JUST AGRICULTURE
multidisciplinary e-Newsletter

A Unique Way of Appreciating Plant Cells and Animal Cells

Arti Kumari [1]*, Manish Kumar[2] and Mohneesh Kalwani[3]
[1]Ph.D. Research Scholar, Division of Biochemistry, I.AR.I, New Delhi
[2]Ph.D. Research Scholar, Division of Nematology, I.AR.I, New Delhi
[3]School of Biotechnology, Banaras Hindu University, Varanasi, Uttar Pradesh

ARTICLE ID: 092

Abstract

This article is related to understanding the morphological as well as the biochemical basis of the difference between plant cells and animal cells. We are very familiar with the characteristics of plant cells and animal cells; but do we know their biochemical basis? If not it is unimaginable to manipulate their properties for our benefit. Therefore this article is mainly covering the facts related to the biochemical basis to appreciate the contrasting characteristics of plant and animal cells.

Introduction

The difference between plant cells and animal cells are mainly covered here. Mainly morphological basis and biochemical basis of different characteristics of the plant as well as animal cells are discussed. This will give a new perspective to understand the function of plant cells and animal cells.

1. **Morphological basis of the difference between plant cell and animal cell**

If we analyze the morphology we can say that plants are non-motile, while animals are motile. Plants are autotrophic as having specialized cell organelle i.e chloroplast; site of photosynthesis, while animal cells lack such organelle, therefore, need to be dependent on others for getting their energy requirement. Animal cells (10 to 30 micrometres) are smaller than plant cells (10 to 100 micrometres) in length. Animal cells are mostly round or irregular in shape, while plant cells are cubic or rectangular. Plant cells have a cell wall as the outermost layer while animal cells lack a cell wall but have only a cell membrane. Animal cells have centrioles that help in the assembly of microtubules, while plant cells lack centrioles. Plant cells form specialized vesicles from Golgi apparatus that help in cell division. Plant cells contain plasmodesmata that are involved in cell to cell connection which

JUST AGRICULTURE
multidisciplinary e-Newsletter

is absent in animal cells. The vacuole is the important storage organelle in plant cells that is not found in animal cells.

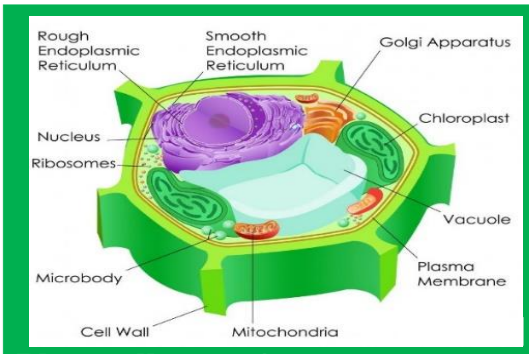
2. Biochemical basis of the difference between plant cell and animal cell

Looking into the biochemical basis, plant cells differ from animal cells in having specific enzymes such as rubisco (ribulose1,5-bisphosphate carboxylase oxygenase), sedoheptulose 1,7-bisphosphatase and ribulose 5-phosphate kinase. Plants can produce their food because of the presence of the above-mentioned enzymes which are lacking in animals, therefore, cannot carry out the net conversion of CO_2 to glucose. These enzymes plays important role in the photosynthesis process. Apart from the important enzymes, several pathways such as glyoxylate cycle (in glyoxysomes), Calvin cycle (in chloroplasts), organic acid storage (in vacuole), and starch synthesis (in amyloplast) are present in plants. Plant cells can fix CO_2 into organic compounds with the help of the rubisco enzyme. The products of CO_2 fixation are utilized to generate trioses, pentoses and hexoses through the Calvin cycle. Acetyl-CoA generated during fatty acid breakdown can be utilized to produce four-carbon compounds (in glyoxylate cycle) and four carbon compounds can be further to produce hexoses (gluconeogenesis). Lacking these processes in animal cells, they are unable to synthesize their food and also unable to utilize acetyl-CoA for gluconeogenesis. Plant store carbohydrate in the form of starch while animal stores carbohydrate in the form of glycogen. Animal cells have well developed immune systems: innate immunity (involves neutrophils and macrophages) and adaptive immunity (antibodies mediated); while plant immune system involves innate immunity, antimicrobial peptides and pattern recognition receptors. Plant growth regulators such as auxin, gibberellin, abscisic acid, cytokinins, and ethylene are involved in the growth and development of plants however, animals have different sets of hormones such as insulin, glucagon, thyroxin, epinephrine, estrogen, progesterone e.t.c. Cell signalling pathways differ in plants and animals. The plant uses enzyme coupled receptors however, animals uses GPCRs (g-protein-coupled receptors) and RTKs (receptor tyrosine kinases). Signalling pathways such as JAK (Janus tyrosine kinase), STAT (Signal transducer and activator of transcription), Wnt (Wingless and Int-1) and TGFβ (Transforming growth factor β) responsible for cell differentiation, growth and immune response in animals which are absent in plants.

Conclusion

JUST AGRICULTURE
multidisciplinary e-Newsletter

The morphological differences between the plant cells and animal cells are easily detectable, while the biochemical basis for observing the differences between plant cells and animal cells requires knowledge about the different metabolic pathways. The detailed knowledge of these contrasting characters of plant and animal cells can help manipulate a particular trait for the benefit of human beings.

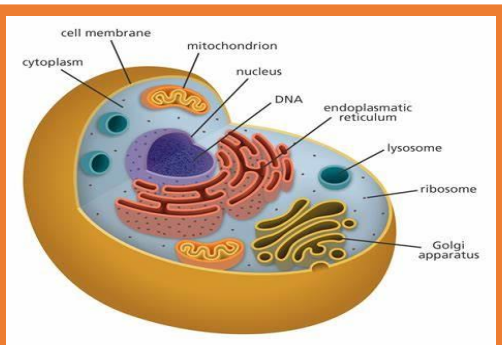


Plant cells contains

- Cell wall
- Chloroplast
- Plasmodesmata
- Vacuole
- Cubic or rectangular in shape
- Larger in size (10 to 100 micrometer)
- Plant growth regulators
- Cell signaling receptors – enzyme-coupled receptors

Important pathways present

- C_3 and C_4 cycle
- Glyoxalate cycle
- Starch biosynthesis
- Innate immunity



Animal cells contains

- Centriole
- Lysosome
- Round or irregular shape
- Smaller in size(10 to 30 micrometer)
- Cell signaling receptors – GPCRs and RTKs

Important pathways

- Adaptive immunity
- Antibodies mediated immunity.
- Signaling pathways
- JAK, STAT, TGF β, Wnt pathways

Figure: The difference in plant and animal cells