Presentation of the results for the dissemination of the Contracting Authority

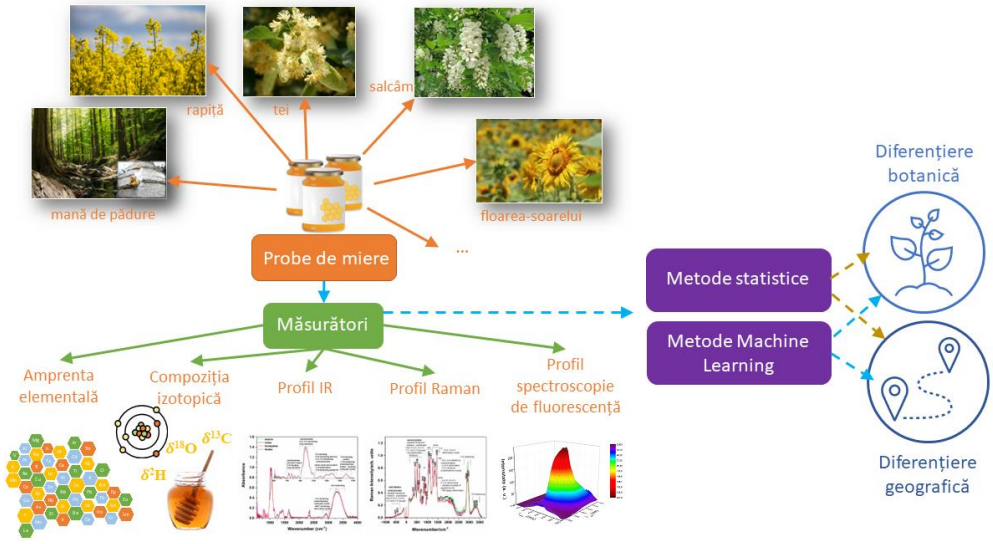
Honey has a complex composition that determines its therapeutic effects, being closely related to the plant(s) that was the basis of the honey production. Thus, the components of honey, namely easily assimilable simple sugars (sucrose, fructose, glucose) that give energy and vitality; quality amino acids and proteins, vitamins (A, B, C, K); minerals (sodium, potassium, calcium, magnesium, silicon), enzymes, pigments (carotene, chlorophyll), aromatic compounds and organic acids, gives honey the consideration of being a super food, in particular, due to the special nutritional value that it has.

At the EU level, the quantities of honey sold are not satisfied by domestic production. As a result, significant amounts are imported from other countries outside the EU (such as China) that require rigorous control, with honey being the third most adulterated product in the world. Also, special attention must be paid to the authentication of honey from the point of view of geographical or botanical origin, taking into account the fact that its price is directly reflected by the rarity of a certain type of honey. In this case, labeling cheap counterfeit honeys as exclusive honeys in order to make an illegal profit is a common practice among traders or even producers.

In this context, the "***Honeyomics***" project pursued the development of new chemometric models capable of differentiating and authenticating honey in terms of geographical and botanical origin, and also detecting the adulteration of honey through the mixture of more expensive varieties with some types of honey cheaper. For this purpose, a database containing the isotopic and elemental fingerprint of more than 200 authentic honey samples was developed. These samples were collected during two consecutive years (2020, 2021) and were produced in Romania, mainly from Transylvania. The botanical origin of the honey samples was diverse, consisting of many varieties currently present on the Romanian market (acacia, linden, rapeseed, sunflower) and varieties with high commercial value (black grass, coriander, etc.).

In addition, metabolomic approaches based on vibrational (IR, Raman) and fluorescence spectroscopies were developed, their classification potential being compared and validated based on recognized methods such as isotopic and elemental profiling. To carry out the isotopic analyses, a prototype for a cryogenic distillation technique was developed and optimized within the project, which allows the total extraction of water from the honey samples, without isotopic fractionation. It was fully realized within INCDTIM Cluj-Napoca and a patent application has been submitted.

The large experimental datasets generated were processed using supervised chemometric techniques (PLS-DA, SIMCA) as well as artificial intelligence (Machine Learning algorithms). A diagram on the development of the honey authentication models in relation to the botanical and geographical origin can be observed in the following figure:



The impact of this project given by the results obtained from an academic level, to the technological transfer:

1. training of young researchers through: **2 bachelor's thesis, one dissertation thesis** and the development of **one chapter of the PhD thesis** of the two PhD. students, members of the project team.
2. creation of **a database** with applications in the authentication of Romanian honey containing the isotopic and elemental fingerprint of **over 200 honey samples**.
3. development of a prototype for the cryogenic extraction of water from honey and submission of a national patent application to OSIM for the optimized installation.
4. dissemination in: **9** ISI articles among which **5** articles are in journals in the first quartile (Q1 – Web of Science), **3** articles in the second quartile (Q2) and one article in the third quartile (Q3); **2 book chapters**, **2 invited lectures**, **10 oral presentations** and **9 poster presentations**.