

**THE EFFECT OF PREHARVEST FACTORS ON
L-ASCORBIC ACID CONTENT OF *L. SATIVA*, *S.
OLERACEA* AND *A. CEPA***

— research paper —

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Abstract: the present paper deals with the content of one of the most important antioxidant vitamins in fruits and vegetables -vitamin C, also known as L-ascorbic acid from active plant tissues of lettuce (*Lactuca sativa*), spinach (*Spinacia oleracea*) and onion (*Allium cepa*), in the seedling stage. It is known that content of vitamin C varies with plant species and different environmental factors. Quantitative determination of L-ascorbic acid in the investigated plants showed in all studied species a slightly increased content of vitamin C when growing on natural soil without chemical fertilization compared to the nitrogen fertilized soil. We obtained a higher content of vitamin C in case of *Allium cepa*, because of better conditions of growth and development and climate conditions. The obtained results of the present study confirm the importance of the nutrients content and antioxidant properties (L-ascorbic acid, respectively) for plants grown in organic agriculture (ecological).

Keywords: L-ascorbic acid, *Lactuca sativa*, *Spinacia oleracea*, *Allium cepa*, preharvest factors

INTRODUCTION

One of the most important antioxidant vitamins in fruits and vegetables is considered vitamin C, also known as L-ascorbic acid, which is the

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biologically active form of vitamin C. L-dehydroascorbic acid is the oxidized form of vitamin C, which is found less than 10% in horticultural crops, but can increase during storage (Wills et al., 1984). Oxidation of vitamin C leads to the biologically inactive dicetogulonic acid (Parviainen et al., 1992). Vitamin C is present in active plant tissues, where content varies on the species and different environmental factors.

In this paper we focused on the effect of preharvest environmental factors that may influence the content of vitamin C in the following vegetables: lettuce (*Lactuca sativa*), spinach (*Spinacia oleracea*) and onion (*Allium cepa*), in the seedling stage. Cultivation technology and climate conditions are among the most intensively studied environmental factors influencing the concentration of L-ascorbic acid in plants (Mozafar, 1993) (Weston et al., 1997). The investigated vegetable plants offer a good content of vitamin C as consumed in relatively large quantities, being considered an important food.

MATERIALS AND METHODS

Lactuca sativa and *Spinacia oleracea* were grown in winter in small nutritional cubes on natural soil (Gușterița area, Sibiu) and on soil with nitrogen fertilizer (red oligotrophic peat and brown eutrophic peat, *Florisol*). Chemical composition (nutrients) of *Florisol* is: 70% organic material, pH 5.5.-6.5, 60-70% humidity, 410 ppm nitrogen, 192 ppm phosphorus and 1350 ppm potassium. *Allium cepa* has been harvested in the spring in garden (sample representing natural ground) and in the field (soil treated with fertilizers).

Monitoring of plants was conducted for 75 days. Cultivation temperature was 20°C for day and 22°C for night. Irrigation water was done twice daily. Ascorbic acid content was determined titrimetric (Barakat et al., 1973) (Pachla et al., 1985). Experiments on the quantitative determination of L-ascorbic acid were performed in duplicate. The results were expressed in mg L-ascorbic acid per 100 g of fresh product.

RESULTS AND DISCUSSION

Extraction with 2% hydrochloric acid and determination of L-ascorbic acid concentration were performed immediately after harvesting in order to avoid oxidation of L-ascorbic acid to compounds which are biologically inactive. The results are presented in Tables 1 and 2. we noticed that *Allium cepa* has a higher content of L-ascorbic acid when grown both on natural soil and on

nitrogen fertilizer. This is due to better conditions of growing (garden and field).

Table 1. L-ascorbic acid content in the investigated vegetable plants grown on natural soil.

| Plant in seedling stage | L-ascorbic acid concentration (mg/100g fresh product) |
|--------------------------------|--|
| <i>Lactuca sativa</i> | 9.52 |
| <i>Spinacia oleracea</i> | 10.18 |
| <i>Allium cepa</i> | 23.85 |

Table 2. L-ascorbic acid content in the investigated vegetable plants grown on soil with nitrogen fertilizer.

| Plant in seedling stage | L-ascorbic acid concentration (mg/100g fresh product) |
|--------------------------------|--|
| <i>Lactuca sativa</i> | 8.56 |
| <i>Spinacia oleracea</i> | 9.20 |
| <i>Allium cepa</i> | 16.67 |

In all cases we found a slightly higher content in L-ascorbic acid in plants grown on natural soil and harvested in the seedling stage. These results are in agreement with literature data which report lower content of vitamin C in plants grown in the presence of increased amount of nitrogen fertilizer (Augustin, 1975) (Lisiewska et al., 1996). The obtained results are shown in Figures 1 and 2.

Comparing the obtained values with the reported variation limits of L-ascorbic acid content in plants (Bota, 1980), 10-28 mg% for *Lactuca sativa* (leaves and flowers), 20-45 mg% for *Spinacia oleracea* (leaves and flowers) and 40-80 mg% for *Allium cepa* (bulbs) we noticed that our results are relevant to the seedling stage, where the literature reports refer to plants the stage of maturity of the plant. Obviously the concentration of vitamin C in plants increases with the maturity.

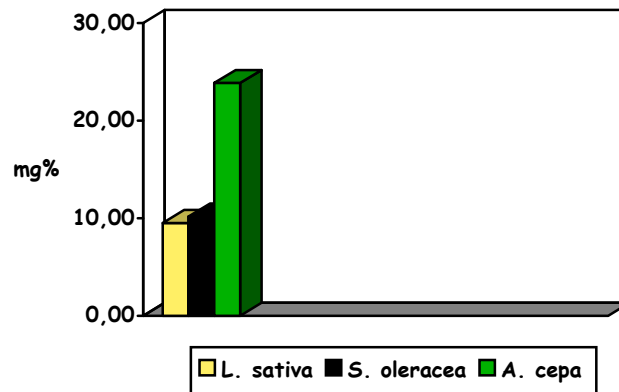


Figure 1. L-ascorbic acid concentration in vegetable plants (seedling stage) grown on natural soil.

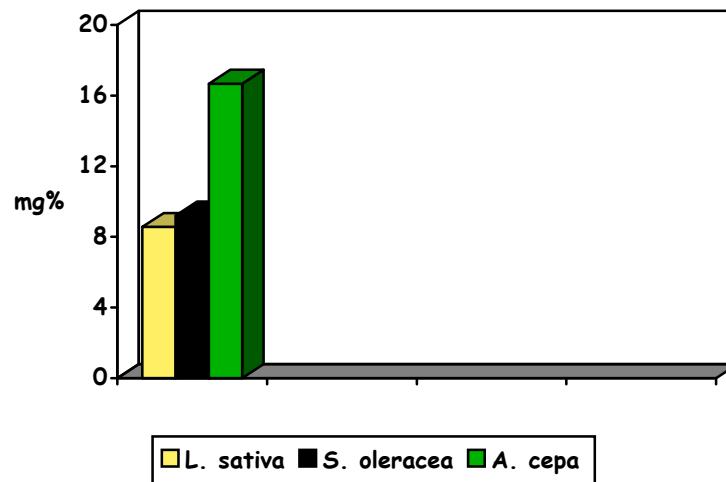


Figure 2. L-ascorbic acid concentration in vegetable plants (seedling stage) grown on soil with nitrogen fertilizer.

Regarding the percentage of seed plants grown on natural soil, as shown in Figure 3, we recorded higher values for spinach (73%) grown on soil with

nitrogen fertilizer (40%). In the case of lettuce, the values are similar, slightly higher for seeds grown on soil with fertilizer (58%) than those on natural soil (54%).

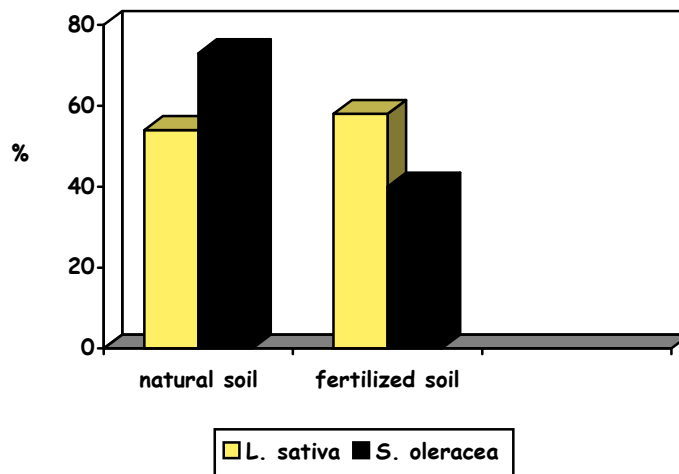


Figure 3. Seeds germination of *L. sativa* and *S. oleracea* cultivated on natural and fertilized soil, respectively.

CONCLUSIONS

Quantitative determination of L-ascorbic acid in vegetable plants as *Lactuca sativa*, *Spinacia oleracea* and *Allium cepa* showed in all the investigated species a slightly increased content of vitamin C when growing plants on natural soil without chemical fertilization compared to the nitrogen fertilized soil. In case of *Allium cepa*, L-ascorbic acid content is higher compared to *Lactuca sativa* and *Spinacia oleracea* because of better conditions of growth and development and climate conditions (solar light, precipitation, temperature, large area growth), factors which are different from the cultivation conditions of the other two species, and also because onion was harvested in a more mature stage.

The obtained results of the present study confirm the importance of the nutrients content and antioxidant properties (L-ascorbic acid, respectively) for plants grown in organic agriculture (ecological).

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