

# Organochlorine Residues Determination in the Air of Zeway Town, Ethiopia

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## Abstract

Organochlorine pesticides are chlorinated hydrocarbons which have vast application in the chemical industry and agriculture. They are known for their high toxicity, slow degradation and bioaccumulation. These chemicals, although banned in most countries, their use has been rising from time to time. Organochlorine pesticides are among the various air contaminants that risk the life of humans, animals and other walks of life. These chemical compounds in the air enter into human and animal bodies with the water and air they use. Organochlorine pesticide in the air is the result of pesticide application on food crops, flowers and evaporation from soil contaminated with pesticides. Organochlorine pesticides from the air fall down on soil and water by wet and dry deposition. These pesticides are persistent in soil and important microorganisms in soil are disrupted from carrying out their normal functions in the soil environment. Pesticide contaminated air is one of the dangerous environmental problems causing many adverse effects on public health and microorganisms in soil and water. Organochlorine pesticides usually impact nervous, reproductive and neurological systems. The purpose of this study was to determine the magnitudes of organochlorine pesticides in the air of zeway town.

**Keywords:** Persistent; Deposition; Bioaccumulation; Precipitation; Hazard; Pollution

**Abbreviation:** DDT: Dichlorodiphenyl Dichloroethane; DDD: Dichlorodiphenyl Dichloroethyne; DDE: Dichlorodiphenyl Dichloroethane; BHC: Benzene Hexachloride; ND: None Detectable

## Introduction

Organochlorine pesticides are a group of chemicals used for destruction of insects, weeds, fungi and pathogens. Most have the ability to destroy a wide variety of pests. Organochlorine pesticides constitute a significant source of contamination of environmental factors such as air, water and soil [1]. Air contamination with pesticides is one of the most dangerous environmental problems that affect people's health in a variety of ways [2]. Long term exposure to high levels of organochlorine pesticides in the air result in cardiovascular, respiratory, reproductive and neurological health defects and lead to the death of many people particularly children [3,4]. Organochlorine pesticides in the air may come from industries and agriculture during pesticide application for pest control. Pesticides from the air enter soil and water by precipitation and adversely affect the quality of water and soil which are the most important resources for community development. Such harmful pesticides from contaminated air enter the bodies of humans and animals through dermal contact, inhalation and ingestion with food and water resulting in an ill health effect [5,6]. Air contaminated with pesticides is a widespread health problem in all countries mostly due to lack of training on effects of pesticides. Thus, pesticides

cause adverse impacts in all life forms and soil microorganisms that are vital for soil fertility and agricultural crop yields [7,8]. Air contaminated with organochlorine pesticides also cause gastrointestinal and neurological effects in humans with enhanced susceptibility in children, older adults and people with heart and lung diseases [9,10]. In the Ethiopian situation use of pesticides has started since the 1940's to enhance agricultural production by controlling pest outbreaks. The fast-growing trend in the use of pesticides for pest control in floriculture and irrigated farmlands around Zeway town is potential source of ambient air contamination with organochlorine pesticides [11].

## Materials and Method

### Site description

This study is conducted in the town of Ziway, which is located 160 kilometers south of Addis Ababa, bordered by Oromia and the Southern Nations, Nationalities and Peoples regional states. Lake Ziway, the fourth largest Lake in Ethiopia is found in this town. This lake is the only single source of water supply for small- and large-scale irrigation farms in and around the town enabling urban and peripheral residents to produce different crop types

and vegetables. Vegetables produced by this irrigation water is distributed to many market centers in the country and many people in the city earn their life by selling vegetables besides to food crop production. Many urban dwellers solely depend on the lake water for drinking water supply and their exposure to organochlorine pesticide impacts from the contaminated water and air is expected to be high and threatening. Zeway town is surrounded by a large number of floriculture industries and irrigated farm lands using different types of pesticides without good pesticides use practices. Pesticides are sprayed on flowers and vegetables exposing the air to pesticides contamination. Residents in the city use pesticides to control ticks, fleas, cockroaches and grain borers at house levels without protective tools. Pesticides enter into air via spray drift and evaporation from pesticide contaminated soil. The determination of organochlorine (OC) pesticides in the air of Zeway town is important to judge the extent to which the city community is vulnerable to the impacts of organochlorine pesticides as well as to instigate policy makers and/ or government bodies to put in place proper pesticide practice mechanisms.

**Method**

**Table 1:** Laboratory analysis results of organochlorine pesticides in air (ppb).

Pesticide Residues in Zeway Town Air Sample in ppb			
Sample Matrices	Heptachlor	BHC	DDT
Capacity building	178.1	70.2	24.35
Research center	ND	ND	ND
Pesticide Residues in Zeway Town Air Sample in mg/m <sup>3</sup>			
Sample Matrices	Heptachlor	BHC	DDT
Capacity building	151.1	4.64	19.61
Research center	ND	ND	ND

Air sample was collected using Monet passive air samplers from two open field locations selected in the study area. The sampling chamber was first washed, solvent rinsed, reserved in two layers of aluminum foil, kept in polyethylene bag and held in a freezer prior to deployment. The passive air sampler was installed at a height of 2 meters above ground for 60 days and the locations selected were made free of obstacles that would hinder the free flow of air around the sampler. The samplers were designed to collect 8m<sup>3</sup> of air per day. Exposed disks housed in the sampler were warped in two layers of aluminum foil, labeled, placed in polyethylene bag and transported in a cooler to the laboratory for analysis. The value of pesticide residues in the samples was obtained from the volume of air passing the sampler within 60 days, which is 180m<sup>3</sup> of air. Target pesticides were then analyzed in the lab in ppb which is later converted to micrograms per meter cube (µg /m<sup>3</sup>) by a formula

used by Kansas state university in 2006 and the concentration of each pesticide residues in the air determined as shown in Table 1 below.

**Result**

Air samples collected using Monet passive air sampler from two sampling sites was analyzed in the laboratory to determine the presence of organochlorine pesticides in the air of Zeway town. Accordingly, the laboratory test indicated air samples to contain heptachlor (151.1µg /m<sup>3</sup>), DDT (19.61µg /m<sup>3</sup>), BHC (4.64µg /m<sup>3</sup>) while metabolites of DDT (DDD, DDE) and BHC showed no result due to may be their presence in the air being below the detection limit. Heptachlor, another man-made organochlorine chemical occurs in the air with a higher concentration compared to DDT and BHC. All these chemical agents present in the air eventually end up in soil and water by precipitation and dry deposition, enter and bio accumulate in the bodies of humans and animals through inhalation and the food and water they use resulting in acute and chronic health effects.

**Discussion**

Analysis of the air sample indicated the presence of three organochlorine chemicals; namely heptachlor, DDT and benzene hexachloride (Table 1) while the remaining ones showed no result. The life time of these chemical agents in the air is short and soon settled down into soil and water by wet or dry deposition. In soil and water they undergo bacterial degradation and DDT and its metabolites become bio-accumulated in the fatty tissues of living organisms. Heptachlor another persistent insecticide is found in the air sample at a conc. of 151.1µg/m<sup>3</sup> and DDT and BHC with concentrations of 19.61µg/m<sup>3</sup> and 4.64µg /m<sup>3</sup> respectively. Acute inhalation exposure to heptachlor result in nervous system and gastrointestinal effects. Studies also show chronic inhalation and oral exposure to heptachlor cause liver and nervous system defects in animals and neurological effects in humans. Human studies are inconclusive regarding heptachlor and cancer, but animal oral studies have reported liver tumors. Heptachlor with a concentration of 151.1µg /m<sup>3</sup> in the air is likely a potential threat to the health of community in the town. Benzene hexachloride, a broad-spectrum insecticide is also present in the air. These chemical agents usually end up in soil and water and enter animal and human bodies through various ways causing reproduction and endocrine disruptions. DDT in the air, being persistent and hazardous pollutant is also a potential risk to birds, mammals, microorganisms and humans living under the blanket of air around Zeway town.

**Conclusion**

The laboratory analysis for pesticide residues indicated the presence of DDT (19.61µg/m<sup>3</sup>), Heptachlor (15.11µg/m<sup>3</sup>) and BHC (4.64µg/m<sup>3</sup>). All these chemical agents are abandoned from use due to their persistent adverse effects on human health and

the environment except DDT which is only applied for malaria eradication in Ethiopia. However, such pesticides are widely used in Ethiopia for controlling pests that damage food crops, vegetables and various insects at house level. These pesticide residues in the air are contributed from pesticide spray on agriculture and evaporation from storages and soil contaminated with pesticides. Long term storage, illegal importation and poor application practice of pesticides may be the main sources of organochlorine pesticides in the ambient air of Zeway town.

### Recommendation

Organochlorine pesticides are characterized by their persistence, bio accumulation in fatty tissues and toxicity. They cause endocrine, reproductive and carcinogenic effects in exposed individuals and their offsprings. Hence, measures to be undertaken should include:

- a) The quality of pesticides must be proved prior to their distribution and application.
- b) Control illegal importation of pesticides into the country
- c) Raise the awareness level of the public on effects of pesticides.
- d) Conduct further research on effects of such pesticides on health and soil microorganisms in the area.

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