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Determination of a Pyrethriod Insecticide Deltamethrin Residues in Sheep and Goat Meat in Sulaimaniya Province

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Abstract

Deltamethrin (DMT) is a pyrethyroid providing valuable insecticidal activity against a large number of pests and it has potential uses for crops, cattle, sheep, goat and human health protection. In Iraq DMT has been widely used now and specifically in the northern provinces for sheep, goat and cattle dipping or spray, by the veterinarians and farmers for the control of ectoparasites in animals and as insecticide in crop production in agricultures. The aims of this study were to determine DMT residues (ppm) in locally produced sheep and goat meat sold in butchers shops in Sulimanyia province. The sheep and goat meat samples were collected from 5 different locations of the Sulimanyia province (Kalar, DarbandiKhan, SiadSadq, Kffri and Sulimaniya markets). Ten meat samples were purchased (8 sheep and 2 goat meat) from different butchers per location. A total of 50 meat samples (40 sheep and 10 goats) were collected and analyzed usingHigh Performance Liquid Chromatography techniques (HPLC) from June to October of 2015. The residues analysis showed that all sheep and goat meat samples were positive for DMT residues and there were no significant differences in concentrations (ppm) of DMT residues at the 5 locations of Sulimanyia province neither in sheep nor in goat meat. The results of this study revealed that there was a significant difference ($P<0.05$) in DMT residues (ppm) between June and July months in sheep meat, but not in goat meat. The obtained data were compared with the MRLs Permissible by the WHO and FAO and it was found that there were 100% violation of the MRLs (above 0.026) in sheep and goat meat.

Keywords: Deltamethrin, ectoparasites, Sulimanyia province, HPLC, MRLs.

Introduction

Pesticides are defined as any substance or mixture of substances intended for preventing, destroying, or controlling any pest, including vectors of human or animal disease, unwanted species of plants or animals (FAO, 2004). 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 livestock products (Thurman *etal*., 2008).

In Iraq Deltamethrin (DMT)has been wildly used now and specifically in the northern provinces for sheep, goat and cattle dipping or spray by the veterinarians and farmers for control of ectoparasite in animals and as insecticide in crop production in agricultures. Meat may contain high levels of pesticide residues as a result of concentration of residues in the tissues following cattle, sheep and goat dipping or vector control or when they feed on feedstuffs contaminated with these chemicals (Jeyashree and Vasudevan, 2007).

In order to minimize the health risks from the ingestion of food contaminated withDMT, it is necessary to determine the levels of DMT in meat of the common food animals (cattle, sheep and goat). Since there is no data on the residual levels of DMT in meat tissue after different routes of exposure, this

study was conducted to determine the levels of DMT pesticide residues in sheep and goat meat collected from Sulaimaniya Province, using High Performance Liquid Chromatography (H.P.L.C).

Materials and Methods

1. Collection and Processing of meat samples:

Five different locations were selected for meat samples collection located in Sulaimaniya Province which include Kffri, Kalar, Darbandikhan, Said Sadiq and Sulaimaniya markets. Ten samples from each location (8 sheep and 2 goatfrom butchers were a purchased). The average weight/sample was around 500 gm.Each sample was packed separately in a sterile polyethylene bag in an ice box and transferred to the laboratory.

2. Preparation of DMT standards:

1. Stock solutions(SS) [lmg/ml] were prepared from Deltamethrin standard (Fig. 3.2) in methanol Ab % and kept in freezer at -20°C. The stock standard solution was used for up to 3months.
2. Suitable concentrations of working standards solutions (WSS) were prepared from the stock solutions (SS) bydilution using with methanol Ab %, immediately prior to sample preparation.

3. Sample preparation and separation:

1. One hundred grams of minced meat sample were homogenized for 5 minutes in a homogenizer and stored in a clean, sealed plastic pack at-18 °C in a deep freezer.
2. One hundred gram of the homogenate was placed into a 250 ml polypropylene centrifuge tube with 100 ml of methanol and Vortex for 1 minute.
3. The sample was extracted ultrasonically for 10 minutes.
4. The sample was centrifuged at a speed of 4000 r/min for 5 minutes.
5. Removed the supernatant and were saved in a clean conical flask(250ml) and evaporated with N2 below 40 °C.
6. The residue was reconstituted in 1ml of 5 % methanol and water.
7. Then 20 µl were subjected to HPLC analysis

Results

1. Determination the levels (ppm) of Deltamethrin residue in sheep meat in Sulaimaniya province:

A total of 40locally slaughtered sheep meat sampleswere collected in this study on Juneand July 2015 from five different locations in Sulaimaniya province (Kalar, Darbandikhan, Said Sadiq, Kffri and Sulaimaniya markets). The HPLC analyses showed that all samples were positive for DMTresidues (Table 1).Overall, one way analysis of variance(ANOVA) revealed that there were no significant differences (P>0.05) in the residual levels (ppm) of DMT among the samples of the five locations(Table 1).

Table1: Levels (ppm) of DMT residues in sheep meat collected from different locations of Sulaimaniya province during June and July 2015

locations	Collection periods					Range	(Mean ± SE)
	June	June	July	July	July		
Kalar	0.33	0.46	1.21 1.11	1.75 1.15	1.04 0.84	0.33 - 1.75	0.98 ± 0.14
Darbandikhan	0.71 0.93	0.77 0.67	0.77 1.20	0.71		0.48	0.48 - 1.20	0.78 ± 0.06
Saed Sadeq	0.52	0.59	0.76 0.86	0.90 0.75	0.96 0.86	0.52 - 0.96	0.77 ± 0.05
Kffri	0.44 0.21	0.54	1.25 1.44	0.84	0.88 0.52	0.21 - 1.44	0.77 ± 0.14
Sulaimaniya Markets	0.19 0.14	⋆NA	2.93 1.16	0.90 0.66	0.06 0.66	0.14 - 2.93	0.84 ± 0.32

⋆NA= Not Available

Comparing the results of DMT residues in June and July months showed that there were a significant differences (P<0.05) between June and July (0.50±0.08), (0.99±0.18) respectively. The highest residues were recorded in July compared to June as illustrated in Table 2.

The results further demonstrated that all the sheep meat samples were 100% above the MRLs that recommended by the WHO and FAO for DMT residues in sheep meat (MRLs > 0.026ppm),(Table 2).

Table 2: Levels (ppm) of DMT residues in sheep meat recorded in Sulaimaniya Province during June July 2015

Months	No. of samples	Range	(Mean± SE)	%violation *MRLs=0.026
June	13	0.14-0.77	0.50 ± 0.08B	100%
July	27	0.48-2.93	0.99 ± 0.18 A	100%
Total	40	0.14-2.93	0.75 ± 0.82	100%

Different uppercase letters in the same columns are significantly different (P<0.05)
* MRLs=Maximum Residual Limits (0.026 ppm)

2. Determination the levels (ppm) of Deltamethrin residue in goat meat in Sulaimaniya province:

A total of 10 locally slaughtered goat meat sampleswere collected in this study onJuneand July 2015 from five different locations in Sulaimaniya province (Kalar, Darbandikhan, Said Sadiq, Kffri and Sulaimaniya markets).

The HPLC analyses showed that all the 10 samples were positive for DMT residues (Table 3).Overall, one way analysis of variance(ANOVA) revealed that there were no significant differences (P>0.05) in the residual levels (ppm) of DMT among the samples of the five locations(Table 3).

Table 3: Levels (ppm) of DMT residues in goat meat collected from different locations of Sulaimaniya Province during June and July 2015.

Locations	Collection Period				Range	(Mean ± SE)
	June	June	July	July		
Kalar	0.56	0.44	*NA	*NA	0.44 – 0.56	0.50 ± 0.05
Darbandikhan	*NA	*NA	1.36	0.91	0.91 – 1.36	1.13 ± 0.21
Saed Sadeq	0.28	0.48	*NA	*NA	0.28 – 0.48	0.38 ± 0.09
Kffri	*NA	0.55	1.16	*NA	0.55 – 1.16	0.85 ± 0.29
Sulaimaniya Markets	*NA	1.78 0.79	*NA	*NA	0.79 – 1.78	1.28 ± 0.48

*NA= Not Available

Comparing the results of DMT residues in June and July months showed that there were no significant differences (P<0.05) between June and July(0.69 ± 0.18), (1.12 ±0.10) respectively. However, higher residues were recorded in July compared to June as showed in Table 4.

The results further demonstrated that all the goat meat samples were 100% above the MRLs that recommended by the WHO and FAO for DMT in goat meat (MRLs > 0.026ppm), (Table 4).

Table 4: Levels (ppm) of DMT residues in goat meat recorded in Sulaimaniya Province during June July 2015

Months	No. of samples	Range	(Mean ± SE)	%violation *MRLs=0.026
June	7	0.28 -1.78	0.69 ± 0.18	100%
July	3	0.91 -1.36	1.12 ± 0.10	100%
Total	10	0.28 -1.78	0.95 ± 0.14	100%

* MRLs=Maximum Residual Limits (0.026 ppm)

Discussion

Pesticides are an important component of an agricultural industry from viewpoint of economic and effective pest control; therefore, their continued use is essential. Among various pesticides being used in the north of Iraq, Deltamethrin was the most heavily used for control of ectoparasite in animals and insects in crop. The results of this study for sheep and goat meat showed that all samples of sheep and goat were positive for the DMT residues and all of them above the MRLs that established by WHO and FAO. These results agreed with Heitzman (2000) who found the levels (ppm) of DMT residues in sheep meat above the MRLs recommended by WHO/FAO. Also, the results agreed with FAO (1999) which reported that the DMT residues in cattle, goat, sheep and pigs were above the MRLs recommended by WHO/FAO. In addition the results agreed with Saqib *et al*. (2005) and Mahboob *et al*. (2013) whom found that the residues of DMT in a various tissue of fish, in which the residue levels were above the MRLs recommended by WHO/FAO. Sallam and Morshedy (2008) whom found the residue of different pesticide (DMT) in the meat of camel, cattle and sheep in Egypt were above the MRLs that established by WHO/FAO.

On the other hands the results of this study disagreed with Misra *et al.* (2005) who found that the levels (ppm) of DMT residues in cow and poultry meat were below the MRLs recommended by WHO/FAO.

In this study, there were high levels (ppm) of DMT residue above the MRLs, There were related to several reasons including: using of DMT in non-appropriate dose, because farmers not well-educated and mostly they do not use veterinarians guidelines, usually farmers used overdose of DMT because they think more concentrations better killed ticks and other ectoparasite. Similar finding mentioned by National Pesticide Information Center (2010) which reported that the amount of pesticides residue remaining after a half-life depends on the amount of pesticide originally applied.

In addition, the intervals between the dipping times may not be well-scheduled by the farmers. Mehhorn *et al.* (2007) whom reported that intervals between dipping baths in ruminants might not be less than 9 weeks if necessary. Furthermore, most of times, butchers slaughter the animals without knowledge on the withholding periods of veterinary drugs. Heitzman (2000) ; Papadopoulos and Farmakis (2012) whom confirmed that the fact withholding period of sheep and goat meat treated by DMT was not less than 3 weeks.

After dipping of the animals farmers disposed their pesticide containers around the dipping area. Tarla *et al*., (2014) whom reported that the contaminated material such as contaminated empty containers, or old application equipment that the main source of pesticide residuesand pasture contaminations,Also most of the dipping areas were located near the water source, the distance between sheep bath and water source less than1km. This caused of water sources contamination with DMT residues. Similar finding mentioned by Chen *et al.* (2007) and Anasco *et al.* (2010) whomreported the presence of DMT and other pesticides in surface water and groundwater close to agriculture lands over the world; from the animals or plants where it was applied the pesticide may leak into groundwater, The pesticide may drain into surface waters or volatilize into the air, from the air it accumulated in sediments on animal and wildlife. Yue (2009) who reported that the amount of these pesticide in the sediment is often hundreds or even thousands of times of that in the water.

Another cause of high levels of DMT residue in sheep and goat meat is the types of animal feed, sometime farmers use deteriorate fruits and vegetables as a source of feed for their animals. In the north of Iraq farmers used DMT for treatment and control of insects in fruits and agriculture; accordingly these fruits and vegetables contain certain amount of DMT residues, which transferred to the animal tissues after eating. Similar finding were reported by Perveen *et al.* (2005)and Bempah *et al.* (2012) whom confirmed that agrochemicals such as DMT residues are present in fruits and vegetables such as cucumber, cabbage, tomatoes, onion and watermelon.

In sheep and goat meat, the higher levels of DMT were recorded on July when compared to June; in sheep meat a significant difference was found between July (0.99 ± 0.18) and June (0.50 ± 0.08) but not in goat meat. Several reasons were related to these results including: in the north of Iraq shearing is usually done in June; therefore, the sheep have less wool in June compared to July. More wool lead to keeping more DMT after dipping and more precipitation of residues on the animal skin and entering to the animals tissues and organs via the skin. Similar finding mentioned by David and Greg (2001) whom reported that the dipping long wool sheep involves significant risks; both to the welfare of the dipped sheep and to the operator through exposure to pesticide and also higher

amount of pesticide residues in the treated animals were remaining.

Another reason was the temperature. In July the temperature is hotter than June, this lead to more sweating of the animal also caused vasodilatation and higher absorption, accordingly higher quantities of DMT enter to the animal body. Stroud (2003) who reported that the heat exhaustion might be a problem during gathering and dipping in hot summers. In addition, usually animals dipping during July month higher than in June; this act as another reason for the presence of higher levels of DMT in sheep and goat meat in July.

Furthermore, in July, animals are usually fed on hay, herbage and wheat, which were left after harvesting; this may also contributed to the presence of high levels of DMT residues in sheep and goat meat on July because farmers in the northeast of Iraq used DMT for crop protection and insect control in agriculture. Similar finding was mentioned by Jermannaud and Pochon (1994) whom confirmed that DMT residues found in Pig and poultry meat after feeding of wheat treated with DMT.

In goat meat no significant difference between June (0.69 ± 0.18) and July (1.12 ± 0.10), this may be due to the fact that farmers are mostly not shearing the goat (goat had the same amount of hair on June and July). Muhammad *et al.* (2010) who reported that the residue of pesticide have the same levels in different months and seasons in Pakistan.

Conclusion

From the data obtained from this study, can be concluded The prevalence of DMT residue detected in sheep and goat meat were comparatively similar and all sheep and goat meat sold in Sulaimaniya Province (5 locations) have had high levels (ppm) of DMT residues which violate the compliance (MRLs) that established by WHO and FAO.

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