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Environmental Toxins in the Beehive: GC-Based Detection of Pesticides in Royal Jelly

TESEA TÉCNICAS DE SEPARACIÓN Y ANÁLISIS APLICADO

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INTRODUCTION & AIM

The presence of **disease-causing mites** in bees (e.g. *Varroa destructor)* has triggered a global crisis due to massive colony losses and **increased the use of pesticides** by beekeepers. Consequently, their residues can **enter the food chain** through edible bee products such as royal jelly.

Fig. 1. *Varroa Destructor* on a bee and application of acaricides to a beehive.

The aim of this work is to develop an analytical methodology that allows the determination of **seven pesticides** in **royal jelly** as a food supplement and fresh royal jelly.

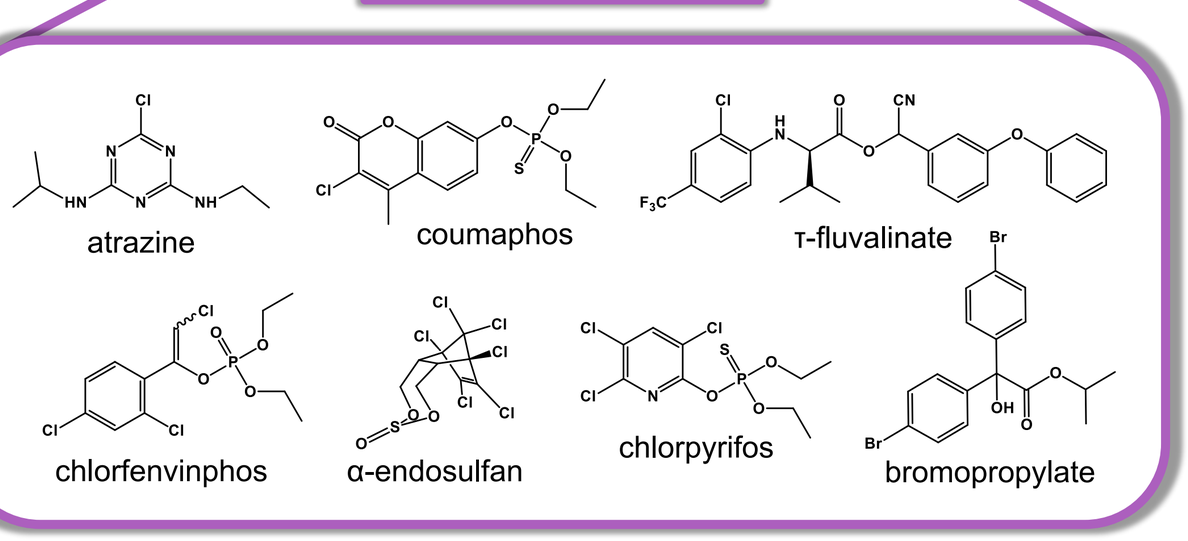

Fig. 2. Pesticides analysed in the proposed method in royal jelly.

METHOD

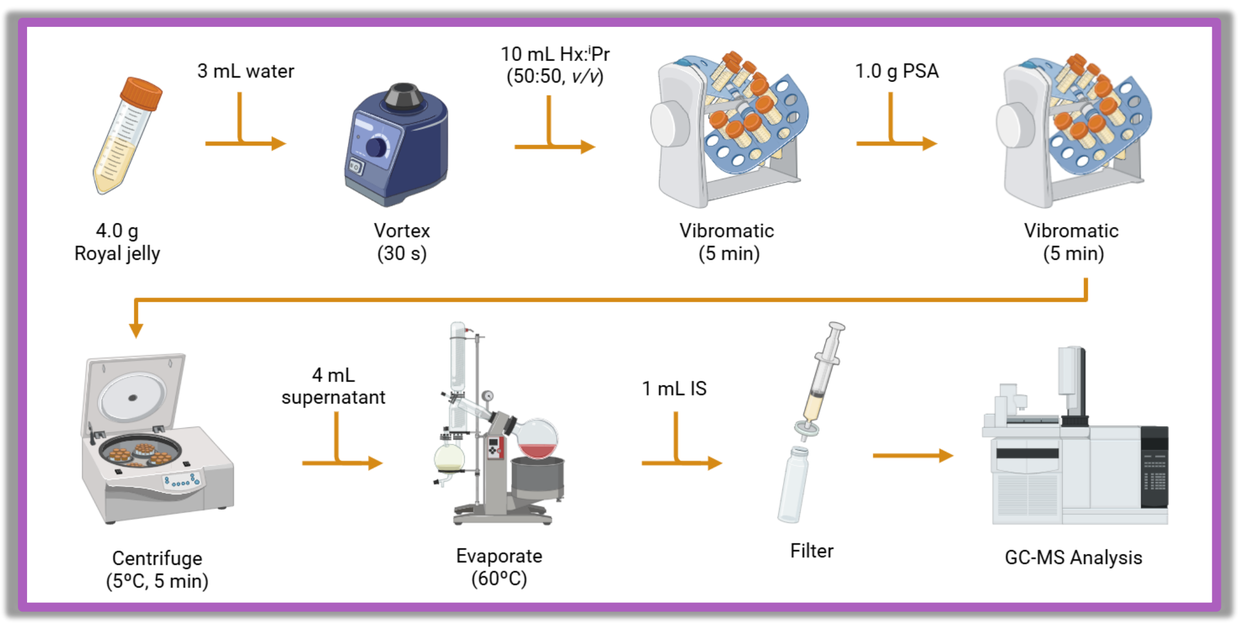

Fig. 3. Sample treatment workflow for royal jelly samples.

RESULTS & DISCUSSION

Table 1. Validation parameters of the method.

Selectivity	No matrix interferences at analyte retention times, similar MS (solvents and matrix), relative intensities within ± 20 %
LODs, LOQs	LODs between 0.1 – 1.9 μg kg^{-1} LOQs between 0.3 – 5.1 μg kg^{-1}
Linearity	Standard in solvent calibration curves, graphs were straight lines, with $R^2 > 0.99$
Matrix effect	Between -9 – 19 %
Trueness	Recoveries between 94 – 118 %
Precision	Relative standard deviation < 11%

Maximum residue level is 10 μg kg^{-1} for both pesticides

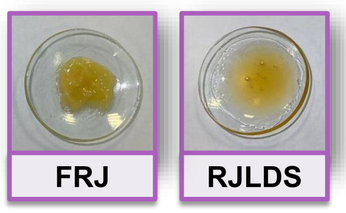

Table 2. Application of the method to royal jelly liquid dietary supplement (RJLDS) and fresh royal jelly (FRJ) samples.

Sample	α-Endosulfan (μg kg^{-1})	Chlorfenvinfos (μg kg^{-1})
RJLDS1	< LOD	**15**
RJLDS2	< LOD	**16**
RJLDS3	**41**	**14**
RJLDS4	< LOD	**19**
RJLDS5	< LOD	**13**
FRJ1	< LOD	6
FRJ2	< LOD	7
FRJ3	< LOD	< LOD
FRJ4	< LOD	6

CONCLUSION

- A method was developed for the analysis of **seven pesticides** based on **gas chromatography** coupled with **mass spectrometry**
- Different **sample treatment** methods were tested for optimal conditions.
- The analytical method was **validated** according to current European regulations, in terms of selectivity, limits of detection (0.1–1.9 μg kg^{-1}), and quantification (0.3–5.1 μg kg^{-1}), linearity, matrix effect (< ± 20%), trueness (recovery 94-118 %) and precision (RSD < 11 %)
- The method was **applied** to 5 royal jelly food supplements and 4 fresh royal jelly **samples**

ACKNOWLEDGEMENTS

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FUTURE WORK / REFERENCES

Future research should include environmental surveillance and regional monitoring, particularly in areas with limited data. In addition, high-resolution chromatographic techniques are expected to be applied to detect lower concentrations of pesticides.

[1] Fuente-Ballesteros, A., Jano, A., Bernal, J., & Ares, A. M. (2024). Development and validation of an analytical methodology based on solvent extraction and gas chromatography for determining pesticides in royal jelly and propolis. Food Chemistry, 437, 137911.