

# SOME CONSIDERATIONS ABOUT THE INFLUENCE OF INDOOR CONDITIONS ON *HEDERA HELIX*'S PHOTOSYNTETIC PIGMENTS

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**Abstract:** The chlorophylls and the carotenes play the most important role among the photosynthetic pigments existing in the green plant. The chlorophyll and the carotene biosynthesis in the leaves of green plants vary depending on different endogenous and exogenous factors. The variation curves for the chlorophyll a, b and carotenes have a similar profile for both inside and outside grown plants, but with more pronounced limits of variation for the outside plants. A constant environment does not necessarily increase the amount of photosynthetic pigments but rather, decreases their seasonal variations.

## INTRODUCTION

All free energy consumed by biological systems arises from solar energy that is trapped through photosynthesis. Chlorophylls and carotenes serve as light harvesting molecules and are essential components of the photosynthetic machinery.

The photosynthetic pigments are characterized through their structural and functional variety [12]. The chlorophylls and the carotenes play the most important role among the photosynthetic pigments existing in the green plant [6]. The chlorophylls are magnesium-porphyrins, and the carotenes represent polyisoprenic combinations [1]. Both chlorophylls and carotenes participate in the chemical reactions involved in the light phase of the photosynthetic process in green plants, leading to the reduced nicotinamide adenine dinucleotide phosphate and adenosine triphosphate synthesis [4].

The chlorophyll and the carotene biosynthesis in the leaves of green plants vary depending on different endogenous and exogenous factors. Thus, the chlorophyll and the carotene content from green plants depend on the systematic position of these organisms [7, 13]. On the chlorophyll synthesis during the life of the green leaf depends at least the life of the plant. The chlorophyll molecule formation has different intensities in the green plants ontogenesis and is influenced by temperature, light [5] and several chemical substances.

The present study focuses on quantitative variations in chlorophyll a, b and carotenes levels in *Hedera helix* plants grown indoors versus outdoors.

## MATERIALS AND METHODS

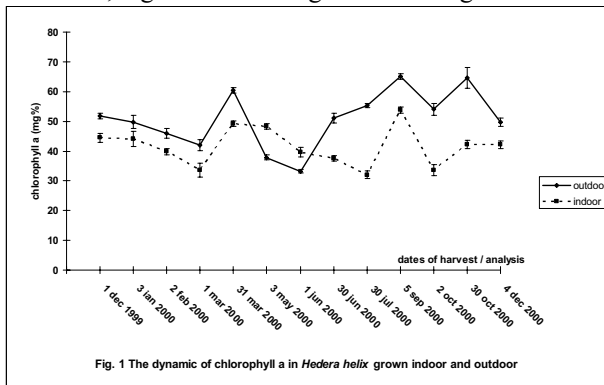
*Hedera helix* leaves were collected from plants cultivated outdoors/ indoors in the "Anastasiu Fătu" Botanical Garden from Iași during 1<sup>st</sup> of December 1999 and 4<sup>th</sup> of December 2000. Quantitative measurements were performed the same day.

The leaves for the tests of the photosynthetic pigments were monthly drawn, every first five or last five days of the month, at the same morning hour (8 o'clock). The pigments content was studied on the very drawn biological material. We used for extraction of the photosynthetic pigments 90% acetone. In the same extract there were measured the chlorophyll a, the chlorophyll b and the carotenes sum using "Spekol" spectrophotometer. The chlorophyll a was determined at 662 nm, the chlorophyll b at 644 nm and the carotenes sum at 440.5 nm, given the used extraction [10, 14]. In all cases there were taken for determination of the pigments five leaf samples from every species of the studied plants.

The experimental data obtained have been processed statistically according to the Student test [9].

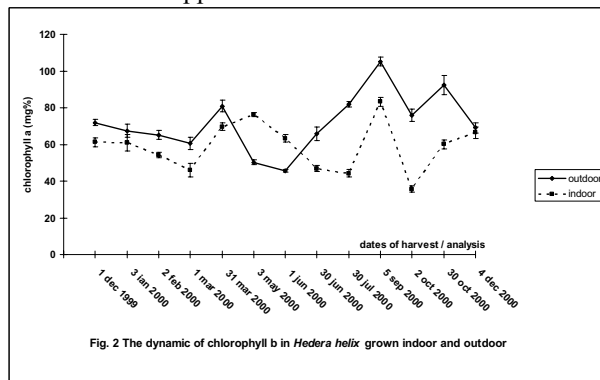
## RESULTS AND DISCUSSIONS

The results that we obtained shows the fact that in the leaves of the *Hedera helix* outdoors and indoors grown the concentrations of the chlorophyll a and b and the carotenes too, register fluctuating values during the months of the year.



The quantity of chlorophyll a (Fig. 1) in *Hedera helix*'s leaves shows three points of maximum in April, September and November for the outdoor grown plants and only two points of higher concentrations, in April and September but with a very low decreasing value in May, for the indoors grown plants. The profiles we recorded for both indoors and outdoors grown plants look similar, with lower variations for the indoors grown plants.

The lowest chlorophyll a values are found for the indoors grown *Hedera helix* in March, August and October but only in June for outdoors grown *Hedera helix*. Other points of minimum appear to be also in March and October for the outdoors plants.



From the results we collect (Fig. 2) the chlorophyll b concentration presents more visible amplitude of variation for both indoors and outdoors grown plants. The higher values for outdoors plants are in April, September and November and for the indoor

plants in May and September. The lowest values seem to be in June for the outdoors plants and in October for the indoor plants.

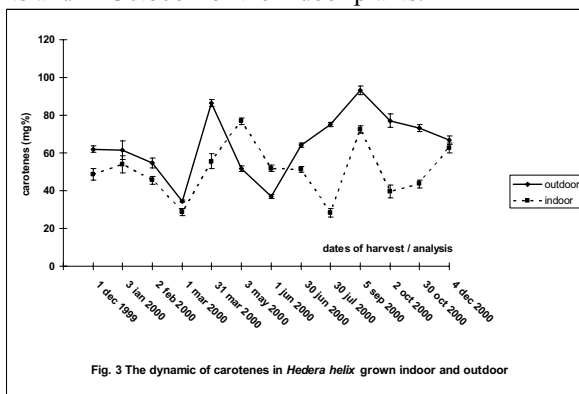


Fig. 3 The dynamic of carotenes in *Hedera helix* grown indoor and outdoor

Even the profiles recorded for the carotenes (Fig. 3) shows us impressive variations with two points of minimum in March and June for the outdoors plants and in March and August for the outdoor plants. The same situation is present for the maximal values: two points in April and September for the outdoors *Hedera helix* and two points in May and September for the indoor *Hedera helix*.

At the outdoor the best period for photosynthetic pigments is in March and in August – September because of the most comfortable weather conditions (plenty of sun and rain) and the worst period is second part of May and June and July because of the excessive heat and rain deficiency. On the other side, the conditions are more stable indoors and with the increasing amount of solar light in April – June the biosynthesis have high values. The higher level of photosynthetic pigments found in September could be a genetic effect, plants needed to enter the Autumn and Winter with enough chlorophyll and carotenes to survive at low metabolic rate during these two seasons.

We observed a significant lower level of pigments in indoor plants, except during April, May and June. We also noticed a smaller quantitative pigment variation in indoor plants as opposed to those grown outside. For all tested pigments maximum is reached in September independent of environmental conditions. On the other side, minimal values vary depending on growing conditions. Chlorophylls a and b reach minimum in October in indoor plants but in June in outdoor plants. Carotenes have two low points: the first one in March for both types of plants and the second one in June or August for outdoors and indoor plants respectively.

## CONCLUSIONS

Quantitatively, in *Hedera helix* leaves grown outside the concentration for each of the studied photosynthetic pigment is higher than in the *Hedera helix* leaves grown inside with an exception, in the period between April and June when there is an inversion.

The variation curves for the chlorophyll a, b and carotenes have a similar profile for both inside and outside grown plants, but with more pronounced limits of variation for the outside plants.

The maximum value for all of the photosynthetic pigments in *Hedera helix*'s leaves is recorded in September for both inside and outside grown plants.

The lowest values for all photosynthetic pigment are found in February and May for the outdoors grown *Hedera helix* and in February, July and October for the outdoors grown *Hedera helix*.

For both of the inside and outside plants the concentration of the chlorophyll b is higher than the concentration of the chlorophyll a. The lower concentration is recorded for the carotenes.

Based on these results we conclude that monthly quantitative variations in photosynthetic pigments depend on environmental conditions. The genomic component is reflected in the general shape of the (pigment – time) curve, while environmental influences are underlined by differences in quantitative variation for each of the three molecules investigated. A constant environment does not necessarily increase the amount of photosynthetic pigments but rather, decreases their seasonal variations.

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