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EFFECT OF NUTRIENT LIMITATION ON BIO-SYNTHESIS OF CAPSAICIN

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Abstract

Capsaicin biosynthesis was studied in callus cultures derived from root tip and shoot tip explants of *Capsicum annuum* L. variety Indra. In callus cultures, the activity of two enzymes, viz. PAL and CS increased till 15 or 12 days of subculturing, when these were induced on media, supplemented with 2mg l^{-1} 2,4-D and 0.5mg l^{-1} kin. Capsaicin content in root-tip derived callus cultures was much higher than that in shoot-tip derived callus cultures. Maximum capsaicin content was estimated (79 mg g^{-1} DW) in nitrogen deficient root-tip derived callus cultures after 15 days of subculturing. When the callus cultures were induced on media, supplemented with NAA, the activity of all the enzymes and capsaicin content was higher than that observed in only 2,4-D and kin. Sucrose and phosphorus depleted media showed a marginal increase for capsaicin content and activity of enzymes in both the root tip and shoot-tip derived callus cultures. Nitrogen depleted (ammonium nitrate and potassium nitrate) medium showed about 6.8 fold increase in capsaicin content and upto 15 and 6 fold increase was observed in activity of CS and PAL enzymes respectively.

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1. INTRODUCTION

Chilli (*Capsicum annuum* L.) belongs to the family *Solanaceae*. It was introduced from South Africa in the seventeenth century and is now grown as a cash crop in all parts of India for its pungent fruits. *Capsicum* consists of approximately 20–27 species (Walsh and Hook 2001). Phylogenetic relationships between species were investigated using biogeographical (Tewksbury et al 2006), morphological (Eshbaugh 1975), chemosystematic (Ballard et al 1970), hybridization (Pickersgill 1971) and genetic (Walsh and Hook 2001) data.

The pungency, a commercially important attribute of peppers, is due to the presence of six chemically related compounds viz. capsaicin, dihydrocapsaicin, norcapsaicin, nordihydrocapsaicin, homocapsaicin and homodihydrocapsaicin; which constitute, the “capsaicinoids” group (Perucka and Materska 2001). Capsaicin and dihydrocapsaicin account for approximately 90% of capsaicinoids in chilli pepper fruit, are most potent capsaicinoids. Capsaicin has great commercial importance as it is a major component of oleoresin which is exported and is a great foreign exchange earner. It has been reported to show anticancer effect (Moore and Moore 2003) and acts against neurogenic inflammation (Szolcsanyi et al 2004). It has been reported to show protective effects against cholesterol and obesity (Kempahmet al 2005).

Plant cell and tissue cultures have been established for a myriad of plant species. This technology is being used for the large scale production of specific secondary metabolites which can be used as food additives, nutraceuticals, and pharmaceuticals. (Zhong et al 2001) However, limited knowledge of secondary metabolism and its regulation proves to be an obstacle to the exploitation of the industrial potential of the plant cell and tissue cultures. Developments in transgenic research have opened up the possibility of metabolic engineering of biosynthetic pathways to produce high value secondary metabolites, like capsaicin and vanillin (Ravishankar and