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

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Abstract:

This paper aims to examine morphological and micro-morphological characteristics of nutlets of five Libyan Salviaspecies (Lamiaceae) and evaluate nutlets characteristics byusing 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, SEM Libya

Introduction

Salvia has always been considered as a magical plant that saves human lives. The genus Salvia L.(Lamiaceae) is one of the largest genera in this family(Cvetkovikjet al. 2015).The plant name Salvia (sage) comes from the Latin word salvare, which means healer(Topçuet al. 2013). The genus Salvia L. belongs to the Mentheae tribe within the Nepetoideae subfamily (Kharazian 2014) includes around 1000 species that have almost cosmopolitan distribution(Saravia et al. 2018);In Libya, it is represented by 10 species; out of which 3 are cultivated(Jafri, 1985).Numerous species of the Salvia genus are economically important since they are used as spices and flavouring agents in the field of perfumery and cosmetics(FeliceSenatore et al.,2004 and 2006);and some species of Salvia have been cultivated worldwide for use in folk medicines (Tohamy et al. 2012).Nutlet ornamentation, shape, sizeand colour particularly proved to be good taxonomic characters for the Egyptian Lamiaceae taxa(Kamel, 2014).

Salvia L. has been shown that gross morphology of nutlets and their sculpturing pattern are variable and taxonomically useful at a species level (Oran 1996).Studies on nutlet micromorphology within Lamiaceae showed that nutlets features e.g., shape and surface sculpturing, were potentially useful at different taxonomic levels (Moon et al., 2009;Khosroshahi&Salmaki, 2018). Among different nutlet characters, type of sculpturing has been considered to be taxonomically most important(Kahraman et al., 2011), however, color, size and shape of nutlets were considered unimportant, either because they did not vary or the variation was random or too great (Oran, 1996). (Ozkan et al.,2009) reported the nutlets are placed in three groups based on the shape and ornamentation.Ozkan explained S. aethiopis and S. virgatanutlets ornamentation are foveate and reticulate, While (Mousavi, et al 2013)preferred to name, surface with hexagonal prominences and undulated stripped respectively.

Recent studies of the nutlets morphology of Lamiaceae taxa have contributed useful information at different taxonomic levels. The importance of mericarp morphology in the modern taxonomy of Lamiaceae has been emphasized by many researchers (Kaya &Dirmenci 2012, Dinç et al. 2009 and Kaya et al. 2014).

(Kahraman&Dogan2010) reported that the pollen size, shape and exine ornamentation, and nutlet micromorphology in the genus Salvia were important in distinguishing between the species.

Methodology

Specimens from five Salvia species were collected from several localities in Libya, collected from different localities of Libya between January 2019 and October 2020 . Identification of species was performed using Flora of Libya (JAFRI et a 1985),Flora Of Europaea(Tutin et al 1992). Nutlets (Mericarps) were first observed with a stereomicroscope to ensure that they were of normal size and maturity. For nutlets length and width, five samples of each taxon were taken and measured. For Scanning Electron Microscope (SEM) observation, dried mature nutlets of five individuals for each species were examined using a SEM microscope model (Joel, JFC 1100). Nutlets were directly mounted on aluminum stubs using double-sided adhesive and were sputter coated with a thin layer of gold. Coated nutlets were examined and SEM micrographs were captured at 200× and 500×. The terms used for describing the cypsela surface patternshave been adopted according to Stearn (1992). All photographs were taken at Central Laboratory of Alexandria University, Alexandria, Egypt. (Figure 1).

Results

In this study, macromorphological and micromrphological characters of Nutlets were observed via SEM. Nutlets shape, size and other features of Nutlets were given in Table (1). In addition, illustrating SEM

photomicrographs are presented in Figure. (1). The shape was variable among the studied species; it is globose-subglobose (S. fruticosa), ovoid (S. lanigira and S. verbenaca) and oblong (S. viridis). The colour of nutlet was Pale green with netted lines (S. spinosa), brown dark brown (S. verbenaca and S. viridis) and black (S. fruticosa). The mean length of nutlets of the studied species ranged from 2mm to 3.5 mm. The smallest nutlet recorded in S. verbenaca where as nutlet of S. fruticosa and S. viridis where the longest ones. The observations in the studied species, surface patterns were divided in three types: **Type I:** Regular: regular hexagonal prominences as in S. fruticosa and regular prominence in chain form as in S. viridis. **Type II:** Irregular prominence with fine and rough folds as in S. lanigiraand Irregular prominence with deep and shallow channels as in S. verbenaca. **Type III:** No microphological features observed (smooth) as in S. spinosa.

Table 1. Macro- andmicromorphologicalfeatures ofthe studied species

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

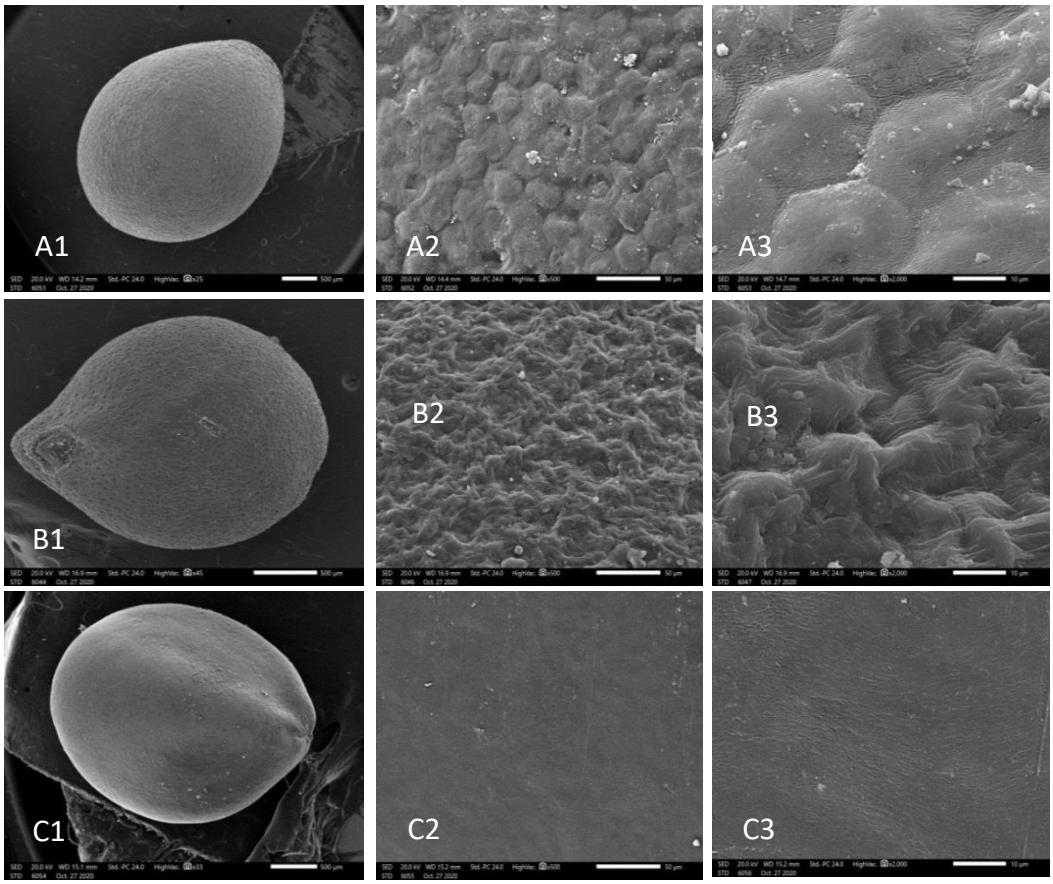
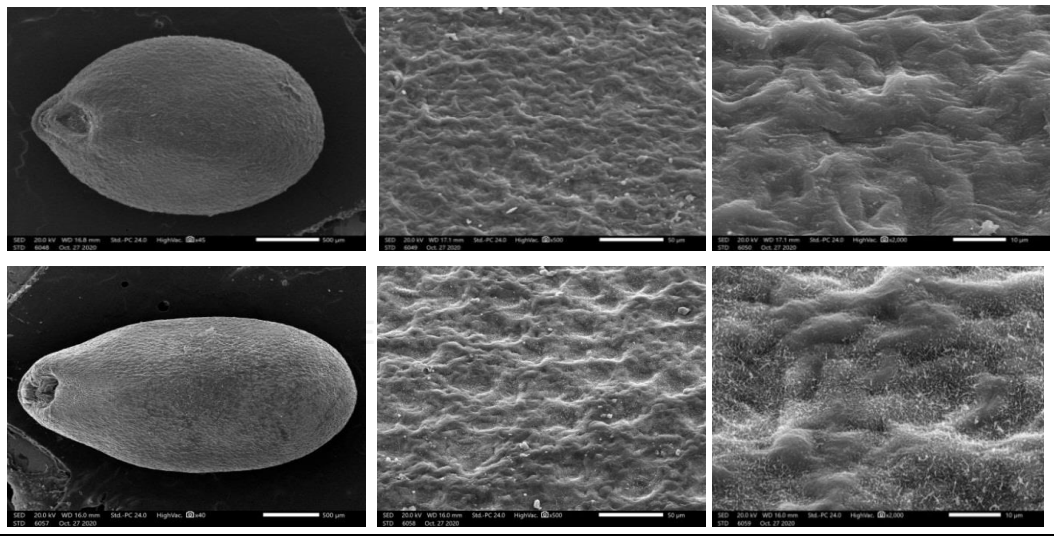


Fig.(1): Scanning electron micrographs of Nutlets in Salvia species consist of 1-shape (x25) ; 2-surface ornamentation (x500): a- S. fruticosa; b- S. lanigera ; c- S. spinosa.D- S. verbenaca; E- S. viridis.



Discussion

In this study, the aim was to determine the micromorphological differences in the nutlets of Salvia species growing naturally in Libya.The size, shape and structure of anticlinal walls varied significantly in the investigated species (Tabs. 1). Salvia nutlet were pale green with netted lines (S. spinosa), brown dark brown (S. verbenaca and S. viridis) and black (S. fruticosa). The mean length of nutlets of the studied species ranged from 2 mm to 3.5 mm. The smallest nutlet recorded in S. verbenaca where as nutlet of S. fruticosa and S. viridis where the longest ones. had also oblong mericarps.(HEDGE ,1982) reported that some species of Salvia had brown or black mericarps and rounded, trigonous or rounded-trigonous.

(Ozkan et al.2009) reported that the nuletswere 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. aethiopis and S. virgata were common with the present research. Ozkan explained S. aethiopis and S. virgata nutlets ornamentation are foveate and reticulate while in present research, it was preferred to name, surface with hexagonal prominences and undulated stripped respectively. Also,(Kahraman et al.2009) pointed the size, shape and ornamentation of S. ballsiana, S. macrochlamys and S. hedgeana are diagnostic. Our findings agree with those of previous studies in Lamiaceae confirming the usefulness of Nutlet characteristics. Nutlet morphology provides valuable data for delimitation of closely related species. Some researchers have found that the nutlet micromorphology is an important taxonomic character in flowering plants, as well as in Lamiaceae(Ryding, 1994; Jamzad, 2000; Salmaki, 2008). According to this study, the size, characteristics, and surface ornamentation of the pollen and the nutlets play an important role in the distinction of species.

Conclusion

Nutlet micromorphology provides diagnostic features foralmost all representatives of Salviaincluded in this study. One of the most valuable features, useful in distinguishing examined species, However, in our opinion, a thorough reanalysis of macromorphological features is necessary to establish such a classification.The shape, color and ornamentation of Salvia nutlets varied among the species and those are taxonomical characters help to identify species.

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