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Effect of Selenium and Cadmium in Chlorophylls and Carotenoid Content of *Cucumis melo* L.

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Abstract: In greenhouse, seeds of *Cucumis melo* L. class melon hybrid F1 ananas germinated in pots. The seeds treated with different concentrations of Cd (0.0, 0.01, & 0.05M, as $CdCl_2$), & a unique concentration of Se (0.05 µM, as Na_2SeO_3) and as a combinations with Cd, in addition to control treatment was with Se only. There were none significant decreasing in chlorophylls a, b & total chlorophyll by 0.05 M of Cd comparing with control (distilled H_2O), whereas carotenoid decreased significantly. Generally, treatment with Se enhanced the chlorophyll content, where chlorophyll content increased significantly in contrast with control (dH_2O). Se + Cd as a combination treatments, especially at Cd with concentration 0.05 M was more enhancing for increasing the chlorophylls a, b, total chlorophyll & carotenoid content at comparing with almost treatments, especially with seeds that treated by Cd at 0.01 & 0.05M. These results indicate the presence antagonistic effect between Se and Cd in chlorophyll contents.

Key words: *Cucumis melo* L., Se, Cd, chlorophylls, carotenoid, detoxification.

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Introduction

The environmental pollution by heavy metals is the most interest in their actions on plants. Cadmium (Cd) is of the heavy metals and the more dangerous among them, because the ability of plant roots to absorb and affecting it on the metabolite and growth (1). The toxicity of Cd belong to motility and toxicity at low concentration (2), and the ability to transport through the nutrition chain (3). It's found in soil, water, and air, especially when these places are crowded with vehicles, factories, fertilizers, sewage, and pesticides (4).

Selenium (Se) is one of the essential elements, it's important for animals and humans at low concentrations (5). Depending on (6) and (7), Se is beneficial for plant at low concentration and harmful at high concentration. (8) referred that Se serves as antioxidant and is of glutathione peroxidase component. Like Cd, toxicity of Se differs depending on plant species, growth medium, and presence of competitive ions as S and P (9). There is antagonistic effect between Se and many of heavy metals included Cd (10). Chlorophyll content of leaf provides valuable information about physiological status of plants (11). The chlorophylls a and b are essential pigments for the formation of stored

chemical energy from light energy, and the solar radiation amount which absorbed by a leaf is determined by the photosynthetic pigment content; thus, chlorophyll content can determine photosynthetic potential and primary production directly (12) and (13). Furthermore, because much of leaf nitrogen is incorporated in chlorophyll, chlorophyll gives an estimation of the nutrient status indirectly (14). Also, leaf content of chlorophyll is closely related to plant stress and senescence (15). Carotenoids belong to light-harvesting which play a photo-protective role, preventing damage in the photosynthetic systems (16, 11, and 17). Some studies indicated that the chlorophyll a, b, total chlorophyll and carotenoid content decreased in some plants under stressed of salinity (18), or under stressed of heavy meatal (19), this refer affecting of chlorophyll at stress conditions. The target of this study is the detoxification of Cd by Se at low concentration by determination the chlorophylls and carotenoid contents.

Materials and Methods

In green house condition, seeds of sweet melon (*Cucumis melo* L.) class melon hybrid F1 ananas germinated in beat moss medium put in pots (high10 cm, diameter 7cm). Ten seeds grew in each pot, then treated with a: Cd (as $CdCl_2$) at different concentration (0.0, 0.01, 0.05 M), b: Se (as Na_2SeO_3) at 0.05µM (selected from a series of concentrations), c: a combination between solution as in a and b. After that seeds irrigated with distilled water along the time of experiment and when plant need it. After 17 day from the beginning of agriculture (age of experiment), take 0.05g of leaves then put in vial contain 20ml acetone (85%), after that kept the vials in dark container in refrigerator for 5-6 day (modifying method from (20). After 6 days, estimated the chlorophylls a, b and total chlorophyll content from the supernatant depending on (21), and carotenoid content according to (22). Statistically, data were analyzed by one-way analysis of variance (ANOVA).The means of three replicates separated by using the least significant difference (LSD) at probability level = 0.05.

Results and Discussion

In all figures (1, 2, 3 & 4), there was increasing in chlorophyll a, b, total chlorophyll and carotenoid content by all treatments except at Cd with concentration 0.05M, which caused non-significant inhibition in pigments content comparing with control. These results indicate that Cd at low concentration is enhancing for chlorophyll content and is inhibiting at high concentration. (23) indicated a presence of gradual decline in dry biomass with increasing doses of Cd. In past study, (24) mentioned that existing of Cd at low concentrations is as a normal constituent in plant tissues. The reduction in pigments content by high concentration of Cd (figures 1, 2, 3 & 4) may be belong to the destruction of the chlorophyll pigments (25), or may be attribute to interfere of ions through *denovo* proteins syntheses of chloroplast structure component rather than the chlorophyll destruction (26).

Se with a unique concentration (0.05µM) caused a significant increasing in the chlorophyll a & b content (figures 1 & 2), and non-significant increasing in total chlorophyll and carotenoid content

(figures 3 , 4). These results compatible with data of (27). They indicate that Se at lowest concentration induced a significant increasing in chlorophyll a, b, & total chlorophyll in spinach leaves. This increasing may be belong to protect effect of Se for chloroplast enzymes, than increasing the photosynthetic pigment biosynthesis as (28) shown that.

The combinations treatments (Se, 0.05 µM + Cd, 0.01, & 0.05M) caused increasing in the content of all pigments significantly comparing with control and almost treatments. The combination of Se, 0.05 µM + Cd, 0.05M was more enhancing which is elevated the chlorophyll a, b, total chlorophyll and carotenoid content significantly at comparing with all treatments, except the other combination (there was no significance between them). From these results, Se removes the toxic effect of Cd in its both concentrations (low & high), and raised all pigments content. This result show that the Se concentration may be increasing in plant leaves by storage it, and then competes with Cd ions lead to prevent the toxic effect of it. (29) referred that no significant change in chlorophyll content of lettuce and chicory leaves when treated with Se (as antioxidant) at harvest, while after storage for 5 day, chlorophyll content of lettuce and chicory increased in these plants. This indicates the increase of Se concentration in the plant leaves, which had a positive effect on plant yield. The current study data is confirmed the results of (10). They referred to reduce the unfavorable effect of many heavy metals as Cd for chlorophylls content by Se.

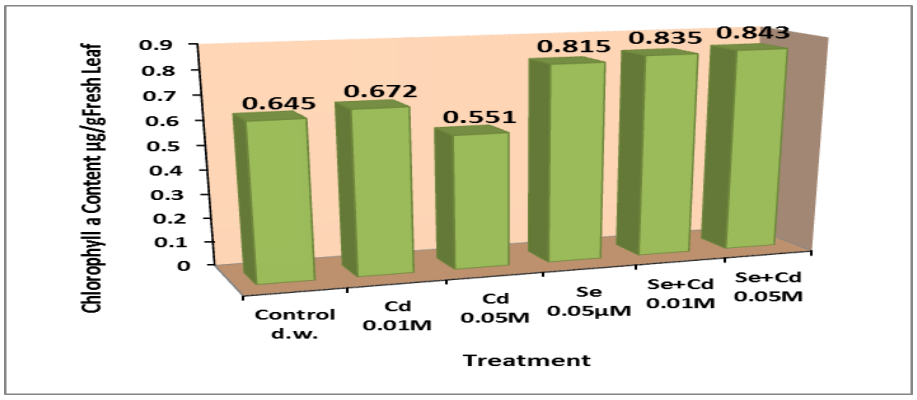

Figure 1: Chlorophyll a content (µg/g) with different treatments of Cd(M), Se (µM) &combination of Cd & Se, LSD (0.05)=0.176 .

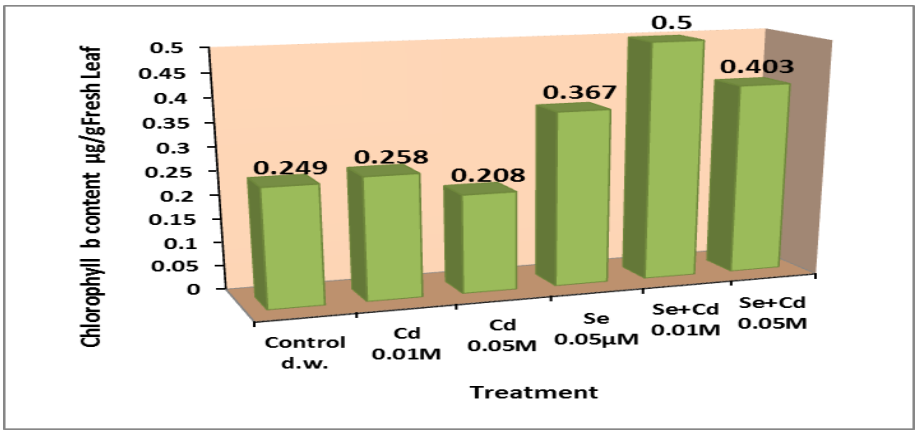

Figure 2: Chlorophyll b content (µg/g) with different treatments of Cd(M), Se (µM) &combination of Cd & Se, LSD(0.05)=0.096 .

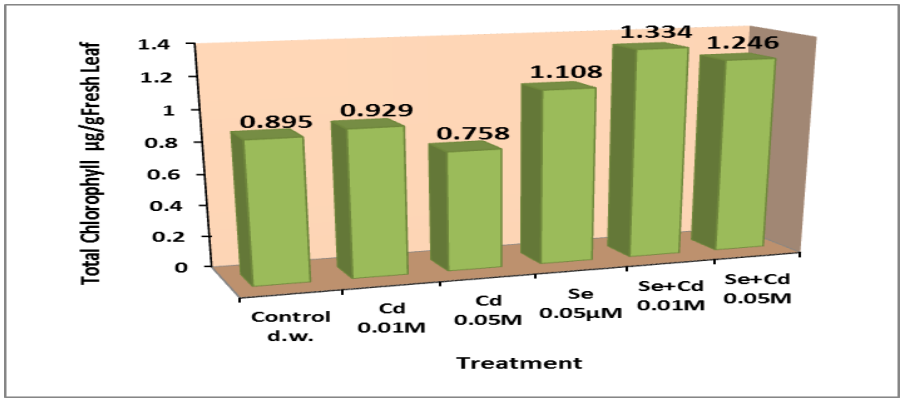

Figure 3: Total chlorophyll (µg/g) with different treatments of Cd(M), Se (µM) & combination of Cd & Se, LSD(0.05)=0.294 .

Conclusion

Se is antagonist with Cd element, and is may be important in chlorophyll synthesis or maintain it from destruction. Se in low concentration is beneficial in detoxification of Cd by increasing all chlorophylls and carotenoid pigments.

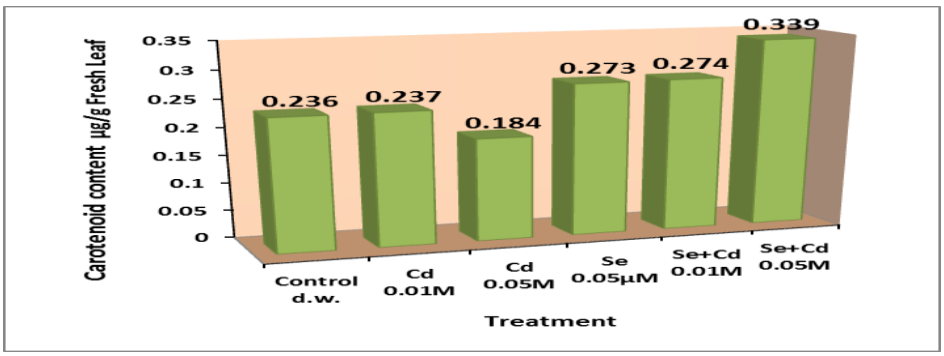

Figure 4: Carotenoid content (µg/g) with different treatments of Cd(M), Se (µM) & combination of Cd & Se, LSD(0.05)=0.061 .

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