Analysis of Multiple Pesticide Residues in Avocados – Comparison of Extraction Methods

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Introduction

The determination of multi class multiple pesticide residues in fruit and vegetable samples has benefitted from the recent advances in rapid extraction techniques (e.g. QuEChERS) [1,2] and the application of LC & GC triple quadrupole mass spectrometer instrumentation.
Although rapid extraction methods have been shown to work with non fat or low fat matrices, their usefulness for fatty or oily foods has proved limited.
Avocados present real problems for the analyst due to the variation in oil content that can be encountered depending on the variety and maturity of the fruit. Oil contents of between 8 and 28 g/100g are not unusual and even higher are possible.

Avocados & Oil Content

Avocados are becoming increasingly popular in the European diet. Although they have a high oil content for a fruit (second only to Olives) they are being promoted as healthy because of the high proportion of monounsaturated fatty acids they contain.
The two most common cultivars encountered are Haas & Fuerte, grown throughout tropical and sub tropical regions, these are imported into the UK/EU from many sources including Spain, Israel, South Africa, Puru, Mexico, Australia, West Africa & USA.
Fruit left on the tree continues to grow but does not ripen, once picked (when the oil content is around 8% w/w) its ripening is carefully controlled in order to reach the consumer at its best. Oil content increases as the fruit matures correlating well with the taste qualities preferred by consumers.
Three different sources of Avocado were selected for analysis; testing being performed immediately and after several days at room temperature to replicate the range of oil content which may be expected.

	Cultivar	Country of Origin	Total Oil Content[#] %w/w
1a	Haas	Spain	11.7
1b	Haas	Spain	15.7
2a	Haas	Peru	21.8
2b	Haas	Peru	22.7
3a	Fuerte	South Africa	17.9
3b	Fuerte	South Africa	26.1

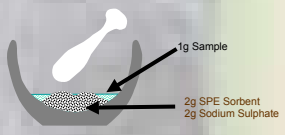
[#]*Acid hydrolysis + Solvent extraction method*

a = *tested as purchased;* b = *tested after 1 week storage*

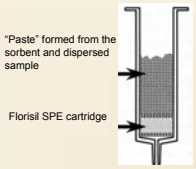
Matrix Solid Phase Dispersion

Matrix Solid Phase Dispersion (MSPD) is a versatile technique which has been used for the extraction of a wide range of residues in oils and fatty food matrices, with the advantages of simplicity, speed & low solvent consumption compared to traditional methods. [3]
In MSPD the sample is homogenised together with the solid phase extraction sorbent (SPE) whereby the sample is completely disrupted and dispersed over the surface of the SPE sorbent. The interactions between the matrix components and the sorbent, and the nature of the elution solvent determine selectivity of the extraction process.
In order to test the effectiveness of the method for unpolar and polar pesticides, two bonded phase sorbents (Bondesil-C18 & -NH_2) have been used.

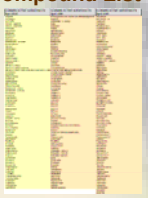
Sample Blending Step



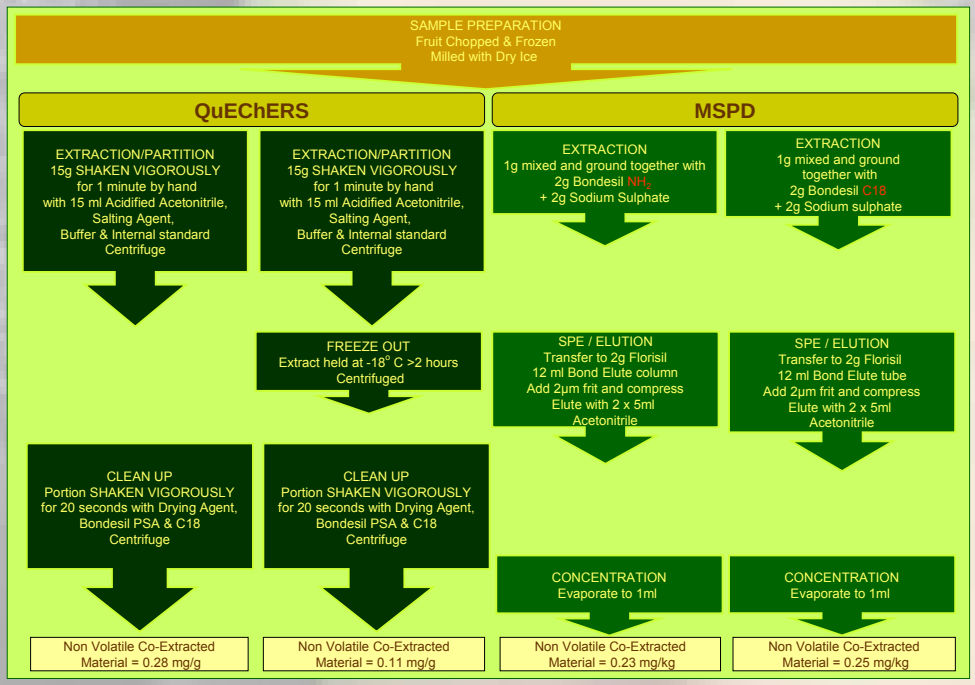
Packing of SPE Column for Elution



Compound List



Extraction/Clean Up Methods



Results

Using the mean non volatile co-extracted material content of the extracts from all six samples as a measure of clean up success - it appears that all routes would give satisfactory LC/MS-MS or GC/MS-MS ready extracts. Extracts from all routes were compared using recovery of 76 compounds using LC/MS-MS. All routes gave mean recoveries between 60 – 140%, but repeatability using MSPD-C18 was less consistent than with MSPD-NH_2.
The addition of the 'freeze out' step to the QuEChERS process provides extra protection to chromatographic systems without significantly making the process more complex or laborious.
The use of Florisil as the base SPE component in the MSPD process is known to lead to poor recoveries of some pesticides, future trials will evaluate other sorbents.
The QuEChERS with freeze out and MSPD-NH2 processes provide fast, cheap, low solvent use alternatives to traditional methods for the analysis of Avocados.

References

[1] Lehotay S.J, & Mastovska K, Journal of AOAC Int. Vol.88, No.2, 2005
[2] Anastassiades M, CVUA Stuttgart, April 2006, www.QuEChERS.com
[3] Steven A. Barker, School of Veterinary Medicine, Solid-Phase Extraction, ISBN:0-8247-0021-X

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