Comparative studies on floral micromorphology among four species of the tribe Gnaphalieae (Asteraceae)

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Abstract

A detailed comparative analysis of the floral micromorphological features was carried out in four selected species belonging to the tribe *Gnaphaleae* (family Asteraceae), with the aim of evaluating the diagnostic and taxonomic relevance of these characters. The study focused on a wide range of floral microstructures known to be of potential systematic value. Specifically, the shape and size of anther appendages and anther bases were examined, as these features often exhibit species-specific variation. The configuration and pattern of endothecial thickenings, which influence anther dehiscence mechanisms, as well as the morphology of anther collars, were also assessed.

In addition, attention was given to the micromorphology of the style branches, particularly the shape, size, and distribution of sweeping hairs, which play a vital role in secondary pollen presentation. The structure and extension of stigmatic areas on the inner surface of the stigma were analyzed, providing insight into species-specific reproductive adaptations. Furthermore, the size and shape of cypselas (the characteristic dry fruits of Asteraceae) were evaluated, as were the number, types, and spatial arrangements of pappus bristles, which are crucial for seed dispersal and often display taxonomically informative traits.

The comprehensive analysis of these floral micromorphological characters not only contributes to a better understanding of species-level differentiation within the tribe *Gnaphaleae*, but also reinforces their utility as reliable taxonomic markers in the family Asteraceae.

Key words: Taxonomy, Micromorphology, Gnaphaleae, Asteraceae.

Introduction

The tribe Gnaphalieae is a moderately large tribe; it was traditionally nested within the tribe Inuleae. The tribe was first recognized by Cassini (1821) as one of the three sections of the tribe Inuleae *sensu lato*. In the section Inuleae – Gnaphalieae the plant group was recognized as taxa with scarious bracts, truncate style branches and long tailed anthers. The first modern approach of Merxmüller et. al. (1977) considering cytological, phytochemistry and palynological characters along with classical morphological features produced a classification with three subtribes – Inulinae, Gnaphaliinae and Athrixiinae. Kaderreit and Jeffrey (2007) classify the tribe based on a mixture of morphological and molecular data.

Bremer (1987) and Anderberg (1989) used morphological cladistics and found polyphyletic nature of 'Old' Inuleae. Anderberg (1991) demarcated tribe Gnaphalieae out of Inuleae sensu lato. He divided the tribe into five monophyletic subtribes. The tribe comprises 185 genera and about 1,240 species.

Present study is concentrated on micromorphological studies of 4 species belonging to 2 genera: *Anaphalis contorta, A. triplinervis, Gnaphalium pencylvanicum, G. polycaulon.*

Materials:

4 species belonging to 2 genera of the tribe Gnaphaleae (family- Asteraceae) are analyzed. The studied specimens are arranged along with their source locality.

Sl. No.	Name of the Species	Locality
1	*Anaphalis contorta* Hook. f	Darjeeling, W.B.
2	*Anaphalis triplinervis* Hook. f.	Shillong, Meghalaya
3	*Gnaphalium pensylvanicum* Willd	Darjeeling, W.B
4	*Gnaphalium polycaulon* Linn.	Darjeeling, W.B.

Methods

Fresh plant materials were used for the study of micromorphological character of four species of the tribe Gnaphaleae. At least five capitulua from each taxa were collected from different plants to study the range of variations within the taxon. The capitulum were fixed in FAA solution. Florets from different capitula were taken randomly and washed in water. Then the florets were kept in 2% NaOH solution for 5-7 days for soften and clearing the tissue. The florets were washed in water anddissected under stereo

dissecting binocular microscope. Stamen, style and pappus were separated out carefully and stained with 0.5% aqueous safranin. After proper staining, dissected parts were mounted in 70% phenol glycerin solution and sealed with wax for semi-permanent preservation. Micromorphological features were drawn by the prism type of camera lucida. Measurements were facilitated by stage and ocular micrometer. Pictures were taken by microscopic attachment Olympus imaging corp camera.

Obsrevation

***Anaphalis contorta* Hook. f**.

Capitula heterogamous, disciform, borne in terminal corymbs, many flowered. Involucres many, subequal, campanulate, arrange in 2-3 rows, green. Receptacles flat or slightly convex, epaleate.

Ray florets many, arranged in many rows, similar, pistillate, 3.5-4 mm long; cypsela 1mmx0.2mm, hairy. Corolla tubular, 2-3 toothed, 2-2.2 mm, white, trichomes on corolla absent; style 2-2.5 mm long, bifurcated.

Disc florets bisexual, 3.5-4.2 mm. Corolla tubular, lobes 5, trichomes on corolla lobes tubular, clavate.

Stamens 5, syngenecious, 2 mm long; filament glabrous,1mm; anther 1.0x0.2 mm, ecalcarate; anther collar cylindrical, 0.4mmx0.7mm; anther appendage small, rounded, 0.15x0.07 mm.; endothecial cells strictly polarized.

Style thin, 2.2- 2.4mm long, linear, acutely bifurcate; bifurcation upto 1-1.1 mm.; stigmatic surface in separate lines; sweeping hairs distributed above the bifurcation of the style arms , short, more or less similar in size, obtuse. Style arms tangentially oriented in relation to capitulum.

Cypsela 1.0x0.4 mm, with basal carpodium and apical cup shaped stylopodium; hairs are tubular and narrow acute. Pappus many, bristillate, subequal, 2.5-2.8 mm long.

***Anaphalis triplinervis* Hook. f**.

Capitula heterogamous, disciform, borne in terminal corymbs, many flowered. Involucres many, subequal, campanulate, arrange in 2-3 rows, green. Receptacles flat or slightly convex, epaleate.

Ray florets many, arranged in many rows, similar, pistillate, 3.5-4 mm long; cypsela 1mmx0.2mm, hairy. Corolla tubular, 2-3 toothed, 2-2.2 mm, white, trichomes on corolla absent; style 2-2.5 mm long, bifurcated.

Disc florets bisexual, 3.5-4.2 mm. Corolla tubular, lobes 5, trichomes on corolla lobes tubular, clavate.

Stamens 5, syngenecious, 2 mm long; filament glabrous,1mm; anther 1.0x0.2 mm, ecalcarate; anther collar cylindrical, 0.4mmx0.7mm; anther appendage small, rounded, 0.15x0.07 mm.; endothecial cells strictly polarized.

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Cypsela 1.5x0.4 mm, with basal carpodium and apical cup shaped stylopodium; hairs are tubular and narrow acute. Pappus many, bristillate, subequal, 2.5-2.8 mm long.

***Gnaphalium leuto-album* Linn**.

Capitula heterogamous, disciform, borne in terminal corymbs, many flowered. Involucres many, subequal, campanulate, arrange in 2-3 rows, green. Receptacles flat or slightly convex, epaleate.

Ray florets many, arranged in many rows, similar, pistillate, 3.5-4 mm long; cypsela 1mmx0.2mm, hairy. Corolla tubular, 2-3 toothed, 2-2.2 mm, white , trichomes on corolla lobe absent; style 2-2.5 mm long, bifurcated. Pappus smaller than disc florets, sub equal 2-2.2 mm long, hairy. Cypsela1.2x0.3mm, spiny.

Disc florets bisexual, 3.5-4.2 mm. Corolla tubular, lobes 5, trichomes on corolla lobes tubular, clavate.

Stamens 5, syngenecious, 2 mm long; filament glabrous,1mm; anther 1.0x0.2 mm, ecalcarate; anther collar cylindrical, 0.4mmx0.7mm; anther appendage small, rounded, 0.15x0.07 mm.; endothecial cells strictly polarized.

Style thin, 2.2- 2.4mm long, linear, acutely bifurcate; bifurcation upto 1-1.1 mm.; stigmatic surface in separate lines; sweeping hairs distributed above the bifurcation of the style arms , short, more or less similar in size, obtuse. Style arms tangentially oriented in relation to capitulum.

Cypsela 1.0x0.4 mm, spiny, with basal carpodium and apical cup shaped stylopodium; hairs are tubular and narrow acute. Pappus many, bristillate, subequal, 2.5-2.8 mm long.

***Gnaphalium pensylvanicum* Willd.**

Capitula heterogamous, disciform, borne in terminal corymbs, many flowered. Involucres many, subequal, campanulate, arrange in 2-3 rows, green. Receptacles flat or slightly convex, epaleate.

Ray florets many, arranged in many rows, similar, pistillate, 3.5-4 mm long; cypsela 1mmx0.2mm, hairy. Corolla tubular, 2-3 toothed, 2-2.2 mm, white in colour, trichomes on corolla lobe absent; style 2-2.5 mm long, bifurcated. Pappus smaller than disc florets, sub equal 2-2.2 mm long, hairy. Cypsela1.2x0.3mm, spiny.

Disc florets bisexual, 3.5-4.2 mm. Corolla tubular, lobes 5, trichomes on corolla lobes tubular, clavate.

Stamens 5, syngenecious, 2 mm long; filament glabrous,1mm; anther 1.0x0.2 mm, ecalcarate; anther collar cylindrical, 0.4mmx0.7mm; anther appendage small, rounded, 0.15x0.07 mm.; endothecial cells strictly polarized.

Style thin, 2.2- 2.4mm long, linear, acutely bifurcate; bifurcation upto 1-1.1 mm.; stigmatic surface in separate lines; sweeping hairs distributed above the bifurcation of the style arms , short, more or less similar in size, obtuse. Style arms tangentially oriented in relation to capitulum.

Cypsela 1.0x0.4 mm, with basal carpodium and apical cup shaped stylopodium; hairs are tubular and narrow acute. Pappus many, bristillate, subequal, 2.5-2.8 mm long.

***Gnaphalium polycaulon* Pers.**

Capitula heterogamous, disciform, borne in terminal corymbs, many flowered. Involucres many, subequal, campanulate, arrange in 2-3 rows, green. Receptacles flat or slightly convex, epaleate.

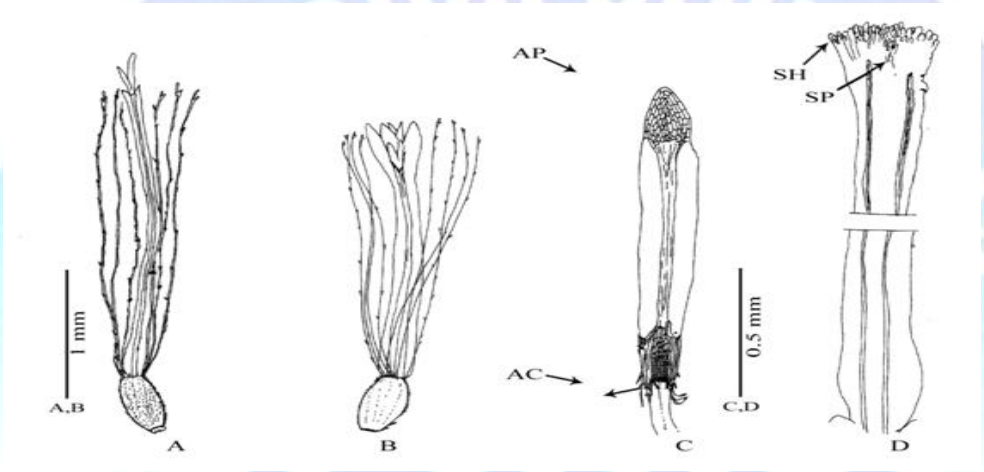
Ray florets many, arranged in many rows, similar, pistillate, 3.5-4 mm long; cypsela 1mmx0.2mm, hairy. Corolla tubular, 2-3 toothed, 2-2.2 mm, white in colour, trichomes on corolla lobe absent; style 2-2.5 mm long, bifurcated.

Disc florets bisexual, 3.5-4.2 mm. Corolla tubular, lobes 5, trichomes on corolla lobes tubular, clavate.

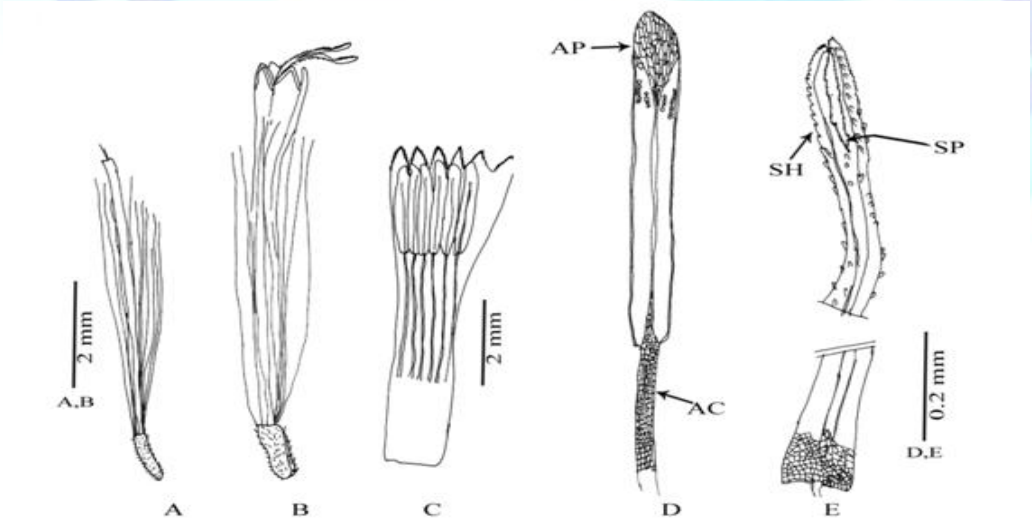
Stamens 5, syngenecious, 2 mm long; filament glabrous,1mm; anther 1.0x0.2 mm, ecalcarate; anther collar cylindrical, 0.4mmx0.7mm; anther appendage small, rounded, 0.15x0.07 mm.; endothecial cells strictly polarized.

Style thin, 2.2- 2.4mm long, linear, acutely bifurcate; bifurcation upto 1-1.1 mm.; stigmatic surface in separate lines; sweeping hairs distributed above the bifurcation of the style arms , short, more or less similar in size, obtuse. Style arms tangentially oriented in relation to capitulum.

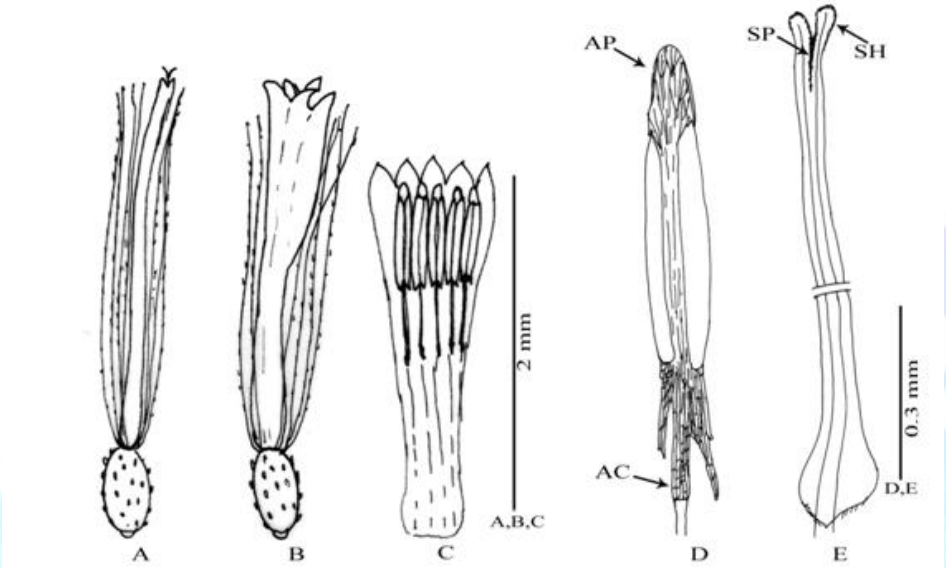
Cypsela 1.0x0.4 mm, with basal carpodium and apical cup shaped stylopodium; hairs are tubular and narrow acute. Pappus many, bristillate, subequal, 2.5-2.8 mm long.



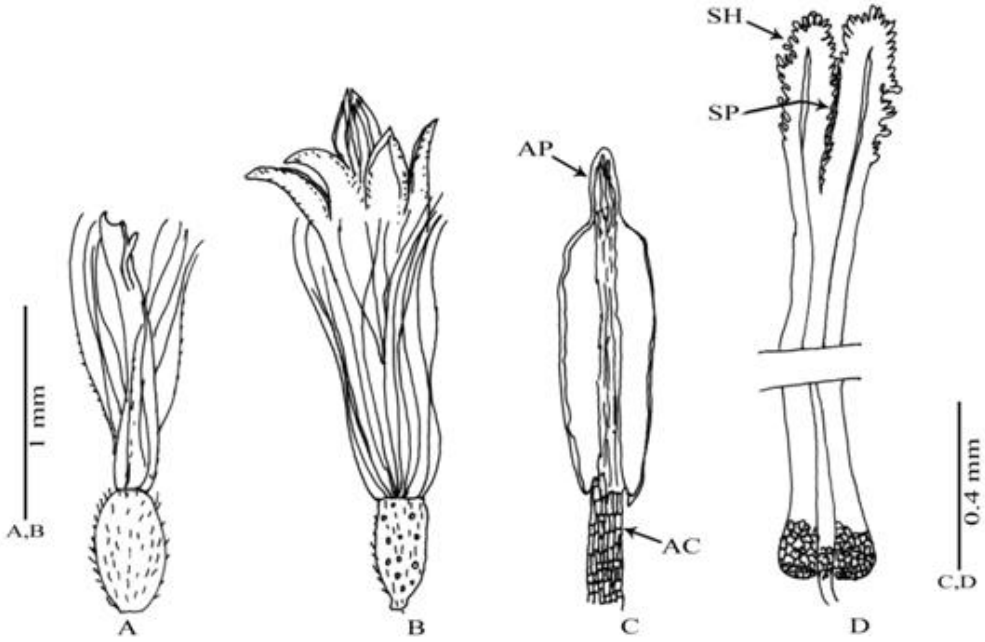
Diag. 1- *Anaphalis contorta:* A- Ray floret, B- Disc floret, C-Dissected disc corolla showing anther attachment, D- Anther with collar and appendage, E- Style and stigma.



Diag. 2- *Anaphalis triplinervis:* A- Ray floret, B- Disc floret, C-Dissected disc corolla showing anther attachment, D- Anther with collar and appendage, E- Style and stigma.



Diag. 3- *Gnaphalium pensylvanicum:* A- Ray floret, B- Disc floret, C-Dissected disc corolla showing anther attachment, D- Anther with collar and appendage, E- Style and stigma.



Diag. 4- *Gnaphalium polycaulon:* A- Ray floret, B- Disc floret, C-, Anther with collar and appendage, E- Style and stigma

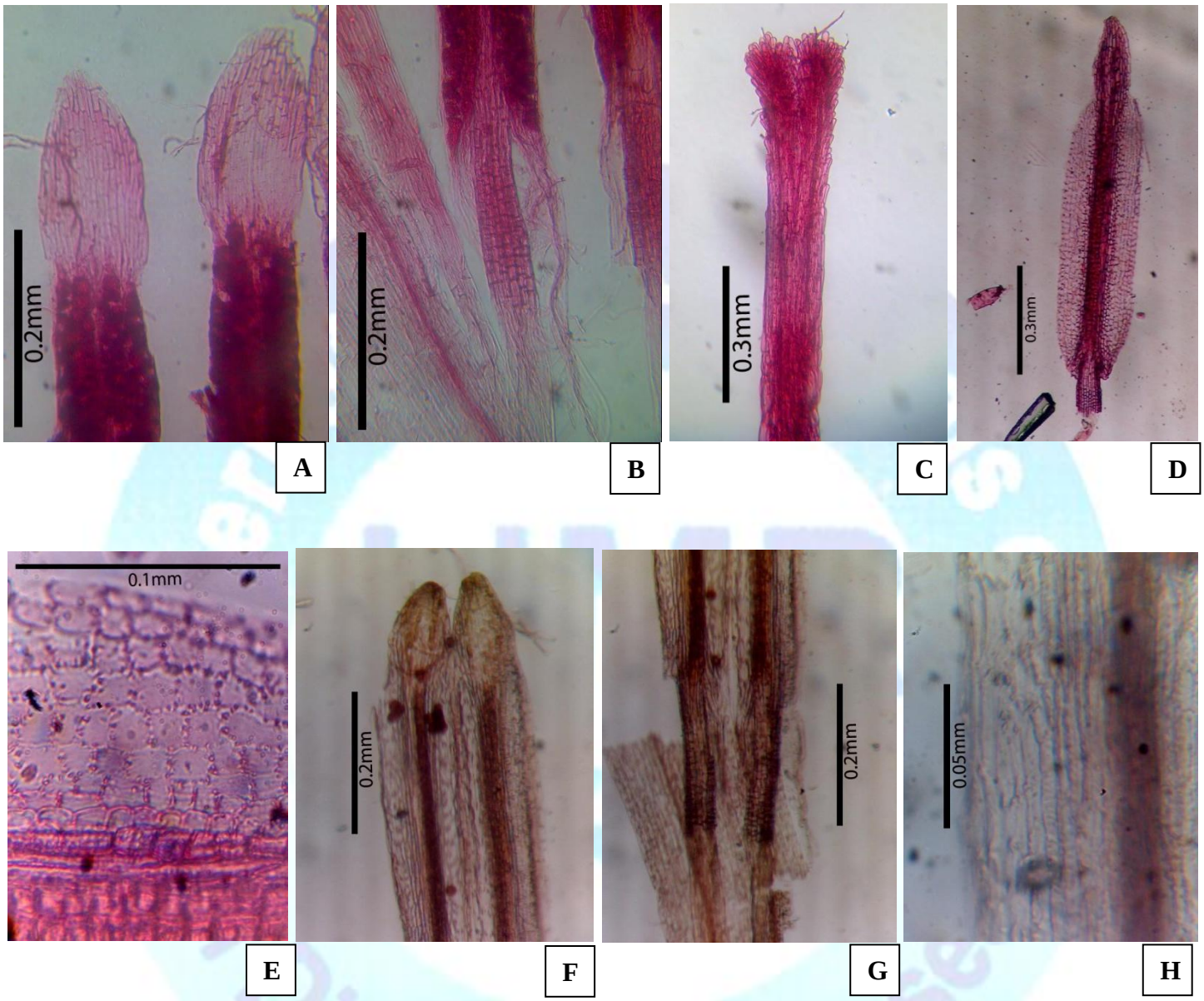


Figure 1.A-C: *Aanaphalis contorta*: A - Anther apex with appendage, B - Anther base and collar, C - style apex; D-E: *Aanaphalis triplinerves*:, D Total anther, E - Anther endothecial cells, F-H: *Gnaphalium pensylvanicum*: F - Anther apex with appendage G - Anther base and collar, H - Anther endothecial cells.

Results and Discussion

Present study reveals that, the tribe Gnaphalieae possess the following diagnostic features- capitula heterogamous, discoid, many flowered. Involucral bracts usually in many rows, usually papery, bright coloured or hyaline and with a thickened, cartilagenious basal portion (stereome) compossed of compact sclerenchyma. Receptacle usually epaleate, flat or slightly convex or concave. Ray florets usually filiform, tubular and pistillate; disc florets few in numbers, actinomorphic, bisexual, tubular-campanulate. Trichomes on corolla lobe present in most of the species. Stamens 4-5, syngenecious*;* filaments inserted near the top of the corolla tube; anther base calcarate, caudate; filament surface glabrous; anther collar cylindrical; anther appendages rounded or ovate; anther endothecial cells are polarized. Style slender, bifurcated, style branch relatively narrow; stigmatic areas confined to two separate lines on style arms; sterile style appendages are present. Sweeping hairs distributed below the bifurcation; style arms spreading tangentially; style base cylindrical or slightly bulbous with sclerified cells; nectary present at the base of the style.

Cypselas of all the studied species are homomorphic, straight or slightly curved, either truncate or concave at the apex and generally tapered toward the base. Cypselas generally pubescent with densely distributed twin hairs (biseriate forked). This observation is well supported by Wilson (1992), who also noted normal, mostly non-thickened twin hairs on the cypselas of most of the members of Gnaphaleae group. Stylopodium well-developed, tubular, solid; and carpopodium symmetric, complete circular ring-like. Pappus of all the studied species are persistent, represented by many, uniseriate, free plumose bristles.

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