

Morphological and Anatomical Features among the Two Cypselae of the Family *Compositae*

Sourav Paul*

Department of life sciences, Central University of Tamil Nadu, Tamil Nadu, India

*Corresponding Author: Sourav Paul, Department of life sciences, Central University of Tamil Nadu, India, Tel: +918902783694; E-mail: souravpaul.136@gmail.com

Received date: July 18, 2017; Accepted date: October 18, 2017; Published date: November 10, 2017

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Citation: Paul S (2017) Morphological and Anatomical Features among the Two Cypselae of the Family Compositae. J Plant Sci Agric Res. Vol. 2 No. 1:007.

Abstract

The family *Asteraceae* is characterized by the presence of a special type of fruit known as cypselae. The present study deals with the detailed external and internal features of cypselae of the two species *Emilia sonchifolia* and *Calendula officinalis* of the tribes *Senecioneae* and *Calenduleae*, respectively. The cypselae were studied with the help of light microscope. Morphologically, special attention has been taken on the shape and size of cypselae, colour, pappus structure, stylopodia and its structure, surface, presence or absence of hairs etc. Anatomically, cellular nature of pericarpic region was studied. The present work has a great taxonomically significance, on the basis of both morpho-anatomical characters, which are helpful for the identification of taxa on the basis of cypselar features.

Keywords: *Asteraceae*; Pollen; Cypselae; Family *asteraceae*

Introduction

The family *compositae* (*Asteraceae*) is one of the predominant and morphological most advanced families of the dicotyledons, comprising of 43 tribes, 1600-1700 genera and some 24000 species. The members of the family *Asteraceae* are easily recognized by the presence of some characteristic features, namely pseudoanthial heads with a specialized mechanism of pollen presentation and pappus structure, nature of fruit and their range of chemical defenses. Due to the great variability of morphology and anatomy of tissue composition of vegetative and reproductive structures, they are pertinently fascinating to the taxonomist.

The fruits of *Asteraceae* are known as cypselae (from the Greek kypsele, a box, according to Spjut 1994), based on Mirbel, who used this name for a type of monospermic fruit that is capped by the calyx, in added words formed from an inferior ovary [1]. According to Spjut (1994), cypselae differ from achenes by the presence of an extra layer derived from the perianth formed over the pericarp as a result of the inferior position of the ovary. The first work that used both terms achene

and cypselae was Beck (1891), who considered achenes exclusively as a dry indehiscent fruit originating from the apocarpic gynoecium. Beck (1891) called the fruits of *Asteraceae* cypselae and defined them as dry indehiscent unilocular with a single seed not adnate to the pericarp (linked only by the funicle) and originating from an inferior ovary [2]. In other words these are fruits with persistent calyx (pappus) originating from an inferior ovary composed of 2 carpels and 1 loculus. As such the cypselae were included in the Angiocarpi series which includes fruits with extra-carpelar structures adhering to the pericarp.

Despite the long history of morphological and anatomical studies on fruits of *Asteraceae*, there is still a lack of detailed information on the cypselar features of many members of the family. Our study aims at addressing this gap by focussing on the morpho-anatomical features of the fruits of two species namely *Emilia sonchifolia* and *Calendula officinalis* belonging to tribe *Senecioneae* and *Calenduleae* respectively [3].

Materials and Methods

Some fully mature cypselas of each species were selected from the mass of each sample. These were boiled for few minutes with water by adding few drops of glycerol. Then all specimens were preserved in FAA solution for study. After that 3 cypselas were immersed within the 5% NaOH solution for few days depending upon the amount of mechanical tissue of cypselas. Different parts of cypselas were stained in 0.5% aqueous safranin solution and different parts of cypselas were studied with the help of light compound microscope. Cross-section from each cypselae was taken from the middle part.

Specimens

Emilia sonchifolia Benth KAL-1295

Calendula officinalis Hohen SP-105

Observations

Cypselar morphology

Emilia sonchifolia Benth: Cypselas homomorphic cream to brown coronet 2.5–3 mm × 0.5 mm subterete or angled straight or slightly curved oblong with truncate base and apex 5-ribbed pappose pubescent hairy glossy short white simple usually two celled club shaped and restricted at the furrow region cypselar base round and concave cypselas with pappus of 5 mm long biseriate caducous white simple barbellate shiny or glossy narrow filifora unbranched fine capillary bristles or hairs connate at the base each bristle with pointed outwardly and upwardly directed barbs (Figure1).

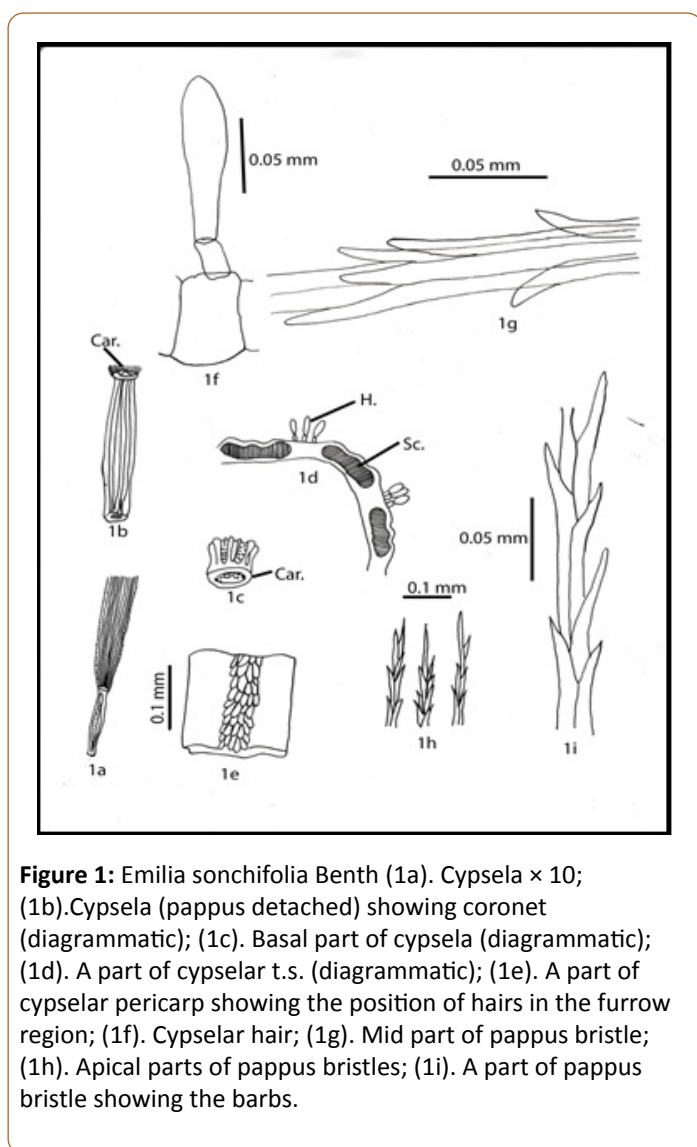


Figure 1: *Emilia sonchifolia* Benth (1a). Cypselas × 10; (1b).Cypselas (pappus detached) showing coronet (diagrammatic); (1c). Basal part of cypselas (diagrammatic); (1d). A part of cypselar t.s. (diagrammatic); (1e). A part of cypselar pericarp showing the position of hairs in the furrow region; (1f). Cypselar hair; (1g). Mid part of pappus bristle; (1h). Apical parts of pappus bristles; (1i). A part of pappus bristle showing the barbs.

Cypselar anatomy

Emilia sonchifolia Benth: Cypselas more or less spherical & 5-ribbed in transection; each flat ridge comprises of one central small and 2 lateral broader ridges. Cotyledons plano-convex.

Pericarp consists of outermost uniseriate cuticularised parenchymatous epidermis in the furrow region the cells are

bulliform and larger than those of ridges Epidermal hairs bi-celled, The apical cell club shaped the rest part of pericarp parenchymatous except the broad & lobed sclerenchymatous braces below the ridges. Vascular trace present only below the ridges. Endosperm biseriate and cellular (Figure 2).

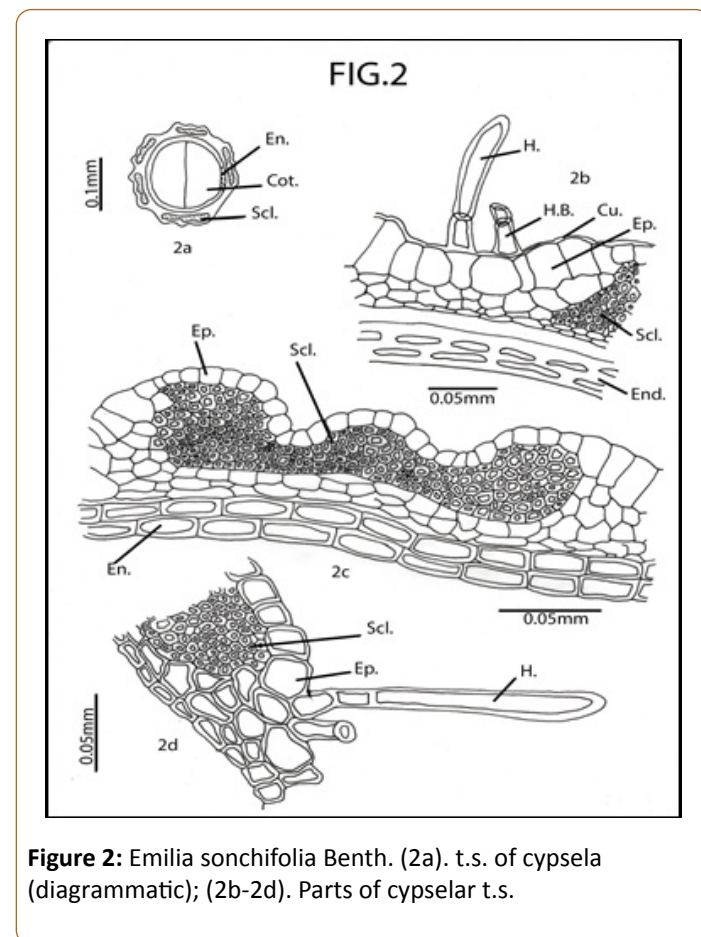


Figure 2: *Emilia sonchifolia* Benth. (2a). t.s. of cypselas (diagrammatic); (2b-2d). Parts of cypselar t.s.

Cypselar morphology

Calendula officinalis Hohen: Cypselas heteromorphic; straw or light brown colored; both ray and disc cypselas incurved and pubescent; hairs multicellular & of 3 forms of different sizes; three forms of cypselas present in each hand-(a) ray cypselas with wing, (b) disc cypselas without wings, (c) disc cypselas with short wings; winged cypselas 1.5 cm × 0.4 mm; wingless cypselas 0.5 cm-1 cm × 2-3 mm; cypselar warty (Figure 3).

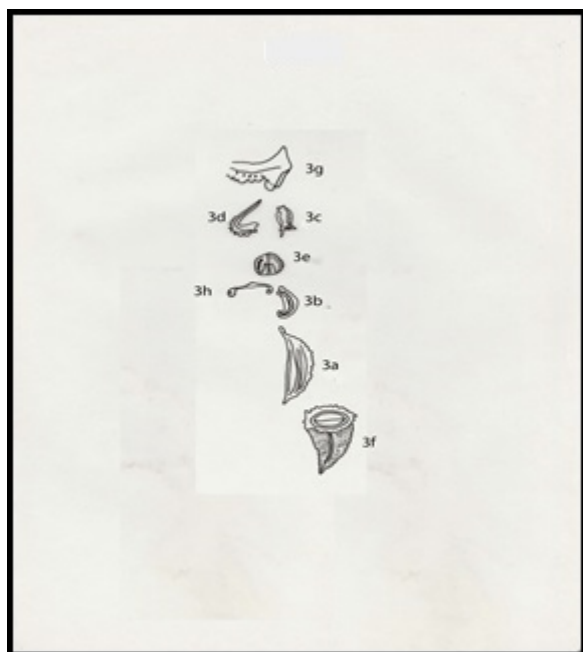


Figure 3: *Calendula officinalis* Hohen. (3a-3e). Cypselas $\times 1$; 3f- Lower part of cypselas showing t.s. (diagrammatic); (3g). Cypselar muricate surface (diagrammatic); (3h). Base of cypselas (diagrammatic); (3i). Cypselar t.s. (diagrammatic).

Cypselar anatomy

Calendula officinalis Hohen: Cypselas heteromorphic; winged and unwinged; irregularly label.

Pericarp multiplicative massive differentiated into (i) adherent epicarp which is uniseriate parenchymatous and cuticularised consisting of barrel shaped tangentially elongated cells epidermal hairs are multi-cellular short simple and in one row of cells or long with two (or more) rows of cells apical cells of hairs obovate elevate or pointed (ii) Mesocarp zone of irregularly shaped (of different size also) thin walled parenchymatous tissue (with intercellular spaces) composed of cells with pitted wall (pits are prominent); vascular traces observed in thin zone represented by a group of thick-walled trashsidal tissues below the ridges (iii) Endocarp with a massive (5- celled thick) layer of thick-celled sclerenchyma cells thick-walled penta or hexagonal with narrow lumen underlying this layer a narrow zone of parenchyma consisting of tangentially elongated barrel shaped cells present testa represented by layers of compressed parenchyma endosperm uniseriate. In winged cypselas fibro-vascular braces present in the terminal part of wing (**Figure 4**) [4].

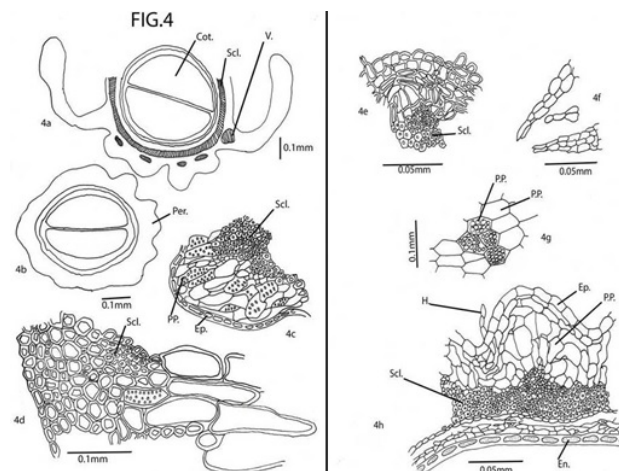


Figure 4: *Calendula officinalis* Hohen. (4a & 4b). Cypselas t.s. (diagrammatic); (4c & 4d). Parts of cypselar t.s. (diagrammatic) (4e & 4f). Parts of cypselar t.s.; (4g). Cypselar hairs; (4h). Pitted parenchyma of cypselar pericarp.

Results and Discussions

For a century Bentham's classification of this tribe remains unchanged basically. Bentham (1873) recognized four subtribes Senecioneae, Liabinae, Tussilaginae and Othonniae. Hoffmann (1892) recognized three subtribes and merged Tussilaginae and Senecioneae. Some genera of Helenieae have been included in Senecioneae (Powel and Turner, 1974).

According to researchers Senecioneae is characterized by many characters: vegetative, floral and achenial. "Achenes in this tribe are homomorphic or variously ribbed or sculptured, glabrous or glandular or pubescent; achene hairs duplex or sometimes simple, with or without mucilaginous properties. Achenial and or ovarian wall often with short or flexuous Ca-oxalate crystals".

"Pappus uni-to multiseriate or of straight or flexuous barbellate scabrid smooth or rarely subplumose soft or coarse bristles sometimes connate to a basal annulus or rarely to a single scale (Emilia), persistent or caducous white or coloured (straw coloured tawny purple etc. Recent data on the carpological studies in this tribe denote that "Achene hairs may also be considered in taxonomic studies. So called twin or duplex hairs typically formed by two large cells and one small basal cell are wide spread in this tribe" [5].

Some observations have indicated the taxonomic value of the calcium oxalate crystals in the ovary found sometimes in the achene wall. The distribution and shape of such crystals appear to be genetically controlled and hence taxonomically useful.

Present study on the cypselar morphology of this tribe includes only *Emilia sonchifolia*. In this plant, the cypselas are linear-oblong with slightly attenuate base and with distinct broad ribs (each rib consists of two large flat rib and one narrow rib between two large ribs). Cypselas possess simple barbed setose fine capillary bristles with pointed tips. In *Emilia*

sonchifolia the carpodium is either absent or represented by a narrow ring like structure Pappus is biseriata (*Emilia sonchifolia*). Pappus bristles are usually cream coloured to brown in both the species studied. From the present investigations of the species only it is evident that nothing conclusive remarks could be made on the tribe [6].

Some authors formerly placed the Calenduleae close to the tribe Arctotideae According to scientists probably these two tribes are not closely related Majority of the modern authors such as Cronquist (1955) Carlquist (1976) and have indicated that Calenduleae is closely related with Senecioneae On the basis of present cypselar studies its affinity is not clear but cypselar features are quite different from both Senecioneae and Arctotideaeas has been shown by other researchers [7].

Conclusions

Based on the above observations, it can be concluded that the members of the family compositae are with diverse macro as well as micromorphological features of cypselas. These characters are a mixture of both primitive and advanced features. However, their value as taxonomic criteria will be greatly increased in combination with other lines of evidence.

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