

## BOTANICAL AND GEOGRAPHICAL ORIGIN OF HONEYS OF PERM KRAI

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Floral diversity of Perm Krai (Russia) enables to get honeys of different botanical origin. They are predominantly polyfloral honeys. However, depending on the geographical and natural climatic conditions there is a possibility of producing monofloral honeys. This research was done in order to study different types of monofloral honeys and to confirm their geographical origin.

During the years of 2005-2008 and 2010-2012, 409 honey samples from five phytogeographical regions of Perm Krai (1a, 1b, 2a, 3, 4, 5) were analyzed. The following documents were used: GOST 19792-2001 "Natural honey. Specifications", GOST R 52940-2008 "Honey. Determination of the relative frequency of pollen", "Harmonised methods of the International Honey Commission". The results were processed using discriminant and cluster analyses by the programme STATISTICA.



Figure 1. Phytogeographical regions of Perm Krai (according to Ovesnov S.A., 2000)

1 – middle-taiga spruce-fir forests: a – North European pine and spruce forests predominating, b – Kama-Pechora-Western Urals spruce-fir forests predominating; 2 – south-taiga Kama-Pechora-Western Urals spruce-fir forests: a – agricultural lands predominating, b – aspen and birch forests predominating at the location of dark coniferous forests; 3 – broadleaved-spruce-fir (sub-taiga) forests; 4 – Kungur insular forest-steppe; 5 – middle and south taiga submontane fir-spruce and spruce-fir forests; 6 – north and middle taiga cedar-spruce mountain forests.

We analysed the most number of samples from two regions (1b and 3). It was carried out pollen spectrum analysis of 117 honeys from region 1b and of 199 honeys from region 3. Dock (*Rumex L.*) proved to be marker of region 3 which was found in 3 % of samples. Several markers are typical of region 1b: Cyperaceae Juss. (5 % samples), primrose (*Primula spp.*) (4 % samples), Ericaceae Juss. (13 % samples).

We determined the highest pollen-grains frequency in honeys (more than 80% of samples).

- Umbelliferae Juss. and meadowsweet (*Filipendula ulmaria L.*) in all samples;
- mint (*Mentha spp.*), willow (*Salix L.*) in region 1a;
- willow (*Salix L.*), white clover (*Trifolium repens L.*) in region 1b;
- willow (*Salix L.*), white clover (*Trifolium repens L.*), snowy clover (*Trifolium hybridum L.*), meadow clover (*Trifolium pratense L.*), melilot (*Melilotus spp. L.*) in region 2a;
- white clover (*Trifolium repens L.*), snowy clover (*Trifolium hybridum L.*), melilot (*Melilotus spp. L.*), meadow clover (*Trifolium pratense L.*), small-leaved lime (*Tilia cordata Mill.*) in region 3;
- meadow clover (*Trifolium pratense L.*), small-leaved lime (*Tilia cordata Mill.*) in region 4;
- willow (*Salix L.*), white clover (*Trifolium repens L.*), red raspberry (*Rubus idaeus L.*) in region 5.

### **Botanical origin of honeys**

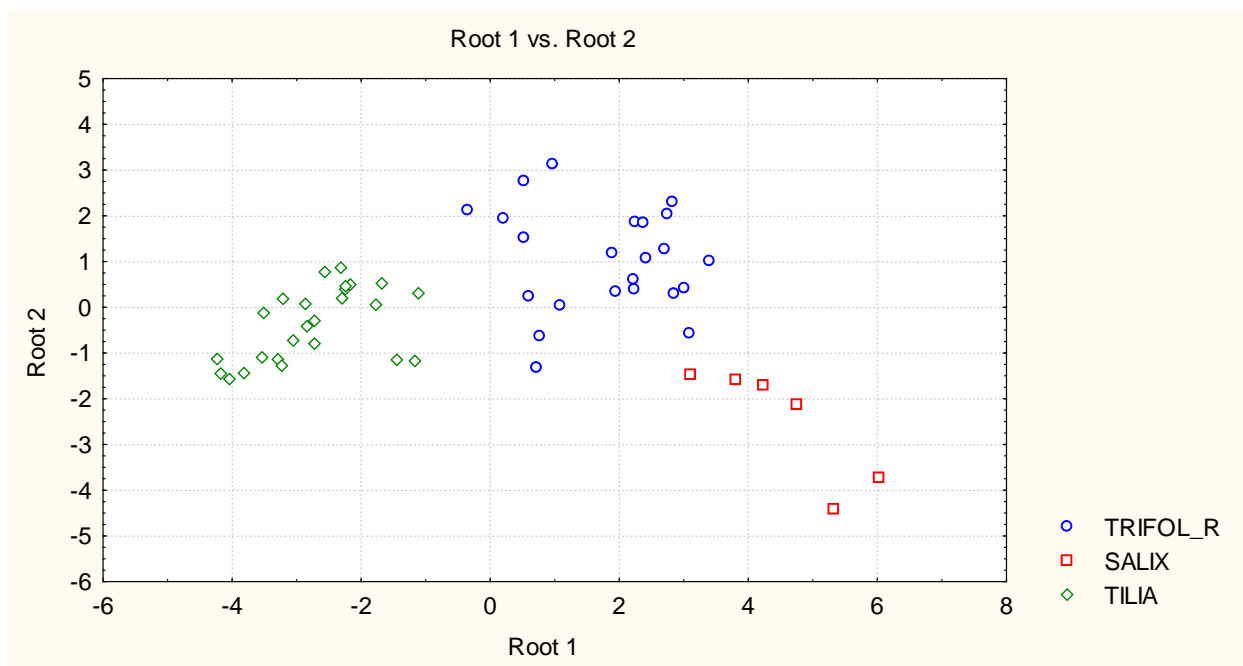
Honeys containing more than 45% of the pollen grains were determined:

- white clover (*Trifolium repens L.*), willow (*Salix L.*), meadowsweet (*Filipendula ulmaria L.*), red raspberry (*Rubus idaeus L.*) in region 1b;
- white clover (*Trifolium repens L.*), snowy clover (*Trifolium hybridum L.*), willow (*Salix L.*), small-leaved lime (*Tilia cordata Mill.*) in region 2a;
- white clover (*Trifolium repens L.*), snowy clover (*Trifolium hybridum L.*), goat's-rue (*Galega L.*), small-leaved lime (*Tilia cordata Mill.*) in region 3;
- small-leaved lime (*Tilia cordata Mill.*) in region 4;
- white clover (*Trifolium repens L.*), small-leaved lime (*Tilia cordata Mill.*), red raspberry (*Rubus idaeus L.*) in region 5.

Using discriminant analysis we defined the basic monofloral honeys of Perm Krai. To make calculations we choose honeys from different regions containing 35% of pollen grain: 25 samples of lime, 6 – of willow, 23 – of white clover.

According to some physicochemical parameters (pH, conductivity, colour, hydroxymethylfurfural, total acidity, diastase number) three types of monofloral honeys with more than 35 % of pollen grains were classified: small-leaved lime (*Tilia cordata Mill.*), white clover (*Trifolium repens L.*), willow (*Salix L.*). The statistical values of Wilks' Lambda for all parameters are about 0.1, that is indicative of good discrimination of these honeys.

Figure 2. Results of discriminant analysis



The numerical values of monofloral honeys are specified

Table 1. The numerical values of monofloral honeys

Values	Diastase number, Gothe units	Total acidity, cm <sup>3</sup> /100 g of honey	Hydroxymethyl-furfural content, mg/kg	Conductivity, mS/cm	pH	Colour Pfund scale, mm	Pollen-grains content, %
White clover ( <i>Trifolium repens</i> L.)							
min	8.3	1.00	1.00	0.12	3.5	19	35.5
max	36.2	2.73	4.32	0.53	4.5	78	86.1
average	20.2	1.61	2.42	0.23	3.9	41	51.4
Willow ( <i>Salix</i> L.)							
min	11.4	1.50	1.00	0.22	3.8	60	41.3
max	25.4	2.91	10.56	0.64	4.3	91	78.8
average	20.5	2.00	6.07	0.34	4.1	70	53.1
Small-leaved lime ( <i>Tilia cordata</i> Mill.)							
min	7.3	1.00	1.00	0.30	4.3	15	35.0
max	24.5	1.65	2.30	0.59	6.4	34	86.0
average	14.7	1.08	1.19	0.46	5.3	24	51.0

On basis of the results obtained from cluster analysis (the similarity of physicochemical parameters) honeys from white clover (*Trifolium repens* L.) and willow (*Salix* L.) were referred to one group.