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Medicinal Plants, Containing Cardiac Glycosides and Their Distribution

[1]A.I. Ahmetzhanova
[2] S.N. Atikeyeva
[3] A.K. Auyelbekova

[1] Karaganda State University of the name of academician E.A. Buketov, Kazakhstan
28 Universitetskaya Str., Karaganda 100028
PhD (Biology), Professor
[2] Karaganda State University of the name of academician E.A. Buketov, Kazakhstan
28 Universitetskaya Str., Karaganda 100028
PhD (Biology), Assistant Professor
E-mail: s-atikeeva@mail.ru
[3]Karaganda State University of the name of academician E.A. Buketov, Kazakhstan
28 Universitetskaya Str., Karaganda 100028
PhD (Biology), Assistant Professor
E-mail: a-auelbekova@mail.ru

ABSTRACT. In this paper the authors consider bioecological peculiarities of some species of medicinal plants, containing cardiac glycosides and their distribution. The paper presents the tables, which contain data of the quantitative content of the amount of cardiac glycosides in the aerial and underground parts of some species of the Cruciferous, Buttercups, etc. in different ecological conditions. The article also introduces the specie of foxglove from the family of figwort, which defines the quantitative content of cardiac glycosides, as the leaves of these plants are a source of raw materials, producing cardiac glycosides.

Keywords: cardiac glycosides; Cruciferous; ecological conditions; Syrenia siliculosa; Patrinia (valerian family) in natural conditions.

INTRODUCTION. The aim of our work is to study the biological and ecological characteristics of some species of medicinal plants, containing cardiac glycosides, their distribution and quantitative content of glycosides in the above-ground and underground organs.

MATERIALS AND METHODS. Such core indicators, as color, flavor and the main components were introduced for all the samples of essential oils.

A comparative study of the quantitative content of cardiac glycosides in the flowering stage of seven species of plants, collected from different habitats and of eight introduced species has been carried out. The technique, developed by G. Genkina and NK Abubakirova was used to determine the total content of glycosides in the studied species [7].

DISCUSSION. Despite the significant progress, achieved in the synthesis of drugs, the problem of using plants for medical purposes is still relevant. Special attention of researchers in recent years has been attached to plants, containing cardiac glycosides, which are similar in their effect to strophanthin. Some of the cabbage family: Syrenia siliculosa MB Andrz in DC, Syrenia sessiliflora Ledeb., Erysimum diffusum Ehrh. Beitz., Erysimum cheiranthoides L., Erysimum Czernjajavii N. Bucsh., of the buttercup family – Adonis wolgensis L., from the family of valerian – Patrinia intermedia Hornem Roem, Et Schult., and 4 species of foxgloves of the figwort family [1] are among them.

Syrenia siliculosa MB Andrz in DC – biennial herb, its height is 40-80 cm. Stem is straight, more or less branched, covered with leaves, double-ended and villous. It grows in the following floristic regions: Tobol-Ishim, Semipalatinsk, the Caspian, Mangyshlak, North Ustyurt, Aral Sea, Aktobe, Turgay, Balkhash-Alakul, Tarbagatai, Junggar, Zayliskiy and Kungei Alatau. It also grows in South and South-East Lake Balkhash, in addition to the Syrenia siliculosa, the other widespread

type of Syrenia Syrenia sessiliflora Ledeb, which grows in this region [2, 3]. Both types of plants are ammophilous and according to ecomorphs they refer to psammoxerophytes. Both species are spread in the open expanses of desert and semi-deserts of Kazakhstan, they do not grow in the mountains. In addition, they usually prefer dry, thin soil with rather deep groundwater table.

Top reserves of Syrenia siliculosa and Syrenia sessiliflora Ledeb in the deserts of South and South-Eastern Balkhash are 262.2 m [3]. Above-ground parts contain cardiac glycosides of strophanthinous function. About 8 flavonoid substances are found in the blooms, and alkaloids are in the roots [3, 4].

In the above-ground part of Syrenia siliculosa the amount of glycosides is equal to 0, 152-0,420 %, in Syrenia sessiliflora Ledeb – 0,163–0,447 %, in leaves – 0,303–0,315 %, in inflorescences – 0,034–0,041 %. The maximum amount of glycosides are found in the seeds (it is equal to 0,760-0,800%). Above-ground part of Syrenia siliculosa is used in medicine, collecting is carried out in southern areas in the first half of May at the second year of life at the beginning of plant's blooming. The pharmacological activity of herbs of Syrenia siliculosa is due to its content of cardiac glycoside-syrenid and syrenia toxin. The drug, containing syrenia is used in the treatment of circulatory deficiency [3].

Erysimum patula – Erysimum diffusum Ehrh. Beitz – Biennial herb, 60-90 cm tall, stem is single or multiple, branched, covered with double-ended hair. It is widespread in European part, Caucasus, Central Asia, Western and Eastern Siberia, Western Europe, the Balkans, in Mongolia. It is found in floristic regions of Kazakhstan as Tobol-Ishim, Mugojar, West Hummocks, Ulutau, Zayliskyi and Kungei Tau, Tau, Western Tien-Shan, Karkaralinsk, Tarbagatai, Junggar and Altai, and the Balkhash-Alakul. This plant grows in mountain belts and shrub as well as in the steppes and high mountains, there are many xerophytes among them, locating on cliffs, dry hills, steppes and deserts. All of them are adjusted to dry soil [4].

Erysimum diffusum thickets are of commercial importance in southern Kazakhstan. Flowering above-ground part of Erysimum are harvested in early May, in the northern regions in June in the second year of plant life. The grass contains cardiac glycosides: flowers and seeds - 0.4–0.6 %, leaves – 1–1.5 %, stems – 0.5 to 0.7 %. Glycoside – erizimin, erizimotsid are isolated from grass and seeds. Pharmacological action of diffusum Erysimum glycosides is close to strophanthin. Erysimum 'kardiovalen "and erizid – concentrate drugs are used in rheumatic heart defects, cardiosclerosis, angina and vegetative neurosis. Treacle erysimum – Erysimum cheiranthoides L. is an annual herb, unlike diffusum Erysimum it is characterized by a broad lanceolate leaves, bright yellow color of petals, longer pedicels in comparison with calyx and short pods. It grows on dry meadows, forest edges, coastal cliffs, and as a weed – all across Kazakhstan. Erihrozid, eritrozid, dizglukoericordyn and ericordyn were isolated from Treacle erysimum, they possess strophanthinous action.

Erysimum Chernyayev – Erysimum Czernjajavii N. Bucsh is a biennial herb, 35–60 cm in height, differs from the diffusum Erysimum by branched, nearly naked stems, long branches and almost horizontal, 40 cm in length, yellow or pale yellow flowers. Sepals are pubescent with five-pointed hair and star-shaped hair on top. Pods are glabrous or slightly covered with 2–3 separate hair. It grows on rocky and sandy steppes, dry mountain slopes. Reserved stocks are observed in the northern part of Taukum. The Erysimum Chernyaev's quantitative content of cardiac glycosides in the flowering stage is equal to 0,416–0,539 % and the biological activity is observed in fruiting stage [3].

Adonis wolgensis – Adonis Wolgensis L. is perennial herb of 15–30 cm tall. It is widespread in Europe, some parts of the CIS, the Caucasus, Western Siberia, Western Europe, Northern and Central Kazakhstan. It grows on the steppes, hummocks, declensions of the slopes, and brushwood. There is almost no brushwood of industrial importance in Kazakhstan. At least 10 substances of kardinol nature were found in the above-ground parts. Their leaves contain about 0.117% cardiac glycosides. Adonis Wolgensis hasn't been used for medical purposes yet, but has biological activity and is considered as a substitute for spring Adonis [4, 5, 6].

Patrinia Intermedia Hornem Roem, Et Schult is perennial herb, 20-35 cm in height. It occurs in Semipalatinsk, Borovoye, West and East hills, Karkaralinsk, Betpakdala, Balkhash-Alakol, Altai, Tarbagatai, Junggar Alatau Ketmen, Terskey-Alatau, Chu-Ili mountains, Kirghiz Alatau Western Tien-Shan. It grows in mountain-steppe zone on rocky hillsides, in river gravels and in the feather rocky grassland steppes. Considerable natural reserves of Patrinia have been found in Jungar

Alatau. The reserves of Patrinia are established in some rocky-gravelly places along the mountain slopes and screes of Karkaraly mountains. Reserves of Patrinia's dry roots, found in several valleys of ridges of Ketmen, Zaylisky, and Kirzisky Jungar Alatau, range from 0.45 to 34 m. Underground parts contain 13 % of triterpene saponins, tannins, volatile oils, alkaloids, sugars and organic acids [6–9].

Comparative data of the cardiac glycosides quantitative content and their amount in plants growing in different ecological conditions showed, that their number is not the same and undergoes considerable fluctuations (Table 1).

Plant species	Phases of evolution	The quantitative content of glycosides
Syrenia siliculosa	bloom, the beginning of fruiting	0,152–0,420
Syrenia sessiliflora	bloom, the beginning of fruiting	0,163–0,447
Erysimum diffusum	bloom	0,09–0,340
Erysimum cheiranthoides	bloom, the beginning of fruiting	0,154–0,370
Erysimum Czernjajavii	the beginning of fruiting	0,104–0,512
Adonis wolgensis.	bloom, the end of the fruiting	0,173–0,431
Patrinia intermedia	bloom, the end of the fruiting	0,187–0,577

Table 1: The quantitative content of the amount of glycosides in the above-ground parts of some species of Cruciferous family and underground bodies of Adonis Volga (Buttercup family) and the average Patrinia (valerian family) in natural conditions (% of air-dry plants weight).

As it can be seen from the table the content of glycosides in the above-ground parts of the studied species, taken at the same stage of growth from different habitats, varies in all of the studied species, for example: a Syrenia siliculosa fluctuates from 0.152 to 0.420, Syrenia sessiliflora 0.163–0.447, Erysimum diffusum 0.09–0.340, Erysimum cheiranthoides 0.154–0.370, Erysimum Czernjajavii 0.104–0.512. Other species, for which underground part is a source of raw materials and rhizomes of the Buttercup family Adonis wolgensis contained 0,173–0,431 glycosides; while the content of glycosides in Patrinia intermedia valerian family was equal to 0.187 % – 0.577 [11].

Besides, studying the quantitative content of glycosides in the above-ground parts of the studied species, we also distributed cardiac glycosides into body parts. As a result of our research, we came to conclusion that the highest content of glycosides is observed in the seeds of two species of Syrenia and Erysimum. In Syrenia sessiliflora - 0,560–0,680, Syrenia siliculosa - 0.486–0.570; a diffusum Erysimum – 1.301 %, Erysimum Czernjajavii - 1.782, the lowest number 0.009 % - 0.040 % was found in the roots of Czernjajavii.

The quantitative content of cardiac glycosides was also conducted for four types of introduced digitalis from figwort family, since the leaves of these plants are the raw material source for production of cardiac glycosides. The results are shown in the table. It should be noted that the digitalis do not occur in natural conditions in Kazakhstan. Therefore, we studied four types of introduced digitalis (Digitalis ferruginea, Digitalis lanata, Digitalis grandiflora, Digitalis ciliata) to reveal the quantitative content of glycosides in the leaves of these species for the first time in Karaganda. Studying plants, containing cardiac glycosides, special attention should be paid to the dynamics of accumulation of glycosides during their ontogenetic development, which allows to establish the optimum time for harvesting raw materials.

Species name	Phases of evolution			
	vegetation	budding	blossoming	fruiting
Digitalis grandiflora,	0,136	0,185	0,219	0,165
Digitalis ferruginea,	0,138	0,228	0,272	0,202
Digitalis ciliata.	0,144	0,164	0,196	0,152
Digitalis lanata,	0,160	0,192	0,231	0,350

Table 2: The quantitative content of the amount of glycosides in the leaves of the species naperstyanok (in% of air-dry weight) in culture in the second year of life in the dynamics.

According to the table, Digitalis ferruginea contains the largest amount of glycosides in the leaves at the flowering stage and it is equal to 0.272 %, Digitalis grandiflora – 0.219 %, Digitalis ciliata – 0.196 %. Digitalis lanata rosette form in the first year of life in the leaves contains more glycosides (0.350 %), compared with other species. It should be noted that digitalis lanata did not enter the generative phase in cultural conditions in the second life period. Thus, it was found out that raw materials optimal harvesting time in cultural conditions is a phase of flowering for biennial Digitalis, and for the annual Digitalis – the end of the growing season (in rosette leaves), because the maximum content of glycosides and the largest formation of leaves were observed in this period.

Besides, we studied the quantitative content of glycosides in four species of plants from the Cruciferae family, grown in cultural conditions.

The results of the research has shown the following regularity: the quantitative content of cardiac glycosides in two species of Syrenia: Syrenia sessiliflora and Syrenia siliculosa in cultural conditions is slightly higher than that of the natural conditions; amount of cardiac glycosides in the seeds of Erysimum diffusum and Erysimum Czernjajavii, grown in the cultural conditions is equal to 1.78 – 4.1, it exceeds almost 8 times in comparison with those, grown in wild conditions. The greatest amount of glycosides in the above-ground parts of all the studied species of Syrenia and Erysimum was found in phases of mass budding and in the period of initial blossom.

Thus, the content of glycosides in wild and introduced species varies, depending on the phases of development; their maximum accumulation is related to the most important periods in the life of plants – setting up and development of the generative organs. Therefore, the most efficient harvesting period for both wild and cultivated species is considered to be the period of full budding and beginning of flowering. During this period they contain maximum amount of glycosides.

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Количественное содержание сердечных гликозидов в некоторых лекарственных растениях

[1] А.И. Ахметжанова
[2] С.Н. Атикеева
[3] А.К. Ауельбекова

[1] Карагандинский государственный университет им. Е.А. Букетова, Казахстан
100028, г. Караганда, ул. Университетская, 28
Кандидат биологических наук, профессор
[2] Карагандинский государственный университет им. Е.А. Букетова, Казахстан
100028, г. Караганда, ул. Университетская, 28
Кандидат биологических наук, доцент
E-mail: s-atikeeva@mail.ru
[3] Карагандинский государственный университет им. Е.А. Букетова, Казахстан
100028, г. Караганда, ул. Университетская, 28
Кандидат биологических наук, доцент
E-mail: a-auelbekova@mail.ru

Аннотация. В настоящей работе авторами рассмотрены биоэкологические особенности некоторых видов лекарственных растений, содержащих сердечные гликозиды, их распространение. В работе представлены таблицы, в которых данные о количественном содержании суммы сердечных гликозидов в растениях из различных экологических условий в надземных и в подземных органах некоторых видов сем. Крестоцветных, сем. Лютиковых, сем. Также в работе представлены интродуцированные виды наперстянки из семейства Норичниковых, где определены количественное содержание сердечных гликозидов, так как у этих растений источником сырья для получения сердечных гликозидов являются листья.

Ключевые слова. Сердечные гликозиды; крестоцветные; экологические условия; Сирения стручковая; сем. Валериановых из естественных условий.