

A review on Anti-HIV activities of compounds isolated from the medicinal plant and advantage of plant tissue culture in development of Anti-HIV

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ABSTRACT

Introduction-The AIDS pandemic is one of the most disastrous health and development issue in our world today. Tissue culturing of medicinal plants is widely used to produce active compounds for herbal and pharmaceutical industries. Natural products provide a large reservoir for screening of anti-HIV agents with novel structure and anti-viral mechanism because of their structural diversity. This work reviews in vitro micro propagation techniques and gives examples of various commercially important medicinal plants. **Advantages-**To produce many copies in any time of the same plants then which may be used to produce plants with better flowers, odour's, fruits or any other properties of the plants that is beneficial to the human beings. **Conclusion-** HIV is the most common untreated world wide disease in now a days and Plant tissue culture is most important technique for growing new plant species in proper aseptic condition which are useful for the cure of HIV. **Acknowledgement-** I would like to record my gratitude to my esteemed respected guide Dr. (Prof.) Shalini Tripathi, Department of Pharmacy, Rameshwaram Institute of Technology and Management

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INTRODUCTION

The human immunodeficiency virus, or HIV, is the virus that causes HIV infection. During HIV infection, the virus attacks and destroys the infection-fighting CD4 cells of the body's immune system. Loss of CD4 cells makes it difficult for the immune system to fight infections. Acquired immunodeficiency syndrome, or AIDS, is the most advanced stage of HIV infection. HIV is transmitted (spread) through the blood, semen, genital fluids, or breast milk of a person infected with HIV. Having unprotected sex or sharing drug injection equipment (such as needles and

syringes) with a person infected with HIV. (Fig 1) Antiretroviral therapy (ART) is the recommended treatment for HIV infection. ART involves taking a combination (regimen) of three or more anti-HIV medications daily. ART prevents HIV from multiplying and destroying infection-fighting CD4 cells. This helps the body fight off Life-threatening infections and cancer. The plasma HIV RNA test (also called a viral load test) and HIV antibody test can detect HIV in a person's blood within 9 days of infection, before the body develops detectable HIV antibodies. (aidsinfo.nih.gov/guidelines) Tissue culture (TC) is the cultivation of plant cells,

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tissues, or organs on specially formulated nutrient media. Under the right conditions, an entire plant can be regenerated from a single cell. Plant tissue culture is a technique that has been around for more than 30 years. Tissue culture is seen as an important technology for developing countries for the production of disease-free, high quality planting material and the rapid production of many uniform plants.

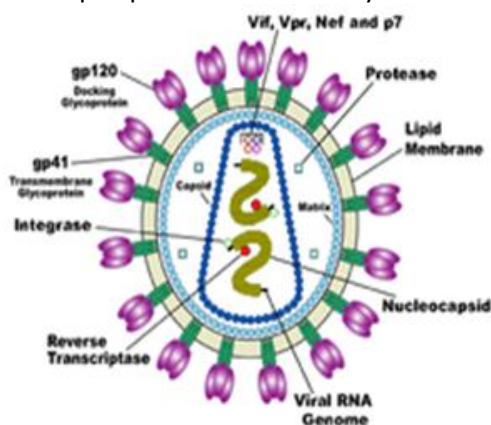


Figure 1

Plant tissue culture is a straightforward technique and many developing countries have already mastered it. Its application only requires a sterile workplace, nursery, and green house, and trained manpower. Unfortunately, tissue culture is labor intensive, time consuming, and can be costly. Plants important to developing countries that have been grown in tissue culture are oil palm, plantain, pine, banana, date, eggplant, jojoba, pineapple, rubber tree, cassava, yam, sweet potato, and tomato. This application is the most commonly applied form of traditional biotechnology in Africa. (Fig 2)

Types of Tissue Culture:

The plant tissue culturist should have a good idea at the outset as to the purpose of the Experiments. There are a number of different types of in vitro tissue culture approaches. For tissue culture, the term in vitro refers to growing pieces of plants separate from the

entire organism. We will explore some of these in our laboratory. Before we begin our experiments, it is helpful to describe some of the more important types of tissue culture.

Micropropagation: Micropropagation uses small pieces of tissues such as axillary buds, tubers or rhizomes for rapid cloning or generation of new plants. Think of a bud on a plant. The bud contains the meristematic area. Under in vivo (on the plant) conditions, growth is carefully controlled by different plant growth regulators (which ones?). Under these conditions, a bud continues to grow as part of a whole system. The tissue culturist excises the bud and alters the plant growth regulators.

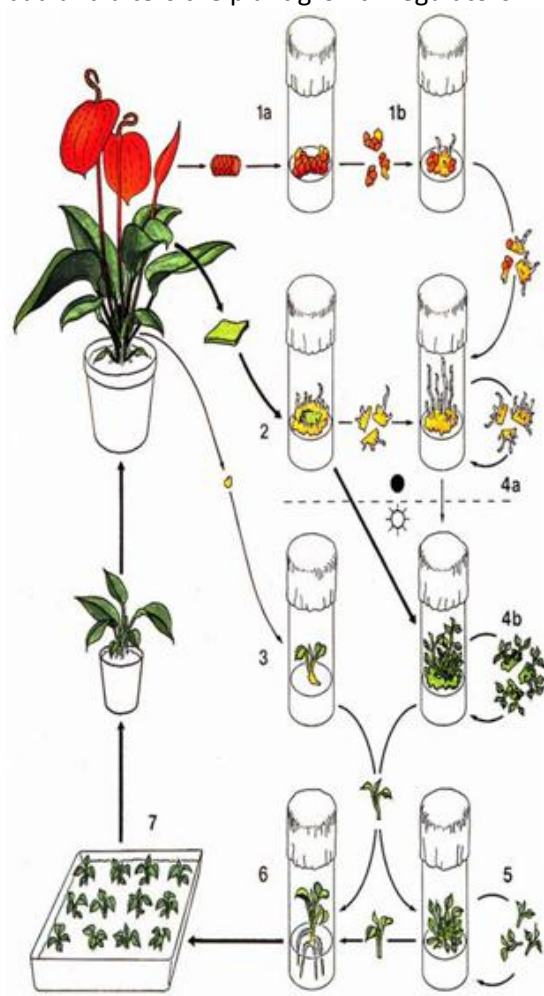


Figure 2

Growth then changes and multiple shoots will arise from a single bud. Each of these shoots have buds, which in turn can be cultured. The culturist can repeat this process over and over again to produce huge numbers of buds, each capable of producing a whole plant. Similar multiplication steps can be performed with rhizomes, nodes, tubers or other plant part. Micropropagation is the type of tissue culture used in the commercial horticulturist industry.

Organogenesis: Organogenesis refers to the development of plant organs such as leaves, roots or shoots from undifferentiated callus. A callus is a mass of "unorganized" plant cells. Callus can occur as a result of a plant wound. In plant tissue culture, it usually arises from pieces of tissue which the culturist places on a medium containing certain plant growth regulators. When the culturist moves the callus onto a new medium with different plant growth regulators, the cells in the callus are induced to organize and form new plant organs.

Embryogenesis: Plant embryos can arise from the manipulations of certain calluses. These embryos arise from undifferentiated cells in the callus. They reform into embryos. The term indirect embryogenesis is used when the

embryos arise from a callus. If the embryos form from developed plant tissue, the term direct embryogenesis is used. Generally, embryogenesis is defined as an embryo arising from a single cell.

Embryo/Ovule Culture: In some plants, embryos or ovules have insufficient nutrient reserves to develop and germinate. Orchids are excellent examples. The seeds of orchids must be placed on a nutrient medium to allow full germination. This medium contains important salts, vitamins, sugar and plant growth regulators. The latter may improve germination or overcome any germination blockers.

Protoplast Culture and Uses: When a plant cell is stripped of its wall, it is bound only by its plasma lemma. This cell is called a protoplast. Such cells may be fused with other cells to create entirely new species. This process is called protoplast fusion. The new fused protoplasts are cultured to reform new cell walls. The complete plant cells are then cultured back into new plants. Protoplasts can also be excellent choices for the injection of foreign DNA.

Table 1 There are several class of herbal remedies and there phytoconstituents which are responsible for anti HIV activity such as ^{6, 16,26,25,22}

S.no	Class of Drug	Biological source	Phytoconstituents
1	Alkaloids	<i>Eodia roxburghiana</i>	Buchapine
		<i>Stephania cepharantha</i>	Cepharanthine
		<i>Toddalia asiatica</i>	Nitidine
		<i>Berberise aristata</i>	Berberine
		<i>Strynchos nuxvomica</i>	Brucine, Strychnine
2	Coumarins	<i>Callophyllum lanigerum</i>	(+) Calanolide A
		<i>C. lanigerum</i>	(-) Calanolide B
		<i>Coriandrum sativum</i>	Coriandrin
3	Flavonoids	<i>R.succedanea</i>	Robustaflavone
		<i>Wikstoemia indica</i>	Wikstrol B

		<i>Humulus lupulus</i>	Xanthohumol
4	Phenols	<i>Green and black tea</i>	8-C-Ascorbyl(-)-epigallocatechin
		<i>Hopea malibato</i>	Balanocarpol
		<i>Arnebia eubroma</i>	Caffeic acid tetramer salts
5	Quinones	<i>Conospermum incurvum</i>	Conocurvone
		<i>Hypericum perforatum</i>	Hypericin
6	Saponins	<i>Cimicifuga racemosa</i>	Actein
		<i>Soybean seeds</i>	Saponin B1
7	Terpenes /Sterols	<i>Clathria</i>	Clathsterol
		<i>S.claviformum</i>	Oleanolic acid

Table 2: Plants and other natural products with known active compounds and modes of action against HIV

Family species	Active constituents	Mechanism of action	References
Andrographis Paniculata Araliaceae	Aqueous extracts of leaves Diterpene lactones (andrographolide)	Inhibition of HIV protease and reverse transcriptase.	Otake et al., 1995
		Inhibit HIV-infected cells from arresting in G2 phase in Which viral replication is optimal? Inhibit cell-to-cell transmission, viral replication and syncytia formation in HIV-infected cells	Calabrese, 2000
Panax ginseng	Gallic acid and galloyl glucose	Increases CD4/8 cells; has serious side effects.	Sung et al 2005
		Inhibits ribonuclease H activity of reverse tran.scriptase; also has HIV integrase inhibitory activity.	Ahn, 2002
Mentha piperita	Sulfonated Polysaccharides	Inhibit HIV-1 particles carrying R5 Envs; inhibit HIV-1	Hauber et al., 2009
		Replication; target HIV-1 virion (virucidal).	Yao et al., 1992
Musa acuminate	BanLec, a jacalin-related Lectin	Binds to glycosylated viral envelopes and blocks viral entry, hence is a good microbicide; potent inhibitor of HIV-1 Replication	Swanson et al., 2010

Family species	Active constituents	Mechanism of action	References
Phyllanthus niruri	Niruriside	Specific inhibitor of REV protein/RRE RNA	Qian-Cutrone, 1996
Punica granatum	PJ-S21	PJ-S21 inhibits binding of gp120 III-CD4 complexes to cells expressing CXCR4; inhibitor of X4 and R5 virus binding to the cellular receptor CD4 and co-receptors CXCR4 / CCR5	Neurath et al., 2004
Citrus spp.	Limonin and nomilin	Inhibit HIV-1 protease. Inhibit the production of HIV-1 p-24 antigen in infected monocytes and macrophages	Battinelli et al., 2003
Curcuma species	Curcumin	Inhibits HIV-1 integrase, HIV-1 and HIV-2 protease, and HIV-1 Long Terminal Repeat-directed gene expression.	Itokawa et al., 2008
Garcinia speciosa	Protostanes, Garcisaterpenes A and C	Inhibitory activity against HIV-1 reverse transcriptase	Rukachaisirikul, 2003
Arnebia euchroma	Monosodium and monopotassium salts of isomeric caffeic acid tetramer	Inhibitory activity against HIV replication in acutely infected H9 cells	Kashiwada, 1995
Melissa officinalis	Aqueous extracts	Exhibited a high and concentration-dependent activity against HIV-1 infection in immune cells; active against virions carrying diverse envelopes X4 and R5. Ethanol extract of L. leonurus inhibit HIV-1 by 33%; and Inhibits HIV induced cytopathic effect; moderate	Geuenich et al., 2008

ADVANTAGES OF TISSUE CULTURE IN DEVELOPMENT OF ANTI-HIV MEDICINAL PLANTS

1. To produce many copies of the same plants then which may be used to produce plants with better flowers, odors, fruits or any other properties of the plants that is beneficial to the human beings.
2. To produce plants anytime we want although the climates are not appropriate to produce a plant. Moreover, if seed is not available, it is possible to produce a plant with this method.
3. If there is plant with partially infected tissue, it is possible to produce a new plant without infection.
4. Very helpful in the genetically modified organism studies.
5. Very useful solution for the prevention of starvation in third world countries since the process is highly efficient, by using only one plant, it is possible to produce more than one thousand of the same plant with higher productive if its genome changed.
6. The biochemical engineer can grow plant cells in liquid culture on a large scale—Bioreactor
7. The production of dihaploid plants from haploid cultures shortens the time taken to achieve uniform homozygous lines and varieties.
8. The crossing of distantly related species by protoplast isolation and somatic fusion increases the possibility for the transfer and expression of novel variation in domestic crops.

9. Cell selection increases the potential number of individuals in a screening program.

10. Micro propagation using meristem and shoot culture techniques allows the production of large numbers of uniform individuals of species from limited starting material.

11. Genetic transformation of cells enables very specific information to be introduced into single cells which can then be regenerated.

CONCLUSION

Now days HIV is the most common untreated world wide disease. Approx 55 plant families containing 95 plant species, and other natural products, were found to contain anti-HIV active compounds that included Diterpenes, Triterpenes, biflavonoids, Coumarins, Caffeic Acid Tetramers, Hypericin, Gallotannins, Galloylquinic Acids, Curcumins, michellamines, And Limonoids. These active compounds inhibited various steps in the HIV life cycle. Plant tissue culture is most important and easy way to increase the quality and quantity of that plant which are useful for the cure of HIV in short time of period by the help of micro propagation. Micropropagation, which is a form of tissue culture, increases the amount of planting material to facilitate distribution and large scale planting. In this way, thousands of copies of a plant can be produced in a short time. Micro propagated plants are observed to establish more quickly, grow more vigorously and are taller, have a shorter and more uniform production cycle, and produce higher yields than conventional propagules.

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