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Analysis of Residual Pesticides Present in Edible Locusts Captured in Kuwait

Talat Saeed, Faisal Abu Dagga and Maie Saraf

Central Analytical Laboratory, Kuwait Institute for Scientific Research, P.O. Box 24885, Safat – 13109, Kuwait

ABSTRACT. Locusts which invaded Kuwait during the 1988/89 winter were captured to evaluate for the risk to the health of the people who had consumed them. Residual pesticides were extracted from these insects and subjected to gas chromatographic analysis using fused silica capillary columns connected with electron capture and flame photometric detectors. The results showed that some chlorinated pesticides were present in the residues. More importantly, relatively high amounts of phosphorus-containing pesticides (sumithion and malathion) were detected in the residues. Since these pesticides are toxic to humans, there is a health risk in consumption of insects contaminated with the pesticides.

During the winter in 1988-1989, the Arabian peninsula, including Kuwait, was invaded by many waves of locust. To protect the crops and vegetation, the invading insects were sprayed with different insecticides. In the past, when the locusts invaded more frequently, local people used to capture and consume the insects which were considered to be a delicacy. The reappearance of locusts revived this age old tradition. In spite of the warnings about the possibility of contamination of locust with insecticides, issued by the health authorities in the region, a large number of people captured and consumed locusts in Kuwait.

In order to get some information about the health risk associated with the consumption of contaminated locusts, some insects were captured, prepared in the traditional way and analyzed for residual insecticides by capillary gas chromatography using electron capture and flame photometric detectors. In this paper we show that phosphorus pesticides, as well as chlorin containing pesticides, are present in the residues of the insects.

Experimental

A) Materials: Live locust insects were captured, at random, by the staff of the Public Authority for Agriculture and Fish Resources (PAAF), Kuwait, and supplied to our laboratory. The average weight of the insect was 8 g. Standard chlorinated pesticides were obtained from Supelco, USA. Phosphorus pesticides were supplied by PAAF, Kuwait.

B) Sample Handling: The insects were treated in a manner as also used traditionally by the public for consumption. The whole insects were kept in boiling water for ten minutes and then head, wings, legs and gut were removed. The remaining edible portion was weighed and used for analysis.

C) Sample Preparation: The samples for analysis were prepared according to the procedure described in AOAC (1984). The sample was extracted several times in a high speed blender with petroleum spirit (40-60°C) and anhydrous sodium sulfate. The extract was filtered and the filtrate was concentrated to about 1 ml using a Kuderna-Danish concentrator.

i) Acetonitrile Partitioning

Acetonitrile saturated with petroleum ether (30 ml) was added to the sample in a separatory funnel and shaken vigorously for 3 minutes, and the acetonitrile and petroleum ether layers were allowed to separate. The acetonitrile layer was drained in a 1 l separatory funnel containing 650 ml water, 40 ml saturated sodium chloride solution and 100 ml petroleum ether. The petroleum ether layer was extracted three times with acetonitrile (30 ml) saturated with petroleum ether. All extracts were combined in a 1 l separatory funnel and shaken vigorously and then the layers were allowed to separate. The aqueous layer was again extracted with 100 ml of petroleum ether. The aqueous layer was discarded and the petroleum ether layer was combined with that in the original funnel. The petroleum ether layer was washed twice with 100 ml water, dried over anhydrous sodium sulfate and concentrated to 10 ml in a Kuderna-Danish concentrator.

ii) Florisil Clean-up

Activated florisil was filled in a chromatographic column (11 mm ID) up to 20 cm. The florisil was topped with 3g of anhydrous sodium sulfate. The concentrated sample was loaded on this column and eluted with 200 ml of 6% diethyl ether in petroleum ether. The effluent were collected as fraction 1. Fraction 2 was eluted with 15% diethyl ether in petroleum ether and fraction 3 with 50% diethyl ether in petroleum ether. The collected fractions were concentrated to 1 ml using a Kuderna-Danish apparatus.

iii) Gas Chromatographic Analysis

Gas chromatographic analyses of the three fractions were carried out on a Perkin-Elmer Sigma-2000 gas chromatograph equipped with an electron capture detector (ECD)

and a split/splitless injector and a Shimadzu CR-3A integrator. The fractions were also analyzed on a Shimadzu GC-9A gas chromatograph equipped with an on-column injector, flame photometric detector (FPD) and a Shimadzu CR-4A integrator.

iv) Gas Chromatographic Conditions

For ECD Column, capillary fused silica (25 m, 0.2 mm ID, SE-54); Injection port temperature, 260°C; Detector (ECD) temperature, 350°C; Column temperature, 100°C to 240°C at 4°/min.; Carrier gas/flow rate, nitrogen at 2 ml/min.; ECD Auxiliary gas/flow rate, argon/methane (95/5) at 40 ml/min.

For FPD: Column, capillary fused silica (25 m, 0.25 mm ID, CP-SIL-8CB); Injection port, cold on-column; Detector (FPD) temperature, 250°C; Column temperature, 100°C to 260°C at 3°C/min; Carrier gas/flow rate, helium at 2ml/min.

Results and Discussion

Three fractions collected from a florisil column were analyzed by gas chromatography using ECD and FPD. The analysis using an electron capture detector showed that fraction 1 contained some chlorinated pesticides. BHC (benzene hexachloride), lindane and aldrin were detected. The quantities of chlorinated pesticides were very small. External standard quantitation indicated that the levels in the edible portions were below 10 ug/kg. No chlorinated pesticides were detected in fractions 2 and 3.

All three fractions were also analyzed for phosphorus-containing pesticides using a cold on-column injector for reliable quantitation and a flame photometric detector (FPD) in the P-mode. Fractions 1 and 2 showed no peaks corresponding to any phosphorus pesticides. The chromatogram for fraction 3 showed the presence of one large and several small peaks. The large peak and the peak immediately following were identified as sumithion (fenitrothion) and malathion, respectively.

Table 1 summarizes the results on the measurements of chlorinated and phosphorus pesticides. These results indicate that the sample was not seriously contaminated with chlorinated pesticides. On the other hand, phosphorus-containing pesticides were present in relatively high amounts. Malathion is considered to be "slightly toxic" (tolerance = 4 mg/kg) (Sittig 1980) and has a much higher tolerance level than that of sumithion which is regarded to be "moderately toxic" and has a tolerance limit of 100 ug/kg. The presence of such a high level of sumithion raises concern over the health risk in consumption of these insects which have been sprayed with toxic chemicals.

Admittedly, the analyses of samples obtained form the insects captured at random may not give an accurate picture of this problem, but, however, our results show that some of the locusts captured for human consumption could be highly contaminated with toxic pesticides and pose a significant risk to the people who consume them.

Table 1. Residual pesticides found in locusts

No.	Name	Amount (ug/kg)
	A. Chlorinated pesticides	
1	BHC (benzene hexachloride)	3.00
2	Lindane	2.20
3	Aldrin	6.20
	B. Phosphorus pesticides	
1	Sumithion	740.00
2	Malathion	49.20

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تحليل بقايا المبيدات الحشرية في الجراد المصطاد للاستهلاك الآدمي بالكويت

طلعت سعيد و فيصل أبو دقة و مي الصراف

مختبر التحاليل المركزي - معهد الكويت للأبحاث العلمية
ص.ب. ٢٤٨٨٥ - صفاة ١٣١٠٩ - الكويت

تم في شتاء ١٩٨٨ - ١٩٨٩ اغراق الكويت والبلاد الخليجية بكميات من الجراد، واحياءاً لعادة قديمة، قام كثير من الكويتيين باصطياد هذه الحشرة للتغذي عليها، وقد سبب رش هذه الحشرة بالمبيدات الحشرية من قبل السلطات المعنية خطراً على الصحة العامة. وفي محاولة لتقييم الخطر الناجم عن تناول هذا الجراد فقد تم اصطياد وطهي البعض منه بالطريقة المعتادة وتبع ذلك استخلاصها بمذيب ايثير البترول والذي غسل بمذيب الاسيتونيتريل ثم نظف على عامود الفلوروسيل.

هذا وقد تم تحليل الأجزاء المجمعة باستخدام كروماتوجرافيا الغاز المتصل بجهاز الأسر الالكتروني وجهاز القياس الضوئي. وتشير النتائج إلى وجود كميات قليلة من المبيدات المكلورة في مستوى أقل من ١٠ ميكروجرام لكل كيلوجرام، بينما لوحظ وجود المبيدات الحشرية المحتوية على عنصر الفوسفور بتركيزات عالية، فمادة سيماثون كان تركيزها ٧٤٠ ميكروجرام لكل كيلوجرام بينما كان تركيز مادة المالاثيون في حدود ٥٠ ميكروجرام لكل كيلوجرام.

تدل هذه النتائج على أن بعض الجراد - على الأقل - كان ملوثا بدرجة كبيرة بالمبيدات الحشرية وقد يسبب تناوله خطراً على صحة الإنسان.