



ISSN 2395-650X

International Journal of
Life Sciences Biotechnology Pharma Sciences

IJLBPS



www.ijlbps.org

E-mail: editorijlbps@gmail.com editor@ijlbps.org

Microsculpture of Nutlets Surface of some Libyan *Salvia* L. species (Lamiaceae)

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Abstract

A comprehensive morphological and micro-morphological study of the nutlets of five Libyan *Salvia* species (Lamiaceae) was conducted to evaluate nutlets characteristics by using scanning electron microscopy (SEM). Differences in surface ornamentation, size, shape and color were observed between the species. The studied species were categorized in three basic types based on surface ornamentation: irregular prominences, regular prominences and smooth nutlets. The shape of nutlets were described as oblong, ovoid-oblong to globose-subglobose and their size range is 2–3.5 mm in length and 1.5–2.5 mm in width. Nutlet micromorphological characteristics such as surface ornamentation can be useful for classification and identification of *Salvia* species in Libya.

Keywords: *Salvia*, Microsculpture, Nutlets, Lamiaceae, Libya

Introduction

Cvetkovikj et al. (2015) note that *Salvia* L. (Lamiaceae) is one of the biggest genera within the Lamiaceae family. *Salvia*, or sage, is a plant whose name derives from the Latin word *salvare*, meaning "to save" (TOPU et al., 2013). There are around a thousand different species of *Salvia* (Saravia et al., 2018), and they can be found almost everywhere on Earth. In Libya, you can find 10 different species, three of which are farmed (Jafri, 1985). Some species of *Salvia* have been cultivated all over the world for use in traditional medicine, and many others are used as spices and flavoring agents in the perfumery and cosmetics industries (Felice Senatore et al., 2004 and 2006). For the Egyptian Lamiaceae taxa, nutlet ornamentation, shape, size, and color

proved to be very useful (Kamel, 2014). Gross nutlet shape and their sculpturing pattern are demonstrated to be changeable and taxonomically helpful in *Salvia* L., but only within species level (Oran 1996). Micromorphological studies of Lamiaceae nutlets (Moon et al., 2009; Khosroshahi & Salmaki, 2018) revealed that nutlet traits, such as form and surface sculpturing, might be relevant at several taxonomic levels. While sculpturing type has been deemed the most taxonomically significant among nutlet traits (Kahraman et al., 2011), nutlet color, size, and shape have been deemed insignificant due to a lack of variation or excessive variation (Oran, 1996).

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According to Ozkan et al., there are three distinct categories of nutlets distinguished by their level of decoration and overall form. While Ozkan noted the foveate and reticulate ornamentation of *S. aethiopsis* and *S. virgata* nutlets, Mousavi, S. et al. (2013) favored the more descriptive names of surface with hexagonal prominences and undulated stripping. The mericarp shape of Lamiaceae species has recently been studied, and the results have provided insights at several taxonomic levels. Researchers have stressed the significance of mericarp shape in the contemporary taxonomy of Lamiaceae (Kaya & Dirmenci 2012, Dinç et al. 2009, and Kaya et al. 2014). Pollen size, form, and exine ornamentation, as well as nutlet micromorphology, were shown to be significant in differentiating taxa in the genus *Salvia* by Kahraman & Dogan (2010).

Substances and Techniques

Five distinct species of *Salvia* were represented by specimens gathered from various locations throughout Libya between January 2019 and October 2020. Flora of Libya (JAFRI et al 1985) and Flora of Europaea (Tutin et al 1992) were used for species identification. First, a stereomicroscope was used to inspect nutlets (Mericarps) for signs of abnormal size or maturity. Five specimens of each taxon were collected, and their nutlets were measured for length and breadth. Dried, fully developed nutlets from five individuals of each species were studied using a Scanning Electron Microscope (Joel, JFC 1100). Using double-sided glue, the nutlets were attached to the stubs of aluminum,

which had been sputter coated with a thin coating of gold.

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Species	Shape	Colour	Length (mm)	Width (mm)	Ornamentation
<i>S. fruticosa</i>	Globose-subglobose	Dark brown to black	3 - 3.5	2.5	Regular reticulate, hexagonal, with narrow depressed anticlinal wall and wide raised periclinal wall
<i>S. lanigira</i>	Ovoid, oblong	Dark brown to black	2.25-2.5	1.25-1.5	Irregular prominence with fine and rough folds
<i>S. spinosa</i>	Ovoid	Pale green with netted lines	3	2	No microphological features observed (smooth)
<i>S. verbenaca</i>	Ovoid	Dark brown	2	1.5	Irregular prominence with deep and shallow channels
<i>S. viridis</i>	Oblong	Brown	3-3.5	2	Regular prominences in chain form with tangled strands on the surface

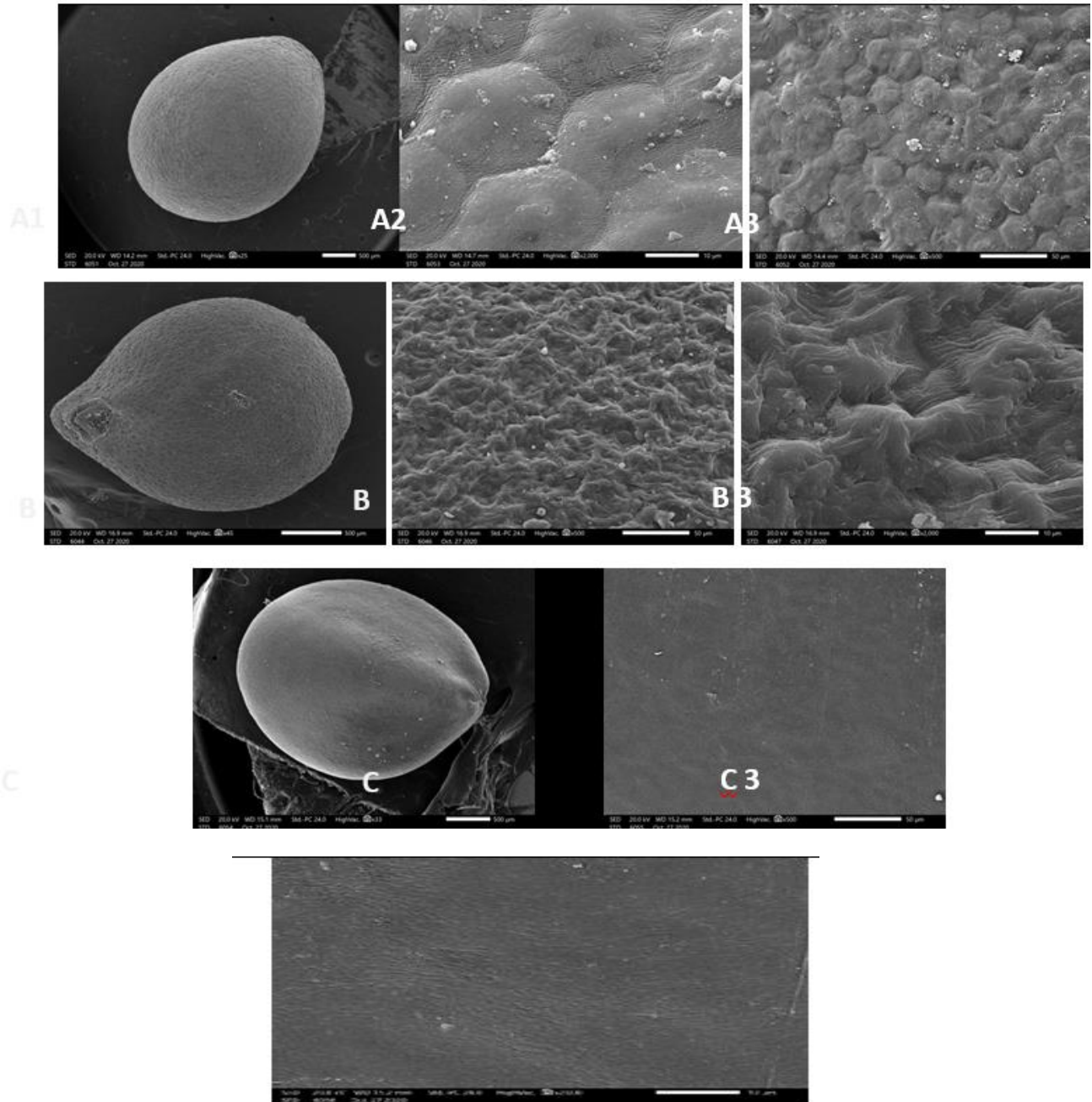


Fig.(1): Scanning electron micrographs of Nutlets in Salvia species consist of 1-shape (x25) ; 2 surface ornamentation (x500): a- *S. fruticosa*; b- *S. lanigera* ; c- *S. spinosa*
Ozkan et al. (2009) reported that the nutlets were placed in three groups based on the shape and ornamentation (spherical, trigonous and prolate spheroidal) and (foveate, reticulate and verrucate) respectively. Between 12 studied Salvia nutlets in their study, *S. ceratophylla*, *S. aethiopsis* and *S. virgata* were common with the present

research.

Ozkan elaborated In the past, researchers have used the terms foveate and reticulate to describe the ornamentation of the nutlets of *S. aethiopsis* and *S. virgata*, respectively. In the current study, however, the terms surface with hexagonal prominences and undulated stripped were used instead. Size, form, and ornamentation of *S. ballsiana*, *S. macrochlamys*, and other species were also highlighted by Kahraman et al.

characteristics. Nutlet morphology provides valuable data for delimitation of closely related spe

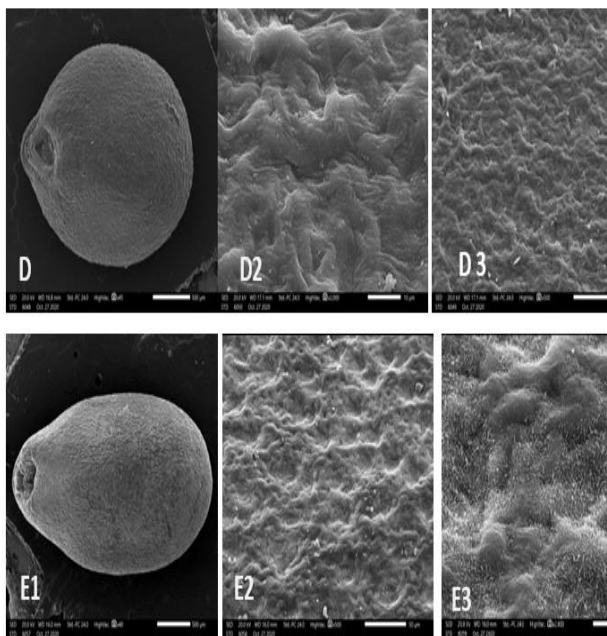


Fig. (1): Scanning electron micrographs of Nutlets in *Salvia* species consist of 1-shape surface ornamentation (x500): D- *S. verbenaca*; E- *S. verbenaca*

Conclusion

1. our S. (2011). Mericarp morphology

Taxonomic features such as nutlet form, color, and ornamentation are used to distinguish between *Salvia* species.

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