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Effect of substrate, bleaching plants and cultivar on the nitrate content in endive leaves (*Cichorum endivia* L.) depending on growing period in the year

INTRODUCTION

Endive is a valuable leaf vegetable with a characteristic bitter taste. The content of mineral compounds and vitamins in endive is higher than in lettuce. For many consumers bitter taste is not desirable thus in order to enhance the taste, endive plants are subjected to the bleaching treatment. High biological value of the species is also proved by low content of compounds which are harmful to health. An excessive content of nitrates in vegetables is not undesirable because resulting from their reduction there appear nitrites and nitro-compounds which are harmful to consumer's health. Obtaining vegetables with high biological value includes many cultivation factors, such as cultivars, microclimatic conditions, soil, and rational fertilization.

The aim of the investigation was the assessment of the effect of substrate, bleaching the plants and plant cultivars on the nitrate content in the leaves of endive grown in different period of the year.

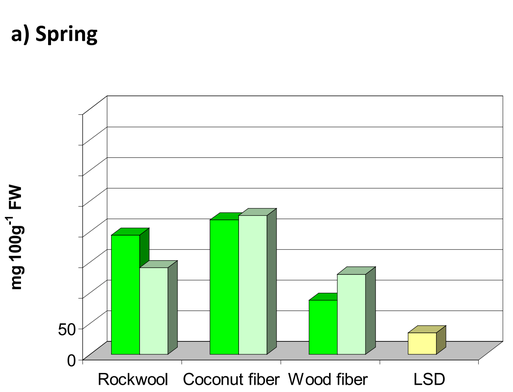
MATERIAL AND METHODS

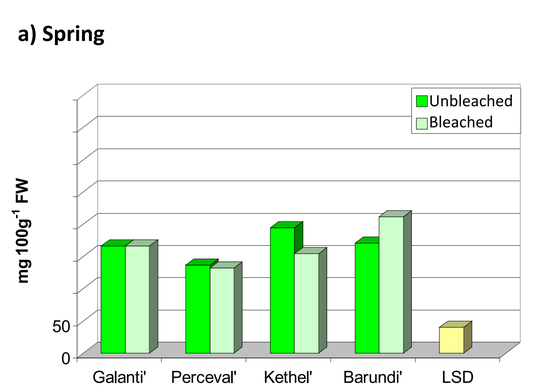
Experiments were carried out in a greenhouse with the controlled microclimate and involved four endive cultivars, three crispum leaf cultivars: 'Galanti', 'Perceval' and 'Barundi' and one latifolium leaf cultivar (escarole chicory) – 'Kethel'. The plants were cultivated two times in a spring, autumn and winter cycle on organic media such as coconut fiber slabs (manufacturer: Ceres Intern.), wood fiber slabs (Steico S.A.) and rockwool slabs (Grodan BV, Master type). Ten days before the harvest half of the plants were subjected to bleaching by being covered with black foil tunnels. The experiment was established in random design, with three replications, each comprising 15 plants. Four-week-old endive seedlings were replanted on growing slabs, 5 plants on each. Fertigation for plants contained 140 mg dm^{-3} of nitrogen in the form of ions NO_{3^-}. The nutrient solution in 1 dm3 contained the following amounts of elements in mg: P – 50, K – 300, Mg – 40, Ca – 200, Fe – 2, Mn – 0.6, B – 0.3, Cu – 0.15, Zn – 0.3 and Mo – 0.05. The nutrient media were applied to plants via 3 individual droppers for each rockwool slab. Last week before the harvest the plants were only watered and no nutrient solutions were applied. The plants were examined to the content of nitrates using the spectrophotometric flow method in the Fiastar apparatus.

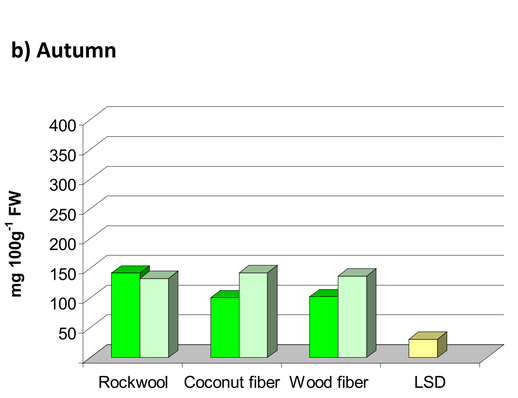
The obtained results were analyzed statistically using analysis of variance and the Tukey test, for significance level α=0.05.

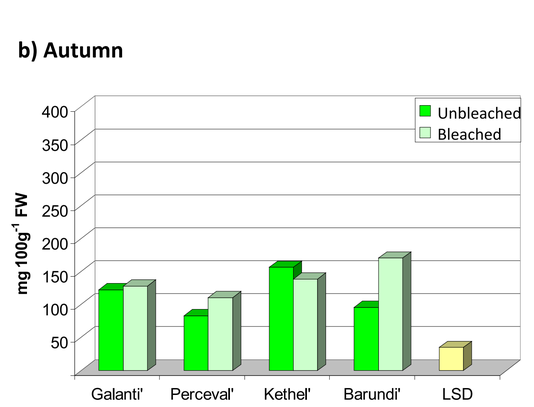
RESULTS

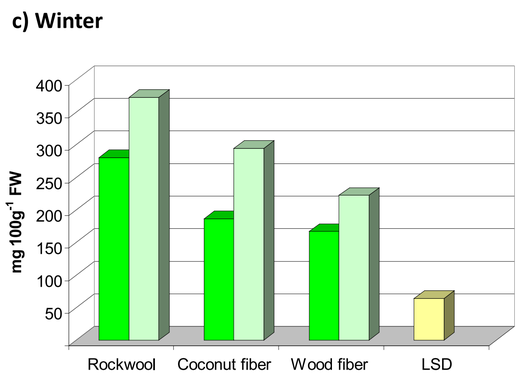
Nitrate accumulation in endive leaves was much higher in the case of the plants grown during winter (mean - 253.6 mg 100 g^{-1} FW) as compared to plants from an autumn (mean - 126.0 mg 100 g^{-1} FW) or spring (mean - 166.5 mg 100 g^{-1} FW) production (Fig. 1 and 2).The endive plants subjected to bleaching during autumn or winter cultivation terms showed a significantly higher content of nitrates comparing to the unbleached plants. On the other hand, the bleaching had no effect on the increase of nitrate content in the leaves of endive coming from a spring cultivation term. Some differences in the amount of nitrates accumulated by endive were observed in relation to the substrate used. The unbleached endive plants cultivated during autumn or winter on coconut fiber slabs or wood fiber slabs had a significantly higher content of nitrates than the plants cultivated on rockwool slabs. The plants grown on wood fiber slabs were characterized by the lowest content of nitrates (88.0 mg 100 g^{-1} FW) also for the spring term when compared to the plants cultivated on rockwool or coconut fiber slabs, showing 194.1 mg 100 g^{-1} FW and 218.9 mg 100 g^{-1} FW of nitrates' content respectively (Fig. 1). The lowest content of nitrates accumulated the cultivar 'Perceval', the highest 'Barundi' (Fig. 2).











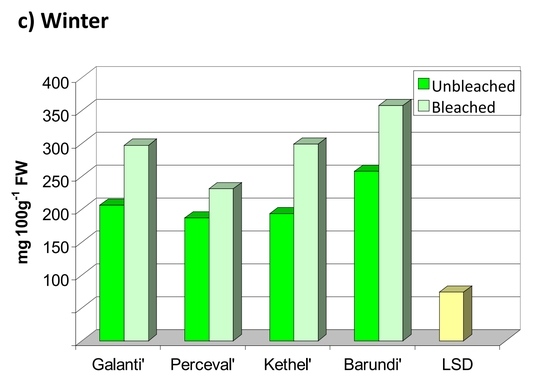


Figure 1. Content of nitrates in endive leaves growing on different substratus in: a) spring, b) autumn and c) winter cycles

Figure 2. Content of nitrates in endive leaves of different cultivars in: a) spring, b) autumn and c) winter growing cycles

CONCLUSIONS

- **Nitrate accumulation in endive leaves was much higher in the case of the plants grown during winter as compared to plants from an autumn or spring**
- **The endive plants subjected to bleaching during autumn or winter cultivation terms showed a significantly higher content of nitrates comparing to the unbleached plants**
- **The bleaching had no effect on the increase of nitrate content in the leaves of endive coming from a spring cultivation term.**
- **Some differences in the amount of nitrates accumulated by endive were observed in relation to the cultivar and the substrate used**

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