On the flora of honey plants of the Northern and Northwestern Altai regions within the Altai Territory

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Abstract. The revision of honey plants in the regions' floras and nature objects is regularly made for estimation of melliferous capacity of the territory. The article is devoted to the investigation of the melliferous flora of Northern and North-Western Altai in the area of Altai Territory. The goal of the research was to reveal the botanical composition of authentic honeys. The representativeness of melliferous species among common floristic richness in the studied districts is the following: in Altaiskiy – 56.49 %, Smolenskiy – 60.17 %, Soloneshenskiy – 53.61 %, Charyshskiy – 44.57 %. The examples of the botanical content of samples typical for each of these districts have been shown. In the angelica (djagilevyj) honey from Altajskiy district the maximum content of pollen belongs to the representatives from Apiaceae family 78.86 %. For the angelica (djagilevyj) honeys from surveyed districts the high content of pollen from the families Asteracerae, Brassicaceae, Fabaceae, Rosaceae are typical with different percentage in the samples. The article provides information on examples of wild-growing plant species including relicts, potential melliferous which pollen can be used as "marker" for determination of honey as Altai-origin.

Honey plants were actively examined in 20 century; nowadays the interest to this theme is still alive. The importance of the melliferous group studying is connected with the wish of customers to know the botanical composition of honey and its origin with the aim to identify falsifications.

The information on the species content of this group is regularly enriched thanks to publications. For example, A. N. Burmistrov, V. A. Nikitina [1] gave the characteristic of 88 melliferous plants. M. K. Hushnazarov [2] reported that in vegetation cover of the reserve "Romit" (Tajikistan) from 1240 wild plant species the fifth part are milleferous or beebread flowers. In the reserve "Shulgan-tash" (Bashkiria) melissopalynological analyses of honey, pollen pellet, beebread have been made. As a result, 187 milleferous and beebread plant species were revealed [3].

For the purpose of investigation of botanical and geographical origin of Russian honeys R. G. Kuminov, A. R. Ishbirdin [4] conducted the palynological analyses of 119 samples of honey from 31 regions of Russia. The content of studied samples included pollen of 183

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taxa from 51 families. The authors presented photos of 40 pollen of honey species identified in samples.

In the rich and divers flora of the Russian Far East 90 primary, 100 secondary and more than 100 weak melliferous plants have been revealed. The most valuable are all species of *Tilia*, *Acer*, *Salix*, *Phellodendron amurense* Rupr., *Padus maackii* (Rupr.) Kom., *Kalopanax septemlobus* (Thunb.) Koidz., *Aralia elata* (Miq.) Seem., *Eleutherococcus senticosus* (Rupr. et Maxim.) Maxim., *Lespedeza bicolor* Turcz., *Rubus crataegifolius* Bunge etc. [5].

Melliferous capacity of the territory is mostly depended on the area on which the honey plants grow and less on the diversity of species content. V. N. Kulakov [6] examined melliferous sources in Russian federation (RF) and payed attention that there are melliferous lands the contribution of which in the honey potential is high. For example, the vegetation of burnt areas, felling sites, open forests etc. produces 2.5 milliards kg of honey (22 % of the whole deposit of honey in the country). These lands occupy a vast territories (101.7 mil. ha), but have less melliferous capacity. Moreover, big part of those lands is situated in the territories that hard to reach with not always suitable climatic conditions for bee farming. The plantings of entomophile cultures occupy 27.6 thousand ha (4 % from all of melliferous cultures of RF) and produce 1.7 milliards kg, that is 15 % from all potential deposit of RF. The highest value in creation of the melliferous storage belongs to the forest and other natural melliferous vegetation sources – 84 % from the total maximum potential. Altai Territory has high relative input of agricultural crops in potential honey deposit – 88 % [6].

Determination of geographical origin of honey is based on that fact that the whole spectrum of pollen corresponds with the flora of the region in which the honey is gathered and with the standard spectrum or descriptions of botanical content, published in the literature [7]. For the identification of the honey from Spain, for example, can be used the results of the following investigation. O. Escuredo, M. Fernández-González, M. C. Seijo [8] carried out melissopalynological analyses of 86 honey samples, gathered in north-western part of Spain, and revealed 90 types of pollen. *Castanea sativa*, *Cytisus*-type and *Rubus* occurred in 100 % of samples, as well as *Erica* in 97,7 % and *Eucalyptus* in 86 %. In addition, the pollen of *Echium*, *Quercus* и *Trifolium*-type frequently appeared. Pollen of *Salix*, *Crataegus monogyna*-type, *Campanula*-type, *Conium maculatum*-type, *Frangula alnus*, *Lotus*-type, *Lithodora* and *Myosotis* comprised 3 % of the pollen spectrum and had a big value in honey. Fifty types of pollen occurred in several samples (less than 10 %).

The present study was aimed to examine the melliferous flora of Northern and North-Western Altai in the area of Altai Territory on the territories of four administrative districts. It has a goal to reveal plant species which pollen existence characterize authenticity of local honeys. According to the scheme of botanic-geographical zonation of Altai Territory, the territory of Altaijskiy, Smolenskiy, Soloneshenskiy districts belongs to *North Altai*, and Charyshskiy – to the *Northwesternaltai* botanic-geographical regions in *North-Altai-North-Westernaltai* floristic area. The vegetation cover of those districts is characterized by diversity of vegetation types from low- to uplands: steppes, meadows, mires, fir and mixed forests, riparian and littoral vegetation.

V.I. Vereschagin [10] have written that there are different formation of forests, meadows and wetlands in Altai Territory, which are different in milleferous plants' composition. The list of milleferous (nectariferous, polliniferous) plants is compiled based on the published data [4, 5, 9–11]. We give status of milleferous to the species which nature was confirmed by the bee farming experience, and, in addition, by examine of the flower's structure and existence of pollen from mellitophilae plants in honey. For the identification of pollen in the samples of honey, we compare it with the pollen from flowering plants and from taken herbarium specimen. There are some important conditions for the good quality

identification of pollen in honey. They are resolving power of the microscope and existence of preserved pollen samples of identified milleferous species. In 2015, we created the collection of recent pollen of 341 honey plant species and 103 specimen of honey. For the pollen identification we used works of L. V. Kupriyanova, L. A. Aljoshina [12], R. G. Kurmanov, A. R. Ishbirdin [4], Austrian database of the project PONET (Pollen, https://www.ages.at/themen/umwelt/pollen/projekt-ponet/) [13], containing the high resolution images of pollen of 800 plant species from regional and adventive flora.

According our data the group of melliferous plants in examined districts includes in Altaiskiy – 326 species, Smolenskiy – 343, Soloneshenskiy – 364, Charyshskiy – 415 [14]. However, representativeness of melliferous species on the background of floristic diversity in districts is another: Altaiskiy – 56.49 %, Smolenskiy – 60.17 %, Soloneshenskiy – 53.61 %, Charyshskiy – 44.57 %. Such occurrences can be explained by that fact that in Soloneshenskiy and Charyshskiy districts vegetation communities are more different with many species that not presented in two other districts, especially species that are not melliferous. The melliferous qualities are not examined for many species of high lands.

We have made the calculation of frequency of the botanical taxa pollen among 1000 pollen grains in each specimen made from honeys from each of four districts. We will show the examples of the most representative samples of honey. In the specimen of angelica (djagilevyj) honey from Charyshskiy district the high content of pollen from the families Apiaceae (59.92 %), Brassicaceae (11.98 %), Fabaceae (8.26 %) и Rosaceae (7.29 %) is presented. In addition, in small concentration the pollen grains of the following families have been found Valerianaceae (5.83 %), Asteraceae (4.86 %), Polygonaceae (1.62 %), Pinaceae (0.16 % – occasional import of pollen) and Tiliaceae (0.08 % – *Tilia* is growing frequently in artificial plantings around apiary which the sample of honey was taken from).

In the sample of angelica (djagilevyj) honey from Soloneshenskiy district the pollen from Apiaceae (76.54 %), Brassicaceae (10.26 %), Asteracerae (3.62 %), Fabaceae (3.36 %), Lamiaceae (2.86 %), Rosaceae (2.44 %), Polemoniaceae (0.50 %), Liliaceae (0.34 %) and Polygonaceae (0.08 %) families has been identified.

In the sample of angelica (djagilevyj) honey from Altajskiy district the proportion of the pollen was the following: Apiaceae (76.86 %), Asteracerae (10.36 %), Rosaceae (5.87 %) and Brassicaceae (6.91 %).

In the sample of polyfloral honey from Smolenskiy district: Brassicaceae (36.23 %), Polygonaceae (26.69 %), Fabaceae (14.65 %), Rosaceae (8.38 %), Asteraceae (6.84 %), Ranunculaceae (6.45 %), Apiaceae (0.48 %), Boraginaceae (0.28 %).

In the districts under the examine farmers traditionally plant the following agricultural crops which are in the same time milleferous plants and become the base of monofloral honeys: *Helianthus annuus* L., *Fagopyrum esculentum* Moench., *Brassica napus* L., *Onobrychis arenaria* (Kit.) DC.; rare plant – *Phacelia tanacetifolia* Benth., *Galega orientalis* Mill., *Sinapis alba* L. Those crops are usual for many regions and their pollen will be found in honeys from different territories. And only the floristic composition of wild species is important for determination of the honey authenticity. For the honeys from examined districts of Altai Territory the pollen of the following species are typical: *Angelica decurrens* (Ledeb.) B. Fedtsch., *Pastinaca sylvestris* Mill., species of genus *Heracleum* L. etc.; Asteracerae – *Achillea* L., *Bidens* L., *Centaurea* L., *Cichorium intybus* L., *Sonchus* L., *Taraxacum officinale* Weber ex F. H. Wigg. etc.; Caryophyllaceae – *Dianthus* L., *Cerastium* L., *Stellaria* L. etc.; Fabaceae – species of genus *Lathyrus* L., *Medicago* L., *Trifolium* L. etc.; Geraniaceae – *Geranium* L.; Lamiaceae – *Dracocephalum* L., *Origanum vulgare* L., *Thymus* L. etc.; Onagraceae – *Chamaenerion angustifolium* (L.) Scop., species of genus *Epilobium* L.; Rosaceae – *Fragaria* L., *Padus avium* Mill., *Rosa* L., *Rubus* L. etc.; Valerianaceae – species of genus *Valeriana* L.

Among the relicts in studied areas, the potential milleferous have been found. They are *Cimicifuga foetida* L., *Corydalis nobilis* (L.) Pers., *Geranium robertianum* L., *Viola mirabilis* L., *Epilobium montanum* L., *Myosotis krylovii* Serg., *Pulmonaria mollis* Wulf. ex Hornem., *Stachys sylvatica* L., *Galium odoratum* (L.) Scop., *Campanula latifolia* L., *Adonis villosa* Ledeb., *Thalictrum petaloideum* L., *Paeonia hybrida* Pall., *Gymnospermium altaicum* (Pall.) Spach., *Lychnis chalcedonica* L., *Potentilla rupestris* L., *Astragalus glycyphyllos* L., *Scrophularia altaica* Murr., *Alfredia cernua* Cass. etc. In the middle lands and high lands the relicts of tall grasses occurs *Saussurea latifolia* Ledeb., *Allium ledebourianum* Schult. et Schult. fil., *Sanguisorba alpina* Bunge [15].

One of the most important thing for the determination of geographical origin of examined honey samples is the skills of the specialists in identification of pollen "markers" from the local territory, which has small distribution areas. For that purpose, it is needed to form collections of pollen of these plants and to publish catalogue with descriptions and images. In addition, for elaboration of studied honeys it is necessary to compare botanical composition of pollen with other databases of honeys from the other regions.

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