J. Agric. Sci. Mansoura Univ., 34 (8): 8861 - 8866, 2009

PESTICIDE RESIDUES IN TUBERS OF SOME POTATO VARIETIES GROWN IN EGYPT

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ABSTRACT

Pesticide residues in tubers of four potato varieties (Oceania, Pamina, Lady Rosetta and Lady Balfour) have been determined using gas chromatography–mass spectrometry. Twelve pesticide residues including insecticides (3 organophosphorus compounds – 3 organochlorines), herbicides (4) and fungicides (2) were analyzed in the samples. The obtained results showed the predominance of propamocarb (in a range of 0.551-0.987 mgkg-1) and Ethyl -N-benzoyle – (3, 4-dichlorophenyle)-DL-alinate (0.190-0.407 mgkg-^{1}) in all of the analyzed samples. Unforturanatly, the concentrations of propamocarb detected in all potato varieties and dimethoate in Lady Rosetta samples (0.216 mgkg1) exceeded the maximum permissible levels (MPLs). Low levels of dinoseb acetate (0.0094-0.016 mgkg-^{1}) were determined in the analyzed samples of Oceania and Pamina varieties. The results from the current study should stimulate the Ministry of Public Health to be interested in controlling the use of pesticides in the cultivation of potatoes.

Keywords: Potato tubers, Oceania, Pamina, Lady Rosetta, Lady Balfour, Pesticide residues.

INTRODUCTION

Potato (*Solanum tuberosum L*.) is one of the most important staple crops grown worldwide, ranking fifth in terms of human consumption and fourth in worldwide production (Horton, 1987). Because of its low cost, low fat content and a good source of carbohydrates, high quality protein, fibre and vitamins, it plays an important role in human nutrition (FAO, 2005–2006, Al-Weshahy and Rao, 2009).

Pesticieds constitute a major group of potential environmental hazards to man. They are an integral part of modern hazards, and an integral part of modern agriculture in most countries as a tool for controlling harmful pests. The stability of certain pesticides, and the fact that residues can remain in food, increases the human health hazard.

The use of the agricultural pesticides turned out to be a need throughout the whole world, and this since antiquity, certain species of insects being able to be indirectly harmful for the man while attacking the cultures. This is why it is essential to protect the cultures and harvests using chemicals which thus contribute to improve the quality, the quantity and the conservation. However, it was recognized that the subsequent residues of those pesticides are a clear factor of pollution of food and of the biological chains. For the human being, this can involve toxic effects that can even be mutagenic and/or carcinogenic (Rachdi *el al.,* 2006).

A number of long persistent organochlorines and highly toxic organophosphates,which have been banned or severely restricted, are still

marketed and used in many developing countries. The misuse of pesticides by concerned individuals, in addition to lack of or weak national controlling plans are behind the outbreak of adverse effects in developing countries. Since about 25 years, the use of DDT and many other organochlorine pesticides in Egyptian agriculture has been banned. However, these long persistent compounds are still detectable in many different types of environmental samples (e.g., water, fish, sediment, vegetables, fruits, milk, foodstuffs, etc.). Large number of compounds known as “extremely hazardous”, “highly hazardous”, “probable human carcinogenic” and “possible human carcinogenic”, are listed among the pesticides registered and recommended for use in Egypt during the season of 2001/2002 (Mansour, 2004).

Many studies were carried out on pesticide residues in vegetables and fruits. It was reported that the main residues were hexachlorobenzene (HCB), lindane, heptachlor and its epoxide, DDT and its derivatives, as well as malathion, pirimiphos-methyl, profenofos and dimethoate (Abou-Arabet *et al.,* 1995; Abou-El-Ghar, 1961; El-Lakwah *et al.,* 1995 & Abou-Arab, 1999).

This study was designed to shed light on the occurrence of pesticide residues in tubers of different potato verities grown in Egypt.

MATERIALS AND METHODS

Sample collection

Potato tubers of 4 varieties (Oceania, Pamina, Lady Rosetta, Lady Balfour) were collected from a local supplier in the El-Minia city, Egypt.

Determination of pesticide residues analysis by Gas Chromatography/ Mass Spectrometry (GC/MS)

The pesticide residue in potato tubers were determined following the Environmental Protection Agency (EPA) (1978) methods 8270D, 8141B at the Analytical Chemistry Laboratory, Chemistry Department, Faculty of Science, Assiut University.

All reagents used including solvents (AR grade), anhydrous sodium sulphate, florisil and pesticide standards were obtained from Sigma Chemical Co., Germany.

3. Sample Extraction and Clean-up

Samples of potato tubers were cut into small cubes, chopped and thoroughly blended using a food processor. A 30-g sample was weighed into a Mason jar and an appropriate volume of spiking solution of the standard pesticide was added. 60 g of anhydrous sodium sulfate was added into the Mason jar. The sample was then extracted with 150 ml of 5% ethanol (v/v) in ethyl acetate in an ultrasonic bath for 10 min. The extract solution was then decanted through a filter funnel fitted with a Whatman No. 1 filter paper into a round-bottomed flask. 100 ml of 5% ethanol (v/v) in ethyl acetate was used to rinse the Mason jar and decanted through the filter funnel into the round-bottomed flask. The filtrate was then evaporated to dryness by a rotary evaporator (Carter, 1996).

The round-bottomed flask was then rinsed three times with 1-2 ml of petroleum ether. The extract was then transferred quantitatively to a Florisil column and eluted with 80 ml of 40% diethyl ether in petroleum ether (v/v). The eluate was then evaporated to dryness with a rotary evaporator. The round–bottomed flask was then rinsed 2 – 3 times with 5 ml of methanol and the washings were collected in vials for the GC-MS analysis.

Gas Chromatography/Mass Spectrometry (GC/MS)

A Hewlett-Packard (HP) system 6890 series gas chromatograph coupled with a HP model 5975B quadrupole mass spectrometer; cross-linked 5% phenyl methyl siloxane capillary column (HP-5MS, 30m x 0.25mm id x 0.25µm film thickness). GC operating conditions were as follows: initial temperature 40ºC (1 min hold), increased at 20ºC min^{-1} to 210ºC, then increased at 1.5ºC min^{-1} to 215ºC (4 min hold); injector temperature 240ºC; carrier gas Helium (99.999%), flow-rate 1.3 ml $^{-1}$ min; ion source temperature 270ºC; operated in the splitless mode; purge off time 1 min; injection volume 1 µl nominal. MS operating conditions were: solvent delay 6 min; electron-impact (EI) mode ionization voltage 70 eV using selected ion monitoring (SIM); dwell time for each ion 100 ms. Data acquisition and processing were provided by a Vectra VL 5/90 Series 3 Computer equipped with a HP G1030A ChemStation data system.

RESULTS AND DISCUSSION

Results presented in table (1) reveal the presence of pesticide residues of the organophosphorus insecticides (Dimethoate, Fenobucarb and Butocarboxim); the herbicides Dinoseb acetate, Bromacil, Cycloate, Ethidimuron; Fungicides Propamocarb and Ethyl -N-benzoyle –(3,4-dichlorophenyle)-DL-alinate in the tuber of one or more of the potato varieties. On the other hand, the Organochlorine insecticides DDT, DDD and DDE were not detected in any of the varieties analysed.

Of the three organophosphorus insecticides, Dimethoate and Butocarboxim were detected in Lady Rosetta (at average concentrations of 0.216±0.019 $mgkg^{-1}$and 0.171±0.015 $mgkg^{-1}$ and Fenobucarb in oceania (at average concentration of 0 .017±0.019 $mgkg^{-1}$ potato), respectably).

Unfortounately, concentration of the organophosphorus insecticide dimethoate the detetected in potato tubers of Lady Rosetta variety was above the maximum permissible limits (MPLs) which is 0.05 $mgkg^{-1}$ FAO/ WHO (1982) or 0.10 $mgkg^{-1}$ in potatoes (Rachdi *et al*., 2006).

Tubers of Lady Balfour variety had neither organophosphorus nor organochlorine insecticides. It is worthed to mention that organophosphorus pesticides (OPPs) are widely used in agriculture and animal production for the control of various insects. These compounds have higher acute toxicity than chlorinated pesticides (OCPs) and they have the advantage of being more rapidly degraded in the environment. Organochlorine pesticides, which 25 years ago were being used in Egypt, are highly persistent. Most of them have been banned, yet their residues still appear as pollutants in food as well as in the environment (Mansour, 2004).

Table 1: Incidence of pesticides residues in potato tubers of different varieties.

Pesticide	Oceania mean ±SD mg kg^{-1}	Pamina mean ±SD mg kg^{-1}	Lady Rosetta mean ±SD mg kg^{-1}	Lady Balfour mean ±SD mg kg^{-1}
Insecticides				
Organophosphorus (OPPs)	_*	-	0.216±0.019	_
Dimethoate				
Fenobucarb	0.017±0.019	-		-
Butocarboxim	-	-	0.171±0.015	-
Organochlorine (OCPs)	-	-	-	-
DDT, DDD & DDE				
Herbicides	0.009±0.029	0.016±0.029	-	-
Dinoseb acetate				
Bromacil	0.011±0.030	-	-	-
Cycloate	-	-	0.0410±0.026	0.054±0.031
Ethidimuron	-	-	-	0.019±0.018
Fungicides	0.797±0.031	0.854±0.031	0.551±0.032	0.987±0.015
Propamocarb				
Ethyl–N-benzoyle–(3,4dichlorophenyle) -DL-alinate	0.407±0.018	0.379±0.018	0.203±0.028	0.190±0.029

*** - not detected**

Table (1) shows also that the herbicide Dinoseb acetate was detected in tubers of both Oceania and pamina varieties at concentrations of 0.009±0.029 mgkg-1 and 0.016±0.029 $mgkg^{-1}$, respectively, while Cycloate was detected in tubers of both Lady Rosetta and Lady Balfour at concentrators of 0.0410±0.026 $mgkg^{-1}$ and 0.054±0.031 $mgkg^{-1}$, respectively. On the otherhand, Bromacil herbicide was detected in tubers of Oceania variety only, and Ethidimuron in tubers of Lady Balfour variety only at concentration of 0.011±0.030 $mgkg^{-1}$, 0.019±0.018 $mgkg^{-1}$, respectively.

The fungicides Propamocarb and Ethyl -N-benzoyle– (3,4-dichlorophenyle)-DL-alinate were detected in tubers of all potato varieties analysed, at concentrations ranging from 0.551±0.032 - 0.987±0.015 $mgkg^{-1}$ and 0.190±0.029 - 0.407±0.018 $mgkg^{-1}$, respectively. The present study shows also that the concentration of propamocarbis is above the permissible level which 0.03 $mgkg^{-1}$ (FAO/ WHO 1982).

No available literatures to compare our results with and to the best of my Knowledge, the current results report for first time the incidence of herbicides and fungicides in potato tubers in Egypt.

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بقايا المبيدات في درنات بعض أصناف البطاطس المنزرعة فى مصر

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تم تقدير بقايا المبيدات فى درنات أربع اصناف مختلفة من البطاطس المنزرعة فى مصر وهى Oceania و Pamina وLady Rosetta وLady Balfour وذلك باستخدام جهاز Gas chromatography–mass spectrometry. تم تقدير ١٢ نوع مختلف من المبيدات الحشرية فى عينات البطاطس المختبرة وهى كالتالي ٦ مركبات للمبيدات الحشرية ٣ من organophosphorus و٣ من organochlorines و ٤ من مبيدات الحشائشherbicides و ٢ من مبيدات الفطريات fungicides. وكانت النتائج التى تم الحصول عليها كالتالى ,فالمركبات الاكثر تواجداً هي propamocarb وكميتة ٠,٥٥١ – ٠,٩٨٧ مج/كج و-(3,4 Ethyl -N-benzoyle -dichlorophenyle)-DL-alinate وكميتة ٠,١٩٠- ٠,٤٠٧ مج / كج فى جميع العينات المختبرة . ولسؤ الحظ فإن تركيز propamocarb فى جميع العينات المختبرة (٠,٥٥١ – ٠,٩٨٧ مج/ كج) وdimethoate فى Lady Rosetta (وكميته ٠,٢١٦ مج/ كج) تزيد عن الحدود المسموح بها . اما اقل مستوى كان لمركب dinoseb acetate الذى تراوح تركيزة ما بين ٠,٠٠٩٤ – ٠,٠١٦ فى العينات المختبرة. ويتضح من الدراسة الحالية انه يجب وضع ضوابط على كمية المبيدات المستخدمة في زراعة البطاطس وكذلك وجوب التحليل الدوري لعينات عشوائية من درنات البطاطس لتقدير الحد المسموح به لمثل هذة المبيدات لما لها من تأثير على صحة الإنسان.