

FSL 4: Agronomical and phytochemical evaluation of *Stevia rebaudiana* genotypes

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Abstract

The agronomical potential and the phytochemical variability of 18 genotypes of the Paraguayan plant *Stevia rebaudiana* have been investigated in Switzerland in order to identify the best genotype for local cultivation. Over a two-year period, yields in dry leaves ranged from 10 to 170 g m⁻², with a percentage of leaves ranging from 53 to 75 %. HPLC analyses showed a notable variability in phytochemical composition, with stevioside content ranging from 0.3 to 7.9 % w/w and rebaudioside A from 0.3 to 6.5 % w/w. Cultivation of *S. rebaudiana* in Switzerland is feasible. With a density of 10 plants per m², the potential yields of dry matter are approximately 1-2 t ha⁻¹. The most productive genotypes (Pharmasaat, Hem Zaden, Stepa and Mediplant 3 and 11) will be submitted to the industry for organoleptic evaluation.

Keywords: stevioside, rebaudioside A, sweetener plant, Switzerland

Introduction

The Paraguayan shrub *Stevia rebaudiana* (Bertoni) Bertoni contains large amounts of calorie-free sweeteners that are up to 400 times sweeter than sucrose. The main ones are stevioside and rebaudioside A. Due to the high content of stevioside in some plants, *Stevia* also has a marked bitterness or licorice-like aftertaste that some manufacturers would like to avoid. The agronomic potential and the phytochemical variability of several genotypes have been investigated in Switzerland in order to identify the best genotype for local cultivation. The most productive genotypes will be submitted to the industry for organoleptic evaluation.

Materials and Methods

Plantlets of 21 genotypes (GAWI/Eustas, F/Eustas, Jelitto, Pharmasaat, Hem Zaden, Stepa and 15 Mediplant clones descending from seeds from the Botanical Garden in Asunción, Paraguay) were planted in February 2013 in Conthey (480 masl, continental climate) in randomized blocks with a density of 10 plants per m². Dry matter yield and percentage of leaves were measured over three harvests (August 26 and October 18, 2013; October 10, 2015). Steviol glycoside content (stevioside and rebaudioside A) was estimated by UPLC based on the Waters Application Notes WA60128 and WA60129, with a detection at UV 200 nm.

Results

Dry leaf yield of all genotypes ranged from 10 to 170 g m⁻², with a percentage of leaves ranging from 53 to 74 %. The genotypes Pharmasaat, Hem Zaden, Med1, Med3, Med11, Med15 and Med16 showed the best yields (Fig. 1). A great diversity of the steviol glycoside content was observed, with stevioside levels ranging from 0.3 to 7.9 % w/w, whereas rebaudioside A ranged from 0.3 to 6.5 % w/w (Fig. 2). The total steviol glycoside content was the highest in the genotypes Pharmasaat, Hem Zaden, Stepa and Mediplant 3 and 11. The stevioside-to-rebaudioside ratio was smaller than one for Hem Zaden, Stepa, Mediplant 6, 9, 11, 14 and 16, likely resulting in a less bitter aftertaste. In 2015, the genotypes GAWI and F from EUSTAS were compared to plants from seeds from Pharmasaat, showing that F has the lowest content in stevioside and the highest content in

rebaudiosid A, thus being much less bitter (Fig. 3). These results are comparable to previous studies (ANDOLFI *et al.*, 2006; LANKES & MORA ZABALA, 2011).

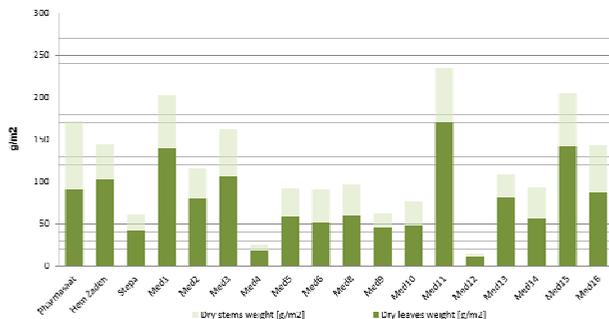


Fig. 1. Yields in dry stem and leaf matter [g/m²] for 18 genotypes of *Stevia rebaudiana* over two harvests. The most productive genotypes are Pharmasaat, Hem Zaden and Mediplant 1, 3, 11, 15 and 16.

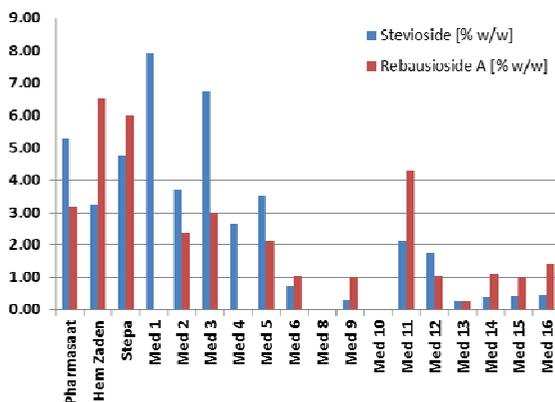


Fig. 2. Steviol glycosides content for 18 genotypes of *Stevia rebaudiana*. The global content in steviol glycosides was the highest in the genotypes Pharmasaat, Hem Zaden, Stepa and Mediplant 3 and 11. The stevioside/rebaudioside ratio was <1 for Hem Zaden, Stepa, Mediplant 6, 9, 11, 14, 15 and 16, likely resulting in a less bitter after taste.

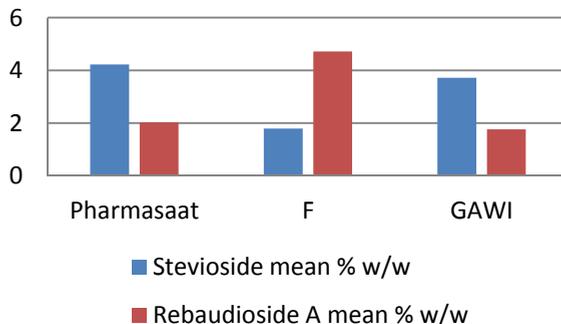


Fig. 3. Steviol glycosides content for 3 genotypes of *Stevia rebaudiana* selected in 2015, one harvest with four repetitions. Plants from Pharmasaat seeds and the GAWI clone from EUSTAS have more stevioside while the clone F from EUSTAS has more rebaudioside A.

Cultivation of *Stevia rebaudiana* is feasible in alpine areas. With a planting density of 10 plants/m², the potential yield of dry matter is 2.5 - 3.0 t ha⁻¹ (leaves and stems) and 1 - 2 t ha⁻¹ (leaves only) over two harvests (August 26 and October 18), which is much lower than the highest quantity of leaf dry matter of 3.6 t ha⁻¹ estimated by Andolfi et al. (2006) for the most productive genotype in the first year in Central Italy. Under Swiss conditions in the first year, the theoretical yield range is 3-158 kg ha⁻¹ of stevioside and 3-130 kg ha⁻¹ of rebaudioside A. Pharmasaat, Hem Zaden, Stepa and Mediplant 3 and 11 showed the highest global content in steviol glycosides. The clone F from EUSTAS showed the lowest stevioside-to-rebaudioside A ratio, resulting in a less bitter after-taste.

References

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