

ON THE RELEVANCE OF THE APICOL 12 Gamma "Blue Honey" IN COGNITIVE AND BIOCHEMICAL FUNCTIONS

Mirela DRAGAN¹, Tudor ILIE², Alin CIOBICA³, Eman H. RASHWAN⁴

¹ University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Mărăști Blvd., District 1, Bucharest, Romania

² Synergy Plant Products, No. 12 Milano Street, Prejmer, 507165 Brasov, Romania

³ CENEMED Platform for Interdisciplinary Research, "Grigore T. Popa" University of Medicine and Pharmacy, 700115 Iasi, Romania, Academy of Romanian Scientists.

⁴ Department of Animal Hygiene and Management, Faculty of Veterinary Medicine, Cairo University, Cairo, Egypt.

Abstract. *We are bringing here a brief description on our latest results from the Honey Enriched with Additives Alleviates Behavioral, Oxidative Stress, and Brain Alterations Induced by Heavy Metals and Imidacloprid in Zebrafish-related study, which is referring on the Apicol 12 Gamma "Blue Honey" in cognitive and biochemical functions, as well as additionally describing pollinic spectrum of honey, reflecting the diversity of pollen sources and providing details about floral and geographical provenance, by referring also to some local and regional aspects on this matter.*

Keywords: Apicol 12 Gamma "Blue Honey", cognitive and biochemical functions, pollinic, local, regional, Romania.

DOI [10.56082/annalsarscibio.2024.2.52](https://doi.org/10.56082/annalsarscibio.2024.2.52)

INTRODUCTION

The study titled "Honey Enriched with Additives Alleviates Behavioral, Oxidative Stress, and Brain Alterations Induced by Heavy Metals and Imidacloprid in Zebrafish" investigated the impact of **the Apicol 12 Gamma "Blue Honey"** on behavior, oxidative stress, and brain alterations induced by heavy metals and imidacloprid (a pesticide) on the zebra fish (*Danio rerio*) [1].

Histological and immunohistochemical analyzes showed astrocyte activation and neurotoxic damage in the brain, with notable damage and increased expression of GFAP and S100B proteins. IMI exposure reduced cell proliferation, while Hg + Cd exposure increased it. HF supplementation reduced oxidative stress and neurotoxicity, suggesting that bioactive compounds in honey may mitigate the negative effects of chemical pollutants in aquatic ecosystems.

The global functional food market is expanding as consumers become more aware of the link between nutrition and health and seek innovative products. Enriching honey with functional ingredients improves its nutritional profile and provides significant health benefits, including antioxidant, antibacterial, antiviral and hepatoprotective properties. Research has shown that various natural supplements can counteract the toxic effects of pollutants, highlighting honey's potential as a protective agent.

The study used zebrafish (*Danio rerio*) to assess the sub-chronic toxic impact of cadmium (Cd), mercury (Hg) and imidacloprid (IMI) and explored the mitigating effects of a honey formula (HF). Exposure to these pollutants resulted in behavioral disturbances, oxidative stress and neurotoxic damage, evidenced by increased oxidative stress markers (SOD, GPx, MDA) and brain damage marked by astrocyte activation. HF supplementation significantly reduced oxidative stress and neurotoxicity, supporting the hypothesis that bioactive components in fortified honey may ameliorate combined pollutant toxicity [2,3].

Other related studies

In fact, in connection to this we can mention that analyzes of honey according to the study Spulber R., et al. (2020) [4] highlighted the pollinic spectrum of honey, reflecting the diversity of pollen sources and providing details about floral and geographical provenance. This type of analysis helps to certify the authenticity and quality of the honey. The main pollen sources identified include:

- *Amorpha fruticosa* and a diverse mix of herbaceous and shrub pollens.
- *Taraxacum* spp. (dandelion), *Trifolium* spp. (clover), pollen from the families Asteraceae, Fabaceae, Rosaceae.
- *Brassica napus* (rapeseed), present in large quantities (>70%) and other crucifers.
- *Robinia pseudoacacia* (acacia), predominant (>50%), together with pollen from the adjacent spontaneous flora.
- *Tilia* spp. (lime trees), in significant quantities (>40%).

This research emphasizes the importance of assessing combined exposure to environmental contaminants to understand their cumulative health impact and highlights honey formulations as potential protective agents against such exposures.

The analysis investigated the physicochemical properties and antimicrobial activity of a honey formulation (HF) enriched with 12 ingredients compared to raw polyfloral honey.

The results highlighted several key points:

- **Moisture content:** Raw polyfloral honey had a moisture content of 19.46%, below the maximum limit of 20% set by Codex Alimentarius and European standards. HF had a slightly higher moisture content of 22.66% due to the addition of aqueous extracts. This aspect can influence storage stability, as a higher moisture content increases the risk of fermentation and acetic acid formation.
- **Total solids (TSS):** The TSS value for raw honey was consistent with literature data, corresponding to the high level of total solids specific to honey with low moisture.
- **pH level:** Both honey samples were acidic, with pH values between 3.93 for raw honey and 4.05 for HF, in the acceptable range of 3.2-4.5 for honey. This interval contributes to the stability and quality of the honey.
- **Acidity:** Both samples met the required maximum level of acidity of 50 meq·kg⁻¹, with results in line with previous studies. Free acidity can increase over time due to fermentation and conversion of sugars to organic acids.
- **Electrical conductivity:** The measured electrical conductivity value was below the maximum limit of 0.8 mS·cm⁻¹, indicating an adequate level of ions, organic acids and proteins.
- **Improved properties:** HF, enriched with functional additives, exhibited vibrant color and robust flavor, improving sensory characteristics and potential health benefits.

The results showed that honey, known for its natural antioxidant properties, enriched with specific additives, had a beneficial effect in alleviating symptoms caused by exposure to toxins. This led to improved behavior, reduced oxidative stress and ameliorated changes in the brain. In conclusion, the research demonstrated the potential of enriched honey as a protective agent against the toxic effects of heavy metals and pesticides.

The study addresses the ecological threat posed by environmental contamination with heavy metals and pesticides, focusing on rapid exposure to imidacloprid (IMI), mercury (Hg) and cadmium (Cd). Using the zebrafish (*Danio rerio*) as a model, the researchers explored the individual and combined toxic effects of these contaminants and evaluated the protective role of a polyfloral (HF) honey formulation. Exposure to IMI (0.5 mg·L⁻¹), Hg (15 µg·L⁻¹) and Cd (5 µg·L⁻¹) resulted in impaired social behavior, reduced swimming performance and increased markers of oxidative stress (SOD, GPx, MDA) over a period of 21 days.

Polyflora honey is a high-quality product, with a balanced composition and obvious nutritional benefits. Due to its high content of essential minerals and enzyme activity, it can contribute to a healthy diet.

ACKNOWLEDGEMENTS

Ciobica Alin is funded through The Operational Program for Competitiveness 2014-2020, Axis 1, under POC/448/1/1 Research infrastructure projects for public R&D institutions/universities, project” Multidisciplinary platform for medical research-development in N-E region, CENEMED”, grant agreement no. 127606.

REFERENCES

- [1] Paduraru, E., Jijie, R., Simionov, I. A., Gavrilescu, C. M., Ilie, T., Iacob, D., ... & Solcan, C. (2024). Honey Enriched with Additives Alleviates Behavioral, Oxidative Stress, and Brain Alterations Induced by Heavy Metals and Imidacloprid in Zebrafish. *International Journal of Molecular Sciences*, 25(21), 11730. Google Scholar]
- [2] Derewiaka, D., Majewska, E., & Pruszkowska, P. (2024). The Effects of Bee Additives on the Physico-Chemical and Antioxidant Properties of Rapeseed Honey. *Applied Sciences*, 14(3), 1292. Google Scholar]
- [3] Drăgan, M., Spulber, R., Livadariu, O., & JURCOANE, Ș. (2022). The antioxidant effect of raw bee pollen collected from ecological crops-minireview. *Scientific Bulletin Series F. Biotechnologies*, 26(2). Google Scholar]
- [4] Spulber R., Popa V., Băbeanu N. (2020). Flavonoid /Phenolic Profile and Antioxidant Activity of Raw Monofloral Be Pollen from South Romania, *AgroLife Scientific Journal*, 9(2), 305-312. Google Scholar]