PHARMACEUTICAL BOTANY PRACTICE

LAB NUMBER 6

- MICROSCOPIC STUDY
- LEAF CROSS SECTION & LEAF POWDER

LEAF

- **Leaf** is responsible for photosynthesis, respiration and transpiration of the plant.

Anatomical structure of a leaf;

- Protective Tissue
- Ground Tissue
- Conducting Tissue
- Supportive Tissue

1)PROTECTIVE TISSUE:

-Protective tissue covers the surface of leaves
(and also the living cells of roots and stems).

-The upper and lower **epidermis of the leaf** are examples of protective tissue.

The epidermal cells generally form single row layer, covering the entire surface of the plant.

Epidermal Cells in Cross Section;

--It is more likely to appear as a single row cell array, which is more or less rectangular and side by side.

--Its cells are flattened with their top and bottom surfaces parallel.

Epidermal Cells in Powdered Drug;

Their walls are usually observed as wavy (or polygonal) cells. The aim here is to ensure tight adhesion and durability at the junction of the cells.

The epidermis aids in the regulation of gas exchange via stomata.

A stoma (plural "stomata") is a tiny opening or pore that is used for gas exchange.

They are mostly found on the under-surface of plant leaves.

--Air enters the plant through these openings.

--The carbondioxide is used in photosynthesis.

--Some of the oxygen produced is used in respiration (solunum).

--Surplus oxygen exits through these same openings.

--Also, water vapor goes into the atmosphere through these pores in a process called transpiration (terleme).

The pore is formed by a pair of cells known as GUARD CELLS. These adjust the size of the opening by opening or closing.

CUTICLE:

A noncellular, waxy protective covering outside the epidermis of plants.

The cuticle is located outside the epidermis and protects against water loss.

Hairs (=Trichomes (*Triçom))

-Some of the epidermal cells of most plants grow out in the form of hairs (=trichomes).

-They may be found singly or less frequently in groups.

-They may be unicellular or multicellular and occur in various forms.

-They vary from small protuberances (=kabartı) of the epidermal cells to complex branched or stellate multicellular structures.

Hair types and their distribution are useful characters in distinguishing species from each other.

Types of Hairs (=Trichomes):

1-Non-glandular Hairs (Covering Hairs,Stinging Hairs)

**They have tapering (to become smaller or thinner toward one end) structure ends in a small a sharp point.

**The cell walls of trichomes are commonly of cellulose and are covered with a cuticle.

A covering of any kind of hair on a plant is an INDUMENTUM.

NON-GLANDULAR HAIR (=TRICHOME) TASKS:

**Trichomes can be insulating by keeping frost away from leaf cells.

**They can help reduce evaporation by protecting the plant from wind and heat.

**In many cases, trichomes protect plants from herbivorous insects that may want to feed on them.

**And in some cases, if the trichomes are especially stiff or irritating, they may protect a plant from larger herbivores.

2-Glandular Hairs

-These hairs may secrete oil, resin or mucilage.

-A typical glandular hair possesses a stalk and an enlarged terminal/head portion, which may be referred to as gland.

-The glandular hairs may be uni- or multicellular.

-Active secretory cells of glandular trichomes elaborate various substances, such as volatile oils, resins and mucilage's, and gums.

-These substances are excreted and accumulate between the walls and cuticle. Their final removal from the hair occurs by rupture of the cuticle.

Principal function(s) of glandular hairs may be to produce insect- or pollinator-interactive chemicals which are stored or volatilized at the plant surface.

2)GROUND TISSUE:

The ground tissue is responsible for photosynthesis and storing the carbohydrates produced by the plant.

Ground tissue comprises the majority of a plant and lies between the vascular and dermal tissues.

The major cells of the ground tissue are *PARENCHYMA CELLS,* which function in photosynthesis and nutrient storage.

They have thin walls, many chloroplasts and they form the mass of most leaves (also of stems, and roots).

---Parenchyma forms the "filler" tissue in the soft parts of plants.

--Most of the interior of the leaf between the upper and lower layers of epidermis is a parenchyma (ground tissue) or chlorenchyma tissue called the MESOPHYLL (Greek for "middle leaf").

The mesophyll is found between the upper and lower epidermis; it aids in gas exchange and photosynthesis via chloroplasts.

Mesophyll consists of two different cell groups:

1-Palisade parenchyma

2-Spongy parenchyma

An upper **PALISADE MESOPHYLL (LAYER)** **is composed of *vertically elongated** cells,

-**directly beneath the upper epidermis**,

-**with minor intercellular air spaces between them.**

ITS CELLS CONTAIN MANY MORE CHLOROPLASTS THAN THE SPONGY LAYER.

****These long cylindrical cells are regularly arranged in one to five rows.**

****Cylindrical cells with the chloroplasts close to the walls of the cell, <u>can take optimal advantage of light</u>.**

BENEATH THE PALISADE LAYER IS THE SPONGY MESOPHYLL (LAYER) .

--The cells of the spongy layer are more branched and not so tightly packed,

--So that there are large intercellular air spaces between them for oxygen and carbon dioxide to diffuse in and out of during respiration and photosynthesis.

---These cells contain fewer chloroplasts than those of the palisade layer.

Palisade parenchyma

--They are long, cylindrical cells.

--The cells are lined up relatively dense and in one to five rows (perpendicular to the axis of the leaf axes) on the upper or lower surfaces of the lamina.

Sponge parenchyma

It does not have a certain shape.

The intercellular spaces are quite large.

They are more or less rounded cells.

There are two types of leaves according to arrangement of the sponge and palisade parenchyma in the mesophyll:

BIFACIAL LEAF
Epiderm
Palizat Parenchyma
Sponge Parenchyma
Epiderm

a leaf which has distinct upper and lower layers

MONOFACIAL LEAF
Epiderm
Palisade Parenchyma
Sponge Parenchyma
Palizat Parenchyma
Epiderm

a leaf which has similar upper and lower layers

3)VASCULAR TISSUE:

Vascular tissue is a complex conducting tissue, formed of two cell types;

XYLEM:

- Xylem consists of:
- Tracheid
- Vessel members
- Xylem fibers
- Xylem parenchyma

Xylem serves as a chief conducting tissue of vascular plants.

It is responsible for the conduction of water and mineral ions/salt.

PHLOEM:

Phloem consists of:

- Sieve tube
- Sieve cell
- Companion cell
- Phloem fiber
- Phloem parenchyma

Phloem is an equally important plant tissue as it also is part of the 'plumbing system' of a plant.

Primarily, phloem carries dissolved food substances throughout the plant.

3)SUPPORTING TISSUE: It provides mechanical support, elasticity, and tensile strength to the plant body. **formed of two groups:**

- **COLLENCHYMA** (**kollençima*)
- Collenchyma tissue is composed of elongated cells with irregularly thickened walls.
- They provide structural support, particularly in growing shoots and leaves.

SCLERENCHYMA (**sklerençima*)

- **This tissue consists of thick-walled, dead cells.**
- **These cells have hard and extremely thick secondary walls due to uniform distribution of lignin.**
- **LIGNIN deposition is so thick that the cell walls become strong, rigid and impermeable to water..**

1. Sclerenchyma fibers

2. Sclereids (=Stone cells)

Crystals

In plants, some acids in which the cell is thrown into the cell vacuole as an increase in metabolism constitute salt here. (Salt is an ionic compound that results from the neutralization reaction of an acid and a base.**)**
As the density of these salts increases, they crystallize. They are usually calcium oxalate.

- Many plants accumulate calcium oxalate crystals in response to surplus calcium, which is found throughout the natural environment.
- The crystals are produced in an intriguing variety of shapes.
- The crystal morphology depends on the taxonomic group of the plant.
- Crystal morphology and the distribution of raphides (in roots or leaves or tubers etc.) is key characteristics for systematic identification.
- Raphides typically occur in parenchyma cells in aerial organs especially the leaves, and are generally confined to the mesophyll.
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Simple Crystals:

- Simple prismatic crystals
- Rafite crystals
- Crystal sands

Raphide : Raphides are needle-shaped crystals of calcium oxalate found in many families of plants. Both ends are needle-like.

Crystal sands: Crystals like small grains of sand.

Complex crystals

-Druse:

It is like a ball covered with prickles

-Twin crystals:

They are twins of crystals

in the form of rectangular prisms

- **Druse:** A druse is a group of crystals of calcium oxalate.

Cystolith: Crystals in the form of calcium carbonate, generally like grape clusters.

Reagents

1. **Distilled Water**
2. ***Chloralhydrate (aqueous solution of 50% chloralhydrate)**
3. ***Sartur**

***Chloralhydrate and Sartur reagents must be activated by using heat. (On the flame of gas burners.)**

Sartur

- **Sartur** were developed in 1949 by two Turkish scientists, **Sar**ım ÇELEBİOĞLU and **Tur**han BAYTOP.

- It is prepared to identify many elements in one preparation.

Content of Sartur

Because of its content the use of this reagent provides color differences between different types of tissues.

- Lactic acid -------- provides the acidity of the environment and allows us to see the tissues clearer.
- Sudan III ---------- stains oil, cuteness, and suberium tissues **orange color**.
- Pure aniline -------- Stains lignified tissues **yellow color** in acidic medium. (Wood pipes, sclerenchyma fibers, stone cells, stone fungus cells, idioblasts)
- Iodine ------- → Reacts with starch to starch granules with blue-violet color.
- Potassium iodide
- Ethanol 95%
- Distilled water

OBSERVATIONS TO BE DONE in TODAY'S LABORATORY

Microscopic Study

1. Leaf cross-section

PN (=Plant Name): *Prunus laurocerasus*

(Taflan, Karayemiş; cherry laurel)

DN (=Drug Name): Folia Laurocerasi

IM (= Investigation Medium): Chloralhydrate

MM (=Microscope Magnification):

2)Investigation of the Leaf Powder

- PN: *Cassia angustifolia* (Sinameki, Senna)
- DN: Folia Sennae
- IM: Chloralhydrate
- MM (=Microscope Magnification): 10x40