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A COMPARATIVE MORPHOLOGICAL SYSTEMATIC STUDY OF THE GENUS *CLINOPODIUM* L. (LAMIACEAE) IN IRAQI KURDISTAN REGION WITH THREE TAXA WHICH FIRST NEW RECORDED FROM IRAQ.

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Abstract

The current research included a comprehensive study of the genus *Clinopodium* L.(Lamiaceae) in Iraq. The study examined the characteristics of the four taxa of this genus included *Clinopodium vulgare*sub sp. *vulgare* L., *Clinopodium vulgare* sub sp. *arundanum* Boiss., *Clinopodium congstum* Boiss. & Hausskn ex. Boiss., *Clinopodiumum brosum* (M. B.) C. Koch, for the first time, including the study of the external appearance of the roots, stems, leaves, bracts, bracteoles, flowers, fruits and nutlets. Also the characteristics of the value of the classification of the genus were not mentioned previously, The flowering calyx, the contact points of the filaments with anthers, the connection of the stamens to the petals, the stamens are four where two lower pairs are longer than two upper ones while all were shorter than corolla. In all studied genera the filaments are exerted from lower lip, the color of the corolla, the shape of the nutlets and it's surface ornamentation, the location of its hilum and it's color, and study of the indumentum of the parietal cover of all parts of the plant, and draw diagrams of the various parts of the plant and its subsidiaries for the photographic images and the work of tables for all measurements and attributes for all parts of the characters of the all parts of studied taxa was also identified the environment and the quality of the soil in which the growth of plants and state the flowering periods of all studded taxa and determine the geographical distribution of the district of Iraq in Iraqi Kurdistan Region. Depending on the apparent and distinct phenotypic characteristics the key was laid to separate all the taxa for the above genus. Three taxa which are *Clinopodium vulgare* subsp. *arundanum* Boiss., *Clinopodium congstum* Boiss. & Hausskn ex. Boiss., *Clinopodium brosum* (M.B.) C. Koch, were described and new recorded for the first time in Iraqi Kurdistan region and added to Iraqi plants.

Key words: New recorded, Lamiaceae, flowering calyx, geographical distribution.

Introduction

The Lamiaceae is the sixth largest family of flowering plants and one of the most economically important, (Drewand Sytsma, 2012). The original family name is Labiateae, so given because the flowers typically have petals fused into an upper lip and a lower lip. Although this is still considered an acceptable alternative name, most botanists now use the name "Lamiaceae" in referring to this family. Lamiaceae is represented by about seven subfamilies, 258 genera and 3500 species in the world (Duarte and Lopes, 2007). Morphological features have long been classified as the basis for describing and classifying groups of plants, and external morphology still provides the largest amount of information for the wide number of plants taxonomically including flowering plants, as many system of classification among them were developed based primarily on morphological data. It is still the foundation for most of plant classification (Stuessy, 1990). Based on morphological parameters, (Engler and Prantlen, 1888-1897) placed Lamiaceae in the order Tubiflorae, followed by (Hallier, 1905; Wettstein 1924; Rendle, 1925 and Pulle, 1938). Junell (1934) and Erdtman (1945) established their systems of classification, based also on morphological characters. The Lamiaceae members are characterized by their peculiar morphology and aromaticity which were well recognized for centuries by (Swingle, 1971). The same system of classification of Lamiaceae proposed by (Goebel, 1984), The morphological features are used as discriminative

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characters at subfamiliar level in the Lamiaceae family (Ascensao *et al.*, 1998), and more recently it was used by (Burt, 2004) for classification of this family. The genus name *Clinopodium* is derived from the Latin Clinopodion or the Greek klino podion. These were names for *Clinopodiumvulgare* L.. The Greek klino means "a bed" and the Greek podion means "a little foot" (dioscorides name, for the knob. Shaped appearance of inflorescence). (Gledhil, 2008), but in English called "Wield Basil", while in Arabic language called "Raihan Barii". And in Kurdish language called (Rihanna Kwela). The genus *Clinopodium* were not detected to possess medicinal uses however this genus contain many species which have recognized with very high content of essential oil and used from the same of *Ocimum* uses in different area. It's oil is also used to make perfume; though perfumers rarely use the volatile oil because they are able to stimulate the aroma of "wield basil" with cheaper extracts from other plants (Burt, 2004). According to (Al. Rawi, 1964) one species for genus *Clinopodium* which is *C. vulgare* distributed in MRO and MSU districts. Leblebici (1982) described only one subspecies from genus *Clinopodium* (*C. vulgare* subsp. *arundanum*) which distributed in north Iraq. Ridda and Daood (1982) indicated only one species from genus *Clinopodium*, *C. vulgare* distributed in MAM, MRO and MSU districts. Rechinger (1982) described only one subspecies from genus *Clinopodium* (*C. vulgare* subsp. *orientale*) in MSU Mountains. The taxonomic position of the genus which studied in Lamiaceae family by (Stevens, 2001) are: Class: Magnoliopsida (dicotyledons). Order: Lamiales. Family: Lamiaceae (Mint family). Genus: Clinopodium L. Species: a) *C. vulgare* subsp. *vulgare* L., subsp. *arundanum Boiss*., b) *C. congstum Boiss*. &Hausskn ex. Boiss., c) *C. umbrosum* (M.B.) C. Koch. The present study aims to investigate morphological features of four taxa of Lamiaceae family from the genus (*Clinopodium*) in order to evaluate the usefulness of these characters for systematic purposes. Three taxa which are *Clinopodium vulgare sub* sp. *arundanum* Boiss*., C. congstum* Boiss. & Hausskn ex. Boiss*., C. umbrosum* (M. B.) C. Koch, were described for the first time in Iraqi Kurdistan region and added to Iraqi plants.

Materials and Methods

Field trips

This part of the study depended on the specimens, collected during field works which started in April 2012 and continued to November 2012 which included more than 45 field trips. Specimens obtained from 25 collections in different areas of Kurdistan region of Iraq including MAM, MRO, MSU, FAR and some areas of FPF and FKI districts. Each trip took one day except two of them took between three to ten days, ecological and field notes were recorded, photographical pictures were taken for the studied species by using digital Camera Sony (10.3 mega pixels) and the altitude was measured by GPS. Also depending on identified dried specimens in Iraqi herbaria (table 1) and botanical references, all collected materials treated as herbaria specimens. There are some Floras used by this investigation for identification geographical distribution such as Flora of Lowland Iraq (Rechinger, 1964), Flora of Europe (Tutin *et al*., 1972), Flora Iranica (Rechinger, 1982) and Flora of Turkey (Davis, 1982).

Drying of specimens

Drying was done by placing the specimens between old newspapers, which possess the ability in absorbing high amount of humidity. This process was repeated for one week to obtain dried specimens without humidity and to prevent wrinkles.

Mounting and Labeling of specimens

The specimens were hold very carefully then adhere to the white rectangular boards that have standard size. The labeling was done by giving them special numbers, herbarium name, district name, scientific name, common names, position, date of collection, the altitude, GPS cordination, type of soil and the name of collector with other required information. Then, the samples were saved in the herbarium of Sulaimani Polytechnic University.

Table 1: Herbaria abbreviations used during the study (Holmgren and Keuken, 1964).

ASUH	Erbil, Iraq: College of Science, University of Salahaddin.
ESUH	Erbil, Iraq: Dep. Of Biology College of Education, University of Salahaddin.
BAG	Baghdad, Iraq: National Herbarium of Iraq.
BUH	Baghdad, Iraq: The University Herbarium, College of Science.
BUE	Baghdad, Iraq: Dep. Of Biology College of Education, University of Baghdad.
SUFA	Sulaimani, Iraq: Sulaimani University Faculty of Agricultural Sciences.
BUNH	Baghdad, Iraq: National History Research Center and Museum

Morphological study

The assessment of the role of morphological feature is related to the taxonomy of the genus *Clinopodium of* Lamiaceae provided. Herbaria those depended on this study are listed in (table 1) and the terminologies which

employed are in accordance with the followings:

Post(1933), Zuhary (1946), Lawrence (1955), Rechinger(1964), Guest (1966), Lindman (1969), Chakravarty (1976), Dothan (1977), Dothan (1978), Niering& Olmstead (1979), Davis (1982), Rechinger (1982), Heukels (2000), Thome & Thome (2007), Scully (2008) and Sell & Murrell (2009).

Result and Discussions

Habit and Duration

All species from the genus Clinopodium, are perennials monoecism usually herbs (rarely low shrubs), their species have herbaceous habit. All of them are perennials.

Roots

The root system of the species of *Clinopodium*, are differentiated by having tap root system regular or irregular, having branches in type primary, secondary, tertiary and titrate (fig. 1, 2). Also variation can be observed in root dimension and brunch extension. Root extension in the soil depends on plant habits and type of soils. The species that grow in sandy and clay soil have large root system and increased branch elongation, but those which grow in rocky place, limestone soil and between splits of rocky place have strong and thick roots with few branches (Mahmood, 2008). There are several factors controlling the dimensions of root as type of soils, duration and water availability. The root system of perennial plants is different from annual plants in having strong woody tap root system, irregular, thick and relatively giant with many extensions to different direction. The root in all studied species from genus *Clinopodium* is tap root, which branched in middle to end, the length of roots are ranged between (6.6-14.2) cm in *C. congstum* with the minimum length and *C. vulgare* subsp. *arundanum* with the maximum length, the width ranged between (6.4-22.4) mm in *C. vulgare* subsp. *vulgare with* minimum and *C. umbrosum* with maximum, and the colors were brown, light brown and brown-red. (table 2, fig 1, 2).

Stems

Based on the present results, it was found that variations did not appear between stem types and shapes of all studied species because all are erect and quadrangular in section, however variations were appeared in dimension, mode and number of branching, color and in dumentums. Mode of branching usually starts from the lower part between the stem and root of plants in taxa from *Clinopodium* start from the lower or middle part of the main stems. The branching number differs among species from this genus. In all studied taxa the stem almost always has numerous glandular and non-glandular hairs, releasing the aromatic compounds that detected by our noses. The stem dimensions in species of genus *Clinopodium* can be noted length between (33.5- 48.2) cm, with *C. umbrosum* as a minimum and *C. congstum*as a maximum, width ranged between (1.9-2.4) mm, with *C. congstum* as a minimum and *C. vulgare* subsp. *arundanum* as a maximum, the indumentums contain glandular and non- glandular hairs which are velutinos, villous of pilose, woolly and hirsute. (table 2).

Leaves

Leaves in all studded taxa are opposite, simple, entire to serrate, crenate, or serrulate, without stipules, the positions of leaves are different (lower, middle and upper cauline leaves) on the stem which has variations in apex, base, margin, indumentums, petiole and blade shapes.

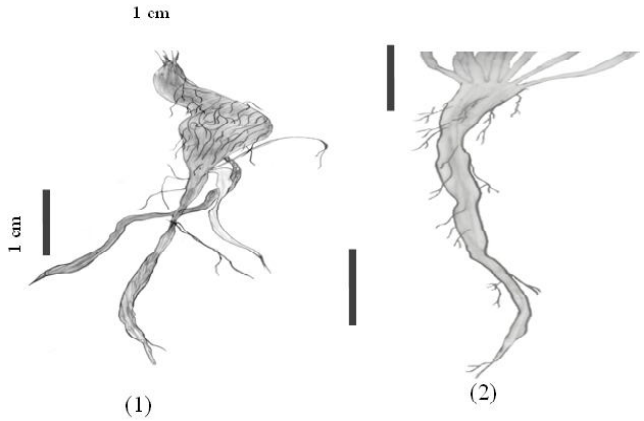

Fig. 1: Roots morphology: 1- *Clinopodiumvulgare* subsp. *vulgare*, 2- *Clinopodiumvulgare* subsp. *arundanum*.

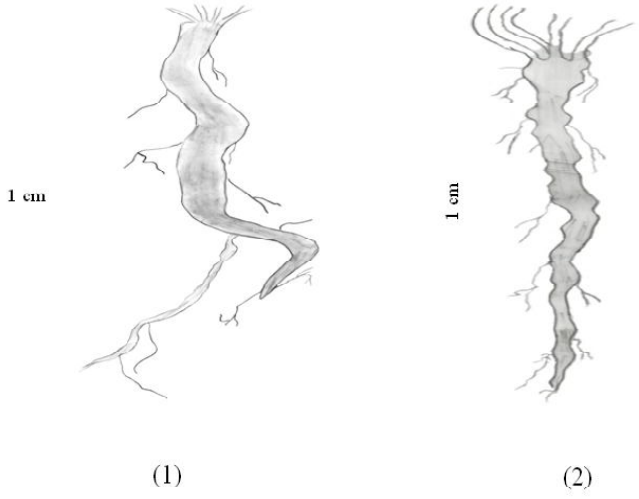

Fig. 2: Root morphology: 1- *Clinopodiumcongstum*; 2- *Clinopodiumumbrosum*.

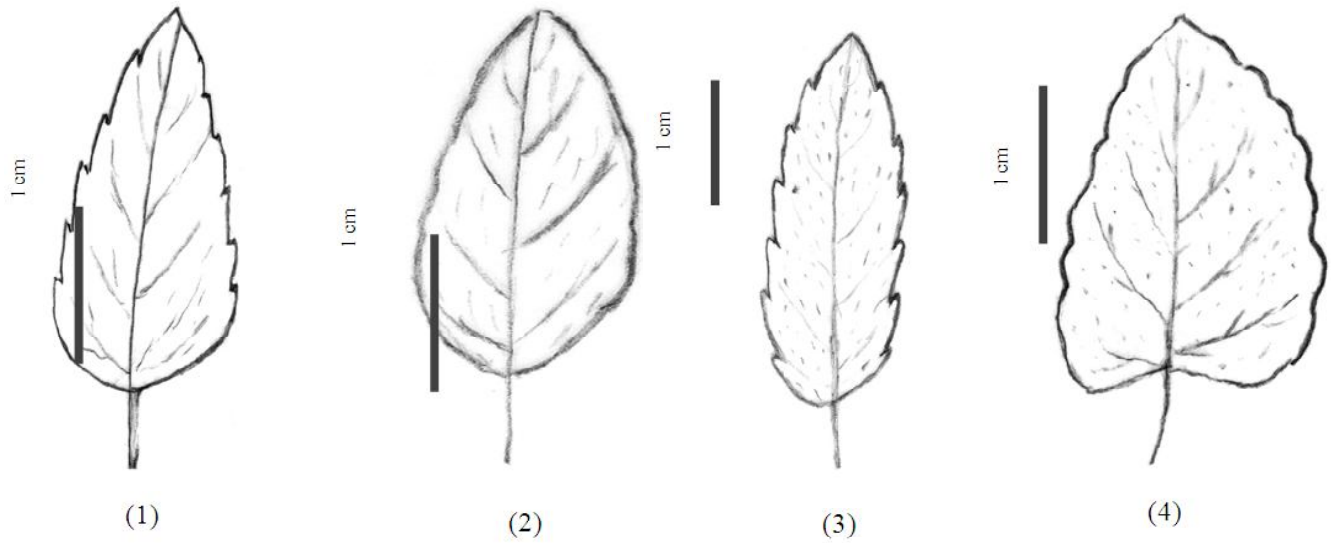

Fig. 3: Lower cauline leaf morphology: 1- *Clinopodiumvulgare* subsp. *vulgare*; 2- *Clinopodiumvulgare* subsp. *arundanum*; 3- *Clinopodiumcongstum*; 4- *Clinopodiumumbrosum*

Table 2: Dimensions and Morphology of Roots and Stems of studied taxa.

Species	Root				Stem			
	Length (cm)	Diameter (mm)	Type	Color	Length (cm)	Width (mm)	Color	Indumentums
Clinopodiumvulgare subsp. vulgare	(5-18)10.8	(1-8)6.4	Normal tap root	Light brown	(23-52)41.8	(1-3)1.85	Light green	Velutinous
C. vulgaresubsp. arundanums	(8-24)14.2	(2-25)9.2	Woody tap root	Brown	(28-61)46.4	(1-5)2.4	Green -haulmy	Wooly -villous pilos
C. congstum	(5-12)6.6	(2.5-30)9.5	Semi woody root	Brown -red	(34-59)48.2	(0.5-3)1.9	Green-brown	villous pilos
C. umbrosum	(6-24)11.4	(2-74)22.4	Conical tap root	Brown	(25-42)33.5	(1-3)2.2	Green -violet	Hirsute-pilos

The numbers inside the brackets represent minimum & maximum and the number out sided represent the average between (20-25) plants.

Lower cauline Leaves

All studied taxa have opposite decussate petiolate, the shape of lower cauline leaves are ovate, elliptic and lanceolate, but bases are various, cuneate, obtuse and truncate, and the margins are serrulat, entire and crenate .serrate, but the blade length ranged between (7.7-41.4) mm in *C. vulgare subsp. arundanum as* a minimum and *C. congstum* as a maximum, width ranged between (5.8-17.2) mm in *C. vulgare subsp. arundanum as* a minimum and *C. umbrosum as* a maximum, while petiole length ranged between (4.1-39.6) mm in *C. vulgare subsp. arundanum as* a minimum and *C. congstum* as a maximum and the variation indumentums contain glandular and non. glandular hairs which are velutinous, puberulent, tomentose, wooly and villous of pilose. (table 3, fig 3).

Middle cauline Leaves:

All studied genera have opposite decussate petiolate middle cauline leaves with different shapes and dimensions for blades and petioles. The leaf types in taxa of *Clinopodium* are ovate and lanceolate, but the apex is acute-acuminate, the bases are obtuse, cuneate and truncate-obtuse, the margins are serrulate, undulate, entire and crenate-serrate, and the indumentums contain glandular and non-glandular hairs which are velutinouse, puberulent, Tomentose, wooly and villous of pilose, but the blade length ranged between (14.6-39.8) mm and the width rang between (9.2-18.1) mm, in the species *C. vulgare* subsp. *arundanum* a minimum and the *C. congstum* as a maximum and the others between these two ranges, petiole length ranged between (1.8-15.7) mm in the species *C. vulgare* subsp. *arundanum* as a minimum and the *C. congstum* as a maximum and the others between these two ranges. (Table 4, Fig 4).

Upper Cauline Leaves:

The upper cauline leaves have opposite decussate phyllotaxy, simple petiolate or sessile, they have different dimension for blades and petioles. The upper cauline

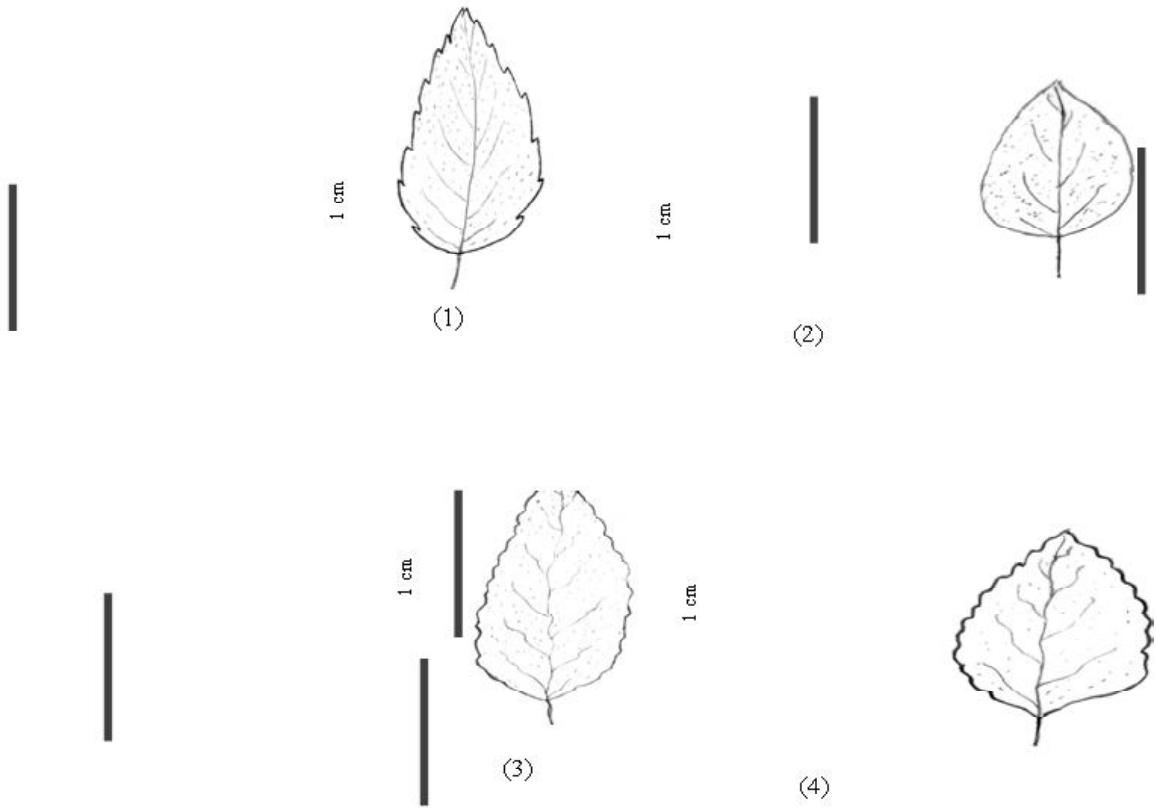

Fig. 4: Middle cauline leaf morphology: 1- *Clinopodiumvulgare*subsp. *Vulgare*2- *Clinopodiumvulgare*subsp. *arundanum*; 3- *Clinopodiumcongstum*; 4- *Clinopodiumumbrosum*.

Table 3: Lower cauline leaves characters, measurement in (mm) of all studied taxa.

Species	Blade length(mm)	Blade width (mm)	Petiole length(mm)	Average Length B/P	Margin	Type	Indumentums
Clinopodiumvulgare subsp. vulgare	(21-32)27.3	(11-16)13.8	(5-9)6.1	4.47	Serrulate	Ovate	Velutinous, Puberulente
C. vulgaresubsp. arundanum	(6-9)7.7	(4-7)5.8	(2-6)4.1	1.87	Entire	Ovate. Lanceolate	Velutinous, villous of pilose
C. congstum	(38-47)41.4	(9-14)11.8	(36-42)39.6	1.04	Serrulate	Elliptic	Tomentosee, Wooly. villous of pilose
C. umbrosum	(15-24)18.3	(12-23)17.2	(4-7)5.9	3.10	Crenate	Ovate to broad ovate	villous of pilose

Numbers inside the brackets represent minimum and maximum and the number outside represent the average between (20-25) plants.
B: Blade, P: Petiole.

leaves types in taxa of the genus *Clinopodium* are ovate, lanceolate and elliptic, but the apex is acute and acuminate, the base part is cuneate. obtuse and obtuse, the margins and the indumentums were the same as the middle cauline leaves exactly, but blade lengths ranged between (14.6-33.5) mm in the species *C. umbrosum* as a minimum and the *C. vulgare* subsp. *vulgare* as a maximum, the width ranged between (7.8-19.1) mm with the *C. vulgare* subsp. *arundanum* as a minimum and the *C. vulgare* subsp. *vulgare* as a maximum and the petiole length ranged between (0.8.5.6) mm in the *C. vulgare* subsp. *arundanum* as a minimum and the *C. congstum* as a maximum. (Table 5, Fig 5).

Bracts:

The bracts in all studied species are characterized by short petiole or sessile, similar to the upper cauline leaves but different in dimensions. The length of the bracts in taxa of genus Clinopodium are the ranged between (4.8) mm in *C. umbrosum* as a minimum, (27.3) mm as a maximum in *C. vulgare* subsp. *vulgare* and the other taxa were between these two ranges, however the width ranged between (2.7-14.8) mm in the *C. umbrosum* as a minimum and *C. vulgare* subsp. *vulgare* as a maximum

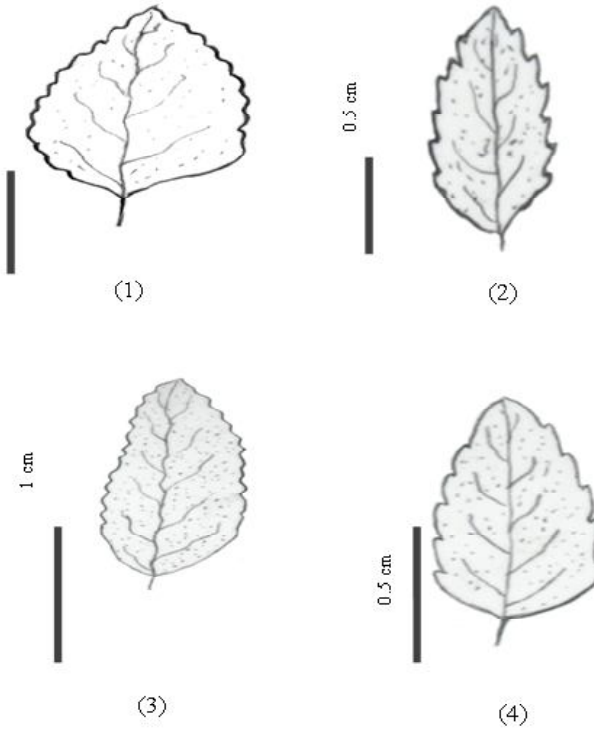

Fig. 5: Upper cauline leaf morphology: 1- *Clinopodiumvulgare*sub sp. *vulgare*; 2- *Clinopodiumvulgare*subsp. *arundanum*; 3-*Clinopodiumcongstum*; 4- *Clinopodiumumbrosum.*

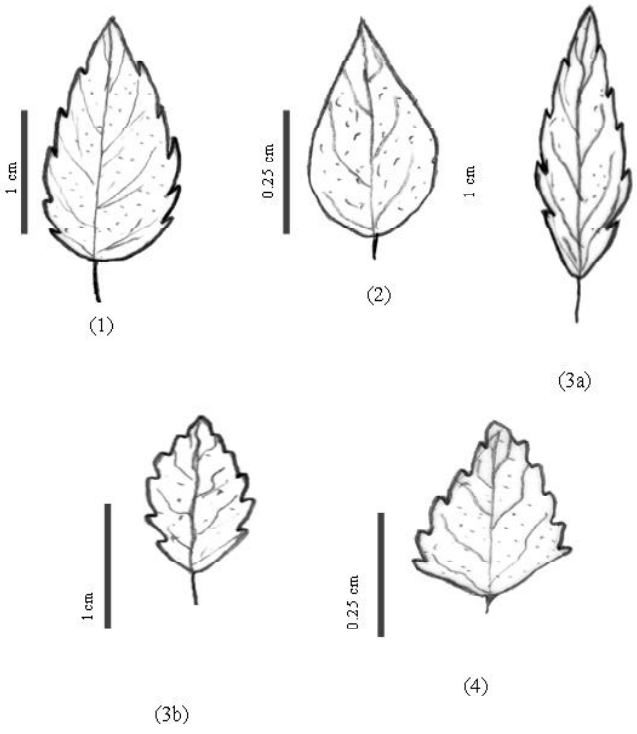

Fig..6: Bract morphology: 1- *Clinopodiumvulgare*subsp. *vulgare*; 2- *Clinopodiumvulgare*subsp. *arundanum*; 3 a , 3 b - *C l i n o p o d i u m c o n g s t u m* ; 4 - *Clinopodiumumbrosum.*

Table 4: Middle cauline leaves characters, measurement in (mm) of all studied taxa.

Species	Blade length(mm)	Blade width (mm)	Petiole length(mm)	Average Length B/P	Margin	Type	Indumentums
Clinopodiumvulgare subsp. vulgare	(20-27)25.4	(14-19)17.1	(9-13)10.5	5.68	Serrulate	Ovate	Velutinous, Puberulente
C. vulgaresubsp. arundanum	(11-19)14.6	(7-12)9.2	(0.5-2)1.8	8.11	Entire	Lanceolate	Velutinous, villous of pilose
C. congstum	(35-48)39.8	(13-25)18.1	(13-20)15.7	2.53	Undulate	Lanceolate	Tomentosee, Wooly
C. umbrosum	(19-26)22.7	(13-20)16.3	(2-3)2.4	9.45	Crenate	Ovate	villous of pilose

Numbers inside the brackets represent minimum and maximum and the number outside represent the average between (20-25) plants.
B: Blade, P: Petiole.

and the other taxa were between these two ranges. (Table 6, Fig 6).

Bracteoles:

Bracteole in species *Clinopodium vulgare* subsp. *vulgare* is linear, puberulent, it has (12.0×0.5) mm average dimension and the length ratio to the calyx is equalize, while the bracteoles in subspecies *C. vulgare* subsp. *arundanum* is subulate, puberulent, the average dimension is (3.0× 0.4) mm and the length ratio to the calyx is lesser, when in species *C. cogstum* is filiform, puberulent, the dimension is (0.8×0.4) mm and the length ratio to calyx is lesser, in species *C. umbrosum* the bracteoles is subulate, velutionous, the dimension is (3.1×0.8) mm and the length ratio to calyx is lesser, (Table 6, Fig. 7).

Inflorescences:

The inflorescence in Lamiaceae a contracted cyme in the axils of leaf. like to much reduced bracts, the opposite pairs of cymes often forming a false whorl (verticillaster) of flowers, sometimes the whole forming a terminal, spike-like inflorescence (Sell and Murrell, 2009). The inflorescences in all genera that studied are verticillaster. In taxa of genus *Clinopodium* the inflorescences are dense or spreading, many flowered, subtended by floral leaves and have various dimension which ranged between (10.4-20.1) × (16.6-34.2) mm, in

Table 5: Upper cauline leaves characters, measurement in (mm) of all studied taxa.

Species	Blade length(mm)	Blade width (mm)	Petiole length(mm)	Average L/W blade	Type	Apex	Base	Margin
Clinopodiumvulgare subsp. vulgare	(26-39)33.5	(14-22)19.1	(3-5)4.1	1.75	Ovate	Acute	Obtuse	Serrulate
C. vulgaresubsp. arundanums	(12-20)16.2	(5-10)7.8	(0.5-1)0.8	2.07	Ovate. lanceolate	Acuminate. cuneate	Cuneate -obtuse	Entire
C. congstum	(15-35)27.8	(6-14)11.3	(4-8)5.6	2.46	Elliptic	Acute	Obtuse	Undulate. entire
C. umbrosum	(10-22)14.6	(8-15)11.3	(1.2-5)1.5	1.29	Ovate	Acute	Obtuse	Crenate. serrulate

The numbers inside the brackets represent minimum and maximum and the number outside represent the average between (20-25) plants.
L: length, W: width.

1 2 3 4

Fig.7: Inflorescence: 1- *Clinopodiumvulgare* subsp. *vulgare*; 2- *Clinopodiumvulgare* subsp. *arundanum*; 3- *Clinopodiumcongstum*; 4- *Clinopodiumumbrosum.*

C. vulgare subsp. *arundanum* as a minimum and the *C. vulgare* subsp. *vulgare* as a maximum and other taxa were between these two ranges, but the peduncle length ranged between (6.1-31) mm with the species *C. vulgare* subsp. *vulgare* as a minimum and the species *C. vulgare* subsp. *arundanum* as a maximum and the other taxa between these two ranges, the numbers of flower in each inflorescences in this genus ranged between (11-21) flowers, with *C. vulgare* subsp. *arundanum* as a minimum and the *C. congstum*as a maximum. (Table 7, Fig. 7).

Flowers:

The flowers in all studied taxa, are hermaphrodite (bisexual) or male-sterile in some flower such as in *C. congstum*, in axillary cymes, often condensed into pseudo-whorls. The length for pedicles in taxa of the genus genus Clinopodium ranged between (2.2-4.2) mm, in *C. vulgare*subsp. *arundanum* as a minimum and the *C. congstum*as maximum and other taxa between these two ranges. (Table 7).

Calyx:

The calyx tube in all studded taxa are curved, it had five subulate teeth and thirteen veins, bilabiate, lower teeth always long ciliate and hairy generally, but especially densely hirsute. Pilose to sparsely hirsute, Pilose, tomentose, and velutinouse, apex acuminate, the length for calyx ranged between (6.7-9.1) mm in the species *C. umbrosum* as a minimum and the species *C. vulgare*subsp. *vulgare* as a maximum,

Table 6: Bracts and bracteoles characters, measurement in (mm) of all studied taxa.

Species	Bract			Bracteoles				
	Length (mm)	Width (mm)	Average L/W	Length (mm)	Width (mm)	Tpye	Length ratio to the calyx	Indumentums
Clinopodiumvulgare subsp. vulgare	(14-32)27.3	(5-19)14.8	1.84	(9-14)12	(0.3-0.6)0.5	Linear	Equal	Puberulent
C. vulgaresubsp. arundanums	(3-10)6.4	(2-6)3.8	1.68	(1.5-3.5)3	(0.3-0.5)0.4	Subulate	Lesser	Puberulent
C. congstum	(15-30)27.1	(5-12)8.3	3.26	(0.6-1.2)0.8	(0.3-0.5)0.4	Filiform	Lesser	Puberulent
C. umbrosum	(4-7)4.8	(1-3)2.7	1.77	(2-4)3.1	(0.5-1)0.8	Subulate	Lesser	Velutionous

The numbers inside the brackets represent minimum and maximum and the number outside represent the average between (20-25) plants.

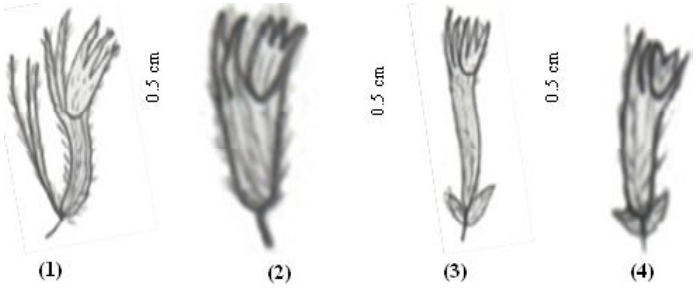

Fig.8: Flowering Calyx with Bracteols: 1- *Clinopodiumvulgare*subsp. *vulgae*; 2- *Clinopodiumvulgare*subsp. *arundanum*; 3- *Clinopodiumcongstum*; 4- *Clinopodiumumbrosum*.

while the width ranged between (1.8-4.3) mm in the species *C. vulgare*subsp. *arundanum* as a minimum and the *C. vulgare* subsp. *vulgare* as a maximum, calyx teeth length ranged between (2.1- 4.0) mm in *C. congstum* as aminimum and *C. vulgare* subsp. *vulgare* as a maximum, while teeth width ranged between (0.8-3.3) mm in *C. vulgare* subsp. *arundanum* as a minimum and the *C. vulgare* subsp. *vulgare* as a maximum. (Table 8, Fig 8).

Corolla:

The corolla in *Clinopodium* taxa are narrowly infundibulariform, two lips the upper slightly concave and distantly emarginated the lower three lobed with different dimension, the color is pink, violet and purple which differs in there taxa of this genus, corolla length in species *C. umbrosum* is (9.8) mm as a minimum and in species *C. congstum* is (14.6) mm as a maximum, the width ranged between (3.2-5.8) mm in *C. vulgare* subsp. *arundanum* as a minimum and the species *C. congstum* as a maximum. The length for corolla tube ranged between (6.4-8.4) mm in *C. vulgare* subsp. *arundanum* as a minimum and species *C. umbrosum* as a maximum, the width ranged between (1.7-2.9) mm, in species *C. vulgare* subsp. *arundanum* as a minimum and species *C. umbrosum* as a maximum. The length for corolla limb ranged between (1.7-6.2) mm in the species *C. umbrosum* as a minimum and species *C. vulgare* subsp. *vulgare* as a maximum, the width ranged between (3.4-6.5) mm in the species *C. vulgare* subsp. *arundanum* as a

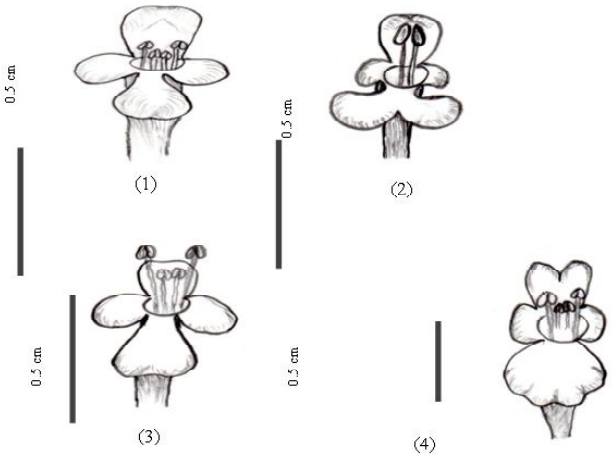

Fig. .9: Corolla morphology: 1- *Clinopodiumvulgare*subsp. *vulgare*; 2- *Clinopodiumvulgare*subsp. *arundanum*;3-*Clinopodium. congstum*; 4- *Clinopodiumumbrosum.*

minimum and species *C. congstum* as a maximum.(Table 9, Fig 9).

Androecium:

The stamens in Lamiaceae are didynamous and consist of two parts; Anther and Filament. Sell and

Table 7: Inflorescences characters, measurement in (mm) of all studied taxa.

Species	Inflorescences		Peduncle		Pedicle length (mm)	No. of flower per inflorescences	Flower density
	length (mm)	Width (mm)	length (mm)	Width (mm)			
Clinopodiumvulgare subsp. vulgare	(15-27)20.1	(23-42)34.2	(3-8)6.1	(2-3)2.4	(2-5)3.5	(11-25)19	Dense
C. vulgaresubsp. arundanum	(8-13)10.4	(8-20)16.6	(25-40)31	(1.5-2)1.8	(1-3)2.2	(6-13)11	Many

Table 8: Flowering calyx characters, measurement in (mm) of all studied taxa.

Species	Length (mm)	Width (mm)	Average L/W	Teeth length		Indumentums
				L (mm)	W(mm)	
Clinopodiumvulgare subsp. vulgare	(7-13)9.1	(3.5-5)4.3	2.11	(3.5-6)4	(3-4)3.3	Ciliate, hirsute, pilose
C. vulgaresubsp. arundanum	(6.5-9)7.8	(1-2)1.8	4.33	(2.3-5)2.6	(0.5-1)0.8	Velutinouse
C. congstum	(8.5-12.5)9	(2.5-3)2.7	3.33	(1.2-5)2.1	(0.5-1.5)1	Tomentosee, pilose
C. umbrosum	(6-7.5)6.7	(1.5-2.5)2.1	3.19	(2.3)2.6	(0.5-1)0.9	Ciliate, velutinouse

The numbers inside the brackets represent minimum & maximum and the number out sided represent the average between (20.25) plants.
L: length, W: width, T: teeth, C: calyx.

Table 9: Corolla characters, measurement in (mm) of all studied taxa.

Species	Corolla		Tube		Limp		Color
	Length (mm)	Width (mm)	length (mm)	Width (mm)	length (mm)	Width (mm)	
Clinopodiumvulgare subsp. vulgare	(10-14)12.3	(3-4.5)4.1	(6-8.5)7.5	(1.5-2.5)2.2	(5-7)6.2	(4-6)5.6	Pink
C. vulgaresubsp. arundanum	(8-12)11.2	(2-4)3.2	(5.5-7)6.4	(1-2)1.7	(2.5-4)3.6	(3-4)3.4	Violet
C. congstum	(12-16)14.6	(5-6.5)5.8	(7-9)8.2	(1.5-2.5)2	(5-7)6.1	(6-7.5)6.5	Violet
C. umbrosum	(7-11)9.8	(4-6)5.4	(5-10)8.4	(2-3.5)2.9	(1.5-2)1.7	(5-6.5)5.8	Purple

The numbers inside the brackets represent minimum & maximum and the number out sided represent the average between (20.25) plants. L: length, W: width, T: teeth, C: calyx.

Table 10: Stamens characters, measurement in (mm) of all studied taxa.

Species	Filament length	Anther			Average length F/A
		Length	Width	Shape	
Clinopodiumvulgare subsp. vulgare	(2-5.5)4.4	(0.5-1.5)1.2	(0.3-0.8)0.6	Reni forme	3.416
C. vulgaresubsp. arundanum	(5-5.7)6.4	(0.5-1.5)1.1	(0.3-0.5)0.4	Oblong	5.818
C. congstum	(3-6)5.1	(0.5-2)1.4	(0.3-1)0.7	Oblong	3.642
C. umbrosum	(4-6)5.1	(1-2.5)2.2	(0.5-1.5)1	Reni forme	2.318

The numbers inside the brackets represent minimum and maximum and the number outside represent the average between (20-25) plants.F: Filament, A: Anther.

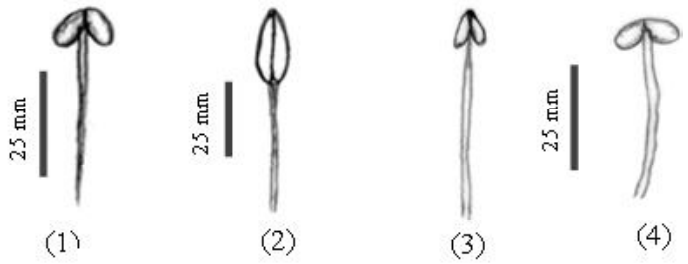

Fig. 10: Stamen morphology:1- *Clinopodiumvulgare*subsp. *vulgae*; 2- *Clinopodiumvulgare*subsp. *arundanum*; 3- *Clinopodiumcongstum*; 4- *Clinopodiumumbrosum.*

Murrell (2009) stated that the androecium of these genera, studied were composed of four stamens two of them long and the two other are two short and sometimes reduced to two anther alternating with the corolla lobes and borne on the corolla tube. In studded taxa of genus *Clinopodium* the stamens are four where two lower pairs are longer than two upper ones while all were shorter than corolla. (Table 10, Fig 10).

Anther:

The anther is introrse, composed of two thecae sometimes one theca sterile or absent. In all taxa studied the attachments of anther are versatile, the common shapes of anthers in all studied genera are reniforme and oblong (Table 11). In *Clinopodium* species the anthers with different shapes and thecae divergent, the anther number is four except subspecies *C. vulgare* subsp. *arundanum* which have two anther only or absent, the anthers dimensions ranged between (1.1-2.2) × (0.4-1.0) mm in *C. vulgare* subsp. *arundanum* as a minimum and the species *C. ambrosum* as a maximum, and had not staminode.

Filament:

In all studied genera the filaments are exerted from lower lip, they are filiform or linear shape and glabrous. They were convoluted inside the corolla before opening flower, but the time when the flower expanded and opens excreted outside the corolla, all filaments attached with corolla tube. The filament in studied genera are flattened, in Clinopodium species glabrous, it is purplish and it is length ranged between (4.4-6.4) mm in *C. vulgare* subsp. *vulgare* as a minimum and the species *C. vulgare* subsp. *arundanum* as a maximum. (Table 11, 10).

Gynoecium:

The gynoecium of *Clinopodium* species consist of one pistil forming from two carpels. The pistils are distinguished to stigma, style and ovary (Table 11, Fig 11).

Stigma:

Stigma in all studied genera consist of two divergent lobed, glabrous, but they are varied in their length and color. The color of stigma in *Clinopodium* species are yellow, light yellow and violet while the length ranged between (2.0-4.5) mm in the *C.* vulgare subsp. *vulgare* as a minimum and the *C. vulgare* subsp. *arundanum* as a maximum.(Table11, Fig 11).

Style:

All studied genera has a filiform shape, glabrous and terminally attached with ovary. The colors ranged between yellow, light yellow, dark yellow, light brown, chaffy, and white. The style lengths in *Clinopodium* species ranged between (6.5-11.0) mm in the *C. vulgare* subsp. *vulgare* as a minimum and *C. vulgare* subsp.*arundanum* as a maximum, width ranged between (0.3-0.55) mm in the *C. vulgare* subsp. *vulgare* as a minimum and the *C. umbrosum* as a maximum. (Table 11, Fig 11).

Ovary:

The ovary in all studied taxa are superior, divided into four lobed or celled, each cell with one ovule. In *Clinopodium* species the dimension ranged between (0.75-1.2) × (0.6-1.0) mm in *C. vulgare* subsp. *arundanum* as a minimum and *C. umbrosum* as a maximum. (Table 11, Fig 11).

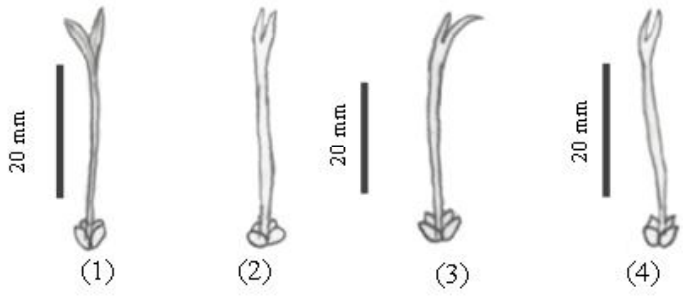

Fig. 11: Gynoicum morphology:1-*Clinopodium vulgare*subsp. *vulgae*; 2- *Clinopodiumvulgare*subsp. *arundanum*; 3- *Clinopodiumcongstum*; 4- *Clinopodiumumbrosum*.

Fruiting parts:

Fruiting calyx:

All studied genera the fruiting calyx has permanent because it remains with fruit for maturation's stage where the calyx broaden and accrescent into fruiting stage, the fruiting calyx remain longest than the nutlet. The indumentums in taxa ranged between velutionouspilose, puberulent and wooly, the length of fruiting calyx ranged between (9.2-12.5) mm in the *C. congstum* as a minimum and the *C. vulgare* subsp. *vulgare* as a maximum, the width ranged between (3.1-4.3) mm in the *C. vulgare* subsp. *vulgare* as a minimum and the *C. umbrosum* as a maximum.(Table 12, Fig 12).

Hilum:

The hilum position in *C. vulgare* subsp. *vulgare* and *C. vulgare* subsp. *arundanum* are basal, the shapes are ‹V› shape and the color is white, but in the species *C. congstum* seriatim are basal, cordate shape and white-cream, while the hilum in the *C. umbrosum* was semi basal, ‹V› shape and white. (Fig 13, 14).

Key to the Species of genus *Clinopodium*

1- Bracteoles subulate, velutinous indumentums, nutletoblong, black……***C. umbrosum***

1- Bracteoles linear, filiform, puberulent indumentums, nutlet ovoid, semi globoid, brown,

Table 11: Pistilescharacters, measurement in (mm) of all studied taxa..

Species	Stigma		Style			Ovary	
	Length	color	Length	Width	color	Length	Width
Clinopodiumvulgare subsp. vulgare	(1.5-2.5)2	Yellow	(5-8)6.5	(0.2-0.5)0.3	Light brown	(0.7-1)0.8	(0.5-0.9)0.7
C. vulgaresubsp. arundanum	(3-5)4	Violet	(9-13)11	(0.2-0.5)0.4	Light brown	(0.6-1)0.75	(0.5-0.8)0.6
C. congstum	(3-5)4.5	Violet	(8-12)10	(0.3-0.6)0.5	Yellow	(0.7-1.3)1	(0.5-1)0.75
C. umbrosum	(2-4)3.5	Light yellow	(7-10)9	(0.4-0.6)0.55	Light yellow	(1-1.5)1.2	(0.8-1.2)1

The numbers inside the brackets represent minimum & maximum and the number out sided represent the average between (20.25) plants.
L: length, W: width, T: teeth, C: calyx.

Table 12: Fruiting calyx and nutletscharacters, measurement in (mm) of all studied taxa.

Species	Fruiting calyx			Nutlets			
	Length	Width	Indumentums	Length	Width	Shape	Color
Clinopodiumvulgare subsp. vulgare	(10-15)12.5	(2-4)3.1	Velutionous	(1.5-3)2.2	(1-2)1.7	semi. globoid	Brown yellowish
C. vulgaresubsp. arundanum	(9-13)10.1	(2-4)3.3	Puberulent	(1.5-3)2.6	(0.5-1.5)1	Ovoid	Chestnut
C. congstum	(6-11)9.2	(3-5)4.1	Velutiono-uspilose	(2-5)3.2	(1-3)2.3	Ovoid	Chestnut
C. umbrosum	(7-12)9.6	(3-5)4.3	Wooly	(2-2.5)2.3	(1-2)1.5	Oblong	Black

The numbers inside the brackets represent minimum & maximum and the number out sided represent the average between (20.25) plants.

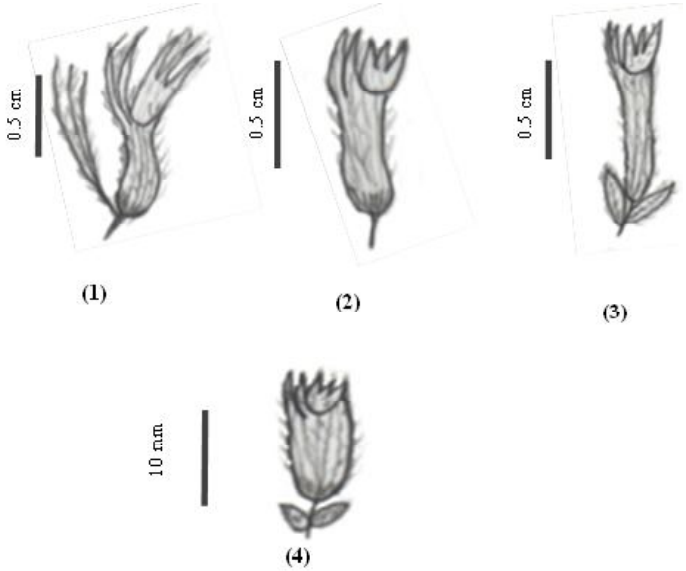

Fig.12:: Fruting Calyx: 1- *Clinopodiumvulgare*subsp. *vulgae*; 2- *Clinopodiumvulgare*subsp. *arundanum*; 3- *Clinopodiumcongstum*; 4- *Clinopodiumumbrosum* .

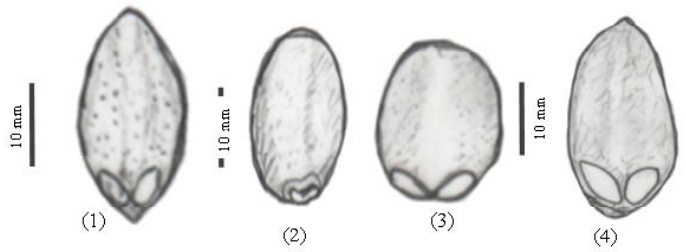

Fig.13: Nutlets and Hilum morphology: 1- *Clinopdiumvulgare*subsp. *vulgare*; 2- *Clinopdiumvulgare*subsp. *arundanum*; 3- *Clinopdiumcongstum*; 4- *Clinopdiumumbrosum.*

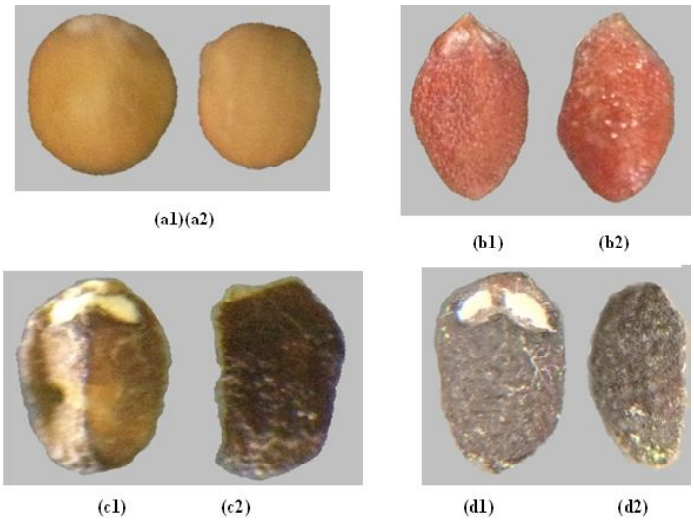

Fig.14: Morphological nutlets picture of *Clinopodium* taxa.: 1- ventral view; 2- dorsal view; a- *Clinopodiumvulgare*subsp. *vulgae*; b- *Clinopodiumvulgare*subsp. *arundanum*; c- *Clinopodiumcongstum*; d- *Clinopodiumumbrosum*.

yellowish .....……2

2- Lower and upper cauline leaves elliptic, bracteoles length (0.6-1.2) mm……***C. congstum***

3- Lower and upper cauline leaves ovate, lanceolate, bracteoles length (1.3-14) mm…….... ***C. vulgare***

Key to the subspecies of *Clinopodiumvulgare*.

1- Bracteoles linear, equal with calyx length, nutlet semi-globoid, color brown yellowish……...**subsp. *vulgare***

1- Bracteoles subulate, shorter than calyx length, nutlet ovoid, color chestnut ….**subsp. *arundanum***

Flowering period:

Flowering period of studied taxa of the genus *Clinopodium* were approximately defined depending on clear from the field trips, literatures and herbarial specimen (Table 1).The flowering period for

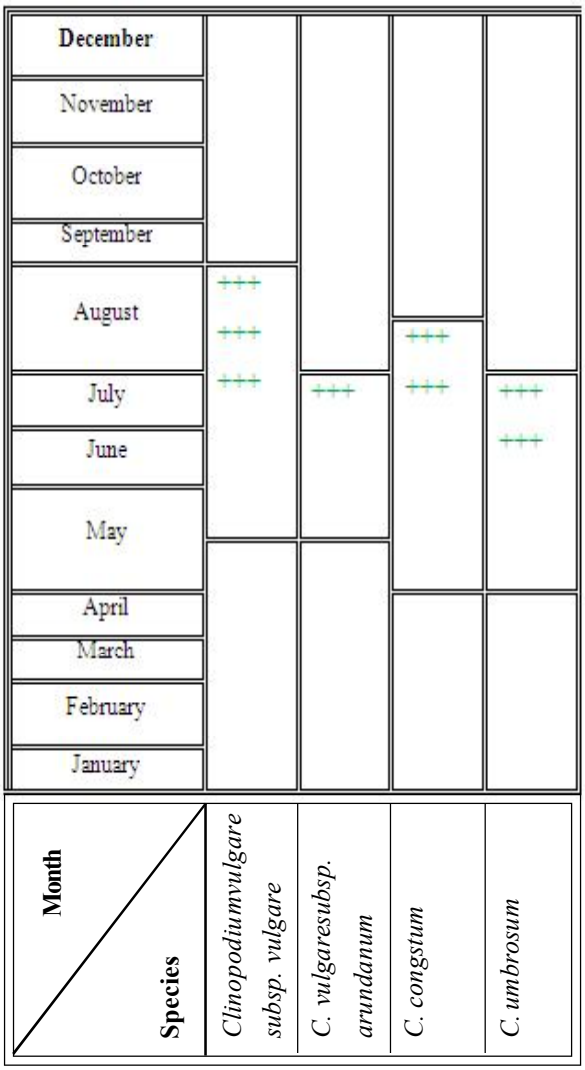

Fig. 15: Estimated flowering periods for different taxa.

Clinopodium taxa appeared that the optimum period of blooming durated from mid of May to mid of July. It was also appeared that the flowering period usually starts from hills and plateaus gradually to high mountain regions (Fig. 15).

Conclusions

The study was done in comparison with four taxa from the genus (*Clinopodium* L.) of the family (Lamiaceae) in Iraq and included a comprehensive study of all parts of the plants of the taxa of the return of the above genus and give a precise and comparative description for all studded taxa. Depending on the apparent and distinct phenotypic characteristics the key was laid to separate all the taxa for the above genus, as the results of this research by registering three taxa (*Clinopodium vulgare* subsp. *arundanum, Clinopodium congstum, Clinopodium umbrosum*,) of the first recorded for Iraq and added to Iraqi Plants. This study is the first in terms of the taxa of the above genus in Iraq.

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