Plant Tissue Culture (PTC)

➢ Introduction

Plant tissue culture is an in-vitro technique in which clone of plants are produced by using plant cells, tissues or organ under suitable environment condition or in nutrient culture medium.

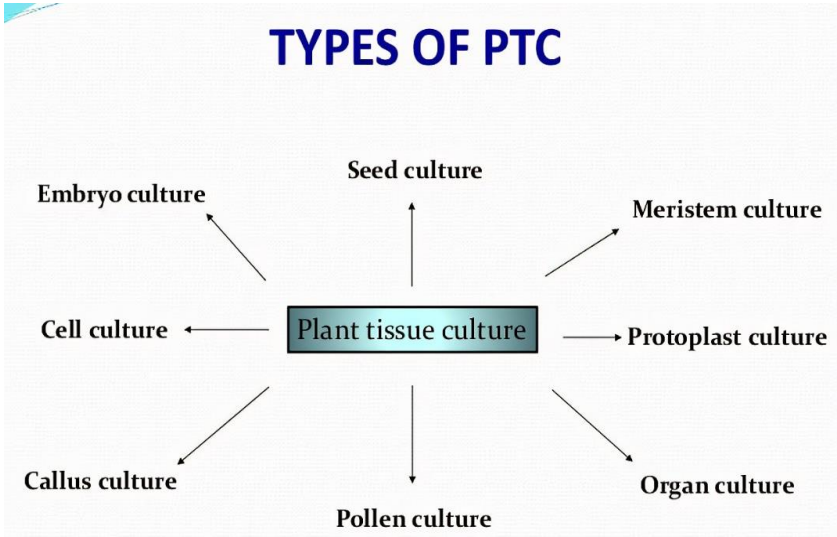
IMPORTANCES:

- Desired medical plant can be produced.
- Production of genetically modified plants.
- Produce disease free plants.
- This technique also helpful for production of primary and secondary metabolites.
- Help to produce new plants from a single or small part of parent plant such as seed, embryo, root tip, shoot tip, pollen grains, etc.

➢ Historical development of PTC

Sr.no	Year	Name of scientist	Development
01	1902	Haberlandt	1st proposed the concept of PTC.
02	1904	Hanning	Establishment of embryo culture for 1st time
03	1909	Kuster	1st observation of fusion cell
04	1922	Robins, Kotte	In-vitro culture of root tips.
05	1934	White	Permanent root culture for 1st time(tomato).
06	1942	Gautheret	Observation of secondary metabolites in PTC.
07	1953	Muir	Develop single cell culture
08	1955	Mothes and kala	1st report of metabolites in liquid medium.
09	1965	Hildebrandt	Regeneration of plant from 1 single cell

➢ Types of culture



(A)Callus culture

It is undifferentiated mass which produce from an explant of plant in nutrient medium under aseptic condition is called as callus culture.

(B) Flower culture

In which new plant is generate from a flower.

(C) Pollen culture

Pollen culture is an in-vitro technique by which the pollen grains preferably at the uninoculated state, are squeezed out aseptically from the intact and anther then cultured on nutrient medium.

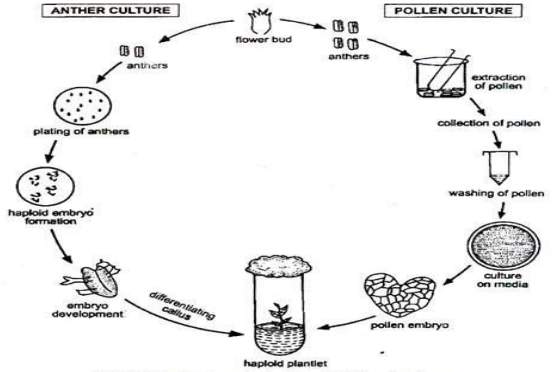
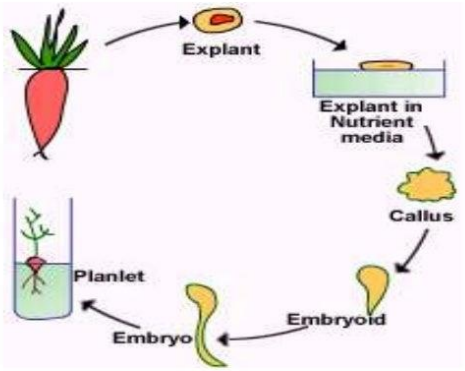


Fig. 9. Androgenesis for Haploid Production.

(D) embryo culture

Embryo culture is a technique for cultivating an embryo under aseptic condition on a nutrient medium.

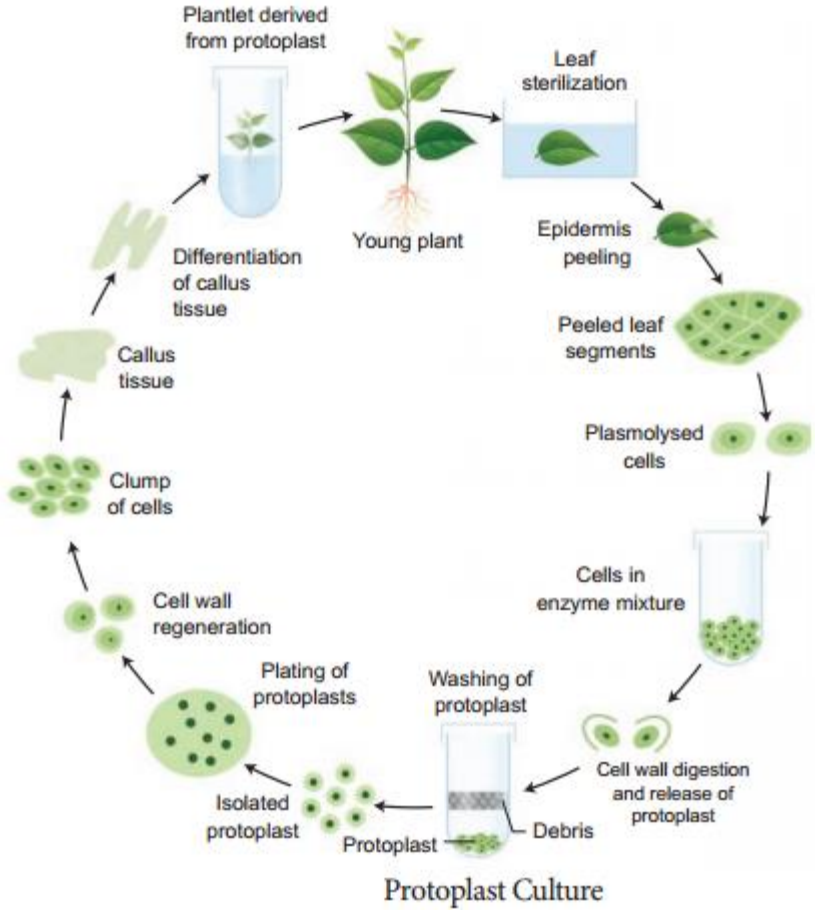


(E) Seed culture:

Seed culture is a type of tissue culture i.e. extensively employed in the cultivation of orchids and other plants.

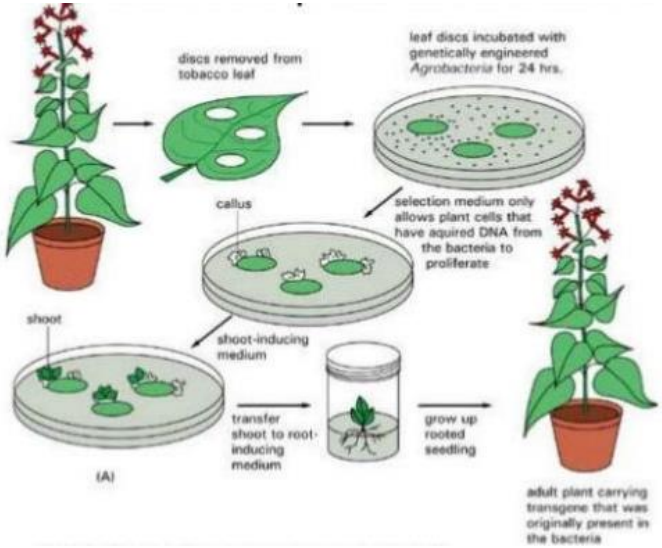
(E) protoplast culture

It refers to the process in which whole plant are developed from the culture of cells without cell wall. This technique was discovered over 10 decades ago and is still widely used in plant breeding and crop.



(F) Leaf culture

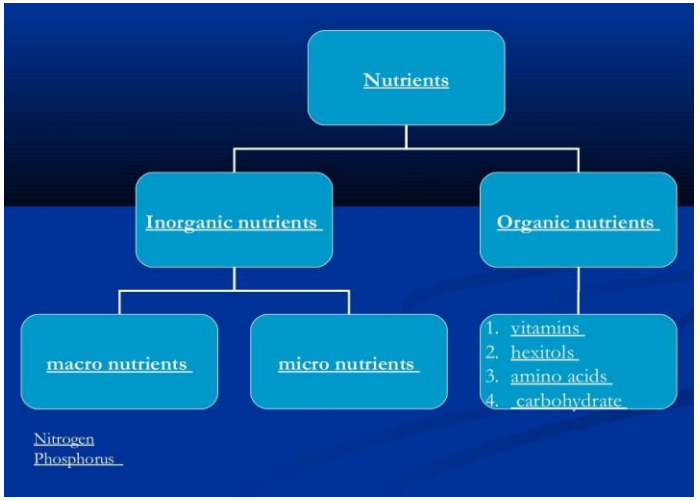
Leaf culture is the culture of excised young leaf primordia or immature leaf of the shoot apex.



➢ Nutritional requirement

to maintain the vital function of culture, the culture media consists of various elements. They are as follows:

- ✓ Organic.
- ✓ Inorganic salts.
- ✓ Solidifying agents.
- ✓ Antibiotics.
- ✓ P^H.



- Solidifying agent

These are used in the preparation of semi solid or solid tissue culture medium.

E.g. Agar, gelatin.

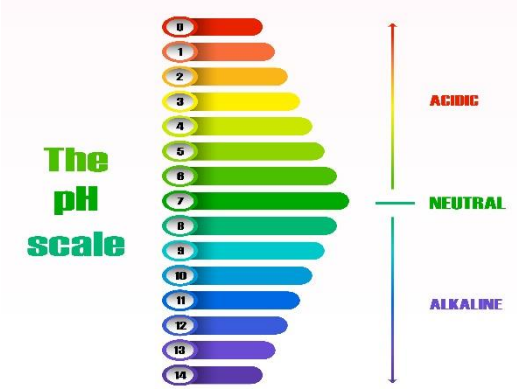
- Antibiotics

  It prevents the growth of microbes in PTC.

  E.g. Streptomycin, kanamycin.

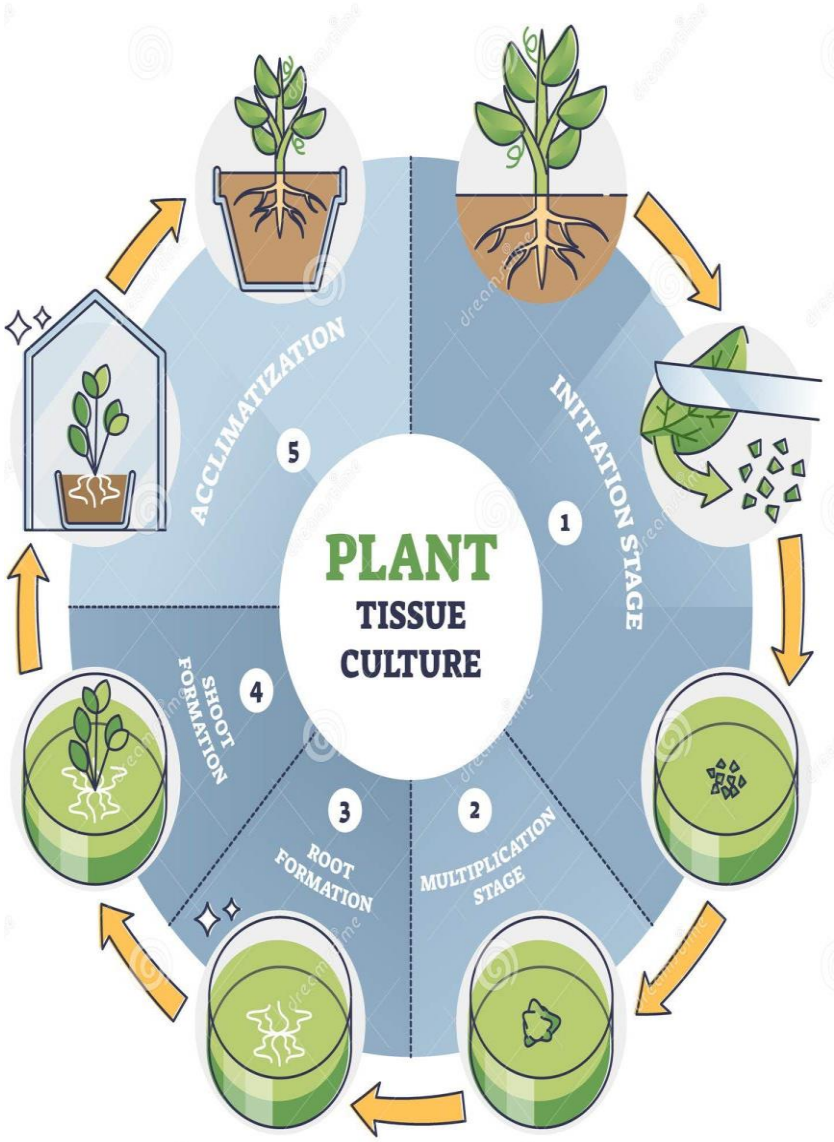
- P^H

  The p^H of nutritional medium is generally adjust between 5 to 6.



➢ Growth and their maintenance

- ✓ Sterilization of glassware.
- ✓ Preparation and sterilization of explant.
- ✓ Production of callus from explant.
- ✓ Proliferation of cultured callus.
- ✓ Subculture of callus.
- ✓ Suspension culture.



Application of PTC

1. The use of plant cells to generate useful products and or services constitutes plant biotechnology.

2. In plant biotechnology, the useful product is a plantlet. The plantlets are used for various purposes.

3. All the cells in callus or suspension culture are derived from a single explant by mitotic division.

4. Therefore, all plantlets regenerated from a callus/suspension culture generally have the same genotype and constitute a clone. These plantlets are used for rapid clonal propagation.

5. Genetic variation present among plant cells of a culture is called soma clonal variation.

6. A gene that is transferred into an organism by genetic engineering is known as transgene.

7. An organism that contains and expresses a transgene is s, called transgenic organism.

8. The transgenes can be introduced into individual plant cells. The plantlets can be regenerated from these cells.

9. These plantlets give rise to the highly valuable transgenic plants.

10. Mutagens are added to single cell liquid cultures for induction of mutations.

11. Tolerance to stress like pollutants, toxins, salts, drought, flooding, etc. can also be obtained by providing them in culture medium in increasing dosage. The surviving healthy cells are taken to solid medium for raising resistant plants.

12. Weedicides are added to culture initially in very small concentrations.

13. Dosage is increased in subsequent cultures till the desired level of weedicide resistance is obtained.

14. The resistant cells are then regenerated to form plantlets and plants.

15. Both apical and axillary meristems are free from virus even if the whole plant is infected by it. Virus free plantlets are obtained by using meristem culture to grow new plants.

16. Embryos which normally do not survive inside seeds can be grown in tissue culture to form new plants. It is useful in interspecific hybridization.

Edible vaccines

- An **edible vaccine** is a food, typically plants, that produce vitamins, proteins or other nourishment that act as a vaccine against a certain disease.
- Once the plant, fruit, or plant derived product is ingested orally, it stimulates the immune system. it stimulates both the mucosal and humoral immune systems.
- Edible vaccines are genetically modified crops that contain antigens for specific diseases.
- Edible vaccines offer many benefits over traditional vaccines, due to their lower manufacturing cost and a lack of negative side effects.
- However, there are limitations as edible vaccines are still new and developing.
- Further research will need to be done before they are ready for widespread human consumption.
- Edible vaccines are currently being developed for measles, cholera, foot and mouth disease, Hepatitis B and Hepatitis C

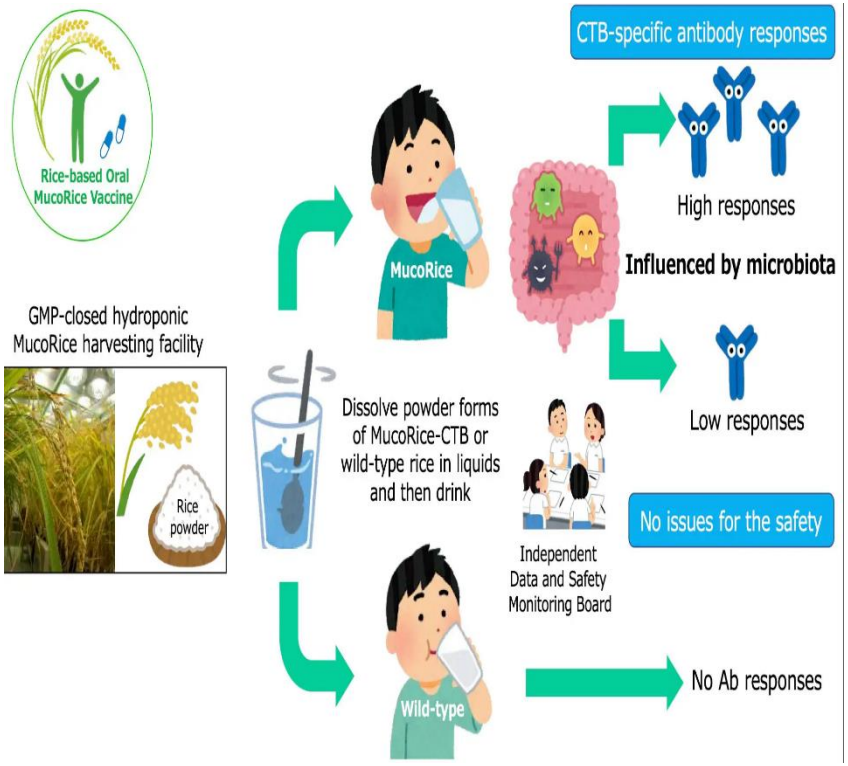
Benefits

- Edible vaccines differ from traditional vaccines in many ways and overcome many of their limitations.
- Traditional vaccines can be too expensive or restricted to manufacture and develop in certain countries.
- In contrast, edible vaccines are easy to produce, purify, sterilize, and distribute.
- Since they do not require expensive manufacturing equipment, only rich soil, the cost to grow the vaccines is significantly lowered.
- In addition, edible vaccines do not require sterilized production facilities or the biosafety standards required to cultivate certain pathogenic agents for traditional vaccines which are expensive to implement and maintain.
- They are also easier and less expensive to store since they do not require strict refrigerated storage.
- This necessity for cold chain storage creates many issues in third world countries.
- The seeds from an edible vaccine plant can also be easily dehydrated and preserved for cheap and quick distribution which makes them easily accessible in times of need.
- Edible vaccines also offer a profuse amount of potential health benefits over traditional vaccines.
- Eating a vaccine is a simpler means of administration compared to injection, making them extremely economical.
- This reduces the need for medical personnel and sterile injection conditions that are not always achievable in developing countries.
- Edible vaccines are considered a "pharmafood" which is a food source that increases health while also fighting diseases.
- The benefit of using plants is that plants are efficient vectors for vaccine production.
- Many traditional vaccines that are developed from cultured mammalian cells can lead to contamination with animal viruses.
- However, edible vaccines eliminate this issue because plant viruses cannot impact humans.
- Moreover, as a result of numerous antigens being integrated, the M-cells are randomly stimulated; leading to the possibility of second-generation vaccines.

Limitations

- Edible vaccines also have multiple disadvantages compared to traditional vaccines.
- Since edible vaccines are still in their infancy, there are still many unknowns left to discover.
- The adequate dosage amount and how long it lasts is still undetermined.

- The dosage varies due to many factors including: the plant generation, the individual plant, the protein content, the ripeness of the fruit and how much of it is eaten.
- The dosage also varies due to the difficulty in standardizing the concentration of the antigen in the plant tissue; it can be tedious to produce both consistently and large scale.
- The antigen concentration can also vary significantly between individual fruits on a plant, individual plants, and between plant generations.
- Low doses result in the consumption of less antibodies but a high dose results in establishing an oral and immune tolerance to the vaccine proteins.
- The logistics of controlling dosage, quality, and consistency still need to be determined and verified.



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