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ANALYSIS OF LINDANE RESIDUES IN *SARI* AND *NEKA* CULTIVATED RICE OF IRAN

M. Shokrzadeh[1], A.G. Ebadi[2] and M. Moslemi[3]

[1]*Department of Toxicology, Mazandaran University of Medical Sciences, Sari, Iran*
[2]*Department of Biology, Islamic Azad University of Sari Sari, Iran*
[3]*Department of Fishery, Islamic Azad University of Jouybar, Jouybar, Iran*

ABSTRACT

In Iran, organochlorine insecticides such as lindane are used for agriculture purpose, in rice-field to destroy the pests. Due to high stability and long life, lindane can remain in rice crop and creates health problem for human after eating rice. Due to the rate of consumption of this group of pesticides in Mazandaran province, Iran, a sectional inspection was performed at Tarom rice crop of Sari and Neka cities. This pesticide was drew out sampling rice of the different regions of these cities with using organic solvent N-hexane, then examined with gas chromatography. The results showed that nearly all samples have the residues of this lindane at ppb level which is non toxic but continuoue use may cause health problems such as liver disorder or gastrointestinal cancer.

Key-words: Lindane, pesticide, rice, Sari, Neka, Iran

INTRODUCTION

Several hundred compounds are available for use as pesticides and the widespread application of these agents in contemporary agriculture has resulted in considerable environmental contamination and is responsible over 20,000 deaths in a year (WHO, 1990). South countries use these poisons nowadays considerably (Dewailly *et al*., 1999; Harris *et al*., 1997; Hayes, 1994; ICPS, 1990).

Lindane is a moderately toxic compound via oral exposure for animals and human (ICPS, 1990; Karl *et al*., 1993). Effects of high acute exposure to lindane may include central nervous system stimulation (usually developing within 1 hour), mental/motor impairment, excitation, clonic (intermittent) and tonic (continuous) convulsions, increased respiratory rate and/or failure, pulmonary edema, and dermatitis. Other symptoms in humans are more behavioral in nature such as loss of balance, grinding of the teeth, and hyper-irritability. Most acute effects in humans have been due to accidental or intentional ingestion, although inhalation toxicity occurred (especially among children) when it was used in vaporizers (Lino *et al*., 1999; Timothy, 1995; Abbassy *et al*., 1999). Workers may be exposed to the product through skin absorption and through inhalation if handled incorrectly. Lotions (10%) applied for scabies have resulted in severe intoxication in some children and infants. It is reported that single administrations of 120 mg/kg inhibited the ability of white blood cells to attack and kill foreign bacteria in the blood of rats, and 60 mg/kg inhibited antibody formation to human serum albumin. It is not clear whether these effects were temporary, or for how long they may have lasted (Abbassy *et al*., 1999; Caldas *et al*., 1999; Keith,1997).

Lindane is very stable in both fresh and salt water environments, and is resistant to photodegradation. It will disappear from the water by secondary mechanisms such as adsorption on sediment, biological breakdown by microflora and fauna, and adsorption by fish through gills, skin, and food (Lopez-Avila *et al*., 1995; Silgoner *et al*., 1998; Trigg *et al*., 1998).

In Iran a half of pesticides are used in Mazandaran province and according to above have mentioned and analysis of chlorinated hydrocarbon pesticide residues (Lindane) in Tarom rice of Sari and Neka by GC have investigated in this study.

MATERIALS AND METHODS

Sampling time and location

Sampling was carried out in Tarom rice paddies of Sari and Neka, in considered areas and immediately after the produce was harvested. In Sari and Neka districts, five areas were selected and in each area five spots were considered randomly for sampling.

Choosen areas in Neka district

1) The southernmost area of Neka per the upper area of Darya Street.
2) Hezar Jarib region in the north of Neka.
3) The lower region of Zarandin Street in the west of Neka.

4) Noudiak region in the center.
5) Zaghmarz area in the east.

Choosen areas in Sari district

1) Dashte Naz in the North area of Sari.
2) Eastern and Wastern Dodangeh in the south area of Sari.
3) Khazar Abad and Shafra in the East area of Sari.
4) Semeskandeh area in the west area of Sari.
5) The central area of Sari.

The 40 samples were taken, 20 from Neka district and 20 from Sari and one sample as control was taken from the field in which pesticides have not been used. The time of sampling was almost between Aug. 10 to sept. 6, 2003 and immediately of Tarom the reaping. Nearly 500 g of Tarom rough rice was removed from each field, Separately peeled off in factory, labeled and enclosed and then dispatched to laboratory.

Methodology

Sample preparation and poison extraction (in conformity with ICPS. WHO & ILO textbook) was performed under standard methods. Samples were washed 3 times to remove all dust. Attention must be paid to avoid wetting the kernel of seeds. Samples were dried by sunlight perfectly. Dry samples were separately milled and this step was carried out two times for each sample to achieve better extracts. The 50 g of each grinded sample was transferred to Erlenmeyer 250ml. In order to extract poisons, 100 ml N-Hexane was added to Erlenmeyer containing sample, because have aliphatic stretchers and appropriate solubility in organic solvents. The appropriate volume of solvent for extraction is nearly two fold of what has had sample. The Erlenmeyer in steps was placed on shaker for 20 min. (50 shakers per min) to permit the solvent perfectly penetrates that followed by 5 min motionless state. Using of Buckner funnel and filter paper (watman No. 42), samples were filtrated and taken to next step. In this stage, samples were transferred to vacuum distillatory with the optimum temprature (70°), according to boiling point of the solvent (n-Hexane) and decomposition point of the Analyte. Following the solvent evaporating, Acetone was added to residual contents in volumetric flask to desired volume. The moved to special vials for GC. The vials must be closed tightly labeled and covered with aluminum foil. Vials were transferred to center investigation Center laboratory to be analyzed by GC. Before injection of samples. A 10 ml of pure lindane solution in n-hexane by 1 ppm concentration, was added to 50 g of one sample, in order to extraction quality of poisons be determined. Then extraction according to AOAC was carried out and eventually injection to GC and detection by ECD indicated the presence of lindane in samples. Lindine was identified in all samples.

Statistical analysis

Since there is no available previous data to establishing a comparison and to concluding an increase or decrease in residual poison, in this study dealing with two hypotheses have been considered:
1) There is significant difference between Amol and Babol populations.
2) There is significance difference between Amol and Babol population's first hypothesis was by using student's t-test and later by using oneway ANOVA.

RESULTS AND DISCUSSION

Our results showed that all of the rice samples have had residual lindane on a scale of ppb in which this amount of poison has no oral acute toxicity (US Environmental Protection Agency, 1986; Van der Velde *et al*., 1994 ; Kumar *et al*.,1995; Lovley, 1993), But lindane has a long half-life and too much stability in environment, more over it biomagnifying in fatty tissues, hence, long term using of products that contain residual poisons such as rice (Moffat, 1995; Norwell,1984) can cause or lead to health complications such as liver disorders or even gastrointestinal cancer and so on and this can be consider as one reason of high incidence of GI cancers in Mazandaran. On the other hand, these results should be taken into consideration especially by farmers and responsible persons in agriculture offices.

Table 1. The average mean lindane in rice sample of Sari Areas (P<0.05).

Area	**Lindane (ppb)**	**Area**	**Lindane (ppb)**
North 1	2.10	West 3	0.29
North 2	5.11	West 4	0.86
North 3	1.71	East 1	6.35
North 4	1.40	East 2	2.96
South 1	1.25	East 3	2.85
South 2	0.97	East 4	2.40
South 3	1.70	Center 1	2.06
South 4	8.65	Center 2	3.03
West 1	14.45	Center 3	0.70
West 2	0.30	Center 4	1.80

Table 2. The average mean lindane in rice sample of Neka Areas (P<0.05).

Area	**Lindane (ppb)**	**Area**	**Lindane (ppb)**
North 1	3.15	West 3	2.81
North 2	2.10	West 4	5.06
North 3	2.80	East 1	7.30
North 4	4.92	East 2	2.12
South 1	3.58	East 3	7.80
South 2	3.93	East 4	0.25
South 3	3.28	Center 1	3.90
South 4	0.00	Center 2	3.25
West 1	3.96	Center 3	0.62
West 2	3.10	Center 4	9.95

According to Table 3**,** the mean of residual lindane in the rice samples from center and areas of Neka is more than other areas; also according to Table 3 and 4, the mean of residual lindane in the rice samples from west and areas of Sari is more than other areas. These results can be explained as below:
1) Water that use in this areas is from flowing water unlike the other areas that use well water for irrigation.
2) Over flowing water of other areas in the noticed areas.

3) More agricultural expansion and lands under rice cultivation in the noticed areas than others in addition to two reasons above, lead to receiving more poison by flowing water and more contamination. The results show that the mean of residual poison, SD and Sample size for Sari are 3.05, 3.40 and 20 and in Neka are 3.69, 2.46 and 20 respectively. Therefore significant difference between the means of residual Lindane in Neka and Sari districts cannot be established ($P<0.05$) and difference between sample means of various areas of Sari and Neka was not significant.

Table 3. The average Mean and SEM lindane residues geographical area of Sari.

Area	**Mean**	**SEM**
North	3.4225	0.6002
South	2.6950	0.9084
West	3.7325	0.5054
East	4.3675	1.8794
Center	4.4300	1.9789

Table 4. The average Mean and SEM lindane residues geographical area of Neka.

Area	**Mean**	**SEM**
North	2.5800	0.8554
South	3.1425	1.8419
West	3.9750	3.4942
East	3.6400	0.9114
Center	1.8975	0.4789

Suggestions:

1) Measurment of poison residues in food products (agricultural, sea, etc) should be regularly performed according to per capita consumption of poisons.
2) Establishment of reference laboratory, which was equipped with analytical apparatus such as GC. GC-Mass , HPLC, etc in the districts unavoidable.
3) Health care organization such as fishiness agriculture, rice, environmental and the ministry of health investigational centers have to precisely identify environmental pollutions and determine better strategies to achieving wholesome foods.
4) Establishing the poison and environmental pollution information center to guide the people all the time and inform them about the control of toxicity, can be helpful.
5) Educating the province's farmers about the better using of poisons especially chlorinated poisons that their using has been abolished, is necessary.
6) Replacing new methods in combat against vegetable pest such as biological pesticides (e.g. trichograma beens against phyllophagous worm) and bacterial pesticide (e.g. Bacillus).
7) Chlorinated poison residues in husbandry products such as dairy products should be determined.
8) Measuring chlorinated poison residues in sea products, because the contaminated water eventually reach to sea.
9) Measuring chlorinated poison residues in human (Milk, fatty tissue, blood, liver, etc.) should be done.

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