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Determining the Residual Cypermethrin, Permethrin, Indoxacarb and Mancozeb in Tomato Produced in Bushehr Province Farms

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ABSTRACT

Food is necessary for a healthy lifestyle, but it's an important way of spreading many pathogens and toxic chemicals. The food contamination may happen during planting, harvesting, storing, processing or transporting. Hence, the food quality monitoring is necessary. Plants constitute the main source of food for human being. Fighting against pests and plant diseases in some cases, prevents product loss. It is obvious that the pest control is crucial for the future agriculture, industry and hygiene. Despite the current discussions and critics in scientific conventions about the adverse effects of pesticide use on human life, chemical based methods of pest control are still the most common among the farmers. Pesticide residues in agricultural products due to inappropriate and excessive consumption of pesticides is a worldwide problem that has overshadowed the health of human societies (1). Bushehr province, according to its weather conditions, is one of the major tomato growers in the country in autumn and winter. In this study, the residues of 9 toxins (Cypermethrin, Permethrin, Indoxacarb And Mancozeb, Chlorothalonil, Iprodione, Thiophanate methyl, Carbendazim Golsam, and Abamectin) has been investigated in 37 Tomato samples from the farms of Jam, Dashtestan, Dashti, Deir and kangan cities, and Except Abamectin other toxins were detected. Cypermethrin rate was higher than standard in 2.8% of the samples. The residues of Permethrin, Indoxacarb, Mancozeb, Chlorothalonil, Iprodione and Thiophanate methyl was lower than the allowed limits in all the samples. The amount of Carbendazim was determined to be higher than the allowed limits in 4.8% of the samples.

Keywords: Tomato, Pesticide Residues

INTRODUCTION

Food is necessary for a healthy lifestyle, but it's an important way of spreading many pathogens and toxic chemicals. The food contamination may happen during planting, harvesting, storing, processing or transporting. Hence, the food quality monitoring is necessary. Food-borne disease is now considered a serious threat to human health. Plants constitute the main source of human food, and many factors including viruses, bacteria, micro plasma,

fungi, algae, nematodes and insects can cause severe damages to the plants and reduction of the product. The activities in confronting pests and plant diseases in some cases prevent a large percentage of wasting the product. Almost a third of the world's food is destroyed by pests during growing and harvesting seasons and storage facilities. When the damage and loos caused by insects, plant diseases, weeds and rats is estimated to about several billion dollars annually, evidently pest control activities is crucial for the future of agriculture, industry and hygiene. Despite the current discussions and critics in scientific conventions about the adverse effects of pesticide use on human life, chemical based methods of pest control are still the most common among the farmers. Pesticide residues in agricultural products due to inappropriate and excessive consumption of pesticides is a worldwide problem that has overshadowed the health of human societies. Unfortunately, most chemical pesticides have a relatively long curing time in the environment, and consequently enter the human food chain. Laboratory studies on animals and human exposure to pesticides and the residues, has revealed that many pesticides have consequences that affect human health in various ways including nausea, vomiting, inflammation and malfunction in immune system, birth defects, neurological disorders and cancer [1]. Due to the proper weather conditions in autumn and winter, Bushehr province is one of the major tomato growers in the country, providing the annual average of approximately 14,000 hectares of land under cultivation and which yielded the average of 560000 tons from the farms of the province in 2012. Given the issues discussed above, the necessity of investigating the residues of pesticides in the products is obviously felt, and the results of this study could be the basis for planning by the custodians and officials of the province.

Literature Review

Pests are microorganisms with associated economic and health threats to human life. Their origin could be plants or animals. Animal originated pests include insects, snails; rodents and plant originated pests are such as fungi and weeds. There are a variety of methods to confront pests such as environmental sanitation, mechanical control, biological control and chemical control. Chemical control in agriculture is carried on by taking advantage of pesticides [7].

Pesticide is a compound or mixture of chemical compounds that is used to prevent, eliminate, remove, or reduce the population of insects, rodents, mushrooms, weeds or any of aquatic plants, animals and the viruses, bacteria and microorganisms that are known as pests. The pesticides are natural or synthesized compounds that are used to control or destroy pests. Most of the pesticides are selected from toxic compounds and in most cases, especially in recent years, pesticides are chosen in such a way that the dose chosen for the pests [the target] are not toxic to humans, domestic animals and useful arthropods [1].

The use of pesticides in agriculture is called “chemical control”. Chemical control procedure is the last means to control the pests. This method, which has been increasingly common since World War II, and offers quick and decisive results in comparison to other methods of control [1]. Sulfur based pesticides have been used over a hundred years. Green arsenic sprays containing copper and boron mixture are also used for more than a hundred years [8].

If the farmers did not use chemicals, there would be a significant reduction in the amount of food available, and consequently a dramatic increase in the costs. The potato famine in the nineteenth century as a reason of potato blight is an outstanding example of the tragedy pests can cause. Chemicals and pesticides in many cases are complex organic compounds and are increasingly becoming more complex. Many of them are toxic to animals and humans. But usually they are applied when the edible part of plants have not grown, or at least there is enough time for the elimination of toxins from the plant. The amount of chemical residues that remain until the product consumption stage, is very low, which is not more than a few ppm or even less. Toxicologists have been able to determine the Acceptable Daily Intake [ADI] of the chemicals used. ADI represents the amount of material that can be received throughout life without significant risk [8].

There is an ongoing debate on the costs and benefits of pesticides use. The most important risks are on the environment and the health of human, wildlife, plants and organisms, but on the other hand, the advantages are improvement of the quality in life of human, pets and plants. The approaches towards pest and plant disease confrontation has caused preventing a large percentage of waste in the product. Almost one third of the world's food is destroyed by pests during harvest and storage facilities. The damage rate is even higher in developing countries [1].

While the losses from insects, plant diseases, and weeds and is estimated several billion dollars annually, definitely pest control is vital for the future of agriculture, industry and global hygiene. Therefore, using pesticides for securing food, clothing and hygiene of global population is necessary, until an effective way is found. Despite advances in technology, the production and preparation of pesticides is not totally safe, and there are risks of

accidental and intentional Poisoning. The number of people subjected to such poisonings resulted from the consumption of foods containing pesticide residues, is increasing. It is estimated that a large percentage of food, especially fruits and vegetables are contaminated with pesticide residues, and its content is above the allowed limits. Pesticide residues in agricultural products due to inappropriate and excessive consumption of pesticides, is a global problem that has affected the health of human societies. as a result, many international conventions and countries are seeking solutions, and have taken effective measures so far [1].

Today, along with the talks in most scientific conventions about the adverse effects of pesticides on the environment and human health, their, application is criticized. But it should be noted that among the farmers, the use of chemical control is still the most common method of pest control. Moreover, the farmers' and even agricultural experts' lack of access to information and resources about new pesticides registered in the country, indications, time, dosage and instructions, has resulted in the use of few types of pesticides, herbicides, and fungicides on farms against a vast variety of pests, so that the amount of these few types of pesticides is so high that farmers were worrying about the reduction of their impact. On the other hand, there is a concern about growth usage of pesticides, and the consequent environmental issues about the resistance of pests and weeds. As people get to know more about the pesticides and the proper instructions on how use them, we can better control factors causing loss in agriculture and help the stability of the environment [11].

Some studies reveal that the residues of some of these chemicals have been found thousands of kilometers away from the location of use, and some of them have survived in the environment for decades. For example, despite the prohibition of DDT in North America for more than 30 years, the residues can still be found in the soil samples even in urban areas. However, the harms of chemicals on the environment have quite been proved. The evidence on negative effects of these substances on human health is more valid in lab scale, but in real life, it's hard to prove. However, unfortunately sometimes there is news about the increase in some types of diseases that the assumptions and diagnosis by specialists reveal that they could root in chemical compositions [10].

Laboratory studies on animals and human exposure to pesticides and the residues, has revealed that many pesticides have consequences that affect human health in various ways including nausea, vomiting, inflammation and malfunction in immune system, birth defects, neurological disorders and cancer. Although, the food provided in international markets usually contains a high level of residual pesticides, but it has been identified that they are within the maximum limited range. In developing countries, consumers are exposed to high levels of some pesticides in their food sources, because they often lack the necessary executive regulations for pesticides applications. In most developed countries, some restrictions are applied in the use of pesticides. However, Breastfeeding sometimes in both developed and underdeveloped countries has relatively high levels of Organochlorine pesticides and a large number of infants fed with breast milk may be exposed to Higher levels of these pesticides, in short term [10].

Another disadvantage of pesticides aims the wildlife. Also, the indiscriminate use of pesticides, brings suitable conditions to make the dominant strains of pests more resistant to these pesticides. Information on the effects of pesticides in Iran is very limited and is heavily dependent on sporadic reports and tests conducted by Universities or research institutes [10].

Since agriculture is the major source of income for more than 51% of the world's population, any damage caused by pests can lead to a significant reduction in performance and income. As a result, a significant amount of such chemicals are used each year, in order to avoid the loss of products. An evaluation of biohazard of these pesticides reveals that these difficulties have extended over time, and this issue is confirmed by the growing number of researches related to the environmental effects of the pesticides in United States and Europe. Unfortunately, despite the intense and excessive use of these pesticides the developing countries, the statics of studies are low. In some provinces of Iran, these toxins are used intensively and without following the instructions and procedures, disregarding the pre harvest intervals, and ignoring precautions and consequences by farmers. Increasing farmers' knowledge and awareness about the instructions and standards of proper application, is the most important ways to reduce the use of pesticides [3].

In recent years consumption of some specific types of pesticides is banned in Iran. However, being banned does not mean the absence of such pesticides in the market. Even though some of the pesticides that have been removed from the list of authorized pesticides by plant protection organization, they are illegally imported and sold [11].

Although the industry of pesticides production was started in 1309 in Iran, but is lagging behind. According to the law, Plant Protection Organization, in accordance with the relevant regulations is in charge of giving permission to import different combinations for use within the country. Pesticides which are allowed to be used in the country are

called the authorized pesticides. List of authorized pesticides will be published every several years by the plant protection organization [1].

The results of some investigations on distribution centers and stores in Bushehr province reveal that according to the agricultural calendar, some types of unauthorized pesticides and sold in the province. There are also evidences that some combinations of pesticides or pesticide products are used at harvesting course or close to the time, which leaves high levels of pesticide residues in agricultural products, and threatening consumer health. Regarding to the duties of University of Medical Sciences, it seems that the assessment of pesticide residues in agricultural products such as tomato in the province is necessary in [11].

Aghilinejad et al. investigated the relationship between consumption of pesticides and their effects on the health of farmers in different provinces of Iran, and showed that only 25% of farmers claim that they were able to understand and interpret the information contained on the label of pesticides. As a result, providing educational services about the pesticides for farmers in felt necessary [4].

For years, thousands of tons of chemicals have been used in Iran for safe keeping agricultural production against pests, and this situation is still ongoing. In recent decades, billions of dollars of subsidies has been granted to the pesticides section, to get them to the hands of consumers for less expense. If the farmers complain about the weak effects of chemical pesticides, it's recommended that they mix two or more types together and use them at different intervals. Chemical pesticides include more than 240 types of insecticides, acaricides, fungicides, and other biocides. The black markets are still hot, and farmers are seeking more hazardous materials [6].

The diazinon residues in Mazandaran's rice fields were reported about 1.5 ppm in 1992, which was three times the standard limit of pesticide residues in rice. Since then, the maximum residues of this pesticide were not reported, which can be attributed to the fact of not using this chemical in the fields [6].

In May 2003, 20 people at a party in the city of Karaj were hospitalized because of contaminated cucumbers [Heidari, 2003]. This source points out that Malathion and Aldrin residues have been recovered from cucumbers in vegetable and fruit markets. Cucumber samples collected from Chaharmahal and Bakhtiari province contained 3 ppm of diazinon [approximately 30 times the limit], while the standard limit was equivalent to 0.1 parts per million [ppm]. The measured diazinon in the tomato sample of the province was equivalent to 2.5 ppm which was 5 times the authorized limit [0.5 ppm] in the product [6].

In other collected samples of cucumber from Varamin city, Confidor was determined approximately 1.7 ppm for which the authorized limit is about 1 ppm [almost 2 times]. Notably the health center of Amol city was carried out a research on rice samples which showed that unfortunately measured diazinon residues was reported to be about 0.7 ppm [authorized level 0.1] which is 7 times the standard level [6].

In another study on exporting dried fruits from Kerman and Rafsanjan, it was found that in 35% of almond samples had 2.5 times the authorized limit of diazinon, 24% of the samples had up to 1.5 times endosulfan, and 21% of the samples contained up to 15 times the allowed limit of Eaton.

In a study by Maki al-Agha et Al., which was conducted on Damavand Golden Word apples, the diazinon and Chlorpyrifos residues in the area were determined to be about 0.65 to 0.7 and 1.08 to 1.34 ppm, respectively, and in accordance with the results, the concentration of Chlorpyrifos in the apples was higher than the global authorized levels [2].

Hadian et al. investigated the chlorinated pesticide residues in vegetables at nutritional and food industries institute in 2005. In this study, the amount of pesticides [Endosulfan [I], Quintozene, Endosulfan [II], DDT, HCH, Endosulfan, Sulphate, Tecnazene, hexachlorobenzen] in 30 samples of cantaloupe, melon and watermelon were investigated. The results showed that the melon samples contained endosulfan [II] pesticide to an extent of 0.03 – 0.04 mg/kg, the content of Sulphate and endosulfan in the cantaloupe and melon samples was about 0.03 - 0.04 and 0.05 – 0.07 mg/kg, respectively. In addition, none of the samples contained chlorine pesticide residues higher than the maximum permitted residues determined by WHO / FAO [5].

Rezvani Moghadam et al. investigated the diazinon residues in tomato, cucumber and melon. In this research, the tomato samples were collected from Shirvan and Mashhad, melon samples from Shirvan and Torbat-e Jam, and cucumber samples from Dezful, Jiroft, Kerman, Shirvan, Mashhad and Rafsanjan. The results showed that diazinon residues in melon samples from Torbat-e Jam and Shirvan was 4.98 and 4.11 times the allowed limits, respectively. The content of this toxin in cucumber samples of Dezful, Rafsanjan, Jiroft, Kerman, and Shirvan was 6.1, 4.4, 4.2,

2.1, and 1.8 times the authorized limits, respectively. Even though, the content of this toxin was lower than the determined limits in tomato and cucumber samples of Mashhad [12].

The presence of pesticides more than authorized limits in vegetables has been confirmed in Malaysia. In an experiment led by two researchers, which was conducted in 1977, a large number of diamond-back moths which were in vegetable cabinets, died because of exposure to high pesticide residues [Lim and Ong, 1977]. Another study reveals that high levels of high levels of organo-chlorinated factors in peoples blood is due to food contamination in Malaysian people with pesticides. It clearly shows that Malaysian farmers do not conform to the spraying regulations and intervals during the last week of the treatment before harvest, and continue until two to three days before harvesting [6].

A study conducted by a researcher from Agriculture University of Malaysia in Seri Kembangan, revealed that the chemicals found in the blood serum of the Malaysian people were more than of the people in the United States. Dr Kin Ki-Ung Wong [1980] reported that the total amount of cyclic compounds of pesticides measured in the blood of Malaysian people is 14 times more than the amount in the blood of Americas [6].

In another thesis in the same university it was found that the DDT content in the blood samples of Malaysians 3 to 8 times more than the Americans'. It was also found that the DDT content in the blood serum of spraying workmen involved in malaria eradication program was 6 to 10 times more than the other Malaysian people. In addition, this study revealed that organo-chlorinated pesticides residues was similar between the sprayer workers and other people. It seems that this similarity between the ordinary people and the spraying workmen comes from the same sources of organo chlorine toxin residues which is found in their food. In this study, 12 types of toxic organo chlorine insecticides such as Gamexan, Lindane, Aldrin, Dieldrin, Heptachlor, Epoxide and DDT were detected and their residual value was determined [6].

All hazardous pesticides that are used excessively in Thailand, are clearly found in unlimited levels in this country. Although these chemicals have warning labels, but few farmers use these toxins based on the instructions written on the label. They often act on the basis of recommendations of sellers [6].

Studies have shown that 70% of pesticides are imported illegally to Afghanistan.

Crentsil Kofi Bempah et al. investigated organo chlorine residues in 240 samples of vegetables in the markets of Accra area from July, 2010 until February, 2011. This study showed that 71.9 percent of the samples contained pesticide residues, and the pesticide residues in 31.78 per cent of the samples was higher than the maximum allowed amount of these toxins [13].

In another study conducted by Franc cus et al. on residual pesticides in grapes in 2007, it was found that the amount of toxins like Boscalid, Cyprodinil, Dimethomorph, Fenhexamid, Metalaxyl, and Procymidone were in the range of 0.01 – 0.02, 0.04, 0.01 – 0.08, 0.12 – 0.13, 0.09 – 0.11, and 0.07 – 0.13, respectively [14].

Khaled A. osman et al. investigated the presence of residues of 23 pesticides in 160 samples of various products of greenhouse vegetables in Al-Qasim region, Saudi Arabia. Pesticide residues were detected in 89 samples, and in 50 of them, the content of pesticide residues was higher than the authorized levels [15].

A study was conducted by A. A. K. Aboal -Arab In 1999 investigating the residual pesticides in tomatoes in Egypt. According to this study, HCB, Lindane, Heptachlor, Dieldrin, Epoxides and DTT derivatives were detected to the amounts of 0.009, 0.003, 0.006, 0.008, and 0.083 mg/kg, respectively. The study also showed that washing with water or cleaning solutions reduces the remaining contents [16].

In a study by Arnindo Melo et al. the level of pesticide residues in tomato samples collected from the shops of north of Portugal in winter was investigated. According to this study, the Cyprodinil residues in tomatoes was about 0.33 mg/kg. Other residual pesticides Like K-Cyhalothrin, Tolyfluanid, Fenhexamid, and Azoxystrobin were also detected in the samples [17].

M. Arienzo et al. investigated the pesticide residues in 145 samples of 14 different vegetables in Italian markets in 2010, and the residues were detected in 41.4% of the samples, in which 2.1% of samples contained pesticide residues above the standard limits, and this can be attributed to improper time of using pesticides. In just one of the samples, oxadixyl was detected, which is an unauthorized pesticide in the market [18].

In a research conducted by Carlos Ricardo Bojaca et al. which was carried in Columbia, the presence of 17 pesticides in tomato was investigated, and the results showed that the rate of acephate in all the samples was higher than the authorized levels [19].

MATERIALS AND METHODS

In this research, the sampling procedure will be started just after identifying the leading farmers in the cities where tomato is being planted, and following this level, the samples will be transferred to the lab. The tests will be conducted according standards for determining the residual pesticides, and the obtained data will be compared with national standards. Regarding to environmental considerations taken from pesticides retailers, interviews with farmers and information received from the State Agriculture Organization, 4 types of pesticides that are most commonly used in the province, (including Cypermethrin, permethrin, Indoxacarb and Mancozeb) will be investigated.

RESULTS

In this study, 37 Tomato samples from farms in five cities of Jam, Dashtestan, Dashti, Deir and Kangan were collected in different months. Among the 9 toxins examined, the residues of 8 toxins were detected in tomato crops harvested from the farms in the province. Cypermethrin and Chlorothalonil were used in 36 farms. Frequency, mean, standard deviation, minimum and maximum amount of the used pesticides is reported in Table 1.

Pesticide Type	Number of farms using the pesticide	Authorized limit (ppm)	Mean and Standard average deviation	Median	Min	Max
Cypermethrin	36	0.2	0.071 ±0.069	0.06950	0.006	0.230
Permethrin	25	1	0.272 ± 0.19	0.03200	0.004	0.950
Indoxacarb	10	0.5	0.03 ± 0.017	0.03450	0.004	0.052
Mancozeb	5	0.5	0.035 ± 0.019	0.03700	0.010	0.060
Chlorothalonil	36	5	0.15 ± 0.238	0.06550	0.002	1.120
Iprodione	2	5	0.004 ± 0.003	0.00400	0.002	0.006
Thiophanate methyl	6	0.5	0.11 ± 0.183	0.04650	0.004	0.480
Carbendazim Golsam	21	0.5	0.107 ± 0.156	0.05300	0.001	0.570
Abamectin	0	-	-	-	-	-

The Cypermethrin content was above the standard limit in 2.8% of the samples.

The Permethrin, Indoxacarb, Mancozeb, Chlorothalonil, Iprodione and Thiophanate-methyl in all samples were below the limits.

Amount Golsam Carbendazim was detected to be higher than normal limits in in 4.8% of the samples.

The results suggest that the residual Cypermethrin measured in January and early in February is more than the end of February. Also it was found than the average content of Permethrin was higher compared to other months. However, the residual Indoxacarb content in late February was higher in comparison to other months. Chlorothalonil residuals in January were higher than in February, while the residual amount of Carbendazim Golsam in late December. There was no significant change in the Mancozeb, Iprodione, and Thiophanate residues methyl, in different months.

Mean and standard deviation of pesticides at different times is as follows.

Statistics[a]

a. time = 1

Pesticide Type		Cypermethrin	Permethrin	Indoxacarb	Mancozeb	Chlorothalonil	Iprodione	Thiophanate methyl	Carbendazim Golsam	Abamectin
N	Valid	11	12	4	3	11	0	0	11	12
	Missing	1	0	8	9	1	12	12	1	0
Mean		.06573	.09850	.02725	.02367	.12936			.03936	
Std. Deviation		.059753	.164401	.013150	.013503	.330711			.027919	

Statistics[a]

Pesticide Type		Cypermethrin	Permethrin	Indoxacarb	Mancozeb	Chlorothalonil	Iprodione	Thiophanate methyl	Carbendazim Golsam	Abamectin
N	Valid	8	8	4	2	8	0	4	8	8
	Missing	0	0	4	6	0	8	4	0	0
Mean		.08750	.43200	.04400	.05250	.32450		.16100	.22400	
Std. Deviation		.028031	.325941	.008641	.010607	.260428		.213224	.207948	

a. time = 2

Statistics[a]

Pesticide Type		Cypermethrin	Permethrin	Indoxacarb	Mancozeb	Chlorothalonil	Iprodione	Thiophanate methyl	Carbendazim Golsam	Abamectin
N	Valid	11	0	0	0	11	0	0	0	11
	Missing	0	11	11	11	0	11	11	11	0
Mean		.08645				.11355				
Std. Deviation		.035294				.075629				

a**. time = 3**

Statistics[a]

Pesticide Type		Cypermethrin	Permethrin	Indoxacarb	Mancozeb	Chlorothalonil	Iprodione	Thiophanate methyl	Carbendazim Golsam	Abamectin
N	Valid	6	5	2	0	6	2	2	2	6
	Missing	0	1	4	6	0	4	4	4	0
Mean		.02950	.00640	.00550		.02633	.00400	.00850	.00850	
Std. Deviation		.031653	.004336	.002121		.015253	.002828	.006364	.006364	

a. time = 4

CONCLUSION

Given that depending on the pests in different areas as well as the type of pesticides in the market, use of pesticides by farmers follow different routes in choosing toxins, so that the toxins studied in this research are according to the Department of Agriculture, pesticides retails of the regions, and interview with the farmers. As a result, according to investigations, the types of pesticides chosen to study are different with other studies, as it's expected in other studies. As an example, in the case of tomato samples collected from Chaharmahal and Bakhtiari, the study on diazinon residues revealed that the content was equal to 2.5 ppm, which is 5 times the standard limit (0.5 ppm) (6). While, in a study by Arnindo Melo et al. pesticide residues in tomato samples from shops of North of Portugal were investigated in winter. According to this study, Cyprodinil residues in tomato was equal to 0.3 mg/kg. Also other pesticides such as K- Cyhalothrin, Tolyfluanid, Fenhexamid, azoxystrobin were detected in the samples (17). It seems that in most studies, pesticide residues in tomatoes has been reported and in some cases a percentage of the pesticide residues has been detected to be above the allowed limits. For example, Residual pesticides in tomato samples of Egypt were investigated in 1999 by A. A. K Aboal -Arab. According to this study, HCB, Lindane, Heptachlor, Dieldrin, Epoxides and DTT derivatives' contents were 0.009, 0.003, 0.006, 0.008 and 0.083, respectively (16). In another study which was conducted by Carlos Ricardo, Bojaca et al. in Columbia, the presence of 17 pesticides in tomato market was investigated, and it was found that the acephate content in all samples exceed the authorized limits (19). In the present study, the residues of 9 toxins (Cypermethrin, Permethrin, Indoxacarb and Mancozeb, Chlorothalonil, Iprodione, Thiophanate methyl, Carbendazim Golsam and Abamectin) in 37 samples of tomato farms in Jam, Dashtestan, Dashti, Deir and Kangan was investigated, and it was found that, except for Abamectin, other toxins were detected in the samples. Rezvani Moghadam et al. investigated the diazinon residues in tomato, cucumber and melon samples of Mashhad, and it was revealed that the concentration of pesticides in tomato and cucumber samples was lower than the allowed limit (12). In this study, the Cypermethrin content is higher than the allowed limits in 2.8% of the samples. The Permethrin, Indoxacarb, Mancozeb, Chlorothalonil, Iprodione and Thiophanate methyl in all the samples were below the limits. The Golsam Carbendazim has been detected to be above the limits in 4.8% of the samples.

Recommendations

Due to the sensitivity and importance of pesticide residues measurement in agricultural products, it's highly recommended that such studies be conducted on other types of agricultural products in the province, such as dates in particular.

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