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Changes in the Taxonomy based on Phytochemistry of the Species of the Rose Family (Rosaceae)

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Abstract

The article is focused on the peculiarities and phytochemistry of the species belonging to the relatives of the Rose family (*ROSACEAE*). The phytochemistry of seeds of *Prunus domestica* L. and *Armeniaca vulgaris* L. has been studied. The research has shown that the two types of seeds are identical in terms of the contained trace elements, vitamins and certain fatty acids. If *Prunus domestica* L. and *Armeniaca vulgaris* L. belonged to two separate species, they would not form hybrid *Armenoprunus*. Mineral elements were determined by atomic absorption spectroscopy (AAS). The atomic absorption spectroscopy (AAS) is the method of quantitative analysis based on the properties of the atoms measured along the actual wavelength. Tissues of the seeds that absorb atoms were identified using two methods of atomic spectroscopy. Flame melt-down. The flame occurs during evaporation and atomization. Elements were discovered at the concentration of 0.01-100 µg/l. The similarity of phytochemistry of the two species indicates the presence of trace elements (Ca, Mg, Fe), vitamins (B_1, B_2, C, B_3, E), fatty acids (palmitin, olein, linolegen). Therefore, there is a reason to believe that "*Armeniaca* Mill" is subgenus of *Prunus* Mill.

Keywords: taxon, roof, bowl, carotene, pectin, carbohydrate, microelement, permanganometry, nicotinic acid, cholesterol, immunity, palmitin, olein, linolegen, hyperlipemia, amino acids, enzymes, folic acid.

INTRODUCTION

Separation of plums of the Rosaceae family [1] into affined branches is one of the taxa in the systematics that have not been completely studied. How many relatives are there for the Prunoideae branch of plums family? This issue is still unclear. According to the recommendation of the Russian botanist V. N. Gladkova (1981), American dendrologist A. Roeder (1940,1949), Irish botanist D. A. Webb (1968) and other prominent botanists have joined species of the cherry laurel (*Laurocerasus* L.) and bird cherry (*Padus* Mill.), cherry (*Cerasus* Juss.), apricot (*Armeniaca* Mill.), almonds (*Amygdalus* L.), peach (*Persica* Mill.) family with the plums family (*Prunus* Mill.). Association of all these plants into one family is based on their systemic closeness (especially close are almonds and peaches, plums and apricots). Their taxonomic closeness is seen in hybrids (hybrid "Amygdalopersica", "Armenoprunus" and others). Thus, the above taxa in a broad sense are combined into sections and branches of relatives of the *Prunus* Mill. plum. There are 400 species growing in several regions of the Eastern hemisphere, in the subtropical rain forest region of the Andes in South America, and in the moderate climatic zone of the Northern hemisphere.

The novelty of the research: The chemical composition of the seeds has been determined in order to clarify the taxonomy of the bioecological characteristics of species *Prunus domestica* L. and *Armeniaca vulgaris* Lam. The phytochemical research was performed at the Laboratory for Assessing Safety and Quality of Food Products of the Technological University of Almaty. Obtaining the *Armenoprunus* hybrid of two relative species proves their systematic affinity to each other, unlike other relatives. If they belonged to different species, they would not reproduce sexually, forming a hybrid. The similarity of the biological features of the two species is confirmed by the presence of trace elements (Ca, Mg, Fe), vitamins (B_1, B_2, C, B_3, E), and fatty acids (palmitin, olein, linolegen).

The objective of the research: Many botanists consider prune (*Prunus sogdiana* Vass.), peach (*Persicacommunis* L.) and almonds (*Amygdalusvulgaris* L.) as different (though related) species. English botanist John Hutchinson (1964), who supported the accession of other taxa to the relatives of plum (*Prunus* Mill.), relatives of bird cherry (*Padus* Mill), taxa of laurel cherry (*Laurocerasus* L.) proposed to treat them as separate taxa. He believed that it was necessary to perform comprehensive comparative studies of all branches of the plum family using modern methods of taxonomy in order to clarify the features of the level of kinship, the family, the taxa division [2].

MATERIALS AND METHODS

Drain (*Prunoideae*) is a genus of plants of the rose family. The plants are shrubby, woody. The shoots are sympodial, the leaves are simple, the inflorescences are few-flowered roof-shaped, each flower has 5 cupped leaves, 5 bunches, ripens freely without stopping. The producers are cup-shaped, manifold to the number of bunches. The pistil is cup-shaped; the hypanthium is connected via the base – the receptacle. The fruit is single-seed, with a stone, the fruit is juicy.

There are 3 species of plum's relatives: black thorn (*Prunus spinosa* L.), common plum (*Prunus domestica* L.) (Fig. 1), Sogdian prune, cherry plum (*Prunus sogdiana* Vass.). Of these 3 species, a sample of common plum (*Prunus domestica* L.) was taken for the research. The plum has been zoned in the cultural conditions, the cultivated plant is commonly grown as a local variety.

Apricot (*Armeniaca* Mill.) belongs to the Plum genus.In natural conditions, it grows in Eastern Siberia, in the Far East, in Central Asia, and in China. The Apricot genus has 3 species: Siberian apricot, Mongolian apricot and Common apricot. Common apricot (*Armeniaca vulgaris* Mill.) is an important species in agriculture. In Kazakhstan, in Zhambyl, South Kazakhstan, Almaty region, common apricot is grown (Fig. 2). It is widespread in Central Asia, in the East of the Caucasus. Due to the fact that apricots were exported to Europe from Armenia, Armenia has long been considered the homeland of apricots. This is the reason in Latin the genus is called "armeniacas" [3, 4].

Almonds *(Amygdalus* L.) belong to the Plum genus. Modern scientists distinguish 5 species: common almond (*Amygdalus communis* L.), Russian almond *(Amygdalus nana* L.), Ledeburov almond (*Amygdalus ledebouriana* Schlecht.), Petunnikov almond *(Amygdalus petunnikovii* Litw.), and Pricky almond *(Amygdalus spinosissima* Bge.). Of these, common almond (*Amygdalus communis* L.) is a not very high tree with a branchy top (Fig. 3).

In the wild state, almond grows in the mountainous and rocky areas. It is also sown as a cultivated plant. Fruits and oil are used for medications. The plant contains oil, glycoside amygdalin, hydrocyanic acid, and aldehyde benzene.

During the research, chemical composition of seeds was determined in order to update the taxonomy, biological and

ecological features. The raw materials were prepared at 21^0C, humidity of 81%, the particles were powdered for screening through a 0.5 cm sieve, followed by chemical analysis. The phytochemical research was performed at the Laboratory for Assessing Safety and Quality of Food Products of the Technological University of Almaty.

Figure 1 – *Prunus domestica* L. (fruit) (http://www.baike.com)

Figure 2 – *Armeniaca vulgaris* Lam. (fruit) (http://www.baike.com)

Figure 3 – *Amygdalus communis* L. (fruit) (http://www.baike.com)

RESULTS AND DISCUSSION

The phytochemical characteristics of raw materials obtained while studying the seeds according to the specified method revealed (Tables 1, 2) the presence of carbohydrates, fatty acids, vitamins (B_1, B_2, C, B_3, B_5, B_9, A, E), and trace elements (calcium, magnesium, iron). The amount of carbohydrates in the seeds of species *Prunus domestica* L., *Armeniaca vulgaris* Lam. *Amygdalus communis* L. was determined by the method of permanganometry. The amount of carbohydrates in the seeds of species *Prunus domestica* L. (the amount of dry organic substance) was 10.69 %, in the seeds of species *Armeniaca vulgaris* Lam. (the amount of dry organic matter) – 4.0%, and in the seeds of species *Amygdalus communis* L. (the amount of dry organic matter) – 3.09%.

Trace elements are very important for the physiological processes in plants. The amounts of mineral elements in the seeds of the fruits change depending on the environment, soil composition, humidity, and other factors.

The initial studies of trace elements laid the foundations for the science of geochemistry. The physiological importance of macro-elements has drawn attention of many researchers. As a result, many papers devoted to the macro-elements are published in today's scientific literature. The main physiological and biochemical properties of macro-elements were studied by Zichman (1957), Y. V. Peive (1960), P. A. Vlasyuk (1969), M. Y. Shkolnik (1974), O. K. Kedrov-Raven (1990) and others, and in Kazakhstan – by Zh. Kalekenov (1980), K. Kenzheev (1989), and others [5-11]. To prove the plants' need in trace elements, it is sufficient to perform a series of experiments, growing plants in glass containers with distilled water.

It has been found that in the composition of the seeds of *Prunus domestica* L., *Armeniaca vulgaris* Lam. *Amygdalus communis L.*, the contents of essential trace elements (such as Ca, Mg, Fe) is different. In particular, in the seeds of species *Prunus domestica* L., the content of Ca, unlike in the seeds of species *Armeniaca vulgaris* Lam., is 3 times higher. Calcium is involved in the process of activating muscle nerves, heart muscles it helps speed up the effect of enzymes and blood coagulation. With the lack of calcium in the organism, bones and nerve tissues decompose, break, the overall ability of the organism to resist diseases deteriorates [12, 13].

It has been found that in the seeds of species *Prunus domestica* L. where the amount of Mg was 434.4 mg per 100 g, unlike the seeds of species *Armeniaca vulgaris* Lam., where the amount of Mg was 191.3 mg per 100 g, the specific weight of magnesium is over 2 times higher. Magnesium is actively involved in preventing such heart diseases as myocardial infarctions and stenocardia, ischemia; it contributes to the process of phosphorus and carbohydrates exchange, and nerves activation. Deficiency of this element in the organism leads to kidney disease and dysfunction of the cardiovascular system and nerves [14].

It has been found that in the seeds of species *Prunus domestica* L. the amount of Fe (28.7 mg/100 g) unlike in the seeds of species *Armeniaca vulgaris* Lam. (6.7 mg per 100 g) is higher. In Japan, almost all food is prepared using the fruits of plum. The population retires at the age of 70. Fe is in the composition of hemoglobin.

The results of the research have shown that the vitamins composition in the studied species is different. This fact is clearly shown in Table 1.

The content of vitamin B_1 (thiamine) in the seeds of species *Prunus domestica* L. is 0.02 mg of dry organic matter, in the seeds of species *Armeniaca vulgaris* Lam. the content of this vitamin is much lower – 0.011 mg of dry organic matter per 100 grams. Lack of vitamin B_1 causes fatigue and digestive dysfunction. When the organism needs thiamin, the nervous system is exposed to diseases. During exercises and creative

work, as well as in case of long exposure to cold, the organism needs a lot of vitamin B_1.

The content of vitamin B_2 (riboflavin) in the seeds of species Prunus domestica L. is 0.02 mg of dry organic matter, and in the seeds of species *Armeniaca vulgaris* Lam. it is 0.005 mg of dry organic matter, which is a negligible fraction. Vitamin B_2 is of great importance for vision. Lack of vitamin B_2 can cause cloudiness of the pupil (cataract) and can cause cornea disease, disruption of the mucosa, the skin around the eyes, ears, nose, lips [16].

It has been found that of the three studied species, the contents of one of the water soluble vitamins, namely, vitamin C, is the highest in the seeds of *Prunus domestica* L. (2.5 mg of dry organic matter). Vitamin C in the composition of ascorbic acid is a biologically active substance. It strengthens the immune system of the organism, and provides powerful protection from viral diseases. In addition, vitamin C strengthens teeth and bones, slows down accumulation of harmful substances in the organism resulting from biological oxidation, is part of enzymes, and prevents thinning of the walls of blood vessels in the skin.

High content of vitamin B_3 was discovered in the seeds of species *Armeniaca vulgaris* Lam. (3.15 mg of dry organic matter), unlike in the seeds of species *Prunus domestica* Mill., where the share of dry organic matter is 2 times lower, 1.6 mg. Lack of vitamin B_3 can manifest itself in case of rare diseases, such as carcinoid syndrome.

In the seeds of species *Prunus domestica* L., vitamin B_9 (folic acid) has not been found. In the seeds of species *Armeniaca vulgaris* Lam., this vitamin has been found in very small amounts – 0.003 mg of dry organic matter. In the seeds of Amygdalus communis L., the share of vitamin B_9 is a little higher – 0.04 mg of dry organic matter. Vitamin B_9 is necessary for females for successful conceiving. It is also believed that vitamin B_9 gives good mood to people. If the content of vitamin B_9 in the organism is stable, the digestive system and functions of the liver will improve.

It has been found that the content of vitamin A in the seeds of species *Prunus domestica* L. is 3 times higher than in the seeds of species *Amygdalus communis* L. However, in the seeds of species *Armeniaca vulgaris* Lam., this vitamin has not been found. Vitamin A (retinol) increases resistance to various diseases, promotes development and growth of the organism. With the lack of this vitamin, the composition of fats changes, the structure of cornea gets disrupted (the disease is called "chicken blindness").

The content of vitamin E (tocopherol) is very high (compared to the other two studied species) in the seeds of species *Amygdalus communis* L. – 14.5 mg of dry organic matter. In the seeds of species *Prunus domestica* L., the content of this vitamin is 1.75 mg (dry organic matter), and in the seeds of species *Armeniaca vulgaris* Lam. – 1.54 mg (dry organic matter). Vitamin E normalizes high blood pressure, relieves fatigue, reduces sugar level in the organism.

To determine the mass fraction of fatty acids in the seeds, GOST 30418-96 was used. This standard specifies the method for determining the mass fraction of fatty acids to their overall content in the triglycerides of oils. The mass fraction of fatty acids in seeds is shown in Table 2 and in Fig. 4.

The indicators of the mass fraction of fatty acids in the compositions of seeds of *Prunus domestica* L. and *Armeniaca vulgaris* Lam. correlate between each other.

Table 1 – Vitamins composition in the studies species (mg/100 g)

Vitamins/species	***Prunus domestica* L.**	***Armeniaca vulgaris* Lam.**	***Amygdalus communis* L.**	**Method of determination**
B1	0.02	0.011	0.15	M-04-41-2005
B2	0.15	0.005	0.45	
C	2.5	0.015	1.5	
B3	1.6	3.15	Not found	
B9	Not found	0.003	0.04	
A	8.4	Not found	0.04	GOST 7047-55
E	1.75	1.54	2.1	
			14.5	

Table 2 – The mass fraction of fatty acids in seeds of the studied species (in % per 100 g of seeds)

Fatty acid	***Prunus domestica* L., (%)**	***Amygdalus communis*L., (%)**	***Armeniaca vulgaris* Lam. (%)**	**Method of determination**
caprin		0.009794	0.016953	GOST 30418-96
palmitin	0.002477		0.002139	
olein	0.022024	0.005100	0.012098	
linolegen	0.106637	0.007909	0.049455	

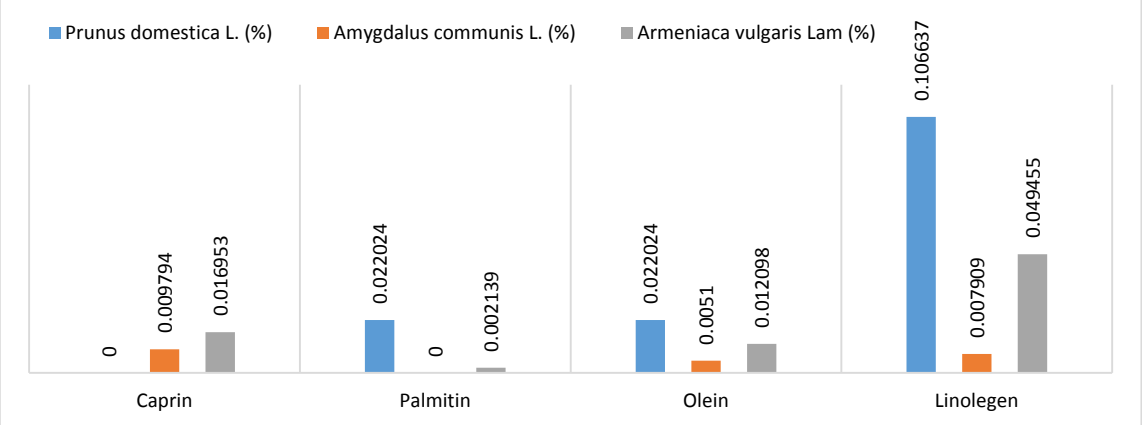

Figure 4 – The numerical values of the mass fraction of fatty acids in the seeds of the studied species

CONCLUSION

Obtaining the *Armenoprunus* hybrid of two relative species proves their systematic affinity to each other, unlike other relatives. If they were different species, they would not reproduce sexually, forming a hybrid. The similarity of the biological features of the two species has been confirmed by the presence of trace elements (Ca, Mg, Fe), vitamins (B_1, B_2, C, B_3, E), and fatty acids (palmitin, olein, linolegen). As a result, it has been found that there are reasons for attributing the affined species *Armeniaca* Mill. to the affined branch *Prunus* Mill. In the seeds of species *Amygdalus communis* L., fatty acid palmitin has not been found. In the seeds of species *Prunus domestica* L., fatty capric acid has not been found. Fats in the seeds stabilize the immune system. Eating seeds cleanses the digestive system, improves the kidneys function, bladder, crushes stones, and improves vision. The studied seeds are used for medicinal purposes for treating asthma, pleurisy, and cough (for example, a mixture of seeds of almonds and wheat starch). Particularly high content of vitamin E (14.5 mg/100 g), calcium, and the complete absence of the palmitin fatty acids have been noted in the seeds of *Amygdalus communis* L.

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