

CHAPTER 4 GENERAL CONCLUSIONS AND FUTURE RESEARCH DIRECTIONS



Six to eleven months oil palms, Sime Darby nursery, Labu, 2008

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4.1 GENERAL CONCLUSIONS

Pesticide use is associated with risk and can be hazardous if not handled properly. Risk associated to human beings can be categorized into acute toxicity, chronic toxicity, carcinogenicity, teratogenicity, and biological concentration. Human exposure to pesticides is an important health and social issue as it usually results in serious health problems such as epilepsy, stroke, respiratory disorders, cancer, leukaemia, brain and liver tumours, and convulsions. It may be that we will never be able to determine the true risk of pesticide residues in food due to the many variables involved and low levels that occur. However, death has been known to occur in some places as a result of exposures to these pesticides [145]. Furthermore, there is evident that infants and children during critical development changes are highly susceptible to pesticide residues in their diet [146], and the European Union has recommended that baby foods should not contain more than 10 ng/g of any pesticide residue [147].

Besides humans, pesticide residues could also affect the environment. This manifests in the disturbance of the ecosystem, principally in the form of pollution of river water, groundwater, drinking water, soil and air, reduction of fish and wildlife population, and destruction of natural vegetation [148]. Hence, the problem of environmental contamination especially by persistent pesticide compounds evokes major concern due to the presence of their residues in the environment and human tissues.

Apart from humans and the environment, one of the important impacts of pesticide application for crop protection is that on the food safety. This is because residues of the pesticide could persist for a long time in the crop and finally in the food products. Widespread use of pesticides in food production has resulted in the occurrence of residues in agricultural crops and in processed foods. For commercial uses, quality is an essential factor in the selection of palm oil, since the quality of end products is dependent on that of the raw materials used. Thus, in the palm oil trade, quality parameters are important to ensure that the quality is not compromised. This is because once quality is compromised, it will affect the image of Malaysian palm oil and may lead to loss of credibility of the suppliers. Therefore, it is important to develop method in order to monitor the quality (in terms of pesticide residues) of the palm oil produced.

In this study, new analytical procedures were developed and optimized for cypermethrin and λ -cyhalothrin in crude palm oil (CPO), crude palm kernel oil (CPKO), and soil samples. The first part of the thesis discussed the development of analytical methodologies for the target pesticides in palm oil matrices. The extraction procedure was based on acetonitrile extraction and low-temperature precipitation at -20 °C. Then, clean-up of extract was accomplished by employing solid-phase extraction technique using GCB/PSA sorbents in tandem. Finally, pesticides were quantified using gas chromatography with electron capture detector (GC-ECD).

The second part dealt with the development of analytical methodologies for the target pesticides in soil samples. The extraction procedure was based on ultrasonic extraction using acetonitrile. From the evaluation of method performance using 15 mL of acetonitrile as extractant in USE for 5 minutes, it was concluded that these conditions exhibited excellent extraction capabilities with just minor defect. Therefore, no further

optimization would be needed especially the clean-up step. Finally, pesticides were quantified using gas chromatography with electron capture detection (GC-ECD).

Both analytical methodologies were then underwent method validation steps to confirm that the method under consideration has performance capabilities consistent with what the application requires. Hence, method validation is an important requirement in the practice of chemical analysis. In this study, both developed method gave acceptable accuracy and precision in terms of recovery (70-120 %) and RSD (<15 %) values.

Finally, the developed methods were applied to real palm oil and soil samples in order to identify the contamination status of both cypermethrin and λ -cyhalothrin. If good agricultural and manufacturing processes are followed, then violative levels of pesticide residues are not going to occur. The reason was because in theory, all farmers and food processors would follow proper procedures according to good agricultural practice (GAP) in the use of pesticides. But in the real world though, appropriate practices are not always followed and pesticide residues violations do sometimes occur [21]. Currently, there are no study on the method and level of cypermethrin and λ -cyhalothrin residues in oil palm matrices. Therefore, the need for a fast, robust, and efficient method for the determination of pesticides residues in palm oil matrices and soil samples is evident. The developed method can be applied by palm oil industries in order to determine the pesticide residues in palm oil products for monitoring purposes. Besides, the developed method could also be employ as the method of choice for MRL determination study of CPO and CPKO. As a conclusion, because pesticide residue analysis increases food costs to consumer, an important goal in method development

and monitoring programs is to achieve maximum efficiency while still meeting the data quality needs.

4.2 FUTURE RESEARCH DIRECTIONS

The scope of pesticide residue method development and analysis has many interesting, challenging, and thought provoking areas for further investigations. Some of the future research directions that worthy to look into are as below:

- Further investigation of other extraction techniques such as solid-phase microextraction (SPME), liquid-phase microextraction (LPME), and disposable pipette extraction (DPX) in palm oil matrices is interesting to be studied.
- It is recommended that further work for cypermethrin and λ -cyhalothrin method development in oil palm fronds be investigated.
- Environmental fate study in Malaysian oil palm agro-ecosystem is highly recommended in order to evaluate the impact of continued application of cypermethrin and λ -cyhalothrin to the growth and development of the oil palm crop, its yield and oil quality including the persistence and mobility of the pesticides under field conditions.
- Field study of cypermethrin and λ -cyhalothrin residues in order to establish the MRLs for these pesticides in CPO and CPKO.