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ANALYSIS OF DDT AND REMNANT METABOLITES OF HUMAN BREAST MILK IN THE PROVINCE OF ISPARTA

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Abstract

Analysis of DDT and Remnant Metabolites of Human Breast Milk in the Province of Isparta

Aim: The aim of this study is to find out DDT and its remnant metabolites in breast milk of mothers who gave birth recently in Isparta city center and to investigate the relation between remnant metabolite level and mother diet, place of living, lifestyle, number of breastfed babies and birth weight of the babies.

Material-Method: 160 breastfeeding women living at least 5 years in Isparta or its districts, giving birth for the last 40 days and eager to participate were included in the study group. A total of 20-40 ml. breast milk samples from both breasts were collected for analysis. Face to face method was used in order to inquire the socio-demographic characteristics, dietary habits and pesticide exposure levels of the mothers. All samples were kept frozen at - 20^0 C and analyzed in 24 hours.

Findings: Mean age of mothers was 27.1±5.3. 68.1% (n:109) of the study group were

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living in Isparta since they were born. 25.6% were consuming bottled water for drinking; only 3.8% were consuming bottled water for cooking. The most common consumed vegetables were spinach, tomatoes and bean; the most common consumed fruits were orange, apple and bananas. None of the breast milk samples had DDT or its remnant metabolites.

Conclusion: DDT and its remnant metabolites were not present in the the breast milk of participants. However, considering the facts that DDT and its metabolites can be detected in the poles where they are not even used; repetition of regional-based studies at times is recommended.

Key words: Breast milk; DDT; Pesticides

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INTRODUCTION

While the world population and food need have been growing rapidly, fertile agricultural lands have been declining in the world. Today 800 million people suffer from hunger. All of these create need to do more efficient agriculture in less land. In spite of the increasing food need, types of pests that give harm to farming and reduce the efficiency have also risen and the existing pests have become more resistant. As a result of these, many types of agricultural pesticides classified under Persistent Organic Pollutants (POP) are being used against pests to increase the efficiency in agriculture. And it is a fact that these chemicals will be part of human health and life in the future as much as they were in the past. [1]

Perhaps the most recognizable of Persistent Organic Pollutants (POP) is dichloro diphenyl trichloroethane (DDT) a very effective agent, which is cheap, easily reproducible and when used for surfaces its insecticidal properties are ongoing for months. Because of these features, its explorer Paul Hermann Müller was awarded The Science Nobel Prize in chemistry field in 1948. During the World War II, DDT was used to protect soldiers and civilians against malaria, typhus and other diseases spread by pests, thereafter it was broadly used for agricultural pest control all over the world and in our country.[2]

Following widespread usage and acceptance of DDT, it has been detected that apart from its fight against pests, DDT is persistent in the environment , it destroys wild life without distinguishing any living organisms, it can accumulate on food chain and it has neurologic effects and it has been determined to be carcinogenic on mice. Therefore it has

started to banned rapidly. [3,4] Although there has not been any production of DDT in our country, its usage was restricted in 1978 and then totally prohibited in 1985. [5]

The half-life of DDT is known to be 75-100% in 4-30 years in nature, in deep soil. [6] In addition, organochlorine pesticides such as DDT may not only create problems in areas they are used but also generate much larger scaled global issues. These substances can be carried over long distances in the atmosphere as vapor. Therefore, although nearly thirty years passed after being banned, organochlorine pesticides such as DDT are still detected all over the world including even the poles and non-residential areas where they were never used. [7,8]

Furthermore, organochlorine pesticides can be accumulated in biological tissues because of their lipophilic properties and they can be detected in higher concentrations in the organisms at the top of the food chain. [9,10]

Breast milk, which is located at the top of the food chain, is among the best indicators to determine the remnants of organochlorine pesticides. [11]

In the light of all this information, being the first study on DDT and its remnant metabolites in the region covering Isparta and the surrounding provinces, this study was planned to investigate the residues of DDT and its metabolites (Dimethoxydiphenyl chloroethane (DDE), 2-4 DDT, dichlorodiphenyl dichloroethane (DDD)) in breast milk of women with recently given birth in the center of Isparta, to evaluate whether the residues of DDT and its remnant metabolites exist and if found, to evaluate the relationship with the features such as mother's diet, the region they live and number of breastfeeding children they have, to follow the changes and effects of

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DDT and its remnant metabolites with future studies, to determine the new usage of them if exist, to raise awareness of society that these pesticides can be detected in humans even after years, to attract attention of the necessity of active surveillance studies.

MATERIAL AND METHOD

Planned as cross sectional and analytical study, target population of the research included breastfeeding mothers who gave birth for the last 40 days, living in Isparta city centre and its districts for at least 5 years and staying in the Maternity Hospital of Isparta and Obstetrics and Gynecology Service of SDU (Suleyman Demirel University) Research and Application Hospital.

Among the mothers who conform to the conditions of target group, first 160 people that gave consent have been included in the study. After feeding the babies, a total of 20-40 ml breast milk samples with the condition of at least 10 ml from each breast were moved to the laboratory at 0°C, stored at -20°C and analyzed within 24 hours.

Remnant analyses of DDT and metabolites (DDE, 2-4 DDT, DDD) in human breast milk have been done by using Shimadzu 17A Gas Chromatography (GC) device in the SDU Laboratory of Experimental and Observational Research and Application Center.

During the preparation of samples, 10 grams breast milk was extracted with 30 ml hexane, volatilized and having been solved in 1 ml toluene, the residue was given to the system. In the study, injection block was adjusted at 300°C, detector at 300°C and flow rate at 10 ml per minute. Helium gas was used as the carrier gas.

After informed consent of all participants was taken, the samples have been gathered. Data was gathered by having face to face interviews with study group and by applying a

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questionnaire to identify the socio-demographic characteristics, drinking water usage habits and frequently consumed food groups and pesticide exposure levels.

The fact that some mothers may not take part in the study as they don't have any or enough breast milk right after birth, that they may not want to give breast milk for analysis due to its importance, that mothers may not be chosen among the ones who are involved in agriculture, that the devices might have limits in DDT and metabolite detection can be counted among the constraints of this study.

FINDINGS

The mean age of women included in the study was 27.1±5.3 (minimum (min) 17, maximum(max) 43) and considering the distribution according to age groups, 25-29 age group was the largest group with 36.9%. 88.7% of the study group was housewives and 41.8% of them finished primary school. (Table 1)

Table 1. Socio-demographic Properties of the Study Group

Age Groups	**N**	**Percentage (%)**
15-19	9	5.6
20-24	48	30.0
25-29	59	36.9
30-34	28	17.5
35-39	13	8.1
40-44	3	1.9
Educational Status	**N**	**Percentage (%)**
Illiterate	7	4.4
Elementary school	67	41.8
Secondary school	34	21.3

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High school	32	20.0
Bachelor/master	20	12.5
Occupation	**N**	**Percentage (%)**
Housewife	142	88.7
Officer	11	6.9
Worker	5	3.1
Self-employed	2	1.3
Spouse occupation	**N**	**Percentage (%)**
Unemployed	6	3.7
Officer	28	17.5
Worker	50	31.2
Self-employed	62	38.8
Farmer	14	8.8

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While the number of women in the study group living in Isparta since they were born was 109 (68.1%), the mean years of residence in Isparta for the ones migrated to Isparta afterwards were 8.9±3.7 (min 5, max 19). The largest number of immigrants were from Afyon, Antalya and Burdur respectively.

While 41.9% (n:67) of women were breastfeeding their first child, 31.1% (n:50) of them were breastfeeding their second child and 26.9% (n:43) of them were breastfeeding their third or subsequent child. The mean weight gain of the women during pregnancy was 12.1±4.7 kg (min 1, max 30).

In the study group, the most commonly consumed vegetables were spinach, tomatoes, beans, and the most commonly consumed fruits were apples, oranges and bananas. 71.2% (n:104) of the participants consuming fish mostly consumed sea fish. The most commonly consumed fish was anchovy, carp and salmon fish. 25.6% (n:41) of the study group drink bottled water, 67.5% (n:108) of the study group drink tap water and 6.9% (n:11) of the study group drink water from other sources. 3.8% (n:6) of the group use bottled water in cooking and 88.8% (n:142) of the group use tap water in cooking.

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Table 2. The Pesticide Exposure Status of Study Group

Questions	Always N	Frequently n	Occasionally N	Rarely n	Never N
I consume fruits after washing them well	128	25	5	1	1
I consume vegetables after washing them well.	134	19	3	1	3
I drink bottled water (plastic bottles or carboys)	27	5	26	24	78
I use bottled water (plastic bottles or carboys) to cook.	4	3	13	20	120
I regularly use drugs for plants that I grow in my house.	16	7	8	6	123
I regularly use drugs for plants/trees that I grow in my	21	8	10	6	115
I actively work in preparing agricultural drugs.	5	1	6	6	142
I actively work in agricultural	4	-	3	7	146
I am present in the environment where agricultural drugs are	4	7	5	4	140
I am present while agricultural drugs are applied.	3	2	5	6	144
I avoid contact with chemicals without gloves.	74	17	19	11	39
I wash my hands after contact with chemicals.	136	17	5	2	-

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Residues of DDT and its remnant metabolites were not detected in any of the breast milk samples collected.

DISCUSSION

Isparta is one of the major agricultural cities of our country. According to the statistics of the Turkish Statistical Institute in 2005, approximately 20% of the apple production of 2.57 million tons of Turkey, which ranked third in apple production in the world, takes place in Isparta. [12]

In apple production, there are lots of pests and diseases causing economical loss such as codling moth [Cydia pomonella (L.) (Lepidoptera: Tortricidae)] and apple scab disease (Ventruria ineaqualis (Cke.) Wint)). If people do not fight with these diseases, there can be contamination and infection of these diseases in apple orchards in the region at intense levels. For this reason, chemical methods are highly preferred by apple producers in the fight of pests and diseases. [12,13]

Since official records of pesticide usage in our country were not kept until recent years, it is not possible to give information about when and how much DDT and its remnant metabolites were used in Isparta. Nevertheless, due to the fact that Isparta has many years of ongoing agricultural history and fruit production such as cherry and apple in

which chemicals are commonly used is mostly done in the region, DDT is likely to have been used in the past years.

Reviewing the studies related to the pesticides in our country; between 1997 and 2004, studies investigating presence of DDT in environment, food ingredients, feeds and humans were mainly concentrated in the Central Anatolian Region and only two studies were conducted in the Mediterranean Region. This is the first study regarding the determination of DDT and its remnant metabolites in breast milk in Isparta and its surrounding cities so there is not any information about previous data.

According to the studies conducted in our country in different years in the provinces of Ankara, Adana, Kocaeli, Van and Manisa, the residues of DDT and its metabolites were identified in breast milk (Table-3). [14,15,16,17] In this research conducted in Isparta, no DDT and remnant metabolites of it were detected in breast milk. This can indicate that DDT with a half- life of 4-30 years is not found in the fruits and vegetables produced in Isparta and its

neighborhoods and no such residues exist in drinking water of Isparta Province. In addition, the results of our research are consistent with results of the research of the Ministry of Agriculture and Rural Affairs investigating illegal use of DDT in the agricultural products, soil and the rivers in Izmir and surroundings, in which illegal use was not detected. [5]

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Table 3: The Results of Studies Regarding Residuel Analysises of DDT and Its Remnant Metabolites in Turkey (mg/kg)

Province	Study Year	N	DDE	DDT	DDE/DDT
Sivas	1983	18	-	-	-
Ankara	1984-1985	61	2.71	0.42	6.45
Adana	1984-1985	52	8.55	1.17	7.31
Kocaeli	1984-1985	50	2.56	0.37	6.92
Kayseri	1989	51	2.39	0.41	5.61
Van	1995-1996	41	2.26	0.141	14.74
Manisa	1995-1996	63	1.85	0.072	17.45

On the other hand, in the study that Turgut and his friends did in an agricultural land in Söke, while DDT was not detected on the surface, it was detected in 10% of the samples taken from the deep area. This is not surprising when half-life is considered to be up to 30 years. The detection of DDT metabolites have also been attributed to the usage of Dicofol. [18]

It is a likely result not to detect DDT and metabolites in human breast milk while they are not detected even at 10 % in soil. Even though they may exist in the area land, it may

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be diluted and fall below detection limits until it arrives to fatty tissue. Analysis studies on the cultivated land in the area might clarify the argument. Dicofol metabolites have not been detected in our study in spite of their resemblance to DDT metabolites. This can be explained by the fact that the apple cultivators in our region do not prefer Dicofol. [19]

DDT use was banned at the end of 1970s in Spain. A study on breast milk taken from 72 women in Canary Islands was conducted by the Governor and his friends and DDT was found in the 43.3 % of the samples. The analyses were done with the method of gas chromatography. Unlike our studies, they used H_2SO_4 instead of Hexane for the extraction. In spite of such differences in the method, the differences in our results are likely to stem from the fact that Canary Islands are 100 km far from Morocco where DDT is still used and the pesticides like DDT are carried by air and water ways. And this implies the fact that there is no illegal use of DDT in the study area and its surroundings.[20]

Remnants of metabolites and DDT have been found in all the samples taken from mothers living in some villages in South Africa and in Madeira River in Brazil where DDT is widely sprayed onto the walls of houses against frequent incidences of Malaria. This shows that breast milk is a good sample for the exposure of DDT if there is. On the other hand, studies done in the years of 2000 in the countries like Sweden and Germany where DDT use was banned in 1970s indicated that the detectable DDT remnants in breast milk decreased by 82%. Therefore, not detecting DDT in breast milk in our country where DDT was banned in 1985 is considered to be in parallel with our studies as long as there is no exposure to illegal use or any other usage nearby.[21,22,23]

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According to the questions asked in order to determine the exposure to the pesticides of the mothers, while the ratio of the ones washing fruits and vegetables before they eat should be 100%, it was approximately found as 80%. The rate of mothers washing their hands after contacting with chemicals was 85% and the rate of ones using gloves to avoid contact

was found as low as 46.25%. According to the information obtained, it can be said that our society has to be informed about the danger of such kinds of materials. (Table 2)

CONCLUSION

In this research carried out for the first time in Isparta region, no residues of DDT and its metabolites were found in breast milk of women living at least 5 years in Isparta. The absence of such residues in breast milk, which is at the top of the food chain, indicates that DDT and its remnant metabolites are not found in the food and water chain of humans. However DDT and its remnant metabolites can be transported via wind, atmosphere, underground and surface water stream, and be detected even in the poles where they are not even used, besides its usage is still allowed in some countries. Considering these facts repetition of regional-based studies such as this at times is recommended to find out whether they have reached our region or to determine existence of illegal use of these chemicals.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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