

# Honey as an Indicator of Environmental PAH Contamination

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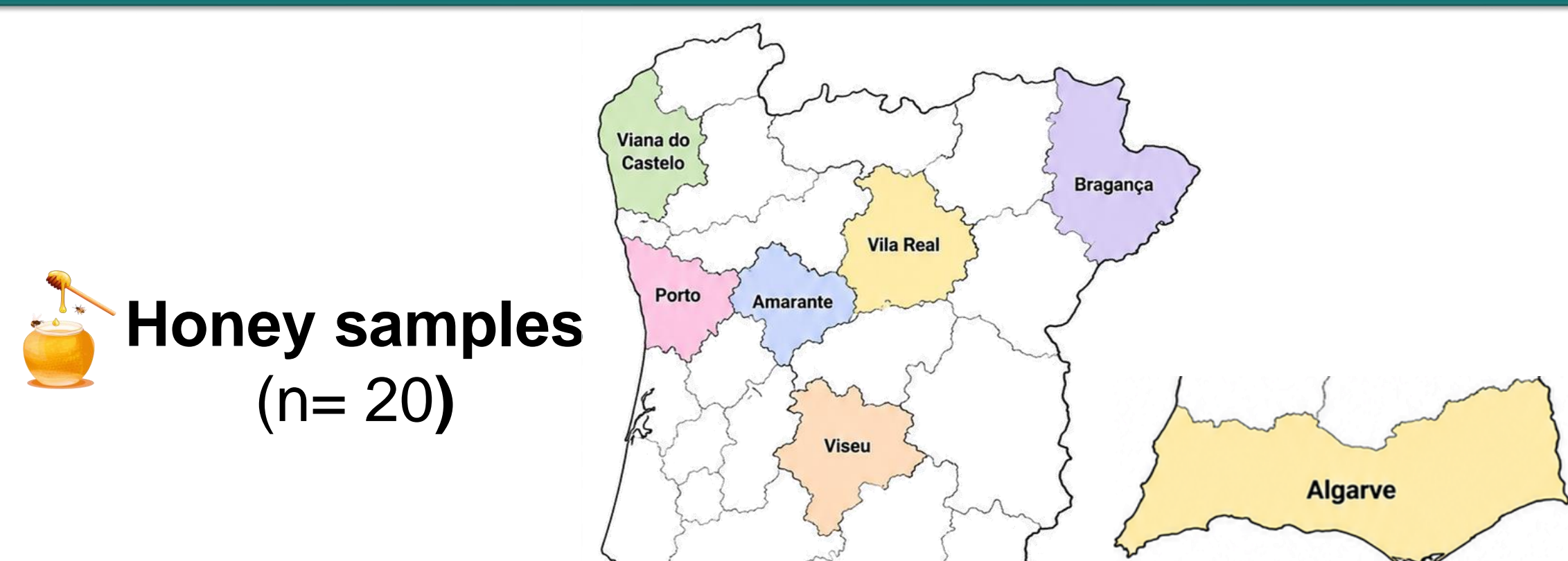
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## INTRODUCTION & AIM

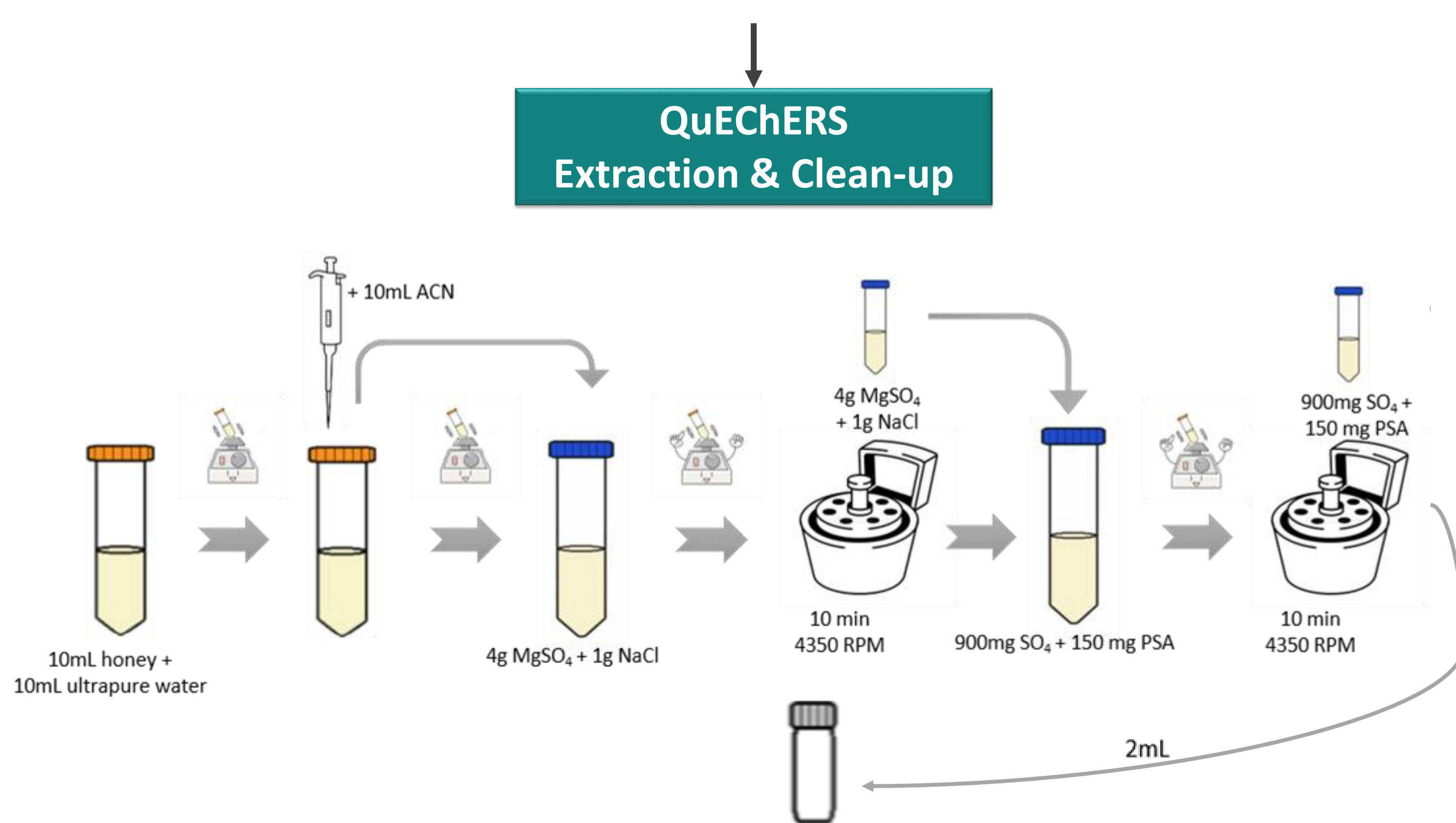
- Polycyclic aromatic hydrocarbons (PAHs) are persistent organic pollutants released mainly through combustion processes and other anthropogenic activities. Atmospheric deposition can transfer these contaminants to vegetation and bee products, including honey (1-3).
- As honey reflects environmental conditions within the bees' foraging area, it is considered a useful bioindicator of environmental contamination (4, 5).
- This study evaluated PAH levels in honey samples collected from six Portuguese regions and investigated potential pollution sources using diagnostic ratios.

## METHOD

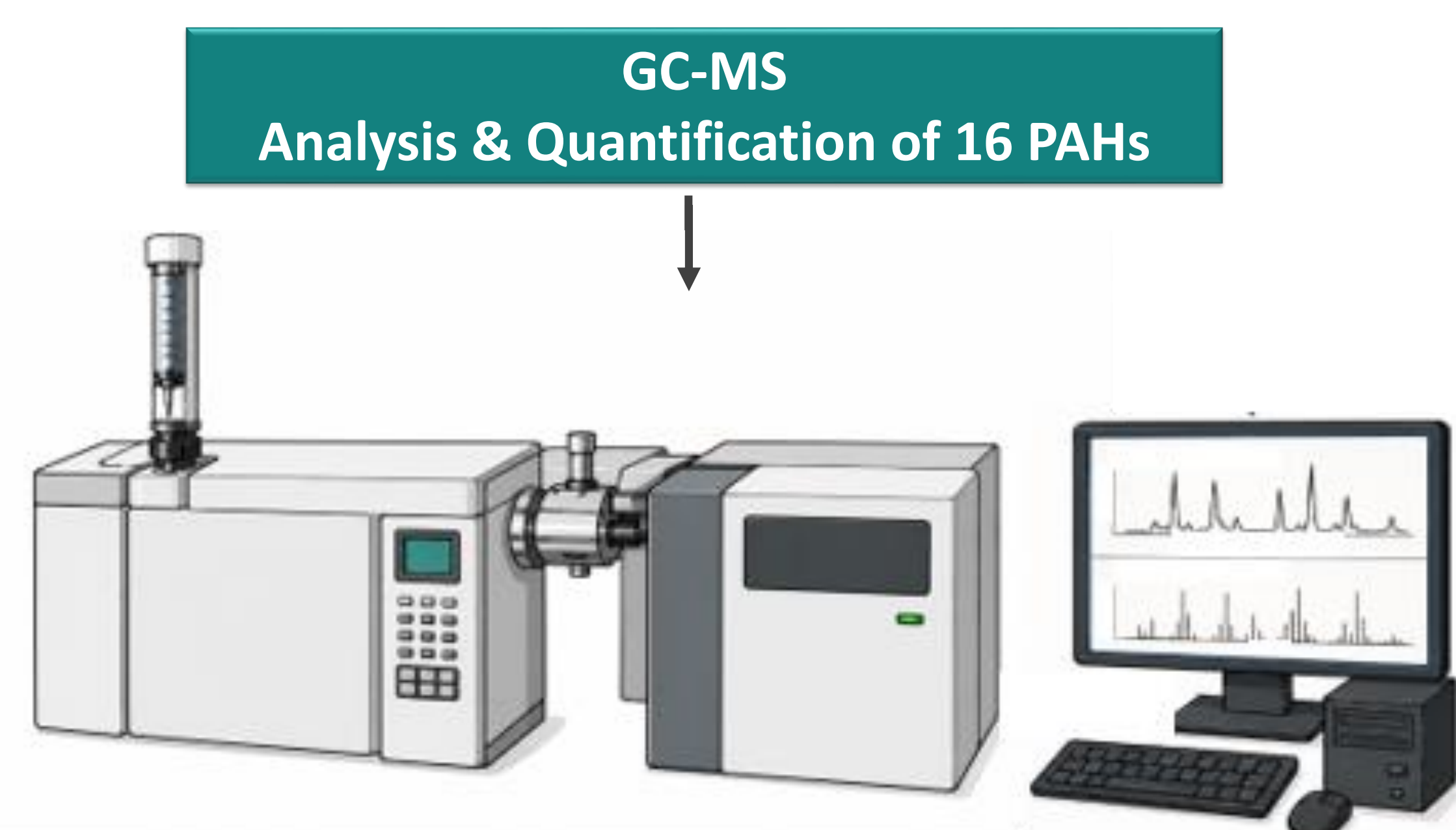


Honey samples  
(n= 20)

**Figure 1.** Location of the six honey sampling areas in Portugal: Algarve (L1), Bragança (L2), Porto (L3), Viana do Castelo (L4), Vila Real (L5), and Viseu (L6). Honey samples were collected for PAH determination and future health risk assessment.



**Figure 2.** Workflow of the QuEChERS extraction and clean-up procedure applied for the determination of PAHs in honey samples, including sample dilution, acetonitrile extraction, salting-out partitioning (MgSO<sub>4</sub>/NaCl), centrifugation, PSA clean-up, and preparation of the final extract for chromatographic analysis (6, 7).



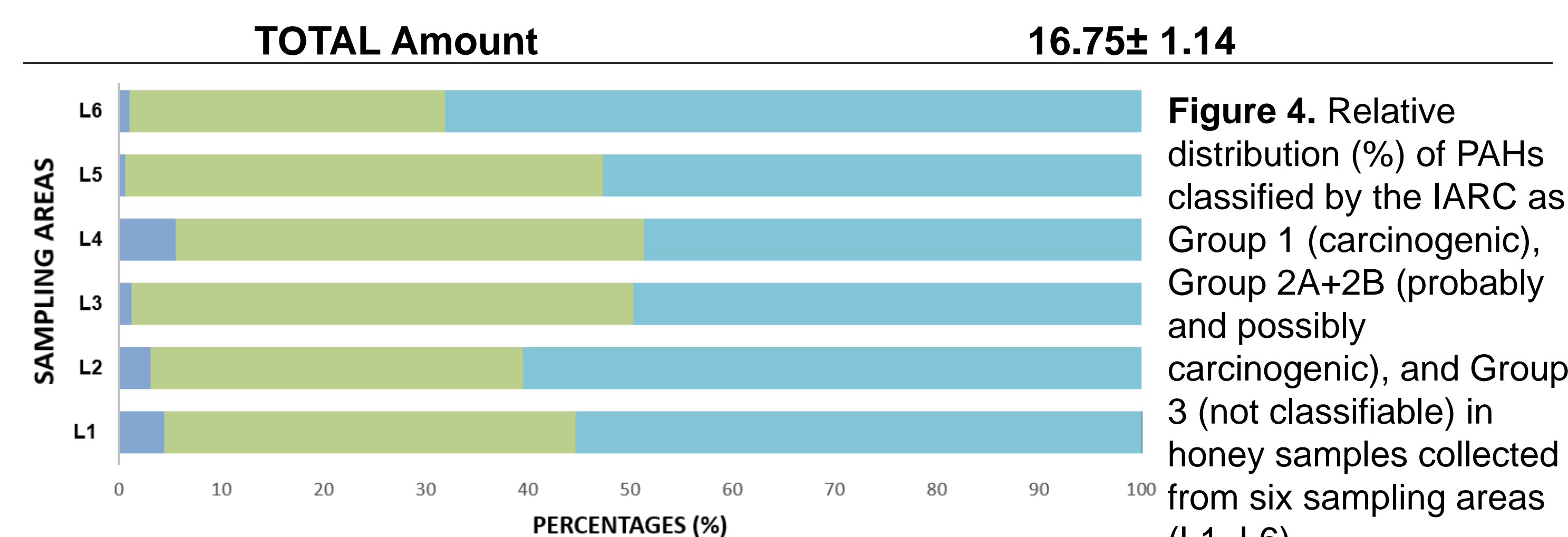
**Figure 3.** GC–MS system (Thermo Scientific TRACE 1310–ISQ LT) equipped with a TriPlus 100™ autosampler and a Trace GOLD TG-5MS capillary column, used for PAH analysis in honey samples (7).

Conflict of Interest: The authors declare no conflicts of interest.

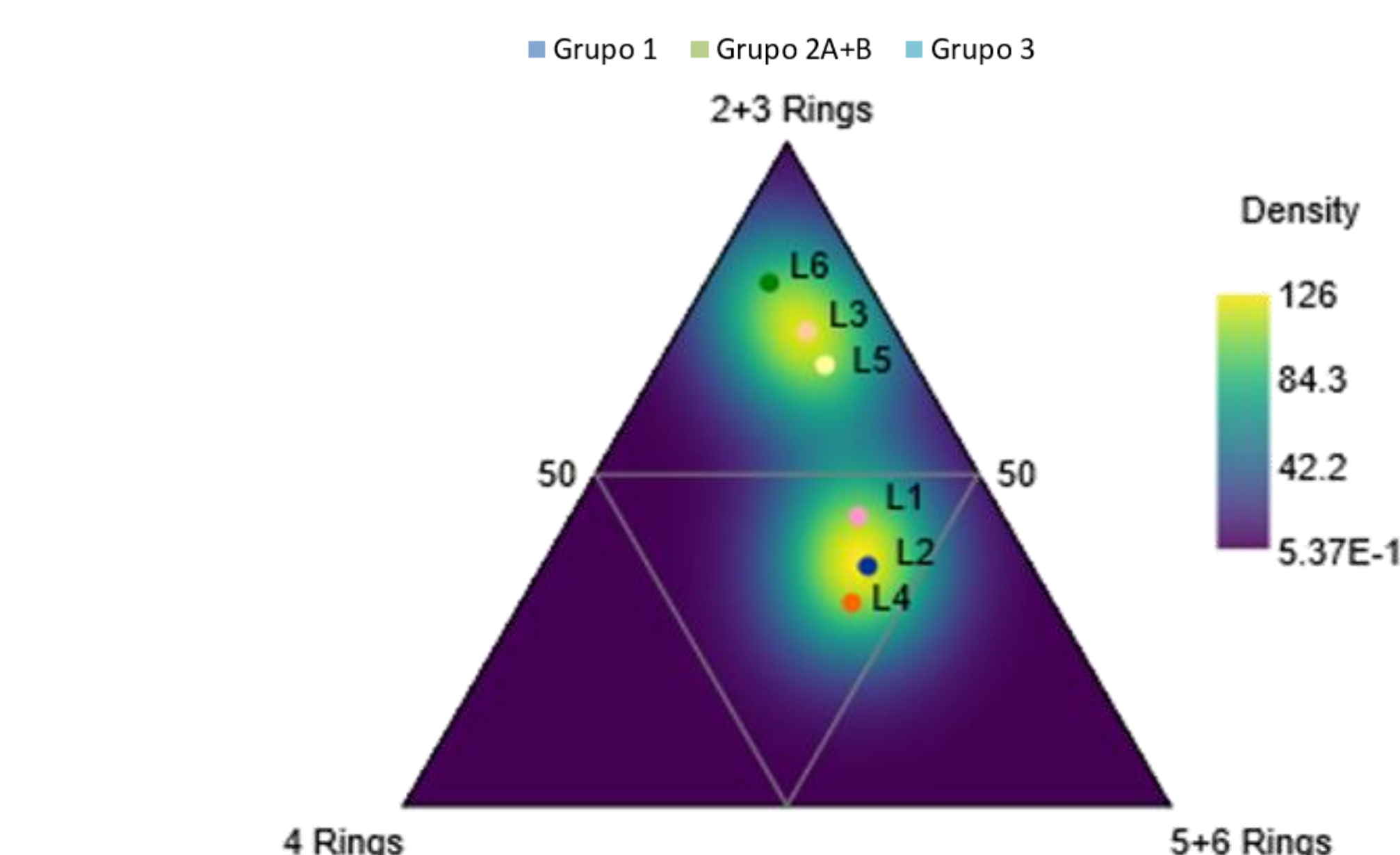
## RESULTS & DISCUSSION

**Table 1.** Mean concentrations ( $\pm$  SD) of total low-molecular-weight (LMW) and high-molecular-weight (HMW) PAHs in honey samples ( $\text{ng g}^{-1}$ ).

PAHs	IARC Group (WHO 2016)	Number Rings	PAH concentration in honey from L1-L6 ( $\text{ng g}^{-1}$ )
NaP	2B	2	3.56 $\pm$ 3.62
AcP	-	3	1.29 $\pm$ 1.12
AcPY	3	3	1.97 $\pm$ 0.99
Ant	3	3	0.16 $\pm$ 0.09
Flu	3	3	0.44 $\pm$ 0.44
Phe	3	3	2.91 $\pm$ 1.84
Global LMW (average)			10.33 $\pm$ 1.35
BaP	1	5	0.22 $\pm$ 0.09
DBA	2A	5	1.17 $\pm$ 0.74
BaA	2B	4	0.03 $\pm$ 0.05
BbFL	2B	5	0.06 $\pm$ 0.03
BkFL	2B	5	0.10 $\pm$ 0.05
Chr	2B	4	0.08 $\pm$ 0.09
Ind	2B	6	0.01 $\pm$ 0.01
FL	3	4	0.90 $\pm$ 0.79
Pyr	3	4	1.51 $\pm$ 1.24
B[ghi]P	3	6	2.34 $\pm$ 1.25
Global HMW (average)			6.42 $\pm$ 0.81



**Figure 4.** Relative distribution (%) of PAHs classified by the IARC as Group 1 (carcinogenic), Group 2A+2B (probably and possibly carcinogenic), and Group 3 (not classifiable) in honey samples collected from six sampling areas (L1–L6).



**Figure 5.** Ternary diagram illustrating the relative distribution of PAHs according to ring number (2–3, 4, and 5–6 rings) in honey samples from six sampling areas (L1–L6). The density contour highlights the predominant compositional patterns among sampling locations.

- LMW PAHs predominated, accounting for approximately 62% of total PAH burden.
- IARC Group 3 compounds were dominant, while Group 1 carcinogenic PAHs represented only a minor fraction of total contamination (8, 9).
- Distinct regional PAH fingerprints were observed, and the predominance of 2–3 ring compounds suggests a relevant contribution of atmospheric deposition (1, 10–12).

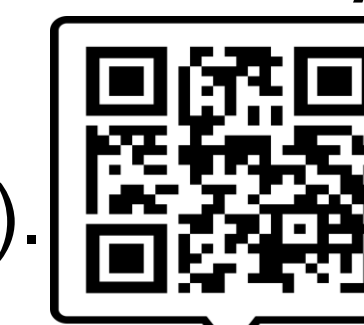
## CONCLUSION

- Honey proved to be a sensitive bioindicator of environmental PAH contamination, revealing regional differences in PAH composition and potential pollution sources (13).

## FUTURE WORK / REFERENCES

- Human health risk assessment (15).
- Analysis of PCBs and pesticides in honey (16).
- Extension to other regions and food matrices (17).
- Contaminant source apportionment (10).

## ACKNOWLEDGEMENTS



References