nébih
termőföldtől
az asztalig

Role of Honeybees, Diseases of Honeybees

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Introduction

Importance of beekeeping in ecosystems and food production

Significance of bee health: animal welfare, economic, and food safety aspects

Use of apicultural products in human and veterinary medicine

Market for bee products and the issue of adulteration

Importance of Beekeeping

1. Pollination and Food Security

• Approximately 75% of plant species worldwide rely on animal pollination.

• 35% of crops for human consumption directly depend on pollinators.

• Without bees, yields of many fruit, vegetable, and oilseed crops would be reduced or lost.

2. Agricultural and Economic Significance

• Pollination by bees enables crop production worth several hundred billion USD annually worldwide.

• Beekeeping is an important economic sector, providing income to beekeepers and related industries (honey, wax, propolis, royal jelly, pharmaceuticals).

3. Biodiversity Conservation

• 60–80% of wild plants depend on bees and other pollinators for reproduction.

• Pollination supports the maintenance of natural habitats, food chain stability, and the survival of wildlife.

4. Apicultural Products and Health Uses

• *(to be detailed later)*

5. Environmental Indicator

• Bees respond sensitively to environmental changes, making them effective indicators of pollution, climate change, and agricultural chemicals.

DG ENV, DG SANTE and DG AGRI presented to COMAGRI (the Agriculture Committee) (source: AGRA FACTs 92)

- The value of pollination: Humberto Delgado Rosa (DG ENV) highlighted that pollination is worth between €5 and €15 billion per year to EU agriculture.
- Population decline: Wild pollinator populations (wild bees, butterflies, bumblebees) have declined dramatically in recent decades; one in three species is in decline or threatened with extinction.
- New deal: The EU has reinforced the Pollinators Initiative in 2023, which aims to reverse the decline of pollinators by 2030 under the Nature Restoration Regulation (known as the ‘New Deal for Pollinators’).
- PESTICIDES: Klaus Berend (DG SANTE) noted that existing harmonised risk indicators already show a reduction in the risk and use of chemical pesticides in the EU.

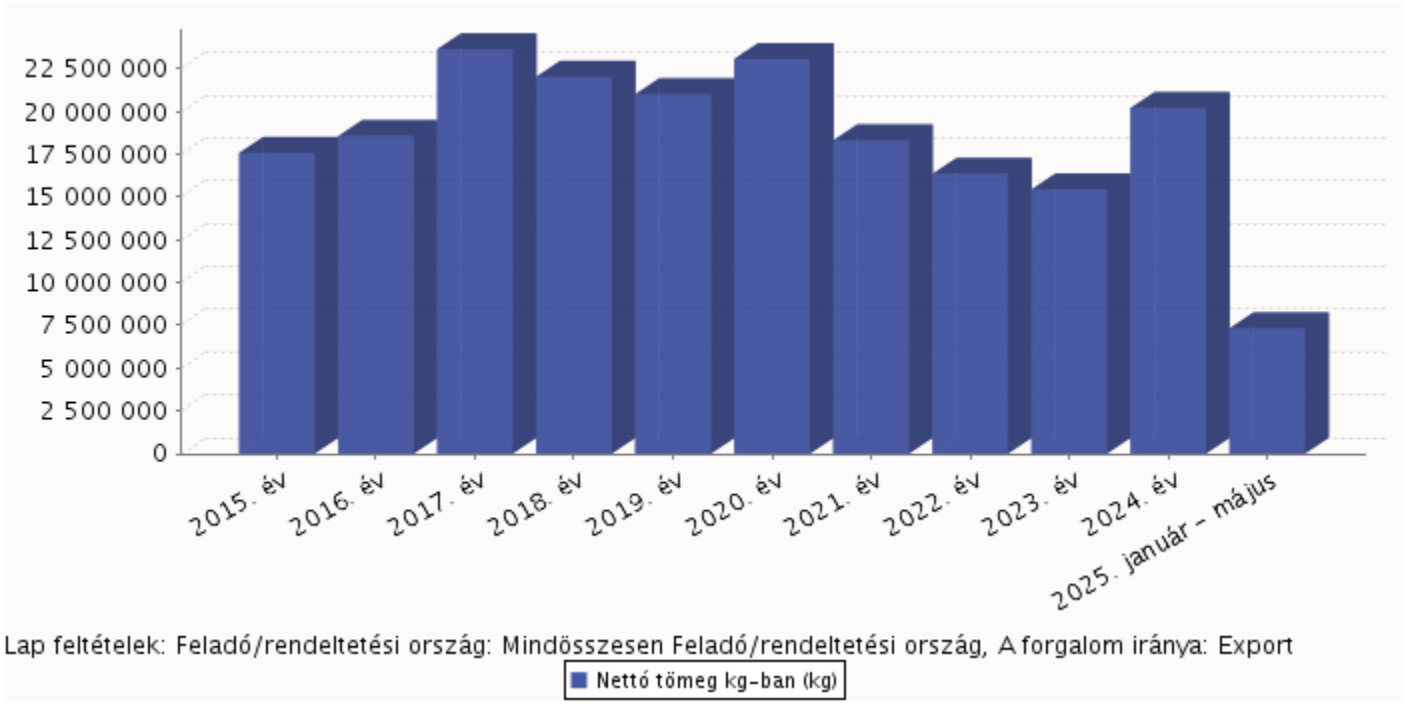
Recent Data on Beekeeping (2025)

County	Number of beehives	Number of apiaries	Number of beekeepers
Bács-Kiskun	171 103	2 288	2 438
Baranya	107 606	1 485	1 512
Békés	90 630	1 517	1 622
Borsod-Abaúj-Zemplén	109 917	2 007	2 093
Budapest	8 129	194	190
Csongrád-Csanád	55 951	903	1 001
Fejér	46 241	972	980
Győr-Moson-Sopron	48 742	963	931
Hajdú-Bihar	93 707	1 522	1 648
Heves	46 823	911	979
Jász-Nagykun-Szolnok	83 856	1 375	1 499
Komárom-Esztergom	18 685	454	410
Nógrád	44 902	833	918
Pest	85 746	1 814	1 814
Somogy	121 559	1 942	2 029
Szabolcs-Szatmár-Bereg	196 622	3 067	3 413
Tolna	52 252	878	880
Vas	31 970	678	663
Veszprém	48 194	915	959
Zala	82 649	1 246	1 220
Végösszeg	1 545 284	25 964	27 199

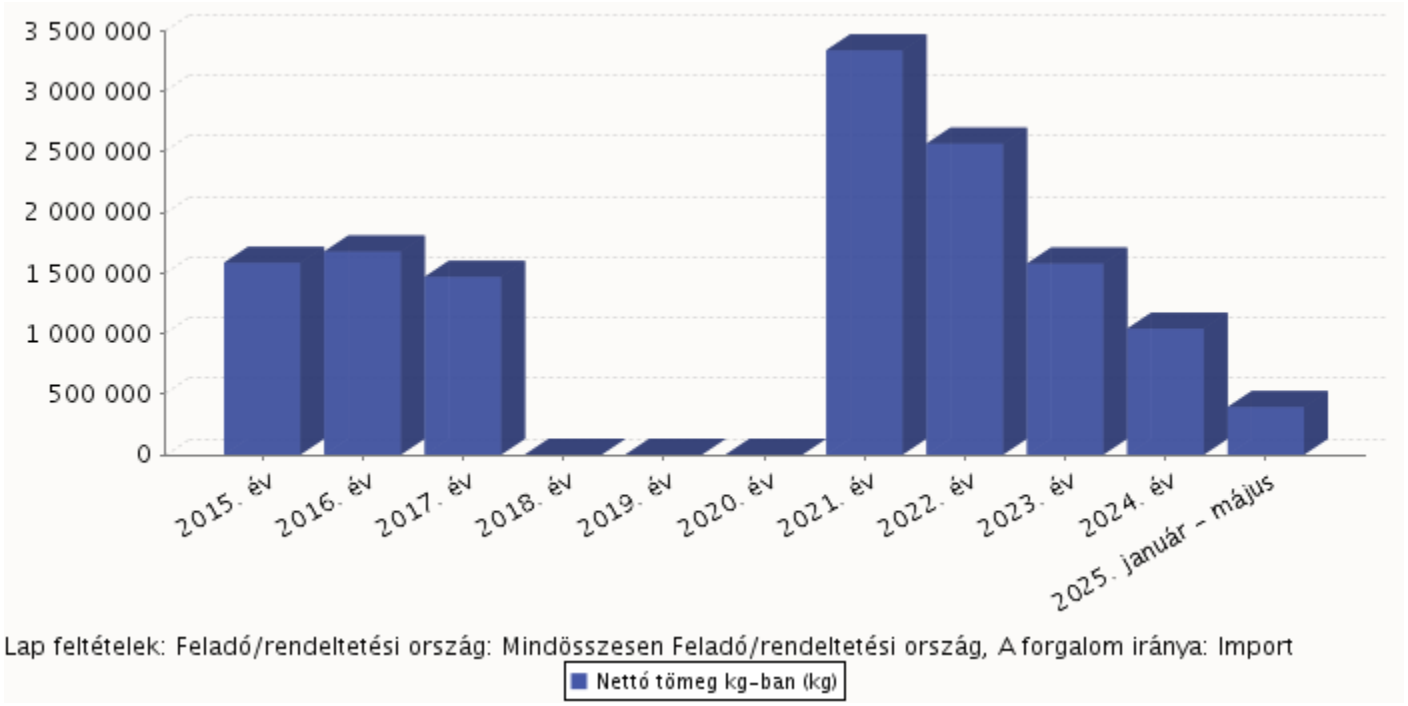
Honey trade data

- Estimated honey production: 25–30,000 tons/year (≈25 kg per colony)
- Estimated domestic consumption: ~1 kg/person/year (retail, direct sales, HoReCa, industrial use)
- **Average daily honey consumption based on EUMENU: 13 g/person (4,7 kg/person/year) – overestimated…**
- **For comparison: average daily sugar consumption is nearly 22 g/person**

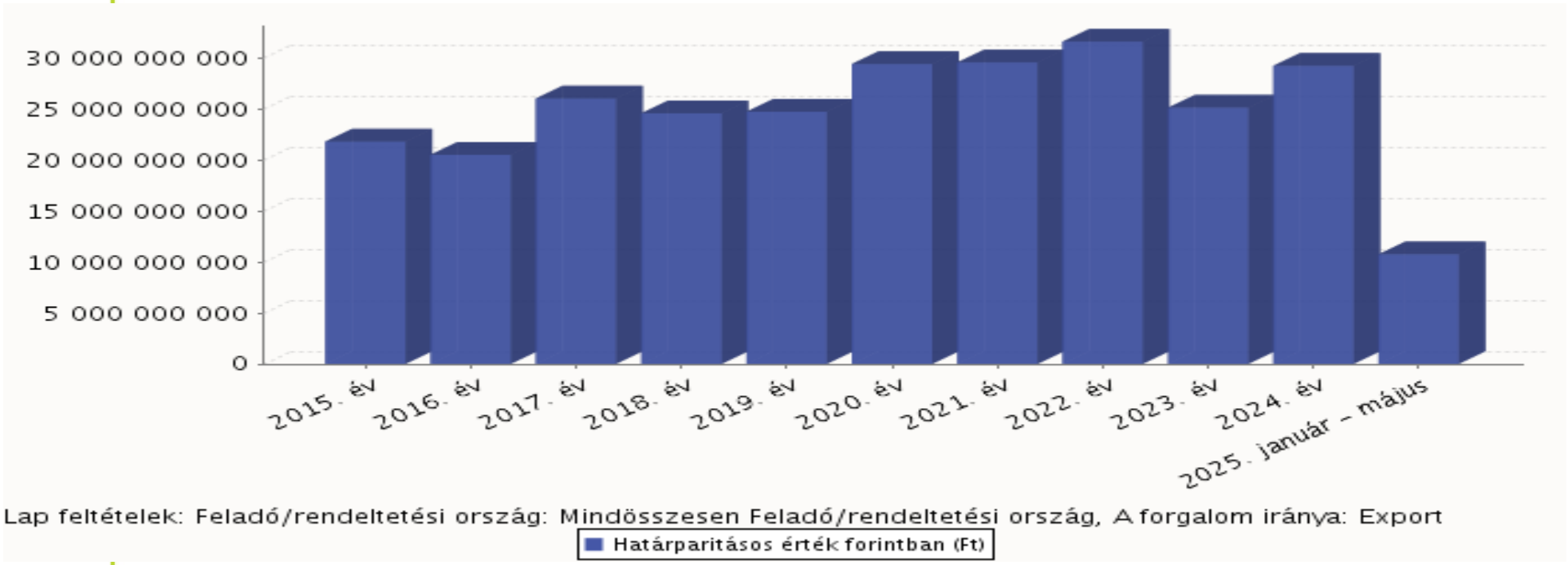
Hungarian Honey Exports (2015–May 2025) /kg/



Hungarian Honey Imports (2015–2025) – DECREASING TREND!

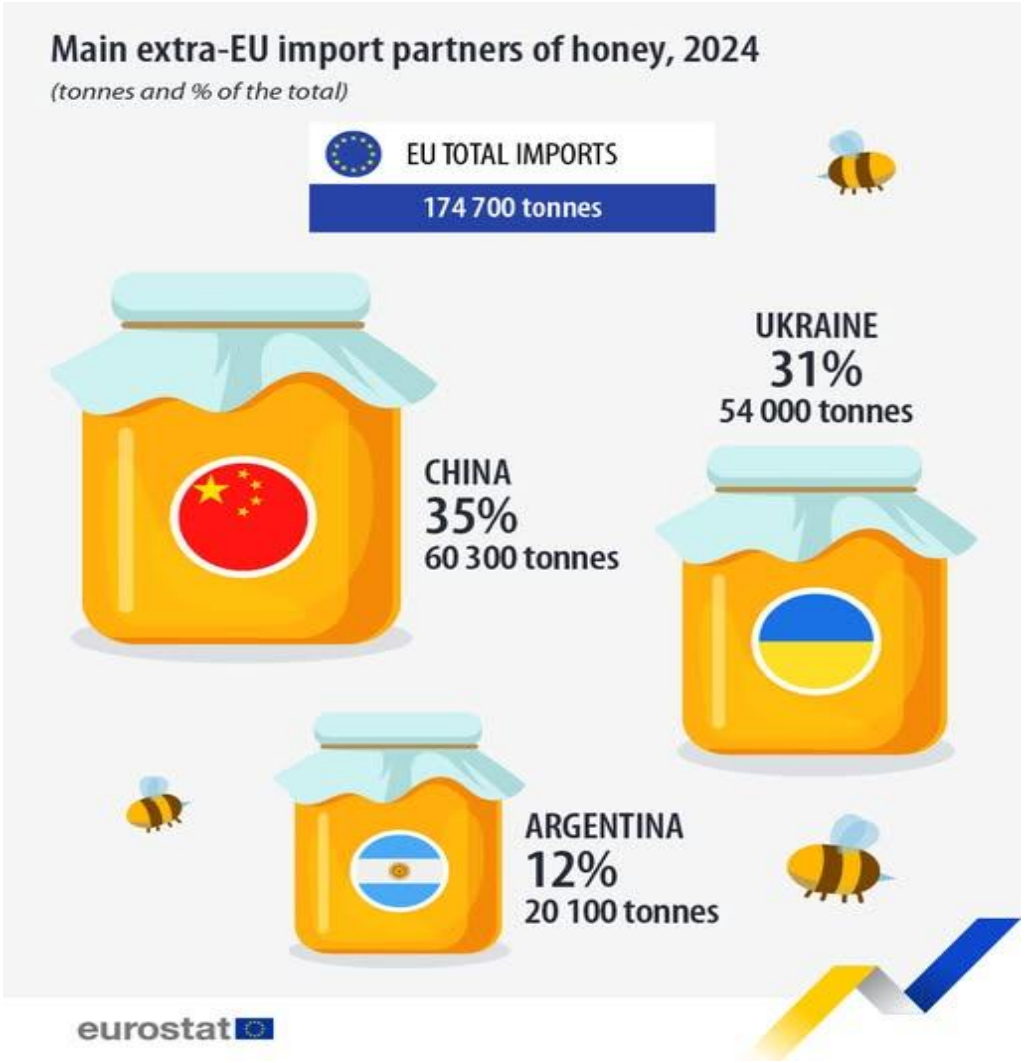


Export revenues (2015–May 2025) – average producer purchase price including compensation premium: 1145 HUF/kg



Export average prices, calculated with approx. 400 HUF/kg costs

In 2024, the EU imported a total of 174,700 tons of honey from outside the EU.



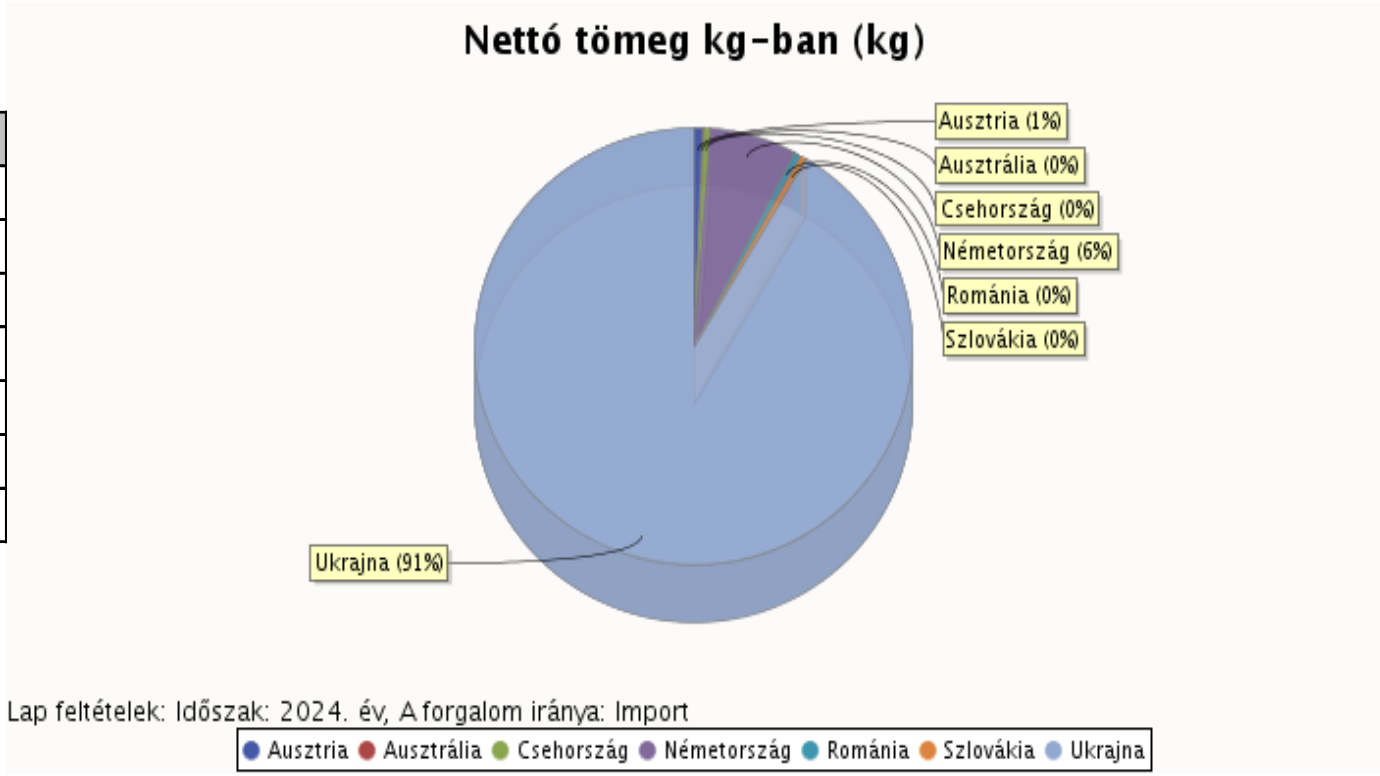
Main Honey Buyers of Hungary in 2024

Feladó/rendeltetési ország	Nettó tömeg kg-ban (kg)
Olaszország	6 018 437
Németország	4 463 732
Franciaország	1 536 149
Japán	969 879
Ausztria	944 617
Lengyelország	834 838
Spanyolország	631 872
Románia	321 525
Belgium	167 364
Szlovénia	163 779
Írország	143 891
Egyesült Királyság	122 309
Dánia	120 656
Egyesült Államok	113 810
Szaúd-Arábia	113 339
Csehország	72 579

Feladó/rendeltetési ország	Nettó tömeg kg-ban (kg)
Bulgária	45 467
Svájc	40 388
Hollandia	32 349
Horvátország	29 183
Finnország	23 100
Arab Emírségek	18 350
Szerbia	18 185
Szlovákia	15 267
Kanada	13 710
Svédország	9 345
Portugália	5 292
Katar	3 004
Lettország	2 755
Koreai Köztársaság	1 975
Ciprus	1 824
Szingapúr	1 641
Ausztrália	829

Hungary’s Honey Imports in 2024

Feladó/rendeltetési ország	Nettó tömeg kg-ban (kg)
Ukrajna	876 773
Németország	62 199
Ausztria	6 451
Szlovákia	4 710
Csehország	4 558
Románia	4 320
Ausztrália	550



Criteria for Acacia Honey

Acadia Honey

Parameter	Average range	Tolerance range
Robinia pollen content [%]	> 20	> 10 ha F/G > 1,55
	the pollen source is underrepresented	
Electrical conductivity [mS/cm]	< 20	
F/G ratio	> 1,55	> 1,50
Colour [mm Pfund]	< 15	< 20
Remarks	may show low enzyme activity, low proline content, sucrose max. 10 mg/kg according to the EU Honey Directive	
Sensory characteristics	*colour*: from water-clear to light yellow *odour*: mild, slightly aromatic *taste*: sweet, slightly floral, slightly aromatic *other*: remains liquid for a long time due to its high fructose content	

Basics of Bee Health

Bee Diseases and Pathogens

- Structure and responsibilities
- Bacterial diseases (e.g. American and European foulbrood)
- Viral diseases (e.g. Deformed Wing Virus – DWV)
- Fungal diseases (e.g. Nosemosis)
- Parasitic diseases (e.g. *Varroa destructor*, *Tropilaelaps* spp.)

- Poisoning and environmental factors
  - Effects of pesticides (e.g. neonicotinoids)
  - Heavy metals and other contaminants
  - **Monocultures and nutritional stress**
- Prevention and Treatment
- Veterinary procedures and interventions
- Biological and chemical control methods
- Role of veterinarians in bee health, **eco-toxicological asp**ects

Bee Health Monitoring

- Under Decree 70/2003 (VI. 27.) §§ 5–8, the tasks of official veterinarians are supported by bee health officers.
- Their main responsibilities include:
  - Annual monitoring of bee colonies (July 15 – October 15) for early detection of bee diseases
  - Health inspection of colonies prior to migration
  - Issuing health certificates based on satisfactory bee health examination results
  - Participation in poisoning-related procedures, particularly sample collection
  - Eradication of notifiable infectious bee diseases
  - Administrative and reporting duties related to the above
- Bee health officers are appointed by the Department of Food Chain Supervision of the competent county office.

Diagnostics in Official Laboratories

	2023	2024	2025
Varroa	**112**	**622**	**126**
Varroa (+)	68	353	55
Varroa (-)	44	269	71
Nosema	**74**	**48**	**54**
Nosema (+)	70	44	54
Nosema (-)	4	4	0
American foulbrood	**3498**	**3746**	**2205**
American foulbrood (+)	2451	2244	1402
American foulbrood (-)	1047	1502	803
European foul brood	**8**	**1211**	**394**
European foulbrood (+)	1	978	267
European foulbrood (-)	7	233	127

Regulated Bee Diseases – EU

Infestation with *Varroa* spp. (Varroosis)	C+D+E	Apis
Infestation with *Aethina tumida* (Small hive beetle)	D+E	*Apis, Bombus* ssp. FREE
American foulbrood	D+E	Apis
Infestation with *Tropilaelaps* spp.	D+E	Apis FREE

Regulated Bee Diseases – Hungary (Decree 113/2008 (VIII. 30.) of the Ministry of Agriculture and Rural Development)

- 12. Small hive beetle (*Aethina tumida*)*
- 19. American and European foulbrood of honeybees
- 34. *Tropilaelaps* spp.

* *Reportable to the European Commission*

National Reference Laboratory for Microbiology

National Reference Department for Parasitology, Fish and Bee Diseases

- National Reference Laboratory (NRL) in the fields of parasitoses, parasitozoonoses, and fish and bee diseases;
- Responsibilities include national surveys on the prevalence of parasitoses, parasitozoonoses, and fish and bee diseases;
- Oversight of veterinary laboratories in its jurisdiction and organization of proficiency testing;
- Monitoring of notifiable parasitic, fish, and bee diseases.

Aquatic Physiology and Ecotoxicology Unit

➢In cases of bee mortality, expert opinions are prepared on the basis of analytical, veterinary, and on-site findings.

Key Steps in the Procedure for Investigating Mass Bee Deaths

- Reporting, contacting authorities;
- Official inspection, on-site inspection and sampling;
- Shared IT data storage;
- Transport of samples;
- Communication with press and the public;
- Management of laboratory results;
- Official procedures by the county government office (plant and soil protection authority);
- Official procedures by the NFCSO Veterinary Medicines Directorate;
- Beekeeper’s legal claim.

Ecotoxicology

- NÉBIH laboratories and experts
- Complex analysis of bee mortality cases
  - Beekeeping technology and management factors
  - Foraging areas of the bees
  - Responsibility of the beekeeper vs. farmer
  - Animal health issues
- Experimental studies
  - Synergistic effects of antifungal agents

Case report of mass bee mortality						Justification of bee poisoning		Rationale for uterine pathology examination
Year	Number of incoming cases	Verified problem	Location	Number of affected bee colonies (pcs)	Sample type	Reweighed active ingredient	Remeasured active ingredient concentration (mg/kg)	
2023	22	5	Gödöllő	7	bee	dimethoate	0,91	
						omethoate	0,31	
					pollen	dimethoate	0,035	
			Királyszentistván	60	bee	clothianidin	0,0081	
						thiamethoxam	0,03	
			Nábrád	60	bee	clothianidin	0,0078	
						thiamethoxam	0,087	
			Panyola	17	bee	thiamethoxam	0,027	
			Nyírbéltek	65	bee	thiamethoxam	0,008	
					apple blossom	clothianidin	0,051	
						thiamethoxam	1,6	

Case report of mass bee mortality						Justification of bee poisoning		Rationale for uterine pathology examination
Year	Number of incoming cases	Verified problem	Location	Number of affected bee colonies (pcs)	Sample type	Reweighed active ingredient	Remeasured active ingredient concentration (mg/kg)	
2024	25	4	Bátmonostor	42+130+63 (total: 235)	bee	fipronil	0,078	
					bee	fipronil	0,043	
					bee	fipronil	0,059	
					rapeseed flower	diazinon	0,013	
					rapeseed flower	fipronil	0,4	
			Dávod	40+110+126+120 (total: 396)	bee	fipronil	0,0097	
					bee	fipronil	0,04	
					bee	fipronil	0,056	
					bee	fipronil	0,061	
					rapeseed flower	fipronil	0,8	
					rapeseed flower	fipronil	0,17	
			Kiskunmajsa	28	honeycomb	-	-	Positive for European foulbrood
			Madaras	100	honeycomb	-	-	Positive for European foulbrood

Table: In the virological examination: number of samples and prevalence of individual bee viruses in adult bees and brood

	Worker bee sample (n = 45)		Brood sample (n = 23)		Total number of samples (n = 68)	
Infected samples **Pathogen of viral infection**	**number**	**pro-portion**	**number**	**pro-portion**	**number**	**pro-portion**
Acute bee paralysis virus (ABPV)	18	40	1	4,34	19	27,9
Black queen cell virus (BQCV)	33	73,33	3	13,04	36	52,94
Chronic bee paralysis virus (CBPV)	1	2,22	0	0	1	1,47
Deformed wing virus (DWV)	14	31,11	1	4,34	15	22,05
Sacbrood virus (SBV)	21	46,66	3	13,04	24	35,29

Viral Diseases OMME 2020–2021

ÁTE MÁL - 2025

Gál J., Sós E., Ziszisz Á., Hoitsy M., Schönhardt K., Mándoki M., Halász G.: Háziméh (Apis mellifera Linnaeus, 1758) egyes vírusfertőzéseinek vizsgálata magyarországi méhészetekben tavaszi hordáskor

In spring 2024, screening tests were conducted in 26 Hungarian apiaries using both hive-collected and free-foraging bee samples.

- Deformed Wing Virus (DWV): positive in 54% of samples,
- Chronic Bee Paralysis Virus (CBPV): 38%
- Acute Bee Paralysis Virus (ABPV): 19%
- Black Queen Cell Virus (BQCV) and Israeli Acute Paralysis Virus (IAPV): not detected
- Proportion of virus-free samples: 35%

Effects of Monoculture Farming

- Advantages :
  - High nectar availability at once, in close proximity
  - Effective only if colonies are in good condition
- Disadvantages :
  - Nectar abundance is limited to a short period → requires migration, leads to honey with lower diastase activity and higher water content → nutritional stress
  - Unbalanced nutrient intake
  - Crop-dependence (species-specific reliance)
  - Agrochemical exposure and interactions (multi-toxin effects, sublethal doses, chemical odor signals)
  - Extreme example: U.S. pollination practices (overstocking → epidemiological disaster)
  - Deterioration of microclimate (reduced soil moisture, increased temperature fluctuations)

Apicultural Products: Composition and Health Significance

- Honey
  - Composition: sugars, enzymes, flavonoids, phenolic compounds
  - Antimicrobial and anti-inflammatory properties
  - Special honeys (e.g. Manuka, chestnut)
- Pollen and Propolis
  - Rich in proteins and antioxidants
  - Immunomodulatory and antibacterial effects
- Royal Jelly
  - Composition and pharmacological properties
  - Potential applications in human and veterinary medicine
- Bee Venom and Wax
  - Medical and industrial uses
- Allergenicity and toxicological considerations

Definition of Honey

*„Honey is the natural sweet substance produced by **Apis mellifera** bees from the **nectar** of plants or from **secretions** of living **plant parts**, or from excretions of plant-sucking insects on living plant parts. The bees **collect, transform, and combine it with their own specific substances, store it, dehydrate it, and leave it in honeycombs to ripen**."*

Adulteration of Honey and Other Apicultural Products

Common Techniques

- Addition of sugar syrups (HFCS, rice syrup, beet syrup)
- Manipulation with additives
- Misrepresentation of geographical origin
- Improper heating or filtration

Detection Methods

- Physico-chemical methods (pollen analysis, sensory evaluation, refractometry, viscosity measurement)
- Spectroscopic and isotopic analysis
- PCR and other molecular biological techniques

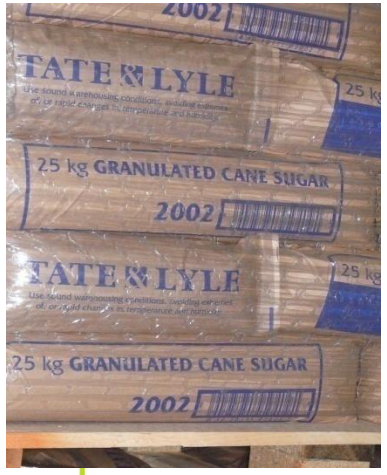
Impacts of Adulteration

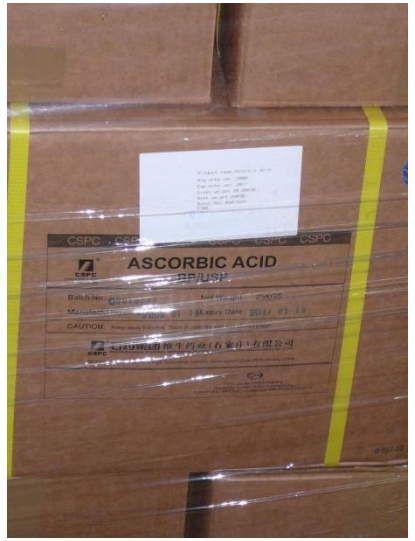
- Nutritional and health consequences
- Economic losses for beekeepers and consumers
- Risks to animal health and food safety

Act XLVI of 1895

on the Prohibition of the Adulteration of Agricultural Products

- **§1.** The adulteration of agricultural produce, products and articles, namely: milk and dairy products, animal and vegetable fats, greases, oils, as well as grain, flour and the pasta made thereof, **honey**, paprika, in general seeds and fodder seeds, fodder grain and manures, and the placing on the market of such adulterated goods, is prohibited.
- **§2.** By the adulteration of agricultural produce, products and articles, as listed in §1, shall be understood any imitation thereof, or such alteration which is suitable to mislead the consuming public or the buyer with regard to the origin, composition, or quality of the produce, product, or article.





Non-Natural Technologies for Honey Production, Methods of Honey Testing

Old and New Issues – Future Outlook

EU Survey “From the Hives” (not surprising)

Member state of destination / Member state of control

Mexico	BIO MIELES DEL SURESTE SA DE CV	**DK**			
	DOMINGO JIMENEZ PEREZ	**BE**	**BE**	**BE**	
	Hermes Honey SA de CV	**DE**			
	Maya Honey, SA de CV	**BE**	**DE**		
	MIEL GABRIELA, S.A. DE C.V.	**DE**			
	MIEL MEX S.A. DE C.V.	**BE**	**BE**		
	Najil Cab S.A. de C.V.	**PL**			
	NOREVO MEXICO, SA DE CV	**DE**	**ES**	**ES**	
	OAXACA MIEL SA DE CV	**FR**	**ES**		
	Productos Mayaland SA DE CV	**BE**	**BE**	**DE**	**DE**

EU Survey – China

CHINA	AHCOF INDUSTRIAL DEVELOPMENT	RO	ES	BG	BG	GR									
	ANHUI FENGLIAN BIOTECHNOLOGY INC.,LTD.	PL													
	Anhui Honey Origin Biological Technology CO ., LTD	DE	DE (FF23.2594)												
	Anhui Melissa Foodstuff Co Ltd.	DE/BE	DE/BE	LT	DE/BE	DE/BE	DE/BE	DE/BE	DE/BE	DE/BE	DE/BE	DE/BE	DE/BE	LT	
	ANHUI MIZHIYUAN FOOD GROUP CO.,LTD	SE	SE	SE	PL	LT (FF23.2871)	DE (FF23.0951)	INTEL 10.2024/722263							
	ANHUI SINOEURO AGRO-PRODUCTS CO LTD	BE (FF22.3737)													
	Anhui Oneco Foods Co., Ltd.	INTEL 03.2023/FF23.2912													
	CHANGGE JIELI BEE'S PRODUCTS CO.,LTD.	ES	ES	ES											
	CHAO YANG HENG TONG FOOD CO LTD	ES													
	DALIAN HENGSHENG BEE PRODUCTS	IT													
	Dongtai Zhongrun Food Co., Ltd.	PL	PL	PL											
	EASY FOOD (JIACING) CO.LTD	PL	PL												
	Hangzhou Golden Harvest Health Industry Co. LTD.	CZ													
	HUBEI HUATIAN FOOD LIMITED BY SHARE LTD.	PL	PL	PL	PL	PL	PL	PL	PL	PL					
	Hubei Lingyang foods	DE	IE	IE	IT	IT	IT	IT	IT	BE (FF24.0405)					
	Jiangsu Runbang Food Co.,Ltd	PL	PL												
	LIANONING SINOEURO AGRO-PRODUCTS	DE	DE	PL	SE	SE	DE	DE							
	Macheng Zongde Apiculture Co., Ltd	DE (FF24.0667)													
	NINGXIA NATURAL HONEY PRODUCT TECHNOLOGY AND DEVELOPMENT CO., LTD.	DE	DE	GR											
	NOREVO (BEIJING) FOOD CO.,LTD.	DE													
	Shandong Huahan Foods Co. Ltd	BE	BE	ES	ES	ES	ES								
	Tianjin Goldenhouse Imp.& Exp. Trading Co., Ltd.	PL	PL												
	Tianjin Sweet Product Co., Ltd.	DE													
	WUHAN HONEYCOMB HEALTHY CO.,LTD	PL													
	YIWU HEQIA IMPORT&EXPORT	PL													
	ZHEJIANG HONGXIANGYUAN IMPORT AND EXPORT CO., LTD	ES	ES/BE	ES	ES	ES	PL	PL	PL						
	ZHEJIANG WILLING FOREIGN TRADING CO LTD	DE (05.04.2023)													

EU Survey – Surprising Findings ☺

Great Britain	Brake Bros Ltd	**NL**	**NL**									
	ROWSE HONEY LTD	**DE**										
	Wilkin & Sons Limited	**BE**	**BE**	**BE**	**ES**	**ES**	**ES**	**FR**	**FR**	**GR**	**NL**	

RASFF – WhatsApp screenshot

Adulterated honey from China (RASFF)

Description: The whistle Blower contacted the Internation Bussines Manager of the Chinese company ANHUI MIZHIYUAN FOOD GROUP CO.,LTD who exports honey to

EU. This company as already found suspicious of honey adulteration during the "From the Hives" Coordinated Control Plan, in which the consignment CHEDP.PL.2021.0015217 was analyzed by the JRC. The WB shared the screen-shots of the conversation with the Bussiness Manager in which she states "Normally Chinese NMR honey is passing by Intertek, but we can select a **premium NMR honey that can pass all 3 laboratories Intertek/Qsi/Eurofins**". Please find attached in this notification the screenshot of the conversation.

NMR?

The word “magnetic” in NMR refers to the fact that the physical phenomenon only occurs in a strong magnetic field, therefore the solution or solid sample to be tested is placed inside a superconducting electromagnetic coil cooled with liquid helium. I UNDERSTAND SO FAR☺

With NMR spectroscopy, those atomic nuclei can be examined in which either the number of protons, or the number of neutrons, or both, is odd. AHA…

Both protons and neutrons are spin-½ particles; if they occur in the nucleus in even numbers, they pair up and cancel each other out, while if their number is odd, the sum differs from zero. OKAY ☺

And from here I lost the thread…

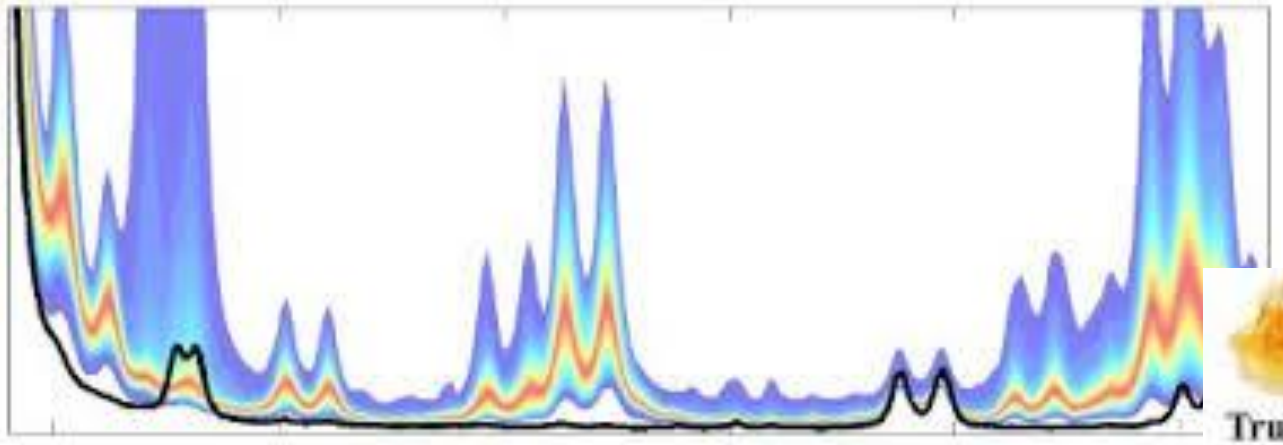
As a result of the external magnetic field, the magnetic moments of the atomic nuclei, similar to a compass needle, strive to align in the north–south direction, but the peculiar rules operating in the micro-world forbid the compass needles from aligning exactly to the north.

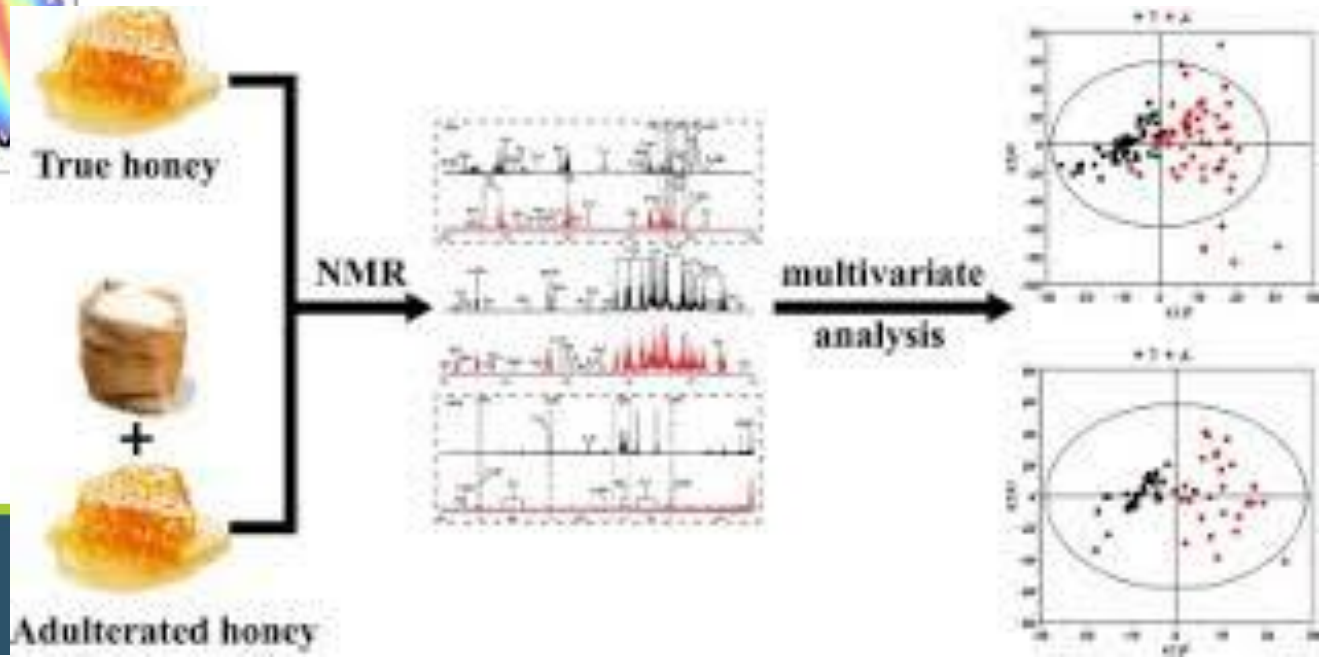
The reasons are as follows:

- Spin (angular momentum) is a vector quantity, having both magnitude and direction. For particles with spin I = ½, the magnitude is $\sqrt{I(I+1)}$, while with respect to any external direction (which we call the z-direction) it can only be oriented so that its projection onto this direction is $\pm\frac{1}{2}\hbar$. ($\hbar = h/2\pi$, where h is Planck's constant). This restriction in orientation is one of the important consequences of the Heisenberg uncertainty principle. For nuclei with spin I = 1, the possible orientations are such that Iz = +1ħ, 0ħ, or –1ħ. (=$zI\hbar$
- The spin and magnetic moment vectors are always parallel to each other. The relation between their magnitudes is given by the equation involving γ (the gyromagnetic ratio), which is a material constant. Its value differs for electrons, protons, neutrons, and every other atomic nucleus (e.g., the I = ½ spin nuclei of ^{3}H, ^{13}C, ^{15}N, ^{19}F, ^{29}Si, ^{31}P, etc.). Thus, different isotope nuclei behave as magnets of different strengths. $Im\gamma=$
- The magnetic moment attempts to align with the north direction, but in doing so it must also turn the spin vector. However, according to point 1, the spin can only adopt a limited set of orientations. Therefore, the magnetic moment also cannot align exactly in the north direction!

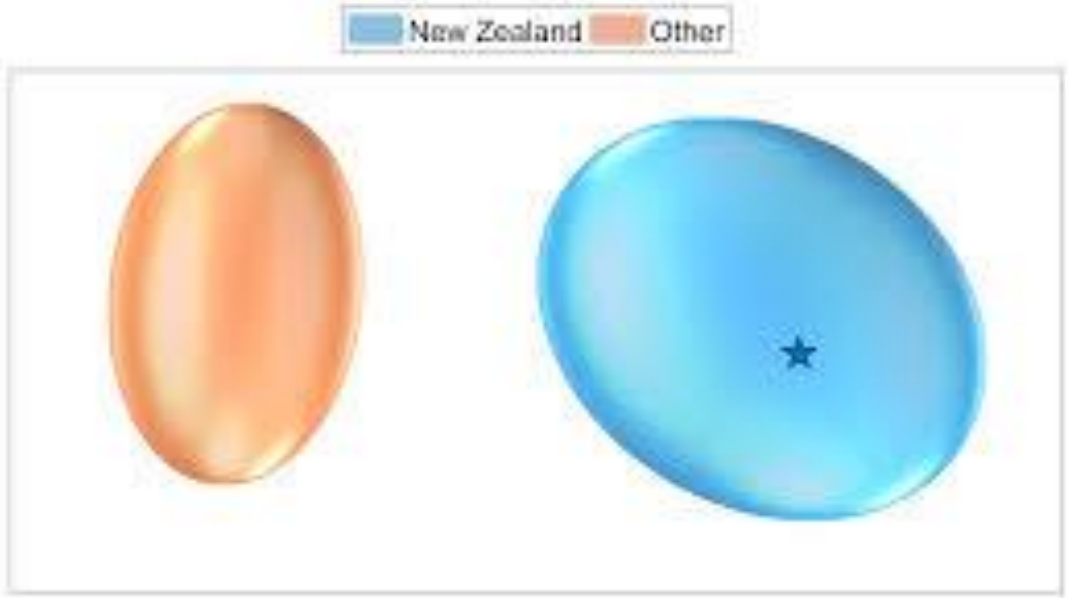
BUT ☺

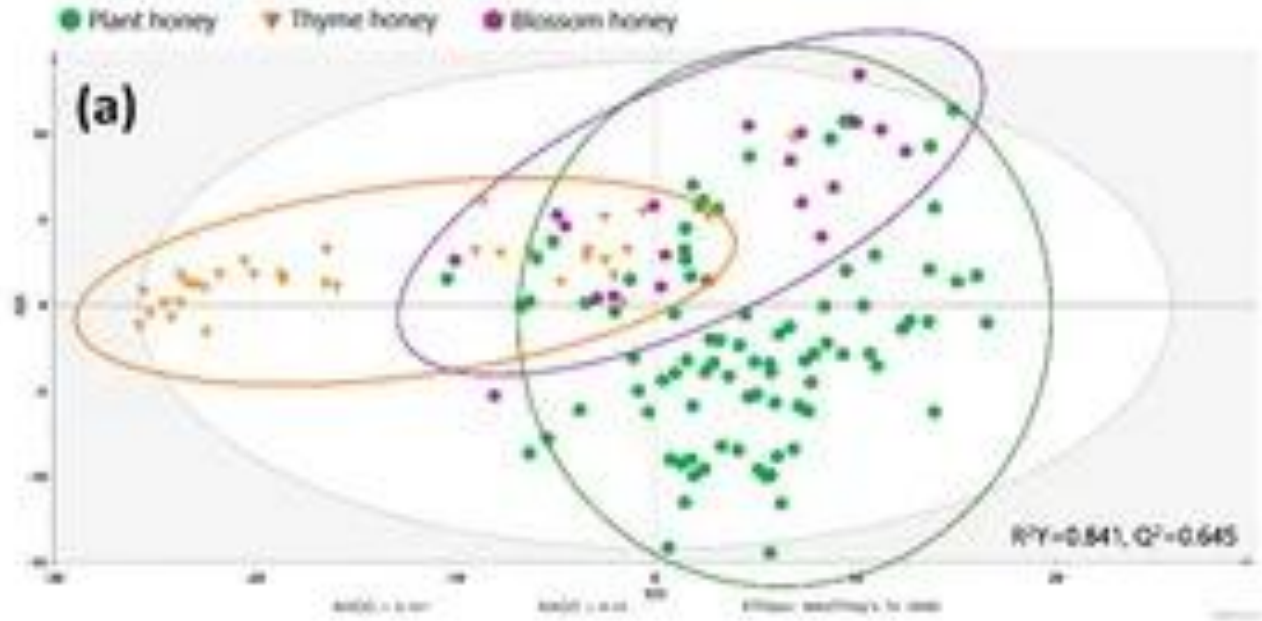
- fortunately, we don’t need to understand this – only to use it:

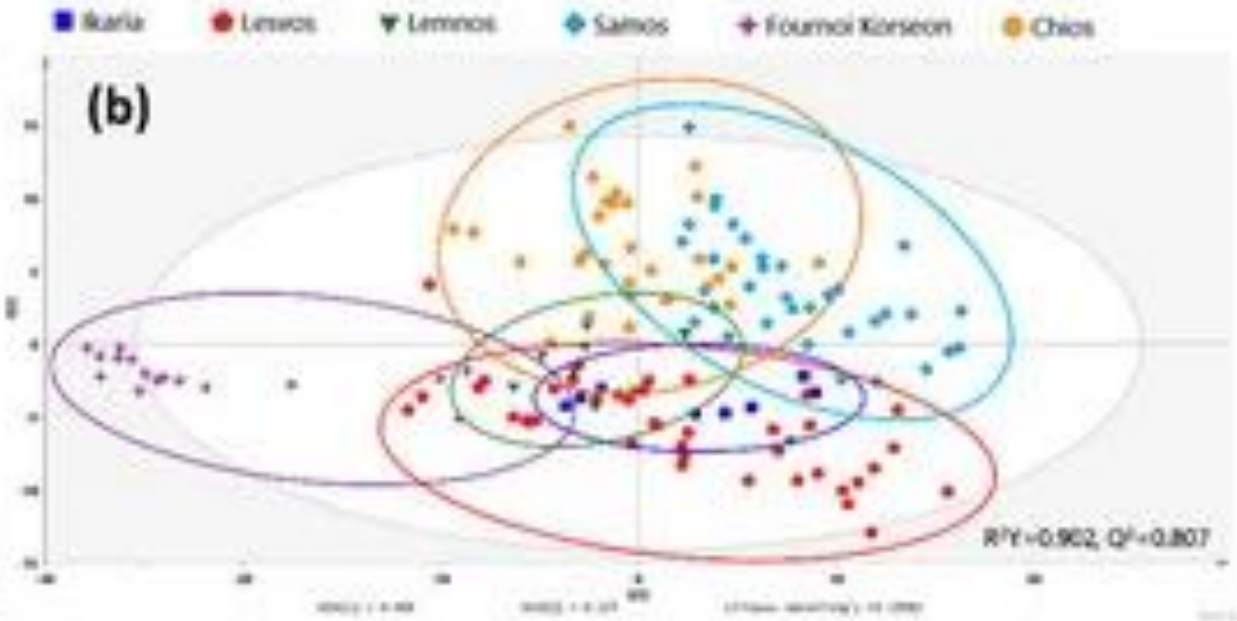




Result


New Zealand
Other


Plant honey
Thyme honey
Blossom honey
(a)
R²Y=0.841, Q²=0.645


Ikaria
Lesvos
Lemnos
Samos
Fournoi Korseon
Chios
(b)
R²Y=0.902, Q²=0.807

EU COM solution

- Working group for drafting an EU regulation
- Accepted methods and parameters for official inspections
- Regulation of profile-based methods
- Development of databases

Hungarian proposal and work

- Authentic database (Hungarian – Acacia)
- Since 2017
- Reliable beekeepers recommended by OMME, 25 samples/year
- “All” examinations (moisture, IRMS, NMR, metal profile, polyphenol profile, Micro-Tester)
- Years 1–2–3

Testing directions	Sub-sample		
	A	B	C
Moisture content	+	-	-
HMF content	+	+	+
Diastase activity	+	+	+
Sugar composition (fructose, glucose, sucrose, fructose–glucose ratio, maltose, turanose)	+	+	+
Free acidity	+	-	-
Pollen composition reproducibility (permanent preparation)	+	-	-
Electrical conductivity	+	-	-
Relative pollen frequency	+	-	-
Free acid content	+	+	-
Proline content	+	-	-
pH determination	+	-	-
Invertase activity	+	+	+
Water-insoluble solid content	+	-	-
Sensory properties	+	+	-
NMR analysis	+	+	+
Polyphenols	+	+	+
Aroma components analysis	+	-	-
LC/EA-IRMS	+	-	-

Summary and closing remarks

- The importance of bee health in veterinary practice
- The role of veterinarians in quality assurance of apicultural products
- Further research opportunities and directions for professional development

Thank you for your attention!