

Pollen morphology of four species of salvia genus (lamiaceae) in periurban areas of Sucre, Bolivia

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SARAVIA - Alexandria ^{1*} & PINTO - Carlos²

¹ Museo de Historia Natural Noel Kempff Mercado, Universidad Autónoma Gabriel René Moreno, Casilla 2489, Santa Cruz Bolivia

² Universidad Mayor Real y Pontificia de San Francisco Xavier de Chuquisaca, Casilla 212, Sucre- Bolivia

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Resumen

Granos de polen de 4 especies del género *Salvia* fueron colectados y descritos en relación a su morfología. Se distinguieron dos grupos de acuerdo a diferencias en tamaño y forma, principalmente en el ancho del colpo y el espesor de la exina. Las especies con polen más grande (*S. haenkei* y *S. Orbignae*) son consideradas arbustos bajos, mientras que *S. personata* y *S. stachydifolia* corresponden a especies herbáceas. Estas características son tomadas en cuenta como rasgos taxonómicos importantes (e.g. la escultura de la exina), de esta manera, esta investigación incrementa el conocimiento acerca de este grupo de plantas.

Palabras Clave

Salvia, Lamiaceae, Sucre, Palynology

Abstract

Pollen grains of four species of *Salvia* genus were collected and described in relation with their morphology. Two groups were distinguished according to size and shape differences, principally in the width of the colpo and thickness of the exine. The bigger pollen species (*S. haenkei* and *S. Orbignae*) are considered as undershrubs meanwhile *S. personata* and *S. stachydifolia* corresponds to herbaceous species. These characteristics are considered as important taxonomic traits (e.g. the sculpture of the exine), in this way, this research increase the knowledge about this important group of plants.

Keywords

Salvia, Lamiaceae, Sucre, Palynology

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Introduction

Displacement and decline of biodiversity are related with factors such as anthropogenic changes (e.g. landscape modification, urbanizations), these changes can affect directly populations of plants and also the organisms depending on them (Walker et al. 2017; Uchida et al. 2018). This can be the case of some species of *Salvia* genus, where little research is done in this group, but it becomes important since certain specific assemblages of pollinators such as native bees and hummingbirds are the main visitors of these species (Gürcan et al. 2016). *Salvia* is a genus with about 1000 species, where Central and South America it represents around 500 spp, while western Asia and eastern Asia show 200 and 100 species approximately (Walker & Sytsma 2007; Kahraman et al. 2009; Gürcan 2016). This genus has different centers of diversity one of which lies in the Andes of South America, in Bolivia 28 *Salvia* species are recognized, most of them considered exclusive and native to the Andes (Wood 2007).

Species of this family showed large variation in floral morphology which include traits like the presence of a lever mechanism for pollination resulting from a modification of the stamens (Clabon et al. 2004; Wester & Clabon 2005), at the same time, it presents a great diversity of growth forms and biology of pollination (Kahraman et al. 2009) as is the case of the four species of *Salvia* studied in this research.

Salvia haenkei (Benth) is a undershrub present in dry valleys, distributed in both sides of the cordillera of Andes, their inflorescence is usually long, sticky, showing terminal racemes with verticillasters with 2- 6 flowered, red corolla, anthers exerted, style strongly exerted and glabrous (Figure 1a) (Wood 2007).

Salvia orbignae (Benth) is also an undershrub endemic to Bolivia, inflorescence of very lax terminal racemes, verticillasters mostly with 2-4 flowered, pinkish/purple corolla, stamens included, style weakly exerted and pilose (Figure 1b) (Wood 2007).

Methodology

The study was conducted in periurban zones of Sucre city, where populations of the four *Salvia* species were located in ruderal habitats: in the South of the city, "La Calancha" zone is situated at (19°04'34.02''S- 65°16'13.03''O) for *S. orbignae*; in the North "Lajas Tambo" zone (19°0'23.40''S- 65°18'20.22''O) for *S. stachydifolia*. And *S. personata* and the last zone corresponds to a population of *S. Haenkei* in the "Circunvalación" (19°2'6.16''S- 65°16'11.52 O) zone. The altitude for all populations is between 2689 and 2936 m.a.s.l.

Sampling was carried out between April to May of 2017 where 5 individuals of each *Salvia* species were selected randomly and floral buttons enclosed in tulle bags until they bloom, after this point, flowers of each individual were collected in paper envelopes, to be later dried in laboratory. Pollen of each sample was acetolyzed according to Erdtman (1986). For pollen description grains slides were prepared, the observation was made using a Olympus SZ61 binocular light microscope with Olympus MD90 camera. The polar length, equatorial length, colpus length, colpus width, exine and intine thickness for 30 pollen grain per species was measured under light microscope with X100 and x40 for polar observation, their exine ornamentation was described with the same procedure. At the same time polar axis/ equatorial axis (P/E) ratios were calculated. Pollen terminology of Colinvaux et al. 1990 and Ybert et al. 2012 was used for descriptions.

Results and discussions

Measurements of pollen grains are detailed in Table 1 and showed that two principal groups are present according to the size and shape of pollen: the largest species were *S. haenkei* and *S. orbignae*, who showed subprolate pollen grains with long colpus; on the other hand *S. personata* and *S. stachydifolia* showed very small subspheroidal pollen grains with short colpus. All the species were hexazonocolpate with differences in the colpus width, being more narrow on those species with small pollen grains. Generally, the shape of exine is different on each species, but at the same time, the intine thickness remains similar along species. The sculpture of exines of these species is reticulate with one exception in the case of *S. orbignae*, showing a bireticulate structure (Figure 1a-d). Pollen grains from the undershrub species tend to be larger than herb species, this pattern is similar in other genus of the Lamiaceae family (e.g. *Elsholtzia*) (Jang et al. 2010). These features present in pollen grains (e.g. type of aperture) in Lamiaceae, are considered as taxonomic traits for the subfamily (Cantino et al., 1992), where at the same time other specific characteristics such as exine sculpture pattern, are important to determine phylogenetic relationships (Özler et al. 2011).

Conclusion

Differences in morphological measurements, specially size, shape and apertures, in the pollen grains of this four species of *Salvia* can become useful for the distinction of species improving the knowledge about taxonomic criteria used in this group.

Acknowledgements

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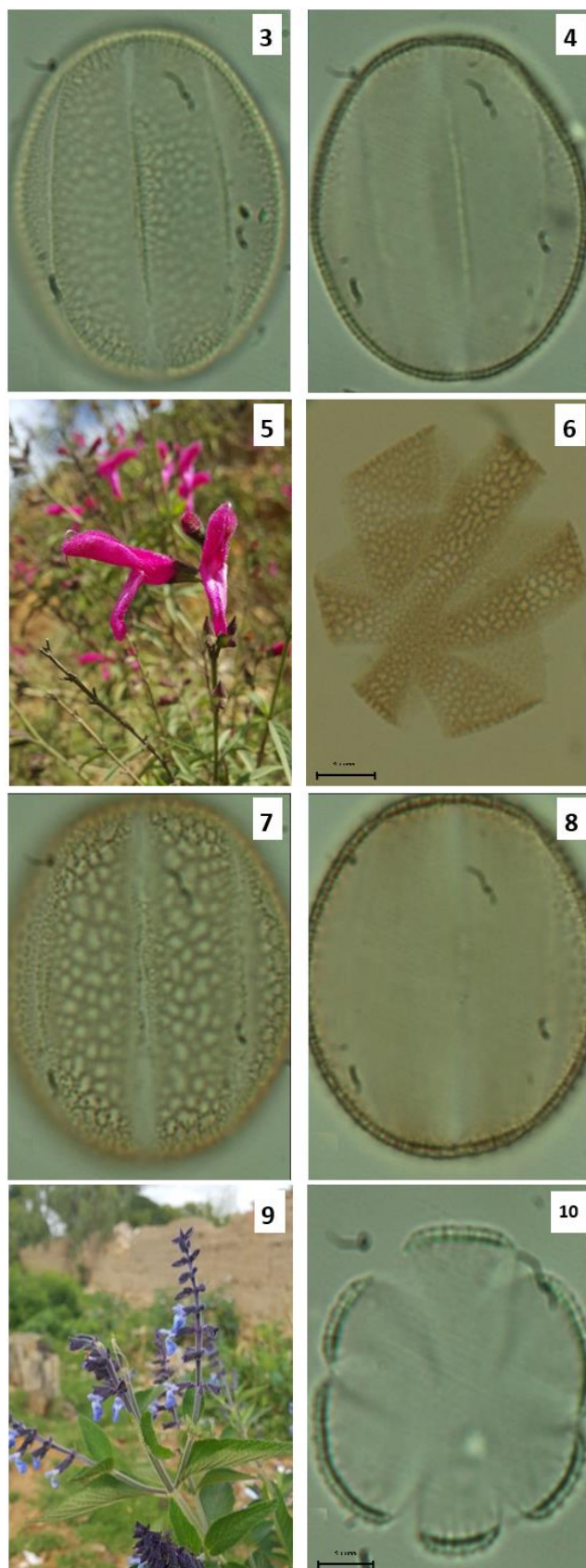
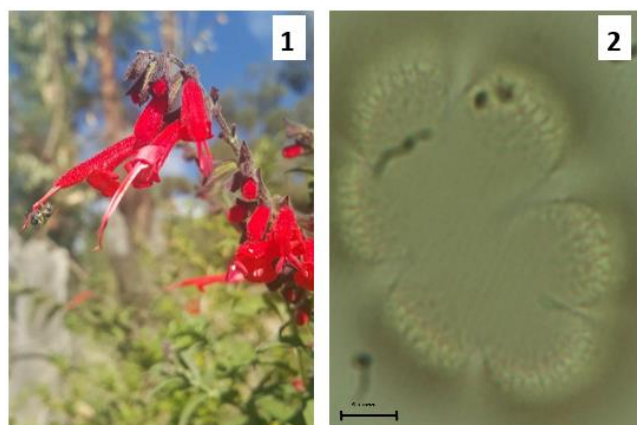
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Figure 1. 1-16. photographs of pollen grains of four species of *Salvia*: (1-4) *S. haenkei*, (5-8) *S. orbignae*, (9-12) *S. personata* and *S. stachydifolia*. (1,5,9,19: flowering plant; 2, 6, 10, 14: polar perspective; 3,7,11,15: colpus width and equatorial view; 4,8,12,16: exine-intine thickness).

Anexos



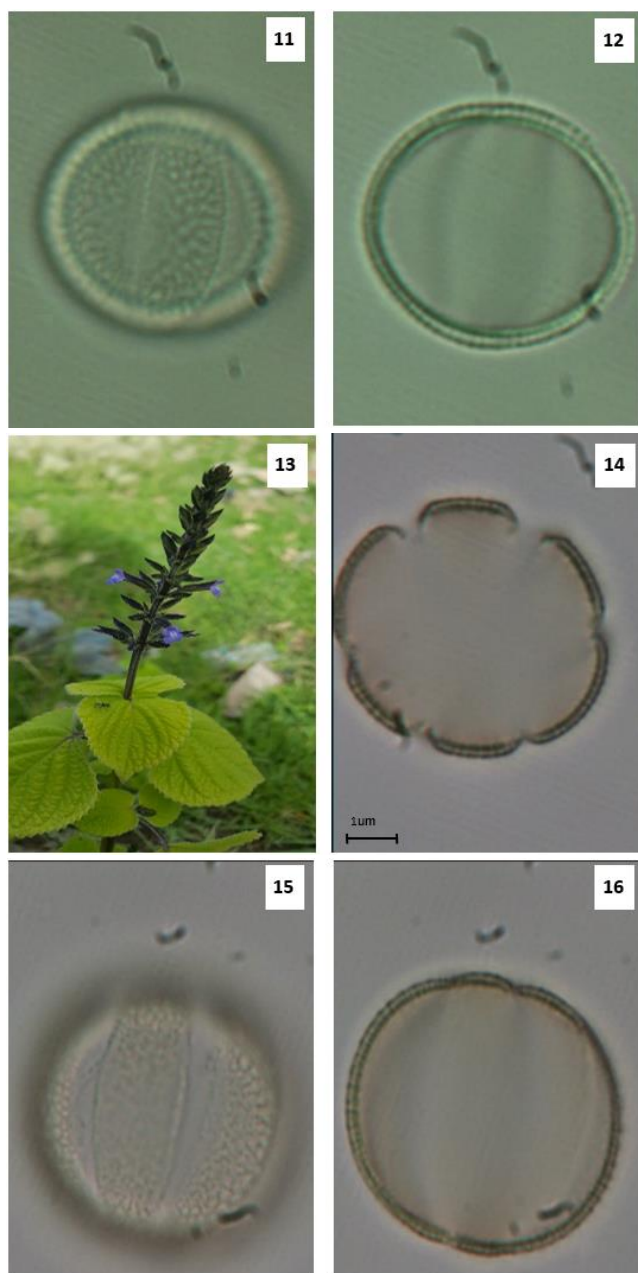


Table 1. Overview of palynological characters of four species of *Salvia* genus. Numbers refer to the average, maximum and minimum values for P (polar axis) size, E (equatorial diameter), P/E is a ratio of polar axis and equatorial diameter, CL is colpus length, CW is colpus width.

Species	E	P/E	CL	CW	Exine thickness	Intine thickness	Shape	Exina ornamentation	Size
<i>S. haenkei</i>	9.0 ± 1.1 (11.64-7.06)	1.2	8.67 ± 0.73 (11.16-7.76)	0.29 ± 0.06 (0.44-0.2)	0.21 ± 0.06 (0.36-0.15)	0.14 ± 0.02 (1.1-0.06)	Subprolate	Reticulate	Small
<i>S. orbignae</i>	10.52 ± 1.51 (13-7.41)	1.3	10.25 ± 1.41 (12.37-7.19)	0.2 ± 0.1 (0.56-0.18)	0.24 ± 0.06 (0.11 ± 0.03)	0.11 ± 0.03 (0.18-0.06)	Subprolate	Bireticulate	Small
<i>S. personata</i>	5.09 ± 1.19 (7.61-3.89)	1.04	4.20 ± 1.02 (6.54-2.95)	0.32 ± 0.20 (0.97-0.14)	0.19 ± 0.04 (0.29-0.14)	0.10 ± 0.03 (0.20-0.06)	Subspheroidal- Protatespheroidal	Reticulate	Very small
<i>S. stachydifolia</i>	5.52 ± 0.22 (5.98-5.24)	0.96	4.56 ± 0.38 (5.46-4.01)	0.48 ± 0.10 (0.63-0.31)	0.18 ± 0.04 (0.27-0.12)	0.10 ± 0.02 (0.14-0.06)	Subspheroidal- Oblate spheroidal	Reticulate	Very small