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Morphological and anatomical studies of involucre bracts (Phyllaries) in some species of *Centaurea* L. of family Asteraceae in Iraq

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Abstract:

Involucre bracts usually considered a diagnostic characters of Asteraceae. In the current research the morphological and anatomical characteristics of the involucre bracts were examined in 24 species of *Centaurea* L.

The morphological features included the general shape of involucre, dimensions, number of rows, colors and the indumentums, more than the presence or absence of peduncle, as well as the presence or absence of appendages for the phyllaries and their nature, colors and site. All these characteristics showed great taxonomic importance and discussed. The characteristics which included shape of anticlinal walls of epidermis, types of stomata, they have proved to be of great importance in separating the species from each other.

Key words : Anatomy, appendages, phyllaries, *Centaurea*

Introduction :

The genus *Centaurea* belongs to the family Compositae (The daisy family), tribe Cardueae.

Its world wide, especially the middle east and southwest Asia, (1), and has a large number of species [1,2,3,4], some species are of medical

importance particularly *C. cyanus*, plants of tribe: Cardueae. mostly annual or perennial herbs, rarely trees, shrubs with homogenous and heterogenous head, phyllaries multiserrate and imbricated, with or without spine

The study of the inflorescence from the evolutionary point of view has been strongly neglected [5], although it is important to identify phylogenetic relationships [6]

The present study is therefore aimed at determine, describe the variation in the capitulum and phyllaries of some species of the genus *Centaurea*

Material and Methods :

The study was conducted on fresh samples collected from the fields during the multiple trips and from different regions of the country, where dried, fixed, numbered and deposited in the herbarium university.

.Study of morphological characteristics based on these samples, measurements were taken for some of the characters, and others were drawn by camera type wild under dissecting microscope type Olympus

The anatomical study has depend on fresh samples after you save in a lcohol, was prepared epidermis scraping way, as stem section and get the paper has been prepared based on the method of [7]. Others are from samples preserved in alcohol 70% and drawn special characteristics to this study by digital camera and enlightening under the microscope and mounting process, the photographs were taken using digital camera.

Results :

C. aggregata Fisch. & C. A. Mey, ex DC.

Morphology: Involucre elongated or ovate –elongated, 1.0-1.7 x 0.2-0.5 cm, sessile, number of phyllaries rows (7-9), number of the appendages on each side of phyllaries 5-7, white in color, terminal spine 0.5-1.0 cm, light brown. Figure 3

Anatomy : both of abaxial and adaxial epidermis have undulate anticlinal walls, stomata usually anomocytic and actinocytic, idumentum glandular hairs and unicellular hairs Figure 4

C. alveicola Rech. F.

Morphology Involucre ovate –elongated, 2.5-4.0 x 0.9-1.8 cm, pedicellate, pedicel length 1.5-7.2 cm, number of phyllaries rows (8), the appendages on each side of phyllaries usually absent, terminal spine 1.5-3.0 cm, brown. Figure 1

Anatomy : both of abaxial and adaxial epidermis have curved -straight anticlinal walls, stomata usually anomocytic and actinocytic, idumentum glandular hairs, eglandular multicellular and unicellular hairs. Figure 4

C. ammocyanus Boiss.

Morphology : Involucre ovate –elongated, 1.0-1.3 x 0.6-1.2 cm, pedicellate, pedicel length 0.6-4.7 cm, number of phyllaries rows (7), number of the appendages on each side of phyllaries 6-8, white in color, terminal spine 0.2-0.5 cm, light brown. Figure 3

Anatomy : both of abaxial and adaxial epidermis have curved -straight anticlinal walls, stomata usually anomocytic, idumentum glandular hairs and unicellular hairs. Figure 4

C. balsamita LAM

Morphology :Involucre ovate ,2.5-3.5 x 1.3-2.8 cm ,pedicellate,pedicel length 3.5-5.5 cm ,number of phyllaries rows (9) , the appendeges on each side of phyllaries usually absent, ,terminal spine 0.4-1.7 cm , brown . Figure1

Anatomy : both of abaxial and adaxial epidermis have curved -striaght anticlinal walls , stomata usually anomocytic and actinocytic ,idumentum glandular hairs and unicellular hairs. Figure 4

C.behe L.

Morphology: Involucre ovate –oblong ,1.5-3 x 0.9-1.3 cm , pedicellate,pedicel length 0.5-3.5 cm ,number of phyllaries rows (8) the appendeges on each side of phyllaries usually absent , also terminal spine absent . Figure1

Anatomy : both of abaxial and adaxial epidermis have curved-striaght anticlinal walls , Figure 4

C.bruguriera (DC.)HAND-MZT.

Morphology Involucre ovate – oblong,1.3-2.0 x 0.8-1.0 cm , pedicellate,pedicel length 0.8-1.0 cm ,number of phyllaries rows (4-5) ,number of the appendeges on each side of phyllaries usually absent , terminal spine 1.7-2.0 cm ,white in color . Figure2

Anatomy : both of abaxial and adaxial epidermis have curved-striaght anticlinal walls , stomata usually anomocytic ,idumentum glandular hairs,multicellular and unicellular hairs. Figure 4

C.cyanus L.

Morphology Involucre ovate – oblong,1.2-1.7 x 1.0-1.4 cm , pedicellate,pedicel length 1.8-14.5 cm ,number of phyllaries rows (6-7) ,number of the appendeges on each side of phyllaries 10-12 ,white in color , without terminal spine. Figure

Anatomy : both of abaxial and adaxial epidermis have curved-striaght anticlinal walls , stomata usually anomocytic ,idumentum glandular hairs and unicellular hairs. Figure 4

*C.gigantea*Shults-Bip ex Boiss

Morphology Involucre ovate ,3.5-4.5 x 2.5-5.0 cm , pedicellate,pedicel length 0.7-6.0 cm ,number of phyllaries rows (8) the appendeges on each side of phyllaries5-11 , terminal spine 0.5-1.2 cm , golden yellow . Figure2

Anatomy : both of abaxial and adaxial epidermis have curved-striaght anticlinal walls , stomata usually anomocytic ,idumentum glandular hairs and unicellular hairs. *C.handeli*wagenitz

Morphology Involucre ovate ,2.8-3.2 x 1.8-2.2 cm , sessile ,number of phyllaries rows (6-8) ,the appendeges on each side of phyllaries 5-6 ,golden yellow , terminal spine 0.4-0.5 cm , golden yellow . Figure1

Anatomy : both of abaxial and adaxial epidermis have curved -striaght anticlinal walls , stomata usually anomocytic ,anisocytic ,actinocytic ,idumentum glandular hairs and unicellular hairs. Figure 4

Hyalolepis C

Morphology Involucre ovate-elongated ,1.0-2.0 x 0.8-1.3 cm , , pedicellate,pedicel length 1.8-14.5 cm ,number of phyllaries rows (6) ,the appendeges on each side of phyllaries usually absent , terminal spine 0.8-3.0 cm , golden yellow. Figure2

Anatomy : both of abaxial and adaxial epidermis have straight- curved anticlinal walls , stomata usually anomocytic and actinocytic ,idumentum glandular hairs and unicellular hairs. 5

*C. iberica*TREV.exSpring

Morphology Involucre ovate-elongated ,1.8-3.6 x 1.7-3.2 cm , , pedicellate,pedicel length 0.4-7.2 cm ,number of phyllaries rows (7) ,the appendeges on each side of phyllaries is 2-3,golden yellow in color , terminal spine 1.5-2.8 cm , golden yellow. Figure3

Anatomy : both of abaxial and adaxial epidermis have straight- curved anticlinal walls , stomata usually anomocytic,idumentum glandular hairs multicellular and unicellular hairs. Figure 5

*C.intricata*Boiss.

Morphology :Involucre elongated ,1.0 -1.3 x 1.7-3.2 cm , , pedicellate,pedicel length 0.4-7.2 cm ,number of phyllaries rows (7) ,the appendeges on each side of phyllaries is 4-5,light brown in color , terminal spine 1.0-2.0 cm light brown. Figure3

Anatomy : both of abaxial and adaxial epidermis have striaght anticlinal walls , stomata usually anomocytic,idumentum glandular hairs and unicellular hairs. Figure5

*C.laxa*BoissetHausk.

Morphology :Involucre ovate- elongated or elongated ,1.0 -1.7 x 0.4-0.6 cm , , pedicellate,pedicel length 0.3-1.8 cm ,number of phyllaries rows (7) ,the appendeges on each side of phyllaries is 5-6,white in color , terminal spine 0.1-0.3 cm ,golden yellow . Figure1

Anatomy : both of abaxial and adaxial epidermis have curved -striaght anticlinal walls , stomata usually anomocytic and actinocytic ,idumentum glandular hairs and unicellular hairs . Figure 5

*C.mesopotamica*Bornm.

Morphology Involucre cup like-shape ,1.2 -1.5 x 0.9-1.5 cm , , pedicellate,pedicel length 0.5-1.8 cm ,number of phyllaries rows (6-7) ,the appendeges on each side of phyllaries is 6-10, brown in color , terminal spine 0.4-0.5 cm brown. Figure3

Anatomy : both of abaxial and adaxial epidermis have curved -striaght anticlinal walls , stomata usually anomocytic,idumentum glandular hairs and unicellular hairs Figure 5

*C.persica*Boiss.

Morphology Involucre ovate, 2.2 -3.0 x 1.1-2.5 cm , , pedicellate, pedicel length 0.8-5.5 cm , number of phyllaries rows (7) , the appendages on each side of phyllaries is 5-7, golden yellow in color , terminal spine 0.5-0.8 cm , golden yellow . Figure 2

Anatomy : both of abaxial and adaxial epidermis have curved -straight anticlinal walls , stomata usually anomocytic , actinocytic and anisocytic , idumentum glandular hairs and unicellular hairs . Figure 5

C. pulchella Ledeb

Morphology Involucre campanulate , 0.8 -1.4 x 0.7-1.2 cm , , pedicellate, pedicel length 0.3-0.5 cm , number of phyllaries rows (6-7) , the appendages on each side of phyllaries is 20-22, white in color , terminal spine 0.5-0.8 cm , brown. Figure 1

. Anatomy : both of abaxial and adaxial epidermis have curved -straight anticlinal walls , stomata usually anomocytic, idumentum glandular hairs and unicellular hairs. Figure 5

C. regia Boiss.

Morphology Involucre ovate, 5.5 -9.0 x 4.0-8.5 cm , , pedicellate, pedicel length 5-7.5 cm , number of phyllaries rows (12) , the appendages on each side of phyllaries is 10-15, light yellow- brown in color , terminal spine 0.8-1.5 cm , golden yellow-brown . Figure 2

Anatomy : both of abaxial and adaxial epidermis have curved -straight anticlinal walls , stomata usually anomocytic, idumentum glandular hairs and unicellular hairs , filiform sclerids also present. Figure 5

C. rhizantha C.A. MEY.

Morphology Involucre cup like-shape , 1.5 -3.0 x 1.3-1.8 cm , sessile, number of phyllaries rows (5-7) , the appendages on each side of phyllaries is 2-3, golden yellow in color , terminal spine 0.6-1.2 cm , golden yellow. Figure 1

Anatomy : both of abaxial and adaxial epidermis have curved -straight anticlinal walls , stomata usually anomocytic, idumentum glandular hairs and unicellular hairs. Figure 6

C. rigida Bank and Soland

Morphology Involucre ovate-oblong , 1.7 -2.5 x 0.5-1.1 cm , , pedicellate, pedicel length 0.5-3.5 cm , number of phyllaries rows (9) , the appendages on each side of phyllaries usually absent , terminal spine 0.7-1.4 cm in length , golden yellow-brown . Figure 1

Anatomy : both of abaxial and adaxial epidermis have straight- curved anticlinal walls , stomata usually anomocytic and actinocytic , idumentum glandular hairs and unicellular hairs. Figure 6

C. sinaica DC

Morphology Involucre cup like-shape , 1.8 -3.0 x 0.7-1.2 cm , pedicellate, pedicel length 0.2-1.2 cm , number of phyllaries rows (7) , the appendages on each side of phyllaries is 3-4, golden yellow in color , terminal spine 0.7-1.2 cm , golden yellow. Figure 3

Anatomy : both of abaxial and adaxial epidermis have curved- straight anticlinal walls , stomata usually anomocytic and actinocytic, idumentum glandular hairs and unicellular hairs. Figure 6

C. solstitiales L.

Morphology Involucre ovate, 1.0 -2.3 x 0.8-2.2 cm , , pedicellate, pedicel length 0.5-10.2 cm , number of phyllaries rows (7) , the appendages on each side of phyllaries is 3-4 , terminal spine 0.7-1.4 cm in length , golden yellow-brown . Figure 3

Anatomy : both of abaxial and adaxial epidermis have curved -straight anticlinal walls , stomata usually anomocytic and actinocytic , idumentum glandular hairs and unicellular hairs . Figure 6

C. spectabilis (FISCH & C.A. MEY) SCHUITZ-BIP.

Morphology Involucre ovate, 2.5 -3.4 x 1.8-2.4 cm , , pedicellate, pedicel length 5.5-12 cm , number of phyllaries rows (8) , the appendages on each side of phyllaries is 5-6 , redish golden yellow , terminal spine 0.4-0.5 cm in length , redish golden yellow . . Figure 1

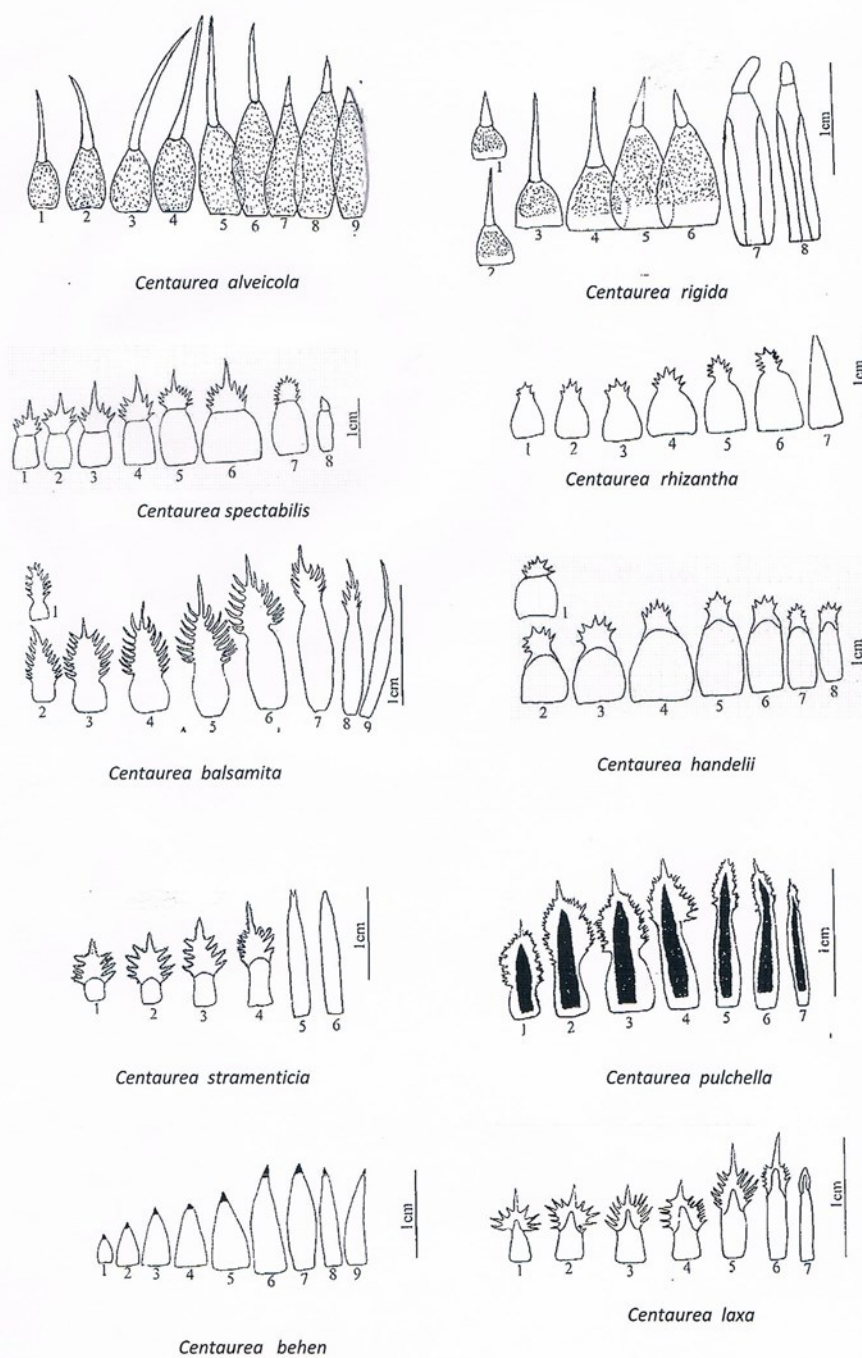
Anatomy : both of abaxial and adaxial epidermis have curved -straight anticlinal walls , stomata usually anomocytic and actinocytic, idumentum glandular hairs and unicellular hairs. . Figure 6

C. stramenticia Hand-Mzt

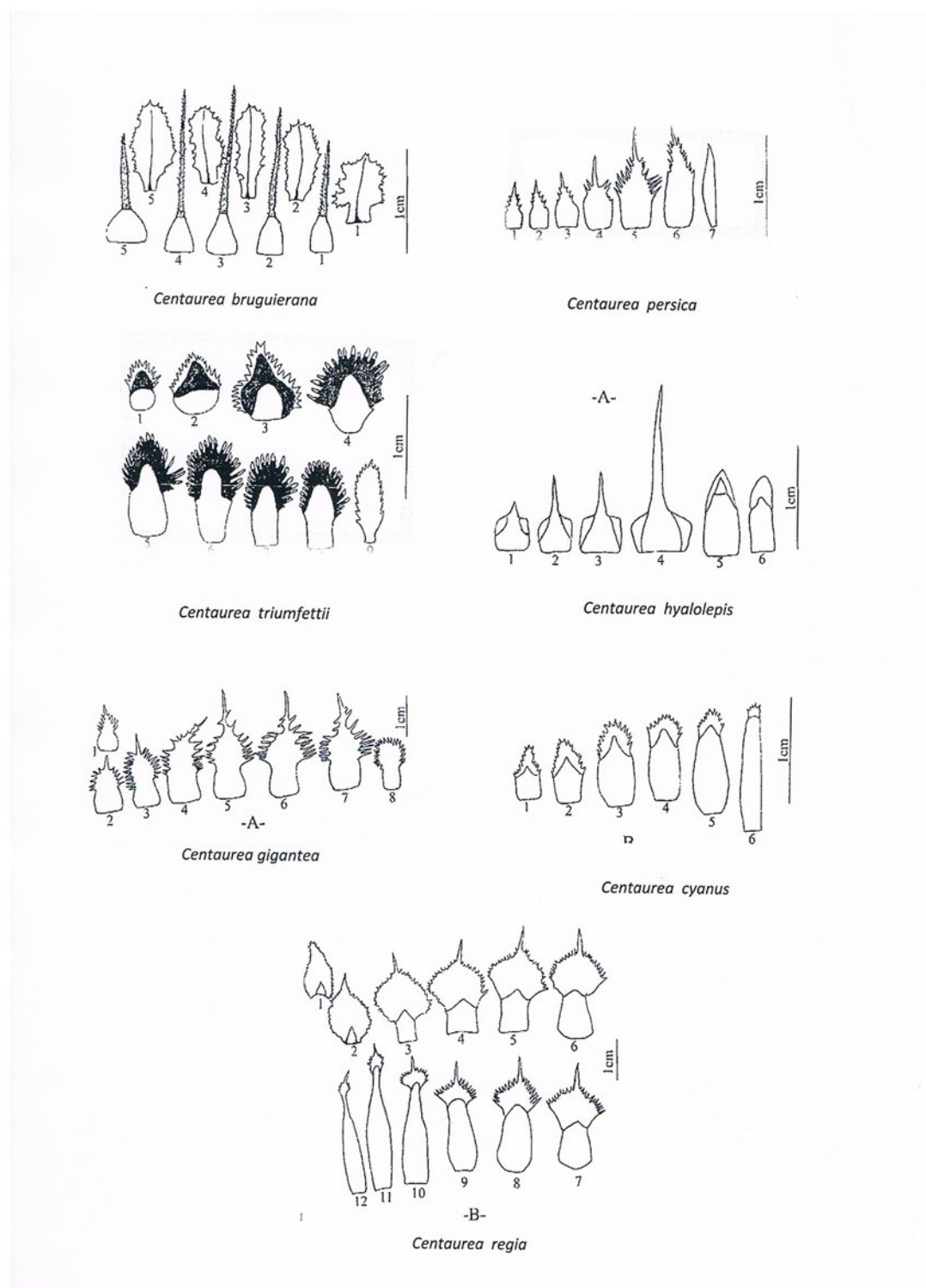
Morphology Involucre campanulate, 1.2 -2.0 x 0.5-1.2 cm , , pedicellate, pedicel length 0.5-5.5 cm , number of phyllaries rows (7) , the appendages on each side of phyllaries is 5-7 , golden yellow , terminal spine 0.2-0.7 cm in length , golden yellow . . Figure 1 Anatomy : both of abaxial and adaxial epidermis have straight anticlinal walls , stomata usually anomocytic, idumentum glandular hairs and unicellular hairs. Figure 6.

C. triumfettii All.

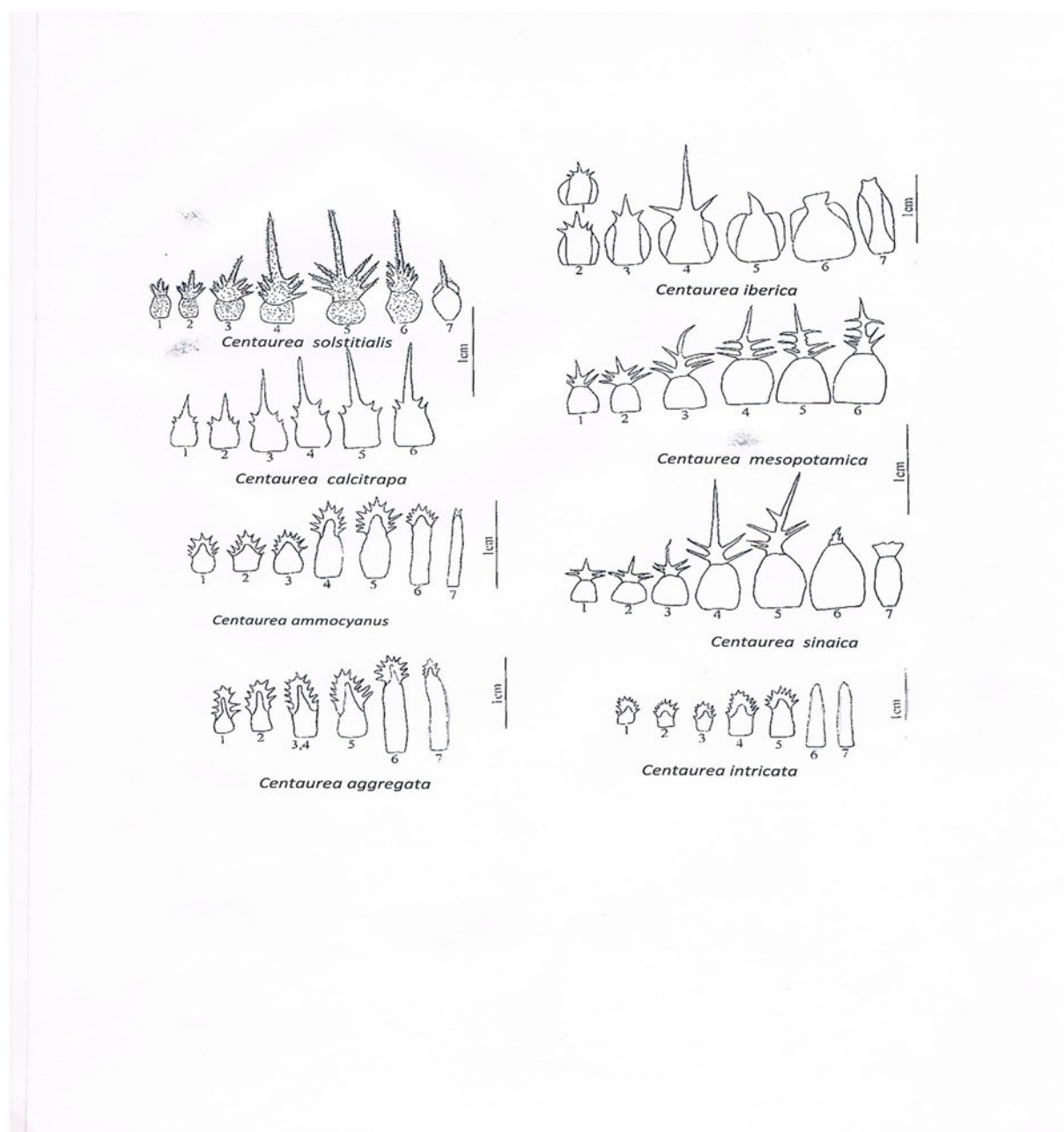
Morphology Involucre campanulate, 2.2 -3.0 x 1.1-2.5 cm , pedicellate, pedicel length 0.9-2.5 cm , number of phyllaries rows (9) , the appendages on each side of phyllaries is 8-9 , yellow , terminal spine usually absent . . Figure 2



Figure(1)showing morphological characteristics of phyllaries in some species of Centaurea L.



Figure(2)showing morphological characteristics of phyllaries in some species of *Centaurea* L.



Figure(3)showing morphological characteristics of phyllaries in some species of *Centaurea* L

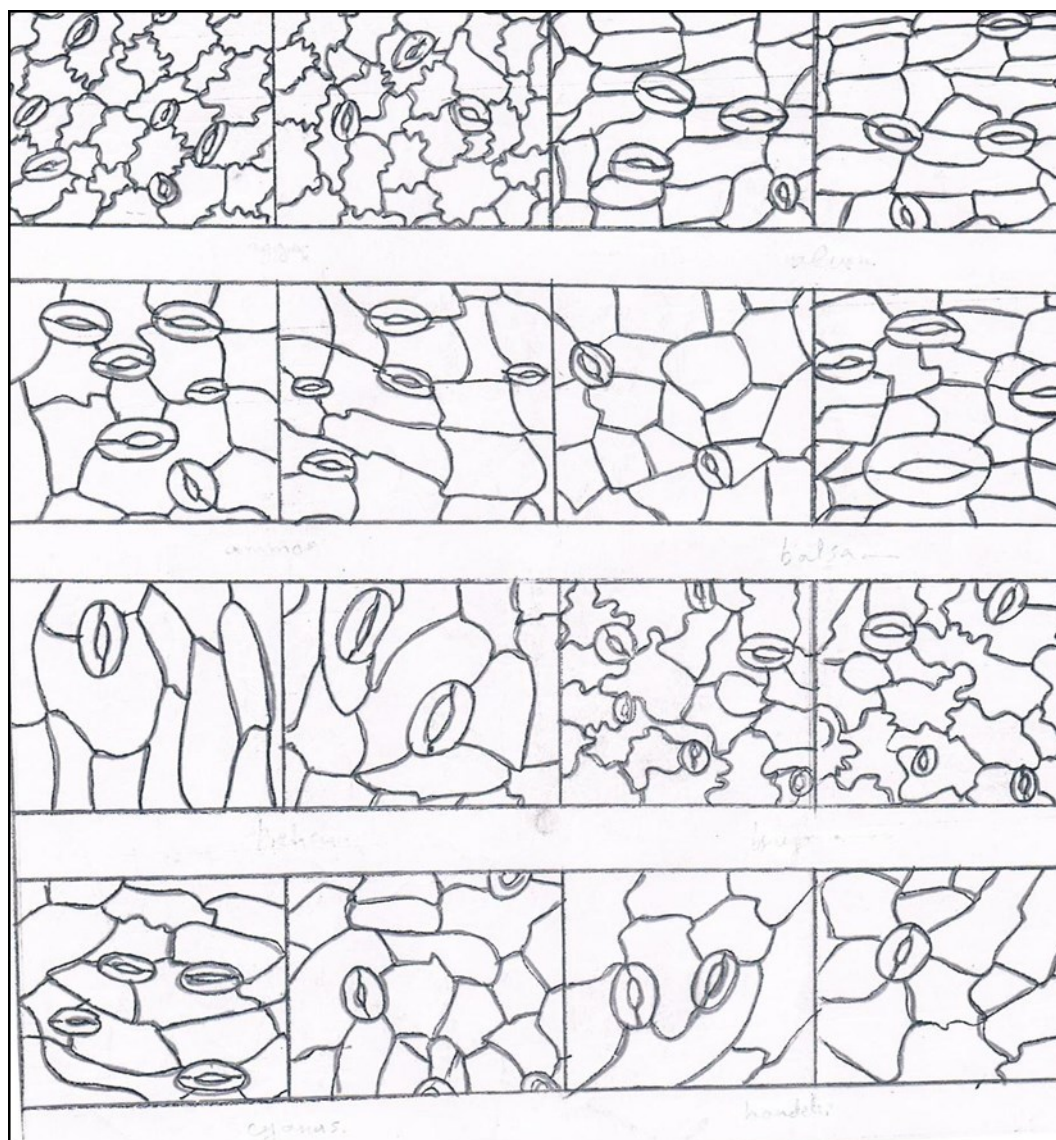


Figure (4) showing the epidermis of phyllaries in some species of Centaurea

A: abaxial

B: adaxial

Discussion

Cassini, who was termed an involucre to the outer bracts when they are foliaceous, while [2] named the involucre to all of the bracts subtending the florets, later various authors used the term involucre to the whorls of green specialized bracts occurring at the base of inflorescence. Involucral bracts of taxonomic importance, however, it was neglected [8]. From the results of this research, inflorescence and bracts of *Centaurea* species have diagnostic characters such as size of inflorescence, number of rows with presence or absence of the appendages and others, as mentioned by [9].

The size of inflorescence was valuable to distinguish the species *Centaurea regia*, which was larger than others, also aggregated inflorescence of importance to isolate the species *Centaurea*

aggregata from other species studied, this character has been confirmed by [10,11]. Presence or absence of pedicel is another very important character usually to isolate the species of *Centaurea intricata*, *Centaurea aggregata*, *Centaurea rhizantha*, *Centaurea handelii*, which were sessile while others pedicellate, also presence or absence of indumentum is valuable to distinguish the two species *Centaurea alveolata* & *Centaurea persica*, which were smooth while others have glandular and eglandular hairs. Different morphological characters such as number of phyllaries were examined by researcher [10,11], according to this study *Centaurea regia* has the largest number of phyllaries while *Centaurea bruguieriana* has the smaller number. Presence or absence and types of phyllaries appendages was of taxonomic importance, as mentioned by [10]. Length of terminal spine has importance, so it has been used by [12,13] in their keys. Another important character is the presence of hyaline margins for the phyllaries of *Centaurea hyalolepis*, *Centaurea solstitialis*, *Centaurea cyanus*, *Centaurea iberica*, *Centaurea pulchella*, this character was confirmed by [12].

For anatomical characteristics, the species differ in the type of anticlinal walls of epidermis of phyllaries. All species have amphistomatic leaf. Anomocytic is the common type of stomata, in addition to actinocytic and anisocytic. These characters have been mentioned by [14,15].

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