

# Contamination of Dioxins in Foods

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## Abstract

Dioxin and dioxin-like compounds are complex chemical materials occurring as intermediates and by-products during the production process of chlorination in many chemical industries. Dioxins can conserve their stable chemical structure in natural environment due to their hydrophilic physical character and low solubility in water. They accumulate in both food and living body because they have lipophilic physical character that makes them be able to dissolve only in fatty tissue, their catabolism can occur only at higher temperatures. Since the mechanism of disintegration in the living body is so difficult, dioxins lead to many adverse effects on human health and cause diseases such as cancers, chloroacne, wasting syndrome, growing abnormalities, congenital anomaly etc. It is very important to determine the presence and levels of the dioxin complex compounds in both ecosystem and industrial processes according to the statutory legislation for protecting the health of living beings and preventing environmental pollution.

**Keywords:** *Dioxin, dioxin-like compounds, human health, toxicity, Dioxin analyzing techniques*

## Introduction

In parallel with the rapid development of the industry, it is observed that industrial production worldwide has also increased on a global basis. As a result of these developments, the number and diversity of the product portfolio that we use in our daily lives have also increased. Apart from the products used, many unwanted byproducts are produced as a result of the industrial production processes and also as a result of user wastes. [11] If these byproducts are not eliminated by recycling, they return into our living sources; water, soil, air and food sources and also they adversely affect the general health of people.

Dioxins are colorless, odorless, and crystalline solids containing C, H, O, and Cl, which are formed, unintendedly, in consequence of the exposure of organic compounds to high temperatures in the presence of chlorine during industrial operations, and are also water-soluble and volatile chemical compounds. These components were produced exclusively until 1970 and were used in many branches of the industry. Despite being banned, after many years, they can still be found in systems and in many environments.

In this article, general information about the chemical and physical properties of dioxins; their sources, toxicity, how they affect our lives and their negative effects on living life is given, and also their importance for our country, the communicate and regulations and how the components of these chemicals are analyzed in the food will be reviewed.

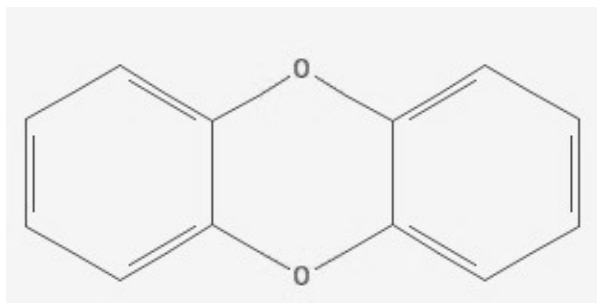
## Chemical and Physical Properties of Dioxins

The term “dioxin” is a common name given to two large chemical groups with similar structures but containing a chlorine molecule in different proportions; there are a variety of different dioxins because chlorine is found in different positions in these complex chemical molecules. The simple structure formula of dioxins is dibenzo-para-dioxins (DD) molecule. Dioxins and similar compounds are formed by the para-carbon atoms of the two benzene rings combining with 2 oxygen atoms in 3 different ways and have a 3-ring structure. [14] These compounds are also present in the environment as dioxins in tetra, penta, hexa and octatypes. There are 75 types of complex chemical groups of dioxin classes: 2 monochloro dibenzo-p-dioxins (MCDDs), 10 dichloro dibenzo-

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p-dioxins (DCDDs), 14 trichloro dibenzo-p-dioxins (TrCDDs), 22 tetrachloro dibenzo-p-dioxins (TCDDs), 14 pentachloro dibenzo-p-dioxins (PeCDDs), 10 hexachloro dibenzo-p-dioxins (HxCDDs), 2 heptachloro dibenzo-p-dioxins (HpCDDs) and 1 octachloro dibenzo-p-dioxins (OCDD). The numbers in the naming of complex structures vary depending on where the chlorine atom is located in the structure of the compound. [15]



**Picture 2.1.1:** Chemical structure of dibenzo-p-dioxin(DD)molecule(URL 1)

There is a strong bond between the number of chlorine in the dioxins and the position of the molecule in the molecule to the stable structure; it is generally known that those containing 4 or more chlorine atoms form a more stable structure than other types of molecule structures, which makes their catabolism very difficult. Another characteristic of the chlorine atoms found in dioxins is that they play a role in determining the toxicity of the structure. When the number of chlorine molecules is high, the toxicity is high because the catabolism in the liver becomes significantly difficult. In other words, chlorine atoms make up the structure of the molecule that has a higher electron affinity.

As a result, these complex molecules bind to Ah receptors in the body and cause the formation of carcinogenic effects to start. When dibenzo-p-dioxin (DD) molecule is examined, the structure can be easily catabolized as a result of the absence of chlorine in the atomic structure, and in the liver turns into mercapturic acid removed from the body by way of excreting the toxic property

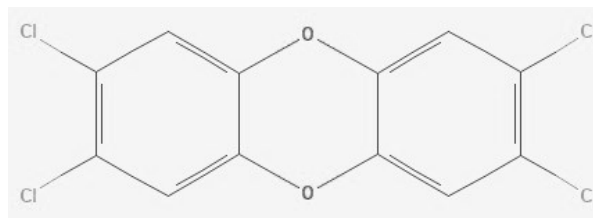
that is less than others. Other dioxins containing chlorine atom cannot be catabolized in the liver and excreted from the body, therefore they become accumulated in the body; this type of pollution is called “persistent organic pollution (POP)”.

The chemical and physical properties of the whole family of dioxin chemical complex compounds were not investigated, and it was determined that dioxins have hydrophobic properties that are not soluble in water and are not dissolved in water. For this reason, the catabolism in the living structures are very difficult; and these compounds, containing lipophilic properties, can be stored in the fat tissues of living organisms and are also called “environmental contaminants” which are stable in nature. [1]

In order to name a compound as dioxin, it must contain the following properties:

1. The molecule must combine with 2 oxygen atoms of carbon atoms of the para position of two benzene rings in 3 different ways to represent 3-ring structural properties,
2. The molecule must combine to Ah receptors,
3. It should be able to accumulate the compound by showing lipophilic properties, and thus by passing through the food chain without collapsing between living things,

Dioxins are considered to be the most toxic chlorinated organic compounds, and the most toxic ones are tetra-, penta- and hexachloro chemical complex compounds in the groups (2,3,7,8-tetra-p-dioxins (TCDD), 2,3,7,8-penta-p-dioxins (PeCDD)... as.). [2]



**Picture 2.1.2:** Chemical structure of 2,3,7,8-tetra-p-dioxin (TCDD) molecule (URL 2)

The physical properties of dioxins are used for describing how they can be found in the environment. Because dioxins and their derivatives have hydrophobic properties, they do not dissolve much in water and therefore have the low vapor pressure. Due to these properties, they are able to dissolve very quickly to the gas phase in the atmosphere more than they can in water.

They are resistant to environmental conditions because of the high temperatures and stable compounds of dioxins, thus they can increase their concentration in the living body and cause toxic effects to be observed over time.

The chemical and physical properties of dioxin complex molecular species are examined in detail and given in Table 2.2.1;

**Table 2.2.1:** Properties of Dioxin Compounds

Chemical & Physical Properties	TrCDD	TCDD	PeCDD	OCDD
Molecular Weight	287.5	322	356.4	459.8
Color	Colorless White	Colorless	Colorless	N/D
Physical State	Solid	Crystal/Solid	Solid	N/D
Melting Point	163 °C	306 °C	206 °C	332 °C
Boiling Point	374 °C	446.5 °C	N/D	510 °C
Density (at 25°)	N/D	1.827 g/mL	N/D	N/D
Solubility Water (at 25°)	4.75x10 <sup>-3</sup> mg/L 20°C	3.2x10 <sup>-8</sup> mg/L 20°C	1.18x10 <sup>-8</sup> mg/L 20°C	7.4x10 <sup>-8</sup> mg/L 20°C
Vapor Pressure (at 25°)	6.46x10 <sup>-8</sup> mm Hg	7.4x10 <sup>-10</sup> mm Hg	6.6x10 <sup>-10</sup> mm Hg	8.25x10 <sup>-13</sup> mm Hg
Henry's Law Constant (at 25°)	37.9x10 <sup>-6</sup> atm.m <sup>3</sup> /mol	101.7x10 <sup>-6</sup> atm.m <sup>3</sup> /mol	2.6x10 <sup>-6</sup> atm.m <sup>3</sup> /mol	6.74x10 <sup>-6</sup> atm.m <sup>3</sup> /mol
Degradation (Atmospheric Lifetime)	0.9 day	2 days	2.4 days	9.6 days
Conversion factors in air at (25°/760 mm Hg)	1 mg/m <sup>3</sup> = 0.0850 ppm 1 ppm = 11.76 mg/m <sup>3</sup>	1 mg/m <sup>3</sup> = 0.0759 ppm 1 ppm = 13.17 mg/m <sup>3</sup>	1 mg/m <sup>3</sup> = 0.0686 ppm 1 ppm = 14.58 mg/m <sup>3</sup>	1 mg/m <sup>3</sup> = 0.0532 ppm 1 ppm = 18.81 mg/m <sup>3</sup>

### **Sources of Dioxins**

The paper production industry is shown as one of the most important sources that cause dioxin pollution in the environment. The paper containing chlorophenol chemicals used in the packaging process for the preservation of raw materials contaminates the environment.

Three types of chemical manufacturing processes—bleaching of wood pulp in paper manufacturing, chlorine, and chlorine-derivative manufacturing, and halogenated organic chemical manufacturing—lead to the production of DLCs; DLCs, primarily the 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD). Due to the formation of high-rate carcinogenic byproducts in result of these processes, restrictions have been introduced in many countries and in the new century many research studies related to this subject has been carried out. The industrial processes especially applied in Scandinavia, the USA, Canada and Sweden are changed to ECF bleaching method, in other words, using chlorine dioxide chemical production and/or TCF bleaching method, that is, chlorinated processes are preferred.

The amount of chlorine atom charge increases depending on the amount of salt increased in the logs carried overseas. It is also known that hydrocarbon structure, such as lignin in wood, has an important effect on dioxin formation and, during overseas transportation, it creates chlorinated dioxin molecules that are more dangerous in a chemical process with chlorine atoms. In addition, it pollutes the environment with liquid wastes and/or atmospheric conditions and affects the food chain. [16]

During the production of various chlorophylls used as fungal, insecticide and bactericide, dioxin is released as a by-product especially in the presence of copper. [22] As a result of many pesticides and industrial-chemical processes, chlorophenols and chlorophenolic herbicides (2,4,5-T) are released as byproducts. The determination of these products was based on the years 1986, and these and similar by-product formation processes have been banned in today's manufacturing processes.

There are TCDD isomers at 2000-5000 ppm levels in commonly used pharmaceutical materials (Medicine, Dentistry, and cosmetic products).

Recently, polymer-based products are used for making our lives easier. The products that may contain dioxin are plastic plates and glasses, PET bottles, foam materials, paper tissues, milk and juice cartons, children's diapers and napkins. [4] These materials i.e. plastic bottles containing liquids, being exposed to high temperatures –kept under the sun, hot liquid contact, over keeping in the package-may result in contamination of dioxin.

Natural disasters such as the eruption of volcanoes and forest fires are also result in dioxin release to the atmosphere. In addition, as a result of the combustion reactions of hospital (medical waste), home, sewage, and city residues, many dioxins are exposed to the air and, as stated previously, they can be dispersed to distant areas by atmospheric formations such as air currents, winds, rain, etc. from the environment where their destructions/ degradation are not very easy [22]. The largest source of dioxin contamination in the atmosphere is the OCDD and its components (Germany 47% and Netherlands 82%).

Ignition processes are one of the primary sources of industrial dioxins. [3] As a result of many burning reactions, organic and inorganic chlorinated dioxin chemical sources are obtained as byproducts. Organic materials that are not fully burnt provide a ready environment for the presence of carbon in ash and the formation of dioxin-form chemical compounds. More organic matter and less burnt matter contribute to the formation of a high-form dioxin chemical complex. The tempering of industrial products especially metals at high temperatures (higher than 350 °C), production and casting processes as well as recycling processes for scrap metals may also produce dioxine as a result of chemical processes caused by high temperatures [12]. However, at temperatures above 800 °C, dioxins can easily be degraded.

Other potential products of dioxin can be listed as engine and mineral oils, fluids and hydraulic fluids, paint and wood preservatives etc. In addition, dioxin is widely used in the cosmetic and drug industry as well as detergents, cleaners, shampoos, shower gels and liquid soaps due to its foaming/effervescence properties. The packaging of dioxin-containing products is especially suitable for peg, oksinol, nonoxynol, polysorbate60, polysorbate80, polyethylene glycol, polyethylene, polyoxyethylene. Furthermore, the carcinogenic chloroform chemical and dioxin complex component is formed by the reaction of the chlorine ions in water due to the use of the triclosan chemical in the packaging in antibacterial soaps, deodorants, toothpaste and shower gels.

## Dioxins Toxicity and Toxicokinetics

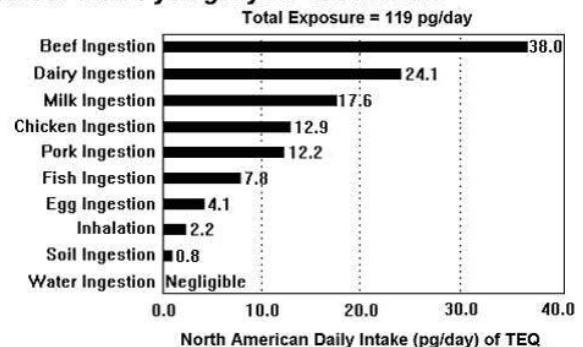
### Dioxins Toxicity

All dioxins are not equally toxic. Only 7 out of 75 dioxins have a high level of toxicity. The most important factor for these chemicals to cause a toxic effect in human body is the compatibility of the molecule with the “AhR receptor”. The chemical attached to the receptor is more toxic than the loose bound. [14] In determining the toxicity rates of the dioxins, the basis of the species known to be the most toxic and its derivatives, and toxicity equivalence factor (TEF) are considered. For this reason, the TEF value of the most toxic derivative which is TCDD is 1; whereas the least toxic PCDD type of dioxin is 0,1. In addition, toxicity values are indicated by TEQ i.e. Total Dioxin Equivalence Factor. According to the World Health Organization (WHO), the TCDD dose values, which can be administered daily as a result of research, has been reported to be 1.4 pg/kg TEQ for humans.

When samples taken from the atmosphere after various burning processes were examined, maximum values of 926 g (1990) and 3870 g (1989) were observed in west Germany and England, respectively. These chemicals are then stored in the air and/or soil by emission and then accumulate in the bodies of living organisms, including the food chain, exposing them to toxic effects. [1] An example to explain the effects and

damages of dioxins is the possibility of health problems caused by the cows grazing near burning ovens in Germany. When an accumulation of fatty tissues was examined, it was determined that dioxin is not excreted from the bodies of cows and instead stored in the milk, due to the lipophilic properties of the molecule, during the metabolism activities of the animal while grazing.

### This is where you get your dioxin from:



**Picture 2.1.5:** Daily dioxin consumption TEQ amounts in North America [18] (Picture 2.1.5).

This graph shows the amounts in picograms of nutrients and TEQ that enter the human body by dioxin complex molecule on a daily basis.

Fish products is thought to be contaminated with dioxins through waste water. It was determined that dioxins exist in rain, erosion and industrial wastes were combined with suspended substances in the water, and in the sediment of water in the bottom of the water resources such as lakes, oceans, and rivers. Fish living in these kind of environments may be contaminated with dioxins. In this way, dioxins enter the food chain. As a result of a research conducted on 25 fish farms using commercial feed, it is stated that fish contains more dioxins than salmon that live in other natural environments.

Dioxins, on the other hand, were found to be not present when fish were washed with water since it accumulates in the leaf-wrapping wax layer.

It has been determined that there may be contamination in plastic packaging and that it may pass to people through milk products. According

to the studies, 8 PVC food packaging materials were examined for the presence of dioxin and it was determined that the PVC had dioxin 2.6-6.9 ng TEQ values per kilogram. The researchers reported that the maximum amount of dioxins in food is estimated to be 0.07 ng TEQ, due to the risk of carrying. [13]

### **The Effects of Dioxins on Human Health**

Dioxin hazards can also be carried from one living organism to another through contamination. The transfer of dioxin to feed, animal and animal food products by air and/or soil in the environment through the human consumption continues.

One of the most dangerous properties of dioxin compounds is that their destruction is difficult, in other words, they are resistant to biological, photolytic and chemical degradation. In this way, they can reach the highest points of the food chain at high concentration without any loss of quantity, and can also be carried away from the environment by means of atmospheric transport mechanisms.

Synthesis and/or production of dioxin complex molecules in any industrial or laboratory environment is prohibited except for the diffusion of the environment through transport. Dioxins can only be analyzed in a laboratory environment, although it is not legal. Dioxins in nature are formed as a result of the exposure of chemical substances to high temperatures during chemical processes. Most of the compounds formed by air are found at high levels in the soil, especially by accumulation/storage method in fat tissues. These complex molecules, which are then transferred to plant sources through the intake of nutrients from the soil, can rise to the upper levels in the food chain through the consumption of contaminated plants by animals. Due to the lipophilic properties, the molecules that accumulate in the fat tissues of animals, which are stable structures, are exposed to dioxins by taking both animal and plant-based foods without being destroyed. It has been determined that there is more accumulation of dioxins than those with high-fat content. Biological half processes were for about a few years for TCDD, recently it is 7-8 years and for PCDF 13 years. [18] Dioxins

are metabolized primarily in the liver, converted to water-soluble complex compounds, and excreted by 30% out of the body through urine.

It can be transferred to humans through packaging, drinking water as well as respiratory and skin contact. This is because of the fact that 90% of dioxin poisoning in humans being due to food chain. [11]

Abnormalities seen in humans due to dioxins are observed if the amount of toxins accumulated in the body is higher than the specified dose (14ng/kg). If the concentration of dioxin in the body is less than this value, it is converted to water-soluble complex compounds in the liver and excreted through urine; however if it is high and passes through the bloodstream by any means, they may cause DNA mutations. These cancer cells do not show up in the standard tests until they have multiplied to a few billion. Dioxins have been shown to cause major digestive, liver and breast cancers, and have caused abnormalities such as defective kidney formation. In addition, cardiovascular toxicity due to dioxins, nausea, difficulty in breathing, high blood pressure, asthma and acne-style lesions may occur in the skin. [1,9]

Women who are exposed to dioxins pass this chemical to their babies through breastfeeding. Thus, babies are under the possible risk of dioxin exposure [19]. During the lactation process, babies take the dioxins accumulated in the fatty tissues of mother's milk into their bodies [20] and according to a study conducted in Japan, it causes mental retardation and cognitive retardation in 8-year-old children in the sense declining their mental ability [21].

The most prominent example of dioxin poisoning is the case of Victor Yushchenko, the strongest candidate in the elections of 2004 in Ukraine. In a few weeks, the lesions developed in the form of acne on the face and his skin became grayish. Yushchenko's body contained 50.000 times more dioxins than the level that human body can tolerate. (Picture 2.1.6)



**Picture 2.1.6:** Vicky Yushchenko, a candidate in Ukraine's presidential election, was poisoned by dioxin (www.basinbulteni.com, 14 November, 2016)

TCDD type dioxin was found in his body, which was also used in many civilians during the Vietnam War. In addition, after the industrial accident in 1976 (Seveso/Italy) during the examination in the region chlorine-linked acne was found to occur on many people and children's faces. 2,3,7,8-TCDD dioxin derivatives spread to the area of 15 square meters affect about 37,000 people and cause poisoning cases; 3300 animals were found dead and 447 people have skin lesions caused by serious diseases. [10]

The mean daily TEQ intake was determined as 6.3 pg/kg body weight in males and 6.1 pg/kg body weight in females between the ages of 1 and 11. This study shows that the TEQ intake decreases as the age progresses. It was determined that 3.5 and 2.7 TEQ pg/kg body weight levels were found to be in the range of 12-19 ages of men and women; while 2.4 and 2.2 pg/kg body weight concentrations were found among men and women at 20-79 ages, respectively. Men who were 80 years old and above found to contain 1.8 pg/kg body weight, in women 2 pg TEQ intake/kg body weight was determined. These results show that more TEQ intake is possible in new born infants and children at growing ages with low body weight [26]. Toxic equivalence of dioxins are given in (Picture 2.1.7.).

2,3,7,8-TCDD	1	2,3,7,8-TCDF	0,1
1,2,3,7,8-PeCDD	1	2,3,4,7,8-PeCDF	0,3
		1,2,3,7,8-PeCDF	0,03
1,2,3,4,7,8-HxCDD	0,1		
1,2,3,6,7,8-HxCDD	0,1	1,2,3,4,7,8-HxCDF	0,1
1,2,3,7,8,9-HxCDD	0,1	1,2,3,7,8,9-HxCDF	0,1
		1,2,3,6,7,8-HxCDF	0,1
1,2,3,4,6,7,8-HpCDD	0,01	2,3,4,6,7,8-HxCDF	0,1
OCDD	0,0003	1,2,3,4,6,7,8-HpCDF	0,01
		1,2,3,4,7,8,9-HpCDF	0,01
		OCDF	0,0003

(T = tetra, P = penta, Hx = hexa, Hp = hepta, O = octa)

**Picture 2.1.7:** Toxic Equivalence of Dioxins (World Health Organization)

#### Analysis Methods of Dioxins

Chromatographic techniques are generally used as the analysis methods of dioxins.

Mainly two methods are commonly used in dioxin analysis;

- HR-GCMS; to determine the source,
- Biotests; contamination frequency, location determination, and size

However, since it has complex structured molecules, specific sample preparation procedures are applied only after a series of different sieving process. The analytical stages are given below.

**1. Dioxin extraction processes;**

The weighing of the sample (the weighing of the sample depends on the fat oil ratio of the analysis sample.)



Adding cyclohexane, propanol (to enable the oil and dioxins in the oil phase to be transferred to cyclohexane phase with solvents)



Evaporation in order to obtain oil



**Picture 2.1.8:** Econo Prep Equipment

Separation of the obtained oil into dioxin and PCB fractions with FMS device

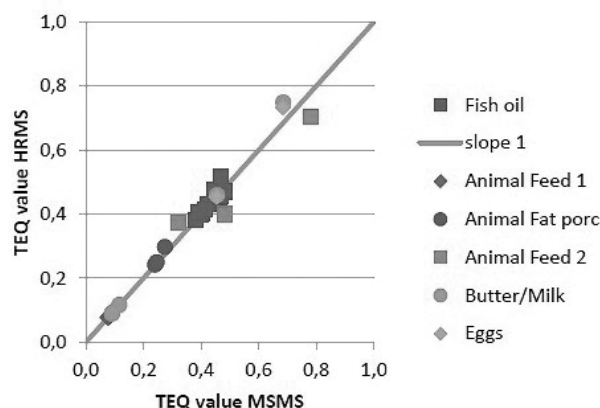


Obtaining data and evaluation process



**Picture 2.1.9:** APGC/LC-MS-MS Equipment (Waters)

The classical method used in dioxin analysis is GC (Gas Chromatography) System and GC-MS (Gas Chromatography combined with Mass Chromatography) System for scanning purposes. GC-MS-MS gas spectroscopy-tandem mass spectroscopy is an approved method of analysis according to EU regulations No. 589/2014 and No. 709/2014, June 2014. The accuracy of the sensitivity measurements and the accuracy of the results of the analyses performed in mass spectroscopy depends on the number of ions measured. For the samples with relatively low detection limits needed for dioxin analysis, analysts have caused the need for the technologies that do the detection at the trace level. Therefore, GC-MS-MS devices developed to achieve higher quality results with developing technology, have been produced with high-efficiency electronic ionization sources which produce more ions. Figures 2.1.8, 2.1.9)



**Picture 2.1.10:** TEQ values for GC-HRMS and GC-MS results (ng/kg) [25]

Available methods for the determination of dioxin and dioxin-like substances are specified in the relevant American and European regulations [23, 24]. The methods used in the analysis are carried out using the EPA 1668B and EPA 1613 methods determined by the United States Environmental Protection Agency (EPA).

Two analysis methods are used within the scope of dioxin analysis



- Dioxin analysis in fixed-source emissions (TS EN 1948/2-3)
- Dioxin analysis in food samples (EPA 1668B/EPA 1613)

In dioxin analysis of fixed-source emissions, it is possible to scan and detect toxic dioxins in the area where they exist. This analysis provides work safety in enterprises. Air, water and soil cleaning of areas from production units is determined through these analyses. Various chemical, physical and microbiological tests are applied to samples taken from these areas and their suitability is determined.

As with all analytical methods, the sample preparation phase is extremely important in dioxin analysis. It is known that consumption material costs and solvent consumption rates in the automatic systems used to prepare dioxin samples are higher than the manual (classical) methods. For this reason, many large and/or small laboratories are using dioxin analysis methods and they complete the sample preparation phase by using classical methods. However, as a result of some analytical studies carried out with the help of the latest technology, classical sample preparation methods are changed towards less expensive automated methods. Also, since this automatic sample preparation method is applied to all matrices, users can easily apply it to their different samples.

### **Legal Regulation of Dioxins on Food**

Dioxins are very stable complex compounds including hydrogen, carbon, oxygen and chlorine atoms in their structures. As a result of the research study carried out, it was determined that they were harmful and triggered by the carcinogenic effect mechanism. These effects, especially as a result of plastics to high temperatures are revealed and many restaurant companies have abandoned the use of plastic and paper products. However, there are some legal gaps in Turkey concerning these matters.

While there are legal sanctions in developed countries on this issue, there is not enough dedication and resources for the implementation of deterrent official procedures in Turkey. In European

countries, there have been restrictions on the use of plastic materials in contact with food, adhered to certain rules. However, there is limited control in Turkey. In our country, these issues need to be dealt with more care and the necessary legal regulations and control systems should be established.

Analysis of dioxin complex chemicals is carried out by the official laboratories of the Ministry of Food, Agriculture and Livestock in Turkey on the foods to be imported and exported.

The levels of dioxins obtained as a result of analyses are evaluated according to the values defined in the regulations on foods i.e regulation on the contaminants of the foods of Turkish Food Codex and the regulation on undesirable substances in Feeds. During exportation of foods, when the product parties belonging to the samples analysed for dioxins and found to be contaminated at exceeding levels are rejected in importation and export and recalled as the result of official controls. When the high levels of dioxins are determined in the parties, the parties are collected and destroyed [6].

EFSA and WHO, the leading work institutions in Europe, continue their research on dioxins and its derivatives worldwide by increasing their research on dioxins and their effects on human health, such as chemical structure, toxicity and the effects on human health. The European Union organizes meetings where certain groups are involved in this issue and conduct studies to determine the maximum daily dioxin level that a person can be exposed to and non-toxic on a mass basis, including the age/gender discrimination arising from the research.

Dioxin and its derivatives are included in the carcinogenic substances group by (EPA) and the (WHO). The American (EPA) states that as a result of experimental studies conducted in guinea pigs, the higher levels of dioxin molecule that can cause harm to humans, the higher the risk of cancer in the body. This value was determined as the lowest dioxin load of 14 ng/kg.

The European Parliament has increased the pressure to create legal legislation to limit the use of this toxic substance, and urged some institutions to take action and emphasized that it should be implemented by using different methods as a result of the technological developments and elaborately examining, developing, and even taking the necessary measures for further analysis of the methods of analysis.

In addition, the world market, especially in Poland and the Czech Republic some exported products through the transmission of meat and animal products a result of analysis dioxin chemical substances containing processed meat and animal products were collected from the market and destroyed.

As a result of such developments, Japan, which is one of the countries concerned about the quality of the products imported to their countries and the health attributes, has reported that it has increased the control of food imports from Germany. Some products imported from Germany as a result of previous research and analysis are pork and pork processed products as a result of the discovery of dioxin chemicals, and thus dioxin was ordered to be analyzed in the imported products.

In the guar gum, which is also known as guarana, the members of the European Union have determined that there is dioxin at the highest values due to the analysis of the guar bean legume, which is also known as guarana, obtained from India. For this reason, following the inspection of suppliers, they increased the frequency of analysis of imports and included some criminal procedures in order to take more deterrent measures for firms. Guaran, guaran beans; dairy products (especially yogurt), and mayonnaise are used quite often, and as a result accumulation of toxic effects have been determined in the body human.

While the other countries in the world, especially European countries are taking more positive steps and critical measures on this issue, Turkey's attitude about this issue is relatively slow and not constructive with respect to taking precautions.

Thus, concerning the dioxins, necessary controls and precautions must be regulated and performed in terms of food safety.

## **CONCLUSION**

Today, toxic chemicals continue to threaten our health and environment all over the world. In other words, it is almost impossible to be not exposed to chemicals in our daily life. It is known that continuous industrial processes and their products pollute our environment and our lives. The chemical complex components of dioxin, which has been in our lives for almost thirty years, is among the most harmful chemicals.

Dioxins are not found naturally in the environment; they are formed as a result of various industrial processes. Their harmful effects on the environment and human are well-known. Dioxins are released as main and/or by-product in result of a process in which they are involved combustion reaction in the presence of chlorine during the production of a substance containing chlorine and bromine. The process of burning and burning in industrial processes, processing and forming of metal and similar products, disposal of solid wastes, bleaching and cooking of paper pulp are the results of the conversion of chlorinated compounds into dioxin complex components.

When the dioxins are formed, atmospheric weather conditions and/or water can be released to areas far away from the environment and thus can be accumulated in soil and plants in solid or gas phase. Dioxins being hydrophilic, the substances they have a dense accumulation in animal tissues and soil. As a result of this accumulation, they easily enter in the food production chain through consumption of contaminated products. This is why the entry of dioxin into the human body is taken by means of animal foods such as meat, chicken and fish, and animal products such as milk and eggs.

In order to provide a healthier society and a clean environment for future generations, everyone needs to be more sensitive about it. The most important task falls to the food authority and

senior officials of the countries. In particular, waste that causes pollution through pre-treatment process and disposals. According to the types of industrial processes, such as burning and control of burning processes and control of foods for dioxin contamination levels. In addition, preparation of regulations, official control of dioxins in foods; developing and using reliable methods of analyses are the main activities in order to prevent and control of dioxins in terms of the food safety.

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## INTERNET SOURCES

**URL 1**><https://pubchem.ncbi.nlm.nih.gov/compound/68512548#section=2D-Structure>

**URL 2**><https://pubchem.ncbi.nlm.nih.gov/compound/15625#section=2D-Structure>