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(Recommended by academician I. O. Baitulin)

MORPHOLOGICAL AND ANATOMICAL ANALYSIS OF CLOSELY RELATED WORMWOODS OF KAZAKHSTAN

Summary

Morphological and anatomical features of two species of *Artemisia glabella* and *A. obtusiloba*, growing in Kazakhstan were studied. The basic morphologo-anatomical features of *Artemisia glabella* and *A. obtusiloba* are character of receptacle, leaves' downiness of T-shaped cells, downiness and character of inner leaves of involucre.

Keyword: morphology-anatomical signs, wormwood smooth, *Artemisia glabella* Kar. et Kir., wormwood blundlobulated, *Artemisia obtusiloba* Ledeb.

91 Species of wormwood with similar morphological features on structure of leaves, heads, stems, i.e. features often used for definition, can be met in the territory of Kazakhstan. One of the most difficult for definition is species, relating to group of species from *A. obtusiloba* Ledeb. genus. First of all, this is *A. glabella* Kar. et Kir, *A. filatovae* Kupr. and *A. hypolitii* A. But., being endemic plants of Kazakhstan (Kupriyanov, Adekenov, 2012).

The comparative morphological analysis of *Artemisia glabella* and *A. obtusiloba* was made repeatedly (Filatova, 1964; Kupriyanov, Mynbayeva, 1989; Amelchenko, 2006). The standard morphological features were used: habitus, structure of stems, sizes and section of leaves, form and sizes of heads. As analysis shows these two wormwoods have close morphological features.

<i>A. obtusiloba</i> Ledeb.	<i>A. glabella</i> Kar. et Kir
Stems – thick arrect, weak leafy, high, 30–40 cm, small number of fruitless sprouts.	Stems – thin, ascending, leafy, 12–30 cm height, big number of fruitless sprouts.
Leaves – lyre-shaped, double pinnately	Leaves – double pinnately divided.

divided.	Primary leaf parts on petiolules, linear, divided in linear oblong whole parts of second order.
Terminal leaf parts – sessile, long lanceolate or lanceolate, top with gristly spinule.	
Heads – globular, 3–4 mm width.	Heads – nearly globular, 2,5–3,5 mm.
Receptacle – thickly downy, long white hairs.	Receptacle – naked.

During the morphological study of large volume of herbarium material was shown that the basic features, using for species differentiation, namely morphology of leaves, give extremely poor results (Kupriyanov, Adekenov, 1987).

Areas of these species are in east part of the Kazakh small hill, where 2 species can be met (Fig. 1). *A. obtusiloba* is widespread in mountain steppe slopes and valleys, in open steppe sites of Tyva, the Western Mongolia, Altai and the Central Kazakhstan. Species is widespread in forest-steppe and steppe zones without lifting highly to mountains. It grows in issues of granites, sandstones, shaly crown layers. The western border of species distribution – Karkaralinsky mountains (East part of the Kazakh small hill), where *A. obtusiloba* is glacial relict.

A. glabella is endemic of Kazakhstan and edificatory of rocky xerophytic vegetation. Its distribution is connected with issues of granitoids in zone of steppe and the northern desert. Areal is small and covers the southern part of the Kazakh small hill from Karkaralinsky mountains in the east up to northern part of desert of Bekpakdala, where replaced with desert species of *A. hypolitii*, which different extremely dense downiness from both species.

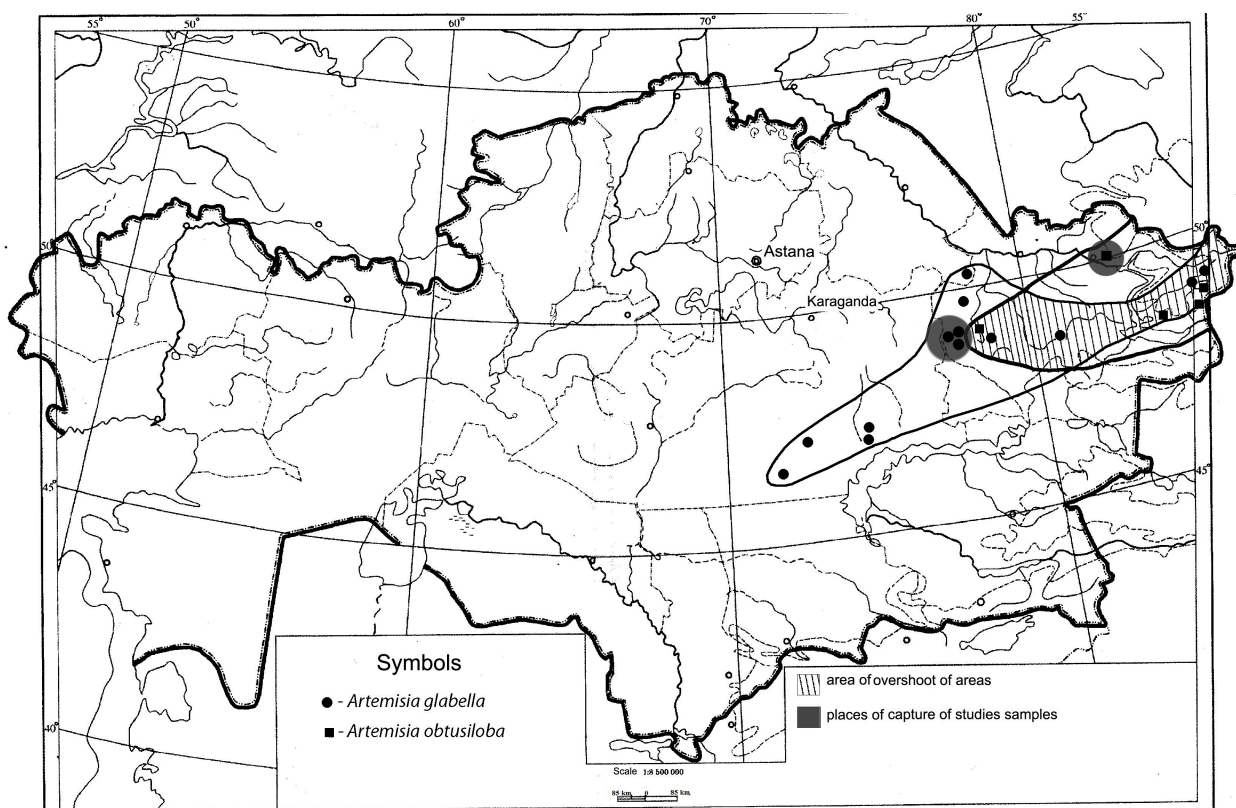


Figure 1 – Natural habitats of *Artemisia obtusiloba* Ledeb., *A. glabella* Kar. et Kir

Question of differentiation of two species of *Artemisia glabella* Kar et Kir and *A. obtusiloba* Ledeb. is interesting in relation of systematization and economic use of these species. For example, *Artemisia glabella* is source of sesquiterpene lactone arglabin, antitumor drug with the same name was developed on its basis (Adekenov, 2002).

Other species – *A. obtusiloba* does not contain sesquiterpene lactones and is not used for the obtaining of biologically active natural compounds (Kupriyanov, Adekenov, etc., 1987).

Flower heads, buds and leaves of *Artemisia glabella* contain sesquiterpene lactones (arglabin, argolide, dihydroamide), and they are absent in aerial part of *A. obtusiloba*, but coumarin was determined (Kupriyanov, Adekenov, 1987).

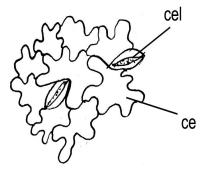
Essential oil of *Artemisia glabella* is blue-green mobile liquid with palatable, persistent, musk smell. Main components of oil: 1,8-cineole (12%), linalool (8%), terpineol – 4 (6.5%), α -terpineol (5%), etc. Main components of essential oil of *A. obtusiloba*: 1,8-cineole (25.2 %), β -myrcene (16.2%), α -terpineol (5.2%) and α -pinene (5.1%). It should be noted that essential oil of *Artemisia glabella* contains azulene-formed sesquiterpenes (up to 1%), which are absent in essential oil of *Artemisia obtusiloba*.

Therefore, search of new features, permitting to differentiate this two species, is an important task.

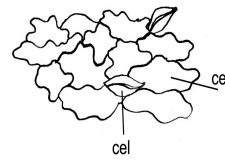
Purpose of our researches is morphological and anatomical comparison of two species of wormwood, meeting in the territory of Kazakhstan – *Artemisia glabella* and *A. obtusiloba*.

Research object is samples of plants, storing in the Herbarium of holding «Phytochemistry» (*Artemisia glabella*: the Karaganda oblast, mountains of Karkaraly, floodplain of Talda river in Burkutty village, 18.07.89. A. Kupriyanov; *A. obtusiloba*: East Kazakhstan, Zaisansky district, Saikan range, Koksoldy hole, 14.06.98. Kupriyanov A.N. Kotukhov Yu.A., Chusovlyanov D.V.). During the research we used methods of study of wormwood, described by V.P. Amelchenko (2006) and M.A. Khanina (1999).

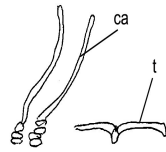
The following features were compared: leaves – surface epidermis, character of downiness, heads – structure of flowers, involuclar bracts and downiness of receptacle. Results are showed in table.



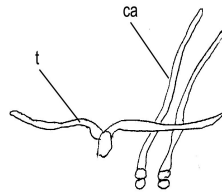
A



B



C



I

20 MCM

II

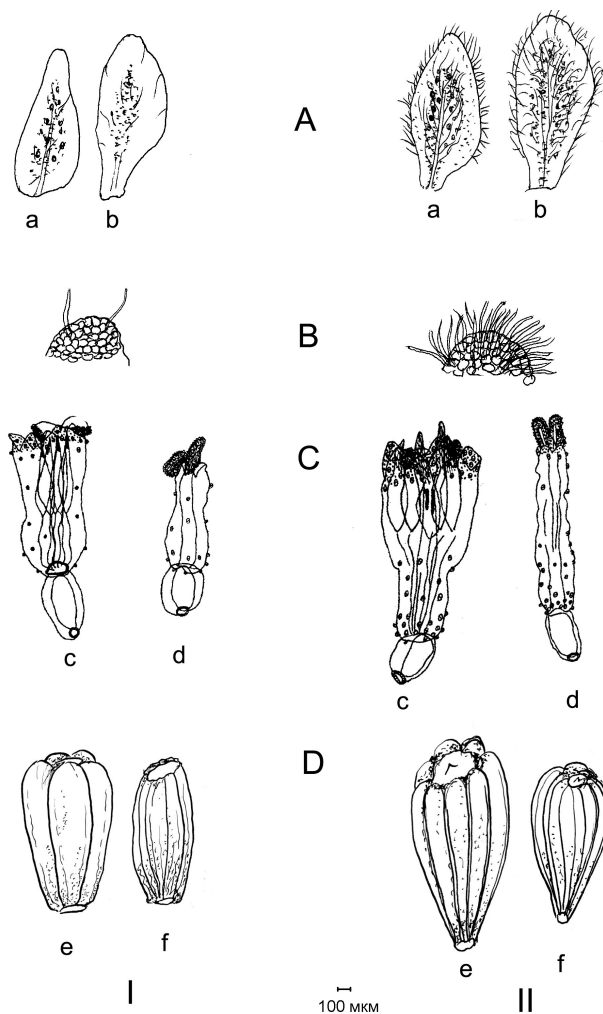


Figure 2 – Epidermis of wormwoods
structure flowers of wormwoods

Figure 3 – The

The morphological and anatomical features of *Artemisia glabella* and *A. obtusiloba*

Organ	Feature	Species	
		<i>Artemisia glabella</i>	<i>Artemisia obtusiloba</i>
Leaf	Upper epidermis (adaxial surface)	Cells – mid-sized, their anticlinal walls - anfractuose, top covered with less developed cuticles (fig.2, IA).	Cells – mid-sized, their anticlinal walls - poor anfractuose (fig.2, IIA).
	Lower epidermis (abixial)	Oblong wall-sided weak anfractuose cells, undeveloped	Prosenchymatous cells with skewed ends (fig.1, IIB).

	sugace	cuticle (fig.1, IB).	
	Hairs	<p>Young leaves – downy with 2-5 cell hairs. The final cell - oblong and acinaciform.</p> <p>Adult leaves - naked with rare T-shaped hairs (fig.2, IC).</p>	<p>Downiness – heavy, consists of two types of hairs: 2 – 3 cell thin-walled, with long final cell and T-shaped 2-3 cell with long thin-walled cross cell.</p> <p>Adult leaves – downy with mainly T-shaped hairs (fig.2, IIC).</p>
Head	Involuclar bracts	Involucre –gmelin type (Amelchenko, 2006), consists from homogeneous leaves, 3-4 in line. Inner leaves - grassy, thick, narrow. Outer leaves - elliptic, with wide scarious edge, grassy and glandular median part (fig.3, IA, a,b).	Involucre –gmelin type (Amelchenko, 2006), 3-4 in line. Inner leaves - grassy, heavy downy, glandular. Outer leaves – wide, their edge – scarious, pilose ciliated (fig.3, IIA, a,b).
	Receptacle	Receptacle – convex, honeycomb-cellulate, naked or rare single-celled hairs (fig.3, IB).	Receptacle – convex, honeycomb-cellulate, not heavy downy with long white silky easy hairs (fig.3, IIB).
Flower	Outer	Pistillate flower - tubular, trilobate, easily ampliate in lower part. Glandules - oval shape, yellow, 2– 4 cellular (fig.3, IC, c).	Pistillate flower – narrow tubular, tricuspid. Glandule - rare, oval form, yellow, 2 – 4 cellular (fig.3, IIC, c).
	Inner	Androgynous flower – wide tubular, easily spread in the end, quinquedentate, one and half time is larger than last pistillate flower, poor glandular (fig.3, IC, d).	Androgynous flower –tubular, spread in top part, quinquedentate, poor glandular (fig.3, IIC, d).
Fruit (Achene)	Outer	Nearly cylindrical, with 5-7 thick rollers, length - 0.8 ± 0.07 mm and width - 0.3 ± 0.07 mm. Areola of affixion of seed to corolla - wide, flat (fig.3, ID, e).	Cone-shaped, with 7 – 9 wide rollers, length – 1.0 ± 0.11 mm. and width - 0.7 ± 0.10 mm. Areola of affixion of seed to corolla - wide with small mucro in center (fig.3, IID, e).
	Inner	Small, not clearly T-shaped, length - 0.5 ± 0.07 mm and	Obtuse, not clearly T-shaped, length – 0.8 ± 0.10 mm and

		width - 0.4 ± 0.06 mm (fig.3, ID, f).	width - 0.7 ± 0.06 mm (fig.3, IID, f).
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Researches showed that the basic morphological and anatomical features of *Artemisia glabella* and *A. obtusiloba* are character of receptacle: *A. obtusiloba* - hairy and *A. glabella* - naked. Examination of big herbarium material, storing in the Herbarium of holding “Phytochemistry” showed that this feature does not depend on the ecological conditions of growth. Downiness of leaves has great systematic value. Adult leaves of *A. obtusiloba* have downiness of T-shaped cells and therefore, leaves seem dimly green. Adult leaves of *A. glabella* have no downiness and therefore, leaves seem brightly green. Young plants and plants at the beginning of vegetation have downiness, but high intensity is observed in *A. obtusiloba*.

A. glabella has poor downy and wide scarious edge of inner leaflets of involucre, while *A. obtusiloba* has downy hairs and narrower membranous edge.

The researches permit to choose the most important morphological and anatomical features for division of morphologically close species of wormwood of Kazakhstan.

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Резюме

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ҚАЗАҚСТАННЫҢ ЖАҚЫН ТУЫСТАС ЖУСАНДАРЫНЫҢ МОРФОЛОГИЯЛЫҚ-АНАТОМИЯЛЫҚ ТАЛДАУЫ

Қазақстанда өсетін жақын туыстас жусанның екі түрі: тықыр жусанның (*Artemisia glabella* Kar. et Kir.) және доғал бөлікті жусанның (*A. obtusiloba* Ledeb.) морфологиялық-анатомиялық ерекшеліктері зерттелді. *Artemisia glabella* үшін жалаң гүл тұғыры тән, жапырақтардың және қабығындағы жапырақтарының мамық-тануы тек жас өсімдікке тән. *A. obtusiloba* үшін гүл тұғырының қалың мамықтануы, жапырақтардың және қабығындағы жапырақтарының гүлдену мерзіміне дейін түспейтін айқын мамықтануы тән.

Кілт сөздер: морфологиялық-анатомиялық сипаттамалар, тықыр жусан, *Artemisia glabella* Kar. et Kir., доғал бөлікті жусан, *Artemisia obtusiloba* Ledeb.

Резюме

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МОРФОЛОГО-АНАТОМИЧЕСКИЙ АНАЛИЗ БЛИЗКОРОДСТВЕННЫХ ПОЛЫНЕЙ КАЗАХСТАНА

Изучены морфолого-анатомические особенности двух видов полыни: полыни гладкой (*Artemisia glabella* Kar. et Kir.) и полыни туподольчатой (*A. obtusiloba* Ledeb.), произрастающих в Казахстане. Для *Artemisia glabella* характерно голое цветоложе, опушение листьев и листочков обертки только в молодом возрасте. Для *A. obtusiloba* – густоопушенное цветоложе, явное опушение листьев и листочков обертки, не стирающееся ко время цветения.

Ключевые слова: морфолого-анатомические признаки, полынь гладкая, *Artemisia glabella* Kar. et Kir., полынь туподольчатая, *Artemisia obtusiloba* Ledeb.

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