Al-Azhar Bulletin of Science

Volume 26 | Issue 2 Article 8

12-1-2015
Section: Botany, Microbiology and Zoology

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How to Cite This Article

Saleh, Ramadan; Bream, Ahmed; Shaaban, Fatma; and Balah, Mohamed (2015) "THE LEECH LIMNATIS NILOTICA AS A BIOINDICATOR FOR ORGANOCHLORINE AND POLYCHLORINATED BIPHENYL RESIDUES IN WELL WATER, AT SOME LOCALITIES OF AL-JABEL AL-AKHDAR, LIBYA," *Al-Azhar Bulletin of Science*: Vol. 26: Iss. 2, Article 8.
DOI: https://doi.org/10.21608/absb.2015.23771

THE LEECH *LIMNATIS NILOTICA* AS A BIOINDICATOR FOR ORGANOCHLORINE AND POLYCHLORINATED BIPHENYL RESIDUES IN WELL WATER, AT SOME LOCALITIES OF AL-JABEL AL-AKHDAR, LIBYA

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ABSTRACT

Pesticides play a critical role in maintaining agricultural productivity, but intensive practice, repeated use and run off into the surface and ground water can pose a threat to the human and his domesticated animals. The study was carried out to identify the level of organochlorine pesticides and polychlorinated biphenyl residues in water wells using Limnatis nilotica leeches as bioindicators during summer and spring of the year 2013 at some localities of Al-Jabel Al-Akhdar, Libya. The chlorinated organic pesticide residues were ranged from 0.001 to 11.449 ng/g extracted from the whole homogenate body of leeches collected from five investigated wells. The obtained results showed that 100% of the analyzed samples contained detectable level of the monitored insecticides (HCH, aldrin, dieldrin, endrin, o.p-DDE, p.p-DDE, o.p-DDD, p.p-DDD and o.p-DDT). It is found that 100% of the samples gave results with levels below the MRL for HCH, aldrin, dieldrin, endrin concentration residues. Among all samples, 60% of the samples gave results with levels of total DDT concentration residues below the MRL, while 40% of the samples contained levels of insecticide residues above the MRL. On the other hand, there were occurrence of several polychlorinated biphenyl derivatives and 100% of the samples gave results above the level of the maximum contamination level for total PCB. The existence of total PCB at the highest levels were detected in Michael and El-Wasita wells at the summer season reaching 29 and 27 ng/g, respectively. However, the lowest detected level of total PCB reached (1.00) ng/g in leach tissues collected from Tiba well during summer season. The high levels of PCB derivatives detection in all leech samples is a health hazard reflected the continue uses of this materials source until this date and may be cause various diseases in Al-Jabel Al-Akhdar areas. Generally, the attained results emphasized that leeches are useful tools in biomonitoring of both organochlorine pesticides and polychlorinated biphenyl residues.

Key words: *Well water; organochlorine pesticide (OCP), polychlorinated biphenyl (PCB), leech, Limnatis nilotica, bioindicators.*

INTRODUCTION

Water pollution is a major global problem which requires ongoing evaluation and revision of water resource policy at all levels and there is an urgent need to prevent contamination of available water resources from various type pollutants due to global water scarcity. Although most of these pollutants are present at low concentrations, many of them raise considerable toxicological concerns, particularly when present as components of complex mixtures (Schwarzenbach *et al*., 2006). Pesticides are one of chemicals contaminating water which is essential to sustain life and a satisfactory supply must be available to all. Pesticides have played a major role in achieving the maximum crop production but maximum usage and accumulation of pesticide residues is highly detrimental to aquatic and other ecosystem (Agrawal *et al*., 2015). The significance of presence of Endosulfans, Lindane and DDT in soil and ground water in close to human and animal should be taken into consideration (Ahmad 1998, Meijer 2001, Okeniyia *et al*., 2009). Monitoring of chlorinated organic pesticides represents a great task due to their long lasting effect in the environment (El-Mekkawi *et al*., 2009). Organochlorines pesticides (OCPs) such as dichlorodiphenyl ethane (e.g, DDT, DDD and DDE), cyclodiene (e.g. aldrin, dieldrin, heptachlor and endosulfan), and chlorocyclohexane (e.g. α, β, γ and δHCH) are of great concern due to their highly persistent nature and global occurrence (Glynn et al., 1995). Contamination from heavy metals and organic chemicals used as pesticides pose special public health concerns because these contaminants can be toxic even in such small quantities as parts per billion (Scheidleder, 1999). On the other side, PCBs are mixtures of aromatic chemicals, manufactured by the chlorination of biphenyl in

presence of a suitable catalyst. The empirical formula for PCBs is $C_{12}H_{10}nCl_n$ where n may be any value from 1 to 10. PCBs with 5 or more chlorine atoms per molecule are referred to as higher chlorobiphenyls and are relatively more persistent in the environment than lower chlorobiphenyls which have four or fewer chlorine atoms (ElKady *et al*., 2007). Hence, there is a need for considerable research to predict these pollutants from the water bodies in a cost-effective manner. The most efficient parameter to assess pollution in streams receiving organic waste material has been shown to be the benthic invertebrate stream community (Hassan *et al*., 2014, Kazanci *et al*., 2014).Pesticides have been widely distributed and their traces can be detected in air, water and soil environment (Yadav *et al.,* 2015). Surface water was found to be more contaminated than ground water with more number of organochlorines (OClPs) and organophosphates (OPPs) and more concentrated pesticides (Lari *et al*., 2014). Benthic organisms are more fixed in habitat than are diatoms. Both groups of organisms can adequately express the state of a stream with respect to pollution. Benthic organisms reveal both present and past environmental conditions, whereas diatoms fecal only present environmental conditions Gallup *et al*., (1970). In this regard, using the leeches, like *Limnatis nilotica,* as bioindicators is a useful tool for the biological assessment of pesticides pollution of the water of wells. Certain features of leeches make them potentially very useful in the biological assessment, especially in moderately polluted lowland watercourses (Koperski, 2005). Al Jabal Al Akhdar is relatively rich and has verities of water resources (groundwater, surface water, desalination and wastewater), however, these resources are mismanaged properly in integrated comprehensive approach (Hamad 2012a). Hence, there is a need for considerable research to monitoring these pollutants from the water bodies in a cost-effective manner. The current work aims to discover organochlorine pesticides residues of certain wells at Al Jabal Al-khadar region using leeches (*Limnatis nilotica*), as bioindicators. In addition to determine the effectiveness of using leech in detecting OCPs and PCBs residues in water with easy and safety tools.

MATERIAL AND METHODS

1-Samples collection:

Leech samples were hand-picked from surface water of five chosen wells **(**Borgho, Michael, Tiba, El Wasita and Alou) located in some regions of Al Jabal Al-khadar, Libya during the spring and summer seasons of the year 2013. Samples were identified by the laboratory specialist as *Limnatis nilotica.* Then, it thoroughly washed with dist. water, pooled to weigh 5 gm and Kept into refrigerator till analysis processes.

1-Chemicals and authentic chemical standards

The used chemicals and solvents were special grade for pesticide residue analysis and purchased from Sigma–Aldrich (St. Louis, MI, USA). The purified water was obtained from a Milli-Q water system (Millipore, Bedford, MA, USA). Pesticide and PCB standards were obtained from Dr. Ehrenstorfer Laboratories, Augsburg, Germany. Pesticide and PCB stock solutions (approximately 1 mg/l) of individual standards were prepared by dissolving in n-hexane and storing in a freezer -18^{0}C in glass bottles with PTFE-faced screw caps. Silica Gel, Grade 634, of 100–200 mesh size was used for sample extract clean up (AOAC, 1990).

2-Samples and Extraction of pesticides and polychlorinated biphenyl (C12H10-nCln).

Typically 5 gram of sample in 40 ml glass vial, 20 ml of extraction solvent (n- hexane) and 3 gram anhydrous sodium sulphate were added and mixed. The resulting mixture was immersed into an ultrasonic bath at 45^{o}C for 60 min. The solvent was concentration by rotary evaporator and extractions residues was removed by using 5 ml n-hexane, then the sample was loaded into mixed silica column for clean up. The standard method of AOAC was applied for pesticides and PCP (Haynes *et al*., 2000).

3-Extraction of pesticides from water samples

Extracting chlorinated pesticides (Aldrin, Dieldrin, Endrin, α–HCH, beta – HCH, Lindane-Gama HCH, *o,p*-DDT, *p,p*-DDT, *o,p*-DDD, *p,p*-DDD, *o,p*-DDE, *p,p*-DDE) residues from water samples according to standard method of AOAC (1990) by partitioning the water sample with

equal volume from hexane: methylene chloride (15:85) three times, then the solvent evaporated to dryness and the extracted subject to clean up on column chromatography filled with activated florisil using diethyl ether as a elution solvent, after that the residue subject to analysis by GCMS (AOAC, 1990).

4-Cleanup procedure:

The sample preparation was carried out into glass columns which were 7.6 cm long with 1.3cm of inner diameter. The columns were filled from bottom to top, with 1g of anhydrous sodium sulphate, 2 g of neutral activated silica, 2 g of sulphuric acid modified activated silica and 2 g of anhydrous sodium sulphate. This multilayer silica column was washed with 20 ml of n-hexane prior to use. The sample was then eluted by 60 ml of n- hexane collecting the eluent and evaporated. Finally, samples were reconstituted with 1 ml of hexane and analyzed by GC/MS.

5- Instrumentation and Operation Method:

The GC/MS analysis of samples was performed using an Thermo GC/MS (Thermo Scientific Trace GC with Single Quadrupole MS DSQ II, USA) equipped with an HP-5 MS capillary column (30 m+0.25 mm,0.25 nm film thickness) the following temperature program was applied : 150 °C (hold 1.5 min.)-180 °C (hold 1min.) –240 °C (hold 2 min. injection temperature)-250°C (hold 1min.) -270 °C (hold to the end 60 min.). Helium was employed as carrier gas at 1 ml/ min. the injector, ion source, and transfer line were respectively set at 250, 250 and 280 °C .one microliter of sample was injected in splitless mode. The mass spectrometer was operated in full scan mode (50-650) Daltons per second. The ionization was made by electronic impact at 70 ev. The detection limit range of the GCMS was 0. 001-0. 002 ppm and the rune time was 60 min. for the studied pesticides (Table 1) and PCB (Table 2) under the experimental conditions (Sibali *et al*., 2008).

Statistical analysis

Data analysis were analyzed using SPSS program (ANOVA) to determine if significant difference existed between means at 0.05 levels

Calibration curves were prepared from a stock solution of 1.0 mg L^{-1} OCPs dissolved in n-hexane by serial dilution to reach calibration concentrations of 5, 10, 20, 40 and 50 µg L^{-1}. The peak areas of the corresponding analytes were plotted against the calibration concentrations and the regression coefficient was calculated for all analytes (Alawi *et al*., 2007). The calibration have an RSD ≤ 20% for the relative response factors and the correlation coefficient *R* must be >0.99 for linear regression in order for the calibration to be compliant (Albro *et al*., 1981). The recovery efficiency ranged from 88% to 82% with coefficients of variation of 5%-8% for all organochlorine compounds. These calcu-

Table (1): GC/MS analysis of organochlorine pesticides authentic samples.

Pesticides	Chemical group	R_t (Min.)	Target ions (*m*/*z*)
Aldrin	OCPs	34.74	66 (100%), 191
Dieldrin	OCPs	41.24	79 (100%),241
Endrin	OCPs	47.03	81(100%), ,281, 243, 191
α - HCH	OCPs	14.81	181 (100%),183
beta - HCH	OCPs	19.23	181(100%),219
Lindane-Gama HCH	OCPs	23.44	111(100%),181
o,p-DDT	OCPs	52.33	235(100%) ,237,165
p,p-DDT	OCPs	54.12	235(100%),199
o,p-DDD	OCPs	44.23	235(100%) ,237 ,199
p,p-DDD	OCPs	51.37	223(100%),306
o,p-DDE	OCPs	36.43	246(100%) ,248 ,316
p,p-DDE	OCPs	17.61	235(100%), 250

Table 2: Identification of polychlorinated biphenyls by retention time and fragments using GCMS.

PCBs	Chemical Name	R_t (Min.)	M	Target ions (*m/z*)
PCB 28	2,4,4'-Trichlorobiphenyl (C12H7Cl3)	27.48	257.5	186
PCB 52	2,2',5,5'-Tetrachlorobiphenyl(C12H6Cl4)	31.24	291.9	220
PCB 101	2,2',4,5,5'-Pentachlorobiphenyl C12H5Cl5)	38.09	326.4	254
PCB 118	2,3',4,4',5- pentachlorobiphenyls ($C_{12}H_5C_{15}$)	49.73	326.4	290
PCB 153	2,2',4,4',5,5'-Hexachlorobiphenyl(C12H4Cl 6)	51.7	360.8	288
PCB 138	2,2',3,4,4',5'-Hexachlorobiphenyl ($C_{12}H_4C_{16}$)	55.18	360.8	322
PCB 180	2,2',3,4,4',5,5'- heptachlorobiphenyls (C12H4Cl6)	56.40	393	324

lated values conducted to control the analytical reliability and assure recovery efficiency and accuracy of the results. These analyses were carried out in National Institute of Oceanographic and Fisheries, Alexandria, Egypt.

RESULTS AND DISCUSSION

The organochlorine pesticides (OCP) were banned in most country due to its health hazard and relatively non biodegradable residues. Therefore, table 3 showed their residues in ng/g in the associated leach of water wells as a bioindicators for OCP and analyzed by GCMS during summer and spring of the study year at El Jabel Al-Akhdar region. The detected residues were range from 0.483 to 0.088 ng/g of α HCH insecticide and 0.151- 0.010 ng/g (β HCH), 0.068-0.008010 ng/g (γ HCH), while the total average range of HCH residues concentration was 0.622-0.151 ng/g. The summarized data showed the detected residues of pesticides in the average range (0.049-0.007) ng/g of Aldrin, (0.043-0.006) ng/g of Dieldrin, and 0.043-0.006 ng/g of Endrin with a total average range of this residues concentration by (0.103-0.040) ng/g. The existence of DDT insecticide and its derivatives in the total average concentration were ranged from 0.024 to 0.001 (*o,p*-DDE), 0.196-0.047 (*p,p*-DDE), 0.036-0.006 (*o,p*-DDD), 0.221-0.021 (*o,p*- DDT), 11.214-0.064 (*p,p*-DDT) ng/g respectively with residues concentration total average ranged of (11.449 -0.218) ng/g (Table, 4). The obtained results showed that 100% of the analyzed leach samples were contained detectable level of the monitored insecticides (HCH, aldrin, dieldrin, endrin, *o,p*-DDE, *p,p*-DDE, *o,p*-DDD, *p,p*-DDD, *p,p*-DDT and *o,p*-DDT). As a result of this study 100% of the samples gave results with levels of total HCH, aldrin, dieldrin, endrin concentration residues below the MRL. However, DDT insecticides, 60% of the samples gave results with levels of total DDT concentration residues below the MRL, while 40% of the samples showed results contained levels of insecticide residues above the MRL. Lindane derivatives α HCH, β HCH and γ HCH were appeared lower the maximum contamination level (WHO &EPA) and less than DDT derivatives *o,p*-DDE, *p,p*-DDE, *o,p*-DDD, *p,p*-DDD, *o,p*-DDT). While the highest detected level of DDTs derivatives was *p,p*-DDT in Michael wells at the spring season in the studying year. In these samples the highest detected level of DDTs, reached 4.35 ng/g, this value is considered above the acceptable levels (WHO, 1996, FAO/WHO 1986). The detectable amount of pesticides residue in water samples at the studied wells, the detected levels of DDTs derivatives were ranged from 35.0-4.0 ng/g and others chlorinated compounds ranged from 9.0 to 5.0 ng/g in most studied water wells at El-Jabal Al-Akhdar regions. These supported our obtained results and confirmed that leach is useful tools in biomonitoring for both organochlorine pesticides residues.

Table 3: The Concentration of organochlorine pesticides (OCPs) residues (ng/g) in leach (*Limnatis nilotica*) associated with water wells.

Wells		α - HCH	beta HCH	Lindane-Gamma HCH	HCHs	Aldrin	Dieldrin	Endrin
Borgho	spring	0.103	0.024	0.025	0.151	0.040	0.006	0.028
	summer	0.118	0.042	0.019	0.179	0.049	0.022	0.025
Michael	spring	0.483*	0.010	0.053	0.546*	0.021	0.036	0.024
	summer	0.088	0.033	0.057	0.178	0.018	0.018	0.026
Tiba	spring	0.322*	0.015	0.068	0.406*	0.017	0.006	0.018
	summer	0.133	0.024	0.013	0.169	0.014	0.013	0.043
El Wasita	spring	0.124	0.151	0.021	0.296	0.017	0.006	0.051
	summer	0.436*	0.121	0.065	0.622*	0.007	0.038	0.006
Alou	spring	0.194	0.119	0.039	0.353*	0.029	0.043	0.031
	summer	0.226*	0.060	0.008	0.294	0.017	0.011	0.028

Values differentiate at the levels of *P < 0.05 analyzed by SPSS program

Table 4: The Concentration of organochlorine pesticides (OCPs) residues (ng/g) in leach (*Limnatis nilotica*) associated with water wells.

Wells		*o.p*-DDE	*p.p*-DDE	*o.p*-DDD	*p.p*-DDD	*o . p* - DDT	*p.p*-DDT
Borgho	spring	0.006	0.114	0.006	0.008	0.221*	0.106
	summer	0.001	0.047	0.011	0.021	0.021	0.117
Michael	spring	0.006	0.121	0.008	0.028	0.072	11.214*
	summer	0.024	0.076	0.006	0.017	0.069	0.064
Tiba	spring	0.003	0.163	0.013	0.008	0.142*	2.442*
	summer	0.004	0.082	0.019	0.024	0.110	4.396*
El Wasita	spring	0.008	0.196*	0.017	0.008	0.033	3.433
	summer	0.019	0.082	0.036	0.008	0.060	0.071
Alou	spring	0.010	0.115	0.015	0.018	0.042	0.175
	summer	0.010	0.071	0.021	0.013	0.029	1.783*

Values differentiate at the levels of *P < 0.05 analyzed by SPSS program

Table (5) illustrates the detection and concentration of polychlorinated biphenyl (PCB) derivatives in the collected leach (*Limnatis nilotica)* samples from water wells in El-Jabel Al-Akhder area. As a result of this study 100% of the samples gave results with levels of total polychlorinated biphenyl (PCB) concentration residues above the level of the maximum contamination level (EPA 2009) which recorded by 0.5 ng/g. In these respect, the highest level of polychlorinated biphenyl (PCB) was achieved in Michael and El-Wasita wells at the summer season by (29.0 and 2.7) ng/g respectively. In the other hand, the lowest detected level of PCB reaching (1.00) ng/g in the leach collected from Tiba wells at summer season, which was considered above with the comparison EPA, 2009. The existence of these derivatives in concentration reflected the continue uses of this material in last decades. The study showed the occurrence of total polychlorinated biphenyl derivatives concentration higher than organochlorine pesticides levels. It could be concluded that the high levels of PCB derivatives in all leach samples indicated the uses of this material source until this date and contaminated the investigated wells.

Table 5: The Concentration of polychlorinated biphenyls (PCBs) (ng/g) in leach (*Limnatis nilotica*) associated with water wells.

Wells		PCB 28	PCB 52	PCB 101	PCB 118	PCB 153	PCB 138	PCB 180	PCBs
	spring	0.083	0.226	0.033	0.100	0.143	0.108	0.389	1.083
Borgho	summer	0.199	0.033	0.106	0.068	0.154	0.494*	0.717*	1.771
	spring	0.115	0.122	0.043	0.221*	0.213	0.844*	1.338	2.896*
Michael	summer	0.157	0.196	0.053	0.033	0.113	0.626*	0.331	1.508
	spring	0.065	0.099	0.019	0.083	0.036	0.339	0.372	1.014
Tiba	summer	0.042	0.049	0.021	0.113*	0.138	0.632*	0.554	1.547
	spring	0.038	0.053	0.036	0.035	0.611*	0.464*	1.496*	2.732*
El Wasita	summer	0.349*	0.279	0.036	0.082	0.165	0.485*	0.161	1.557
	spring	0.035	0.133	0.061	0.072	0.336*	0.496*	0.371	1.504
Alou	summer	0.083	0.067	0.046	0.156*	0.068	0.579*	0.444	1.443

Values differentiate at the levels of *P < 0.05 analyzed by SPSS program

In conclusion, the obtained results provide important information on the current status of organochlorine pesticide (OCP) and polychlorinated biphenyl (PCB) were analyzed to assess the possible health risks to the inhabitant in the water wells by using leach (*Limnatis nilotica)* as a biomontoring agent . The occurrence of highly hydrophobic OCP and PCB in the studied water wells at El-Jabal Al-Akhdar regions were monitored by gas chromatography mass detectors. The data showed the lower contents of OCP compounds in water and leach samples could be explained by assuming the lower solubility of these toxic substances in water; it may be adsorption on the soil or sediment particles of the wells or due to the capability of leach to eliminate this compounds The OCP total residues levels not exceed the EPA Maximum Contaminant Level in water regardless of bioaccumulation and build up through the time in leach tissue as compared with the levels of residue in water samples. In the other hand, there was a recorded risk of polychlorinated biphenyl (PCB) derivatives presented in the target drinking water wells without proper treatment to eliminate these contaminants. These results supported by **Al-Targi et al., (2011**) who determined that the residues of organochlorine pesticides (OCPs) in 40 samples of human milk collected from eight rural and urban regions in El-Gabal AlAkhdar region –Libya, between March to December 2007. Also, **Hamad (2012b) found** that some of northern parts of Al Jabal Al Akhdar springs suffer from pollution problems, as well as the lack of good use, and without any monitoring programs in term of water quality and quantity. According to **AlRewashed (2012)** water samples of 32 wells and 24 springs in the area situated between Shahat and Darna cities tested chemically and bacteriological in 2009/2010. He found an increased pollution was observed in springs and wells that are situated nearer to the town centers. High nitrate concentrations were recorded in some wells and springs. In accordance with the present study, this could be attributed to local percolation of waste water to the ground water sources in this area. Generally, it has been a strong correlation between non-maintained wells and springs and relatively high pollution, which suggested contamination from surface sources. The obtained results are evident for some risks from detecting OCP and PCB in leach tissues of the surface water collected from the different wells. It is clear that this monitoring point to the action needed for controlling this contamination as demanded could depending on *Limnatis nilotica* leaches as a bioindicators. Also, it is suggested that more extensive investigation covering all water wells in all El Jabal Al-Akhdar regions of Libya must be carried out to monitor the exact levels of all pesticide and polychlorinated bi phenyl residues.

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العلق الطبى ليمانتس نيلوتيكا كمؤشر حيوى لمتبقيات المبيدات الكلورينية العضوية والمركبات متعددة الكلور ثنائية فنيل فى مياه الابار ببعض مناطق الجبل الاخضر ، ليبيا

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تلعب مبيدات الافات دور حاسما فى الحفاظ على الانتاجية الزراعية ولكن الممارسات الزراعية المكثفة و الاستخدام المتكرر ادى الى وصول المبيدات المياة السطحية والجوفية والتى يمكن أن تشكل خطرا على الإنسان وحيواناته المستأنسة. وقد أجريت هذه الدراسة للتعرف على مستوى المبيدات العضوية الكلورونية ومتبقيات ثنائي الفينيل متعدد الكلور في مياه الآبار باستخدام العلق الطبي ليمناتيس نيلوتيكا كمؤشر حيوي خلال فصلي الصيف والربيع من عام 2013 في بعض المناطق من الجبل الأخضر، ليبيا. وقد تراوحت قيم متبقيات المبيدات العضوية المكلورة،0.001 الى 11.449 نانوجرام / جرام من الخليط المتجانس لجسم العلق المجمع من خمسة آبار مختبره. وأظهرت النتائج أن ٪100 من عينات العلق التي تم تحليلها تحوي مستويات ملموسة من المبيدات الحشرية (HCH ، ألدرين، والديلدرين، الأندرين، أرثو – بارا- DDE، بارا – بارا- DDE، ارثو – بارا -DDD، بارا –بارا -DDD و ارثو – بارا-DDT-).كما وجد أن ٪100 من العينات أعطت نتائج ذات مستويات أقل من قيم MRL لمستويات متبقيات المبيدات HCH ، ألدرين، والديلدرين و الأندرين.لقد وجد أن ٪100 من العينات التى تم تحليلها كانت مستويات مبيد HCH وألدرين، الديلدرين، الأندرين أقل من الحدود القصوى . بالنسبة لمستوى متبقيات مبيد ٪60 DDT من العينات التى تم تحليلها كانت تحت MRL، وعلى العكس إحتوت ٪40 من العينات على مستويات من بقايا DDT فوق الحدود القصوى.

على الجانب الآخر،مشتقات ثنائي الفينيل متعدد الكلور، وجد ان ٪100 من العينات التى تم تحليلها كان مستوى متبقياتها فوق الحد الأقصى، وكانت أعلى مستوى لإجمالي متبقيات PCB فى عين مخائيل وعين الوسيطة وذلك خلال فصل الصيف حيث قدر تركيزاتها ب 29 و 27 نانوجرام / جرام من ووزن العلق على التوالي. ومع ذلك، فإن أدنى مستوى تم الكشف عنة من إجمالي متبقيات PCB بلغ (1.00) نانوجرام / جرام في انسجة العلق التي تم جمعها من عين طيبة خلال موسم الصيف. من النتائج السابقة نجد ان المستويات المرتفعةى من مشتقات ثنائى الفينيل المكلورة في جميع عينات العلق يشكل خطر على الصحة العامة ويعكس مواصلة استخدامات مصدرهذة المواد حتى هذا التاريخ، وربما يكون السبب فى بعض الأمراض في مناطق آلجبل الأخضر. عموما، أكدت النتائج أن العلق النيلى أدوة مفيدة في الرصد الحيوي لكل من المبيدات الكلورية العضوية ومخلفات ثنائي الفينيل متعدد الكلور