AMITRAZ EXPOSURE AND RISKS TO PESTICIDE APPLICATORS AND NEARBY RESIDENTS IN ZANGIABAD, IRAN

MAJID AGHASI

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AMITRAZ EXPOSURE AND RISKS TO PESTICIDE APPLICATORS AND NEARBY RESIDENTS IN ZANGIABAD, IRAN

By

MAJID AGHASI

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in fulfillment of the Requirements for the Degree of Doctor of Philosophy

August 2010
Dedicated to my parents, my wife, and all researchers in the world
Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Doctor of Philosophy

AMITRAZ EXPOSURE AND RISKS TO PESTICIDE APPLICATORS AND NEARBY RESIDENTS IN ZANGIABAD, IRAN

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August 2010

Chairman : Professor Zailina Hashim, PhD
Faculty : Medicine and Health Sciences

During and after the application of pesticides to crops in agriculture, residues may enter the atmosphere and be transported over varying distances downwind away from the target. As a result, pesticides may be inhaled in sufficient dose to be absorbed through the lungs and into the bloodstream. The exposure to amitraz may be of occupational origin or strongly related to environmental contamination. This study is believed to be the first ever survey for Iran, aimed to determine the concentration of amitraz and its metabolite in inhalation air and serum of pesticide applicators and general population in the Zangiabad area, a Pistachio-growing area, in Southeast of Iran.

This research is a cross-sectional descriptive study, based on interviews and collections of samples from pesticide applicators (70 blood samples and 70
individual air samples), from a residential population who has lived in Zangiabad area for at least two years (70 blood samples and 70 individual air samples), and from a non-exposed population who has lived in the other area which is not in contact with amitraz (70 blood samples and 70 individual air samples) and ambient air (24 samples). After air sampling, a solvent concentration step was made by a rotary-evaporator and then under a soft stream of nitrogen gas. Blood samples of each volunteer were centrifuged and then extracted using solid phase extraction cartridge and vacuum manifold. Finally, the extracts were analyzed using gas chromatography-mass spectrometry. As each participant was interviewed face to face, a questionnaire comprising of questions on socio-demographic characteristics, knowledge of safety practices in handling amitraz, characteristics of pesticide application and use of protective measures to avoid pesticide contamination was filled in.

Quality control of the analysis method was determined for the air and serum samples including recovery efficiency, limits of detection and quantification, accuracy and precision, as well as reproducibility and stability. The techniques used in this study were to validate selectivity, sensitivity, stability, precision, and accuracy. Amitraz and its metabolite were found in the inhalation air and serum samples of applicators and residents, as well as the ambient air samples in Zangiabad area. The mean concentration of amitraz and its metabolite in the applicator serum samples were 135.2 and 78.1ng/mL, respectively. Amitraz and its metabolite were also found in Zangiabad residents’ serum with a mean concentration of 20.4 and 27.4ng/mL,
respectively. These data suggest that a large proportion of Zangiabad zone is continuously exposed to this pesticide with low doses from 0.02 to 0.15µg/m³. In addition, all the applicators did not use any protection. The lack of use of protective measures in the study area was probably related to socio-demographic factors such as educational levels. Using the concentration of 11.51µg/m³, the inhalational intake per working day calculated is equivalent to 0.057 mg. The acceptable daily intake of amitraz is 0.003 mg/kg body weight/day, representing 0.21 mg/day in a 70 kg adult. It appeared that poisoning would not occur due to amitraz exposure alone, but this chemical agent and its metabolite are toxic and may cause chronic adverse health effects. Pesticide exposure has been identified as a major environmental health problem in the Zangiabad area, which is a pistachio cultivated centre in Iran.
Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi sebahagian daripada syarat keperluan untuk Ijazah Doktor Falsafah

PENDEDAHAN AMITRAZ DAN RISIKO KEPADA PENYEMBUR PESTISID SERTA PENDUDUK BERDEKATAN DI ZANGIABAD, IRAN

Oleh

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Semasa dan setelah racun serangga disemburkan kepada tanaman, sisa-sisa memasuki atmosfera dan diangkut jauh daripada sasaran oleh angin mengikut jarak yang berbeza-beza. Hasilnya, racun serangga mungkin disedut dalam dos yang mencukupi untuk diserapkan oleh paru-paru dan ke dalam aliran darah. Pendedahan kepada amitraz mungkin berkaitan dengan asal usul pekerjaan seseorang atau berkait rapat dengan pencemaran persekitaran. Kajian ini merupakan kajian yang pertama dijalankan di Iran, bertujuan untuk menentukan kepekatan amitraz dan metabolit dalam udara sedutan dan serum penyembur racun serangga dan populasi umum di kawasan Zangiabad yang merupakan satu kawasan penanaman kacang pistachio di Timur Selatan Iran. Kajian ini merupakan kajian deskriptif yang dilaksanakan secara keratan rentas berdasarkan temuduga dan koleksi sampel darah dari penyembur racun serangga (70 sampel darah dan 70 sampel udara tersendiri) yang telah tinggal di kawasan Zangiabad sekurang-kurangnya dua tahun (70 sampel darah dan 70
sampel udara tersendiri), dari populasi yang tidak didedahkan dengan amitraz dan yang tinggal di kawasan lain serta udara di sekeliling (12 sampel). Setelah sampel udara diambil, satu langkah pelarutan kepekatan dilakukan dengan menggunakan penyejat berputar dan di bawah satu aliran lembut gas nitrogen. Sampel darah daripada setiap individu diemparkan dan kemudian diekstrakkan dengan menggunakan kartrij pengekstrakan fasa pepejal dan pancarongga vakum. Akhirnya, pengekstrakan dianalisa dengan menggunakan spektrometri jisim gas kromatografi. Apabila setiap peserta ditemuduga berhadapan muka, satu soalselidik yang mengandungi soalan berkenaan ciri-ciri sosio-demografik, pengetahuan amalan-amalan keselamatan dalam pengendalian amitraz, ciri-ciri penyemburan racun serangga dan penggunaan langkah-langkah keselamatan bagi mengelakkan pencemaran racun serangga diisi oleh peserta-peserta kajian. Kawalan mutu ke atas cara menganalisa udara dan sampel-sampel serum termasuk pemulihan kecekapan, had-had pengesanan dan penaksiran, ketepatan dan kejituan, serta kebolehulangan semula dan kestabilan ditentukan. Teknik-teknik yang digunakan dalam kajian ini adalah untuk mengesahkan pemilihan, kepekaan, kestabilan, kejituan dan ketepatan. Dapatan kajian menunjukkan bahawa amitarz dan metabolit terkandung dalam udara sedutan dan sampel-sampel serum penyembur racun serangga serta sampel udara di sekeliling kawasan Zangiabad. Purata kepekatan amitarz dan metabolit di dalam serum sampel darah penyembur serangga masing-masing adalah 135.2 dan 78.08ng/mL. Amitraz dan metabolit juga didapati dalam serum penduduk Zangiabad, masing-masing dengan purata kepekatan 20.4 dan 27.4 ng / mL. Data ini mencadangkan bahawa sebahagian besar penduduk di zon Zangiabad terdedah
kepada racun serangga dos yang rendah iaitu dari 0.02 hingga 0.15 g / m³ secara berterusan. Tambahan pula, semua penyembur racun serangga tidak mengamalkan langkah-langkah keselamatan. Kekurangan pengamalan langkah-langkah keselamatan oleh penyembur racun serangga di kawasan kajian adalah mungkin berkait rapat dengan factor sosio-demografik seperti tahap pendidikan di kalangan penduduk. Dengan penggunaan kepekatan 11.51µg/m³, pengambilan udara sedutan setiap hari bekerja yang dikira adalah sama dengan 0.057 mg. Pengambilan amitraz yang boleh diterima pada setiap hari adalah 0.003 mg/kg berat badan/hari, mewakili 0.21 mg/hari bagi seorang dewasa yang seberat 70 kg. Adalah ditunjukkan bahawa keracunan tidak akan terjadi disebabkan oleh pendedahan kepada amitraz sahaja tetapi agen kimia ini dan metabolit adalah toksik dan boleh menyebabkan kesan-kesan kesihatan yang kronik. Pendedahan kepada racun serangga dikenalpasti sebagai punca utama kepada masalah kesihatan di kawasan Zangiabad yang merupakan pusat kepada penanaman kacang pistachio di Iran.
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Kerman University of Medical Sciences and Ministry of Health and Medical Education in Islamic Republic of Iran were agreed with continuing my study. Thanks very much for giving me this opportunity.
I certify that an Examination Committee met on 6 August 2010 to conduct the final examination of Majid Aghasi on his Doctor of Philosophy thesis entitle “Analysis of amitraz in air and blood, its exposure and risk on pesticide applicators and the nearby residents in Zangiabad, Iran” in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Doctor of Philosophy.

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Date: 21 October 2010
DECLARATION

I declare that the thesis is my original work except for the quotations and citations which have been duly acknowledged. I also declare that it has not been previously, and is not concurrently, submitted for any other degree at Universiti Putra Malaysia or at any other institution.

_________________
MAJID AGHASI

Date: 6 August 2010
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