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Analysis of Abamectin Residues in Peach Juice by Absorption Spectrum

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In this work, two kinds of simple and precise approaches are developed for the determination of abamectin residues in peach juices based on absorption spectrum. One method focuses on the analysis of the intensity at 219 nm wavelength of original absorption spectra. The other one aims at the technology of calculating the intensity at 223, 249 and 259 nm wavelength of the first derivative of ratio spectra. In addition, both of correlation coefficients are found to be all higher than 0.99. Then the prediction models of abamectin residues were obtained in peach juice with good accuracy. The limit of detection was 0.1377 μg/mL and limit of quantifications was 0.4591 μg/mL in peach juice about the original absorption spectra method, while the minimum value of limit of detection was 0.0285 μg/mL and limit of quantifications was 0.0949 μg/mL about the first derivative of the ratio spectra method. Therefore, they can be suitably applied in the estimation of abamectin residues in peach juice.

Keywords: Peach juice, Absorption spectrum, Abamectin, Pesticide detecting.

INTRODUCTION

Abamectin belongs to the family of abamectins which are macrocyclic lactones produced by the actinomycete Streptomyces avemitilis[1,2]. It is a mixture of two components abamectin B_{1a} and B_{1b}, the former is the major component (about 80 %), while abamectin B_{1b} is the minor one (about 20 %). Abamectin acts on insects by interfering with neural and neuromuscular transmission with the widely using[3]. For example, abamectin is used to control insect and mite pests of a range of agronomic, fruit, vegetable and ornamental crops. Abamectin is listed as highly toxic compounds according to the criterion of the World Health Organization (WHO), so the standard of maximum residue level (MRL) about abamectin in vegetables and fruits is very strict all over the world[4].

Nowadays, people usually pay more attention to the safety and pesticide residues in agricultural products all over the world[5-7]. The pesticide residues resulting from extensive use of abamectin in agricultural production must be dangerous to consumers. Especially it is used on peaches and its influence is more dangerous because these fruits are often used as the ingredients for baby foods, so that it is important to have a suitable method for the determination of low levels of abamectin. There are many kinds of analysis methods about the pesticide residue detection, *e.g.*, gas chromatography[8], gas or liquid chromatography-mass spectrometry[9,10] and biochemical assay[11,12], *etc*. In this study, we investigate the possibility of carrying out direct detection of pesticide residues about abamectin in peach juice using absorption spectrum.

EXPERIMENTAL

Peach juice (100 %) samples were obtained from large supermarket. Abamectin was obtained from Jiangsu Provincial Academy of Agricultural Sciences (Nanjing, China).

The absorption spectrum was recorded by using a UV-3600PC spectrophotometer (Shimadzu, Japan) equipped with 1 cm quartz cell. The absorbance from 200 to 700 nm was recorded by UV-3600.

Firstly, abamectin was diluted the standard drug solution of different concentration using pure water. The peach juice was diluted by pure water in accordance with a certain volume ratio. Then their absorption spectra were obtained including the pure water. Secondly, peach juices (3 mL) were taken using cuvette and the abamectin standard solution (0.0402 mg/mL) was mixed with juices by successive addition. Finally, the fruit juice and drug solution should be mixed well after sufficiently stirred and their absorption spectra were obtained.

RESULTS AND DISCUSSION

Absorption spectrum of abamectin: Fig. 1 shows the standard curve of absorption spectrum about abamectin solution, peach juice and pure water. The abscissa indicates the light wavelength while the ordinate indicates absorbance intensity. The curve of a, b, c indicates the absorption spectrum of the abamectin (0.005 mg/mL), peach juice and pure water, respectively. It can be seen that there is no prominent absorption spectrum about peach juice and pure water in 200-260 nm, while there is a maximal absorption shoulder peak at 219 nm about the abamectin solution, which can be used as the characteristic peak of abamectin residues in peach juice.

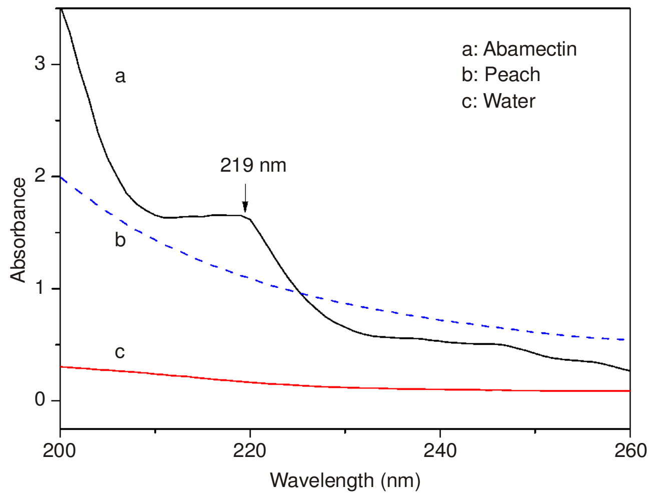

Fig. 1. Absorption spectra of abamectin (0.005 mg/mL), peach juice (100 %) and pure water

Two methods for the determination of the abamectin residues in peach juice: The original absorption spectrum method and the first derivative of the ratio spectra method were developed for the determination of abamectin residues in peach juice. The diluted peach juice (3 mL) was placed in 1-cm quartz cuvette and the abamectin standard solution (0.0402 mg/mL) was added in the juice. The absorption spectra of the juice and abamectin mixture solution were obtained through the same experimental procedure, which were shown in Fig. 2(A). The concentration of abamectin in peach juice solution is corresponding to 0, 1.2968, 2.5125, 3.6545, 4.7294, 5.7429, 6.7 μg/mL from curve 1 to 7. It is seen that there is obvious absorption peak at 219 nm compared with peach juice and the absorbance is improved with the increase of the content of abamectin. It is further proved that the absorption peak at 219 nm can be used as the characteristic peaks of avemectin residues in peach juice.

To further study the difference of the absorption spectrum of abamectin and the peach juice, the first derivative spectra were calculated, which were showed in Fig. 2 (B). It was found that the measured signals have a maximum peak at 223 nm and both small peaks at 249 and 259 nm, but there is no any peak about the peach juice. It is obvious that the method of first derivative of the ratio spectra is much better to indicate the abamectin residues in peach juice than the original absorption spectrum.

The relationship between the concentration of abamectin and absorbance was obtained through the regression analysis of the method of least squares to them (Fig. 3). It can be seen that there is a good linear relationship between the absorbance and the concentration of abamectin and their correlation coefficients are all higher than 0.99. The formulas of prediction models about abamectin residues are: y = 0.2178x + 1.334 at 219 nm, y = -0.0137x-0.0514 at 223 nm, y = -0.004x-0.0148 at 249 nm and y = -0.0039x-0.0073 at 259 nm. According to the prediction model function, the critical evaluation of the proposed methods was performed by the statistical analysis of the experimental data. The obtained correlation coefficient, limit of detection (LOD), limit of quantifications (LOQ) is summarized in Table-1, respectively.

It was found that the correlation coefficient of both methods about the prediction model of peach juice is little difference, while the value of limit of detection and limit of quantifications of prediction model of first derivative of the ratio spectra method are far below the original absorption spectra method. The value of limit of detection and limit of quantifications is 0.1377 and 0.4591 μg/mL at 219 nm, respectively, while it is 0.0285 and 0.0949 μg/mL at 223 nm. On the whole, pesticide residue prediction models of first derivative spectra in peach juice have higher precision. On the other hand, the prediction models at 223 nm are superior to the prediction model at 249 nm and 259 nm about abamectin residues in peach juice. The

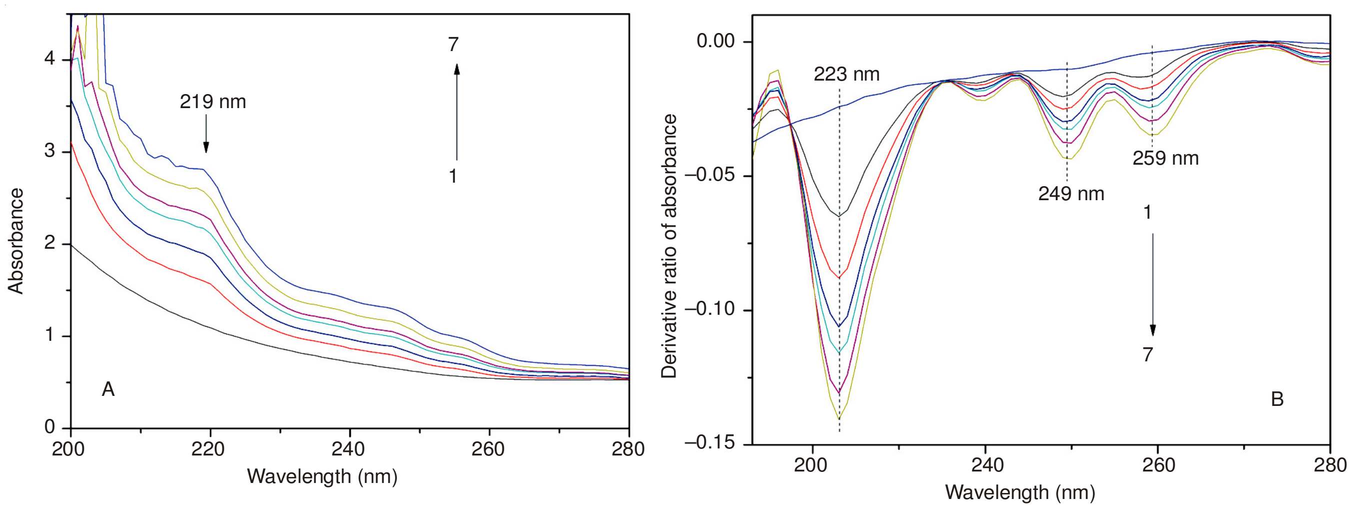

Fig. 2. Absorption and the first derivative spectrum of mixed solution of peach juice and abamectin (abamectin solution: 0.0402 mg/mL; peach juice: 100 %; The abamectin solution is corresponding to 0, 1.2968, 2.5125, 3.6545, 4.7294, 5.7429, 6.7 μg/mL from curve 1 to 7 in peach juice)

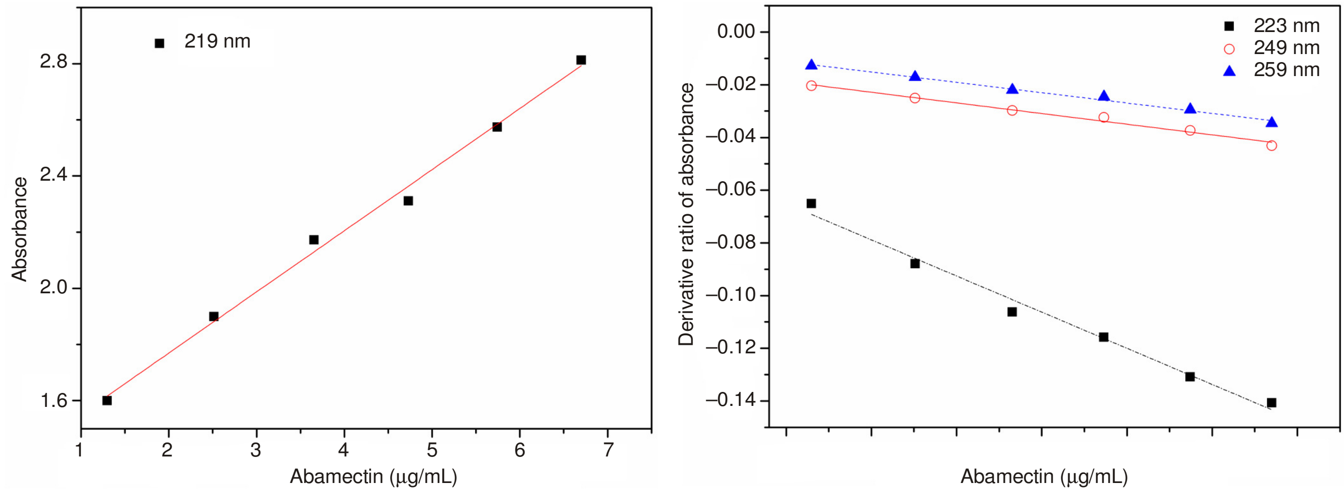

Fig. 3. Relationship between the abamectin content in peach juice and the absorbance (219 nmm), derivative ratio of absorbance (223, 249, 259 nm)

TABLE-1
EVALUATION PARAMETER VALUES OF PREDICTION MODELS ABOUT ABAMECTIN RESIDUES IN PEACH JUICES

Parameter	Original absorption spectra method	First derivative of the ratio spectra method		
Wavelength (nm)	219 (nm)	223 (nm)	249 (nm)	259 (nm)
Correlation coefficient (r)	0.9964	0.9919	0.9919	0.9936
Slope	0.2178	-0.0137	-0.0040	-0.0039
Intercept	1.3340	-0.0514	-0.0148	-0.0073
LOD (µg/mL)	0.1377	0.0285	0.0735	0.0862
LQD (µg/mL)	0.4591	0.0949	0.2450	0.2872

value of limit of detection and limit of quantifications is 0.0735 and 0.245 µg/mL at 249 nm and they are 0.0862 and 0.2872 µg/mL at 259 nm.

Conclusion

The results show that there is a characteristic absorption peak about the abamectin solution at 219 nm comparing with peach juice (100 %) and pure water. More prominent characteristic peaks were found at 223, 249 and 259 nm in the first derivative spectrum. The prediction models of pesticide residues about abamectin in peach juices were obtained according to the experimental results through the linear regression analysis. Both methods of original absorption spectra method and first derivative spectra method were discussed and the later is superior to the former method.

This work has shown that absorption spectrum is a rapid and sensitive technique for the determination of abamectin residues in peach juices. Moreover, the method is simple and does not require complicated sample pretreatment. And the analytical method developed allows to reach the limit of detection (0.0285 µg/mL) and the quantification limit (0.0949 µg/mL) required for the pesticides in peach juice with good linearity.

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REFERENCES

1. M.H. Zhang, *Pesticide*, **37**, 36 (1998).
2. T. Virant Celestina, L. Kolar, I. Gobec, J. Ku•ner, V.C. Flajs, M. Pogacnik and N.K. Er•en, *Ecotoxicol. Environ. Saf.*, **73**, 18 (2010).
3. X.C. Xie, S.H. Zhang, D.S. Wang, P.W.-G. Huang, T. Yang and X.-H. He, *Sci. Agric. Sinica*, **38**, 2254 (2005).
4. X.H. Zhao, Z.Y. Cao, R.-X. Mou, P. Xu and M.-X. Chen, *J. Instrumental Anal.*, **31**,1266 (2012).
5. N.M. Salem, R. Ahmad and H. Estaitieh, *Chemosphere*, **77**, 673 (2009).
6. C.K. Bempah, A. Buah-Kwofie, E. Enimil, B. Blewu and G. Agyei-Martey, *Food Contr.*, **25**, 537 (2012).
7. M. Bhanti and A. Taneja, *Chemosphere*, **69**, 63 (2007).
8. A. Salemi, E. Shafiei and M. Vosough, *Talanta*, **101**, 504 (2012).
9. J.M. Cortés, A. Vázquez, G. Santa-María, G.P. Blanch and J. Villén, *Food Chem.*, **113**, 280 (2009).
10. J. Li, H.F. Zhang and Y.P. Shi, *Food Chem.*, **127**, 784 (2011).
11. L.L. Qian, Y.Z. He and Y.Y. Hu, *Spectrosc. Lett.*, **39**, 581 (2006).
12. N. Chauhan and C.S. Pundir, *Electrochim. Acta*, **67**, 79 (2012).