# ТЕХНОЛОГІЇ ВИРОБНИЦТВА ТА ПЕРЕРОБКИ ПРОДУКЦІЇ ТВАРИННИЦТВА

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## MORPHOLOGICAL CHARACTERISTICS OF *CORYLUS AVELLANA* L. BEE POLLEN

Встановлено морфологічні особливості бджолиного обніжжя отриманого з *Corylus avellana* L. Монофлорність загального збору бджолиного обніжжя з *C. avellana* становила 98,13±0,171 %. Сформованість пилкової грудочки бджолиного обніжжя знаходилася у межах від 3 до 4 балів. Визначено морфометричні параметри пилкової грудочки: довжина 2,84±0,053 мм, ширина 2,25±0,056 мм, маса 4,28±0,222 мг. Параметри спектрометрії для монофлорного бджолиного обніжжя з *C. avellana* були: L* 57,75±0,102, a* 5,13±0,086, b* 27,02±0,168, C* 27,50±0,171, h° 79,24±0,167 одиниць. Низька варіація спектрометричних параметрів підтверджує гомогенність пилкових грудочок бджолиного обніжжя.

**Ключові слова**: бджолине обніжжя, морфологія, спектрометрія, *Corylus avellana* L.

**Formulation of the problem.** Now, it remains questionable the identification of pollen grains as an apiculture products for determination its regional and botanical origin. As monofloral bee pollen production volumes increase, it requires a comprehensive study of morphological and biochemical properties of different types of monofloral bee pollen. Research topic is related to the study, conservation and management of plant material biodiversity.

**Analysis of recent researches and publications.** A group of scientists during 14 years of studying the timing of flowering *Corylus avellana* L. in Italy found that this plant is characterized by large differences in intensity early flowering and production of pollen [1]. In Poland and Ukraine of detailed features of *C. avellana* flowering and pollinating were also studied. It was established the beginning of flowering dates, temperature of favorable pollination, concentration of pollen in the air [2, 3, 4]. However, other scientists associated *C. avellana* flowering with the start of the season for honey bees [5]. Thus, commonly believed polliniferous *C. avellana* is one of the most valuable plants in early spring [6]. Recently, scientists payed more attention to the studies of protein feed for bees, bee pollen and bee bread. Thus, there have been already studied the morphological and biochemical features of bee pollen for many plant species [7, 8]. There were studies about *C. avellana* pollen morphology from different regions [9]. However, morphological characteristics of *C. avellana* bee pollen require further studies, which will be related to the improvement of identification methods among other species of polliniferous plants.

The **objective** of the research was to determine the morphological characteristics of *C. avellana* bee pollen. In accordance with the objective achieving the following tasks were determined: to select samples of bee pollen during flowering *C. avellana* of bee colonies in Kiev region; to find out the monoflorality ratio of total pollen harvesting and botanical origin of bee pollen; to explore the morphological characteristics for *C. avellana*bee pollen.

**Materials and methods.** *C. avellena* bee pollen was taken from three locations in Kiev region in the period from 01.03 to 31.03.2016. Bee pollen is selected by outer pollen traps of bee colonies from local populations. Monoflorality ratio of total bee pollen collection was determined by using percentage of *C. avellana* pollen lumps to all other [10]. Botanical origin of bee pollen was defined by using

pollen analysis [10]. Morphological features of bee pollen were defined in the laboratory of Institute Biodiversity Conservation and Biosafety, Slovak University of Agriculture in Nitra. Weight of individual pollen lumps was determined by using analytical scales ANG 100C (Axis). Length and width of bee pollen were measured with software Ascension Waves Vision on photos of pollen lumps from electron microscope Zeiss SteREO Discovery V20. Color of bee pollen was determined by construct Lab color model by using spectrometry devices at Nicolet 6700 FT-IR Spectrometer and Lovibond SP62 S/N 044929. Bee pollen shaping level was determined by method, which was developed at the Department of beekeeping NULES of Ukraine [11]. Obtained numeric data were subjected to the statistical analysis in the Microsoft Office Excel (2010).

**Results of the research.** Considering macro photos of *C. avellana* pollen grains, we described their appearance. Thus, the surface of pollen grains is smooth without protrusions or spines. Pollen grain has round and a little bit triangular shape. Grain is flattened in the middle. Aperture located on every corner of pollen grain. Bee pollen was taken from bee colonies every day. Thus, in the period from 03.03 to 15.03.2016 bees brought bee pollen dirty yellow color with a smooth surface (Fig. 1, a).

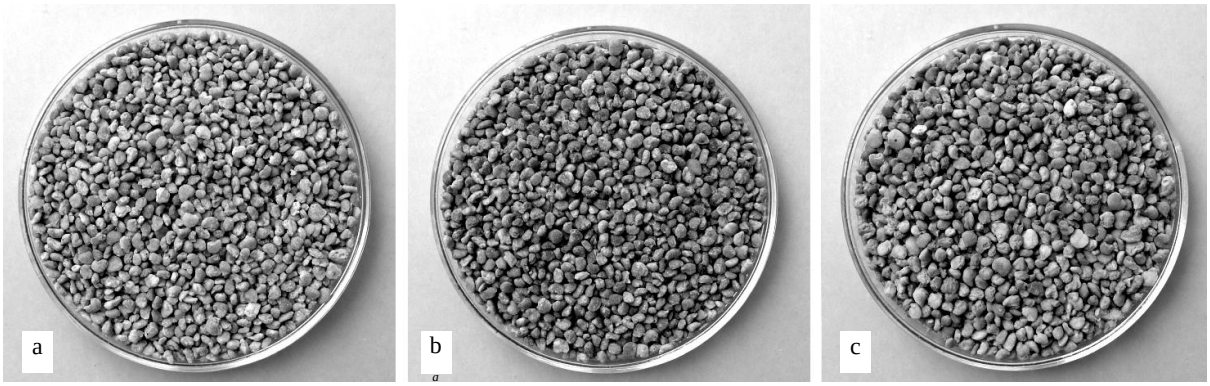


Figure 1. **Samples of bee pollen received in March 2016**
*(a – from 03.03 to 15.03.16; b – from 16.03 to 28.03.16; c – from 29.03 to 31.03.16).*

In the period from 01.03 to 03.03.16 bee families didn't bring bee pollen. After harvesting bee pollen in subsequent periods we found differences in its color and form that was the first feature of falling into the general harvesting pollen from other species. According to the results of pollen analysis for bee pollen, which was collected in the period from 03.03 to 03.15.16, contained pollen grains only *C. avellana*; in the period from 16.03 to 03.28.16 pollen lumps were dual origin and contained pollen grains of *C. avellana* and *Alnus glutinosa* Gaerth; in the period from 29.03 to 03.31.16 pollen grains from three *Salix* L. species were presented in bee pollen. Therefore, in order to research the morphology of *C. avellana* bee pollen we used collection only from 03.03 to 15.03.16 (tab. 1).

Table 1 – **Morphological features of *Corylus avellana* L. bee pollen** (n=30)

| Indicator | M±m | Max | Min | $C_v$ (%) | δ |
|---|---|---|---|---|---|
| Monoflorality, % | 98.13±0.171 | 99 | 96 | 0.95 | 0.94 |
| Shape level, point | 3.50±0.093 | 4 | 3 | 14.53 | 0.51 |
| Length of pollen lump, mm | 2.84±0.053 | 3.42 | 2.30 | 10.17 | 0.29 |
| Width of pollen lump, mm | 2.25±0.056 | 3.09 | 1.75 | 13.75 | 0.31 |
| Weight of pollen lump, mg | 4.28±0.222 | 7.4 | 2.6 | 28.38 | 1.21 |

It was defined, that monoflorality of total bee pollen collection was 98.13±0.171 %. The coefficient of variation was low, which indicates a high level of bees' concentration on pollen harvested from *C. avellana* in the period from 03.03 to 15.03.16. Also, it could be due to the absence of other plant species in nature, they are able to produce pollen at low ambient temperatures.

Assessing the shape level of pollen lumps we found that, it was in the range from 3 to 4 points. That's way bee didn't form bee pollen completely and returned to the hive (fig. 2).

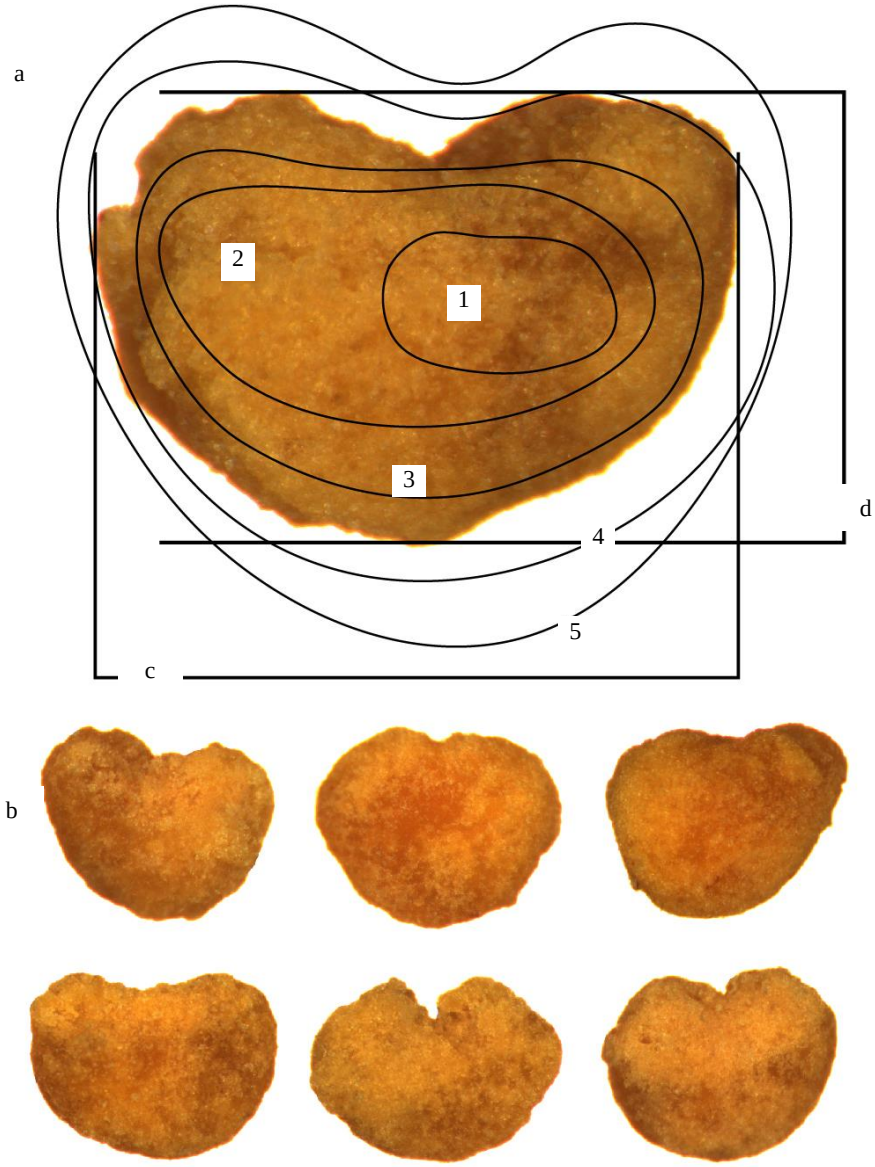


Figure 2. **The shape level and morphology of pollen bee pollen lumps of *Corylus avellana* L.**
*(a – morphometric measurements and scale of pollen shape level; b – diversity of bee pollen; c – the width of pollen lump; d – the length of pollen lump, 1-5 – levels of shaping).*

The small size of pollen lumps harvested typical weak bee families. In the early spring period all bee families are weakened. Another reason is an insufficient number of hairs on the bees' exoskeleton, which for harvesting pollen. This is due to the fact that in the early spring the main flight and harvesting work is done by old wintered bees which had lost almost all hair. Also, the small size of bee pollen can be caused by surface and morphological features of pollen grains. Thus smooth surface of pollen grains are inherited to all anemophily plants and bee reluctant collects pollen, which poorly attached in bee pollen on hind legs of bees. However, there are a few sources of feed in early spring and bees had to collected pollen from *C. avellana*.

Morphometric parameters of length and width show the correct form of pollen lumps. Thus length measuring has always prevailed the width measuring and an average was 20.77 %. Bee pollen weight was in the range from 2.6 mg to 7.4 mg, resulted in a high coefficient of variation – 28.38 %. A low weight can be classified as small bee pollen. For the length and width parameters were typical average variabilities (10.17–13.75 %). Different levels of variability for weight, length and width parameters are indicating on the different density of pollen lumps. Thus, listed morphological characteristics are not sustainable for *C. avellana* bee pollen.

Color of bee pollen was determined by means of color perception by using the parameters: lightness (L*); the ratio from green to red color (a*); the ratio from blue color to yellow (b*); relative saturation (C*); hue angle (h°) (tab. 2).

Table 2 – **Spectrometric parameters of *Corylus avellana* L. bee pollen** (n=10)

| Indicator | Spectrometric parameter | | | | |
|---|---|---|---|---|---|
| | L* | a* | b* | C* | h° |
| Min | 57.25 | 4.70 | 26.17 | 26.66 | 78.45 |
| Max | 58.19 | 5.64 | 27.67 | 28.16 | 80.08 |
| M±m | 57.75±0.102 | 5.13±0.086 | 27.02±0.168 | 27.50±0.171 | 79.24±0.167 |
| | 0.32 | 0.27 | 0.53 | 0.54 | 0.53 |
| $C_v$ (%) | 0.56 | 5.30 | 1.97 | 1.97 | 0.67 |

Low variation of spectrometric parameters confirms the homogeneity of pollen lumps of bee pollen. The lowest correlation coefficient was characterized for lightness and dimension (0.56 %). However, the standard deviation was lower for the ratio index from green to red color. If to estimate the value of hue angle (78.45 units), it shows color location between yellow and green, but visually we see yellow-brown bee pollen.

**Conclusions.** Monoflorality of total collection of *C. avellana* bee pollen was determined and it was 98.13±0.171 %. Level shape of pollen lumps of bee pollen was in the range from 3 to 4 points. Morphometric parameters of pollen lumps: length is 2.84±0.053 mm, width is 2.25±0.056 mm and weight is 4.28±0.222 mg. Parameters of spectrometry for monofloral *C. avellana* bee pollen were, units: L* 57.75±0.102, a* 5.13±0.086, b* 27,02±0.168, C* 27.50±0.171, h° 79.24±0.167. Low variation of spectrometric parameters confirms the homogeneity of pollen lumps of bee pollen.

Further researches in this direction may be relevant to the studies about morphological parameters of bee pollen of other species which have an importance for beekeeping as polliniferous or honey plants.

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**Морфологическая характеристика пчелиной обножки с *Corylus avellana* L.**

**Л. А. Адамчук, В. В. Самойленко, Н. В. Николаева**

Установлены морфологические особенности пчелиной обножки полученных из *Corylus avellana* L. Монофлорность общего сбора пчелиной обножки с *C. avellana* составила 98,13±0,171 %. Сформированность пыльцевого комочка пчелиной обножки находилась в пределах от 3 до 4 баллов. Определили морфометрические параметры пыльцевого комочка: длина 2,84±0,053 мм, ширина 2,25±0,056 мм, масса 4,28±0,222 мг. Параметры спектрометрии для монофлорной пчелиной обножки с *C. avellana* были: L* 57,75±0,102, a* 5,13±0,086, b* 27,02±0,168, C* 27,50±0,171, h° 79,24±0,167 единиц. Низкая вариация спектрометрических параметров подтверждает гомогенность пыльцевых комочков пчелиной обножки.

**Ключевые слова**: пчелиная обножка, морфология, спектрометрия, *Corylus avellana* L.

**Morphological characteristics of *Corylus avellana* L. bee pollen**

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The purpose of the study is to establish morphological features of bee pollen obtained from *Corylus avellana* L. Monoflorality of total collecting of *Corylus avellana* L. bee pollen was 98.13±0.171 %. Level shape of pollen lumps of bee pollen was in the range from 3 to 4 points. Morphometric parameters of pollen lumps: length is 2.84±0.053 mm, width – 2.25±0.056 mm and weight – 4.28±0.222 mg. Parameters of spectrometry for *C. avellana* of monofloral bee pollen were in units: L* 57.75±0.102, a* 5.13±0.086, b* 27.02±0.168, C* 27.50±0.171, h° 79.24±0.167. Low variation of spectrometric parameters confirms the homogeneity of pollen lumps. In this direction further researches may be relevant to the studies about morphological parameters of bee pollen from other species of plants, which have importance as polliniferous or honey for beekeeping.

**Key words:** bee pollen, morphology, spectrometry, *Corylus avellana* L.

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## ПОРІВНЯННЯ ПОКАЗНИКІВ СОРБЦІЇ НОСІЇВ – ЖЕЛАТИНУ ТА КРОХМАЛЮ

Одним із способів підвищення стабільності ензимів і мікроорганізмів, які містяться у закваскаx для кисломолочних продуктів до умов зовнішнього середовища є їх іммобілізація на носіях. Носії, які використовуються для іммобілізації мають буди придатними до харчування, нетоксичними і володіти сорбційними властивостями або здатністю утворювати ковалентні зв'язки. Тому, були проведені порівняльні дослідження сорбційних властивостей желатину натурального, швидкорозчинного харчового (П-11) та крохмалю картопляного розчинного для йодометрії.