# Microsculpture of cypsela surface of *Bellis* L. (Asteraceae) in Libya

**Ghalia T. El Rabiai and Seham H. Elbadry**

**Department of Botany, Faculty of Science, Benghazi University, Libya**

**Abstract**: In this study, the cypsela surfaces of three taxa belonging to the genus Bellis L. were investigated in details by means of electron microscopy. The main aim of this study was to characterize the microsculpture of cypsela surface of the Libyan taxa of Bellis. (Asteraceae). Detailed descriptions of cypsela surface were given for each taxon. The results indicated that the examined taxa had very high variations regarding their cypselae surfaces and these variations have great importance in determining the taxonomic relationships of the discussed taxa. Based on the results, pericarp texture and color could be used for taxonomical diagnosis. The fruit coat was usually roguish and its ornamentation was fairly variable; therefore, this taxonomical microcharacter might also be useful in distinguishing closely related taxa. The hairiness of the surface of the pericarp was characteristic in the studied taxa.

**Key words:** ***Bellis*, Asteraceae, fruit surface, micromorphology, Libya**

## Introduction

The Asteraceae is a large family belonging to Asterales (Sennikov *et al.*, 2016) and is about 10% of all angiosperms, comprises 1700 genera and about 27000 accepted species (Moreira *et al.* 2019). The Asteraceae members are economically essential as medicinal, ornamentals, weeds and green vegetables. Cypselae characters

have been commonly used in the classification of Asteraceae having taxonomic interpretation and significance in general, with special emphasis for tribe Cichoreae (Roque & Funk, 2013). Faruk (2020) has morphologically investigated the shapes of achenes of *Bellis* taxa and found that one-seeded, compressed, obovate or obovoid shaped and without pappus. The cypsellae were dark brown to yellow in color. The achene coat ornamentations were rectangular and short hairy on surface. Therefore, no significant differences in seed morphology were observed among the taxa. Cypselae were dry, indehiscent, unilocular, with a single seed that is usually not adnate to the pericarp (linked only by the funicle) and originating from an inferior ovary (Marzinek et al., 2008).

Cypselae size of *Bellis anuua* L. ranged between 1-1.25 mm long and 0.5 mm wide while *B. sylvestris* Cyr. size was ranged between 1.6-2.25 mm long and 1-1.2 mm wide, pubescent, light brown to yellow in colour and without pappus (Faruk, 2020). Cypsela microsculpture analysis had been considered more taxonomic tool, being also important for higher and medium level classification within the family (Bremer, 1994; Anderberg, 1991).

Cypsela and pappus were the two morphological features which were aiding in taxonomic classifications at tribal levels of Asteraceae (Talukdar, 2008; Frangiote-Pallone and Antonio de Souza 2014; Talukdar and Mukherjee, 2014). For the taxonomic delimitation at tribe level, morphological diversity of cypsela has

been used to distinguish the tribe Heliantheae and Eupatorieae from rest of the tribes in family of Asteraceae (Bremer 1994).

Cypselae microsculpture analysis had been considered more taxonomic tool, being also important for higher and medium level of classification within the family of Asteraceae (Anderberg, 1991; Bremer, 1994). Different morphological features (size, beak, pappus branching and surface structure) were the main investigating characters of Asteraceae taxa (Karaismailoglu, 2015). Therefore, these micromorphological features of cypselae in Asteraceae could be important diagnostic features for solving different taxonomic relationships within the family (Ghimire, Suh, Lee, Heo & Jeong, 2018). Brief cypselae external features have usually been included by different floristic workers during their preparation of floristic accounts. Basak and Mukherjee (2003) concluded that diacritical features of cypselas played a paramount role in isolation of taxa at the species level. According to (Ghimire *et al.*,2020), Cypsela features can show variation between subspecies and varieties of species and the specimens of *Cisium* taxa. Faruk, 2020, found that no significant differences in cypselae morphology.

As a rule, the morphological characteristics are well Known but the knowledge of their micromorphology is still limited.

The purpose of this study is:

**(i)** To describe and compare cypselae morphological characteristics of *Bellis* taxa in Libya.

**(ii)**To evaluate the possible use of cypselae in taxonomy.

**(iii)** To decide the level to which these micromorphological data can be efficiently used as a taxonomic character.

In this study it is characterized that the microsculpture of the cypselae surface of the Libyan species of genus *Bellis* L. which represented by around three taxa, *Bellis anuua* L., *B. sylvestris* var. *cyrenaica* Béguinot and *B. sylvestris* var. *sylvestris* Cyr..

## Materials and Methods

The present work is based on the cypselae of three taxa of *Bellis* collected from different localities of Libya between January 2017 and December 2019. Only mature cypselae were taken for investigation. The dry cypselae were cleaned, and examined by light microscope to examin the different exomorphic parameters, shape, dimensions, color and surface texture. Three to five cypselae for each taxon were taken to cover the range of variations. For Scanning Electron Microscope (SEM) investigation, the cypselae were fixed to specimen stubs with an adhesive and placed on the revolving discs of Joel fine coat ion sputter (Joel, JFC 1100). Each cypsela was uniformly coated with 20-30 nm thick gold. These specimen's stubs were then fixed to the specimen holder of SEM (Joel JSM 350) maintained at accelerating potential voltage of 15 Kv. and photomicrographs were taken at different magnifications (cypsela in whole mount with X= 100-150 and cypsela scan with X=2000-5000). The terms used for describing the cypsela surface patterns have been adopted according to Stearn (1992) and Koul *et al*. (2000). All photographs were taken at Central Laboratory of Alexandria University, Alexandria, Egypt 2018.

## Results

The three studied taxa showed significant differences in the cypselae characteristics. All cypselae were simple without pappus, indehiscent slightly compressed on both sides and narrow to wide ellipsoid in shape. All taxa were light/dark brown in color. The cypsela length ranged from 1-2 mm whereas cypsela width varied from 0.5-1 mm. All cypselae were with hairy surface. SEM study showed differences among the cypselae of all the studied taxa. Major differences were noticed in the density of bristles and surface ornamentation. Three different surface patterns were recognized in the studied taxa.

Type I: Undulate striate cypselae: Cypselae undulate striate with less density of twisted bristles on cypsela surface. Anticlinal wall raised, smooth and narrow whereas the periclinal wall was depressed striate. *Bellis annua* L. have this type of patterns (Fig. 1 A-D).

Type II: Papillose folded cypselae: Cypselae a folded surface, irregular papillae with less density curved bristles on cypselae. Anticlinal wall raised, folded and wide whereas the periclinal wall was deep and folded. *Bellis sylvestris* var*. cyrenaica* have this type of patterns (Fig.2 A-D).

Type III: Irregular reticulate cypselae: Cells elongated, with four to five sides, with more density erect bristles on cypsela surface. Anticlinal wall raised, folded and narrow whereas the periclinal

wall was depressed folded. *Bellis sylvestris* var. *sylvestris* Cirillo have this type of patterns (Fig.3 A-D).

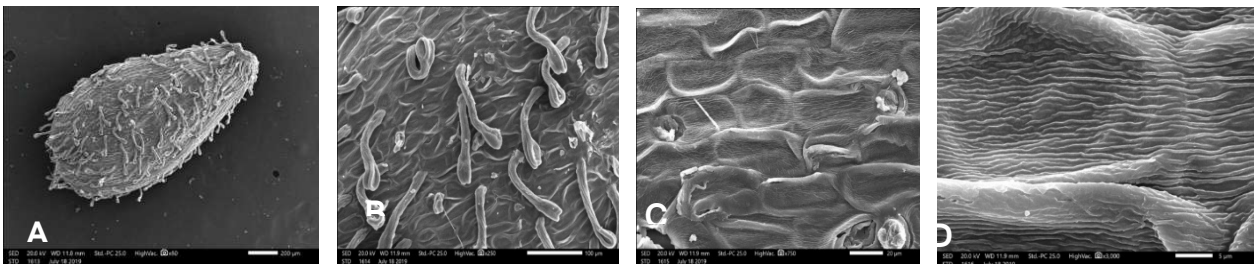


Fig. 1. Scanning electron micrographs: ***B. annua***. A. Cypsela, B. bristles, C-D. Surface ornamentation.

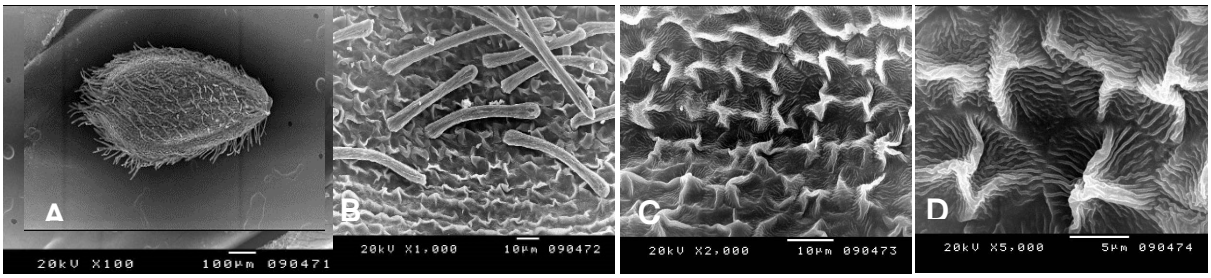


Fig. 2. Scanning electron micrographs: ***B. sylvestris* var. *cyrenaica* A.** Cypsela, B. bristles, C-D. Surface ornamentation.

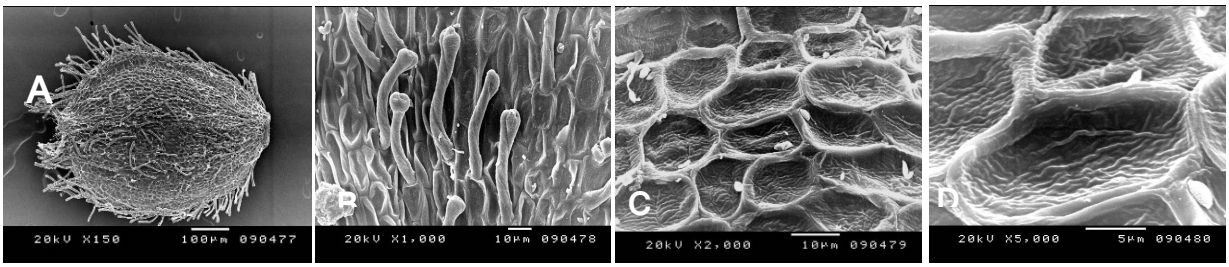


Fig. 3. Scanning electron micrographs: ***B. sylvestris* var. *sylvestris* A.** Cypsela, B. bristles, C-D. Surface ornamentation.

## 4. Discussion

The taxonomic status of many genera and species of Asteraceae has been clarified in the light of their cypselae morphological features especially when they are studied under SEM (Abid &Ali, 2010).

Achene micro-morphological characters have been found useful in systematics of the family Asteraceae (Abid and Qaiser, 2009; Garg and Sharma, 2007; Akcin and Akcin, 2010, 2014).

This is the first detailed study on cypselae macro-micromorphology of the genus *Bellis* L. in Libya.

Our observations of cypselae under SEM had been found very useful in identifying the examined taxa at species and variety levels. Although Our findings appear inconsistent with that of Faruk, (2020) in the ornamentation and surface patterns of cypselae but they appear consistent with that of (Ghimire et al.(2020) of Cypsela of *Cisium* which showed variation between subspecies and varieties of species and the specimens of *Cisium* taxa.

## Conclusion

Cypselae micromorphology studies under SEM provide valuable explanatory characters that help in the identification and delimitation of genus *Bellis* and showed important variation at species and variety level.

## References

Abid, R. and M. Qaiser. (2007). Micromorphology of cypsela in the tribe Plucheeae from Pakistan. Pak. J. Bot., 39(3): 671-677.

Abid, R., Qaiser, M., (2009). Taxonomic significance of the cypsela morphology in the tribe Anthemideae (Asteraceae) from Pakistan and Kashmir. Pakistan Journal of Botany 41, 555-579.

Akcin, T. A., Akcin, A., (2010). Morphological and anatomical characteristics and taxonomical significance of achene micromorphology of endemic Achillea phrygia Boiss& Bal. and A. gypsicola Hub-Mor. (Asteraceae) in Turkey. Nordic Journal of Botany 28, 65-73.

Akcin, T. A., Akcin, A., (2014). Achene micromorphology of seven taxa of Achillea L. (Asteraceae) from Turkey. Bangladesh Journal of Plant Taxonomy 21, 19-25.

Anderberg AA (1991). Taxonomy and phylogeny of the tribe Gnaphalieae (Asteraceae). Opera Botanica 104: 43.

Basak N and Mukherjee SK (2003). Taxonomic significance of cypselar features in some species of Vernonia (VernonieaeAsteraceae). Journal of Hill Research 16(1) 9-15.

Bremer K (1994). Asteraceae: cladistics and classification. Nordic Journal of Botany 14: 462.

Faruk, K., (2020). Morphology, anatomy, palynology and achene micromorphology of *Bellis* L. (Asteraceae) species from Turkey. Acta Bot. Croat. 79(1),59-67.

Frangiote-Pallone, S., De Souza, L.A., (2014). Pappus and cypsela ontogeny in Asteraceae: Structural considerations of the tribal category. Revista Mexicana de Biodiversidad 85, 62-77.

Garg, S.K., Sharma, K. C., (2007). Taxonomical significance of the morphological and scanning electron microscopic surface patterns of cypselas in some members of the tribe Heliantheae (Asteraceae). Feddes Repertorium 118, 165-191.

Ghimirea B., Suha, G.Leea, Kweon Heob and MiJinJeong (2018). Cypsela morphology of Cirsium species (Asteraceae) and its taxonomic implications. Flora 249,40-52.

Karaismailoglu, M. C. (2015). Morphological and anatomical features of cypsela of some Crepis taxa (Asteraceae) from Turkey and their taxonomic importance. Pakistan Journal of Botany, 47(4), 1473-1480

Koul, K., Ranjna, N. and Raina, S.N. (2000). Seed coat microsculpturing in Brassica and allied genera subtribes Brassicinae, Raphaninae, Moricandiinae). Ann. Bot., 86: 85-97

Mabel, A. F., Johnson, A. A., Olufemi, O.-O., & Ayomipo, A.-A. T. (2014).

Foliar anatomy of some species of Asteraceae in South Western Nige-ria. African Journal of Plant Science, 8(9), 426-440.

Marzinek J, De-Paula OC, Oliveira DMT (2008). Cypsela or achene Refining terminology by considering anatomical and historical factors. Revista Brasileira de Botanica 31: 549-553.

Moreira, G. L., Cavalcanti, T. B., Mendonça, C. B. F., & Gonçalves-Esteves, V. (2019). Pollen morphology of Brazilian species of Ver-besina L. (Heliantheae-As teraceae). Acta Botanica Brasilica(AHEAD), 33,128-134.

Roque N, Funk V (2013). Morphological characters add support for some members of the basal grade of Asteraceae. *Botanical Journal of the Linnean Society* 171, 568-586.

Sennikov, A.N., Soltis, D.E., Mabberley, D.J., Byng, J.W., Fay, M.F., Christenhusz, M. J., Group, T. A. P. (2016). An update of the angiosperm phylogeny group classification for the orders and families of flowering plants: APG IV. Botanical Journal of the Linnean Society181(1), 1-20

Stearn W.T. 1992: Botanical Latin. 4th edition. David & Charles Publishers, London, pp. 489-491.

Talukdar T & Mukherjee SK (2008). Comparative study of cypselae in three common species of Asteraceae. Pleione 2(1): 147-149.

Talukdar, T. and Mukherjee, S.K. (2014). Cypselae diversity in four species of Senecio L. (Asteraceae). Bangladesh j. plant Taxon., 21, 13-17.