

Detection of Deltamethrin Residues in poultry Egg and Meat In Dyala province

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Abstract

Deltamethrin (DMT) is one of synthetic pyrethroid compounds having wide insecticidal activity against a large number of ectoparasites and has important uses in veterinary and human health protection. Due to widely used of deltamethrin in Iraq by farmers to control the insecticide in crop production in agricultures and ectoparasites in animals, this study was planned to identify the presence of deltamethrin residues and quantum of this compound in 192 samples comprising 96 of locally poultry eggs and 96 of laying hens meat (Thigh meat) were collected at random from various markets of Dyala province, 48 samples (24 eggs and 24 meat) from each sector (Khalis, Muqdadiah, Baquba and Balad Ruz) for the period from October 2015 to January 2016 by using Gas chromatographic technique (GC) for analyzed. The residues analysis showed that all poultry eggs and laying hens thigh meat samples were positive for DMT residues and above the MRLs when comparing. The highest mean levels of DMT residues in poultry eggs samples were recorded at Muqdadiah, followed by Balad Ruz, Khalis and Baquba (1.02 ± 0.11), (0.99 ± 0.04), (0.95 ± 0.02) and (0.89 ± 0.05) respectively; While the highest mean levels of DMT residues in laying hens thigh meat samples were recorded also at Muqdadiah, followed by Balad Ruz, Khalis and Baquba (0.96 ± 0.07), (0.88 ± 0.02), (0.79 ± 0.05) and (0.76 ± 0.03) respectively. The statistical analysis revealed that the levels of deltamethrin residues were significantly higher ($P \leq 0.05$) in Muqdadiah from other sector of Dyala province in poultry eggs and meat samples. The result of this study clarify the risk of DMT residues to public health and need to create awareness by the local agriculture and public health authorities regarding the preventive measures to decreasing the pesticides residues in poultry products.

Keywords: Deltamethrin pesticides, egg, meat, Gas chromatography, Poultry

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الكشف عن متبقيات الدلتامثرين في بيض ولحوم الدواجن المحلية في محافظة ديالى

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الخلاصة

تعتبر الدلتامثرين احد المركبات الصناعية ضمن مجموعة البيريثرويد ويتميز بكونه مبيد حشري ذا تأثير قوي على الطفيليات الخارجية ويستخدم في الانسان والحيوان. ونظرا لاستخدام هذه المبيدات بنطاق واسع في العراق من قبل المزارعين للسيطرة على الحشرات في إنتاج المحاصيل الزراعية وعلى الطفيليات الخارجية في الحيوانات، فقد هدفت الدراسة على تحديد متبقيات الدلتامثرين وكميتها في 192 عينة مقسمة الى 96 عينة مأخوذة من بيض الدواجن المحلية و96 عينة من لحوم الدجاج البياض (لحم الفخذ) وبشكل عشوائي من الأسواق المحلية لمحافظة ديالى، حيث جمعت 48 عينة (24 بيض و24 لحم) من كل قضاء (الخالص، المقدادية، بعقوبة وبلدروز) للفترة من أكتوبر 2015 إلى يناير 2016 باستخدام تقنية التحليل بالكروماتوغرافي الغازي (GC). حيث أظهرت نتائج التحليل من أن جميع عينات البيض واللحم كانت تحوي متبقيات للدلتامثرين وكانت بمستويات اعلى من الحدود العليا المسموح بها. وسجلت أعلى المستويات من متبقيات بقايا الدلتامثرين لعينات البيض في المقدادية، تليها

بلدروز، الخالص ويعقوبية (0.11 ± 1.02)، (0.04 ± 0.99)، (0.02 ± 0.95) و (0.05 ± 0.89) على التوالي. وكذلك ظهرت أعلى المستويات من متبقيات الدلتامثرين في لحوم الفخذ للدجاج البياض في المقدادية، تليها بلدروز، الخالص ويعقوبية (0.07 ± 0.96)، (0.02 ± 0.88)، (0.05 ± 0.79) و (0.03 ± 0.76) على التوالي. وعكست النتائج الاحصائية للدراسة بان هناك فرقا معنويا بقيمة ($P \leq 0.05$) في متبقيات الدلتامثرين بين اقصية محافظة ديالى وكانت اعلاها في قضاء المقدادية بالمقارنة مع باقي الاقصية. اوضحت نتائج هذه الدراسة مدى خطورة متبقيات الدلتامثرين على الصحة العامة وتؤكد الحاجة الى خلق وعي صحي لدى السلطات الصحية والزراعية واتخاذ اجراءات وقائية للتقليل من هذه المتبقيات في منتجات الدواجن.

الكلمات المفتاحية: متبقيات الدلتامثرين، بيض، لحم، تقنية التحليل بالكروماتوغرافي الغازي، الدجاج البياض.

Introduction

The growing poultry population increases the requirement of agricultural based commodities and these commodities solely depend on a number of chemicals/synthetic pesticides during production and storage period till they are marketed, therefore exposure of poultry to these chemical pesticides can cause health hazard to the birds itself which could result in economic losses, also there could be considerable global set back in trading of poultry products and poultry feed ingredients between nations (1). Pesticides are substance or mixture of substances to preventing, destroying and controlling any pest including vectors of human and animal disease, unwanted species plants or animals (2). The majority of the pesticides used for agricultural and domestic pest control purpose are trans-located from soil to plant tissues and then to animals where they have specific affinity for adipose tissue and ultimately lead to contamination of the animal products (3, 4). The broad use of these insecticides has led to an increased exposure of workers and the ecosystem, increasing the possibility of their entering the food chain via the meat, egg, water, vegetables or via their residues in fruits (5). Deltamethrin (DMT) is a synthetic pyrethroid pesticide that kills insects through dermal contact and digestion. It is applied for a range of commercial crops and by extension controls a variety of pests. It was first synthesized in 1974, and since has been used primarily on cotton, coffee, maize, cereals, fruits, and stored products; however, deltamethrin is also applied in animal health and public health capacities (6). In Iraq DMT has been widely used and specifically in the northern provinces for sheep, goats, cattle and chickens dipping or spraying by the veterinarians and farmers for the controlling of ectoparasites in animals and as insecticide in crop production in agricultures (7). Meat may contain high levels of DMT residues as a result of concentration of residues in the tissues following cattle, sheep, goats and chickens dipping or vector control or when they feed on feedstuffs contaminated with these chemicals (8). To protect consumers and to minimize the health risks from the ingestion of food contaminated with DMT, Environmental Protection Agency (EPA) and public health authorities, including the World Health Organization (WHO) have set Maximum Residue Limits (MRLs) for DMT in different food commodity (9). Eggs from free range hens are known to be often contaminated by several environmental contaminants such as dioxins, polychlorinated biphenyls (PCBs), organochlorine insecticides and heavy metals (10). Due to a high consumption of poultry egg and meat, and an increased awareness for quality/ residue free food concern among the consumers, lead to the investigation for the presence of pesticide residues in eggs and meats. Therefore, this research was conducted to determine the levels of deltamethrin residues in poultry products (egg and meat) collected from Dyala province, using gas chromatographic technique.

Material and Methods

The study was carried out at the laboratories of the Iraqi Ministry of Science and Technology.

- **Chemicals, Reagents and Standards:** All chemicals and standards of deltamethrin were supplied from sigma company.
- **Collection of samples:** It was taken 192 samples comprising 96 of poultry eggs and 96 of laying hens meat (Thigh meat) were collected at random from various markets of Dyala province, 48 samples (24 eggs and 24 meat) from each sector (Khalis, Muqdadiyah, Baquba and Balad Ruz) for the period from October 2015 to January 2016. All of the collected eggs and laying hens meat were locally produced. Samples were kept in cold ice during their transportation to the laboratory where they were kept at 4°C until analysis.
- **Sample extraction and cleanup:** In all samples were analyzed. About 10-15 g of eggs and 25-40 g of meat were mixed with 30 g anhydrous sodium sulfate to remove water. After soxhlet the mixtures extracted with 250 mL of petroleum ether at 50°C for 8 h (11). Extracts were evaporated with N₂ below 40°C to remove petroleum ether. Deltamethrin residues were detected and determined according to the Association Of Official Analytical Chemists (12) methods. Residue was dissolved with 1 mL of *n*-hexane and filtered through a syringe filter of 0.45 µm. The extract (1 µL injection volume) was injected to Gas chromatographic (GC).
- **Gas chromatographic analysis:** The deltamethrin residues were determined by using a DANI- ITALY gas chromatograph.
- **Chromatographic Condition:** The column temperature was initiated at 50°C held for 2 min; increased at a rate of 10°C/min to 150°C, and then at 3°C/min to 270°C, where it was held for 12 min. The carrier gas was helium and it was supplied in constant flow-rate of 1mL/min at splitless mode (13).
- **Statistical analysis:** The data were analyzed using one way ANOVA (14). Differences were considered significant at (P≤0.05).

Results

The present data clearly demonstrated that all 192 samples obtained from Dyala sector (Khalis, Muqdadiyah, Baquba and Balad Ruz) during October 2015 to January 2016 were found to be contaminated with deltamethrin residues and exceeded the maximum residue limits (MRLs) when compared to the FAO/WHO Codex Alimentarius (MRLs > 0.05 in poultry eggs and MRLs > 0.01 in poultry meat) (15). The GC residues analyses showed that all poultry eggs and laying hens thigh meat samples were positive for DMT residues (Table 1). The highest mean levels of DMT residues in poultry eggs samples were recorded at Muqdadiyah, followed by Balad Ruz, Khalis and Baquba (1.02 ± 0.11), (0.99 ± 0.04), (0.95 ± 0.02) and (0.89 ± 0.05) respectively (Fig. 1).

Table (1) Levels of Deltamethrin residues (ppm) in poultry eggs and laying hens thigh meat in Dyala province

Dyala Sectors	Eggs	Meat
	(mean ± SE)	(mean ± SE)
Baquba	0.89 ± 0.05 ^d	0.76 ± 0.03 ^d
Khalis	0.95 ± 0.02 ^c	0.79 ± 0.05 ^c
Balad Ruz	0.99 ± 0.04 ^b	0.88 ± 0.02 ^b
Muqdadiyah	1.02 ± 0.11 ^a	0.96 ± 0.07 ^a

Different letter within the same column are significantly different (p≤0.05).

While the highest mean levels of DMT residues in laying hens thigh meat samples were recorded also at Muqdadiyah, followed by Balad Ruz, Khalis and Baquba (0.96 ±

0.07), (0.88 ± 0.02) , (0.79 ± 0.05) and (0.76 ± 0.03) respectively (Fig. 2). Overall, statistical analysis revealed that the levels of deltamethrin residues were significantly higher ($P \leq 0.05$) in Muqdadiyah than other sector of Dyala province in poultry eggs and meat samples (Table 1).

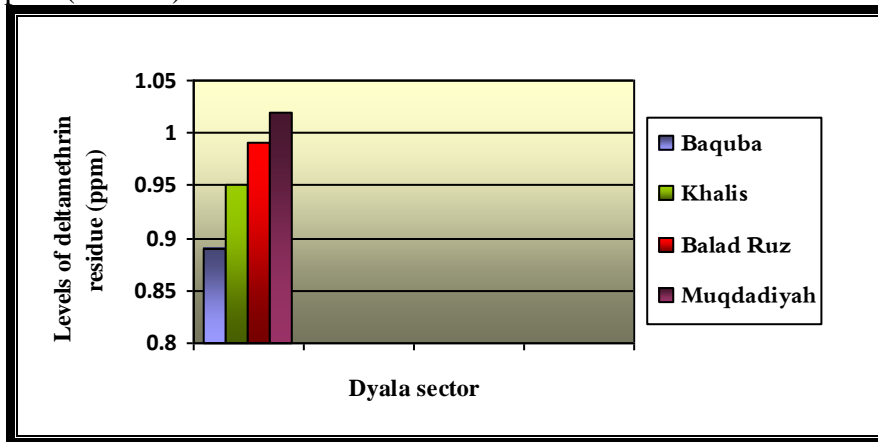


Fig. (1) Levels of deltamethrin residue (ppm) in poultry egg samples in Dyala province

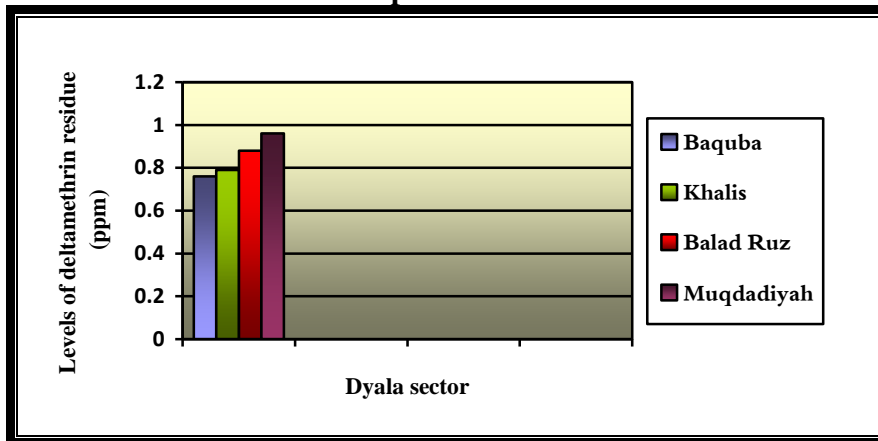


Fig. (2) Levels of deltamethrin residue (ppm) in laying hens thigh meat samples in Dyala province

Discussion

In this study, there were high levels of deltamethrin residue above the MRLs, there were related to several reasons including: usually farmers used overdose of deltamethrin because they think more concentrations better killed ticks and other ectoparasite and farmers not well-educated and mostly they do not use veterinarians guidelines. The available data suggest that, when administer the pesticide to laying hens, a wide variety of pesticide leave detectable residues in eggs laid days to weeks after the cessation of treatment (16). Animal tissue samples having high lipid content (10% or lower) for this reason, we note the high concentration of pesticide, because the pesticide is concentrated in the fat (8). Pyrethroids (deltamethrin) are most often administered to poultry topically, as a spray or dust (8). When topically applied, deltamethrin are absorbed and widely distributed to tissues, but concentrate particularly in fat and skin. Residues in skin and fat are very persistent, as are residues in the egg yolk (17). Moreover, (18) reported that the residue levels of deltamethrin arising in muscles and eggs when laying hens were fed deltamethrin in the diet for 20 weeks. In chickens, orally administered deltamethrin are widely distributed to tissues and extensively metabolized, with the highest residue concentrations occurring in the kidney, liver and fat (8). The main egg components are (yolk, albumen, and shell), the yolk has the

longest development time. Precursors to yolk lipoproteins are produced in the liver and transported through circulation to the yolk follicles in the ovary. In an actively laying hen, several follicles at varying developmental stages reside simultaneously in the ovary. Before an egg is laid, the yolk undergoes a stage of rapid growth, in which it increases in size exponentially over 10 days (19). Deltamethrin that deposit in the yolk will rapidly accumulate during this time and can be present in successive eggs for 10 or more days following treatment. Following yolk maturation, the albumen or 'egg white' is laid down over a period of 2-3 h (20) and can also serve as a residue accumulation site. Residues are found in egg albumen at low levels, and in egg yolks at similar concentrations to those found in kidney and liver for several days following oral dosing (17).

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