International Journal of Botany Studies ISSN: 2455-541X; Impact Factor: RJIF 5.12 Received: 17-11-2020; Accepted: 02-12-2020: Published: 15-12-2020 www.botanyjournals.com Volume 5; Issue 6; 2020; Page No. 501-503



Importance of In vitro micropropagation techniques for Opuntia ficus indica for mass production

Khushbu Verma¹, Anoop M², Komal Sharma³

^{1, 3} Jayoti Vidyapeeth Women's University, Jaipur, Rajasthan, India ² Bhagwant Ayurvedic College and Bhagwant Hospital, Muzzaffar Nagar, Uttar Pradesh, India

Abstract

Opuntia ficus indica, known as prickly pear, is the most important plant species in the Cactaceae family. It is recognized as a multipurpose plant because it can be consumed as human food (fruits and vegetables), forage, medicinal plants, and ornamental sources. *Opuntia ficus indica* parts like pear, roots, cladodes, seeds, and juice have precious properties with high value of antioxidants (flavonoids, ascorbate), pigments (carotenoids, betalains), phenolic acids and various phytochemical compounds (biopeptides, soluble fibers). All of these compounds have been considered and make a payment to the medicinal properties of *Opuntia ficus indica*. This study focuses on the importance of *Opuntia ficus indica* as a medicinal plant, as fodder as a source for other industrial purposes, and emphasizes the popularization of tissue-grown *Opuntia ficus indica*.

Keywords: Opuntia ficus indica, antioxidants, pigments, tissue culture, phytochemical components

Introduction

Opuntia spp. belongs to the Cactaceae family and comes from Central America. The most economically important species is Opuntia ficus indica, which is cultivated for both fruits and cladodes (Nobel, 2002) ^[1, 3, 6]. The genus includes other important edible species found worldwide as wild or cultivated species in many arid or sub-arid areas (eg in the Mediterranean) (Nobel, 2002^[1, 3, 6], Nobel et al., 2002)^{[1, 3,} ^{6]}. Opuntia ficus indica is a xerophytic, juicy, prickly or spine-free CAM plant (crassulacean acid metabolism). The fig is the most cultivated edible cactus plant in the world and is widely distributed in Mexico and the South American continent. It is also cultivated in many other regions of the world, such as Africa, the Mediterranean, Australia, and the southwestern United States (Mohamed-Yasseen et al., 1995) ^[4] a; Piga, 2004) ^[5]. The cactus pear is known as a multipurpose plant because it can be used for human consumption (fruits and vegetables), animal feed, medicinal and ornamental plants (Casas and Barbera, 2002^[6]; Rodríguez-Félix, 2002). This plant is considered a good indicator of harmful substances (Nobel, 1994)^[2]. The low productivity of native forage plants hinders animal nutrition during the dry season. In the arid and sub-arid regions of Morocco, Opuntia clones are an alternative for feeding cattle and goats as a valuable food resource. Prickly pears have been cultivated in Morocco for many years, especially in arid areas. Opuntia plants are not only grown for fruit production, but also as defense hedges or for protection against erosion in reclaimed areas. Recently, prickly pear production has increased due to an increase in surface area (Boujghagh and Chajia, 2001)^[8]. Many types of cacti have been micropageed by multiplication of the axils. Based on the genus, the explants experienced on tissue culture were diverse: concluding shoots of seedlings lateral or vertical segments of plants or cladodes and simple areoles. Numerous studies have been reported unfolding the proficient and speedy multiplication of a variety of prickly pear cactus by "In vitro" microproagation (Escobar et al., 1986 ^[9]; García-Saucedo et al., 2005 ^[10]; Johnson and

Emino, 1979 ^[11]; Rubluo *et al.*, 1996 ^[12]; Smith *et al.*, 1991) ^[13], but, no common protocol is obtainable yet, since mainly plant responses to tissue culture are genotype-dependent and some significant changes and editions can be made to a novel species or diversity for which Tissue culture is considered (Estrada Luna *et al.*, 2008) ^[14], in particular to optimize the general environmental culture conditions, the type of medium, the concentration and the combination of plant hormones etc. during the shoot proliferation phase. Root and plant acclimatization conditions could also be examined as they could limit the success of micropropagation (Hartmann *et al.*, 1997) ^[15].

Traditional uses

Opuntia ficus indica is used in Mexico as a traditional medicine for the curing of burns, wounds, edema and indigestion. Its alcoholic extract has been suggested to have anti-inflammatory, hypoglycemic and antiviral activities. In addition, prickly pear cactus strains are traditionally used in Mexico to cure diabetes. It has also been suggested as medicine for hyperlipidemia (excess lipids in the blood) and obesity (Saenz, 2000) ^[16].

Nutritional content and bioactive chemical constituents of *Opuntia ficus-indica*

The chief constituent in *Opuntia ficus-indica* cladodes observed is water (80-95%), followed by small amounts of carbohydrates (3-7%), fiber (1-2%) and protein (0.5-1%); other compounds are only partially known and have not been quantitatively determined. The sugar moiety includes mucilaginous polymer-containing components, such as linked (1-4) β -D-galacturonic acid chains and R (1-2) linked L-rhamnose residues (Trachtenberg and Mayer 1981 ^[25, 22], Lee *et al.*, 2003) ^[23].

The physiological role of plant mucilage is to regulate cellular water content during prolonged drought and to regulate plant calcium fluxes. (Hernández-Urbiola *et al.*, 2011 ^[27], Rodríguez-García *et al.*, 2007) ^[28] *Opuntia ficus-indica* cladodes also represent a source of phytochemicals,

Pharmacological effects and mechanism of action of *Opuntia ficus indica*

Anti-ulcer activity

In Sicilian traditional medicine, *Opuntia ficus indica* (L.) Mill. Cladodes are popular to cure gastric ulcers (Galati *et al.*, 2001) ^[19]. The pre-treatment experiment in rats exposed a protective result to treat ethanol-induced ulcers (Galati *et al.*, 2003) ^[21]. It was evident that keen direction of *O. ficus indica* lyophilized cladodes usually sustains the gastric cytoarchitecture. The mucus can avert the necrotizing agent from entering the gastric mucosa. It also create outline of protective layer and stops deep necrotic lesions created by ethanol (Trachtenberg and Mayer, 1981) ^[25, 22].

Anti-inflammatory activity

Abundant reports have revealed the analgesic and antiinflammatory possessions of the genus Opuntia via either fruit extract, lyophilized cladodes or phytosterols from fruit and stem extracts (Park *et al.*, 1998) ^[18]. *Opuntia ficus indica* has been suggested to comprise anti-inflammatory activity. B-sitosterol has been recognized as an vigorous anti-inflammatory factor from the stem extract, even though its activity emerges to be comparatively weaker than that of hydrocortisone (Park *et al.*, 2001) ^[19].

Neuroprotective activity

Opuntia ficus-indica has been suggested to have a neuroprotective consequence in primary cultured rat cortical cells (Dok-. Go *et al.*, 2003). *Opuntia ficus indica* have three flavonoids, quercetin, (+) - dihydroquercetin and quercetin-3-methylether, which are mentioned as active antioxidant protective factors. *Opuntia ficus indica* has known to have a protective consequence against the oxidative damage induced by H₂0₂, xanthine / xanthine oxidase (X / XO) or buthione sulfoximine (BSO) in primary cultured rat cortical cells, which restrains lipid peroxidation and interrupts DPPH radicals (Dok-Go *et al.*, 2003) ^[23].

Anti-viral activity

An appealing study by Ahmad *et al.* (1996) ^[17] revealed that the administration of a cactus strain extract *Opuntia ficus indica* to mice, horses and humans created the intracellular replication of a number of DNA and RNA viruses such as herpes simplex virus type 2, equine herpes virus, pseudorabies virus, Influenza virus, slowdowns respiratory syncitial disease virus and HIV-1. Inactivation of extracellular viruses has also been reported by the same authors. Though, the vigorous inhibitory components of the cactus extract used in this study have not been examineD and so far no further study has dealt with this specific topic.

Anti-diabetic property activity

In one study of cactus pear as Anti diabetic agent, an experiment was conducted. Alloxan was applied as a single dose (130 mg / kg body weight) to bring diabetes in rats. A single or repeated dose of cactus fruit juice (5 ml once, twice, three or four times / rat) was orally given on daily basis to alloxane-induced diabetic rats till five weeks. Study revealed that treatment of diabetic rats with a single or repeated dose of cactus juice could convey thealter in the

Antioxidant enzymes parameters in positive manner back to rat's normal values (Hassan *et al.*, 2011)^[24].

Conclusion

Opuntia ficus-indica (L.) Mill. which live on hundreds of thousands of hectares, form a potential plant as a fruit tree, mainly due to their edible fruits and vegetable mass, which are consumed as food. The ever increasing demand for young plants for cultivation requires the research of fast, competent and profitable protocols, which guarantee the increase of the conventionality. Plant tissue culture is one of them, which gives this plant an enormous increase. This technique plants will be beneficial to Framer's view.

Acknowledgement

Authors are thankful to Hon'ble Chairperson JV'n Vidushi Garg and Hon'ble Founder and Advisor JV'n Dr. Panckaj Garg, Jayoti Vidyapeeth Women's University, Jaipur (Rajasthan) for their kind cooperation, encouragement, and providing the facilities of University Innovation Center and other laboratories.

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