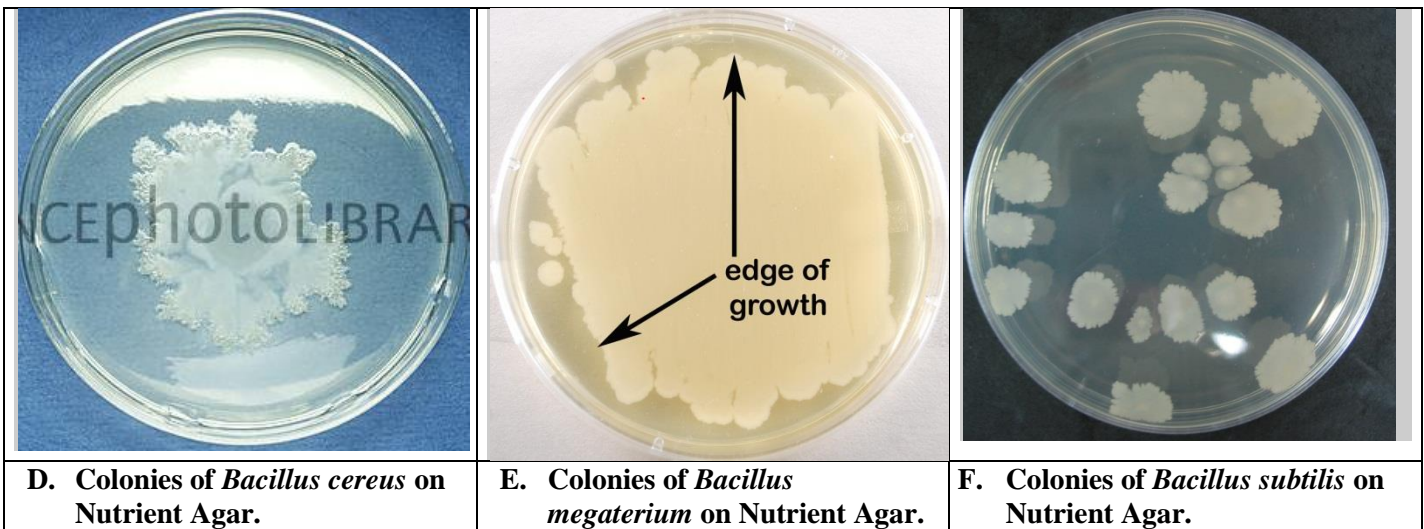
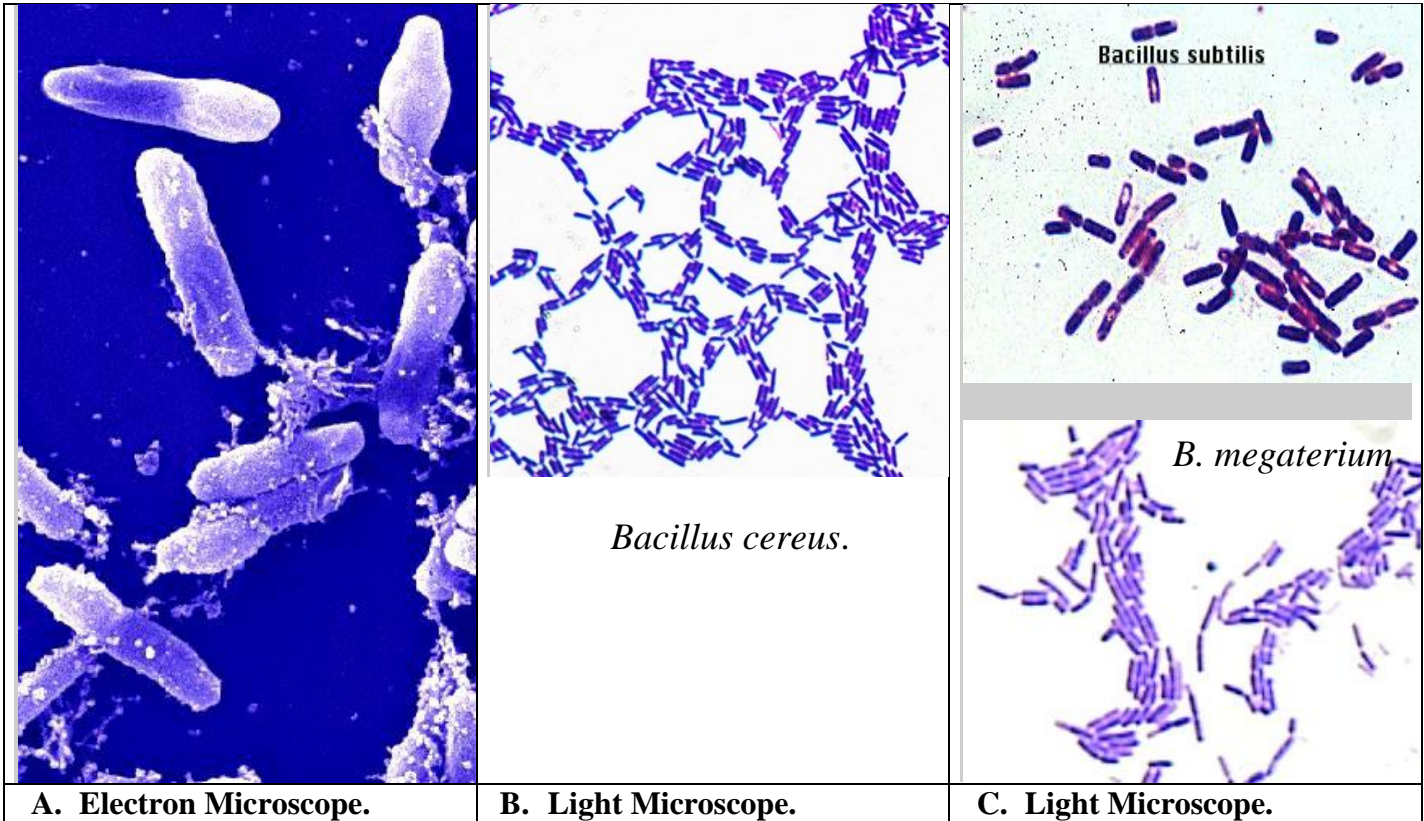
### Macroscopic Characteristics

Small colonies, smooth, cocci, show hemolysis on Blood Agar.



# Gram Positive Bacteria

## 1.3 *Bacillus*



### Microscopic Characteristics

G+ve, bacilli, endospore former.

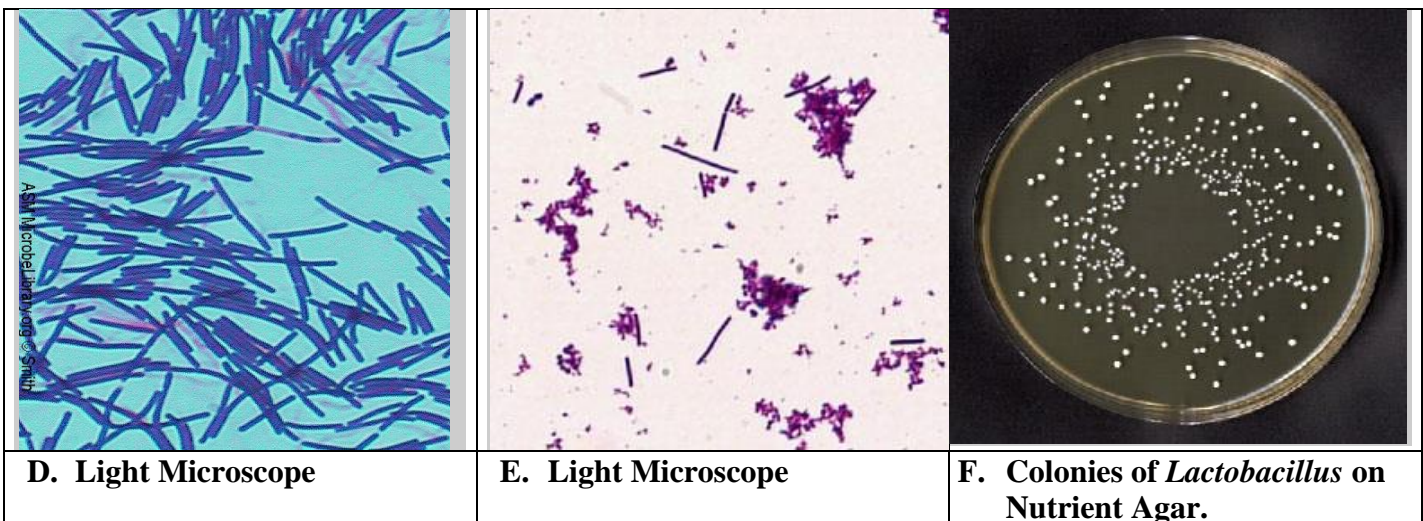
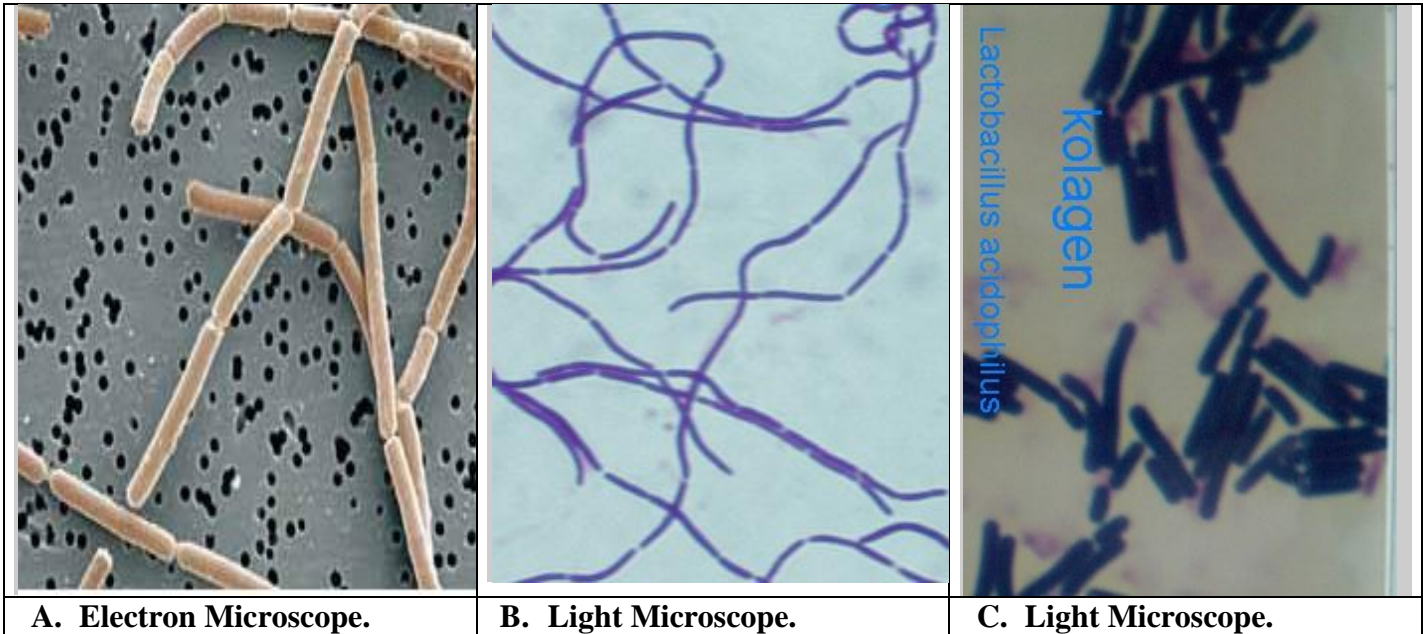
### Macroscopic Characteristics

Rough, opaque, large, branched end, white colonies.



# Gram Positive Bacteria

## 1.4 *Lactobacillus*



### Microscopic Characteristics

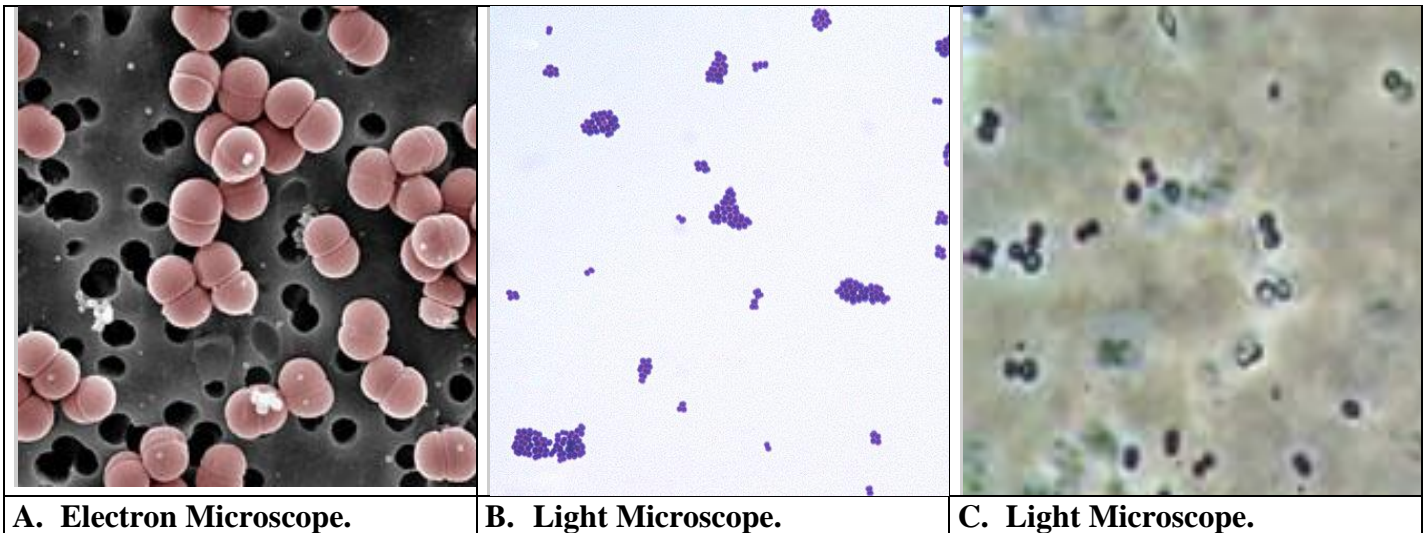
G+ve, long bacilli, non-spore former.

### Macroscopic Characteristics

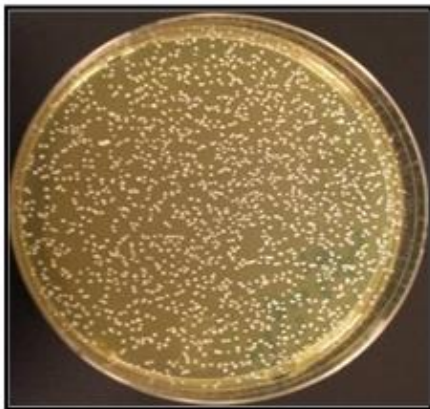
Smooth, opaque, small, white colonies.

# Gram Positive Bacteria

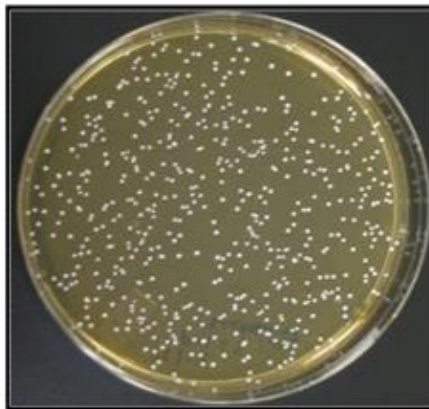
## 1.5 *Pediococcus*



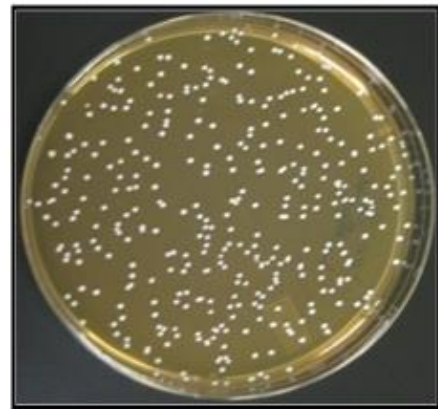
## *Pediococcus*



pH 6.2



pH 2.0



pH 1.5

D. Colonies of *Pediococcus* on Nutrient Agar.

### Microscopic Characteristics

G+ve, coccobacilli, appear in pairs or tetrads.

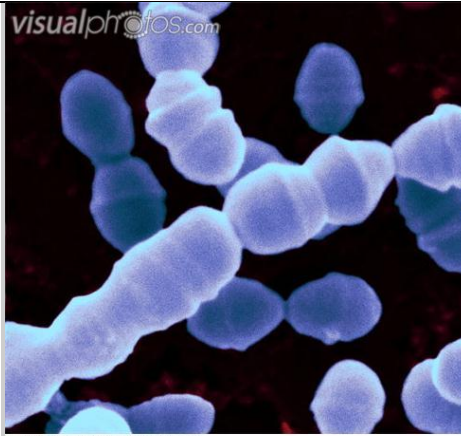
### Macroscopic Characteristics

Smooth, opaque, small, white colonies.

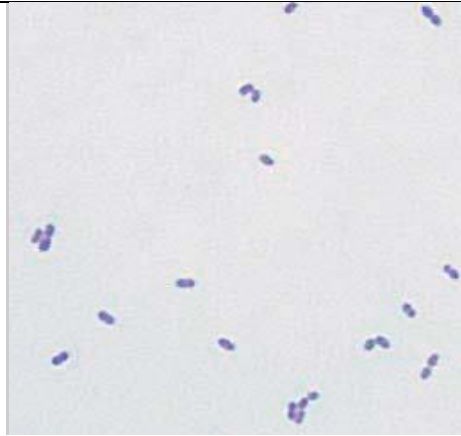


# Gram Positive Bacteria

## 1.6 *Leuconostoc*



A. Electron Microscope.



B. Light Microscope.



C. Colonies on Nutrient Agar.

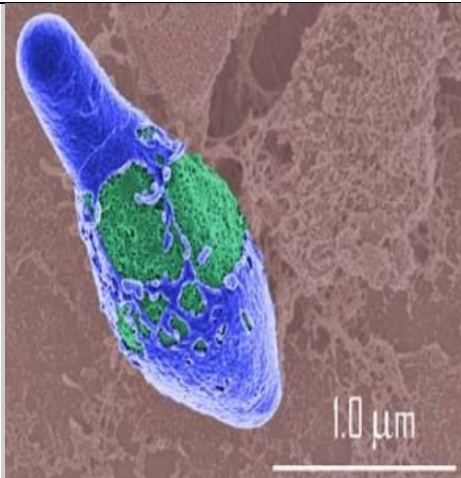
### Microscopic Characteristics

G+ve, ovoid-cocci, appear in pairs.

### Macroscopic Characteristics

Smooth, opaque, slime colonies.

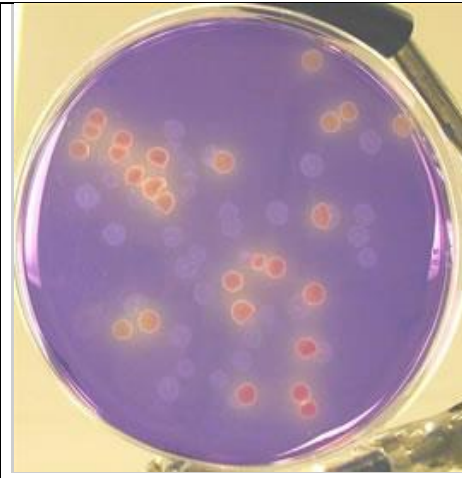
## 1.7 *Clostridium*



A. Electron Microscope.



B. Light Microscope.



C. Pink Colonies on D.R.C.M.

### Microscopic Characteristics

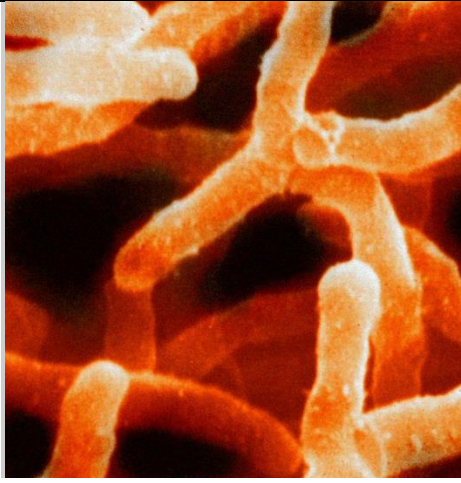
G+ve, rod-shaped, spore forming anaerobic bacteria, drum stick like cell.

### Macroscopic Characteristics

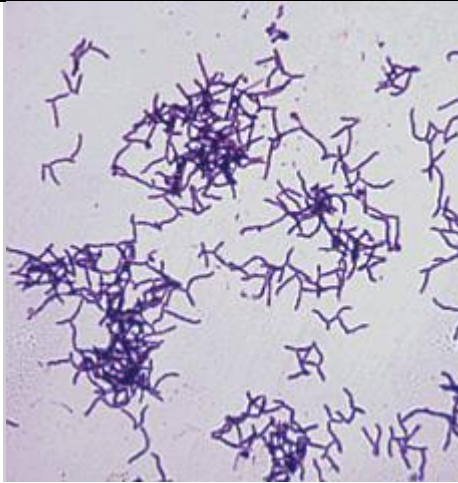
Pink round colonies on D.R.C.M. media after adding NaOH for 20-30sec.

# Other Gram Positive Bacteria

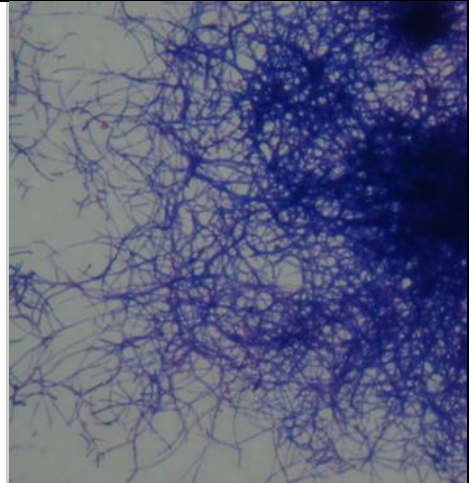
## 1. *Actinomycetes*



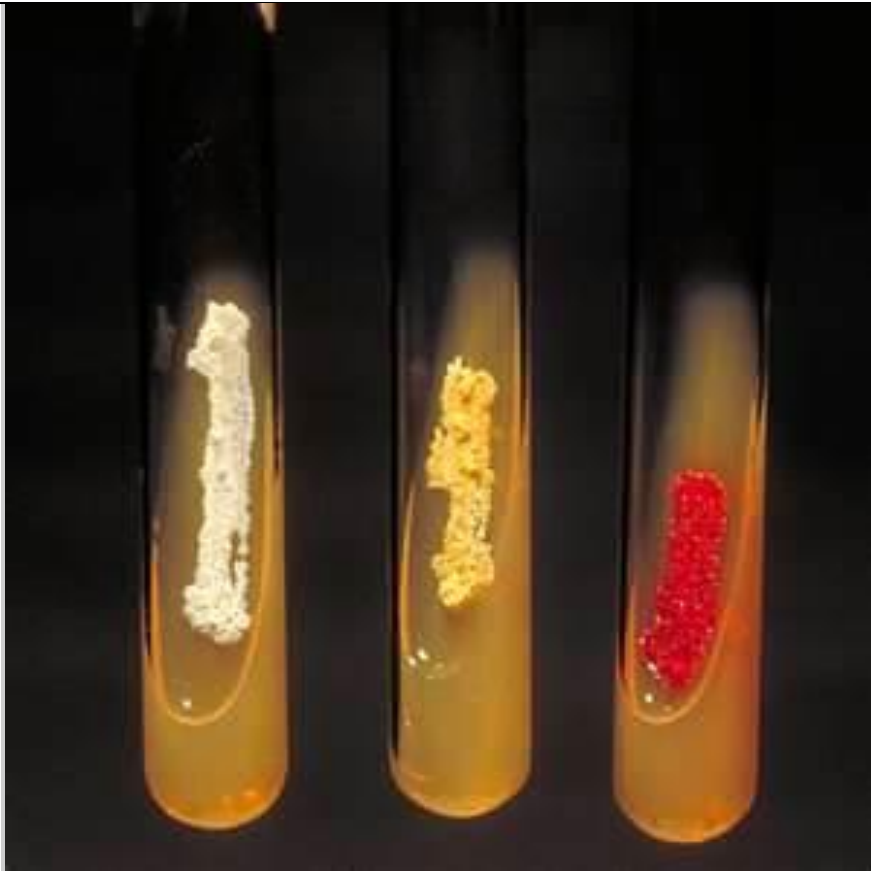
A. Electron Microscope.



B. Light Microscope.



C. Light Microscope.



D. Different morphologies of *Actinomycetes*.

### Microscopic Characteristics

G+ve, non-spore former, appear like branched network hyphae.

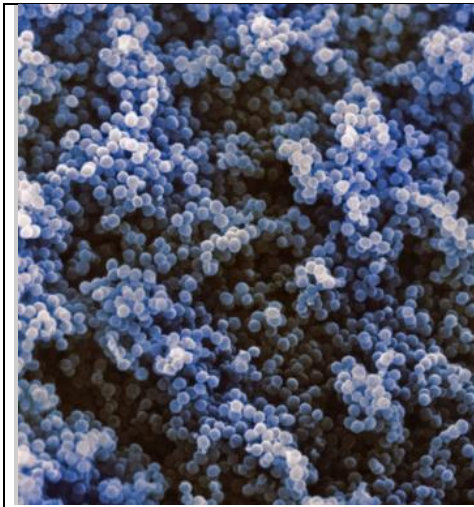
### Macroscopic Characteristics

Colonies small, fragile, compressed, chalky, may be white, yellow or red.

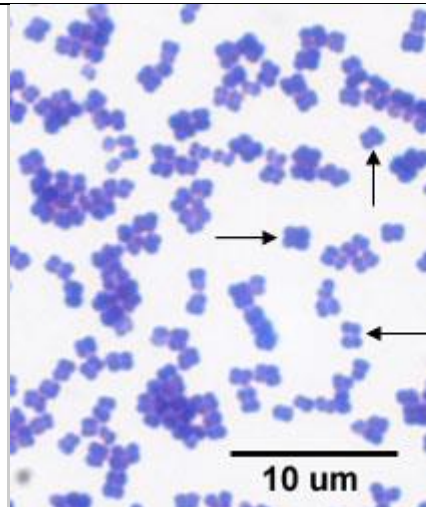


## Other Gram Positive Bacteria

### 2. *Micrococcus*



A. Electron Microscope.

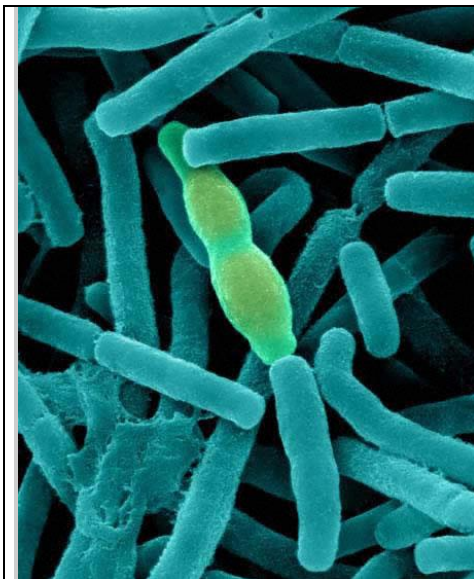


B. Light Microscope.

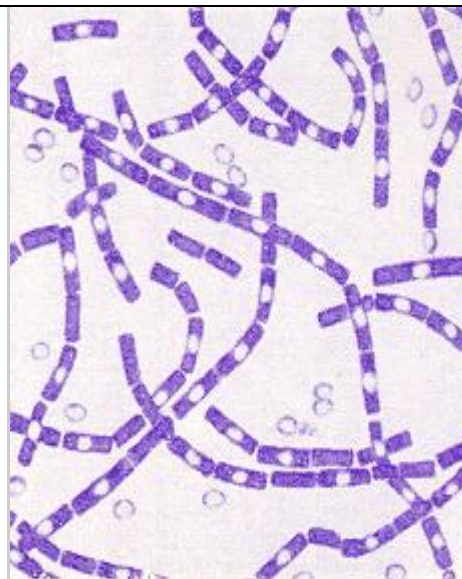


C. Colony on Nutrient Agar.

### 3. *Bacillus anthracis*



D. Electron Microscope.

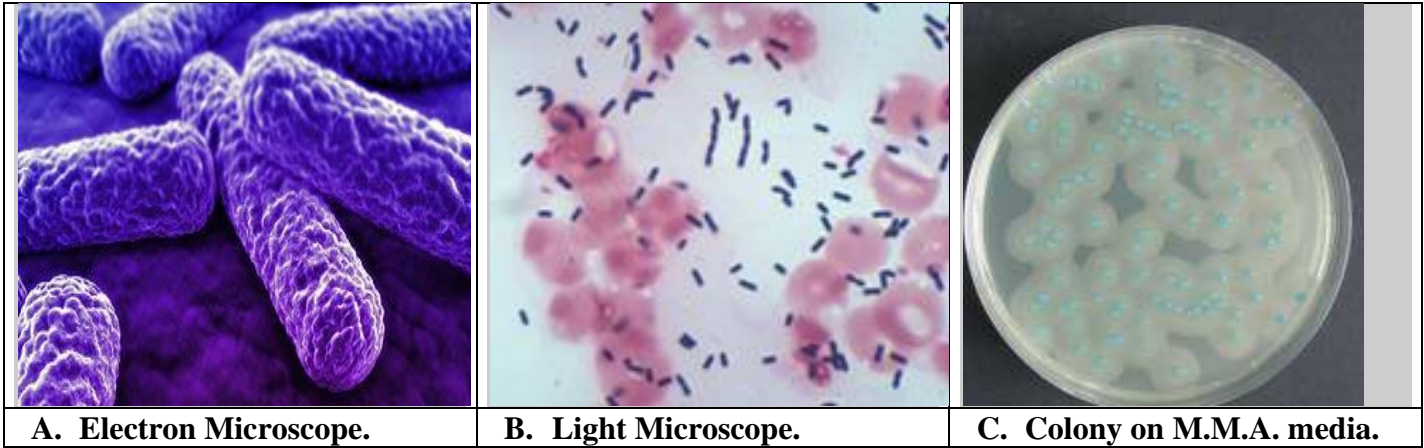


E. Light Microscope.



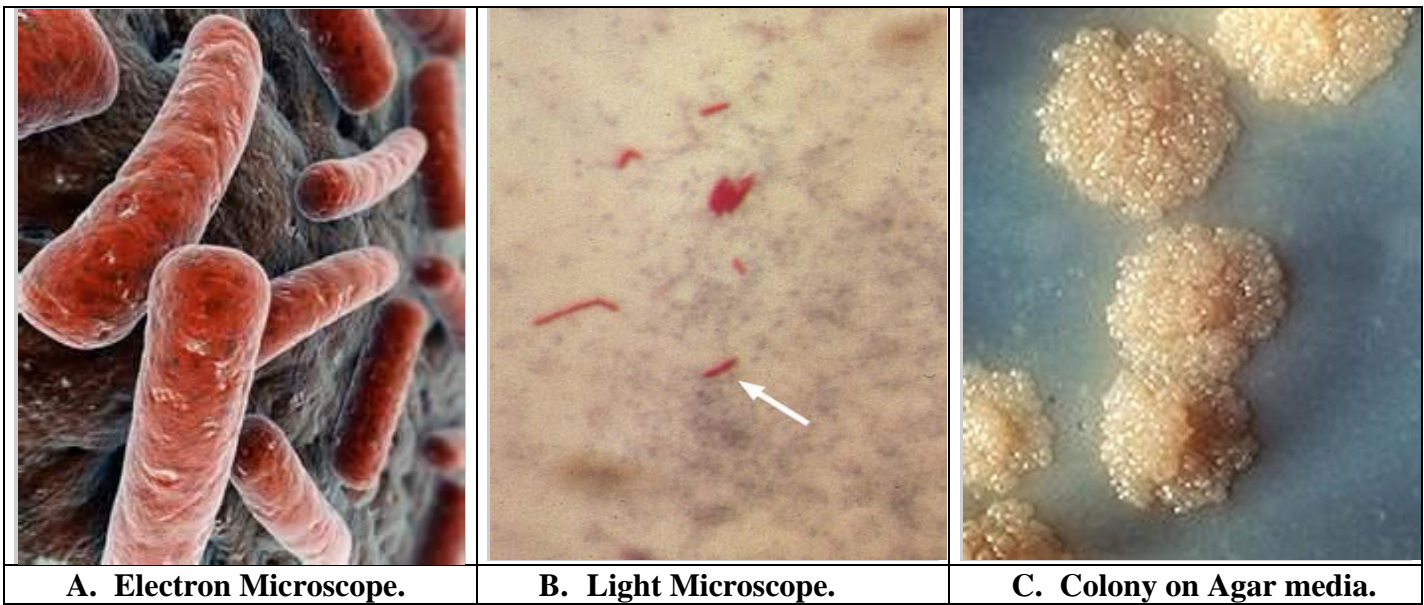
F. Colony on Nutrient Agar.

#### ***4. Listeria monocytogenes***



#### **Acid Fast Stain Gram Positive like Bacteria**

#### ***Mycobacterium tuberculosis***



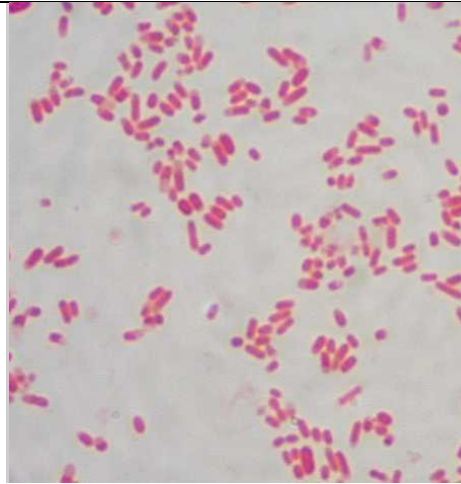


## 2-Gram Negative Bacteria

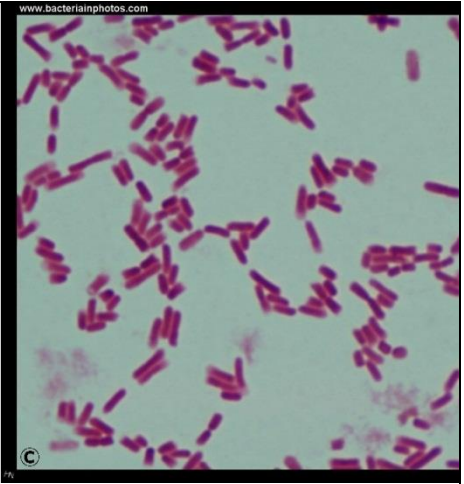
### 2.1 *Escherichia coli*



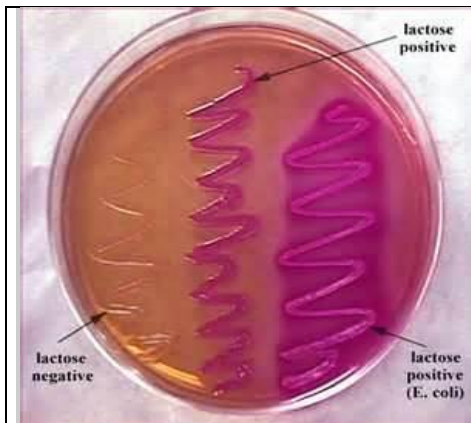
A. Electron Microscope.



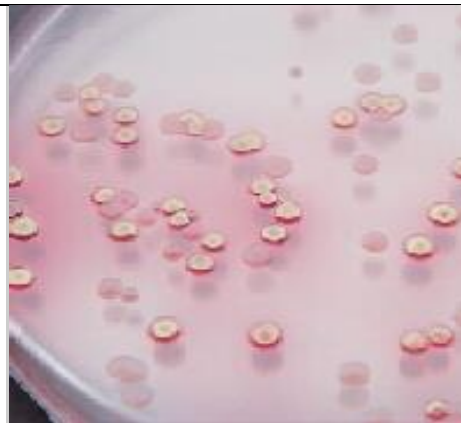
B. Light Microscope.



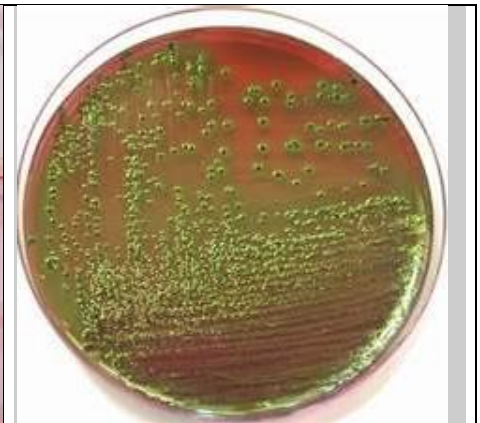
C. Light Microscope.



D. Colonies on MacConkey Agar.



E. Colonies on *Endo* Agar.



F. Colonies on E.M.B. Agar.

#### Microscopic Characteristics

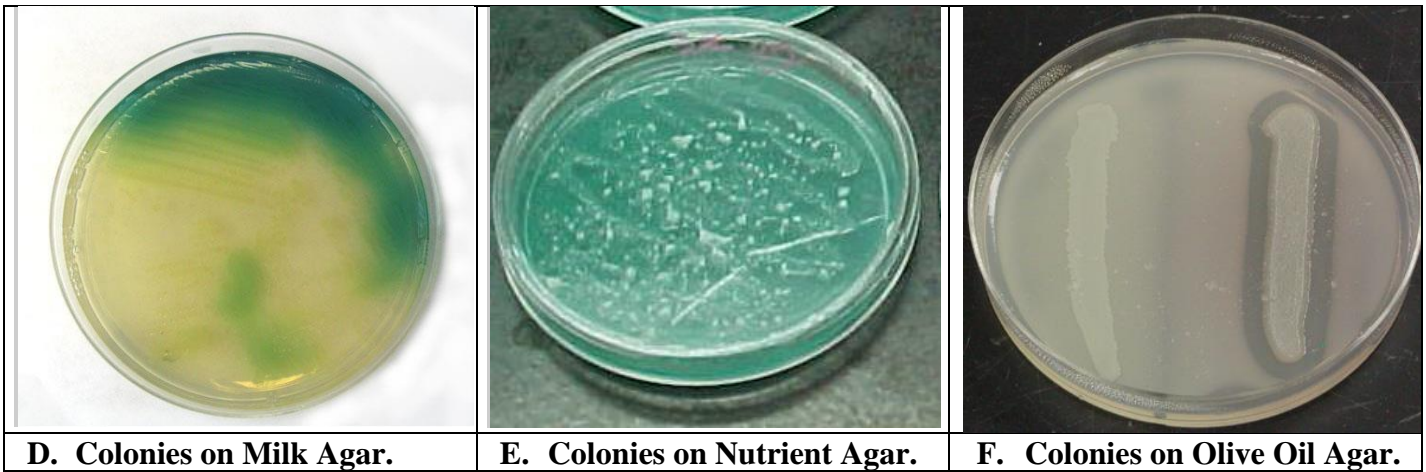
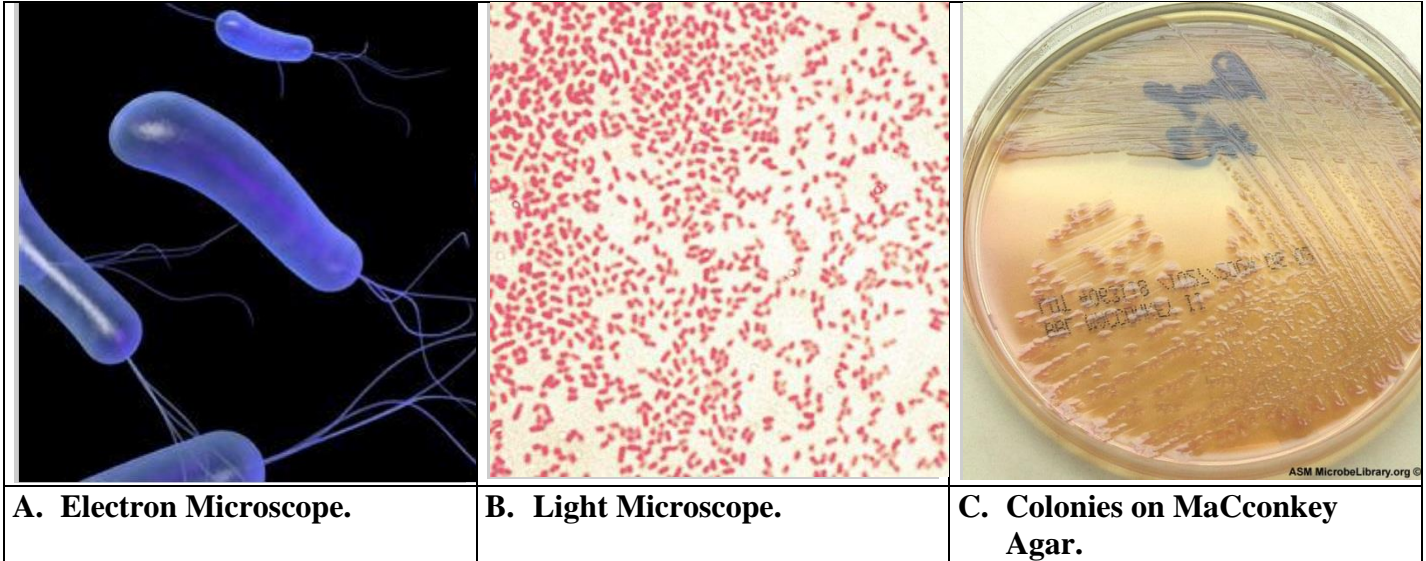
G<sup>-</sup>ve, rod-shaped, non-spore former.

#### Macroscopic Characteristics

Lactose fermenter, Pink colonies on Endo Agar & MacConkey Agar, Green metallic sheen on EMB Agar.

# Gram Negative Bacteria

## 2.2 *Pseudomonas*



### Microscopic Characteristics

G-ve, short bacilli, non- spore former.

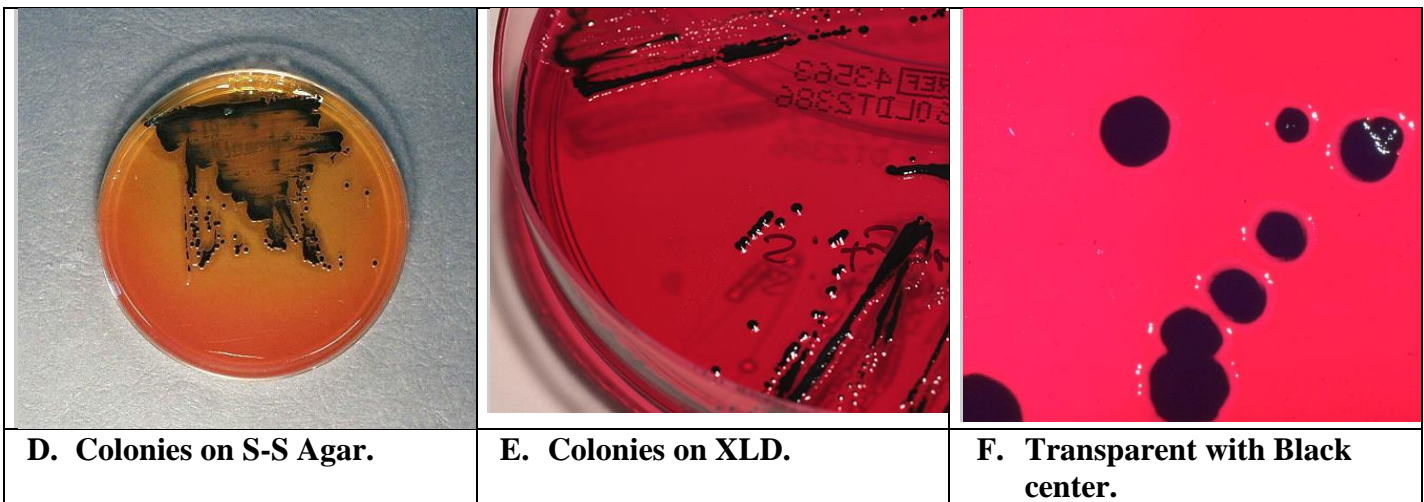
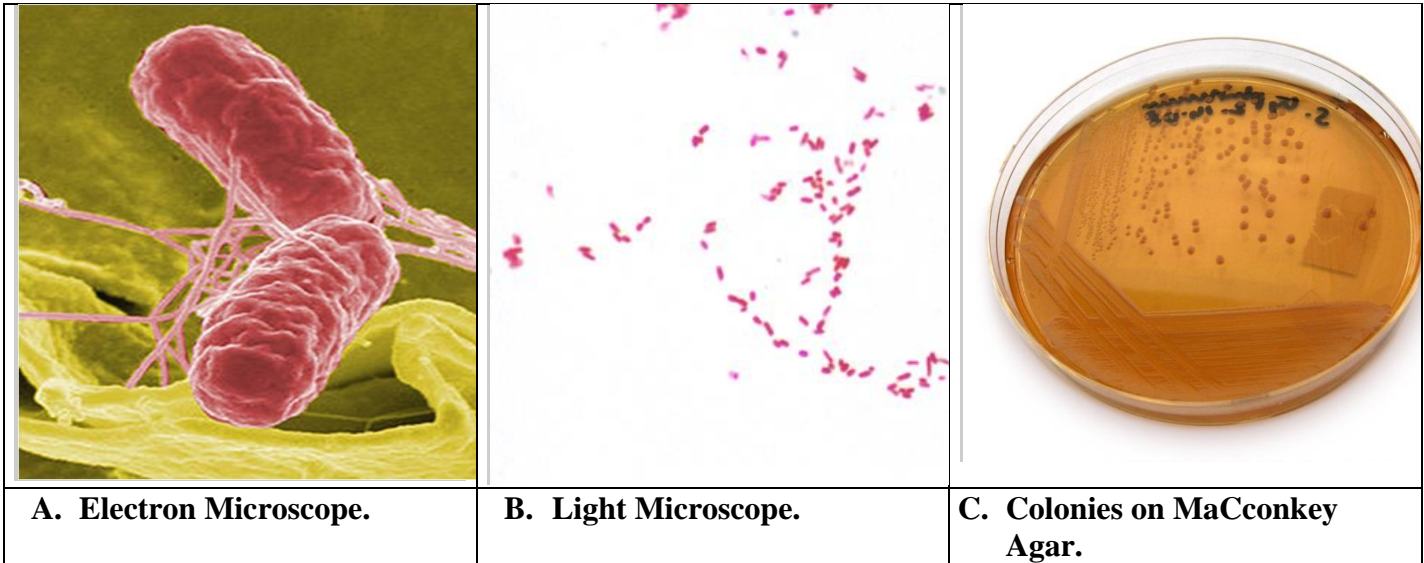
### Macroscopic Characteristics

Lactose non fermenter, Pale colonies on MaCconkey Agar, mucoid colonies, secrete Pyocyanin pigment on Nutrient Agar & Milk Agar, Protease producer cause clear zones on Milk Agar, Lipase producer cause clear zones on Olive Oil media Agar.



# Gram Negative Bacteria

## 2.3 *Salmonella*



### Microscopic Characteristics

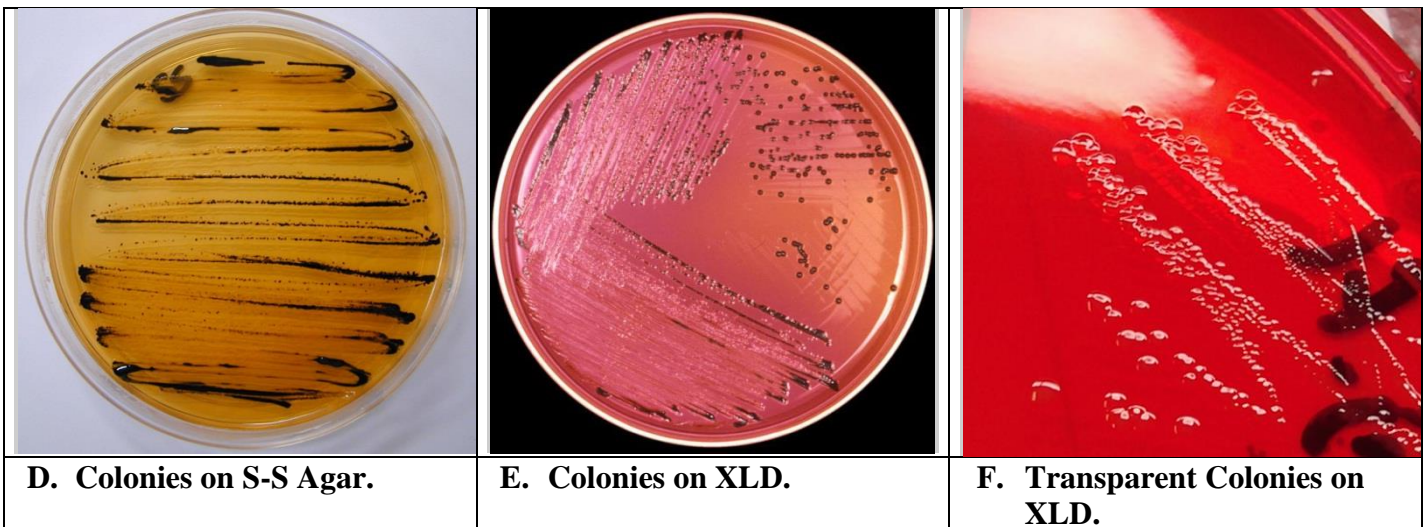
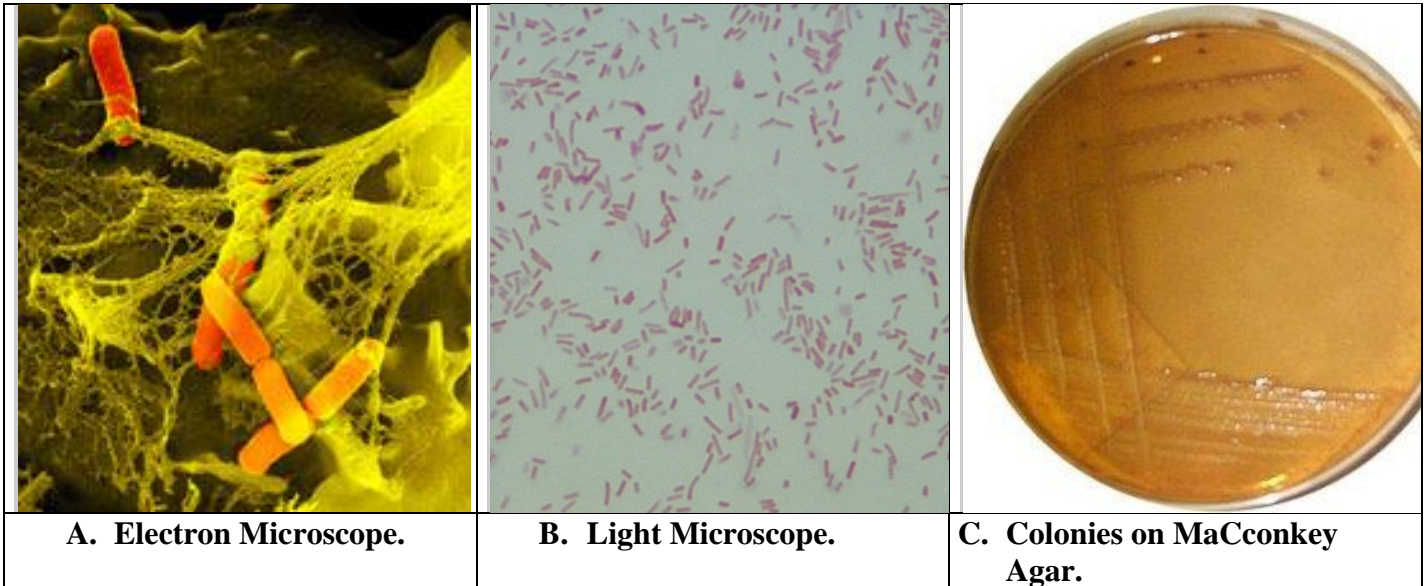
G-ve, short bacilli, non- spore former.

### Macroscopic Characteristics

Lactose non fermenter, Pale colonies on MaCconkey Agar, H<sub>2</sub>S producer, appear as Black colonies on S-S Agar while appear red colonies with black center on XLD medium.

# Gram Negative Bacteria

## 2.4 *Shigella*



### Microscopic Characteristics

G-ve, short bacilli, non- spore former.

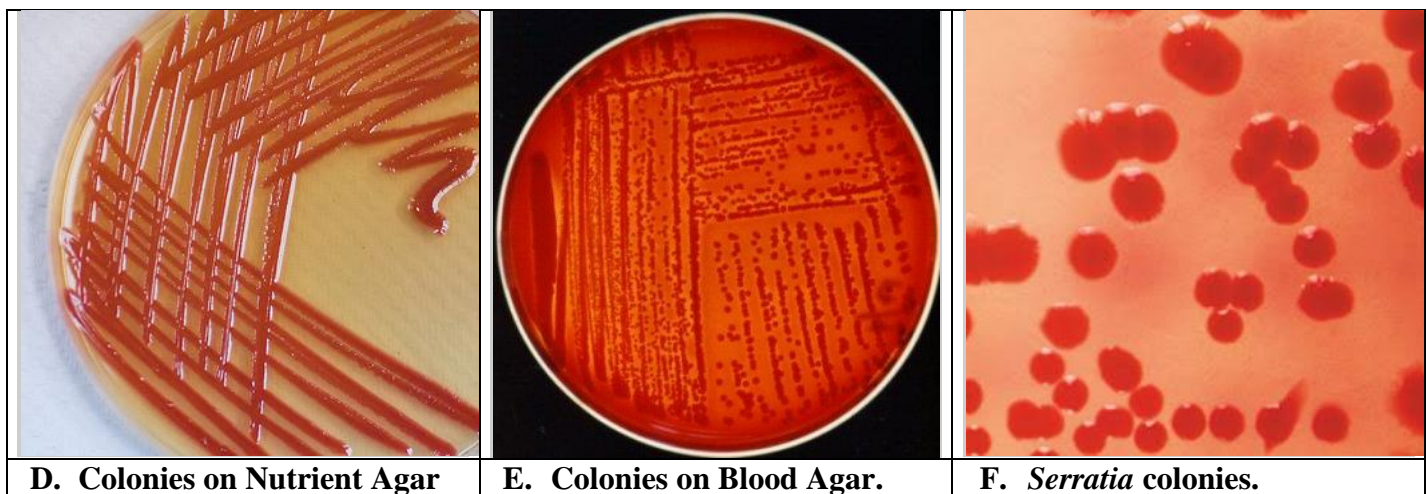
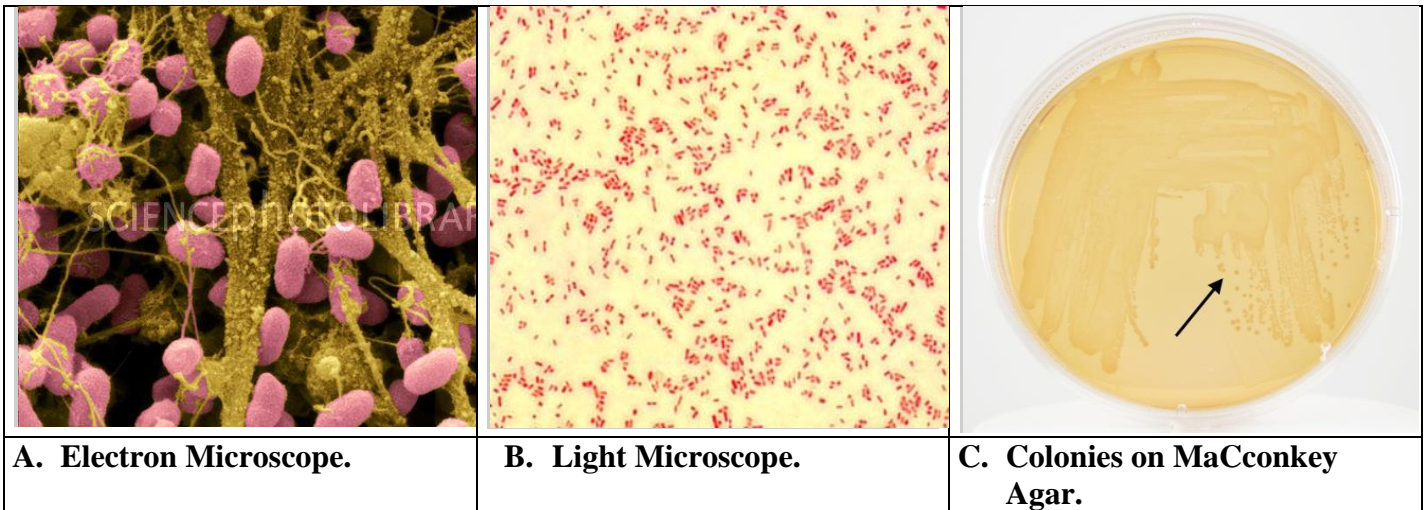
### Macroscopic Characteristics

Lactose non fermenter, Pale colonies on MaCconkey Agar, do not produce H<sub>2</sub>S, appear as colorless colonies on S-S Agar while appear Transparent colonies on XLD medium.



# Gram Negative Bacteria

## 2.5 *Serratia*



### Microscopic Characteristics

G-ve, rods, non- spore former.

### Macroscopic Characteristics

Small, smooth red colonies, Lactose non fermenter, Pale colonies on MaCconkey Agar, produce red pigments.

# Other Gram Negative Bacteria

## 1. *Brucella melitensis*



A. Electron Microscope.



B. Light Microscope.

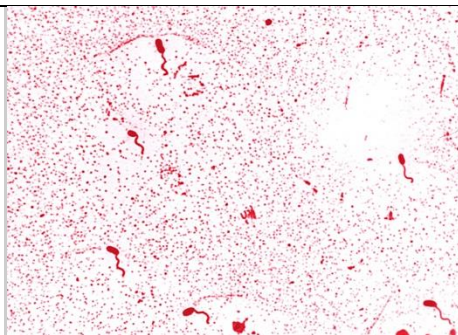


C. Colony on Blood Agar.

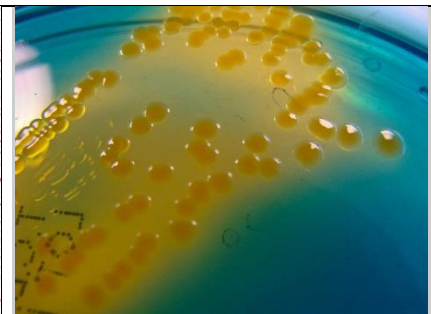
## 2. *Vibrio Cholerae*



A. Electron Microscope.

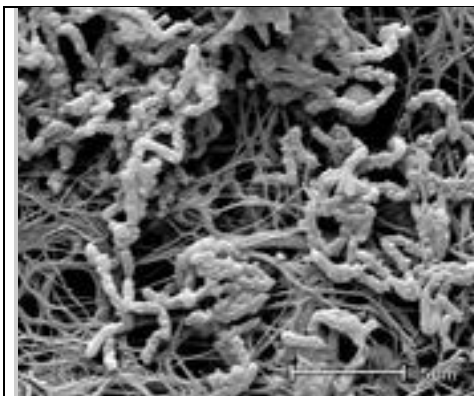


B. Light Microscope.

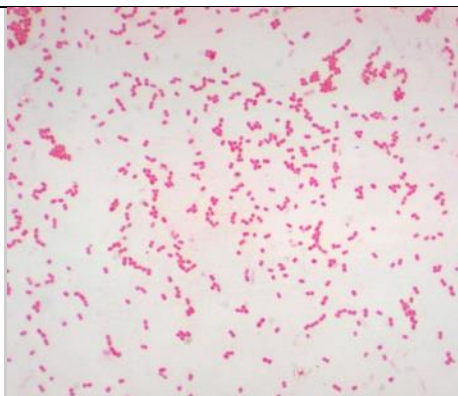


C. Colony on T.C.B.S.

## 3. *Achromobacter*



A. Electron Microscope.



B. Light Microscope.

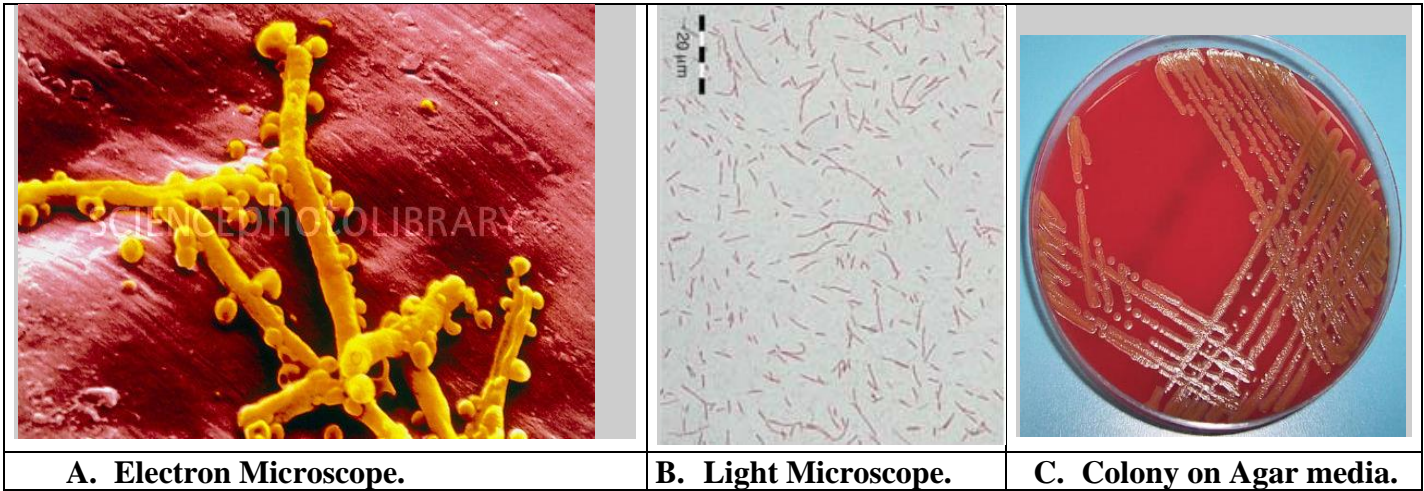


C. Colony on Agar media.

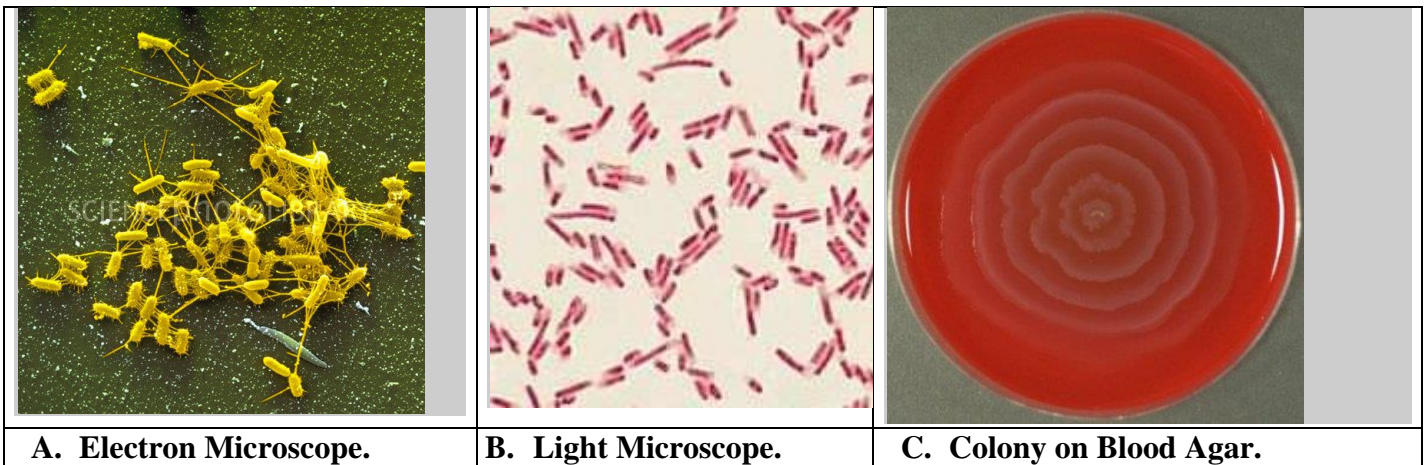


## Other Gram Negative Bacteria

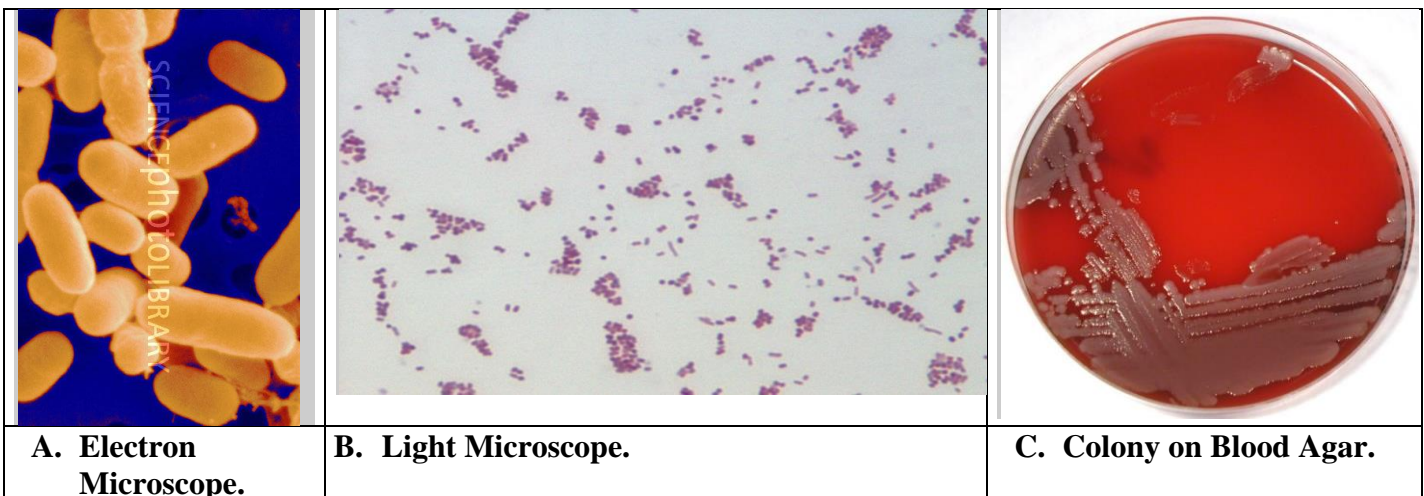
### 4. *Flavobacterium*



### 5. *Proteus*



### 6. *Alcaligenes*



# Fungi



# 1. Molds

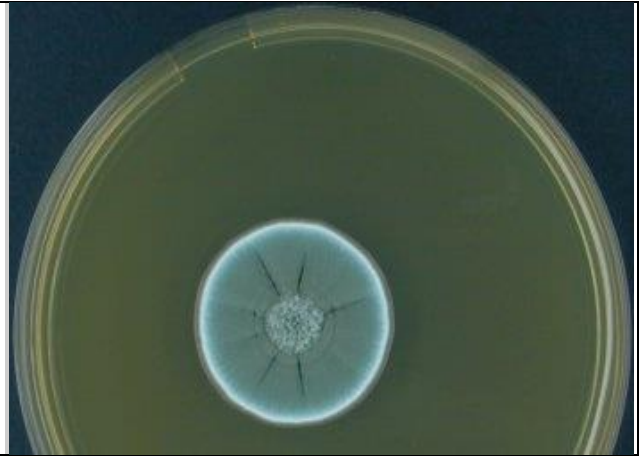
## 1.1 *Penicillium*



A. Electron Microscope.



B. Light Microscope.



C. Colony on Agar media.

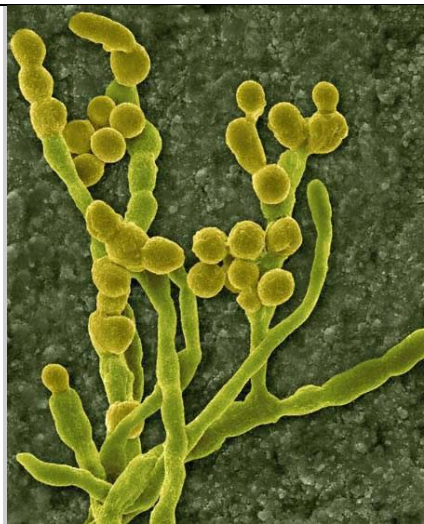
### Microscopic Characteristics

Brush-like conidiophore carries conidia.

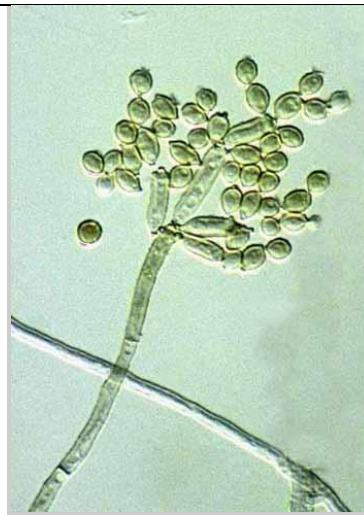
### Macroscopic Characteristics

Green or Green-greyish color colonies grows over fruits especially citrus.

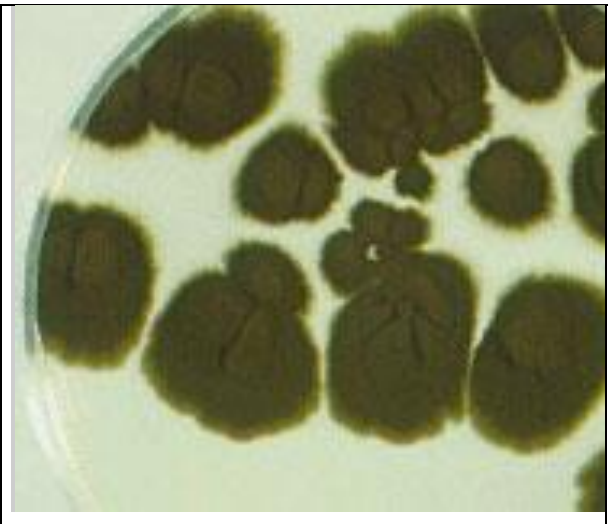
## 1.2 *Cladosporium*



A. Electron Microscope.



B. Light Microscope.



C. Colony on Agar media.

### Microscopic Characteristics

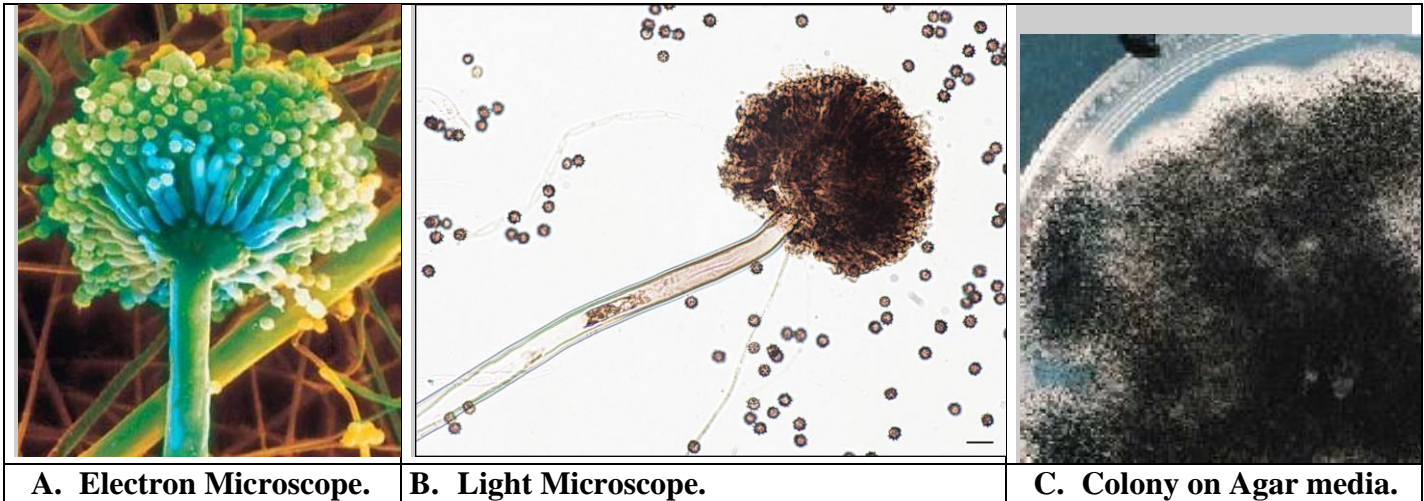
Conidiophores are more or less distinct from the vegetative hyphae, are erect, straight or flexuous, unbranched or branched only in the apical region, with geniculate sympodial elongation in some species.

### Macroscopic Characteristics

Colonies are rather slow growing, mostly olivaceous-brown to blackish brown but also sometimes grey, buff or brown, suede-like to floccose, often becoming powdery due to the production of abundant conidia.

# Molds

## 1.3 *Asperigillus niger*



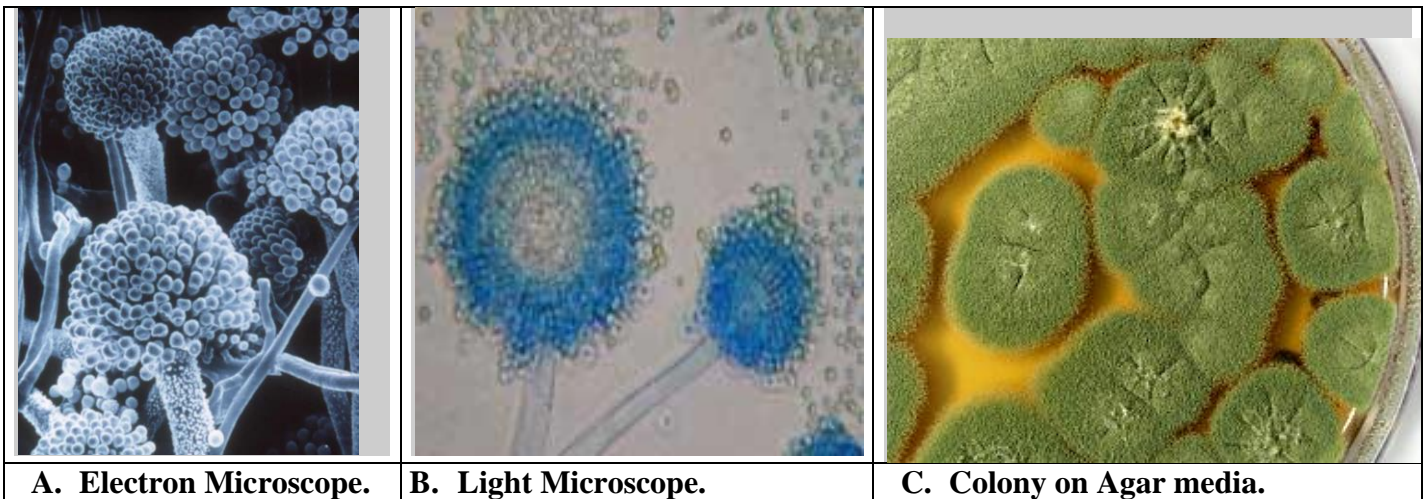
### Microscopic Characteristics

Non-Branched conidiophore with bulb end carries conidia like sun rays.

### Macroscopic Characteristics

Pin like black growth.

## 1.4 *Asperigillus flavus*



### Microscopic Characteristics

Non-Branched conidiophore with bulb end carries conidia.

### Macroscopic Characteristics

Pin like green growth.



# Molds

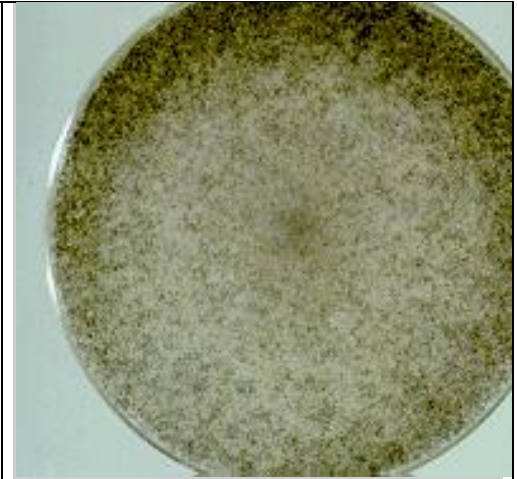
## 1.5 *Mucor*



A. Electron Microscope.



B. Light Microscope.



C. Colony on Agar media.

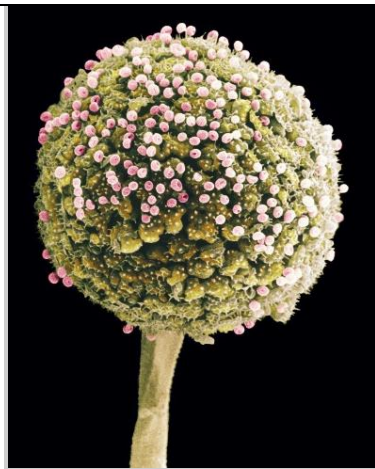
### Microscopic Characteristics

Sporangia contain spores, do not have rhizoids.

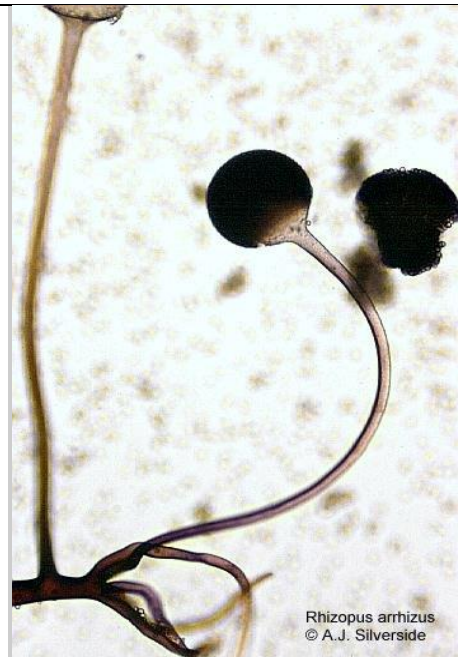
### Macroscopic Characteristics

Cotton like white growth spotted with black color.

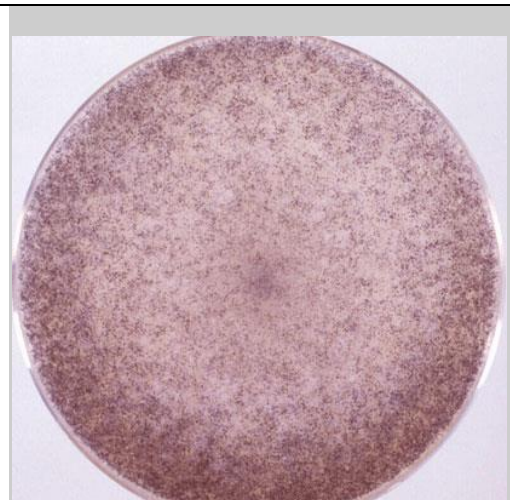
## 1.6 *Rhizopus*



A. Electron Microscope.



B. Light Microscope.



C. Colony on Agar media.

### Microscopic Characteristics

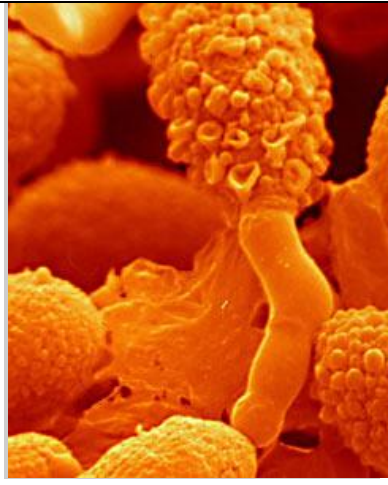
Sporangia contain spores, have rhizoids.

### Macroscopic Characteristics

Cotton like white growth spotted with black color.

# Molds

## 1.7 *Alternaria*



A. Electron Microscope.



B. Light Microscope.



C. Colony on Agar media.

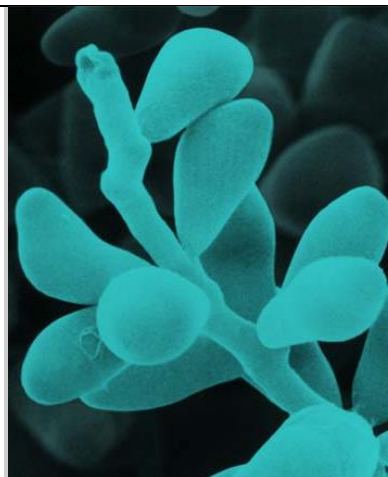
### Microscopic Characteristics

Pineapple like conidia multi-cellular, spiculated horizontally & vertically, arrange in chains.

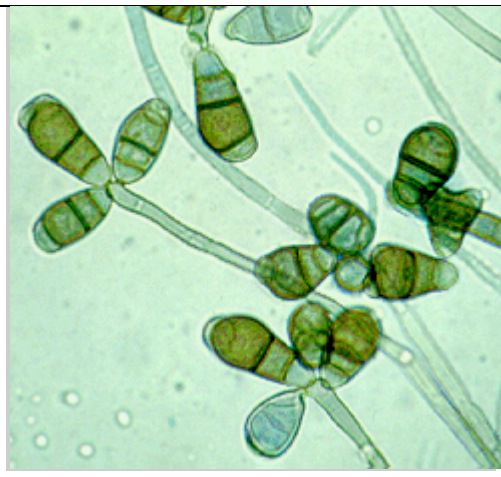
### Macroscopic Characteristics

Dark green deeply grown colonies, oil-drop like colony when seen upside down the Petri-dish.

## 1.8 *Curvularia*



A. Electron Microscope.



B. Light Microscope.



C. Colony on Agar media.

### Microscopic Characteristics

Swollen conidia, spiculated horizontally only, arrange in triple or pentagonal arrangements.

### Macroscopic Characteristics

Green or black deeply grown colonies.

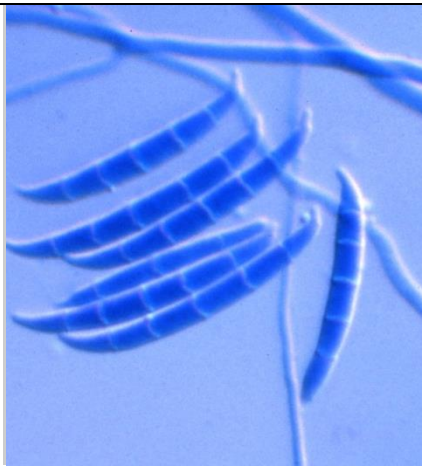


# Molds

## 1.9 *Fusarium*



A. Electron Microscope.



B. Light Microscope.



C. Colony on Agar media.

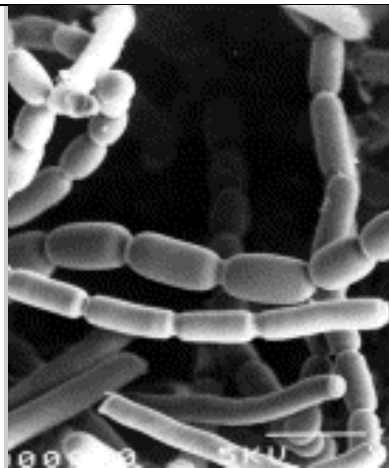
### Microscopic Characteristics

Spindle-like conidia, multi-cellular.

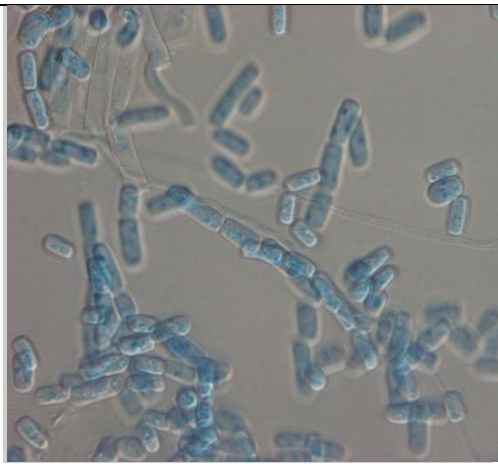
### Macroscopic Characteristics

Colonies appear brown or pink in center & with white edges.

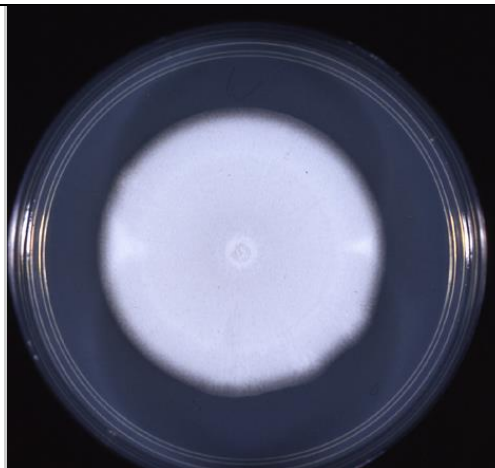
## 1.10 *Geotrichum*



A. Electron Microscope.



B. Light Microscope.



C. Colony on Agar media.

### Microscopic Characteristics

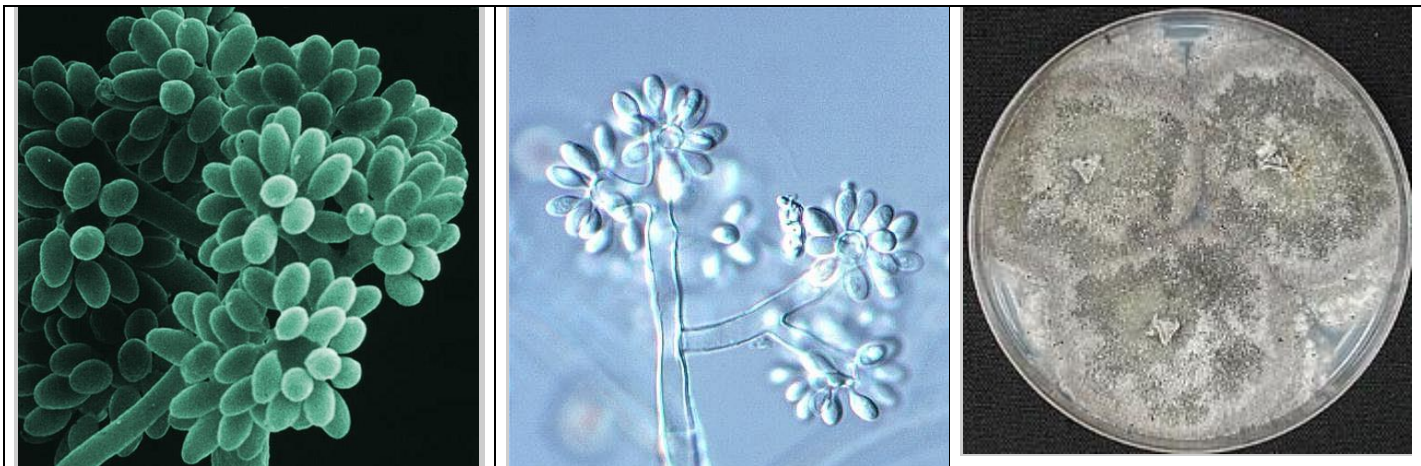
Chains of hyaline, smooth, one-celled, subglobose to cylindrical, slimy arthroconidia (ameroconidia) by the holoarthric fragmentation of undifferentiated hyphae.

### Macroscopic Characteristics

Colonies are fast growing, flat, white to cream, dry and finely suede-like with no reverse pigment.

# Molds

## 1.11 *Botrytis*



A. Electron Microscope.

B. Light Microscope.

C. Colony on Agar media.

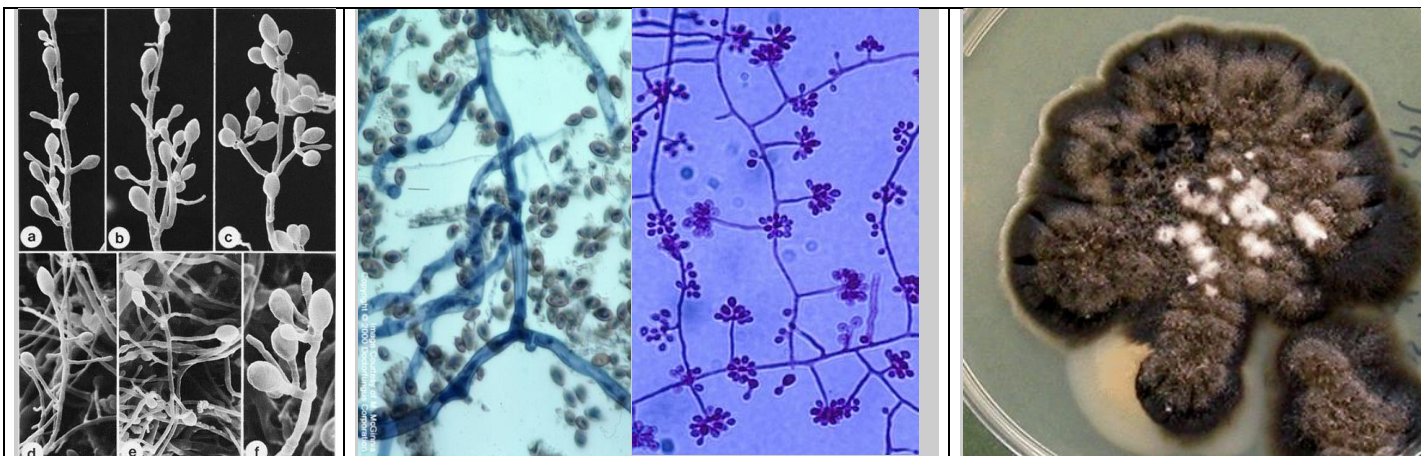
### Microscopic Characteristics

Grape-like conidia on the conidiophore.

### Macroscopic Characteristics

Colonies appear white while the conidia are grey (Grey Mold Rot).

## 1.12 *Sporotrichum*



A. Electron Microscope.

B. Light Microscope.

C. Colony on Agar media.

### Microscopic Characteristics

Septate hyphae, conidiophores, aleuriconidia, arthroconidia, and chlamydospores are observed. Hyphae contain clamp connections (bridges) at the septa. Conidiophores may be short or long, simple or branched.

### Macroscopic Characteristics

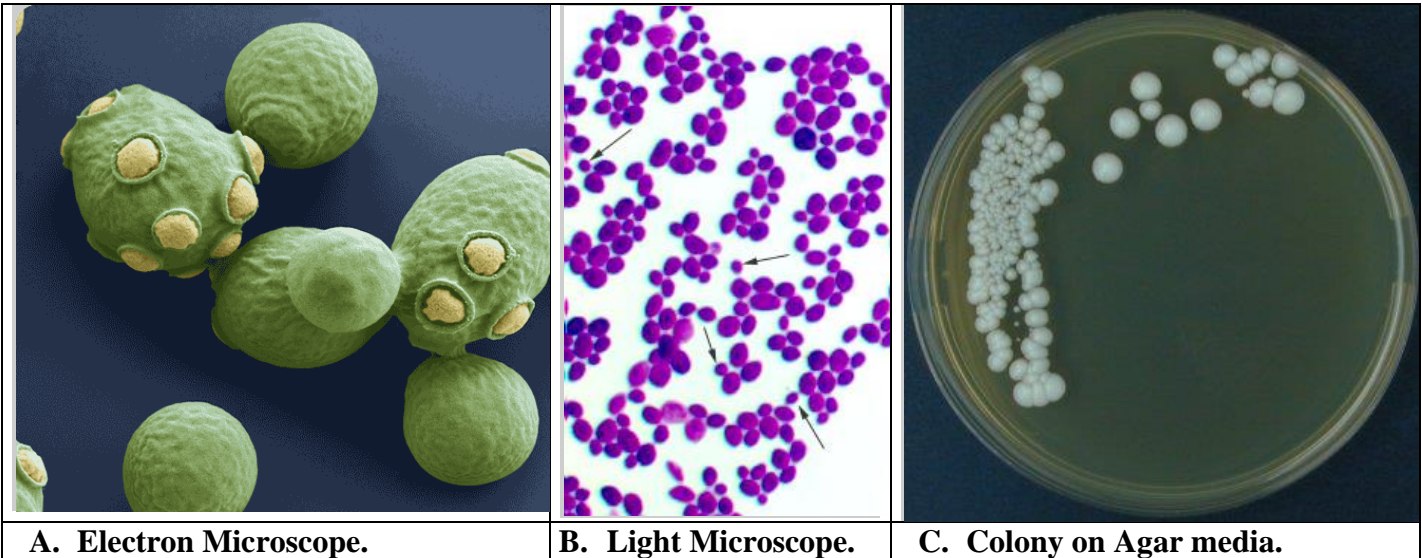
The texture is velvety to powdery. From the front, the color is initially white and then becomes rosy beige, pinkish, yellow or orange. From the reverse, it is tannish.



Yeast

## 2. Yeast

### 2.1 *Saccharomyces*



A. Electron Microscope.

B. Light Microscope.

C. Colony on Agar media.

#### Microscopic Characteristics

Unicellular cocci or ovoid shape, larger than bacterial cells.

#### Macroscopic Characteristics

Flat, smooth, moist, glistening or dull, and cream to tannish cream in color.

### 2.2 *Rhodotorula*



A. Electron Microscope.

B. Light Microscope.

C. Colony on Agar media.

#### Microscopic Characteristics

Unicellular cocci or ovoid shape, larger than bacterial cells.

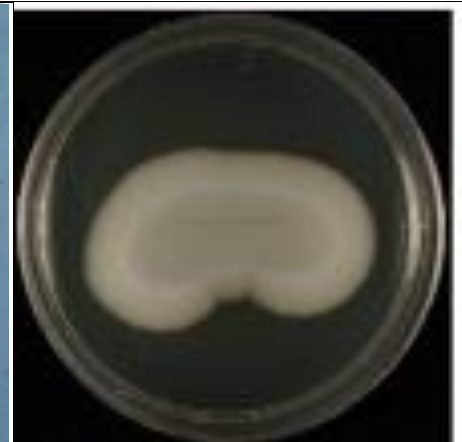
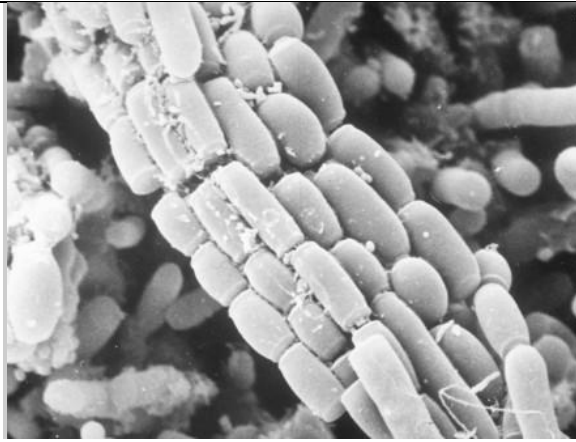
#### Macroscopic Characteristics

Colony color can vary from being cream colored to orange/red/pink or yellow.



# Yeast

## 2.3 *Endomyces*



**D. Electron Microscope.**

**E. Light Microscope.**

**F. Colony on Agar media.**

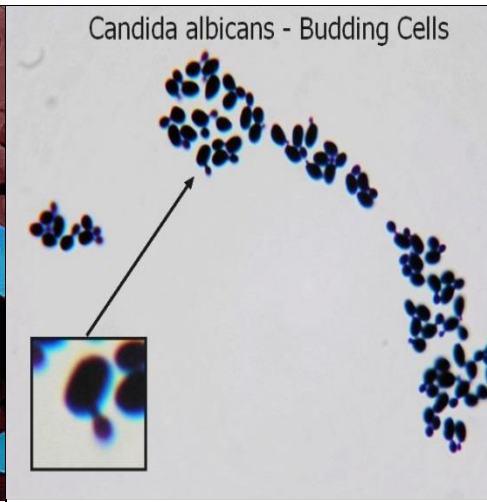
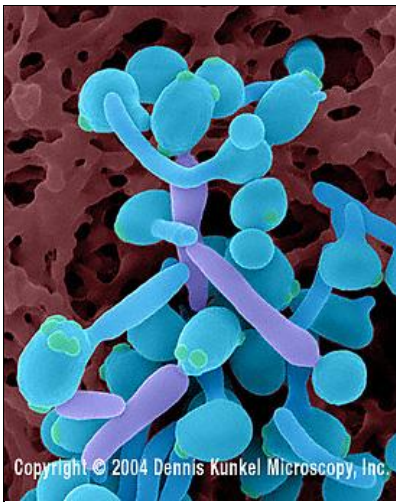
### Microscopic Characteristics

A species of yeast-like fungus that is the perfect state of *Geotrichum*, it forms a real mycelium, cocci or ovoid ascospore, the mycelium divided into cylindrical arthrospores with round edges.

### Macroscopic Characteristics

Large white colonies.

## 2.4 *Candida*



**D. Electron Microscope.**

**E. Light Microscope.**

**F. Colony on Agar media.**

### Microscopic Characteristics

Unicellular cocci or ovoid shape, larger than bacterial cells.

### Macroscopic Characteristics

Flat, smooth, large colonies.

# References

- Dennis Kunkel Microscopy, Inc. Science Stock Photography cited by <http://www.denniskunkel.com/index.php>.
- Free Encyclopedia online cited by [http://en.wikipedia.org/wiki/Main\\_Page](http://en.wikipedia.org/wiki/Main_Page).
- Mycology online reference cited by <http://www.doctorfungus.org/>.
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