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CHROMIUM PHYTOTOXICITY EFFCTS ON THE GERMINATION OF GREENGRAM (*VIGNA RADIATA* L. WILCZEK) SEEDS

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Chromium exists in the natural environment in both hexavalent and trivalent forms out of which hexavalent form is found to be more toxic. Treatment of hexavalent chromium to germinating greegram (*Vigna radiata* L. Wilczek var. K 851) seeds strongly affected germination and produced biochemical lesions. A decrease in germination rate was noticed with increase in chromium concentrations and LC 50 was recorded at around 10mm concentration. An uniform increase in protein content indicating inhibition of protein hydrolysis and a decrease in proline content with the increase in chromium concentration recorded. The activity of two peroxide scavenging enzymes catalase and peroxidase also decreased uniformly with the increasing toxicity of hexavalent chromium.

Keywords : Chromium; Germination; Greengram; Phytotoxicity.

Introduction

Seed germination is a well co-ordinated programme which includes those processes that lead to the inhibition of growth in the quiesent embyonic sporophyte. The environmental requirements for germination are fewer and simpler. In recent days, the high rate of pollution has greately affected the plant population. A great number of phytotoxicity tests during seed germination have been conducted using industrial effluents that contain several heavy metals of debate[1]. Chromium, one of the heavy metals, has been found to be toxic to plants and also produces visual symptoms at higher concentrations [2,3]. It exists in aqueous solutions in two oxidation states, i.e. Cr. (VI and Cr (III). When applied, a restricted movement of chromium into developing seeds is seen. It was found that of the total plant uptake, about 0.02% to 0.1% of chromium moved into developing wheat or bean seeds [4,5]. However, very little is known about the effect of chromium in inducing biochemical changes in germinating seeds. The present investigation attemps to show some of the toxic effects of chromium during germination of greengram seeds.

Material and Methods

Dry graded greengram (*Vigna radiata* L. Wilczek var. K 851) seeds were obtained from National Seeds Corporation, Bhubaneswar, Orissa. The seeds were surface sterilized with 0.1% mercuric chloride solution and germinated in petriplates using relative supply of hexavalent chromium in the form of potassium ($K_2Cr_2O_7$) dichromate (0, 0.1, 0.5, 1, 5, 10, 20,30, 40, 50, 100 and 200 mM). The seeds were germinated under controlled invironment at 25° C in darkness for 2 days. Emergence of a 2 mm redicle was used as the operational defination of germination. Germination rate was observed and expressed as germination percentage.

Biochemical analysis in germinating seeds was done for proline, protein and two oxidative enzymes, catalase and peroxidase. Germinated seeds were homogenized with 10 ml of 3% aqueous sulfosalicylic acid and the homogenate was centrifuged at 3000 r.p.m. for 10 min. The supernatant was taken for proline estimation. Proline content was estimated using the method of Bates *et al*[6]. The method of Lowry *et al*[7]. was followed for the determination of protiens, after their precipitation with trichloroacetic acid (TCA). Enzyme extaction for catalase and peroxidase was done as described previously[8] and assay was performed as per the method of Chance and Maehly[9].

Results and Discussion

Fig. 1 depicts the rate of germination for greegram seeds at varing chromium

concentrations. At 0.1 mM concentration germination was unaffected. However, at 10mM concentration, a 50% inhibition (LC 50) in germination was noticed. With an increase in chromium concentration, germination rate was further inhibited and at 200 mM, there was no germination at all. The inhibitory effect of different heavy metals on seed germination have already been described[10] .

Changes in proline in seeds under chromium treatment is shown in fig. 2(A) It was observed that low chromium concentration resulted in high proline accumulation whereas at higher concentrations, a marked decrease in proline content in germinating seeds was seen as compared to control. Lower concentration of chromium is possibly stimulating some of the enzymes of the proline biosynthetic pathway leading to its accumulation as seen for other metals as proline acts as an osmolyte to overcome to possible induction of a metal specific water deficit condition [11-13]. Effect of chromium on protein content of germinated seeds in shown in fig. 2(B). A marked decrease in the hydrolysis of protein content was observed at different chromium concentrations as compared to control. This may be due to the inhibitory effect of chromium on the hydrolysis of reserve proteins[5].

Changes in catalase and peroxidase activities of germinated seeds in varying chromium concentrations are shown in Fig. 2(C and D). A gradual decrease in the activities of both the enzymes was observed with the increase in the chromium

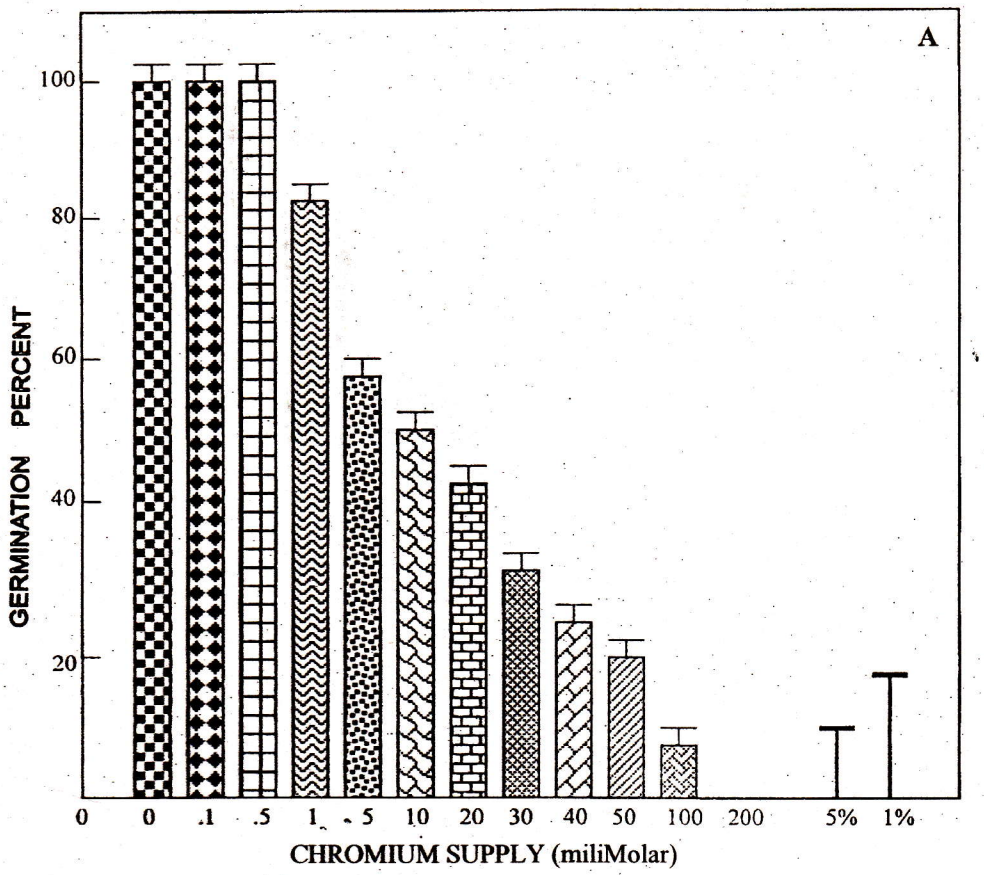

Fig. 1. Effect of Chromium treatment on germination of greengram seeds.

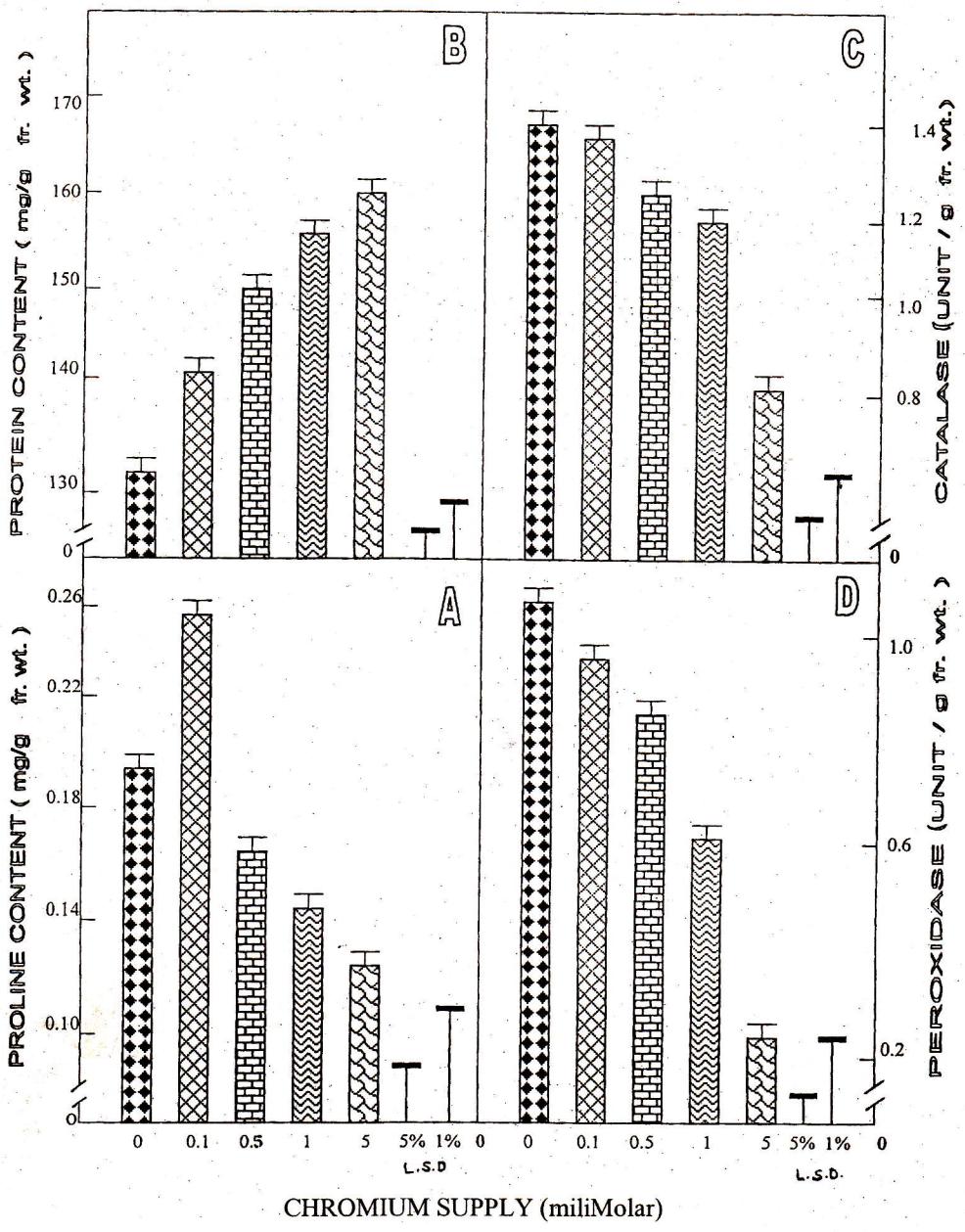

Fig. 2. Effect of Chromium treatment on Proline, Protein, Catalase and Peroxidase activity during germination of greengram seeds.

concentration. This uniform decrease might be due to destabilzation of the quarternary structure of the enzymes by the metal cation as a result of which the catalytic site became deprived of its substrate or might be due to the inhibition of enzyme activity by a chromium and metal specific effect[13-15].

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