

Chlorophyll content in some cultivated and wild species of the family *Lamiaceae*

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Abstract

Chlorophyll (Chl) *a*, *b* and (*a*+*b*) contents were measured in eleven cultivated and wild species of *Lamiaceae* collected from different environments. In nine of these eleven species, belonging to the subfamily *Nepetoidea*, the Chl *a/b* ratio was low. This suggests a prevailing shade aspect, regardless of collection sites and cultivated or wild origin.

Additional key words: *Hyptis pectinata*, *Hyptis sinuata*, *Leonorus japonicus*, *Ocimum basilicum*, *Ocimum campechianum*, *Origanum majorana*, *Plectranthus amboinicus*, *Plectranthus scutellarioides*, *Rosmarinus officinalis*, *Salvia officinalis*, *Scutellaria purpurascens*.

The *Lamiaceae* (*Labiatae*) family is an important taxonomic group that has been extensively studied (e.g. Harley and Reynolds 1992). This family has approximately four thousand species worldwide (Hedge 1992); in Venezuela, it is represented by twenty one genera and eighty species, distributed around the country between 0 and 3600 m a.s.l. (Velazquez 1997, Velazquez *et al.* 1997, Velazquez and Orsini 1997). The family is mainly herbaceous and in Venezuela, the majority of the species grow in the forest border and in savannah. Some species grow under direct sun radiation and others grow under tree shade (Velazquez 1997).

The aim of this study was to compare chlorophyll content in some cultivated and wild species of this family grown in different localities.

The studied species were collected at three different localities:

1) Simón Bolívar University, Sartenejas, Baruta, 1250 m a.s.l., 10°24'N and 66°52'W. *Hyptis pectinata* (L.) Poit. and *Scutellaria purpurascens* Sw. were growing wild in the garden under tree shade; photosynthetically active radiation (PAR) $48 \pm 27 \mu\text{mol m}^{-2} \text{s}^{-1}$ and about $1550 \pm 250 \mu\text{mol m}^{-2} \text{s}^{-1}$ (sun fleck). *Leonorus japonicus* Hout.

was growing wild near road between Baruta and Simón Bolívar University, PAR $1550 \pm 300 \mu\text{mol m}^{-2} \text{s}^{-1}$.

2) Henry Pittier National Park, Aragua, 800 - 920 m a.s.l., 10°24'N and 67°43'W. *Hyptis sinuata* Kunth. was growing wild near main road; PAR $1350 \pm 250 \mu\text{mol m}^{-2} \text{s}^{-1}$. *Plectranthus scutellarioides* R.Br. was growing wild under tree shade; PAR: $45 \pm 20 \mu\text{mol m}^{-2} \text{s}^{-1}$.

3) Commercial greenhouse near Simon Bolívar University, Sartenejas, Baruta. *Ocimum basilicum* L., *Ocimum campechianum* Miller, *Origanum majorana* L., *Rosmarinus officinalis* L., *Salvia officinalis* L., and *Plectranthus amboinicus* (Lour) Spreng were cultivated there. PAR $1350 \pm 300 \mu\text{mol m}^{-2} \text{s}^{-1}$.

Young expanded leaves were collected between 10:00 and 15:00, and transported in plastic bags in a portable ice-box at an approximate temperature of 4 °C to the laboratory. Ten replicates from ten different plants were used. Leaf area was measured using the photographic paper weighing method. Chl determination followed the method of Bruinsma (1963).

The contents of Chl *a* and Chl *b* (Table 1) ranged from 0.37 to 0.60 and from 0.21 to 0.33 g m⁻², respectively.

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The Chl *a/b* ratio (Table 1) ranged from 1.41 to 2.10. In nine of the eleven studied species (*H. pectinata*, *H. sinuata*, *O. basilicum*, *O. campechianum*, *Origanum majorana*, *P. amboinicus*, *P. scutellarioides*, *R. officinalis*, and *S. officinalis*), Chl *a/b* was low (1.41 to 1.76); these species belong to the subfamily *Nepetoidea* (Cantino *et al.* 1992).

Table 1. Chlorophyll (Chl) [g m^{-2}] content in some cultivated and wild species of the *Lamiaceae* family. Each value is a mean of ten replicates \pm SD.

Species	Chl <i>a</i>	Chl <i>b</i>	Chl (<i>a + b</i>)	Chl <i>a/b</i>
<i>H. pectinata</i>	0.41 \pm 0.12	0.27 \pm 0.08	0.70 \pm 0.22	1.52
<i>S. purpurascens</i>	0.44 \pm 0.13	0.21 \pm 0.06	0.68 \pm 0.22	2.10
<i>L. japonicus</i>	0.60 \pm 0.19	0.30 \pm 0.10	0.91 \pm 0.28	2.00
<i>H. sinuata</i>	0.39 \pm 0.13	0.26 \pm 0.09	0.66 \pm 0.21	1.50
<i>P. scutellarioides</i>	0.53 \pm 0.17	0.33 \pm 0.12	0.87 \pm 0.28	1.61
<i>O. basilicum</i>	0.41 \pm 0.12	0.29 \pm 0.09	0.71 \pm 0.22	1.41
<i>O. campechianum</i>	0.37 \pm 0.11	0.21 \pm 0.07	0.56 \pm 0.18	1.76
<i>O. majorana</i>	0.46 \pm 0.14	0.27 \pm 0.09	0.77 \pm 0.23	1.70
<i>R. officinalis</i>	0.48 \pm 0.14	0.33 \pm 0.11	0.84 \pm 0.26	1.45
<i>S. officinalis</i>	0.37 \pm 0.11	0.24 \pm 0.08	0.63 \pm 0.20	1.50
<i>P. amboinicus</i>	0.44 \pm 0.13	0.29 \pm 0.10	0.73 \pm 0.25	1.52

The conversion of protochlorophyllide to chlorophyllide *a* is a light-dependent step; one part is converted into Chl *b* (Ohashi *et al.* 1989, Shimada *et al.* 1990). During the assembly of the photosynthetic apparatus (Paulsen 1997, Sundqvist and Dahlin 1997), the Chl *a* proteins appear before the onset of Chl *b* and concomitant, Chl *a/b* protein accumulation. The precursor for the 7-formyl oxygen in Chl *b* is molecular oxygen (Porra *et al.* 1994). A high proportion of Chl *b* has been reported by Gonzalez *et al.* (1994) who related it to an adaptation or the result of evolution of the plants to fit their habitats: that is the plant, with a certain type of pigment is able to some extent, to vary the ratio of the different kinds of pigments in accordance with the prevailing radiation quality. These authors affirm that the wavelengths between 450 and 480 nm are absorbed by Chl *b* but not by Chl *a* in the shade, so a high proportion of Chl *b* in a shade plant will enable it to use this spectral range more efficiently. Nuñez-Olivera *et al.* (1994) mentioned that a relative enrichment in Chl *b*, mainly located in light-harvesting complexes, make a plant more resistant to degradation than plants enriched by Chl *a*. Viji *et al.* (1997), working with low-irradiance tolerant and susceptible cultivars of rice, found a decreasing trend in Chl *a/b* in all cultivars under low irradiance treatment,

This low Chl *a/b* ratio suggests a prevailing effect of shade, regardless of collection site. The Chl *a/b* ratios for *S. purpurascens* and *L. japonicus* were 2.10 and 2.00, respectively. Leaves of *L. japonicus* were collected from a site under direct sunlight, while those of *S. purpurascens* from a site under tree shade receiving sunfleck.

due to predominant increase of Chl *b* fraction; this decrease was less in the tolerant cultivars when compared with the susceptible ones. Morales *et al.* (1991) mentioned that plants exhibit several kinds of adaptation to the prevailing irradiance: phenotypic adaptation (modulative and modificative) and genotypic adaptation (heliophyte and sciophyte plants), and that these adaptations are not mutually exclusive, but superimposed so that they permit fine adjustments that guarantee the greatest possible efficiency of radiant energy utilization (Larcher 1983).

The lower values of Chl *a/b* observed in the present work are not related to shade environments; the plant species of both wild and cultivated origin were collected from sun and shade environments. Moreover, of the two plant species with higher Chl *a/b* values, one was collected from sun environment and the other from shade environment. The lower Chl *a/b* suggests a shade prevailing aspect, regardless of collection sites and cultivated or wild origin. These lower Chl *a/b* values observed in species belonging to the subfamily *Nepetoidea* may mean another phylogenetic relationship at biochemical level among these species associated with a prevailing shade aspect.

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