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Biological Specifics and Chemical Composition of Medicinal Plant *Eminium regelii* Vved

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Abstract: The aim of the present work was to study areal of *Eminium regelii* Vved in Kazakhstan territory, its biological specifics and chemical composition. *Eminium regelii* Vved was discovered on the territory of Kazakhstan national reserve Aksu-Zhabagly. Distinctive biological characteristic of *Eminium regelii* is a wedge-shaped base of a leaf that smoothly turns into petiole. Leaf base of Eminium lehmannii is heart-shaped or obtuse-angled. Specific weight of aluminium is the greatest of all 21 elements contained in over-ground and underground parts of plant. Leaves contain 24% of aluminium and tubers contain 66% of aluminuim of all amount if mineral elements. Two flavonoids are discovered in *Eminium regelii*: luteolin and quercetin.

Key words: *Eminium regelii* · Aksu-Zhabagly · Mineral Elements · Luteolin · Quercetin

INTRODUCTION

Perennial herbaceous plant *Eminium regelii* Vved belongs to genus Eminium family *Aracea*.

Genus Eminium consists of about 9 species of plants growing on the territory from South Africa to Central Asia: *E. alberti, E.jaegeri, E. heterophyllum, E. infortum, E. koenenianum, E . lehmanni, E. rauwolffii, E. regelii, E. spiculatum*. Two species (*Eminium regelii*. Vved. и *Eminium lehmannii*. Bunge) grow on the territory of Kazakhstan.

Plants of Eminium genus were mentioned for the first time in the work of senior botanist of Peter the Great's Botanic Garden Fedchenko B.A. "Vegetation of Turkestan" [1].

Local population of Central Asia has been applying plants of Eminium genus as medicinal plant for a long time. It is used in treatment of a number of diseases such as splanchnopathy, against neoplasms, tuberculosis and others.

Eminium lehmannii (Bunge) has been included in The Red Book of Kazakhstan, it is protected plant. Its areal in Kazakhstan territory is limited to sandy deserts Moinykum, Qyzylqum and it is very rare [2].

Literature about *Eminium regelii* Vved that is the second specie of Eminium genus growing in Kazakhstan territory are scanty. According to Pavlov N.V., Gegelii grows in foothills and bottom flange of mountain regions [2].

The aim of the present work is to inspect areal of *Eminium regelii* Vved in Kazakhstan territory, its biological specifics and chemical composition.

MATERIALS AND METHODS

Moisture and mineral ashes content in over-ground and underground organs of *Eminium regelii* was defined by gravimetrical method on the first stage of chemical composition definition.

Quantitative definition of mineral elements was made by method of mass spectrometry of inductively coupled plasma with apparatus "Varian 820-MS SINGLE PHASE EUR".

Alkaloids were extracted with acetic acid for qualitative reactions. Granular tubers (Leaves) were placed in test-tube, covered with 1% CH_3COOH with further boiling for 5 minutes. After filtering solution with filtrate qualitative reactions were performed.

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Alkaloids content in filtrate from *Eminium regelii* organs was evaluated by qualitative reactions with Wagner-Bouchard, Meyer and Marmet reagents [3].

The following reactions were made for qualitative detection of saponins:

- Foaming reaction. Aqueous extract of specimen (1:10) was shaken in test-tube for 15 s.
- Coloring of 2 ml of aqueous extract in 1 ml of sodium nitrate 10% solution and 1 drop of concentrated sulphuric acid.

For qualitative reaction of flavonoids detection Chinoda test was made (Qualitative reaction on flavonoids).

Three breakers were filled with 1 g of granulated tuber or leaves and 10 ml of 95% ethyl alcohol. Solution had been kept in water bath for 3 hours. Than solutions were filtered. Than filtrate was evaporated. Dry dark-brown residue was left in breakers. It was diluted with distilled water divided into two volumes and poured in 2 test-tubes. 3 drops of concentrated hydrochloric acid was added in each test-tube and in one tube 0.03 g of blue powder. After that test-tubes were placed in water bath.

Qualitative detection of total flavonoids content in leavers and tubers of *Eminium regelii* was made by spectrophotometry [3]. Individual flavonoids luteolin and quercetin were detected by high effective liquid chromatograph Shimadsu Lab Solutions (Japan) with photometric detecting.

RESULTS AND DISCUSSION

Itinerary expeditions to mountainous regions of East Kazakhstan were undertaken to define areal of *Eminium regelii* Vved. These regions are northern slope of Tarbagatai, Zaisanski region of Saur and Saikan mountains, on Delbegetei - western extremity of mountain range Kalbatau, to coastal deserts of Zaisan lake and over the territory of national reserve of Kazakhstan Republic – Aksu-Zhabagly and neighbouring territories.

Plants of Eminium genus in Eastern Kazakhstan were not found. Populations of plants of this genus were found on the territory of Aksu-Zhabagly reserve and environs of Zhabagly village.

Plants of Eminium genus areal in the reserve is limited by foothills Boransha-Asu, canyons Boransha-Asu and Taldybulak. Outside the reserve plants of Eminium genus were found in intermountain valley Sanlak, in forest replantation along railway Abaily.

Areas where Eminium populations were found in are shown on Fig. 1. Calculation of its abundance, frequency of occurrence was done and phenological observations had been done.

Plant of Eminium genus that we had found was defined as *Eminium regelii* Vved in accordance with Pavlov [2].

Phenological observations of *Eminium regelii* development phases had been carried out in foothills Boransha-Asu, in canyon Taldybulak, in intermountain valley Sanlak beyond reserve territory. These sides are on 1200 m above sea level. Germinants and fist leaves of *Eminium regelii* appeared from 9 to 22 of April. Assimilatory leaves are of petiolar type, dark green, wide lanceolate, germinating directly from bulbotuber. Number of lamina that appears over soil surface depends on age-specific features of plant.

For example, in infant stage of development a plant has only 1 lamina. In matured generative stage a number of assimilatory leaves increase from 4 to 10 (Fig. 2). Length of first lamina is 10-20 cm in average.

Inflorescence ear was observed from 26th of April. Flowering of a plant on the territory on slopes of Boransha-Asu begins 8-10 days later that in all studies territories due to temperature. Mass flowering *Eminium regelii* on experimental grounds began on the 3rd of May and ended on 15th of June.

Inflorescence ear in initial development stage is inside wrap that has expressed long ribs. From outer side of wrap in lower part of a plant (Closer to ground surface) transparent cellular scarious leaves are forming that later turn into closed tubes. At the end of vegetation seeds remain in closed tubes being protected from adverse environmental conditions.

Inner part of wrap is dark vinous, it surrounds an ear only from one side forming a hose. Average length of wrap is 7-11 sm, width is 3-6 sm. Pulpy ear is dark violet, its upper part is sharp (Length of an ear is 4-10 sm) (Fig. 2).

Abortive (Agamic) male and female blooms are formed in hose cavity covered by wrap. In the lowest part of inflorescence female blooms are formed. White subulate small abortive blooms are above them and above the latter there are male blooms (Fig. 3).

Forming and maturing of *Eminium regelii* fruits on all testing grounds were observed from 14th of June to 20th of June. Fruit is white pulpy berry. Number of berries in one plant is 10-40.

Complete drying of pulpy berries inside closed tube formed of inflorescence's wrap was observed from the end of June to the beginning July.

Fig. 1: *Eminium regelii* areal cartogram
♦ - Territories of growing and spread

Fig. 2: *Eminium regelii* in generative stage

Fig. 3: Opened lower parts of ears (In the hose of wrap) with female, abortive and male blooms.

Eminium regelii seeds are globular brown-red. Seed length is 0.5 cm in average. Seeds are covered with firm small cellular shells. Most seeds remain on the surface of the ground.

Bulbotuber is underground organ of *Eminium regelii*. Bulbotuber has closed globular form. Bulbotubers sit on the depth of 10 cm and more. Old bulbotubers die off and new bulbotubers grow over them.

Size and form of bulbotubers depend on age-specific features so they have different morphological construction. Relatively small size of bulbotubers is typical for young populations and old populations are characterized by relatively big size of bulbotubers. Nutritive material necessary for plant living are accumulated in bulbotubers.

Table 1: Moisture and mineral ashes content in *Eminium regelii*

	Plant's organs			
Indicators	Leaves	Ear	Bulbotuber	Fruit
Moisture, %	85.65±0.20	82.01 ±2.85	75.46±3.55	74.80 ±1.21
Ashes content, %	0.85±0.19	0.82± 0.15	0.76±0.11	0.85± 0.17

Additional spindle-shaped white roots forms around the upper part of bulbotuber.

Contracting (Retractive) roots are typical for plants of Eminium reg *Eminium regelii* genus. Such roots are pulpy thick and characteristic for plants older that two years that have only two and three roots. Thick contracting roots near the base begin to corrugate shrink vertically and draw in bulbotuber. In the ground contracting roots are not deep but closer to the surface.

Besides propagation by seeds *Eminium regelii* propagate also vegetatively. Small bulbotubers (Bulbils) grow from side parts of new or last year's bulbotubers. Their form is similar to the form of mother bulbotubers but they are several times smaller than mother bulbotuber. Small bulbotubers formed of one mother bulbotuber produce new plants next year.

Aboveground vegetative organs (Assimilatory, integumentary and lower lamellar leaves) of *Eminium regelii* in examined areas completely finish vegetation and start to die off.

The period of biological rest of *Eminium regelii* is very short. Forming and maturing of seeds starts in July and in the beginning of August new germs form bulbotuber appear. This phenomenon was observed even in herborized *Eminium regelii* plants that were selected for chemical analysis.

There is almost no information about chemical composition of *Eminium regelii* in literature. There are just separate data on the content of alkaloids, lipids and glycolipids in *Eminium regelii* plants [4- 6].

As it may be seen from Table 1 all organs of analyzed samples are characterized by high content of moisture 74.8 to 85.65 %).

Mineral remainder is small lower than 1%, besides, ashes completely dissolved in 10% hydrochloric acid that shows that mineral impurity in the form of soil remainders (Sand, dust, etc.) are almost absent in vegetation preparations.

Eminium regelii samples (Leaves, ear, bulbotuber and fruit) contain different chemical elements (Table 2).

Significant content of such elements as phosphorus, aluminium, chromium, potassium, calcium and also natrium, magnesium, iron and nickel. Other elements are contained in small amount some of them only in trace quantity. For example, trace quantities of lead, thorium, uranium and arsenic were found.

As Table 2 shows largest content of mineral elements was observed in leaves and ears of *Eminium regelii* and the lowest content in bulbotubers.

Aluminium has the greatest share of all 21 elements contained both in underground and over ground parts of a plant. 24% aluminium is contained in leaves while aluminium content in bulbotubers is up to 66% of all mineral elements.

Alunimuim is relatively widely used in medicine. Preparations that contain aluminium have anesthetic, coating, absorbing and antacidic action. Antacidic action means that these preparations interacting with hydrochloric acid in stomach decrease acidity if stomach content that allows relieving the course of drug-induced gastritis with tuberculosis patients resulting from long-term treatment with antituberculous preparations.

Relatively high content of potassium was observed in bulbotubers of *Eminium regelii*. Potassium content is 23% of all amounts of mineral elements. There is 9% of potassium in leaves of *Eminium regelii*. It is necessary to improve cardiac function of tuberculosis patients.

Extract from bulbotubers of *Eminium regelii* produced brown amorphous sediment with Wagner-Bouchard reagent and brick-red sediment with Dragendorf reagent. Meyer and Marmet reagents did not produce sediments. That means that there are indol alkaloids in bulbotubers [3].

Water extract of plant preparation (1:10) after shaking test-tube for 15 seconds produced stable foam that was intact for 5 minutes. Adding 1 ml of 10% nitrate and 1 drop of concentrated sulphuric acid to 2 ml of water extract produced dirty-yellow coloring, after adding water solution of caustic potash initially greenish appeared sediments appeared that turn into red-brown that means that *Eminium regelii* contained saponin.

Table 2: Chemical elements content in *Eminium regelii* organs

	Content of mineral element, mg/kg			
Element	Leaves	Ear	Bulbotuber	Fruit
Beryllium Be	0.67122	0.449164	0.59537	1.03703
Boron B	15.45500	17.79117	15.63073	22.15324
Natrium Na	23.40269	13.47333	0.75214	13.05408
Magnesium Mg	9.82815	5.28467	0.36984	5.41593
Aluminium Al	588.68080	296.92120	961.67850	424.25150
Phosphorus P	1075.37000	1136.20900	129.01790	663.05880
Potassium K	223.66250	336.41470	329.31670	263.56710
Calcium Ca	146.34180	36.73520	5.78123	116.21850
Chromium Cr	335.47210	108.00620	7.93770	116.21850
Manganese Mn	0.64107	0.27929	0.02178	0.23109
Iron Fe	2.98410	1.67121	0.03251	1.02525
Cobalt Co	0.39516	1.52678	0.01811	0.16012
Nickel Ni	2.42594	11.48555	0.11134	0.97805
Copper Cu	0.76020	6.18809	0.05040	0.42615
zInc Zn	0.53499	0.87473	0.07321	0.28937
rubidium Rb	0.48074	0.65475	0.05291	0.51471
strontium Sr	0.05262	0.02325	0.01255	0.03042
Silver Ag	0.00409	0.00675	0.000139	0.00130
Cadmium Cd	0.02929	0.01655	0.00213	0.01284
Caesium Cs	0.06810	0.10650	0.00606	0.05017
Barium Ba	0.00202	0.00099	0.00179	0.00560
Total minerals content	2427.26300	1974.11900	1451.46300	1628.70000

Results of these qualitative reactions indicate possible presence of saponins [6].

Violent reaction with gassing in cyanide test with plant preparations filtrates and dark-red coloring indicate presence of flavonoids in bulbotubers and leaves of *Eminium regelii* [6].

So, qualitative reactions demonstrated that leaves and bulbotubers contain biologically active compounds: indole alkaloids, saponins and flavonoids. Basing on our research we found out that flavonoid total in terms of luteolin is 0.15%.

Two main flavonoids were found in Eminium regelii plants: luteolin and quercetin. 0.069 % of luteolin and 0.066 % of quercetin were fund in bulbotubers. There content in leaves is lower – 0.035 % and 0.044 % respectively.

CONCLUSION

There is almost no information about Eminium genus plants using in traditional medicine while in folk medicine of Central Asia and Kazakhstan Eminium genus plants were applied for treatment of different diseases.

For example in Kyrgyzstan dry and granulated underground part of plants is used for smoking in treatment of syphilitic affections of nose and larynx. Water or milk infusion of bulbotubers is used for treatment of rheumatism, arthralgia, radiculitis. In Kazakhstan kumis infusion of bulbotubers is used for treatment of pulmonary tuberculosis [7].

Our research has shown that besides non-organic elements leaves and bulbotubers contain biologicaly active compounds: indole alkaloids, saponins and flavonoids. We proved presence of two flavonoids – luteolin and quercetin.

It is well-known that luteolin has wide range of medical features. It has anti-inflammatory and anticarcinogenic action. Not only has it prevented development of tumors but increase action of anti-cancerous medical preparations. It has cytotoxic action on tumor cells and it is also high effective antioxidant [8, 9].

Scientists of Cameroon have shown anti-inflammatory activity of luteolin extracted from 2 species of rubber plant against Mycobacterium tuberculosis that is causative agent for 90% of tuberculosis cases [10].

Jordan scientists extracted and studied 6 organic substances extracted from blooming over-ground parts of Eminium spiculatum. These substances are luteolin, luteolin-7-O-glycoside, isoorientin, criseriol -7-O-glycoside, viteksin, β-sitosterol.

Luteolin in concentration 0.625mg/kg demonstrated anti-inflammatory activity against Staphylococcus aureus, viteksin and isoorientin has lower anti-inflammatory activity. Luteolin, isoorientin, criseriol-7-O-glycoside, β-Sitosterol also depressed proliferative activity (Reproduction) of cancer cells MCF-7 and T47D [11].

Viteksin, isoorientin, luteolin-7-O-glycoside, criseriol-7-O- glycoside content in leaves of Eminium spiculatum that vegetated in Greece was shown in 1988 for the first time [12].

So, analysis of literature allows showing anti-tuberculosis and anti-cancerous activity of *Eminium regelii* plant that vegetates on Kazakhstan territory. This activity may be explained by luteolin presence that we found in leaves and bulbotubers. This assumption needs further research.

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