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ORIGINAL RESEARCH PAPER

IDENTIFICATION OF PROPOLIS AND HONEY SOURCES POLLEN ANALYSIS OF THE SOUTH OF NORTH CAUCASUS AND THE LOWER VOLGA

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Abstract: Palynomorphological study of propolis and honey from the regions of the North Caucasus and the Lower Volga Russian Federation and Republic of Abkhazia (RA) has been held. Propolis samples have been obtained in Republic of North Ossetia-Alania (RNO-A), in Volgograd and Saratov regions of Russian Federation and RA at 2010 - 2015 years. Honey samples have been obtained in RNO-A and Republic of Ingushetia (RI) at 2015 year.

Microscopy, determination of pollen types (PTs) and counting of pollen grains (PGs) carried out in 3-fold repetition on temporary preparations with a cover glass area of 24 x 24 mm under a light microscope. An analysis of the palynological spectra of propolis and honey samples showed the dominance of pollen from plants of the Asteraceae family. Propolis always contained pollen from several PT, a third of the samples of honey were monofloral. An analysis of the occurrence of PT was carried out. All propolis samples aligned according to the degree of contamination. Samples of honey can differ greatly in the wind-pollinated component.

Keywords: *insect-pollinated plants, micropreparation, pollen grain, pollen type, spring-flowering plants, summer flowering plants, wind-pollinated plants*

INTRODUCTION

Propolis (bee glue) is a complex of biologically active compounds (BAC) plant and animal origin. Due to the wide range of biological properties of natural propolis compounds, preparations based on them have demanded the needs of modern medicine and production dietary supplement [1 – 4]. New drugs are being developed [5, 6]. Propolis is primarily of plant origin since it contains mainly resinous secretions of plants [7]. Groups of BAC had been distinguished which were being found in propolis samples collected in different territories and their plant origin have been proven. The same substances have been found in *Betula pendula* and *Populus tremula* buds.

Part of propolis samples collected mainly in the southern regions of Russia contained substances identical to the compounds of *Populus nigra* buds. Most of the *Populus* exudate is included in propolis without change, including flavonoid aglycones [8]. Propolis is being used by bees in the beehive as a building adhesive and disinfectant [9]. That is why the study of propolis began with a clarification of its antimicrobial properties [10]. Bees produce the greatest amount of propolis in the second half of July - the first half of August. In terms of quality, propolis must to meet the requirements of the Russian Federation State Standard 28886-90 [11]. In some countries (e.g. China, Brazil), propolis is included in the Pharmacopoeia [12, 13].

Honey is a natural sweet food product, the result of the vital activity of bees. It is being produced from nectar or secretions of living parts of plants, or secretions of insects that parasitize on living parts of plants. Bees collect the nectar, transform it and leave in cells for maturation [14]. Interstate standard 19792-2017 governs the quality of honey in the Russian Federation [15]. In 2014 the monograph “Honey” was being introduced into the State Pharmacopoeia of Ukraine 2.0 [16].

A standard of the Russian Federation has been developed for the minimum pollen content of a plant that determines the type of honey in relation to the total amount of pollen in it [17]. As usual both polyfloral and monofloral honeys are collected in the regions [18]. The complex use of both palynomorphological and physicochemical methods of honey analysis is presented in the work [19]. The author points out the need for additional research.

In honey, pollen is present normally. The State Standard 31769-2012 has been developed in Russia [17].

The issue of regional differences between Russian kinds of honey is urgent. The most reliable method of determining the geographical origin of honey to date is a melissopalinological analysis. The pollen composition of honey reflects the type of vegetation in the region where honey was harvested [20 – 22].

The study of pollen spectra of honey can help to determine whether the labelling of honey matches the region of origin. Such studies are carried out in many countries of the world.

Also, one of the most interesting and little-studied questions is the problem of studying the differences in pollen composition of kinds of honey collected in one region, which covers several natural and climatic zones [20, 21].

Pollen composition of kinds of honey of Krasnodar and Stavropol regions, Republic of Adygea, Rostov and Saratov regions analyzed in work [23]. Detailed melissopalinological analysis of Krasnodar region kinds of honey presented in the work [24].

A significant role among the honey plants of the North Caucasus belongs to the species of plants of the Rosaceae family: *Sorbus aucuparia* L., *Sorbus* umbellata var. cretica (Lindl.) C.K.Schneid. *Sorbus aucuparia* honey productivity is estimated at 30 - 40 $kg \cdot ha^{-1}$ [25].

Tertiary relics of the Rosaceae family of the flora of Dagestan are represented by both trees *Pyrus caucasica* (Fed.), *P. salicifolia* Pall., *Sorbus torminalis* (L) Crantze, and shrubs - *Rubus caucasicus* Fosce., *Mespilus germanica* L. These plants are widespread on the territory of Dagestan, especially in the foothill regions, as components of forest associations. Tertiary species of the Rosaceae family secrete a small amount of nectar. Bee colonies do not completely choose it because of the changeable spring weather conditions and because of the insufficiently strong bee colonies during this period [26].

Plants of the Rosaceae family are among the most important melliferous resources of the forest-steppe zone of Russia. In the Oryol region, plants of this family occupy 3rd place in terms of the number of melliferous species. Also, representatives of 8 genera of this family are cultivated as honey plants [27, 28].

The morphological characteristics of PGs of representatives of the Rosaceae family of 6 varieties of *Cerasus avium* L. and 5 varieties of *Prunus cerasus* L. were studied by scanning electron microscopy. These descriptions can be used to identify pollen and honey [29].

Palynological examination is a standard procedure for honey Therefore, we used this method to palynological examination for propolis [30]. Theoretically, there should be no pollen in propolis. Though, according to the literature, about 5 % of PGs found in it.

The purpose of the study was to identify honey and propolis obtained in the south of the European part of the Russian Federation and in the Republic of Abkhazia by pollen spectra. Compare the characteristics of the spectra.

Tasks:

- to determine the pollen spectra of propolis and honey samples from the regions of the North Caucasus and the Lower Volga;
- to conduct a comparative analysis of pollen spectra.

MATERIALS AND METHODS

Materials

Regions where honey and propolis were studied are not so large. However, they have a wide variety of natural climatic zones. Propolis samples characteristics are shown in Table 1.

Table 1. *Propolis samples characteristics*

Year of sample getting	The origin of propolis samples	Gathering place
2011	PNO-A, village Kamata	Neighbourhood of the Kamata village, Kamatadon river valley, meadow
2011	RA	Neighbourhood of the Kaldakhvara village
2011	Volgograd region, Novoanninsky	Neighbourhood of Novoanninsky town, meadow
2010	Saratov Region, Rtishchevo	Meadows in the vicinity of the city

Places of collection and characteristics of honey samples are given in Table 2. Samples were obtained in 2015. All of them are characterized by a faint odor. All honey samples crystallized after a year of storage.

Table 2. *Characteristics of honey sampling sites, 2015*

Region	Gathering place
RNO-A, village of Chikola	The right bank of the Urukh river, the foot of the northern slope of the Forest Range, the vicinity of the village of Chikola, meadow, 700 m above sea level.
RNO-A, village of Makhchesk	Valley of the Aigomugidon River, (the right tributary of the Urukh River) in the North Jurassic Depression, the vicinity of the village of Mahchesk, meadow, 1250 m above sea level
RI, village of Dalakovo	The right bank of the Kambileevka river (the right tributary of the Terek river), the vicinity of the village of Dalakovo, meadow, 660 m above sea level
RI, village of Alkun	Assa River Valley (right tributary of the Sunzha River) in the Pasture Range, near the village of Alkun, meadow, 980 m above sea level
RI, village of Lyagzhi	Armhi River Valley (right tributary of the Terek River) in the Northern Jurassic Depression, the vicinity of the village of Lyagzhi, meadow
Saratov Region, Rtishchevo	Grass meadow

The method of micropreparations obtaining

Honey samples (5 g) dissolved in a 10 % aqueous NaOH solution and kept in a water bath at 94 - 96 °C for 20 minutes. Then the samples centrifuged, the supernatant drained, and the precipitate washed with distilled water.

The method for determining pollen in honey for pollen analysis of propolis is not suitable. According to Russian Federation State Standard for identification of PGs in honey representative sample take at least 200.0. A hitch of 10.0 is isolated from the sample, dissolved in water, centrifuged, and the sediment and examined [17]. Propolis, unlike honey, is slightly soluble in water. The weight of the honey sample determined for its pollen analysis is too large for propolis. Therefore, we were the first to develop a method for producing a micropreparation from propolis, which allows its pollen analysis [31]. We also used the general Pharmacopeia article 1.5.1.0004.15 from Russian Federation State Pharmacopoeia to characterize pollen. We studied the characteristics of PGs: shape, surface character, character of apertures, size [34]. PGs determined to the PT (family, subfamily, tribe, genus). The PGs of herbaceous and woody plants of the Fabaceae family differ slightly in morphology; we examined them separately.

Microscopy, determination of PTs and counting of PGs carried out in 3-fold repetition on temporary preparations with a cover glass area of 24 x 24 mm under a light microscope LOMO Mikmed-1 with AU-12 binocular 1.5 × (10x eyepiece, 10x, 20x, 40x lenses).

We isolated from the pollen of the Fabaceae family PGs of herbaceous and woody plants. To herbaceous we included PTs *Pisum sativum, Vicia, Melilotus, Trifolium, Lupinus, Medicago, Lotus, Onobrychis*. PT *Robinia* represents woody Fabaceae.

We used a generalized European technique based on organoleptic honey analysis. The organoleptic indicators of propolis and honey are analyzed. We took advantage of the criteria of visual and olfactory evaluation [35].

RESULTS AND DISCUSSIONS

Propolis: palynological characterization of samples

All studied propolis samples contained pollen from plants of the Asteraceae family. It got into propolis both from insect pollinated plants (PTs *Cyanus, Helianthus, Centaurea,* Asteroideae, Cichorioideae and others), and wind pollinated (PT *Ambrosia*) (Figures 1 and 2, Table 3).

Table 3. *The content of pollen grains of various types in the samples, %*

Pollen type	Propolis				Honey					
	RA	Volgograd region	RNO-A	Saratov Region	RI			PNO-A		Saratov Region
		Novoanninsky	Vladikavkaz	Rtishchevo	Dalacovo	Alcun	Lyagzhi	Makhchesk	Chicola	Rtishchevo
Insect pollinated										
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Cyanus	28.5	15.2	-	-	26.4	-	-	-	-	-
Centaurea	-	-	-	-	-	-	-	-	-	3,2
Asteroideae	19.1	21.2	48.4	46.9	10.0	-	-	-	-	0.5
Helianthus	-	-	-	-	0.84	-	-	-	-	69.2
Cirsium	-	-	-	-	15.5	-	-	-	6.4	-
Cichorioideae	-	9.1	-	-	-	-	-	-	-	0,5
Asteraceae in total	47.6	45.5	48.4	46.9	52.7	-	-	-	6.4	73.5
Onagraceae	9.5	-	-	-	-	-	-	-	2.1	-
Tilia	9.5	-	-	-	12.13	-	1.8	8.2	7.4	1.1
Apiaceae	4.8	6.1	5.7	-	-	-	5.4	-	-	-
Boraginaceae	-	27.3	-	-	-	-	0.60	6.1	3.2	-
Dipsacaceae	-	-	10.7	-	-	-	-	8.2	-	-
Lamiaceae	-	-	-	6.3	-	-	-	30.6	-	-
Grassy Fabaceae	-	-	8.2	12.5	5.9	-	4.8	-	-	-
Woody Fabaceae	-	-	-	-	-	-	-	-	-	25.4
Fabaceae in total			8.2	12.5	5.9	-	4.8			25.4
Cornaceae	-	-	15.6	-	-	-	-	-	-	-
Convolvulaceae	-	-	3.3	-	-	-	-	-	-	-
Brassicaceae	-	-	-	-	9.6	-	4.2	-	-	-

Alliaceae	-	-	-	-	3.8	-	6.0	34.7	-	-
Rosaceae	-	-	-	-	15.1	22.8	66.3	8.2	6.4	-
Rubiaceae	-	-	-	-	0.42	-	-	-	-	-
Ericaceae	-	-	-	-	-	-	7.2	-	-	-
Wind pollinated										
Chenopodiaceae	-	-	-	6.3	-	35.1	-	-	4.3	-
Fagus/ Carpinus/Carya	-	-	0.8	-	-	-	-	-	-	-
Betula	14.3	12.0	-	6.3	-	-	-	-	-	-
Pinus	14.3	9.1	-	-	-	-	-	-	-	-
Humulus	-	-	0.8	-	-	-	-	-	-	-
Picea	-	-	-	-	-	-	-	2.0	-	-
Urtica	-	-	-	-	-	10.5	-	-	-	-
Poaceae	-	-	-	-	-	12.3	-	2.0	-	-
Ambrosia (Asteraceae)	-	-	3.3	21.9	-	19.3	-	-	70.2	-
Artemisia (Asteraceae)	-	-	-	-	-	-	3.6	-	-	-
Asteraceae in total	-	-	3.3	21.9	-	19.3	3.6	-	70.2	-
Asteraceae Insect pollinated / Wind pollinated, %	47.6/0	78.9/0	48.4/3.3	46.9/21.9	52.7/0	0/19.3	0/3.6	0/0	6.4/70.2	136/0
Total PG/PT quantity Total PG %	21/7 100	33/7 100	122/9 100	32/6 100	239/11 100	57/5 100	166/9 100	49/8 100	94/7 100	185/6

The PGs content of insect-producing plants was about the same and amounted to 45.5 - 48.4 %. Pollen of wind-pollinated plants in samples of propolis is represented only by PT *Ambrosia* It was present in half of the samples. The number of PGs varied greatly and amounted to 3.3 - 21.9 %.

Other components for each propolis sample were different. Besides Asteraceae, propolis contained 2-5 PTs of insect-pollinated plants. Apiaceae prevailed (in three cases out of four) and herbaceous Fabaceae (in half of the samples) (Figure 3).

We noted mainly spring-flowering *Betula* (in three of four samples) and *Pinus* (in half of them) among the PGs of wind-pollinated plants of other PTs, except Asteraceae. Plants of the Chenopodiaceae family were also noted. In total, pollen from wind-pollinated plants comprised 0.8 - 21.9 % in propolis samples.

Samples from nearby regions (RNO-A and the RA) were characterized by 7 - 9 PTs. The Asteraceae PGs prevailed; the spectrum of others almost did not overlap. However, in the total amount of pollen, these samples were very different. In propolis from the RA there are only 21 PGs, and in the sample from the RNO-A there are 118 of them.

Onagraceae and *Tilia* pollen were present in the sample from RA, and Dipsacaceae, Fabaceae, Cornaceae, and Convolvulaceae were present in the sample from RNO-A (Figures 4 and 5).

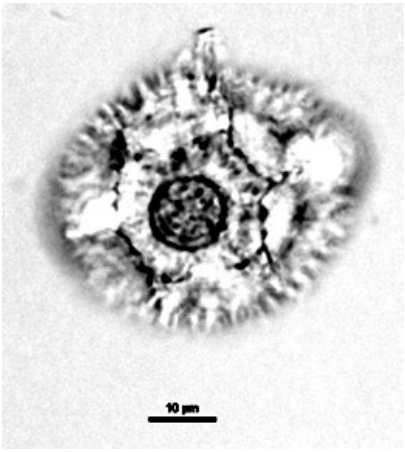

Figure 1. *PT Cichorioideae*

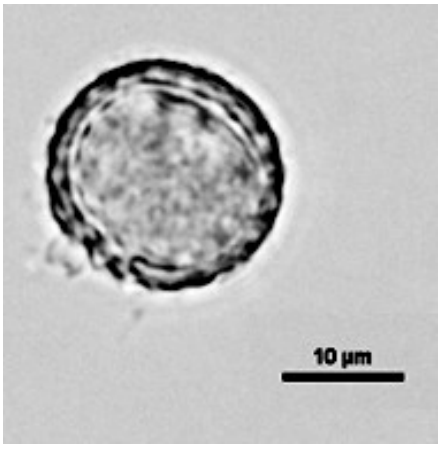

Figure 2*. PT Ambrosia*

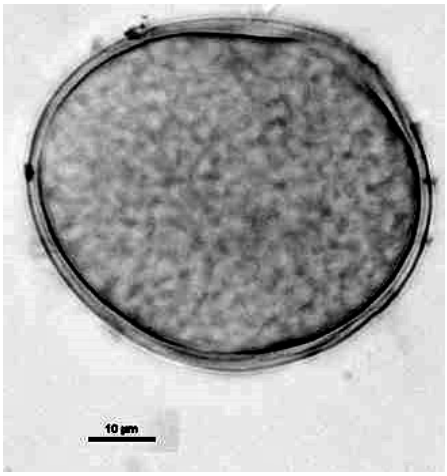

Figure 3*. PT Trifolium*

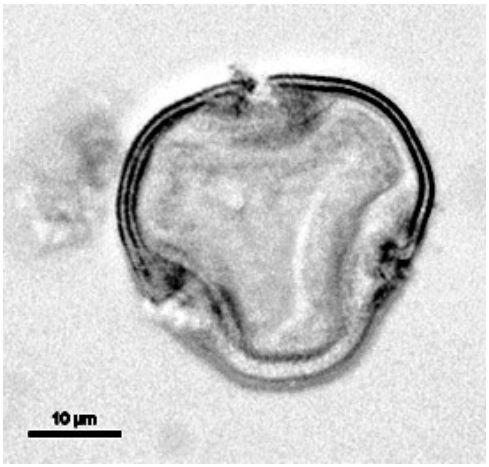

Figure 4*. PT Tilia*

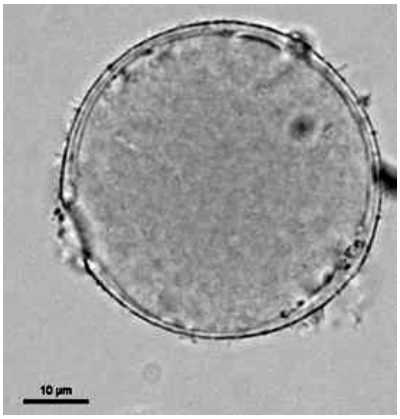

Figure 5. *Knautia sp. PT Dipsacaceae*

In the sample from RA, there are two PTs of wind pollinated plants (*Betula* and *Pinus)*, and in the propolis from PNO-A - three, both spring flowering plants (*Fagus*) and late

summer ones (*Humulus, Ambrosia)*. The amount of PGs of wind pollinated plants in the samples were 28.6 % and 5.1 %, respectively.
In propolis samples from the Volgograd and Saratov regions (Lower Volga region) the total number of PGs were almost the same. The prevailing type in this case were also Asteraceae PGs, accounting for almost half of all pollen. These samples were also peculiar to PTs not belonging to the Asteraceae family. A sample from the Volgograd region from insect-pollinated plants contained PGs Boraginaceae, and from the Saratov region, grassy Fabaceae. Volgograd propolis contained wind pollinated PGs of two PTs: spring flowering plants: *Pinus* and *Betula*. In the Saratov propolis sample, 33.7 % of the total amount of pollen constituted by the PGs of wind-pollinated plants (*Betula*, Chenopodiaceae and *Ambrosia*) with a predominance of *Ambrosia*. This means that three types of PT presented: one of them is spring and two are late summer.

Honey: palynological characterization of samples

Honey from RI represented by three samples. All of them contained PGs of plants of the Rosaceae family: from 15.1 % (sample from the village of Dalakovo) to 66.3 % (from the village of village Lyagzhi) (Figure 6).
The rest PTs partially met in only two of these samples. Honey from village of Dalakovo contained pollen 10 PTs. Asteraceae PGs prevailed - 52.7 % of the total composition. The largest number of PGs from them found in the tribe *Asteroideae* and the genera *Cyanus* and *Cirsium* (Figure 7). PTs of Rosaceae, *Tilia*, Brassicaceae, and grassy Fabaceae also represented quite a lot (Figure 3).

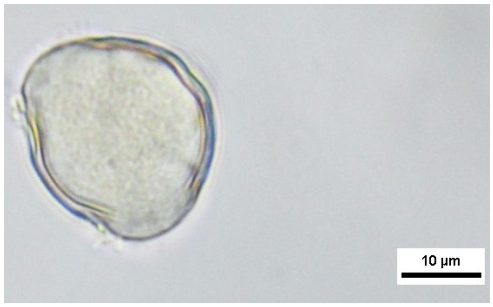

Figure 6. *PT Rosaceae*

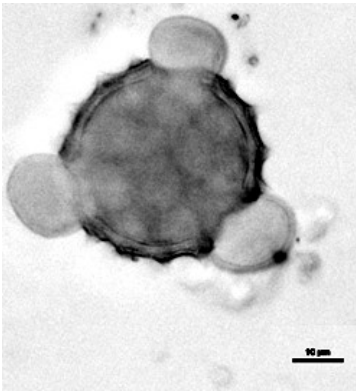

Figure 7. *PT Cirsium*

Impurities PGs of wind-pollinated plants in honey from village of Dalakovo not found.
Honey from v. of Alkun contained 5 PTs. It dominated by wind pollinated PTs in it: from plants with late summer flowering periods: 76.2 %, with the predominance of Chenopodiaceae and *Ambrosia*. Insect pollinated PT represented by only one Rosaceae PT of which only 22.8 %. So, the source of nectar is spring-flowering plants, and the pollutants are late summer.
Honey from v. of Lyagzhi contained 9 PTs. Among them, Rosaceae PG prevail - 66.3 %. In this sample, *Tilia*, grassy Fabaceae, and Brassicaceae PTs often found in kinds of honey in small amounts. There are types of Alliaceae, Ericaceae and Apiaceae that are less common in kinds of honey (Figure 8).

The wind-pollinated PGs in this sample is 3.6 % (only PT *Artemisia*).
Two samples of honey from RNO-A were analyzed: from the villages of Makhchesk and Chikola. Rosaceae, Boraginaceae and *Tilia* PGs were found in both of them, but otherwise they were very different.
Honey from village of Mahschek contained 8 PTs. The largest abundance among them were the Alliacae (34.7 %) and Lamiaceae (30.6 %) PGs. The remaining PTs represented by a small amount more common in honeys *Tilia,* Rosaceae, Boraginaceae and Dipsacaceae. Wind-pollinated PTs are only 4.0 % but it is also spring dusting PT *Picea* and summer Poaceae (Figure 9).

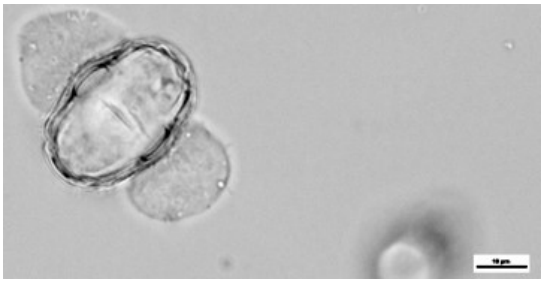

Figure 8. *PT Apiaceae*

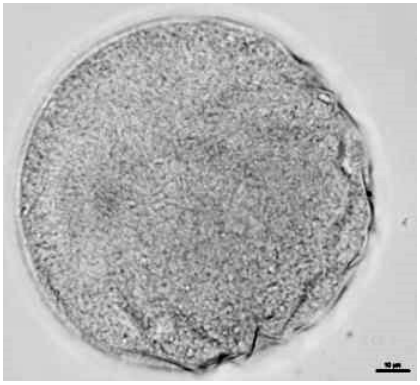

Figure 9. *PT Poaceae*

Honey from village of Chikola contained 7 PTs. The pollen of wind-pollinated plants prevailed (74.6 %). A large number of them found PGs of *Ambrosia* (70.2 %). The main insect pollinating PTs plants represented by *Tilia*, Asteraceae, and Rosaceae.
A sample of honey from the Saratov region (Rtishchevo city) contained only three PTs, and there were no wind pollinated ones. Asteraceae PT prevailed (73.5 %) while *Helianthus* PGs dominated (Figure 10). Much less often were *Robinia* (Fabaceae), and very few *Tilia* PGs.

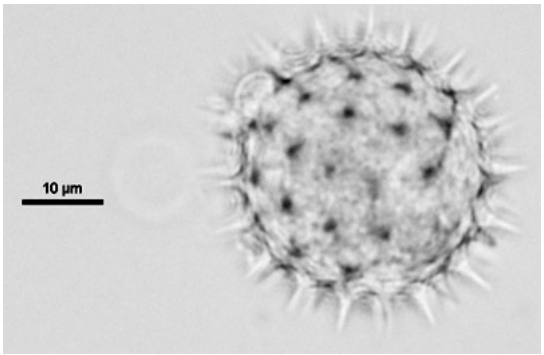

Figure 10. *PT Helianthus*

The palynological spectrum of honey from the city of Rtishchevo was studied earlier [36]. We note the incomplete coincidence of spectrums with our data. For example, our samples do not include Poaceae, Polygonaceae PGs. The authors note the presence of

PGs Zea mays, Fagopyrum sagittatum. This difference is due to the non-systematical sampling and changes in the structure of crops.

Pollen spectra of honey analysis

Some honey specimens, like propolis samples, dominated by pollen from plants of the Asteraceae family. But honey, in addition to the dominant type, contained another 5-6 PTs of insect-pollinated plants. Or honey was almost monofloral.
Honey from v. of Alkun contained pollen from plants of the Rosaceae family only. Three samples of honey from RI were very different from each other. One of them dominated by the *Cirsium* PGs and plants of the Rosaceae family.
The second sample from RI was with the predominance of only PGs of plants of the Rosaceae family, the third was with the predominance of PGs of plants of the families Ericaceae, Alliaceae and Rosaceae. Samples of honey from RI differed in the pollen composition of wind pollinated plants. In one sample the PGs of plants of the families Alliaceae and Lamiaceae dominated, in the other, of the families Asteraceae and Rosaceae, as well as *Tilia.*
The honey sample from the Saratov region turned out to be clean of extraneous PGs and contained a large amount of *Helianthus* PGs (69.2 %).

The occurrence of PTs analysis

From the pollen of Asteraceae, it can be seen that of the wind-pollinated plants in the propolis samples there are no *Artemisia* PGs, but PGs *Ambrosia* are found. The absence of the PGs of wind pollinated *Artemisia* in propolis is possibly related to the collection technology of this product. The collection or repacking of propolis did not occur during the flowering period of *Artemisia* (July-September). Or in the surrounding area, *Ambrosia* completely supplanted *Artemisia.* The second assumption is more likely, because the flowering time of representatives of both genera matches. There are PGs like *Artemisia* and *Ambrosia* in kinds of honey. But kinds of honey can be collected clean, without clogging particles from the atmosphere. We regret to note that *Ambrosia* is the main plant contaminating the melliferous lands of southern European Russia, its PGs pollute bee products. PTs *Cyanus* and *Cichorioideae* are rarely found in honey samples studied.
Although it would be logical to detect in honey PGs *Cyanus* and *Cichorioideae*, because these plants abundantly produce nectar.
The most widely represented were *Helianthus* PGs (almost monofloral honey from the Saratov Region) in kinds of honey and *Cyanus segetum* mixed with PGs plants of the subfamily *Asteroideae* and *Cirsium* (Dalakovo). This may be due to the pumping time of honey. Early summer honey, where the PT Rosaceae found and late summer honey, the PTs Asteraceae. PTs Brassicaceae, Alliaceae and Rosaceae often found in honey. Rosaceae repeatedly dominate, but have never been found in propolis. This is in good agreement with the literature on nectariferous representatives of these families [35]. Honey with a predominance of PGs of plants of the Rosaceae family contained many PTs, including wind-pollinated plants - the Chenopodiaceae, Urticaceae, Poaceae family and *Ambrosia*.

PGs of plants of the Onagraceae family met once in both propolis and honey. Representatives of this family are characterized as nectar producers in the literature, and for *Epilobium latifolium* it is indicated: nectar producer and perga producer [36].

Tilia PGs get into propolis rarely (one sample), and are often found in the honey. Only in one sample out of six they were absent. The result is in good agreement with the literature on the nectar-producing of *Tilia* flowers.

Apiaceae PGs often fall into propolis (in three out of four samples), but they were found only once in the honey. The result does not correspond to the literature, where this family characterized as nectar producer.

PGs of plants of the Boraginaceae family are rarely found both in the honey and in the propolis, which coincides with literature data on the nectar producers plants of this family. Although the family has many representatives visited by bees, the most common (widespread weeds) are plants of the genus *Echium* and *Symphytum* [37].

PGs of plants of the Dipsacaceae family, and in particular, *Knautia arvensis*, noted once, both in propolis and in honey. This coincides with the literature on the nectar producers of these plants [37].

PGs of plants of the Lamiaceae family are presented once in propolis and honey. However, in the literature, representatives of the family are more often characterized as nectar producers [37].

PGs of plants of the Fabaceae family are found many times both in propolis and honey. They are characterized in the literature either as nectar producers or as perga producers [36]. Perhaps the bees visit different species of these plants for different purposes.

PGs of plants of the families Cornaceae and Convolvulaceae are rare (once), and only in propolis from RNO-A. About plants of the Cornaceae family there are instructions in the literature regarding nectar producers or perga producers for different species [37]. Plants of the Convolvulaceae family are not characterized for nectar and pollen.

PGs of plants of the Rubiaceae and Ericaceae families found only in honey in one sample. There is no data on the production of nectar and / or pollen for plants of the Rubiaceae family in the literature.

The characteristics of plants of the Ericaceae family as nectar producers and perga producers are consistent with the literature [37].

PGs of wind-pollinated plants are found in all propolis samples and in four of six honey samples. The pollen of wind-pollinated plants could get into the samples in contact with open air when collecting them from the hive or during packaging. PGs of *Betula* and *Pinus* fell into propolis in the spring, in May and early June, when these plants massively bloom. Spring pollen did not get into honey, because it is obtained in the summer. Therefore, the pollen of plants of the Chenopodiaceae, Poaceae, Asteraceae (*Ambrosia, Artemisia*) families and *Urtica dioica*, which bloom in late summer, often get in honey. However, pollen from both *Betula* and Chenopodiaceae fell into the propolis sample from the Saratov region. This sample was probably packaged; therefore, it was in contact with the surrounding air at the beginning and at the end of summer.

One PG of *Picea abies, Humulus lupulus*, and plants of the Fagaceae family probably came into different samples randomly.

The pollen of plant species pollinated by insects and wind was not found in the samples.

APPLICATIONS

Visual analysis of propolis

Propolis samples characteristics are shown in Table 4.

Table 4. *Propolis samples visual characteristics*

Year of sample getting	The origin of propolis samples	Name of indicator		
		Appearance	Color	Structure
2011	PNO-A, village Kamata	Lumps	light brown	almost uniform
2011	RA	Lumps	dark green	dense, almost uniform in fracture
2011	Volgograd region, Novoanninsky	Lumps	brown with a yellow tint	dense, almost uniform in fracture
2010	Saratov Region, Rtishchevo	Alcohol extraction with sediment	Dark brown	Thick liquid

Table 4 shows that most samples of propolis are dense brown formations of different shades. In one case, the sample was represented by a thick liquid with sediment. The aroma of all samples of propolis we characterize as pleasant.

Organoleptic analysis of honey

We characterize the aroma of all honey samples as strong, pleasant. Other characteristics of honey samples are given in Table 5. Samples were obtained in 2015.

Table 5. *Honey samples visual characteristics*

Region	Name of indicator	
	Appearance	Colour
PNO-A, village Chicola	Honey stratified	The upper part is dark brown, the lower is lighter
PNO-A, village Makhchesk	Honey stratified	The upper part is dark brown, the lower is lighter
RI, village Dalacovo	Homogeneous	Brownish
RI, village Alcun	Top stratification	Light yellow
RI, village Lyagzhi	Homogeneous	Yellowish with brownish spots
Saratov Region, Rtishchevo	Top stratification	Yellowish, the upper thin part is yellowish brownish

CONCLUSIONS

1. Palynomorphological analysis can allows to establish the region of origin of the honey, and for propolis - authenticity. PTs found only in propolis: *Centaurea cyanus*, *Cichorium*, Cornaceae, *Convolvulus*. PTs found only in honey: Cruciferae, Alliaceae, Rosaceae, Rubiaceae, Ericaceae. PTs found in both products, sorted in

decreasing order of occurrence: Asteraceae, *Tilia* (prevails in honey), Apiaceae, Fabaceae, Boraginaceae, Dipsacaceae, Onagraceae, Lamiaceae.

2. The variety of honey according to PTs is so great that it requires the accumulation of much more material for conclusions on the characteristics for honey of different origins and technological features of production. This distinguishes honey from propolis, which in origin is not associated with pollen. The pollen spectrum in it is poorer and is well explained by the contamination of this PGs product from two sources: atmospheric air and honeycombs in the hive.
3. Honey samples from one region differ very much from each other. Honey from different regions close in climatic parameters differ even more. For example, all honey samples from the RI contained a large number of Rosaceae PGs, and there were very few such PGs in honey from neighboring regions.
4. Propolis samples can be divided into two groups: from RA and Volgograd region received a wind-pollinated component of pollen of spring-flowering plants (PGs *Pinus* and *Betula*), samples from RNO-A and Saratov region in contact with both the spring component (*Betula* and *Fagus* / *Carpinus* / *Carya*) and the late summer component (*Ambrosia* and plants of the Chenopodiaceae family). A sample of propolis from the Saratov region turned out to be the most polluted by wind-pollinated PTs.

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ABBREVIATIONS

BAS - biologically active substances
PG - pollen grain
PT - pollen type
RA - Republic of Abkhazia
RNO-A - Republic of North Ossetia - Alania
RI - Republic of Ingushetia

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