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The effects of unknown dangers compost having on heavy metal levels in soil and vegetables in Al-Jiftlik.

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The effects of unknown dangers compost having on heavy metal levels in soil and vegetables in Al-Jiftlik.

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1440 – 2019

Dedication:

"To Our Profit Mohammad (Peace be upon him)"

To my family

To my friends

To you

Name: Mohammed Sameer Musad Bawwab

Declaration

I certify that this thesis submitted for the degree of Master, is the result of my own research, except where otherwise acknowledged, and that this study (or any part of the same) has not been submitted for a higher degree to any other university or institute.

Signed **……………**

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Date**: 5/5/2019**

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Abstract

Researchers and countries around the world attach great importance to the research of compost being used for agriculture, agriculture's soil, and vegetables themselves in this area because of the great danger to human health and life. Pollution with heavy metals is considered to be an environmental issue because these metals are toxic even at low concentrations. This study is conducted to determine heavy metals concentration in leafy vegetables samples (sage and mint) in situ UDC experiment in home garden at Ramallah city and vegetables samples (Corn, Eggplant, Cucumber, Squash, Bell pepper) at Al-Jiftlik region. In addition, it defines heavy metals concentration in soil field sample which is linked to this vegetable samples(Corn, Eggplant, Cucumber, Squash, Bell pepper) and soil samples that are related to leafy vegetables (sage and mint), which were collected from both regions. Moreover, This study aims to determine heavy metals (Ba, Cu, Pb, Th, Se, Mn, Co, As) concentration in unpolluted and polluted soil field with UDC (at 0 cm and 30cm) and vegetables (Corn, Eggplant, Cucumber, Squash, Bell pepper) that are related to this soil field obtained from Al-Jiftlik rejoin. Besides, it determines heavy metals (Ba, Cu, Pb, Se, Mn, Co, As) from in situ UDC experiments in Polluted Soil Pot (PSP) with UDC and unpolluted Soil Home Garden References (SHGR). Also, it determines heavy metals (Ba, Cu, Pb, Se, Mn, Co, As) from in situ UDC experiments in leaf vegetables (Mint, Sage) which are planted in PSP and SHGR at home garden. Thus, these vegetables and soil samples, had been collected from the same farm at Al-Jiftlik area and home garden and analyzed for this heavy metal by inductively coupled plasma-mass spectrometry (ICP-MS). Moreover, these vegetables leaf vegetables and soil samples, had been collected from home garden and analyzed for this heavy metal by ICP-MS Moreover, it also determines heavy metals (Ba, Cu, Pb, Th, Se, Mn, Co, As) concentration in Water irrigation from well or pool that used to irrigate vegetables (Corn, Eggplant, Cucumber, Squash, Bell pepper) in all fields at Al-Jiftlik region by analyzing via ICP-MS. the results exceeds WHO/FAO permissible limit for human consumption, however; other samples were found to be according to the safe allowable limit. Heavy metals in all soil field, pot, vegetables and leaf vegetables that are polluted with UDC was found to be higher than WHO/FAO limit, but heavy metals in all vegetables, leaf vegetables, SHGR and soil fields that are unpolluted by UDC were below the limit set by WHO/FAO. Furthermore, in water irrigation in well

and pond, heavy metals were below the limit set by WHO/FAO. Thus, it was shown that the pollution found in leafy vegetables, vegetables, and soil samples is due to UDC at Al-Jiftlik region or in situ UDC experiment. In addition to, the study demonstrates that the pollution which was noticed in leafy vegetables, vegetables, and soil samples was not linked to either water well or pond, but it was come up with that heavy metals polluted leafy vegetables and vegetables was directly because of the usage of UDC, as a result; the elevated levels of metals in vegetables at Al-Jiftlik region and in situ UDC experiment attributed to utilization of UDC. However, the range of pH values in all samples was between 7. 15and 8.05, which indicates Alkaline soils. Finally, it can be stated that the level of heavy metals in all soils, vegetables and leafy vegetables in situ UDC experiment and at Al-Jiftlik region depend on many parameters such as : the amount of UDC, the concentration of uptake heavy metal from vegetables, and the concentration of heavy metal in UDC .

تأثير الأسمدة (الكومبست) المستمدة من النفايات الخطيرة والمجهولة المصدر على تراكيز المعادن الثقيلة في الخضروات والتربة في منطقة الجفتلك

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الملخص بالعربية

أعطى العلماء والباحثون أهمية كبيره للتلوث الناتج عن المعادن والمعادن الثقيلة لتأثيرها السلبي على صحة الإنسان، خصوصا إذا تسربت هذه المعادن الى الغذاء مثل الخضروات المختلفة، فهذه المعادن سامة حتى عند التراكيز المنخفضة.

تهدف هذه الدراسة الى دراسة تركيز المعادن الثقيلة في الأسمدة المستخدمة في الزراعة والتي مصدرها النفايات الخطيرة أو المجهولة المصدر لأنها قد تكون مصدر لتلوث التربة والخضروات بالمعادن والمعادن السامه، قامت هذه الرسالة بتسليط الضوء على السماد المجهول (الكمبوست) والذي يتم توريده من مكبات نفايات تحت السيطرة الإسرائيلية حيث يتم طحنه وتوزيعه بشكل مجاني على المزارعين الفلسطينيين مع العلم أن الكمبوست المستمد من المكبات الأخرى مكلف من الناحية المادية، فهذا السماد الخطير قد يكون من مخلفات صناعية وطبية خطيرة وسامة، يتوقع أن تحتوي تراكيز غير مقبولة من المعادن الثقيلة مثل (الباريوم، الكوبلت، النحاس، المنغنيس، السيلينيوم، الزرنيخ، الرصاص، الثاليوم).

أخذت عينات من التربة التي تعرضت للتلوث بهذا الكمبوست من عشر مواقع مختلفة من عمق 0 سم وعمق 0-30سم وكذلك أخذت عينات من الخضروات التالية (الذرة، الباذنجان، الكوسا، الخيار، الفليفلة) المزروعة على هذه التربة وذلك من نوفمبر الى ديسمبر حيث تم اخذ 3 عينات في ابريل من الباذنجان والكوسا والفليفلة التي نمت على التربة المعرضة لهذا الكمبوست الخطير، وتم مقارنتها مع تربه وخضروات من عشر مزارع مختلفة لم تتعرض لهذا ا الكمبوست الخطير المجهول من نفس الأعماق وبنفس الطريقة وكذلك عينات من نفس الخضروات المذكورة أعلاه في منطقة الدراسة الجفتلك وفي نفس الأوقات،

وفي تجربة أخرى تم دراسة تراكيز هذه المعادن الثقيلة (الباريوم، الكوبلت، النحاس، المنغنيس، السيلينيوم، الزرنيخ، الرصاص) في النعنع والميرمية حيث تم زراعتها في قوارير تحتوي تربه ملوثه ومقارنتها بشتلات مزروعة في تربه سليمه غير ملوثة بهذا الكومبست، علاوة على ذلك لقد قمنا بدراسة تراكيز المعادن الثقيلة في مياه الري سواء من بركة التجميع او من البئر في منطقة الدراسة في منطقة الجفتلك. لقد تم جلب عينات من هذه الخضروات والتربة والمياه وثم تحليلها مخبريا عن طريق جهاز مطياف الكتلة البلازمي لمعرفة تراكيز هذه المعدان الثقيلة.

ولقد خلصت الدراسة ان كل عينات التربة والخضروات التي لم تتعرض لهذا السماد الخطير كان تراكيز المعادن والمعادن الثقيلة اقل بكثير وضمن الحدود المسموح بها من قبل منظمة الصحة العالمية، بالإضافة الى ذلك فان عينات الماء أيضا كانت سليمة وتراكيز المعادن الثقيلة ضمن حدود منظمة الصحة العالمية المسموح فيه، وكانت قليلة جدا،

وعلى العكس فان جميع عينات الخضروات والتربة التي تعرضت لهذا السماد الخطير الغير معروف كانت تراكيز المعادن فيها عالية جدا وخطيرة واعلى من المسموح فيه من قبل منظمات الصحة العالمية مما يدل ان مصدر التلوث الوحيد هو هذا السماد المجهول الخطير ومكوناته. وعلينا العمل على منع استخدامه.

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Abbreviations	
B	Bell pepper
BF (S),0cm	Bell pepper Field (Soil With compost),0cm
BF (S),0-30cm	Bell pepper Field (Soil With compost),0-30cm
BF (S W UDC),0cm	Bell pepper Field (Soil With UDC),0cm
BF (S W UDC),0-30cm	Bell pepper Field (Soil With UDC),0-30cm
BPo	Bell pepper Polluted
C	Corn
CEC	Cation Exchange Capacity
CF (S),0cm	Corn Field (Soil with compost),0cm
CF (S) ,0-30cm	Corn Field (Soil with compost),0-30cm
CF (S W UDC),0cm	Corn Field (Soil With UDC),0cm
CF (S W UDC) ,0-30cm	Corn Field (Soil with compost),0-30cm
CPo	Corn Polluted
Cu	Cucumber
CuF(S) ,0cm	Cucumber Field (Soil with compost),0cm
CuF(S) ,0-30cm	Cucumber Field (Soil with compost),0-30cm
CuF (S W UDC),0cm	Cucumber Field (Soil With UDC),0cm
CuF (S W UDC),0-30cm	Cucumber Field (Soil With UDC),0-30cm
CuPo	Cucumber Polluted
DTPA	diethylenetriaminepentaacetic corrosive
EDTA	chelate ethylenediaminetetraacetic corrosive
E	Egg plant
EF (S W UDC),0cm	Eggplant Field (Soil With UDC),0cm
EF (S W UDC),0-30cm	Eggplant Field (Soil With UDC),0-30cm
EF (S) ,0cm	Eggplant Field (Soil with compost),0cm
EF (S) ,0-30cm	Eggplant Field (Soil with compost),0-30cm
EPo	Eggplant Polluted
HV	Heavy Metal
MPo	Squash Polluted
MSW	municipal solid waste

Mi	Mint
MiPo	Mint Polluted
MiP (S W UDC)	Mint pot (soil with UDC)
OM	Other Metals
PG	phosphogypsum
PTE	Potentially Toxic Element
Sa	Sage
Sap (S W UDC)	sage pot (soil with UDC)
SaPo	Sage Polluted
SQ	Squash
SQF (S W UDC),0cm	Squash Field (Soil With UDC),0cm
SQF (S W UDC),0-30cm	Squash Field (Soil With UDC),0-30cm
SQF(S) ,0cm	Squash Field (Soil with compost),0cm
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S R for Mi and Sa	Soil References for Mint and sage
World Health Organization	WHO

Chapter one
Introduction

Chapter one

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1. Introduction

The issue of food quality and safety has become a global issue due to contamination of food products in several ways, such as pesticides, fungal toxins, heavy metals (HV) and other microbiological contaminants （Harmanescu, et al. 2011). Agricultural products-free of chemical contaminants are therefore one of the most important aspects of food safety, since consumption of food products contaminated with metals may pose health risks to people. More dangerously is the improper agricultural behavior like the use of inorganic fertilizers (Palestine, Palestinian Ministry of Agriculture, 2016). The dangerous of HV lies in the fact that it tends to be bio-accumulate. Bioaccumulation is the increase in the concentration of chemical material in living organisms over time. The danger of the accumulation of compounds in the living things is that their speed of taking and storage is much greater than the speed of breakdown. (Kabata. And Pendias, 1993).

Use of compost is a significant enthusiasm for the soil as methods for keeping up an appropriate soil structure as well as adding organic matter which is lost due to the practice of intensive agriculture. Among the conceivable negative impacts of applying compost to cropland is the potential arrival of dangerous HV into the earth, and the exchange of these components from the soil into the natural way of life. An intensive assessment of the impact of heavy metals following applying compost might be supported by the information about their action in the soil condition. 'Low metal compost' from isolated gathering sources can be viewed as significant asset in soil management hones because of their supplement supply and natural content, particularly in the Mediterranean soils which mostly contain low amounts of humidified organic matter (Palestine , Palestinian Ministry of Agriculture, 2016).

1.1 Compost

Compost is a decomposed organic fertilizer resulting from the fermentation and decomposition of chopped plant residues, animal waste or aerobic garbage. There are many images of compost, including free organic mineral compounds or non-organic fiber, a small amount of nitrate fertilizer is added to provide the nitrogen element to activate the azotobacterial bacteria as well as phosphate fertilizer to help stabilize the formed nitrogen and not to escalate with the vapors during fermentation process; The main components of the compost including the allowed and not allowed materials are explained below. (Palestinian Ministry of Agriculture , 2016)

1.The main allowed components :

1- Plant source: Crop residues such as straw, rice straw, trimming of trees after sawdust. The residues of home gardens such as falling tree leaves, cutting of the trees.

2- Animal source: Dung and animal, poultry and cattle residues.

3- Household waste: Newspaper and magazine sheets Shells and residues of vegetables and fruits Kitchen waste (coffee residue - tea or tea bags).

4- Some steroids to start fermentation (chemical fertilizers): which works on the speed of Fermentation and the installation of nitrogen (nitrogen) or the addition of red worms to take the tasks of the compost.

5- Water as a source of moisture: Add water, especially in the case of dry materials by up to 60% by weight.

2. **Materials that aren't allowable to be added or presented (Palestinian Ministry of Agriculture, 2016) are:**

   1- Plastic materials
   2- Metal objects
   3- Grease, petroleum materials
   4- Contaminated materials.

1.2 Compost from land fill

The problem of disposal of solid waste from various sources (household, industrial, agricultural, commercial and medical) through healthy and environmentally friendly ways is one of the most important problems the Palestinian community faces. This is due to the small area of land permitted for disposal of waste and environmentally friendly, in the past, it did not worked, was not constituted a severe waste problem, as it was used to people on the packaging of food and goods of natural materials, as paper banana plants and other, and rarely paper of newspapers is used for this purpose. They also used the large yellow pumpkin and clay as bowls, rather than cannons, note that these are the material decompose rapidly and are absorbed by the soil. Today, a large part of the goods that we use are wrapped in plastic or canned in a metal container or bottles, plastic and glass are all stiff, light and cost of manufactured cheap, but the period of decay is long. In fact, we can rotate and reuse most of our waste which can help a lot in reducing the environmental pollution. Waste in large cities has become a source of income and making living for many people. In 1998, a comprehensive approach was initiated to improve waste services in the West Bank within the Environment and Solid Waste Management Project, which recommended that waste disposal methods and waste collection services should be improved more effectively, and so on improving the environment in the West Bank. Consequently, the idea of establishing garbage dumps started out, the first was Zahra al-Finjan dump in Jenin. One of the most important benefits of recycling solid waste is the production of the so-called compost. The benefits of compost and methods of manufacturing engineering are to get rid of accumulated waste; and therefore improving the health conditions. Moreover, to improve the quality of the soil and fertilize it, we have to reuse and recycle food wastes and organic wastes as an organic fertilizer, humus (compost) that enriched soil, or food for chicken. For fertilized worms land and useful soil, the conversion of waste and waste organic to the wealth of food animal and plant should take place " .The organic waste decomposed into its original components mentioned, for example; food wastes, animal dung, waste of Matat poultry slaughterhouses, paper, hair, feathers, straw, twigs, leaves, green and dry grass, shavings of wood, remnants of crops and damaged vegetables and fruits. The preparation of composting process Aerobic fermentation of organic waste such as animal and plant residues and organic household waste , but in a deliberate manner and under specific conditions .As for the stages of preparing the compost, a place was allocated from the land of the station to prepare the compost in the form of basins 30 meters long and 3 meters wide; the ponds were filled with red soil at a height of 30 cm. Also, a layer of green plant residue was spread over the red soil layer, a layer of organic waste was distributed over the green plant layer, and a layer of green plant remains was laid over the organic waste layer. Then the soil is measured in terms of temperature, humidity, and pH of the humus compost. Based on the results of these tests, the humus pile is stirred and sprayed with water as needed. The optimum temperature for the humus stack is 60 to 70 ° C and the optimum pH is 7.5; the optimum humidity range is between 40 ° C and 50 ° C. He adds: "To save the moisture in the heap, leave the heap to decompose a period of time, as a result of decomposition, water, carbon dioxide, carbon and heat released; and during the process of decomposition by microbes that feed on the material, organic rises internal heat degree to the pile between 60 and 70 m, which leads to the killing of the majority of the seeds of harmful germs that cause diseases. The above work is continued until the humus pile is mature, often it takes from three to six months, depending on the seasons of the year and the components of organic waste. He explained that the maturity of the compost pile is indicated and ready for use by not distinguishing its original components. It has an unpleasant odor similar to the smell of dirt. It becomes dark brown and shrinks in size by half. And then the humus is ready to be available on the market and sold to farmers at cheap prices, especially that it is cheaper, better, more useful and less harmful than chemical fertilizers (the Maan-Ctr , 2009).

1.3 Unknown Dangerous compost (UDC)

The phenomenon of the use of the West Bank agricultural land as random dumps and landfills for Israeli solid waste, especially the toxic phenomenon, has become the talks of Palestinian street, especially in the countryside, because of the negative consequences not only on human health, but the soil and agriculture, Water is becoming threatened by pollution. A large number of Israeli factory owners, whether inside Israel or even in the industrial settlements scattered in the West Bank, transfer the waste of their factories to the West Bank to be disposed of there for cheap costs and ease of transportation. Most of these targeted lands are located close to Israeli settlements and beyond the separation wall. This operation is often carried out in coordination with Arab contractors, whether from the Arabs of 1948 or even from within the West Bank, and those who have corrupted consciences. It is suspicious to have a toxic effect on all-natural resources in the region. The toxic waste, which is transported from within the Israeli settlements to be buried and burned in nearby agricultural lands, is not subject to any waste treatment process, as is the practice, according to international standards in the disposal of hazardous waste. The process of environmental pollution that begins with the soil and then the surrounding trees, except for its appearance and unpleasant smells, as it is happening now in the assembly point of factories in Burqan in the heart of Salfit, where the assembly contains a large number of Israeli chemical factories create a conflict such as the "Keter" plastic factory in addition to the lead factory and battery factory ... which were all originally located within the borders of Israel, and were transferred to the settlements in the West Bank because of the impact of toxic and harmful to the surrounding environment, as they are now outside the occupying state are not subject to strict Israeli environmental laws and regulations, especially those related to solid waste disposal method (Maan-Ctr , 2012). A matter of fact, no similar studies have been conducted in Al-Jiftlik region concerning the effects of (UDC) on (HV) levels in soil and vegetables. I can say that (HV) and other metals (om) percentage accumulate in agricultural soils, taken up by vegetable crops and get transferred to humans through consumption of vegetables, in conformity with International Standards That is ensured by Researchers and Research on this subject in the world in order to Prevent any Risk on human health which are important issues in various societies across the World, and mainly at Al - Jiftlik in west bank - Palestine territory.

1.3.1 UDC story

The story starts when Environmental Authority told me about how Israeli Contractors are selling large Amount of UDC (without label of content or any other information) as compost at a very low price; including Metal, Stained glass , medical ,Polymer waste by Eyes observation to Farmers in a very important agricultural region ,so that in this research with Cooperation Environmental Authority HV and OM contaminant percentage will be studied in UDC and Soil and Vegetables which was subjected to UDC.

1.4 Heavy metal s

1.4.1 The toxicity details of some Heavy metal

As of late, there has been an expanding biological and worldwide general well-being concern related to ecological sullying by HV particularly with the ascent in human exposure to these metals and their potential dangers (Bardl, 2002). HV are characterized as normally happening metals with very high thickness, high nuclear weight, and high nuclear number (Tchounwou, et al.2014).

Heavy metals are often considered to be toxic; their toxicity depends on the dose of the metal, the route of exposure, the form, and the nutritional status of the exposed human being. Concentrations of HV and OM in Soil are important not only for environmental purposes, such as quantifying contamination, but also to help solving problems associated with human and Vegetables toxicity. Heavy metals are hazardous contaminants in food and the environment and they are non-biodegradable having long biological half-lives (Maragheh, et al. 2013). The implications associated with metal (embracing metalloids) contamination are of great concern, particularly in agricultural production systems (Shivpuri, et al.2012) due to their increasing trends in human foods and environment.

Heavy metals are not only toxic to human health or animals but also to the environment as a whole; concerns should be raised about their side effects. As a result of mining, industrial waste, industrial activities, agricultural runoff, pesticides, vehicle emissions, fertilizers, etc. heavy metals became more concentrated in the environment (Luckey, 1977). Although heavy metals have a negative consequence on human health but some trace amounts of some heavy metals are required by human body. These include cobalt, copper, manganese, vanadium, zinc and molybdenum. In fact, some major heavy metals have biochemical and physiological functions in plants and animals. They are also a major constituent of several enzymes in addition to their roles in oxidation reduction reactions (World Health Organization,1996) .**For example:**

1- Lead enters into the human body through water, air and food and it cannot be removed from vegetables and fruits by washing (Chaitali, 2015) it is danger that it accumulates in the human body and it is a toxic substance that can affect every organ and system in the body. Exposure to a high-level leads to a breakdown in the brain and kidney and leads to an early death. Besides long-term exposure, performance decreases for some tests that assess the function of the nervous system; weakness in fingers, wrists, or ankles; small increases in blood pressure; and anemia. Others are abdominal pain, anemia, arthritis, attention deficit, back problems, blindness, cancer, constipation, convulsions, depression, diabetes, skin problems, vomiting, heart attacks, dysfunction(Chaitali,2015).

2- Barium it is Short term exposure can cause vomiting, abdominal cramps, diarrhea, difficulties in breathing, increased or decreased blood pressure, numbness around the face, and muscle weakness (Chaitali,2015).

3- Arsenic a carcinogen at very low exposure levels is not useful for metabolic processes of humans. Its low-level exposure cause includes reduction of red and white blood cells production, nausea, vomiting, abdominal pain, at long-time exposure blackness on the skin. Other effects includes fever, loss of appetite, baldness, loss of fluids, thyroid, headache, jaundice, liver and kidney damage, Peripheral, sore throat, weakness and interferes with the uptake of folic acid, herpes, I hem-paired ling (Chaitali,2015).

4- Copper is an essential substance to human life, but its critical doses can cause anemia, acne, adrenal hyperactivity and insufficiency, allergies, hair loss, arthritis, autism, cancer, depression, elevated cholesterol, depression, diabetes, dyslexia, failure to thrive, fatigue, fears, fractures of the bones, headaches, heart attacks, hyperactivity, hypertension, infections, inflammation, kidney and liver dysfunction, panic attacks, strokes, tooth decay and vitamin C and other vitamin deficiencies(Chaitali,2015).

5- Selenium is toxic in large quantities, but the cellular functions are needed in small quantities. Oral Exposure to it at high concentrations for a short time leads to phobia, vomiting and diarrhea. Major signs of selenosis are hair loss, nail fragility and nervous abnormalities. Exposure to high concentrations in the air leads to respiratory irritation, bronchitis, difficulty in breathing, stomach pain as well as bronchial spasms and coughing (Kim, et al.2010).

1.4.2 Heavy metal in soil and vegetables

As a rule, people are very likely to be exposed to HV pollution from the soil that adheres to the plants. Plants taken-up is fundamentally identified with the concentration of metals in the soil solution more than metal groupings of the dirt (Kim, et al.2010). Moreover, HV may enter vegetable tissues through roots and foliage. Likewise, it may be exchanged very well from soil pore water into the plant; however, the roots broke up particles. All things are considered, there are different pathways to be presented to HV pollution through plant utilize. These incorporate breathing in burning from consuming plants materials, and in addition breathing in pollution's from smoking plant materials, volatilization pollution's in plant materials in encased zones, ingestion, or skin contact and day by day utilization of plant materials (McLaughlin, et al.2011) Many complex procedures happen in the soil pore water and yield rhizosphere.

For the most part, leaf vegetables become quicker with higher transpiration rates than non-leaf vegetables (Luo, et al.2011). Therefore, HV taken-up by roots can be more noteworthy in leaf vegetables; this outcomes in the translocation of metals from roots to different tissues (Zheng, et al.2007). Attributable to the leaf area, leaf vegetables are more delicate to metals accumulation by dust from soil or water.

Also, pollution of HV may show up on plants and change its shading or its example of development. Stressed on plants might be too an indication of metal contamination. These conditions normally imply that bio-accumulation of metals is occurring in the plants. In different cases, lack in plant could happen which may impact the plant's probability to accumulate metals (Chang, et al.2013).

1.5 Objectives of the Study

1- To investigate the concentrations of metals in vegetable crops that were grown on UDC soil and evaluate their contamination status with respect to food standard guidelines. Vegetables include: Eggplant, Corn, Bell Pepper, Cucumber and Squash.

2- To investigate the concentrations of metals in soil that was fertilized by polluted UDC soil. And evaluated their contamination status with respect to standard guidelines.

1.6 Significance

This study has a significant importance to Palestinians who consume these foodstuffs, farmers who plant these vegetables and for relevant fields of study. This research could give a general idea about the in situation and the effects of UDC on heavy metal levels in soil and vegetables in study area. It is expected that the outcome of this research could be the essence of a project which can guide farmers and consumers to plant, grow and eat vegetables free from contamination and as much as healthy; however, changing their approach will not be easy. This research would also present concentrations of Barium, Manganese, lead, copper, Cobalt, Arsenic, Selenium, Thallium metals in the chosen vegetables, leafy vegetables and soil field which could be a parameter to be compared to WHO/FAO limit (standards Joint FAO/WHO food Codex ,1996, European Commission on Environment,2000, World Health Organization,2000, 2004). In addition, the pH analyzed was made for soil; that analysis of pH effect on many properties of soil that include Cation Exchange Capacity (CEC), particle size distribution, organic matter content, and oxide content. These characteristics cause HV to either accumulate in the soil or transfer by crop to vegetables or leave for other components of the environment.

Chapter two
Literature Review

Chapter two

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2. Literature Review

An investigation was directed in 1993 by Divrikli et al. on Combined vegetable/soil tests from New York City and Buffalo, NY, gardens. Lead, cadmium and barium were breaking down. The level of Heavy metals in the soil and vegetables were not reliable; the level in vegetables differed by the root compose; lead was just beneath the maximum allowable limits of confinement to the European standard.

Walker et al., 2002 determine the two HV polluted calcareous soils from the Mediterranean area of Spain were considered. One soil, from the territory of Murcia, was Characterized by high levels of Pb (1572 mg kg−1) and Zn (2602 mg kg−1), while the second, from Valencia, had lifted Levels of Cu (72 mg kg−1) and Pb (190 mg kg−1). The impacts of two differentiating organic amendments (fresh manure and mature compost) and the chelate ethylenediaminetetraacetic corrosive (EDTA) on soil fractionation of Cu, Fe, Mn, Pb and Zn, their take-up by plants and plant growth were detected. For Murcia soil, Brassica juncea (L.) Czern. Was grown first, trailed by radish (Raphanus sativus L.). For Valencia soil, Beta maritima was trailed by radish. Bioavailability of metals was communicated as far as fixations extractable with 0.1 M $CaCl_2$ or diethylenetriaminepentaacetic corrosive (DTPA). In the Murcia soil, overwhelming metal bioavailability was diminished more significantly by fertilizer than by Highly- humified manure. EDTA (2 mmol kg−1 soil) had just a constrained impact on metal take-up by plants. The metal-solubilizing impact of EDTA was shorter-lived in the less pollution, all the more exceedingly calcareous Valencia soil.

An investigation was led in 2005 by Zennaro, et al. with the target of enhancing subjective qualities of fertilizer, an analytical survey was carried out in a composting plant in Lombardy (Italy) in all process of production, with specific reference to Heavy metals (HV) Zn and Pb. The examination was essentially planned to think about the level and the accumulation of HV during composting process and to identify a technological solution for reducing HV content in the final product. A mereological examination of MSW contribution to composting plant, , a chemical analysis of the organic fraction of MSW after mechanical separation, and a comparison with values reported by some authors, demonstrated that Zn and Pb are high pollution , despite the fact that level has as of late diminished in contrast with earlier years. Based on Zn and Pb content in crude material contribution to the plant, a gauge of the hypothetical estimation of Zn and Pb in delivered compost was made. The correlation of hypothetical qualities with the real ones, tentatively decided, affirmed that toward the finish of compost procedure the level is 2.6 times the underlying incentive for Zn and 1.6 times the underlying incentive for Pb, as proposed by a few creators. At long last, the analytical investigation of Zn and Pb substance in the compost refining line, completed by methods for sieving tests, demonstrated that by wiping out a small amount of fertilizer < 1 mm, both Zn and Pb, which is the most critical one, can be largely removed, without a substantial yield loss (only 10% of the final product is eliminated).

A study was conducted in 2009 by Farrell and Jones. The point of this study was to survey changes in heavy metals accessibility in two different feedstock during aerobic composting, and the accessibility of mentioned metals in the completed composts. A high C-to-N proportion blended biodegradable municipal solid waste (MSW) feedstock was effectively composted on its own and in mix with green waste. Changes in Heavy metal speciation throughout the composting process were examined utilizing the modified BCR sequential extraction protocol. It was discovered that Heavy metals Cu, Pb and Zn Level expanded after some time because of the dynamic mineralization of compost feedstock. Metals were fractionated contrastingly inside the two feedstock, albeit just Cu demonstrated critical redistribution (for the most part to the oxidizable fraction) over the five-month composting the soil time frame. The MSW-derived composts performed equivalently with other commercially-available composts in a progression of plant development preliminaries. Plant metal gathering was not impacted by heavy metals present in the MSW-inferred compost, suggesting that they are not plant accessible. It is suggested that these generally low value/quality composts might be utilized for remediation of acidic heavy metal polluted sites.

An investigation was led in 2010 by Farrell and Jones**;** Elevated amounts of HV in soil can at last prompt contamination of drunk water and sullying of nourishment. Thus, feasible remediation methodologies for treating soil are required. The potential ameliorative impact of several compost got from source-isolated and mixed municipal wastes were evaluated in a highly acidic heavily contaminated soil (As, Cu, Pb, Zn) in the presence and absence of lime. Overall, PTE (potentially toxic element) improvement was upgraded by compost while lime had little impact and even exacerbated PTE mobilization (e.g. As). All compost lessened soil solution PTE levels and raised soil pH and supplement levels and are appropriate to revegetation of contaminated locales. In any case, care must be taken to guarantee correct pH administration (pH 5– 6) to enhance plant development while limiting PTE solubility, especially at high pH. Furthermore, 'metal excluder' species ought to be sown to limit PTE section into food chain.

An examination was directed in 2010 by Duo et al. Enhancement of multiple heavy metal take-up from (MSW) compost by Lolium perenne L. in a field try was researched with utilization of EDTA. EDTA was included arranged at six rates (0– 30 mmol kg^{-1}) after 50 days of plant growth. Two weeks later, plants were harvested for the first crop and then all the turfgrasses were mowed. After an additional 30 days periods of development, EDTA was included again at over six rates to the comparing locales and the second yield was collected 2 weeks after the fact. The outcomes revealed that EDTA essentially increase Heavy metal amassing in both products of L. perenne. For the primary product, the convergences of Mn, Ni, Cd, and Pb in the shoots expanded astoundingly with expanding EDTA supply, topped at 25 mmol kg^{-1} EDTA, and shoots of 0– 5 cm height (shoots from medium surface to 5 cm tallness) had higher metal concentration than 5– 10 cm and >10 cm shoots. . The highest concentration of Mn, Ni, Cd, and Pb was 2.3-, 2.3-, 2.6-, and 3.2-overlay, separately, in 0– 5 cm shoots higher than control. For the second product, the concentration of Mn, Cu, and Pb in shoots were, as a rule, not exactly those in the principal trim. Nonetheless, the second harvest was essentially higher ($P < 0.05$) than the primary yield in dry biomass, so heavy metals expelled constantly trim was more than the main product. What's more, EDTA altogether expanded the translocation proportions of most overwhelming metals from roots to shoots. For the primary harvest, 38% Zn, 51% of Cd, 49% of Pb, 60% Mn, 55% Ni, and 45% Cu taken up by the plant were translocate in the shoots of 0– 5 cm height. Turfgrass would have potential for use in remediation of substantial metals in MSW compost or contaminated soils.

A study was conduct in 2010 by Bagdatlioglu. had determined the levels of Cu, Zn, Fe, Pb and Cd in various fruits (tomato, cherry, grape, strawberry) and vegetables (parsley, onion, lettuce, garlic, nettle, peppermint, rocket, spinach, dill, broad bean, chard, purslane, grapevine leaves) grown in Manisa region. Flame and Graphite Furnace Atomic absorption spectrometry was used to determine the levels of these metals. The levels concentration ranged from 0.56 to 329.7, 0.01 to 5.67, 0.26 to 30.68, 0.001 to 0.97 and 0 to 0.06 mg/g for Fe, Cu, Zn, Pb and Cd, respectively. While the highest mean levels of Cu and Zn were found in grapevine leaves, the lowest mean levels of Fe and Pb were found in nettles. Cd was not detected in most of the studied fruits and vegetables. Levels of Cu that were found were caused by copper-based fungicides. As for zinc, it was related to soil that contained amounts of zinc. The determined daily intakes of Cu, Zn, Fe, Pb and Cd through fruits and vegetables were discovered to be below the maximum acceptable levels recommended by FAO/WHO. The metal concentrations of fruits and vegetables analyzed in this study were within the safety levels for human consumption.

Another related examination was directed in to analyze and decide the concentration levels of Heavy metals in verdant vegetables with development stage and plant species minor departure from a test field close to the net place of Soil Science Division, Bangladesh Agricultural Research Institute amid November 2008 to January 2009. Seeds of spinach, red amaranth and amaranth were seeded on 14 November 2008. Plant and soil tests were gathered at various development stages, for example, at 20, 30, 40, and 50 days after sowing (DAS). The groupings of lead, cadmium, nickel, cobalt, and chromium in plant increase with the age of the plant. The rate of increment of centralization of these metals at 20 to 30 DAS was discovered lower than that at 30 to 40 DAS, with the exception of Cr. Heavy metal substance increased at the early developing stage and fall amid later phases of development. The examination demonstrated that Pb and Co focuses in amaranth were higher contrasted with those found in spinach and red amaranth. Spinach contained larger amounts of Cd and Cr than those of different vegetables. The reason was utilizing phosphate composts. Notwithstanding, the three vegetables did not vary in Ni focus. The request of Heavy metal level in various vegetables was Cd<Co<Pb<Ni<Cr. In vegetable species in respect of heavy metal concentration Cd, Ni, and Cr was highest in these showed highest concentration in Pb and Co. The most elevated relationship between soil plants was found for Cd, while the least for Ni because of heavy

metals content in soil. Metal fixations in the contemplated vegetables were beneath the most extreme suitable level in India however the groupings of Cd and Cr were higher than the permissible levels set by the World Health Organization (NASER, 2011).

Another related study was conducted in 2012 by Elmaslar-Özbaş and Balkaya about a strategy to extract Heavy metals from compost. Compost samples were at first investigated to decide the sort and the level of Heavy metal compounds. Column studies were completed by solid Liquid extraction strategy utilizing 0.01 M Na2EDTA-0.1 M Na2S2O5 solution. Target Heavy metal elimination efficiencies were accomplished for Cu (72%), Zn (77%), Pb (47%), Cd (86%), but not for Ni (12%) after160 minutes contact time at a solid: liquid proportion of 1:15 g mL and 360 mL solution arrangement volume.

It is true that aluminum range concentrations are allowed in the soil from 10000 to 300000 ppm, but aluminum is not a nutrient of the plant. The high concentration of aluminum in the agricultural soil leads to very low soil pH or poor soil aeration due to compaction or flooding and affects the work of other elements, such as iron. The excess concentration of the aluminum limit range of 200 to 400 ppm in the agricultural soil, it affects the young tissues in the plant and leaves in mature plants (metabunk, 2013).

An examination was directed in 2014 by Esawy and Naser; the utilization of soil compost to immobilize Heavy metals is a promising innovation to meet the necessities for environmentally sound and cost ‐ effective remediation. The present investigation was completed to assess the consequence of phosphogypsum (PG) utilized alone and in blend with fertilizer (CP) at a blend proportion of 1:1 wet weight proportion (PG + CP) at 10 and 20 g dry weight kg−1 dry soil, on Heavy metal immobilization in contaminated soil and on canola development. The outcomes revealed that the Pb, Cd and Zn take-up of canola plants was lessened by the utilization of PG alone and when it was blended with CP as compared and untreated soil. At an application rate of 10 g dry weight kg−1 dry soil of (PG + CP) the dry weight of canola plants expanded by 66·8% was expanded in examination with its weight in the untreated soil. The expansion of PG alone brought about more articulated immobilization of Heavy metal as compared and PG blended with CP. Plant development was enhanced with CP expansion, however Heavy metals immobilization was the greatest in PG alone treatments. Results propose that PG might be valuable for the immobilization of Heavy metals in contaminated soils.

A study was conducted in 2015 by Chaitaliat at Grown near the Area of Amba Nalla, Cadmium was suspected to cause cancer of humans and other health risks when it is high. Major result concludes that Cd and Pb concentrations are very high in potatoes and spinach, therefore a health risk from the point of view of this study.

Chapter three
Study Area

Chapter three

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3. Study area

3.1 Al-Jiftlik (Location Topography)

Al Jiftlik is a Palestinian village in Jericho governorate located (horizontally) 33km north of Jericho City, its land area is 1242 dunums. It crosses the main street in the middle and divides it in half east and west, latitude of 32 ° 08'39 "N longitude of 35 ° 29'36" E (The Applied Research Institute,2012) , figure (3.1 ; 3.2); it is located on the border with Jordan Valley in the occupied territories in 1967. A list along the valley; Fara which is located at an altitude of 189m below sea level, Figure (3.1; 3.2). It is bordered by the Jordan River to The East, Marj al Ghazal village and Tubas Governorate lands to the north. The surrounding villages of Nablus

Figure 3.1: Al Jiftlik Location coordinate in Palestine state (google earth, 2017).

Governorate to the east include Duma, Majdal Bani Fadil, Aqraba to the west and Al Fasayil village to the south, Within the few kilometers of Jiftlik are Israeli settlements, Amara , Hamra and Argoman (The Applied Research Institute,2012) figure (3.1 ; 3.2).

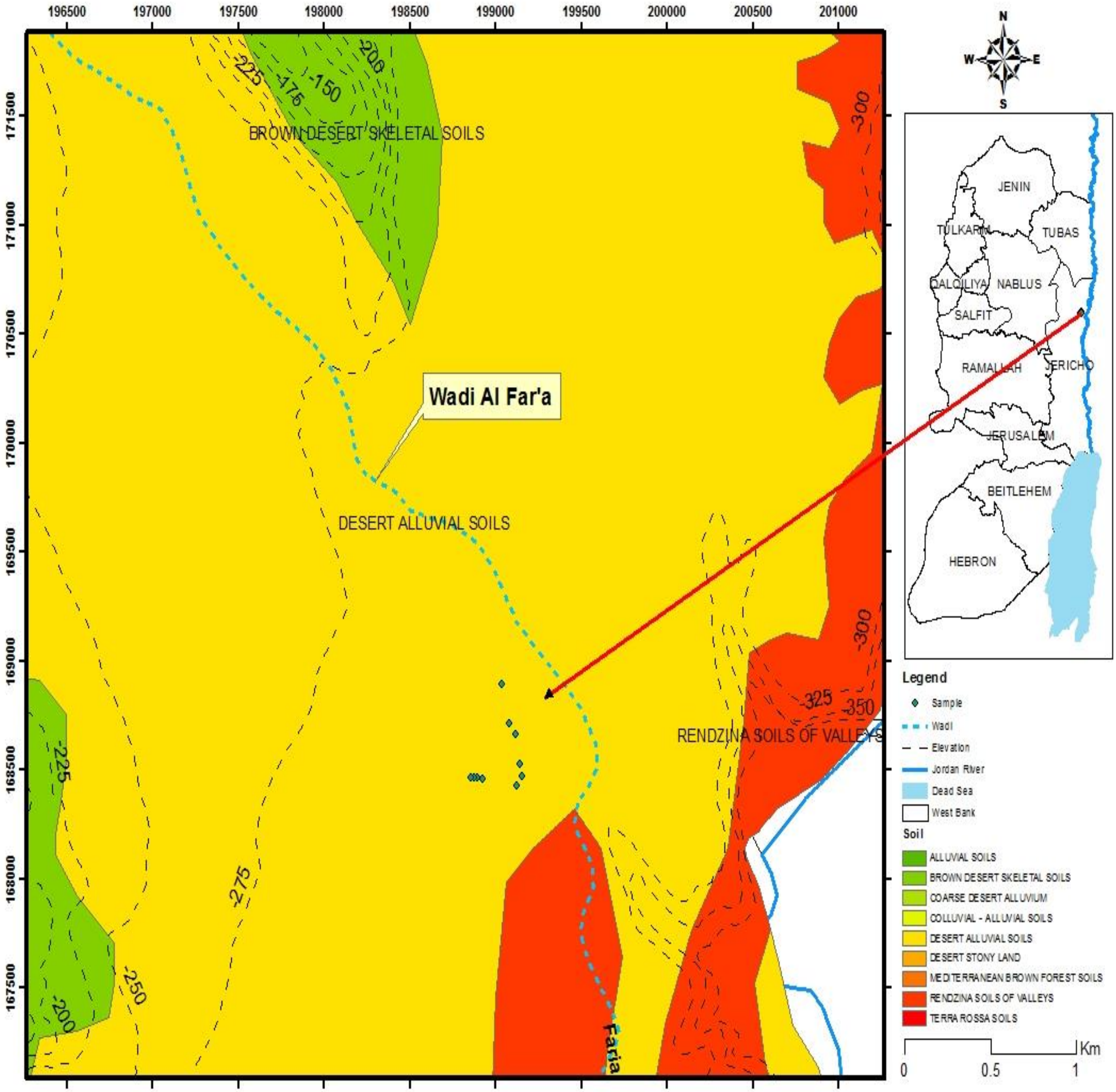

Figure 3.2 :Topographic map of the Study Area Source: GIS Laboratory at Al-Quds University (Atair, 2018).

Locations of the sampling sites are indicated.

Agricultural lands are representative in the south-eastern part of Al-Jiftlik according to the coordinates in the table (3.1), As shown in the figure (3.2, 3.3), it is the first study area of the research, which represents 10 representative points from 10 lands covering the study objective of this area according to type of vegetables that is divided into two parts polluted and unpolluted as shown in table (3.2), As shown in the figure (3.4).

Table 3.1:study area's coordinate

Al-Jiftlik	32°08'39.0"N 35°29'36.0"E	
Lands' Type / **Vegetables' Types**	polluted	Reference Un polluted
Cucumber	32°06'33.0"N 35°30'58.5"E	32°06'32.7"N 35°30'59.6"E
Eggplant	32°06'39.4"N 35°31'07.0"E	32°06'31.7"N 35°31'07.1"E
Corn	32°06'34.9"N 35°31'08.0"E	32°06'46.8"N 35°31'04.0"E
Bell Pepper	32°06'33.0"N 35°30'57.8"E	32°06'33.0"N 35°30'56.9"E
Squash	32°06'33.1"N 35°31'08.3"E	32°06'40.9"N 35°31'05.5"E

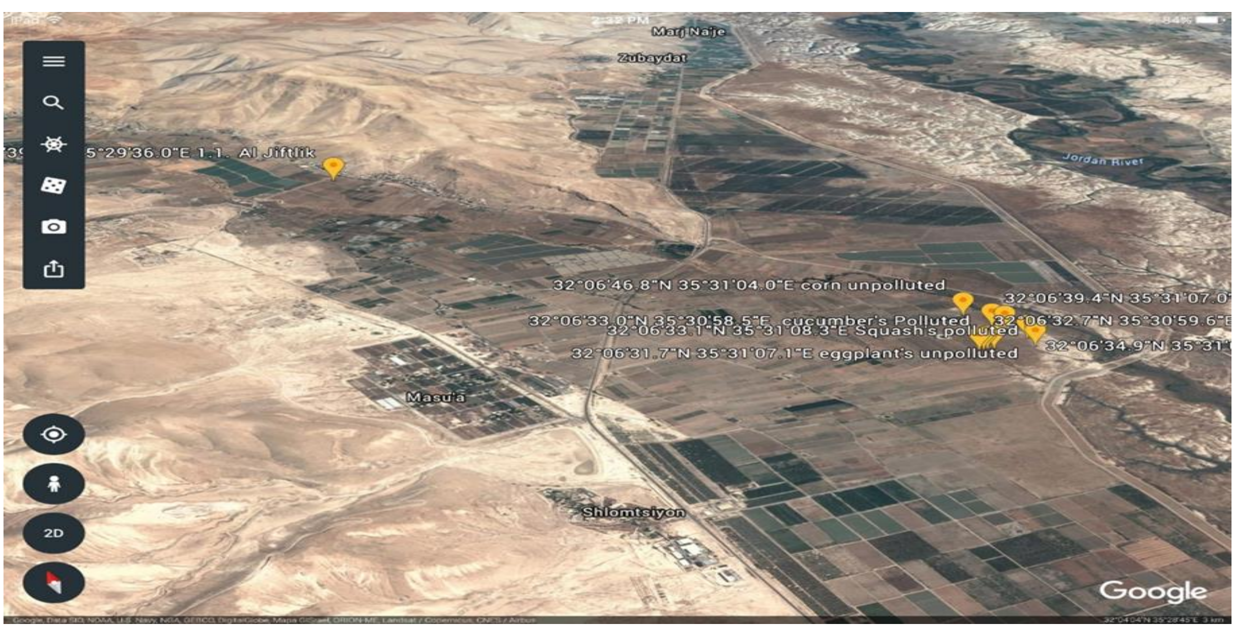

Figure 3.3: study area in the south-eastern part of Al-Jiftlik (google earth, 2017).

Figure 3.4: Ten locations for the study area (google earth, 2017).

3.2 Climate

A mean annual rainfall of 232mm. The average annual temperature is 22 C◦, and the average annual humidity is approximately 49.2% (The Applied Research Institute,2012)

3.3 Agricultural Soil Types in study area (Deseret alluvial soil)]

It is existing of alluvial fans and plains formed as a result of erosion of calcareous silty and clayey materials. This soil type supports herbaceous vegetation of desert annual halophytes and glycophytes and responds well to irrigation, producing various crops, mainly subtropical and tropical fruits, such as citrus, bananas, and dates, as well as winter vegetables. The American great group classifications that represent this soil association are Haplargids and Camborthids (Harriet ,D. 2001).

3.4 Population

3.4.1 Age Groups and Gender:

1- According to the Palestinian Central Bureau of Statistics (PCBS), the total population of Al Jiftlik in 2007 was 3,714; of whom 1, 857 were male and 1,857, female. There were additionally registered to be 578 households living in 692 housing units (Statistics Palestinian Central Bureau, 2018).

2- The General Census of Population and Housing carried out by PCBS showed the distribution of age groups in Al Jiftlik was as following: 45.5% were less than 15 years, 50.3% between 15 - 64 years, whilst 2.7% fell in the 65 years and older category. Data also showed that the sex ratio of males to females in the village is 100:100, meaning that males and females constituted 50% and 50% of the population, respectively (Statistics Palestinian Central Bureau,2018).

3.5 Family

Its residents are composed of several families, mainly: Arab al Masa'id, Arab al 'Ayed, Al Jahhalin tribe, Al 'Ajajrah, Abu Sreis, Abu Dlakh, Abu Dheilah, Al Nfei'at, Al 'Annuz and Al Rtimat families (The Applied Research Institute,2012).

3.6 Economy

The economy in Al Jiftlik depends on several economic sectors, mainly: the agriculture sector, which absorbs 90% of the camp workforce. The results of a field survey conducted by ARIJ for the distribution of labor by economic activity Al Jiftlik are as following (google earth, 2017, The Applied Research Institute,2012):

1- Agriculture Sector (90%)
2- Trade Sector (5%)
3- Israeli Labor Market (3%)
4- Government or Private Employees Sector (2%)

Chapter Four

Methodology

Chapter Four

4. Materials and Methods

4.1 Sampling Locations and collections

4.1.1 Soil sampling (Al-Jiftlik Location)

20 soil samples were sampled from the surface and at the depth of 0-30 cm, from all the coordinates according to the type of vegetables (polluted and references listed in table (4.1). Sampling was done according to the random method (agrienergy,2015) for each location as shown in figures (4.1). The sampling method include:

1- A sample from each location (polluted, Reference), as shown in table (4.1), figure (4.1).

2- The representative sample was taken by the identification of circle with a radius of 6 meter.

3- Five cores were sampled inside the 6-meter circle at the surface and at a depth of 0-30 cm from all the coordinates that listed in the table (4.2), figure (4.2).

4- The five cores were mixed with each other to form a homogeneous represented sample according to each depth, coordinate (polluted, Reference) and the type of vegetables.

5- The representative samples were analyzed in the laboratory.

4.1: samples' collection

Figure 4.2: Polluted and random Polluted soil samples (google earth, 2017)

Table 4.1: Coordinates of soil samples at Al-Jiftlik				
Lands' Type / Vegetables' Types	Soil's polluted with UDC		Soil's unpolluted (Reference) with UDC	
	Depth		Depth	
	0 cm	0-30cm	0 cm	0-30cm
Cucumber	32°06'33.0"N 35°30'58.5"E 2 sample		32°06'32.7"N 35°30'59.6"E 2 sample	
Eggplant	32°06'39.4"N 35°31'07.0"E 2 sample		32°06'31.7"N 35°31'07.1"E 2 sample	
Corn	32°06'34.9"N 35°31'08.0"E 2 sample		32°06'46.8"N 35°31'04.0"E 2 sample	
Bell Pepper	32°06'33.0"N 35°30'57.8"E 2 sample		32°06'33.0"N 35°30'56.9"E 2 sample	
Squash	32°06'33.1"N 35°31'08.3"E 2 sample		32°06'40.9"N 35°31'05.5"E 2 sample	

Table 4.2: Coordinates of vegetables samples at Al Jiftlik

Lands' Type / plants' Types	**Soil's polluted with UDC/ coordinate**	**Soil's unpolluted** (Reference) **with UDC/ coordinate**
Cucumber	32°06'33.0"N 35°30'58.5"E 1 sample	32°06'32.7"N 35°30'59.6"E 1 sample
Eggplant	32°06'39.4"N 35°31'07.0"E 1 sample (November-December) 2017 1 sample April 2018	32°06'31.7"N 35°31'07.1"E 1 sample
Corn	32°06'34.9"N 35°31'08.0"E 1 sample	32°06'46.8"N 35°31'04.0"E 1 sample
Bell Pepper	32°06'33.0"N 35°30'57.8"E 1 sample (November-December) 2017 1 sample April 2018	32°06'33.0"N 35°30'56.9"E 1 sample
Squash	32°06'33.1"N 35°31'08.3"E 1 sample (November-December) 2017 1 sample April 2018	32°06'40.9"N 35°31'05.5"E 1 sample

4.1.2 UDC sampling

One Repersentive sample had been taken from mixed three-side sample of pile in August 2017.

4.1.3 Vegetables sampling (Al-Jiftlik)

10 representative samples were taken during November-December 2017, from contaminated and reference vegetables. Sample coordinates are shown in table (4.2) and figure (4.3). In addition, in April 2018, three more vegetable samples (Squash, Eggplant, Bell pepper) were sampled from the same coordinates.

Figure 4.3: Polluted and unpolluted Random Vegetables samples (google earth, 2018)

4.1.4 Soil sampling, in situ UDC experiments

3 soil samples that represent the total soil samples have been taken, the sample was divided into two groups: in the first group, soil is potted with polluted sample (note: UDC was added to the soil in the pot, as shown in figure (4.4). Two pots were planted with two types of leave vegetables (Sage and Mint), as shown in Table (4.3), with the same soil from home garden at Ramallah location as shown in figure (4.6); in the second one, home garden soil from uncontaminated sample that consists of one soil that planted with two type of leave vegetables (Sage, Mint) at home garden, as shown in table (4.3), figure (4.5).

Figure 4.4: soil's pot polluted sample

Table 4.3: Soils sample in situ experiment		
Lands' Type / Plants' Types	The same coordinate 31°54'38.8"N 35°12'04.8"E	
	Soil's polluted (Pot)	Soil's unpolluted (home garden, Reference)
sage	1 sample	1 sample
Mint	1 sample	

Figure 4.5: soil's home garden unpolluted sample

Figure 4.6: Ramallah (Home garden) Location (google earth, 2018)

4.1.5 Leafy vegetables sampling, in situ experiment

4 samples that were repetitive to the soil samples as shown in table (4.4) .

Table 4.4: vegetable's sample's *in situ* experiment

Lands' Type / **vegetable's' Types**	**polluted (Pot)**	**Un polluted (home garden, Reference)**
	The same coordinate 31°54'38.8"N 35°12'04.8"E	
Sage	1 sample	1 sample
Mint	1 sample	1 sample

4.1.6 Water sampling (Al-Jiftlik region)

Samples were collected and stored in clean plastic bags and brought to the laboratory for analysis. Water samples were collected from well and pool filled with the same water used for irrigating these vegetables at Al-Jiftlik region. Water was stored in clean plastic bottles washed with distilled water. In site, the water bottle was washed with the same irrigating water then was filled with water (Kattan, 2018).

4.2 Laboratory analysis

4.2.1 ICP-MS analysis

4.2.1.1 Chemicals and reagents

1. Ultrapure nitric acid
2. Standard 1 and standard 2 containing multi- metals : (Ag 10 mg/L, Al 50 mg/L, B 50 mg/L, Ba 10 mg/L, Bi 100 mg/L, Ca 10 mg/L, Cd 10 mg/L, Co 10 mg/L, Cr 50 mg/L, Cu 10 mg/L, Fe 10 mg/L, K 100 mg/L, Li 50 mg/L, Mg 10 mg/L, Mn 10 mg/L, Mo 50 mg/L, Na 50 mg/L, Ni 50 mg/L, Pb 100 mg/L, Sr 10 mg/L, Tl 50 mg/L, Zn 10 mg/L, Matrix 5% HNO3), (Kattan, 2018).
3. Internal standard method was used using Indium and Erbium as internal standard (Kattan, 2018) .
4. Milli-Q water is ultrapure water as defined by ISO 3696 (Merck Millipore Organization, 2015). The processes of purification include many steps of filtration and deionization to reach a purity characterized in term of resistivity 18.2 MΩ·cm at 25°C. Milli-Q purifiers produce water pure enough to get accuracy within parts per million (Kattan, 2018).
5. Filter paper- whatman No.41 or equivalent .

4.2.1.2 Preparation of solution

Four solution of eight metals with concentration : 5.0, 10.0, 25.0, 50.0 ppb were prepared from the stock one and two standard by dilution using by 0.5 % ultrapure nitric acid as diluent. These solutions were used for linearity and range study of the method. Each sample was analyzed three times and the results are expressed as mean ± standard deviation(Kattan, 2018).

4.2.1.3 Soil's analysis

As for the soil samples, 20 grams of the soil were weighed and 80 ml of milli-Q water were added. The soil samples were kept for fourteen days, so that what surrounds the soil particles can be tested. This process was performed because it is not the soil particles that need to be analyzed but the surroundings of the particles; in other words the leachate. 2 ml of the sample were taken for analysis (Kattan, 2018). Determination of heavy metals in 2ml sample was achieved using Inductively Couples Plasma Mass Spectrometry (ICP-MS). ICP- MS is an analytical technique used for elemental determinations, as shown in figure (4.7), (Kattan, 2018).

Figure 4.7: Soil sample analysis

4.2.1.4 Vegetables analysis

The collected vegetable samples were washed with distilled water to remove dust particles. After that, samples were cut into small pieces. The vegetables part was taken, and dried in an oven at 50 °C. After drying, the samples were ready for acid digestion. The weight of each vegetable was 0.5 grams. Then 5 ml of 65% pure nitric acid were added to each sample. The mixture was then digested till the transparent solution was achieved. The digested samples were filtered using CA sterile syringe filters which diameter was 30 mm and the pore size 0.22 µm (Kattan, 2018). Determination of heavy metals in the filtrate of vegetables was achieved using ICP-MS, as show in figure (4.8, 4.10).

Figure 4.8: vegetable's sample analysis

4.2.1.5 Water analysis

Water samples were tested for its content by the addition of 65% pure nitric acid. 2 ml of the sample were taken for analysis. They were analyzed by the use of ICP-MS as well (Aweng E.R, et al., 2011).

4.2.1.6 UDC analysis

The same procedure in soil's analysis part (4.2.1.1)

4.2.2 pH-soil analysis

The same sample in part ICP-Ms soil analysis (4.2.1.1) that had been mixed and stirred, I will be measured pH by pH meter (as shown figure (4.11).

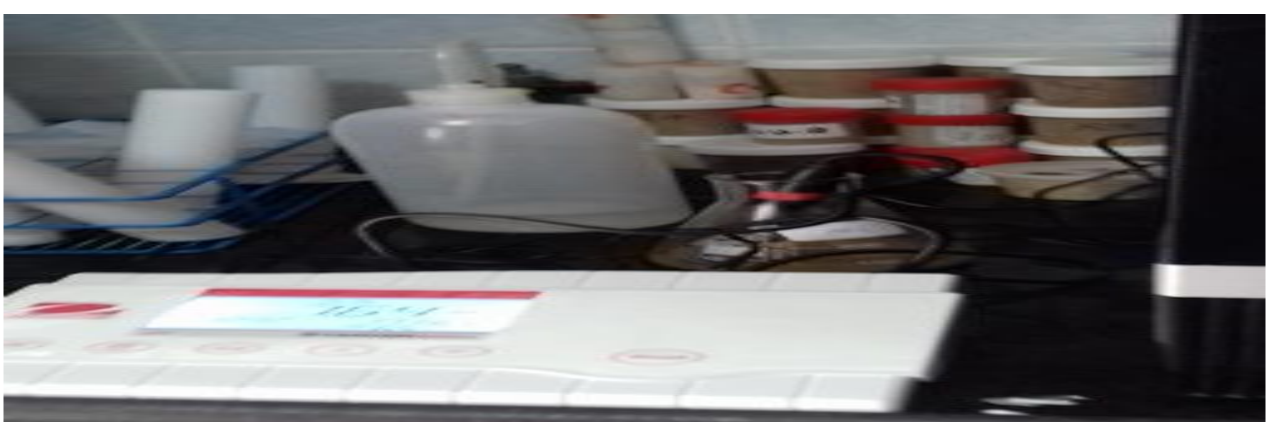

Figure 4.9: pH Analysis

4.3 ICP-MS principle

Regarding ICP-MS methodology, ICP- MS combines a high temperature inductively coupled plasma source with a mass spectrometer. The ICP source converts the atoms of the elements in the samples to ions which are then separated and detected by the mass spectrometer. It can measure trace elements as low as one part per trillion (as shown figure (4.10), (Kattan, 2018).

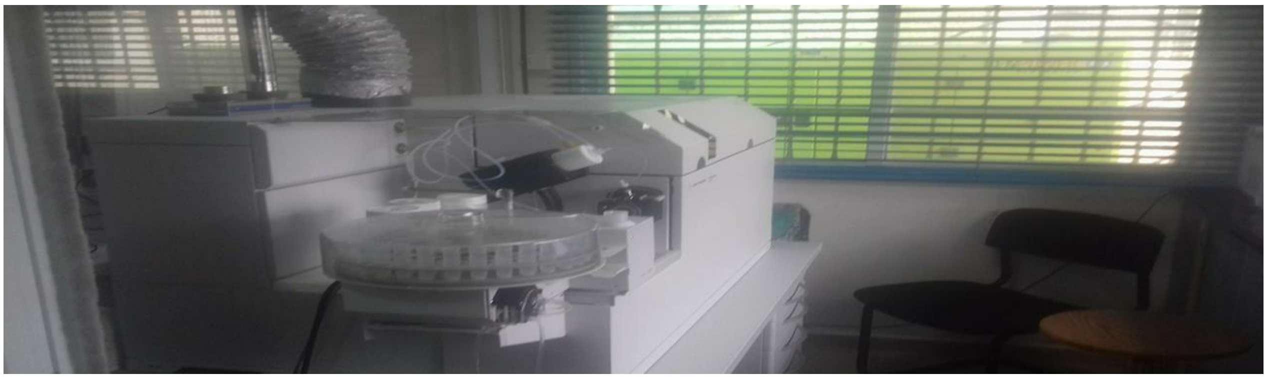

Figure 4.10: Inductively Coupled Plasma Mass Spectrometry (ICP-MS)

4.4 Statistical analysis

The data of heavy metals concentrations were assessed using Microsoft Excel. Data was also interpreted using the appropriate mathematical equations with regards to the initial environmental issue which is the presence of heavy metals in vegetable, leafy vegetables and soil. Besides that, various graphs and figures were plotted to demonstrate the concentrations of heavy metals in the chosen samples and to compare samples for both contaminated and UN contaminated with UDC. Some heavy metals were chosen according to its availability and values in the results. The path of the calculation process that was relied upon is the conversion of units regarding the concentration of chosen heavy metals. As ICP-MS provides the concentration in parts per billion (ppb), it was then converted to explain this ratio mg/kg in order to allow the comparison to WHO standards which are mostly expressed as mg/kg for leafy vegetables (Kattan, 2018).

Chapter Five
Result & Discussion

Chapter Five:

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5. Result and Discussion

5.1 ICP-MS Result and Discussion

5.1.1 UDC Part

According to table 5.1 the concentration of all metals Pb, Ba, Th, Cu, Mn, Co, Se, As in mg/kg in UDC sample Higher & excessed WHO Limit (mg/kg) of compost that related of each element that mean the source of UDC non-natural source only from animal or plant .

Table 5.1 : Metals concentration in UDC

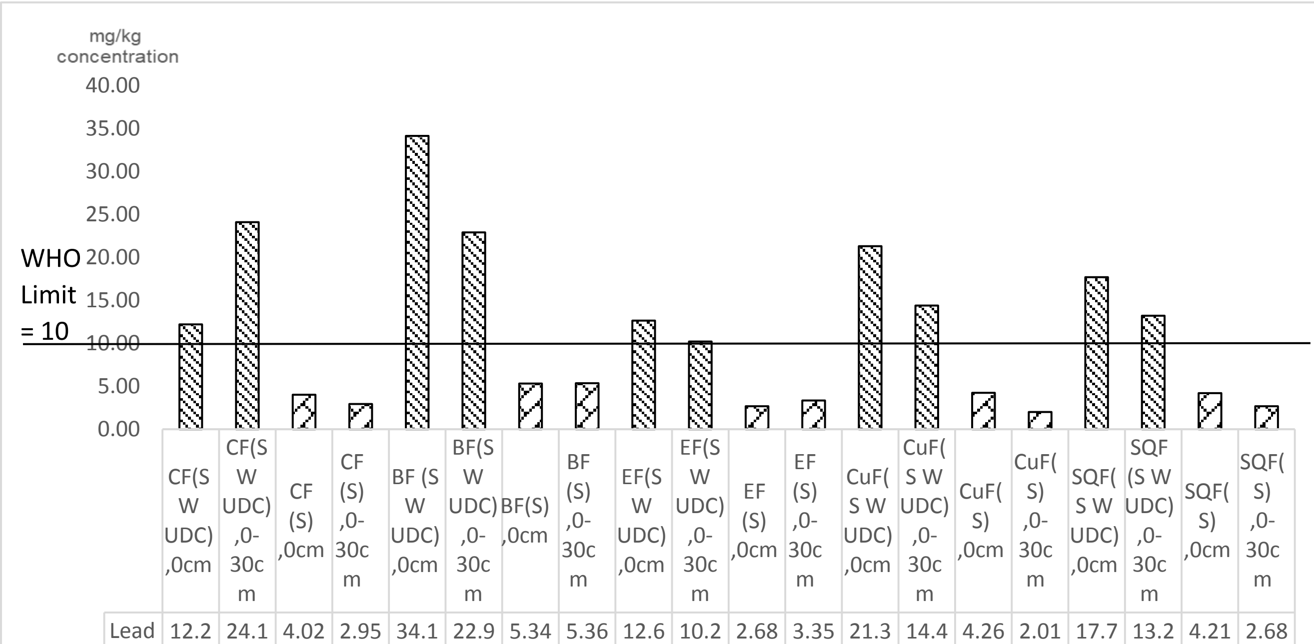
	Metals Concentration (mg/kg)							
Sample Name	**Pb**	**Ba**	**Th**	**Cu**	**Mn**	**Co**	**Se**	**As**
UDC	70.345 ±1.180	152.032 ±2.505	13.241 ±0.861	70.821 ±3.562	750.361 ±5.521	16.143 ±0.004	10.321 ±0.681	0.756 ±0.002
WHO limit For compost	50	100	10	50	600	15	4	0.5

5.1.2 Soil part

5.1.2.1 Lead concentration in soil samples

5.1.2.1.1 Field Samples

Figure (5.1) shows the levels of Lead in Corn Field (CF), Bell pepper Field (BF), Eggplant Field (EF), Cucumber Field (CuF), Squash Field (SQF). Lead concentration in CF, BF, EF, CuF, and SQF soil)S) at 0 cm was ranged between 4.020 mg/kg and 5.344 mg/kg. On the other hand, lead concentration for samples taken from 0-30 cm mixture was ranged between 2.010 mg/kg and 5.360 mg/kg .Lead concentration in samples CF, BF, EF, CuF, SQF (S) With (W) UDC) at 0 cm was (12.211mg/kg; 34.144 mg/kg; 12.651; 21.310 mg/kg, 17.703 mg/kg) respectively. Whereas, lead concentration for 0-30cm samples were 24.106 mg/kg; 22.915 mg/kg; 10.216 mg/kg; 14.402 mg/kg; 13.219 mg/kg respectively. Lead concentration in the CF, BF, EF, CuF, SQF (S W UDC) samples were very high and exceeds the limit given by WHO/FAO which is 10 mg/kg. In fact, Lead is widely used in batteries, cable sheaths, machinery manufacturing, shipbuilding, light industry, lead oxide, radiation protection and other industries such as telecommunications industries, metallurgy, chemical industry, railways, transportation, construction, weapons (metalpedia,2013). It is clear that UDC main source does not come from Animal or Agricultural sources, but it comes from other the source that contains high concentration of lead. However, Lead (Pb) concentrations for all soil reference field samples for CF, BF, EF, CuF, and SQF (S) at 0 cm and 0-30 cm did not exceed the limits given by FAO/WHO.



5.1: Lead concentration (mg/kg) for soil UDC field samples and for the reference soil fields. for surface and for 0-30 cm samples that were related to vegetables types (corn (c), Bell pepper(B), Eggplant (E), Cucumber (Cu), Squash (SQ) & soil,. as compared to WHO.

5.1.2.1.2 In situ experiment samples

Lead concentrations in situ soil samples is shown in Figure (5.2). Lead (Pb) concentrations in Mint Pot (MiP) and Sage pot (SaP) (S W UDC) were 16.865 mg/kg 15.779 mg/kg, respectively. These two values were above the permissible safety limits of 10 mg/kg that was set by FAO/WHO. For the soil references samples (SR) for both Mint (Mi) and Sage (Sa) was (3.205 mg/kg). This value was below the FAO/WHO limit for lead. According to these results, it is believed that contamination found in MIP and SaP (S W UDC) is directly related to UDC addition. UDC soils are highly polluted with lead as described in the previous part (5.1.1.1.1). The lower concentration of Lead (Pb) in SR for Mi and Sa had led to the main source of Lead from air or original soil.

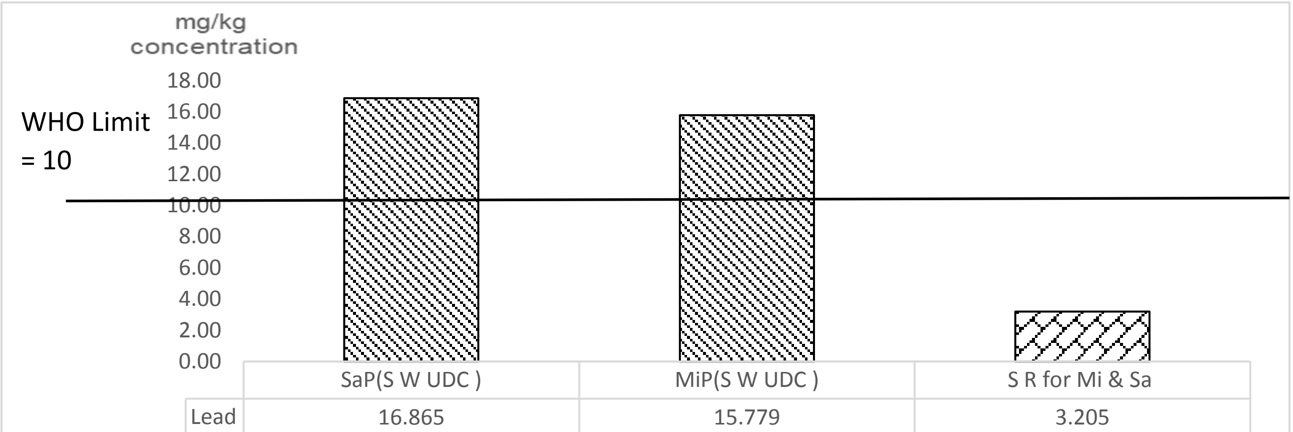


Figure 5.2: Lead concentration (mg/kg) for soil UDC in situ experiments

5.1.2.2 Barium concentration in soil samples

5.1.2.2.1 Field samples

Regarding to Barium concentrations shown in figure (5.3); in general , it was also found that CF, BF, EF, CuF, SQF (S W UDC) at 0 cm was (175.962 mg/kg; 151.793 mg/kg; 125.384 mg/kg ; 103.193 mg/kg;122.875 mg/kg) respectively. On the other hand, Barium concentration for 0-30 cm mixture samples were (230.295 mg/kg; 136.639 mg/kg; 62.641 mg/kg; 70.178; 264.692 mg/kg) respectively. Barium concentration in CF, BF, EF, CuF, and SQF (S) samples at 0 cm was ranged from 7.673 mg/kg to 21.703 mg/kg. On the other hand, lead concentration for samples taken from 0-30cm mixture was ranged from 7.848 mg/kg and 34.028 mg/kg. Barium concentration in CF, BF, EF, CuF, SQF (S W UDC) samples were very high and exceeds the limit given by WHO/FAO which is limit (100mg/kg). It is important to say UDC main source does not come from Animal or Agricultural sources, but it comes from other source that contains high concentration of Barium. It also has many industrial applications. Although pure barium metal can be used to remove undesirable gases from electronic vacuum tubes, barium's compounds are much more important to industry (Hermann,2007) . Barium sulfate is a component of lithopone, a white pigment used in paints.

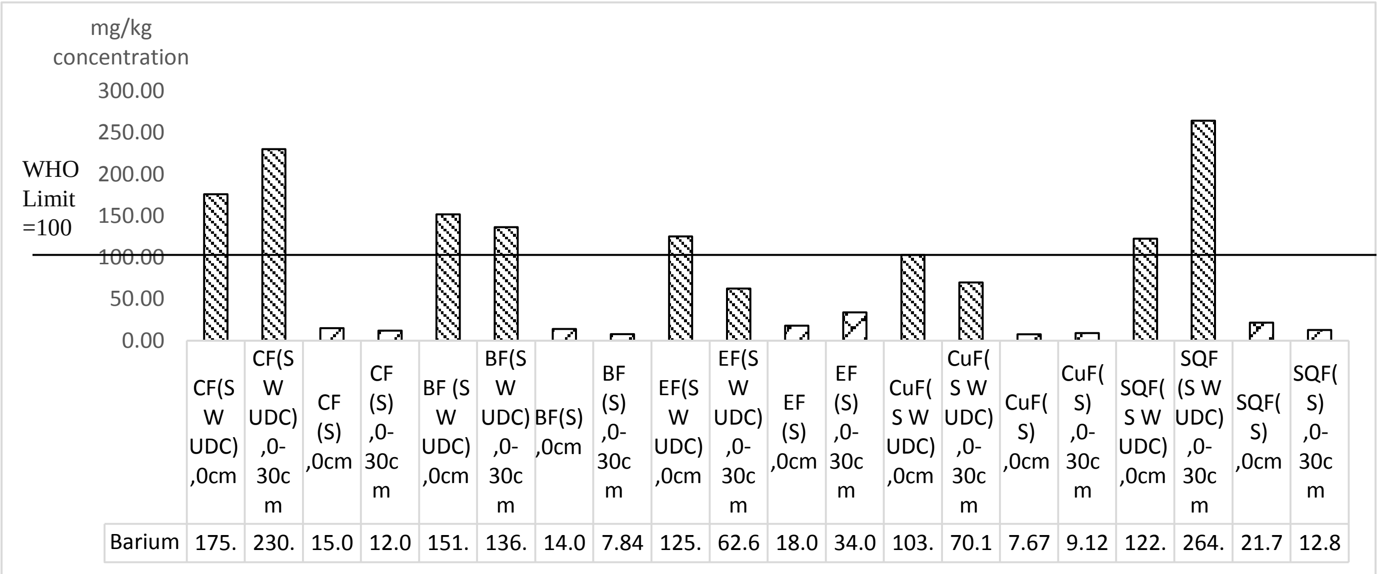


Figure 5.3: Barium concentration (mg/kg) for soil UDC field samples and for the reference soil fields. for surface and for 0-30 cm samples that were related to vegetables types (corn (c), Bell pepper(B), Eggplant (E), Cucumber (Cu), Squash(SQ) and soil,. as compared to WHO.

Barium carbonate is used in the production of optical glass, ceramics, glazed pottery, and specialty glassware. Also, the bright yellow-green colors in fireworks and flares come from barium nitrate. Motor oil detergents, which keep engines clean, contain barium oxide and barium hydroxide (Lide,2004). Barium concentrations for all soil reference field samples for CF, BF, EF, CuF, and SQF (S) at 0 cm and 0-30cm did not exceed the limits given by FAO/WHO.

5.1.2.2.2 In situ experiment samples

The observed Barium concentration of leached from SaP and MiP (S W UDC) were (133.240mg/kg; 115mg/kg, respectively, as shown in figure (5.4)) and they were compared to the recommended limits established by FAO/ WHO and S R for Mi and Sa which was (23.063 mg/kg, as shown in figure (5.4)). In regards to previous Comparison, Barium concentration in SaP and MIP (S W UDC) excessed the allowable WHO/FAO safety limits and Barium concentration in S R, but SR does not excessed the allowable WHO/FAO safety limits.

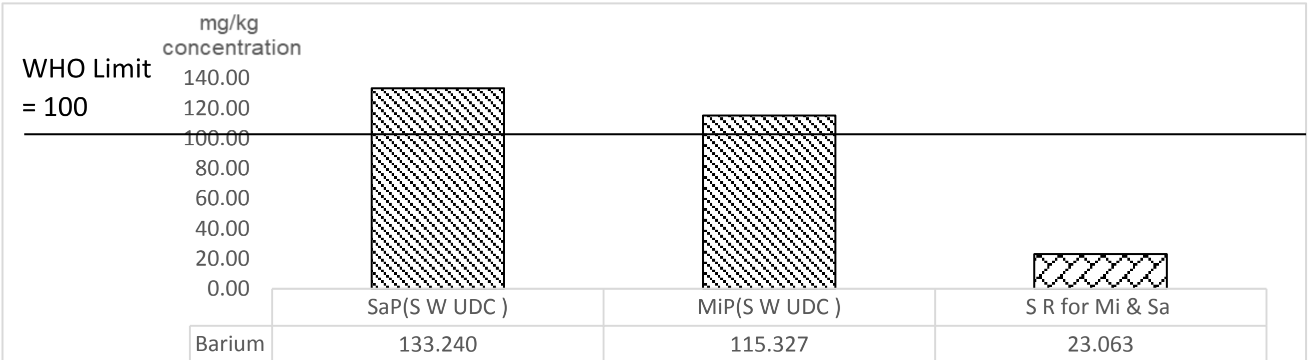


Figure 5.4 : Barium concentration (mg/kg) for soil UDC in situ experiments

5.1.2.3 Thallium concentration in soil samples

5.1.2.3.1 Field samples

From the present analysis, it can be seen that Thallium concentration in soil samples CF, BF, EF, CuF, SQF (S W UDC) at 0 cm was（11.926 mg/kg; 22.042 mg/kg; 23.200, mg/kg; 24.932 mg/kg ; 13.287 mg/kg; respectively） and at 0-30 cm was (12.910 mg/kg; 11.600mg/kg; 16.020 mg/kg; 14.243 mg/kg;12.959 mg/kg ; respectively) in all the field exist FAO and WHO limit (5 mg/kg) and concentration in leachate soil samples CF, BF, EF, CuF, SQF (S) at

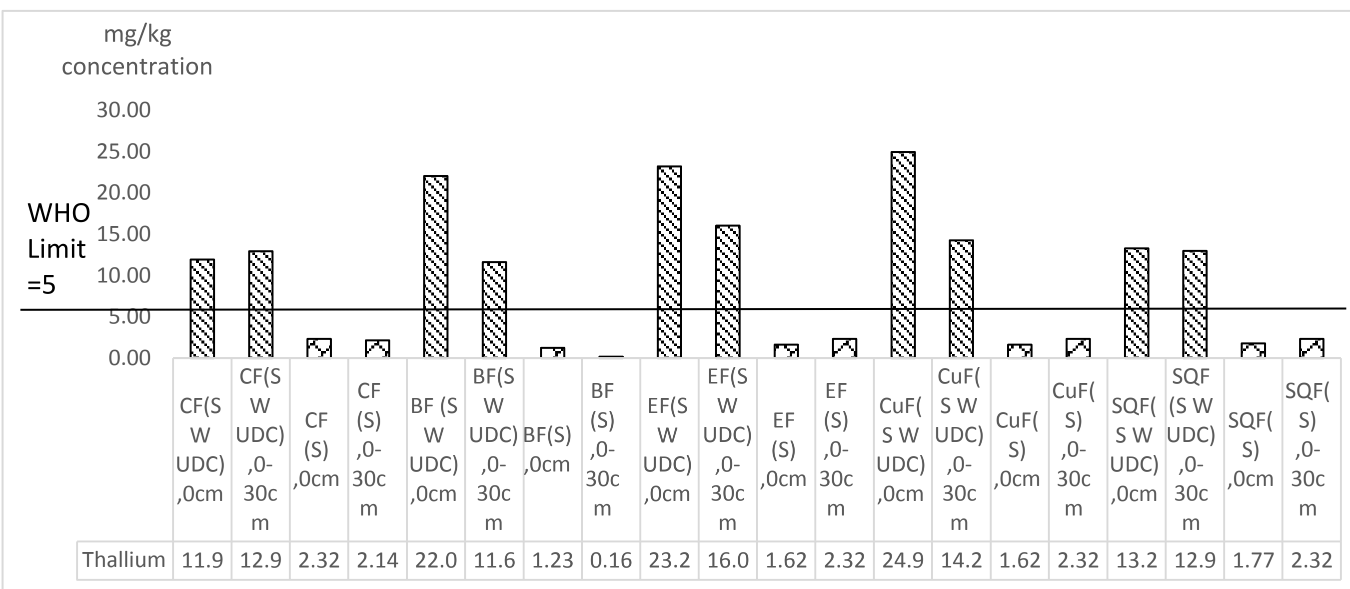


Figure 5.5: **Thallium concentration** (mg/kg) for soil UDC field samples and for the reference soil fields. for surface and for 0-30 cm samples that were related to vegetables types (corn (c), Bell pepper(B), Eggplant (E), Cucumber (Cu), Squash(SQ) and soil,. as compared to WHO.

0 cm was ranged from 1.234 mg/kg and 2.320 mg/kg and at 0-30 cm was ranged from 0.168 mg/kg and 2.320 mg/kg (see figure 5.5). Still, all of these Thallium concentration is harmful or Has any effects above FAO and WHO limit. In addition, it can be said that UDC main source doesn't come only from Animal or Agricultural or both sources, but it comes from a main source which is the application of Thallium: such as Optics: Thallium has been used in the production of high-density glasses that have low melting points in the range of 125 and 150 °C; Electronics such as : photo resistors , thallium doping is the sodium iodide crystals in gamma radiation detection devices, a bolometer for infrared detection; High-temperature superconductivity such as: magnetic resonance imaging, storage of magnetic energy, magnetic propulsion, and electric power generation and transmission (Percival ,1930, et al.1956, Nayer, et al .1977, Galvanarzate, et al. 1998, Rodney,). Finally, the concentration of Thallium in CF, BF, EF, CuF, and SQF (S) at 0 cm and 0-30 cm do not exceed FAO/WHO limit (5mg/kg) that may come from original soil or from animal and agricultural manure.

5.1.2.4 Copper concentration in soil samples

5.1.2.4.1 Field samples

Similarly, Copper level in soil samples CF, BF, EF, CuF, SQF (S W UDC) at 0 cm was (17.656 mg/kg; 12.342mg/kg ;13.709 mg/kg ;10.766mg/kg ;33.246 mg/kg, respectively) and 0-30 cm was (34.870mg/kg; 10.112 mg/kg; 7.110 mg/kg; 9.000 mg/kg ;27.243 mg/kg, respectively) higher than WHO that equals 6 mg/Kg and CF, BF, EF, CuF, SQF (S) at 0 cm was ranged from 1.111mg/kg to 4.559 mg/kg and at 0-30cm ranged from 1.330 mg/kg to 2.873 mg/kg , as shown in figure(5.6).

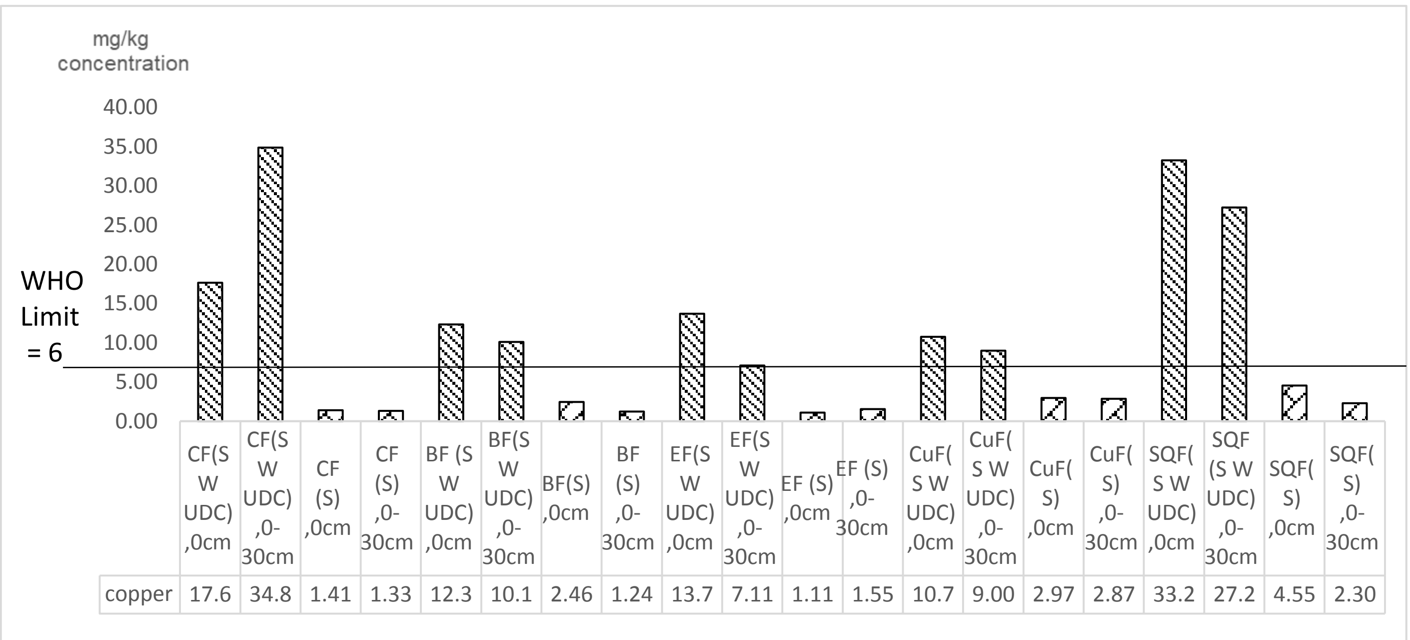


Figure 5.6 : Copper concentration (mg/kg) for soil UDC field samples and for the reference soil fields. for surface and for 0-30 cm samples that were related to vegetables types (corn (c), Bell pepper(B), Eggplant (E), Cucumber (Cu), Squash(SQ) and soil,. as compared to WHO.

This result has shown large concentration of copper in CF, BF, EF, CuF, SQF (S W UDC) that has led to that the UDC main source doesn't come only from Animal or Agricultural or both sources, but it comes from other source that leads to Large amount of concentration, Example of copper main source: Electrical Copper wires and Devices such as electromagnets, integrate circuits and printed circuit boards and Roofing and plumbing and tube and pipe products (Callister, 2013). Finally, the value of copper in CF, BF, EF, CuF, SQF (S) at 0 cm and 0-

30cm was very lower than WHO limit that has led to main source of copper from Animal or Agricultural manure or both sources or original soil.

5.1.2.4.2 In situ experiment samples

From experiment in home garden; copper values of SaP and MiP (S W UDC) were (9.455mg/kg; 7.572 mg/kg, respectively) which is higher than WHO that equals 6 mg//Kg and SR for Mi and Sa (0.756 mg/kg), respectively, as shown in figure (5.7). This result had shown large concentration of copper in SaP and MiP (S W UDC) that had led to the same reason that related to UDC in previous part (5.1.1.4.1). Finally, the value of copper in SR for Mi and Sa very low and lower than WHO Limit that had led to main source of copper from an original soil.

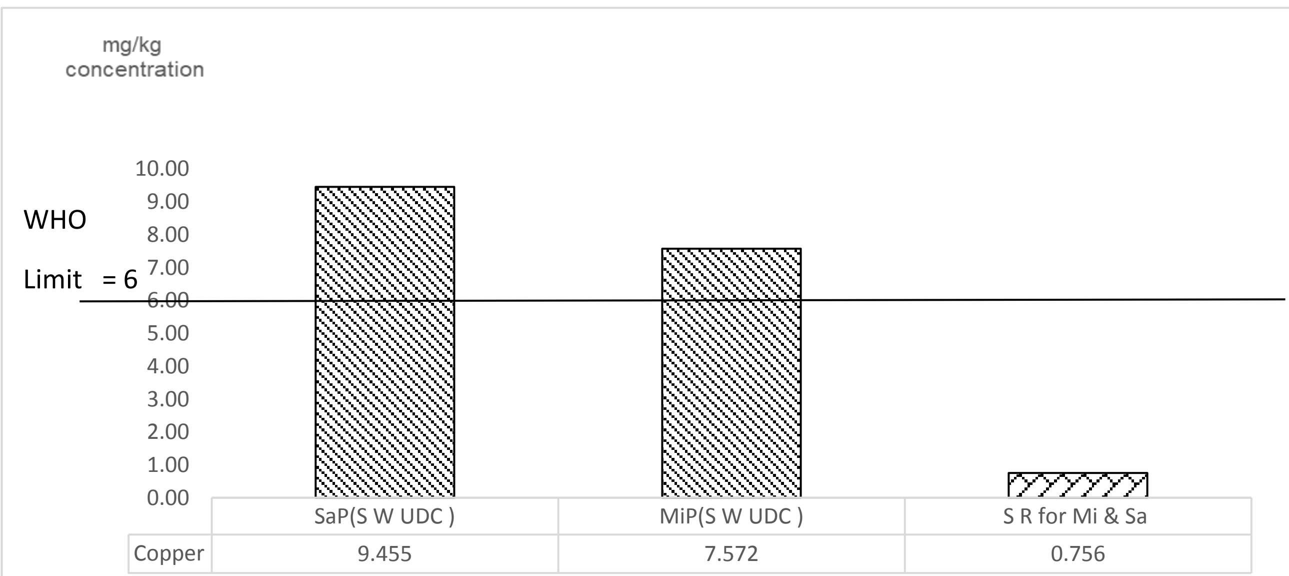


Figure 5.7: Copper concentration (mg/kg) for soil UDC in situ experiments.

5.1.2.5 Manganese concentration in soil samples

5.1.2.5.1 Field samples

From figure (5.8), it can be noticed that Manganese concentration in leached from CF, BF, CuF , SQF (S W UDC) samples at 0 cm was (741.838mg/kg; 951.016 mg/kg ; 572.315 mg/kg; 579.683 mg/kg, respectively) and at 0-30cm was (1075.468 mg/kg; 744.514 mg/kg; 545.220 mg/kg;1099.454 mg/kg, respectively) which exceeded the permissible limit set by WHO /FAO(437mg/kg) and leached from CF, BF, CuF , SQF(S) samples at 0 cm was ranged from 105.889 mg/kg to 128.587 mg/kg and at 0-30cm was ranged from 36.348 mg/kg to 109.044 mg/kg. Moreover, Manganese concentration of sample from EF (S W UDC) at 0 cm (478.976 mg/kg) exceeded WHO/FAO limit and EF(S) at 0cm (73.053 mg/kg). Also, the concentration of EF (S W UDC) at 0-30 cm was (273.820 mg/kg) which exceeded EF(S) at 0-30cm that was (145.392 mg/kg), but it did not exceed WHO / FAO which is (437mg/kg) that the amount of UDC in select EF (S W UDC) sample at 0-30 cm was not large. The highest concentrations of Manganese was in CF, BF, CuF, SQF, EF (S W UDC) at 0cm and 0-30cm

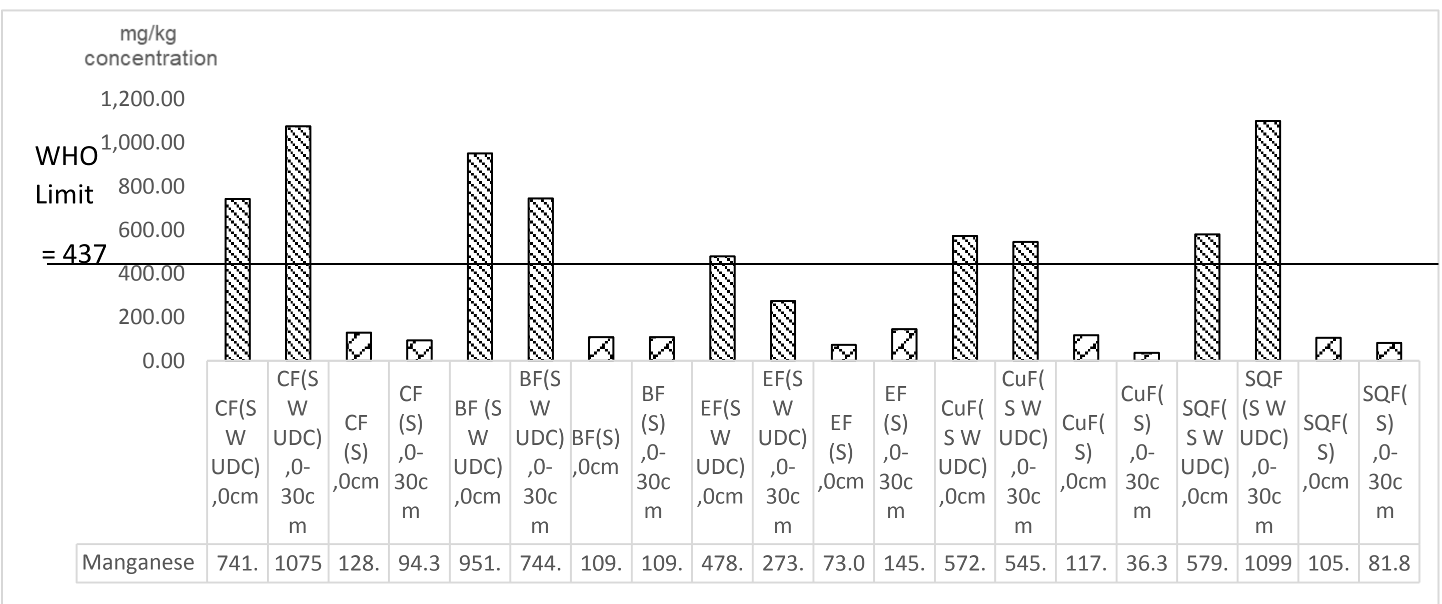


Figure 5.8: Manganese concentration (mg/kg) for soil UDC field samples and for the reference soil fields. for surface and for 0-30 cm samples that were related to vegetables types (corn (c), Bell pepper(B), Eggplant (E), Cucumber (Cu), Squash(SQ) and soil,. as compared to WHO

compared to another because the component that was used in UDC hadn't been come only from animal and agricultural manure, but it had been used as main application source of Manganese in UDC such as: Manganese is an important alloying agent: In steels, manganese improves the rolling and forging qualities and hardenability and in aluminum and antimony, manganese additions forms highly ferromagnetic compounds ; Manganese dioxide or pyrolusite is used for: to depolarize dry cells and to decolorize green glass containing iron and to prepare oxygen and chlorine and to assist the drying of black paints; Manganese permanganate is a powerful oxidizing agent used in: Quantitative analysis techniques and Medicine （AZoM Material，2016）. Finally, its concentration in CF, BF, CuF, SQF(S) at 0cm and 0-30cm that hasn't been subjected to UDC did not exceed the safe limits established by FAO/WHO that had led to main source of Manganese from Animal or Agricultural manure or both sources or Dust or original soil.

5.1.2.5.2 In situ experiment samples

It was found that Manganese level in SaP and MiP (S W UDC) were (534.089 mg/kg ;450.486 mg/kg, respectively, as shown in figure (5.9)) which is higher than FAO/WHO Limit (437mg/kg) and S R for Mi and Sa was (62.108 mg/kg, respectively, as shown in figure (5.9)) because SaP and MiP had been subjected to UDC, but S R for Mi and Sa is lower than FAO/WHO Limit because it hadn't been subjected to UDC.

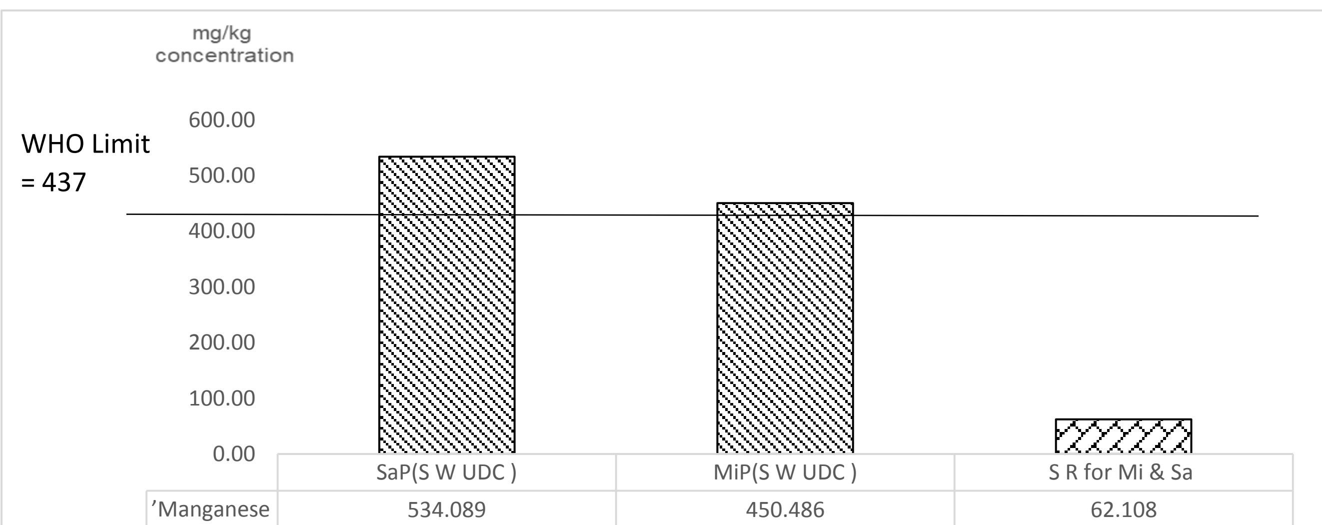


Figure 5.9: Manganese concentration (mg/kg) for soil UDC in situ experiments.

5.1.2.6 Selenium concentration in soil samples

5.1.2.6.1 Field samples

It was found that selenium concentration of leached from samples of CF, BF, EF, CuF, SQF(S W UDC) at 0 cm was (5.860 mg/kg;12.871 mg/kg; 3.621 mg/kg; 7.600 mg/kg; 3.894 mg/kg, respectively, as shown in figure(5.10)) and at 0-30cm was (10.497 mg/kg; 10.536 mg/kg; 2.781 mg/kg; 5.056 mg/kg;8.748 mg/kg), respectively, as shown in figure(5.10)) which is higher than FAO/WHO (2mg/kg) and samples from CF, BF, EF, CuF, SQF (S) at 0 cm ranged from 1.557mg/kg to 0.678mg/kg and at 0-30cm ranged from 0.332mg/kg to 1.347 mg/kg, as shown in figure(5.10) ,because the main source of UDC hadn't been come from animal and agricultural manure only due to Selenium has good photovoltaic and photoconductive properties, and it is used extensively in electronics, such as photocells, light

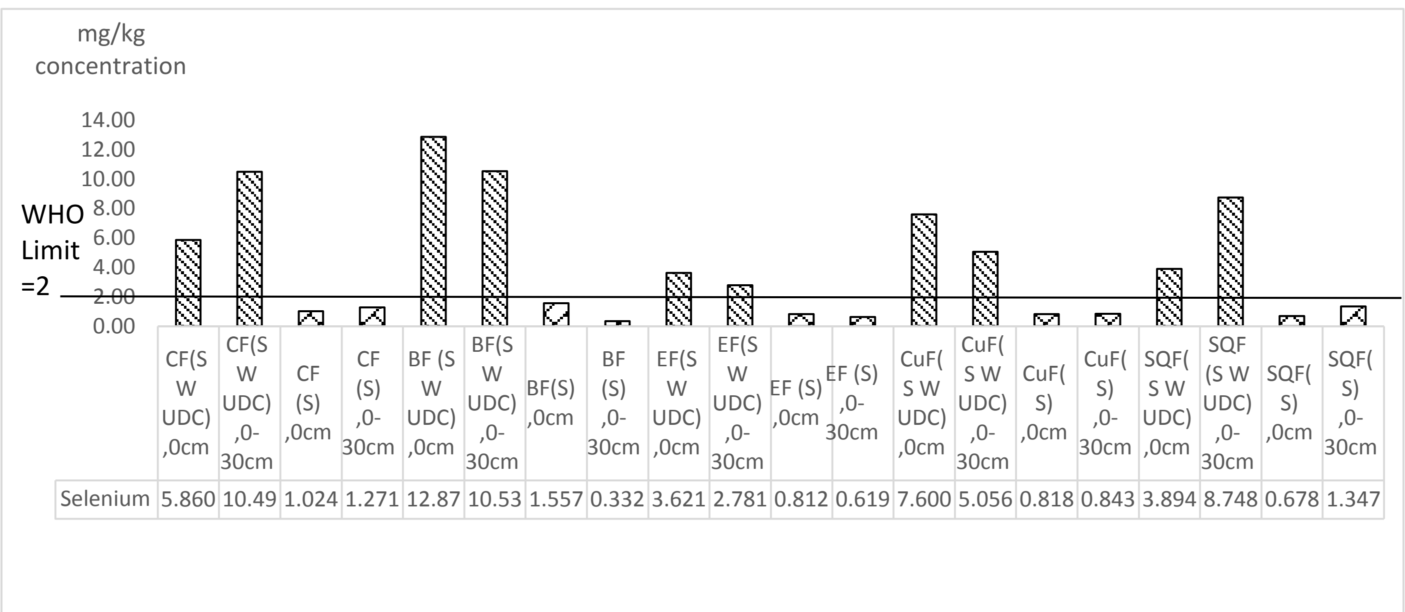


Figure 5.10: Selenium (mg/kg) for soil UDC field samples and for the reference soil fields. for surface and for 0-30 cm samples that were related to vegetables types (corn (c), Bell pepper(B), Eggplant (E), Cucumber (Cu), Squash(SQ) and soil,. as compared to WHO

meters and solar Cells. The second largest use of selenium is in the glass industry: selenium is used to remove color from glass, to give a red color to glasses and enamels. The third min use, taking about 15% is sodium selenite for animal feeds and food supplements. Selenium can also find applications in photocopying, in the toning of photographs. Other uses of selenium are in metal alloys such as the lead plates used in storage batteries and in rectifiers to convert AC current in DC current. Selenium is used to improve. The abrasion resistance in vulcanized rubbers （Lenntech，2016）. However, selenium concentration is found in leached from CF, BF, EF, CuF, and SQF (S) but below WHO/FAO recommended limit because Selenium occurs naturally in the environment. It is released through both natural processes and human activities.

5.1.2.6.2 In situ experiment samples

From the present analysis of Experiment at home garden (see figure (5.11)), it can be noticed that selenium concentration in leached from SaP and MiP (S W UDC) were (6.485 mg/kg; 3.246 mg/kg, respectively) that had been subjected to UDC exceed WHO/FAO limit (2) and S R for Mi and Sa was (0.000 mg/kg) that hadn't been subjected to UDC. However, S R for Mi and Sa doesn't exceed WHO/FAO limit.

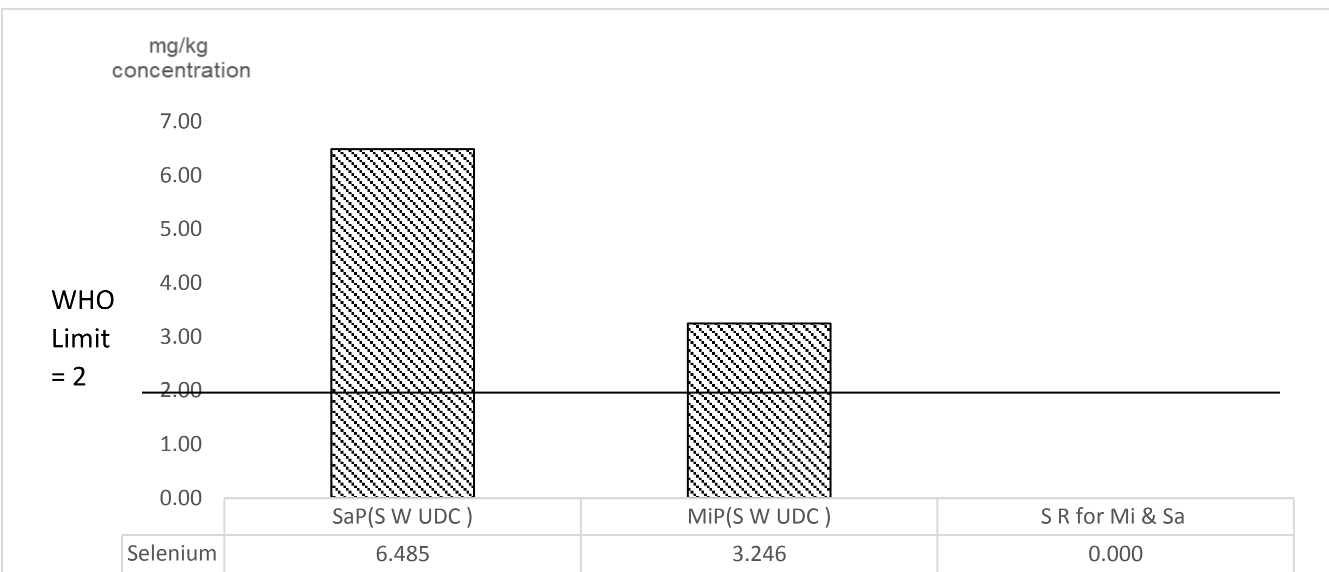
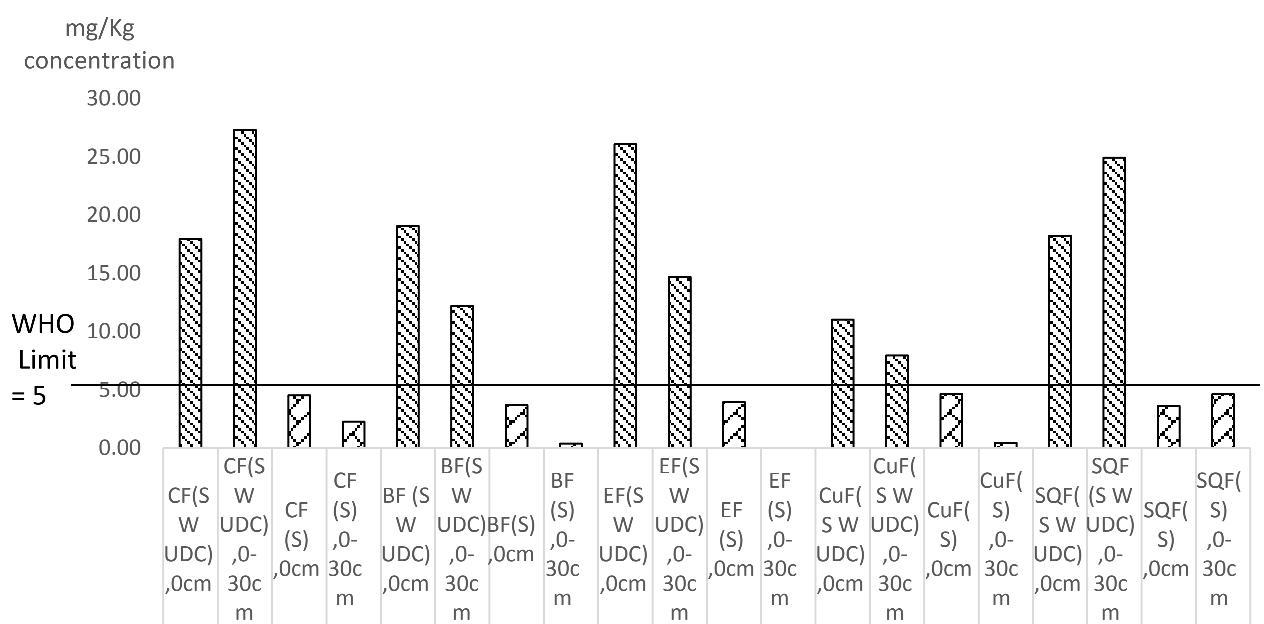


Figure 5.11: Selenium concentration (mg/kg) for soil UDC in situ experiments.

5.1.2.7 Cobalt concentration in soil samples

5.1.2.7.1 Field samples

as shown in figure(5.12), In general Cobalt values of CF, BF, EF, CuF, SQF (S W UDC) at 0 cm was (17.934mg/kg; 19.56 mg/kg; 26.062 mg/kg; 11.019 mg/kg; 18.219 mg/kg , respectively) and 0-30cm was (27.315 mg/kg ;12.197 mg/kg ; 14.655 mg/kg ; 7.943 mg/kg ; 24.917 mg/kg, respectively) higher than WHO/FAO that equal 5 mg//Kg and CF, BF, EF, CuF, SQF (S) at 0 cm ranged between (3.598 mg/kg - 4.627 mg/kg) and 0-30cm from 0.000 mg/kg to 4.606 mg/kg . This result had been shown large concentration of cobalt in CF, BF, EF, CuF, SQF (S W UDC) at 0 cm and 0-30cm compare to WHO/FAO limit and CF, BF, EF, CuF, SQF (S) that leads to UDC main source doesn't come only from Animal or Agricultural manure or both sources, but it comes from other source, such as application that form Cobalt main source : Turbine blades for jet engines, hard facing machine parts, exhaust valves, and gun barrels, cutting applications and mining tools ,magnetic recording media,



	CF(S W UDC) ,0cm	CF(S W UDC) ,0-30cm	CF (S) ,0cm	CF (S) ,0-30cm	BF (S W UDC) ,0cm	BF(S W UDC) ,0-30cm	BF(S) ,0cm	BF (S) ,0-30cm	EF(S W UDC) ,0cm	EF(S W UDC) ,0-30cm	EF (S) ,0cm	EF (S) ,0-30cm	CuF(S W UDC) ,0cm	CuF(S W UDC) ,0-30cm	CuF(S) ,0cm	CuF(S) ,0-30cm	SQF(S W UDC) ,0cm	SQF (S W UDC) ,0-30cm	SQF(S) ,0cm	SQF(S) ,0-30cm
Cobalt	17.9	27.3	4.51	2.25	19.0	12.1	3.67	0.36	26.0	14.6	3.93	0.00	11.0	7.94	4.62	0.43	18.2	24.9	3.59	4.60

Figure 5.12: Cobalt concentration (mg/kg) for soil UDC field samples and for the reference soil fields. For surface and for 0-30 cm samples that were related to vegetables types (corn (c), Bell pepper (B), Eggplant (E), Cucumber (Cu), Squash(SQ) and soil,. as compared to WHO.

Electric motors, (thebalance,2008) Cobalt chemicals are used in the metallic cathodes of rechargeable batteries, as well as in petrochemical catalysts, ceramic pigments, and glass decolorizers . Finally, the value of copper in CF, BF, EF, CuF, SQF (S) at 0 cm and 0-30cm lower than WHO/FAO limit that led to main source of copper from Animal or Agricultural manure or both sources or original soil.

5.1.2.7.2 In situ experiment samples

As shown in figure (5.13),Cobalt values of SaP and MiP (S W UDC) were (16.956mg/kg; 16.022 mg/kg, respectively) higher than WHO/FAO that equal 5mg//Kg and SR for Mi and Sa was (0.932 mg/kg).This result had been shown large concentration of copper in SaP and MiP (S W UDC) lead to UDC main source Doesn't come only from Animal or Agricultural manure or both sources, but it come from other source that lead to large amount of concentration. Finally, the value of cobalt in SR for Mi and Sa (0.932 mg/kg) lower than WHO/FAO limit that lead to main source of cobalt from dust or air or original soil.

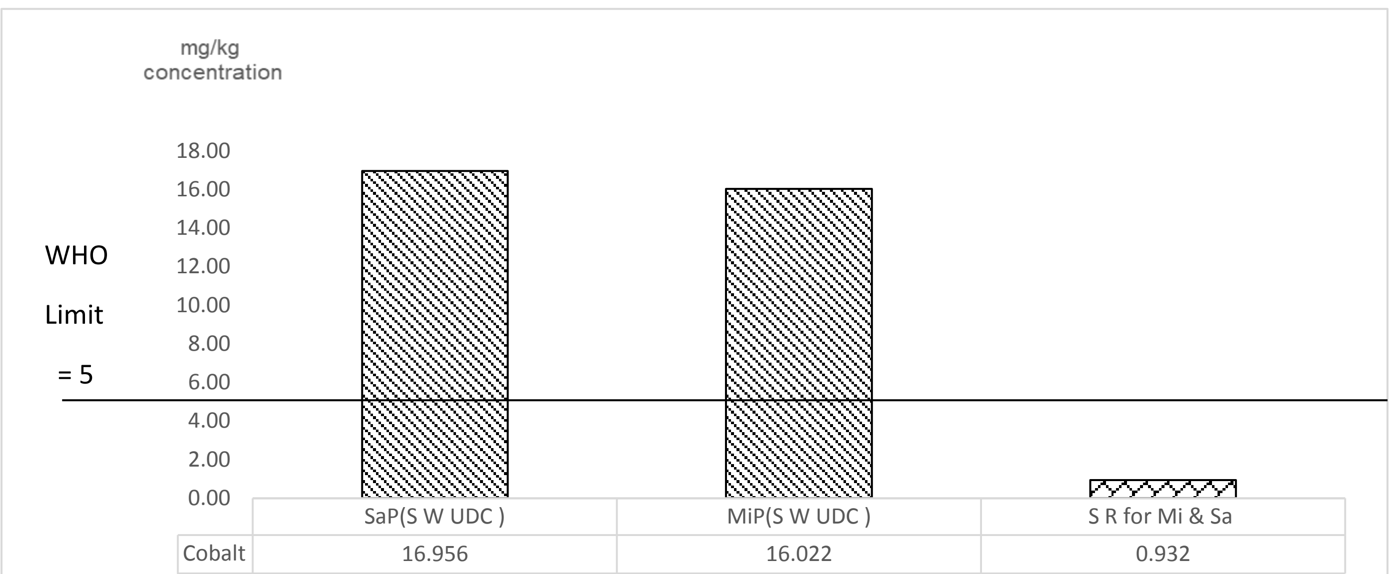
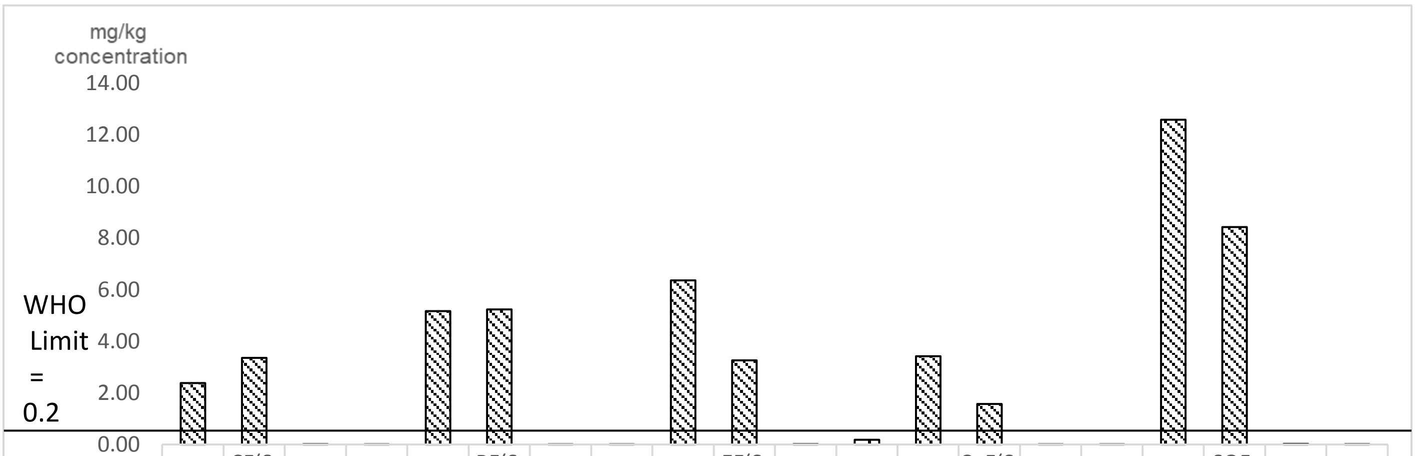


Figure 5.13: Cobalt concentration (mg/kg) for soil UDC in situ experiments.

5.1.2.8 Arsenic concentration in soil samples

5.1.2.8.1 Field samples

From figure (5.14), which shows Arsenic (As) concentration in all soil samples, it can be seen that as levels CF, BF, EF, CuF, SQF (S W UDC) at 0 cm was (2.384mg/kg;5.172 mg/kg; 6.362 mg/kg; 3.423 mg/kg; 12.58 mg/kg, respectively) and at 0-30cm was (3.360 mg/kg;5.237 mg/kg;3.264 mg/kg;1.573 mg/kg ;8.427mg/kg, respectively) are higher than WHO/FAO limit(0.2mg/kg) and CF, BF, EF, CuF ,SQF (S) at 0 cm ranged from 0.007 mg/kg and 0.026 mg/kg and at 0-30 cm ranged from 0.007 mg/kg and 0.186 mg/kg .The presented results of high Arsenic level in leachate (S W UDC) indicates that Arsenic content in UDC is



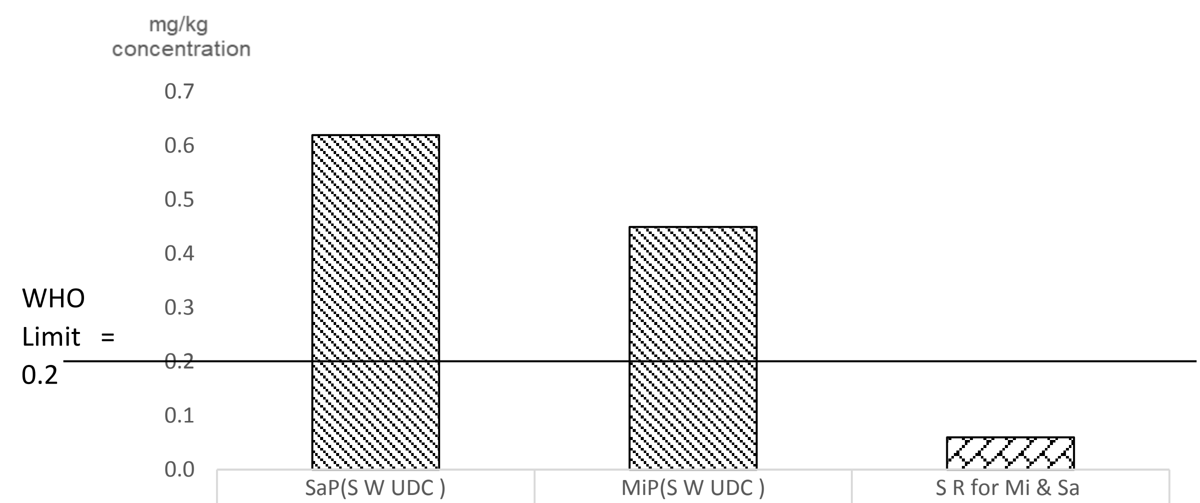
	CF(S W UDC) ,0cm	CF(S W UDC) ,0-30cm	CF (S) ,0cm	CF (S) ,0-30cm	BF (S W UDC) ,0cm	BF(S W UDC) ,0-30cm	BF(S) ,0cm	BF (S) ,0-30cm	EF(S W UDC) ,0cm	EF(S W UDC) ,0-30cm	EF (S) ,0cm	EF (S) ,0-30cm	CuF(S W UDC) ,0cm	CuF(S W UDC) ,0-30cm	CuF(S) ,0cm	CuF(S) ,0-30cm	SQF(S W UDC) ,0cm	SQF (S W UDC) ,0-30cm	SQF(S) ,0cm	SQF(S) ,0-30cm
Arsenic	2.384	3.360	0.017	0.012	5.172	5.237	0.007	0.007	6.362	3.264	0.018	0.186	3.423	1.573	0.010	0.008	12.58	8.427	0.026	0.016

Figure 5.14: Arsenic concentration (mg/kg) for soil UDC field samples and for the reference soil fields. For surface and for 0-30 cm samples that were related to vegetables types (corn (c), Bell pepper (B), Eggplant (E), Cucumber (Cu), Squash (SQ) and soil as compared to WHO.

relevant to that Comes from major source application of Arsenic in making special types of glass, as a wood preservative and, lately, in the semiconductor gallium arsenide, which has the ability to convert electric current to laser light. Arsine gas AsH_3, has become an important dopant gas in the microchip industry, although it requires strict guidelines regarding its use because it is extremely toxic. During the 18th, 19th, and 20th centuries, a number of arsenic compounds have been used as medicines; copper aceto-arsenite was used as a green pigment known under many different names (lenntech,2016). However, CF, BF, EF, CuF (S) still lies below the allowable limit for soil set by FAO/WHO because Arsenic can be found naturally on earth in small concentrations. It occurs in soil and minerals and it may enter air, water and land through wind-blown dust and water run-off.

5.1.2.8.2 In situ experiment samples

It can be noticed that Arsenic concentration at home garden of SaP and MiP (S W UDC) were (0.620mg/kg ;0.449 mg/kg, respectively, as shown in figure (5.15)) are presented in relatively high concentration compared to FAO/WHO limit (0.2 mg/kg) and S R for Mi and Sa was (0.06mg/kg, as shown in figure (5.15)). The presented results of high Arsenic concentration in SaP and MiP (S W UDC) leachate is relevant to commination that has come from UDC, This UDC has come from same source that has been mentioned in part (5.1.1.8.1), but Arsenic concentration S R for Mi and Sa was lower than FAO/WHO limit because of the reason that has been mentioned in part (5.1.1.8.1).



	SaP(S W UDC)	MiP(S W UDC)	S R for Mi & Sa
Arsenic	0.620	0.449	0.060

Figure 5.15: Arsenic concentration (mg/kg) for soil UDC in situ experiments.

5.1.2.9 Another elements

It is also noticed that Cd, Cr, V, Zn (as shown in Table (B), in appendix) do not exist in all soils field samples (S W UDC at 0 cm and 30 cm) and (S at 0 cm and 30 cm)) and only Cd (as shown in Table (F), in appendix) does not exist in soil sample from SaP and MiP (S W UDC) and SR (for Mi and Sa) or have not been detected by the machine due to its tiny amount. In addition, heavy metals such as Fe, Ni, Al ((as shown in Table (B), in appendix) that related to (S W UDC at 0 cm and 30 cm) and (S at 0cm and 30cm) are found in very small amounts or have not been detected by the machine due to its tiny amount as well as Fe, Ni, Al, Zn, V ((as shown in Table (F), in appendix) in soil sample from SaP and MiP (S W UDC) and SR (for Mi and Sa).

5.1.3 Vegetables part

5.1.3.1 Lead concentration in vegetables sample

5.1.3.1.1 Field samples

from figure (5.16) which represents Lead(Pb) in vegetables samples, collected from all fields at Al-Jiftlik regions, it can be observed that Pb concentration in vegetables samples; Corn Polluted(CPo), Bell pepper Polluted(BPo), Eggplant Polluted(EPo), Cucumber Polluted(CuPo), Squash Polluted(SQPo) were (0.900 mg/kg;0.530 mg/kg;1 mg/kg;0.453 mg/kg;0.549 mg/kg, respectively) has the highest value compared to WHO limit which is (0.3 mg/kg) while Corn(C), Bell pepper (B), Eggplant (E), Cucumber (Cu), Squash(SQ) were (0.070 mg/kg;0.091

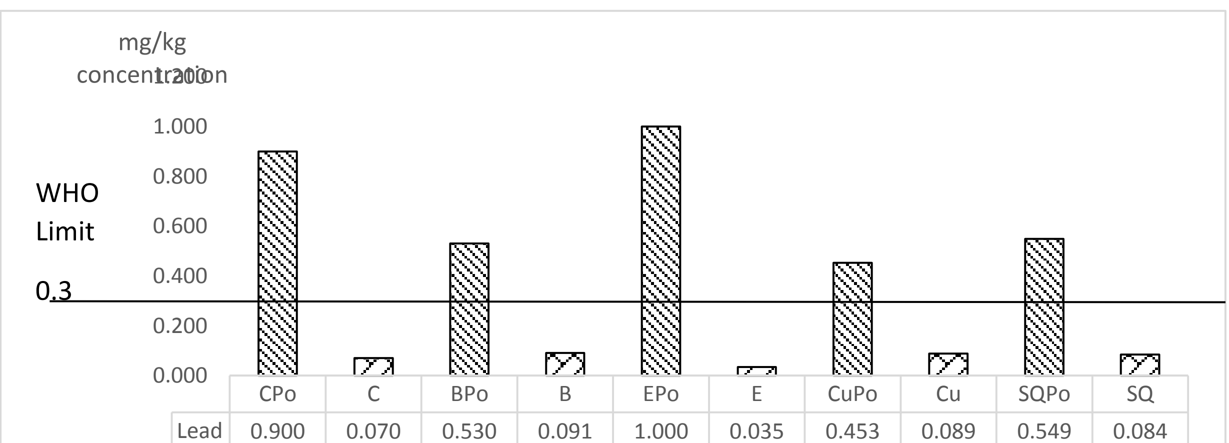


Figure 5.16: Lead concentration in polluted and unpolluted vegetables samples (corn, Bell pepper, Eggplant, Cucumber, and Squash).

mg/kg;0.035 mg/kg;0.089 mg/kg;0.084 mg/kg, respectively) because of the fields soil that related to vegetables samples CPo, BPo, EPo, CuPo, SQPo had been subjected to UDC. Otherwise, all Pb concentration in C, B, E, Cu, SQ do not exceed the permissible limits because the soil fields that related to this vegetable's samples hadn't been subjected to UDC.

5.1.3.1.2 Field samples (SQ, E, B; after three month) and In situ experiment samples

The observed concentrations of Lead in Sage Polluted (SaPo) , Mint Polluted (MiPo), Squash Polluted (SQPo), Eggplant Polluted (EPo), Bell pepper Polluted(BPo) were (1.763 mg/kg;1.593 mg/kg;0.448 mg/kg;0.413 mg/kg;0.336 mg/kg, respectively, see figure (5.17)) and they were compared to the Sage (Sa), Mint(Mi), Squash(SQ), Eggplant(E), Bell pepper(B) and recommended limits established by FAO/ WHO to ensure the safety and well-being of consumers. All concentrations of these metals lie above the permissible limits set by FAO/ WHO which is (0.3mg/kg) and Sa, Mi, SQ, E, B were (0.094 mg/kg; 0.163 mg/kg;0.189mg/kg;0.060 mg/kg; 0.061 mg/kg, respectively see figure (5.17)) because of the soil fields that related to vegetables samples SaPo, MiPo, SQPo, EPo, BPo had been subjected to UDC. Finally, the value of Lead (Pb) in Sa, Mi, SQ, E, B very low and do not exceed WHO permissible limits because of the soil fields that related to this vegetable's samples hadn't been subjected to UDC.

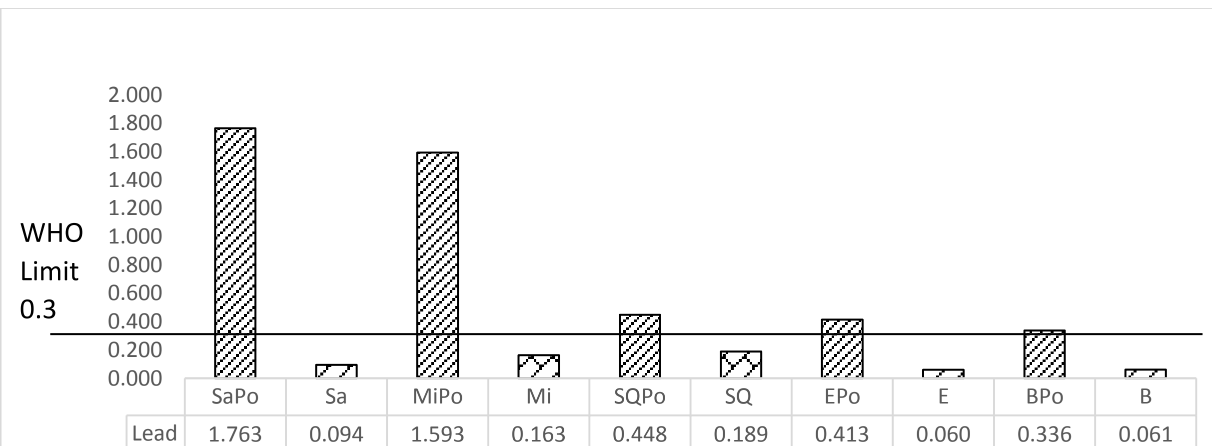


Figure 5.17 : compare concentration of Lead element between polluted and unpolluted leaf vegetables (sage and Mint); polluted and unpolluted vegetables (Squash, Eggplant, Bell pepper after three month).

5.1.3.2 Barium concentration in vegetables sample

5.1.3.2.1 Field samples

Regarding to figure (5.18); the level of concentration of Barium in vegetables CPo, BPo, EPo, CuPo, SQPo were (1.398 mg/kg;1.855 mg/kg;3.021 mg/kg;0.850 mg/kg;2.641mg/kg, respectively) that the soil field had been subjected to UDC exceeded and higher than the limit given by WHO/FAO which is (0.850mg/kg) and in vegetables C, B, E, Cu, SQ it was (0.133mg/kg;0.321mg/kg;0.22 6mg/kg;0.235 mg/kg;0.073 mg/kg, respectively) because of the soil field hadn't been subjected to UDC, but in CuPo it equals to WHO/FAO limit. However, it was found that its concentration in C, B, E, Cu, SQ Vegetables were very low than WHO/FAO limit.

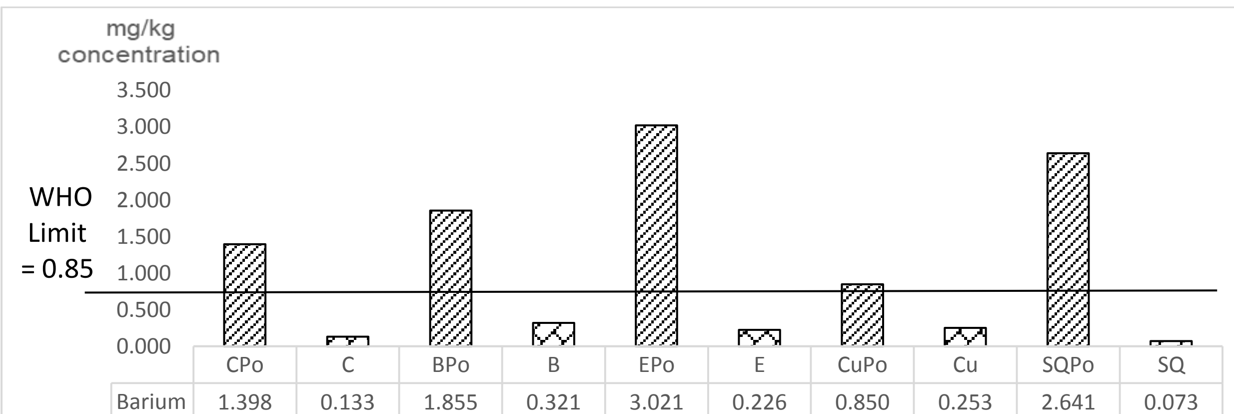


Figure 5.18: Compare Barium element concentration between contaminated and uncontaminated vegetables (corn, Bell pepper, Eggplant, Cucumber, and Squash).

5.1.3.2.2 Field samples (SQ, E, B, after three months) and In situ experiment samples

From figure (5.19), it can be noticed that Barium concentration in SaPo, MiPo, SQPo, EPo, BPo were (2.673 mg/kg;2.286 mg/kg;1.297 mg/kg;1.084 mg/kg;0.964mg/kg, respectively) that the soil pot and field had been subjected to UDC which is relatively higher than WHO/FAO limit is (0.859 mg/kg) and Sa, Mi, SQ, E, B vegetables were (0.470 mg/kg;0.266 mg/kg;0.222 mg/kg;0.270 mg/kg;0.161 mg/kg, respectively) that related to soil pot and field that hadn't been subjected to UDC. Finally, in Sa, Mi, SQ, E, B vegetables it does not exceed the permissible safety limit set by WHO/FAO for Barium.

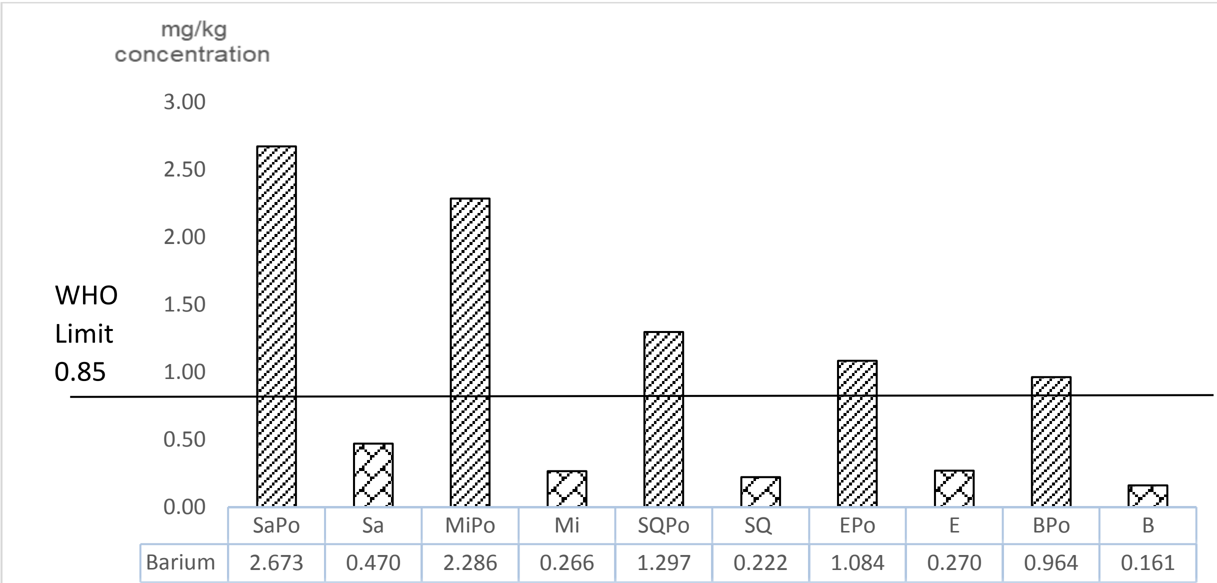


Figure 5.19: compare concentration of Barium element between polluted and unpolluted leaf vegetables (sage and Mint); polluted and unpolluted vegetables (Squash, Eggplant, Bell pepper after three month).

5.1.3.3 Thallium concentration in vegetables sample

5.1.3.3.1 Field samples

The observed Thallium concentrations of CPO, BPo, EPo, CuPo, SQPo vegetables were

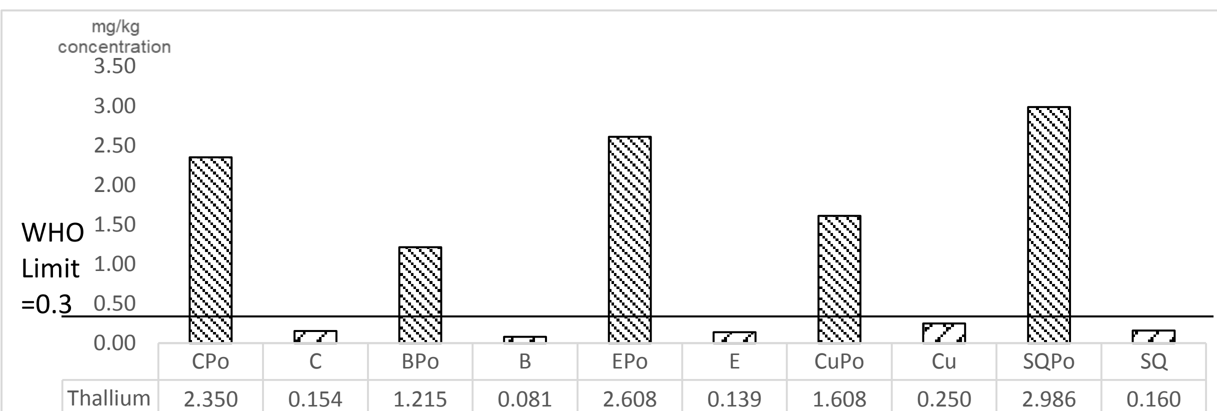


Figure 5.20: Compare Thallium element concentration between polluted and unpolluted vegetables (corn, Bell pepper, Eggplant, Cucumber, and Squash).

(2.350 mg/kg; 1.215 mg/kg; 2.608 mg/kg; 1.608mg/kg; 2.986 mg/kg, respectively) because of the soil field had been subjected to UDC, as shown in figure (5.20)) and they were compared to the recommended limits established by FAO/ WHO and Thallium concentrations of C, B, E, Cu, SQ vegetables were (0.154 mg/kg; 0.081 mg/kg; 0.139 mg/kg; 0.250 mg/kg; 0.160 mg/kg respectively, as shown in figure (5.20)) to ensure the safety and well-being of consumers. Results also revealed that all Thallium concentrations of CPo, BPo, EPo, CuPo, SQPo vegetables exceed the recommended limits established by FAO/ WHO which is (0.3 mg/kg) and Thallium concentrations of C, B, E, Cu, SQ vegetables.in addition; Thallium concentrations of C, B, E, Cu, SQ are lower than FAO/WHO limit and in safe side to human .finally; elevated levels of Thallium concentrations of CPo, BPo, EPo, CuPo, SQPo vegetables can negatively affect human health.

5.1.3.4 Copper concentration in vegetables sample

5.1.3.4.1 Field samples

In general copper values of vegetables CPo, BPo, CuPo, SQPo were (59.586 mg/kg; 56.772mg/kg; 50.527 mg/kg; 63.842mg/kg, respectively, as shown in figure (5.21)) and they were higher than WHO that equals 40mg//Kg and of vegetables C, B, Cu, M were (2.493 mg/kg; 1.540 mg/kg; 7.366 mg/kg; 5.487 mg/kg respectively, as shown in figure (5.21)). This result has shown large concentration of copper in CPO, BPo, CuPo, and SQPo that related to the field which has been subjected to UDC according to WHO limit and C, B, Cu, SQ. In addition, the value of EC vegetables was (23.049 mg/kg) which is below WHO limit and near to E vegetables value which was (6.245 mg/kg) because of the concentration of copper in UDC have not been used large in this field compared to another. Finally, the value of copper in C, B, E, Cu, SQ was lower than WHO limit which led to the main source of copper from animal or agricultural manure or both sources or original soil.

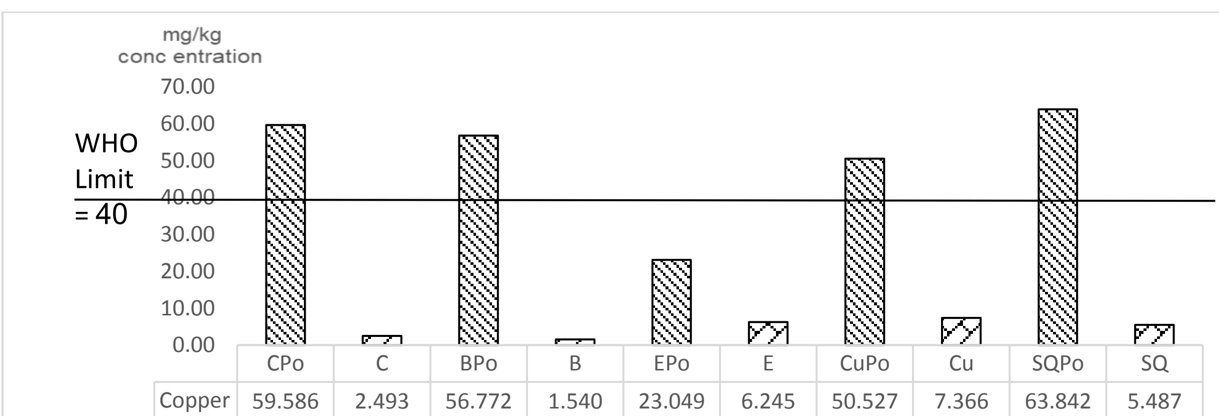


Figure 5.21: Compare Copper element concentration between polluted and unpolluted vegetables (corn, Bell pepper, Eggplant, Cucumber, Squash).

5.1.3.4.2 Field samples (SQ, E, B, after three month) and In situ experiment samples

In general copper values of SaPo, MiPo, SQPo, EPo, BPo vegetables was (52.756 mg/kg; 79.576 mg/kg; 42.248 mg/kg; 49.497mg/kg;45.062 mg//Kg) respectively, as shown in figure(5.22)) which was higher than WHO that equals 40mg/kg and Sa, Mi, SQ, E, B were (6.470 mg//Kg; 5.092 mg//Kg ;5.784 mg//Kg; 6.521 mg//Kg; 1.504 mg//Kg, respectively , as shown in figure (5.22)) that led to the same reason that had been mentioned in part (5.1.2.4.1), but SaPo, SQPo, EPo, BPo were not very high compared to WHO limit because of the concentration of copper in UDC . Finally, the value of   copper in Sa, Mi, SQ, E, B was much less than WHO that led to the main source of copper in SQ, E, B, Sa, Mi from animal or agricultural manure or both sources or original soil.

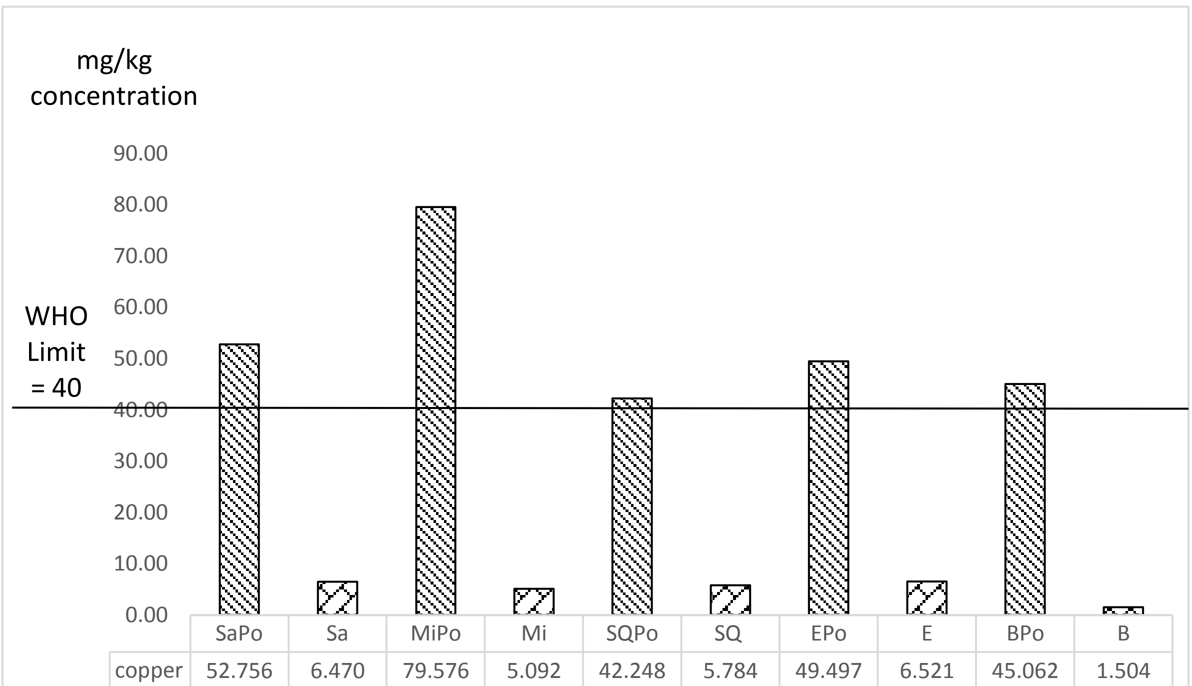


Figure 5.22: compare concentration of copper element between polluted and unpolluted leaf vegetables (sage and Mint); polluted and unpolluted vegetables (Squash, Eggplant, Bell pepper after three month).

5.1.3.5 Manganese concentration in vegetables sample

5.1.3.5.1 Field samples

The observed concentrations of Manganese in CPo, BC, EPo, CuPo, SQPo vegetables were (825.301 mg/kg;463.743 mg/kg;795.835 mg/kg;499.792 mg/kg;446.196 mg/kg, respectively, as shown in figure(5.23)) that related to the field had been subjected to UDC and they were compared to the recommended limits established by FAO/ WHO which is (500mg/kg) to ensure the safety and well-being of consumers and manganese concentration in C, B, E, Cu, SQ vegetables was (21.114 mg/kg ;30.276 mg/kg ;46.808 mg/kg ;88.271 mg/kg ;3.154mg/kg, respectively, as shown in figure (5.23)) that related to the field that hadn't been subjected to UDC. Manganese concentrations of these in CPO, BC, EPo, CuPo, SQPo vegetables were higher than C, B, E, Cu, and SQ. In addition, CuPo, BPo, SQPo vegetables lies within the permissible limits set by FAO/ WHO but it was approximated to FAO/WHO limit and was very high compared to Cu, B, SQ and this was related to the concentration of Manganese in UDC. Finally, it can be noticed that Manganese concentrations of CPo, EPo vegetables was higher than WHO/FAO Limit, but manganese concentration in all C, B, E, Cu, SQ vegetables was very low and lies below WHO/FAO Limit.

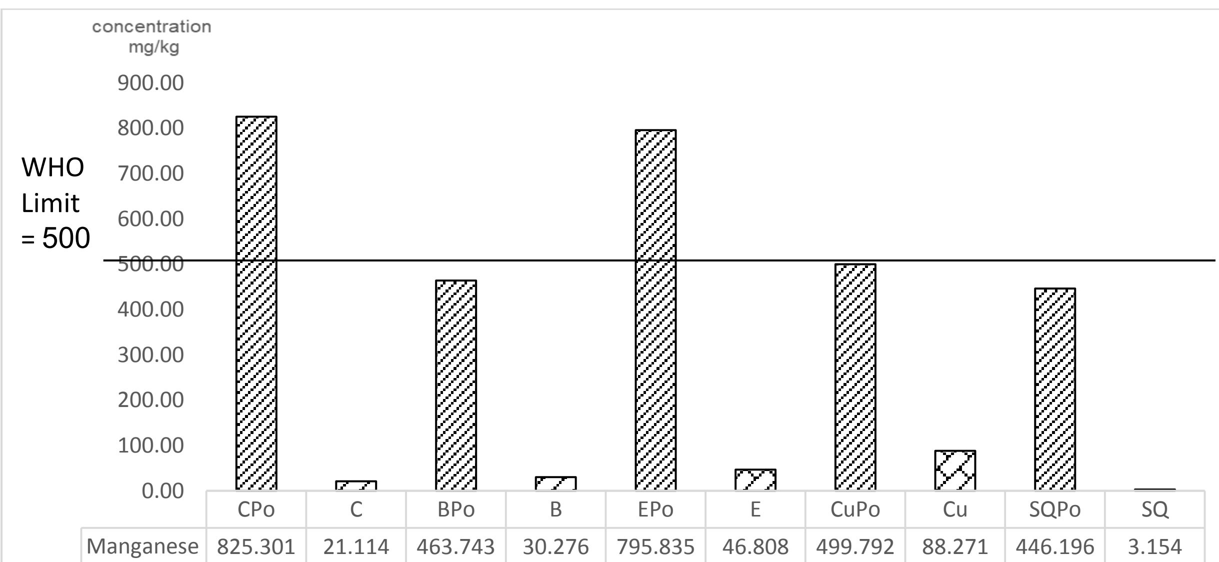


Figure 5.23: Compare Manganese element concentration between polluted and unpolluted vegetables (corn, Bell pepper, Eggplant, Cucumber, and Squash).

5.1.3.5.2 Field samples (SQ, E, B, after three month) and In situ experiment samples

Manganese concentrations in leachate soil samples are shown in figure (5.24). It was found that Manganese concentrations for all SaPo, MiPo, SQPo, EPo, BPo vegetables sample were (756.544mg/kg;774.992 mg/kg;553.289 mg/kg;662.737 mg/kg;538.849 mg/kg), that related to field and pot had been subjected to UDC, which exceeded the permissible limits given by FAO/WHO which is (500mg/kg) and it is much more than the Manganese concentration in Sa, Mi, SQ, E, B vegetables sample which was (81.719 mg/kg ;42.444 mg/kg; 90.000 mg/kg; 70.000 mg/kg; 60.000 mg/kg) that related to a field and pot that hadn't been subjected to UDC . Accordingly, it can be said that Manganese contamination in SaPo, MiPo, SQPo, EPo, BPo vegetables samples could has been resulted from the soil that had been subjected to UDC, but Sa, Mi, SQ, E, B don't exceed FAO/WHO limit and very low comparing to another.

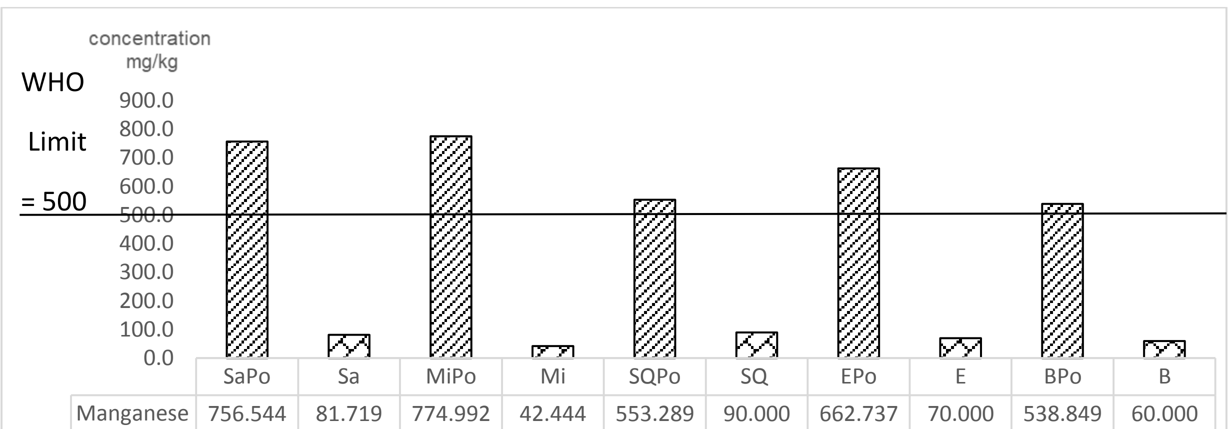


Figure 5.24: compare concentration of Manganese element between polluted and unpolluted leaf vegetables (sage and Mint); polluted and unpolluted vegetables (Squash, Eggplant, Bell pepper after three month).

5.1.3.6 Selenium concentration in vegetables sample

5.1.3.6.1 Field samples

From figure (5.25), it can be noticed that selenium concentration in vegetables SaPo, MiPo, SQPo, EPo, and BPo was (0.550mg/kg; 0.408 mg/kg; 0.348 mg/kg; 0.417 mg/kg; 0.348 mg/kg,

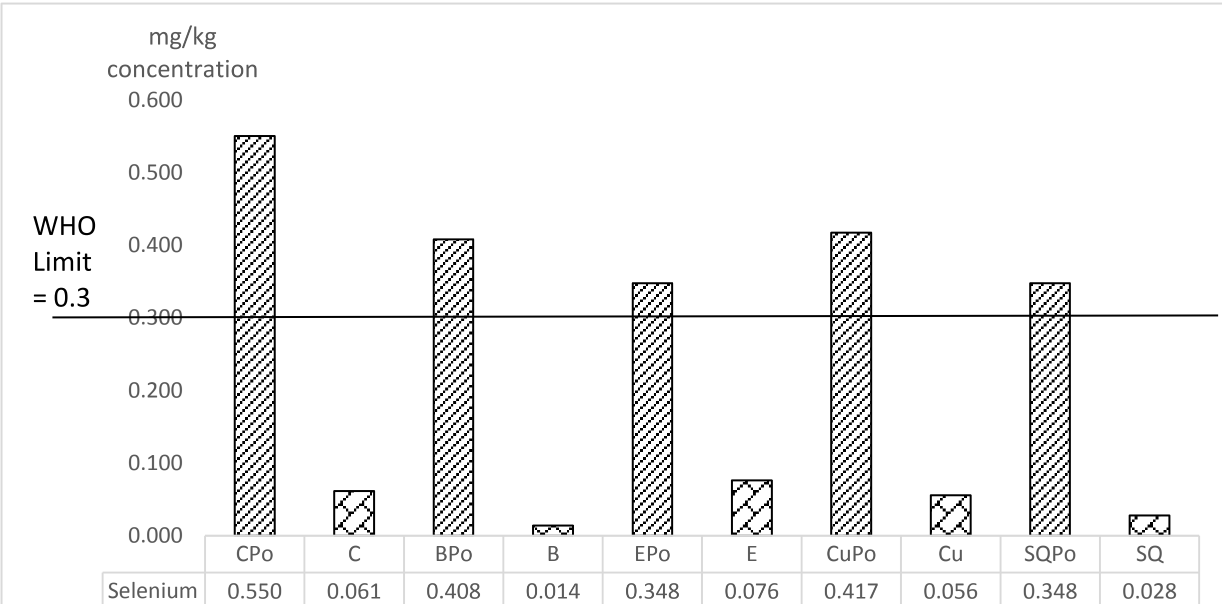


Figure 5.25: Compare Selenium element concentration between polluted and Unpolluted vegetables (corn, Bell pepper, Eggplant, Cucumber, and Squash).

respectively), that related to soil filed that had been subjected to UDC, and it was higher than WHO/FAO limit which is (0.3mg/kg) and in vegetables C, B, E, Cu, SQ, it was (0.061 mg/kg; 0.014 mg/kg; 0.076 mg/kg; 0.056 mg/kg; 0.028 mg/kg, respectively) that related to soil filed that hadn't been Subjected to UDC. In addition, C, B, E, Cu, SQ did not exceed and very low compare WHO/FAO limit.

5.1.3.6.2 Field samples (SQ, E, B, after three month) and In situ experiment samples

It was shown that selenium level in vegetables and leaf vegetables SaPo, MiPo, SQPo, EPo, BPo was (1.145mg/kg;1.224mg/kg;0.684 mg/kg;0.503 mg/kg;0.383 mg/kg, respectively, as shown in figure (5.26)) that related to a field and pot soil that had been subjected to UDC and it highly exceeded WHO/FAO recommended limit (0.3mg/kg) and in vegetables Sa, Mi, SQ, E, B it was (0.048 mg/kg; 0.010 mg/kg; 0.100 mg/kg; 0.090 mg/kg; 0.085 mg/kg, respectively, as shown in figure (5.26)) that related to field and pot soil that hadn't been subjected to UDC. However, Sa, Mi, SQ, E, B was very lower than WHO/FAO limit.

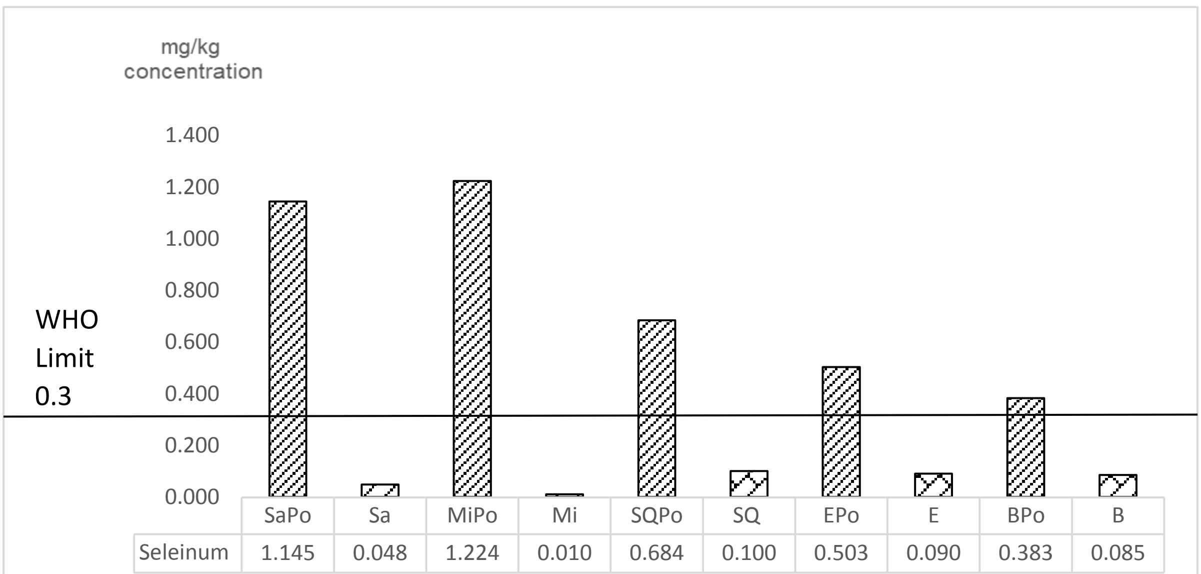


Figure 5.26: compare concentration of Selenium element between polluted and unpolluted leaf vegetables (sage and Mint); polluted and unpolluted vegetables (Squash, Eggplant, Bell pepper after three month).

5.1.3.7 Cobalt concentration in vegetables sample

5.1.3.7.1 Field samples

The values of cobalt in BPo, EPo, CuPo, SQPo vegetables were (0.537mg/kg; 0.917mg/kg; 0.522mg/kg; 1.119 mg/kg) respectively, as shown in figure (5.27)) which is higher than WHO standards that equals 0.1 mg//Kg and in B, E, Cu, SQ vegetables were (0.027 mg/kg; 0.068mg/kg; 0.083mg/kg; 0.057mg/kg) respectively, as shown in figure (5.27)). This result has shown large concentration of copper in BPo, EPo, CuPo, SQPo compared to WHO limit and

B, E, Cu, SQ that led to UDC main source which doesn't come only from Animal or

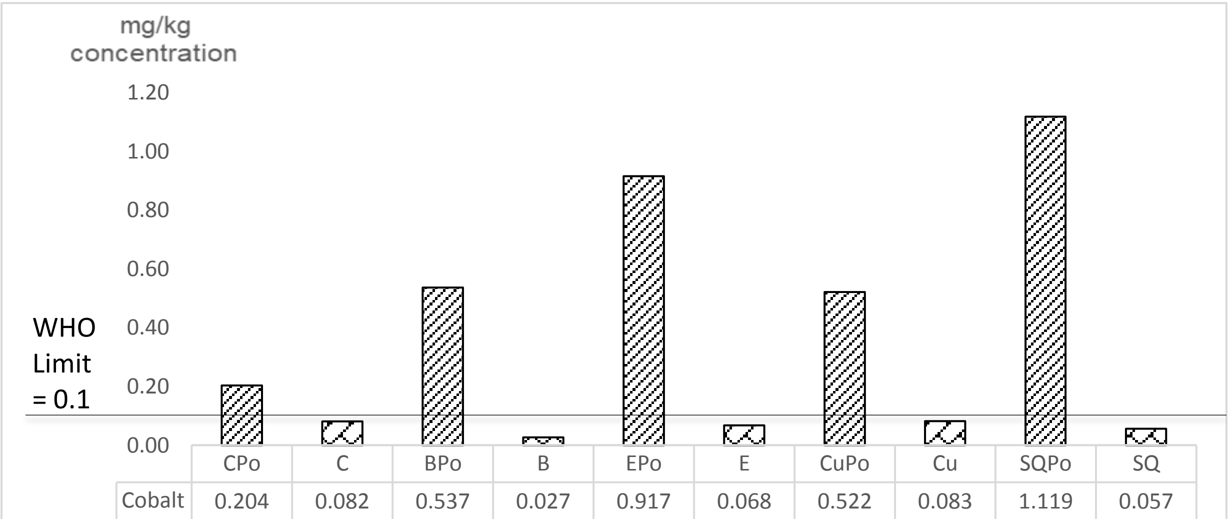


Figure 5.27 : Compare Cobalt element concentration between polluted and unpolluted vegetables (corn, Bell pepper, Eggplant, Cucumber, and Squash).

Agricultural or both sources, in fact it comes from other source that causes a large amount of concentration. In addition, the value of CPO vegetables was (0.204 mg/kg) which was not much higher than WHO limit and C vegetables value was (0.082 mg/kg) because the concentration of Cobalt in UDC has not been used largely in this field compared to another. Finally, in general the values of cobalt in C, B, E, Cu, SQ were lower than WHO limit and that leads to the main source of copper which is from animal or agricultural manure or both sources or air or original soil.

5.1.3.7.2 Field samples (SQ, E, B, after three month) and In situ experiment samples

Cobalt values of SaPo, MiPo vegetables were (1.827mg/kg ;2.209 mg/kg, respectively, as shown in figure (5.28)) and they were higher than WHO that equals 0.1 mg//Kg and Sa, Mi were (0.061 mg/kg; 0.066 mg/kg, respectively, as shown in figure (5.28)). Moreover, the value of SQ Po, EPo, BPo was (0.670 mg/kg; 1.095 mg/kg; 0.802 mg/kg) which is higher than WHO limit and SQ, E, B were (0.057 mg/kg; 0.068 mg/kg; 0.027 mg/kg) respectively. Finally, the value of copper in Sa, Mi, SQ, E, B was much lower than WHO and that leads to the main source of copper in SQ, E, B which is from animal or agricultural manure or both sources or dust or original soil, but in Sa, Mi was from air or original soil or both.

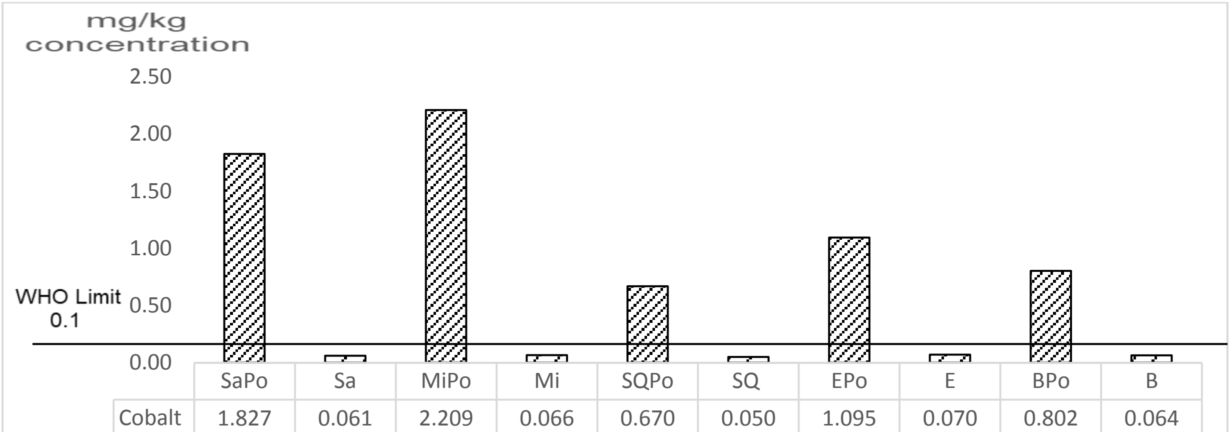


Figure 5.28 : compare concentration of Cobalt element between polluted and unpolluted leaf vegetables (sage and Mint); polluted and unpolluted vegetables (Squash, Eggplant, Bell pepper after three month).

5.1.3.8 Arsenic concentration in vegetables sample

5.1.3.8.1 Field samples

Arsenic concentration in CPo, BPo, EPo, CuPo, SQPo vegetables was (0.662 mg/kg;2.677 mg/kg,4.306 mg/kg,1.591 mg/kg,3.798 mg/kg, respectively, as shown in figure (5.29)) and that is connected to CF, BF, EF, CuF (S W UDC) at 0 cm and 0-30cm which is higher compared to FAO/WHO limit which parallels (0.2 mg/kg) and in C, B, E, Cu, SQ the concentration was (0.162 mg/kg; 0.103mg/kg, 0.049mg/kg, 0.113 mg/kg, 0.088 mg/kg, respectively as shown in

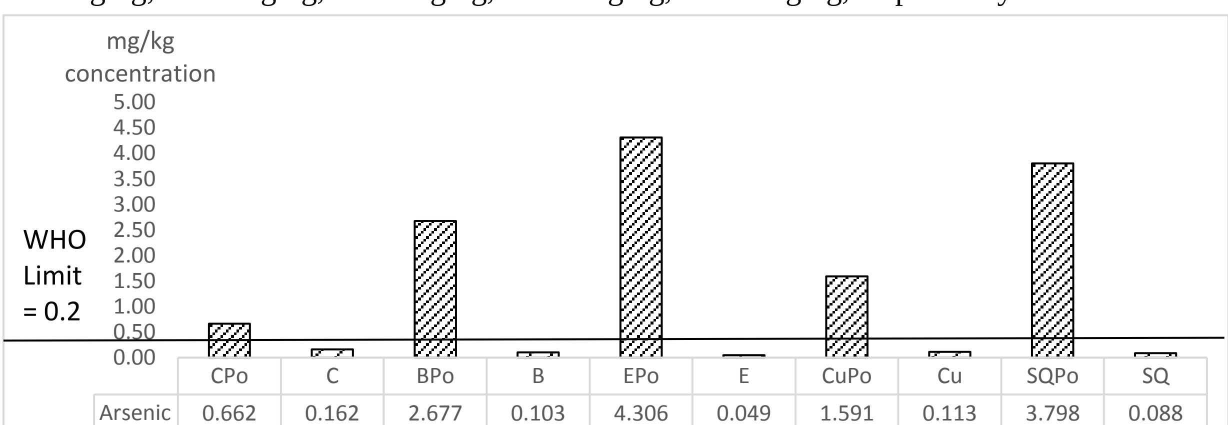


Figure 5.29: Compare Arsenic element concentration between polluted and un polluted vegetables (corn, Bell pepper, Eggplant, Cucumber, and Squash).

figure (5.29)) mg/kg) and it is related to CF, BF, EF, CuF (S) at 0 cm and 0-30cm because of this CPo, BPo, EPo, CuPo, SQPo vegetables related to a field that subjected to UDC, but another, B, E, Cu, SQ vegetables that are related to the filed that not subjected to UDC existed under allowable limit FAO/WHO.

5.1.3.8.2 Field samples (SQ, E, B, after three month) and In situ experiment samples

In figure (5.30), it can be detected that Arsenic level in SaPo, MiPo, SQPo, EPo and BPo vegetables was (1.005 mg/kg;1.008 mg/kg;0.460 mg/kg;0.563 mg/kg;0.368 mg/kg, respectively) that had been subjected to UDC which was higher than WHO/FAO limit that is (0.2 mg/kg) and Arsenic level in Sa, Mi, SQ, E and B vegetables was (0.098 mg/kg;0.018 mg/kg;0.090 mg/kg;0.120 mg/kg;0.110 mg/kg, respectively) and that had not been subjected to UDC. It is noticeable that these concentrations do not exceeded the permissible limit set by WHO/FAO regarding the presence of heavy metals.

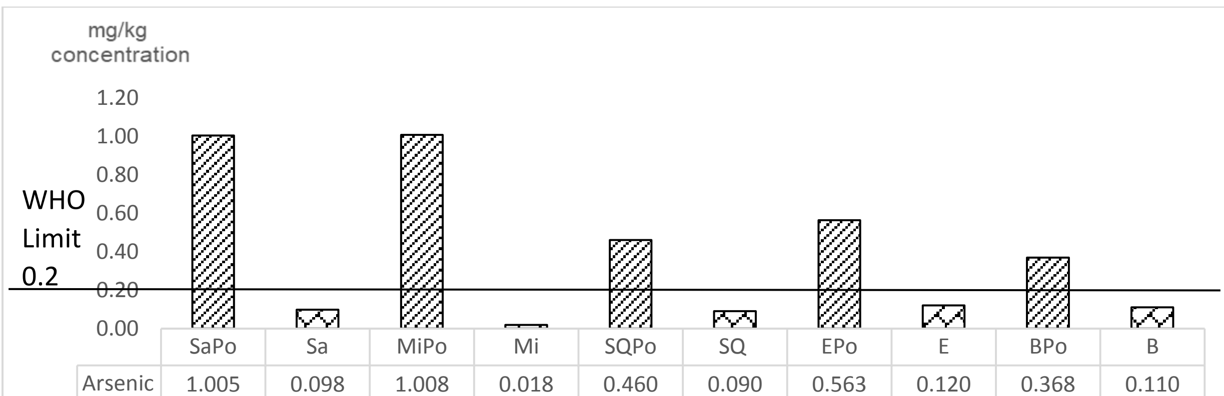


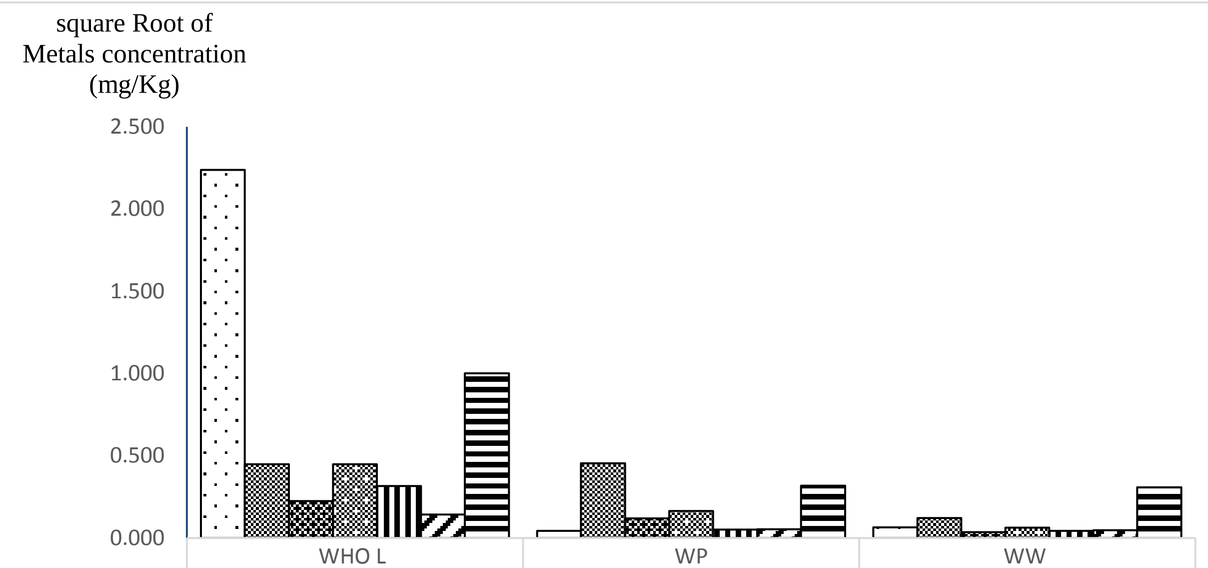
Figure 5.30: compare concentration of Arsenic element between polluted and unpolluted leaf vegetables (sage and Mint); contaminated and uncontaminated vegetables (Squash, Eggplant, Bell pepper after three months.

5.1.3.9 Another element

It is also observed that Cd, Cr, V, Zn (as shown in Table (D), in appendix) in all vegetable's samples (CPo, BPo, EPo, CuPo, SQPo) and (C, B, E, Cu, SQ) as well as Cd, Cr, Th (as shown in table (H), in the appendix) in samples (SaPo, MiPo, Sa and Mi) and (SQPo, EPo, BPo after three months) do not exist or have not been detected by the machine due to its poorly existence. Moreover, heavy metals (as shown in Table (D), in appendix) such as Fe, Ni, Al that related to vegetables samples (CPo, BPo, EPo, CuPo, SQPo) and (C, B, E, Cu, SQ) are found in very small amounts or have not been detected by the machine due to its poorly existence as well as Fe, Ni, Al, Zn, V (as shown in Table (H), in appendix) in vegetables samples (SaPo, MiPo, Sa and Mi) and (SQPo, EPo, BPo after three months).

5.1.4 Water part

In the study area at Al-JiftliK region, it is also noticed that the value of lead, cobalt, copper, Arsenic, Selenium, Barium in Water Pond (WP) were (0.042 mg/kg; 0.118 mg/kg; 0.1 63 mg/kg;0.051 mg/kg; mg/kg; 0.052 mg/kg; 0.317 mg/kg,respectively) and Water Wells (WW) were (0.064mg/kg; 0.034 mg/kg; 0.062 mg/kg; 0.042; 0.047 mg/kg; 0.307 mg/kg, respectively) as shown in figure(5.31) and they were much lower than WHO limi of lead, cobalt, copper, Arsenic, Selenium, Barium in water were (2.236 mg/kg;0.224 mg/kg;0.447 mg/kg;0.316 mg/kg;0.141 mg/kg;1 mg/kg, respectively) as shown in below figure (5.31). Also, Thalium element hadn’t been found in WW and WP. Besides that, the value of manganese in WP was 0.453 which approximately equals to WHO limit 0.447, but in WW it was much lower than WHO limit. To conclude; normal previous results had led to the main source of high concentration of lead, cobalt, copper, Arsenic, Selenium, Barium, manganese in all fields of soil and vegtables and they did not come from WW or WP; in other words, it has come from UDC.

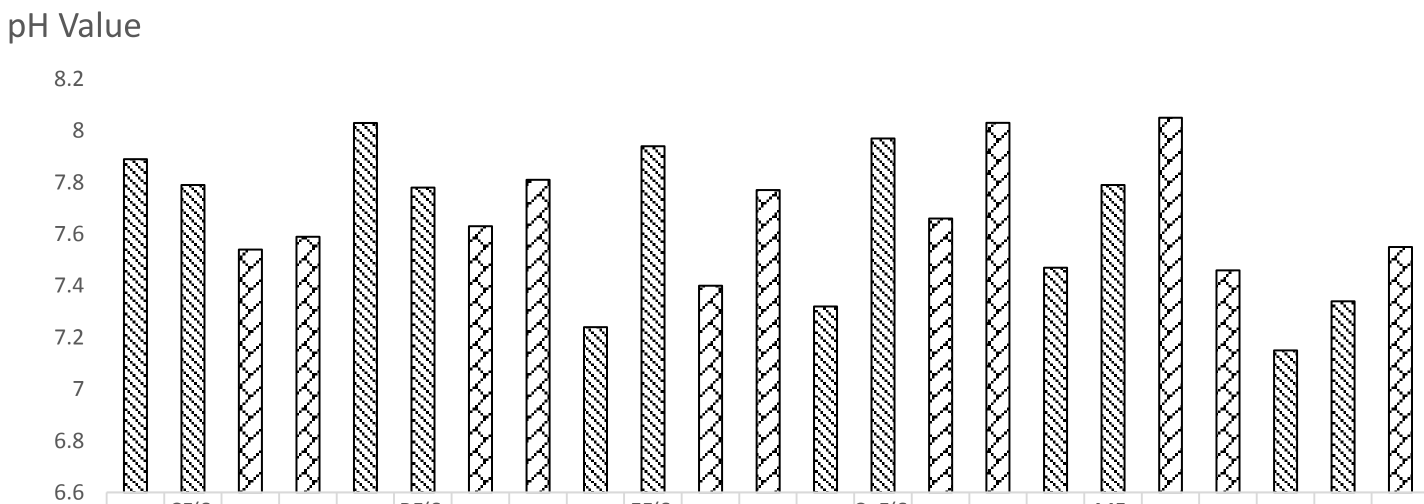


	WHO L	WP	WW
Lead	2.236	0.042	0.064
Manganese	0.447	0.453	0.122
cobalt	0.224	0.118	0.034
copper	0.447	0.163	0.062
Arsenic	0.316	0.051	0.042
Selenium	0.141	0.052	0.047
Barium	1.000	0.317	0.307

Figure 5.31: compare concentration of Lead, Manganese, Cobalt, Copper, Arsenic, Selenium, Barium elements in WP and WW to WHO Limit

5.2 pH result of soil

The range of values in all samples was between 7. 15and 8.05, which indicates alkaline soils. There was not a clear difference between soil fields as shown in figure (5.32)



	CF(S W UDC) ,0cm	CF(S W UDC) ,0-30cm	CF (S) ,0cm	CF (S) ,0-30cm	BF (S W UDC) ,0cm	BF(S W UDC) ,0-30cm	BF(S) ,0cm	BF (S) ,0-30cm	EF(S W UDC) ,0cm	EF(S W UDC) ,0-30cm	EF (S) ,0cm	EF (S) ,0-30cm	CuF(S W UDC) ,0cm	CuF(S W UDC) ,0-30cm	CuF(S) ,0cm	CuF(S) ,0-30cm	MF(S W UDC) ,0cm	MF (S W UDC) ,0-30cm	MF(S) ,0cm	MF(S) ,0-30cm	SaP(S W UDC)	MiP(S W UDC)	S R for Mi & Sa
PH Value	7.89	7.79	7.54	7.59	8.03	7.78	7.63	7.81	7.24	7.94	7.4	7.77	7.32	7.97	7.66	8.03	7.47	7.79	8.05	7.46	7.15	7.34	7.55

Figure 5.32 :pH result of soil sample at Al-Jiftlik area

Chapter Six
Conclusion & Recommandations

Chapter Six: Conclusion and Recommendations

1. Conclusion:

From the present study, it can be concluded that heavy metals (Ba, Cu, Pb, Th, Se, Mn, Co , As) concentrations in unpolluted vegetables (Corn, Eggplant, Cucumber, Squash, Bell pepper) and soil field (at 0 cm and 30cm) that related to this vegetables obtained from Al-Jiftlik region were largely below the WHO/FAO limit, but these heavy metals concentrations in polluted vegetables (Corn, Eggplant, Cucumber, Squash, Bell pepper) and soil field (at 0 cm and 30cm) that subjected to UDC which related to this vegetables obtained from Al-Jiftlik region (the same farm) were above the WHO/FAO limit. Also, heavy metals (Ba, Cu, Pb, Se, Mn, Co , As) concentrations in polluted leaf vegetables (Sage and Mint) that obtained from pot soil that subjected to UDC at home garden and (Squash, Bell pepper, Eggplant after three month) vegetables that obtained from soil field that subjected to UDC at Al-Jiftlik region and soil pot that subjected to UDC were above the WHO/FAO limit ,but unpolluted leaf vegetables (Sage and Mint) and soil references obtained from home garden were below WHO/FAO limit. Moreover, heavy metals (Ba, Cu, Pb, Th, Se, Mn, Co, As) concentrations in Wall and Pool water were much lower than the WHO/FAO limit. However, other elements concentrations such as (Fe, Ni, Al, Zn, V, Cd, Cr) in all Vegetables and leafy vegetables collected and soil related were highly lower than the maximum allowable limit of WHO/FAO or did not exist or have not been detected by the machine due to its poorly existence. The results also indicates that the source of pollution was using UDC. The range of pH values in all samples was between 7. 15and 8.05, which indicates alkaline soils. There was not a clear difference between soil fields. Thus, it can be concluded that the pollution found in leafy vegetables, vegetables and soil samples was not related to neither water well nor pond, but it was clear that pollution of leafy vegetables and vegetables with heavy metals was directly related to usage of UDC, as a result, the elevated levels of metals in vegetables in Al-Jiftlik region and in in situ UDC experiment attributed to utilization of UDC.

2. **Recommendations**:

- Raising awareness among farmers that they shouldn't use UDC that contain High level concentrations of toxic heavy metal instead of normal legal compost.

- Other studies should be conducted for monitoring heavy metals in the same Vegetables and soil in other farms that subjected to UDC in Al-Jiftlik region.

- Other studies should be conducted for monitoring heavy metals in different types of soil and vegetables or leaf vegetables that subjected to UDC.

- It is possible to cultivate areas with these vegetables to absorb heavy metals and then to destroy them and not to be used for human consumption in any form or animal that eaten by humans.

- Raising awareness among farmers, workers, consumers, or institutions working in the fields about high Risk degree of UDC.

- The soil needs to be treated before it is transferred to groundwater and pollutes it.

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Appendix

Table A :Major heavy metal concentration in soil at Al-Jiftlik region								
	Metals Concentration (mg/kg)							
soil filed and depth	Ba	Tl	Mn	Co	Cu	As	Se	Pb
CPo (soil with UDC),0cm	175.962 ±0.003	11.926 ±0.182	741.838 ±0.003	17.934 ±0.006	17.656 ±0.026	2.384 ±0.014	5.860 ±0.133	12.211 ±0.041
CPo (soil with UDC),0-30cm	230.295 ±0.004	12.910 ±0.019	1075.468 ±0.004	27.315 ±0.005	34.870 ±0.019	3.360 ±0.016	10.497 ±0.101	24.106 ±0.010
C(soil with compost) ,0cm	15.043 ±0.001	2.320 ±0.614	128.587 ±0.004	4.514 ±0.015	0.141 ±0.013	0.017 ±0.044	0.051 ±0.170	4.020 ±0.001
C (soil with compost) ,0-30cm	12.067 ±0.006	2.144 ±0.022	94.324 ±0.011	2.254 ±0.020	0.133 ±0.009	0.012 ±0.047	0.064 ±0.095	2.955 ±0.041
BPo (soil with UDC),0cm	151.793 ±0.002	22.042 ±0.786	951.016 ±0.004	19.056 ±0.011	12.342 ±0.077	5.172 ±0.026	12.871 ±0.045	34.144 ±0.065
BPo soil with UDC),0-30cm	136.639 ±0.004	11.600 ±0.003	744.514 ±0.002	12.197 ±0.004	10.112 ±0.050	5.237 ±0.017	10.536 ±0.092	22.915 ±0.019
B (soil with compost) ,0cm	14.060 ±0.004	1.234 ±0.098	109.044 ±0.004	3.670 ±0.013	0.082 ±0.011	0.007 ±0.024	0.311 ±0.027	5.344 ±0.002
B(soil with compost) ,0-30cm	7.848 ±0.003	0.168 ±0.057	109.044 ±0.001	0.369 ±0.046	0.021 ±0.004	0.007 ±0.030	0.066 ±0.036	5.360 ±0.002
EPo (soil with UDC),0cm	125.384 ±0.003	23.200 ±0.156	478.976 ±0.003	26.062 ±0.009	13.709 ±0.006	6.362 ±0.024	3.621 ±0.218	12.651 ±0.013
EPo(soil with UDC),0-30cm	62.641 ±0.006	16.020 ±0.056	273.810 ±0.005	14.655 ±0.005	7.110 ±0.019	3.264 ±0.027	2.781 ±0.772	10.216 ±0.051
E (soil with compost) ,0cm	18.050 ±0.002	1.624 ±0.020	73.053 ±0.009	3.931 ±0.005	0.111 ±0.014	0.018 ±0.016	0.406 ±0.038	2.680 ±0.020
E (soil with compost) ,0-30cm	34.028 ±0.006	2.320 ±0.001	145.392 ±0.002	0.100 ±0.003	0.031 ±0.012	0.006 ±0.055	0.031 ±0.121	3.350 ±0.024
CuPo (soil with UDC),0cm	103.193 ±0.005	24.932 ±0.032	572.315 ±0.002	11.019 ±0.008	10.766 ±0.173	3.423 ±0.026	7.600 ±0.067	21.310 ±0.022
CuPo (soil with UDC),0-30cm	70.178 ±0.005	14.243 ±0.028	545.220 ±0.002	2.383 ±0.017	9.000 ±0.016	1.573 ±0.019	5.056 ±0.150	14.402 ±0.038
Cu(soil with compost) ,0cm	7.673 ±0.003	1.624 ±0.960	117.524 ±0.081	4.627 ±0.009	0.149 ±0.009	0.010 ±0.022	0.082 ±0.028	4.262 ±0.022
Cu(soil with compost),0-30cm	9.124 ±0.010	2.320 ±0.920	36.348 ±0.003	0.433 ±0.014	0.057 ±0.013	0.008 ±0.043	0.084 ±0.052	2.010 ±0.080
MPo (soil with UDC),0cm	122.875 ±0.003	13.287 ±0.124	579.683 ±0.001	18.219 ±0.004	33.246 ±0.035	12.585 ±0.015	3.894 ±0.437	17.703 ±0.026
MPo (soil with UDC),0-30cm	264.692 ±0.004	12.959 ±0.164	1099.454 ±0.005	24.917 ±0.009	27.243 ±0.002	8.427 ±0.043	8.748 ±0.148	13.219 ±0.083
M(soil with compost) ,0cm	21.703 ±0.002	1.777 ±0.010	105.889 ±0.002	10.794 ±0.004	0.182 ±0.009	0.026 ±0.029	0.068 ±0.101	4.212 ±0.010
M(soil with compost),0-30cm	12.839 ±0.001	2.320 ±0.011	81.853 ±0.190	4.606 ±0.012	0.096 ±0.008	0.016 ±0.071	0.135 ±0.119	2.680 ±0.120
FAO/WHO limit(mg/kg)	100	5	437	10	6	0.2	2	10

Table B: Another heavy metal concentration in soil at Al-Jiftlik region

	Metals Concentration (mg/kg)						
soil filed and depth	**Al**	**Fe**	**V**	**Cr**	**Ni**	**Zn**	**Cd**
CPo (soil with UDC),0cm	0.439 ±0.004	N/A	0.122 ±0.009	N/A	0.326 ± 0.004	N/A	N/A
CPo (soil with UDC),0-30cm	1.828 ±0.007	10.63 ±0.006	N/A	N/A	0.823 ±0.003	N/A	N/A
C(soil with compost) ,0cm	N/A	N/A	N/A	N/A	N/A	N/A	N/A
C (soil with compost) ,0-30cm	N/A	N/A	N/A	N/A	N/A	N/A	N/A
BPo (soil with UDC),0cm	1.786 ±0.005	11.016 ±0.012	N/A	N/A	0.308 ±0.010	N/A	N/A
BPo soil with UDC),0-30cm	1.594 ±0.001	5.662 ±0.024	N/A	N/A	0.195 ±0.017	N/A	N/A
B (soil with compost) ,0cm	0.258 ±0.041	18.211 ±0.003	N/A	N/A	0.147 ±0.005	N/A	N/A
B(soil with compost) ,0-30cm	N/A	N/A	N/A	N/A	N/A	N/A	N/A
EPo (soil with UDC),0cm	3.059 ±0.002	1.244 ±0.024	N/A	N/A	0.662 ±0.008	N/A	N/A
EPo(soil with UDC),0-30cm	0.274 ±0.011	N/A	N/A	N/A	0.081 ±0.046	N/A	N/A
E (soil with compost) ,0cm	N/A	30.522 ±0.003	N/A	N/A	N/A	N/A	N/A
E (soil with compost) ,0-30cm	N/A	N/A	N/A	N/A	N/A	N/A	N/A
CuPo (soil with UDC),0cm	0.114 ±0.042	N/A	N/A	N/A	0.080 ±0.014	N/A	N/A
CuPo (soil with UDC),0-30cm	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Cu(soil with compost) ,0cm	0.149 ±0.006	N/A	N/A	N/A	0.107 ±0.021	N/A	N/A
Cu(soil with compost),0-30cm	N/A	N/A	N/A	N/A	0.221 ±0.019	N/A	N/A
MPo (soil with UDC),0cm	1.15 ±0.011	N/A	N/A	N/A	0.241 ±0.022	N/A	N/A
MPo (soil with UDC),0-30cm	0.766 ±0.006	6.481 ±0.026	N/A	N/A	0.489 ±0.010	N/A	N/A
M(soil with compost) ,0cm	0.377 ±0.014	N/A	N/A	N/A	N/A	N/A	N/A
M(soil with compost),0-30cm	10,000 - 300,000	150	0.3	N/A	75-150	-	-

Table C: Major heavy metal concentration in vegetables at Al-Jiftlik region								
	Metals Concentration (mg/kg)							
Vegetables type	**Ba**	**Tl**	**Mn**	**Co**	**Cu**	**As**	**Se**	**Pb**
CPo	1.398 ±0.001	2.350 ±0.009	825.301 ±0.001	0.204 ±0.012	59.586 ±0.001	0.662 ±0.006	0.550 ±0.064	0.900 ±0.001
C	0.133 ±0.001	0.154 ±0.022	21.114 ±0.012	0.082 ±0.001	2.493 ±0.003	0.162 ±0.017	0.061 ±0.015	0.070 ±0.001
BPo	1.855 ±0.002	1.215 ±0.009	463.743 ±0.001	0.537 ±0.012	56.772 ±0.001	2.677 ±0.018	0.408 ±0.050	0.530 ±0.002
B	0.321 ±0.001	0.081 ±0.017	30.276 ±0.001	0.027 ±0.013	1.540 ±0.002	0.103 ±0.017	0.014 ±0.126	0.091 ±0.001
EPo	3.021 ±0.003	2.608 ±0.012	795.835 ±0.025	0.917 ±0.009	23.049 ±0.002	4.306 ±0.003	0.348 ±0.114	1.000 ±0.003
E	0.226 ±0.004	0.139 ±0.032	46.808 ±0.017	0.068 ±0.007	6.245 ±0.001	0.049 ±0.024	0.076 ±0.015	0.035 ±0.004
CuPo	0.850 ±0.006	1.608 ±0.033	499.792 ±0.005	0.522 ±0.003	50.527 ±0.001	1.591 ±0.023	0.417 ±0.041	0.453 ±0.006
Cu	0.253 ±0.001	0.250 ±0.031	88.271 ±0.001	0.083 ±0.007	7.366 ±0.001	0.113 ±0.008	0.056 ±0.038	0.089 ±0.001
MPo	2.641 ±0.003	2.986 ±0.006	446.196 ±0.001	1.119 ±0.004	63.842 ±0.002	3.798 ±0.015	0.348 ±0.108	0.549 ±0.003
M	0.073 ±0.002	0.160 ±0.021	3.154 ±0.001	0.057 ±0.001	5.487 0.035	0.088 ±0.012	0.028 ±0.032	0.084 ±0.002
FAO/WHO limit(mg/kg)	0.85	0.3	500	0.1	40	0.2	0.3	0.3

Table D: Other heavy metal concentration in vegetables at Al-Jiftlik region							
	Metals Concentration (mg/kg)						
Vegetables type	Al	Fe	V	Cr	Ni	Zn	Cd
CPo	0.441 ±0.003	N/A	N/A	N/A	N/A	N/A	**N/A**
C	0.390 ±0.002	137.156 ± 0.001	N/A	N/A	1.013 ±0.001	N/A	**N/A**
BPo	0.518 ±0.000	N/A	N/A	N/A	0.056 ±0.007	N/A	**N/A**
B	0.366 ±0.002	N/A	N/A	N/A	N/A	N/A	**N/A**
EPo	0.983 ±0.001	N/A	N/A	N/A	N/A	N/A	**N/A**
E	0.391 ±0.000	N/A	N/A	N/A	N/A	N/A	**N/A**
CuPo	0.199 ±0.011	N/A	N/A	N/A	N/A	N/A	**N/A**
Cu	1.042 ±0.001	N/A	N/A	N/A	0.142 ±0.004	N/A	**N/A**
MPo	1.046 ±0.001	N/A	N/A	N/A	N/A	N/A	**N/A**
M	0.944 ±0.010	0.900 ±0.009	N/A	N/A	N/A	N/A	**N/A**
FAO/WHO limit(mg/kg)	2	425	-	-	1.5	-	-

Table E: Major heavy metal concentration in soil pot at home garden								
	Metals Concentration (mg/kg)							
Soil pot	Ba	Pb	Mn	Co	Cu	As	Se	Pb
SaP (S W UDC)	133.240 ±1.127	20.091 ±0.379	534.089 ±4.359	16.956 ±1.430	9.455 ±0.413	0.620 ±0.004	6.485 ±0.088	16.865 ±0.034
MiP (S W UDC)	115.327 ±1.055	20.440 ±0.538	450.486 ±3.995	16.022 ±3.418	7.572 ±1.704	0.449 ±0.011	3.246 ±0.588	15.779 ±0.070
S R for Mi and Sa	23.063 ±0.006	2.521 ±0.109	62.108 ±0.105	0.932 ±0.006	0.756 ±0.015	0.060 ±0.005	0.000 ±0.000	3.205 ±0.028
FAO/WHO limit(mg/kg)	0.85	10	437	10	6	0.2	2	10

Table F: other heavy metal concentration in soil pot at home garden								
	Metals Concentration (mg/kg)							
Soil filed	**Al**	**Fe**	**Tl**	**V**	**Cr**	**Ni**	**Zn**	**Cd**
SaPo (S W UDC)	0.772 ±0.004	44.786 ±0.005	N/A	0.163 ±0.009	N/A	0.494 ±0.013	0.266 ±0.004	N/A
MiPo (S W UDC)	0.654 ±0.005	39.444 ±0.004	N/A	0.176 ±0.009	N/A	0.461 ±0.010	0.391 ±0.010	N/A
S R for Mi and Sa	0.042 ±0.018	15.195 ±0.015	N/A	0.126 ±0.007	N/A	0.285 ±0.011	0.287 ±0.012	N/A
FAO/WHO limit(mg/kg)	10,000 - 300,000	150	-	0.3	-	75-150	60	-

Table G : Major heavy metal concentration in in vegetables at home garden and (Al-Jiftlik region after three month)							
	Metals Concentration (mg/kg)						
Vegetables type	**Ba**	**Mn**	**Co**	**Cu**	**As**	**Se**	**Pb**
SaPo	2.673 ±0.004	756.544 ± 0.001	1.827 ±0.002	52.756 ±1.292	1.005 ±0.004	1.145 ±0.111	1.763 ±0.001
Sa	0.470 ±0.001	81.719 ± 0.003	0.061 ±0.014	6.470 ±0.015	0.098 ±0.001	0.048 ±0.003	0.094 ±0.004
MiPo	2.286 ±0.003	774.992 ± 0.001	2.209 ±0.002	79.576 ±4.568	1.008 ±0.006	1.224 ±0.071	±1.593 0.001
Mi	0.266 ±0.004	42.444 ± 0.000	0.066 ±0.013	5.092 ±0.005	0.018 ±0.002	0.010 ±0.002	0.163 ±0.003
MPo	1.297 ±0.002	553.289 ± 0.003	0.670 ±0.006	42.248 ±1.484	0.460 ±0.054	0.684 ±0.043	0.448 ±0.002
M	0.222 ±0.002	90.000 ± 0.001	0.050 ±0.001	5.784 ±0.003	0.090 ±0.001	0.100 ±0.004	0.189 ±0.002
EPo	1.084 ±0.004	662.737 ± 0.001	1.095 ±0.004	49.497 ±2.056	0.563 ±0.021	0.503 ±0.069	0.413 ±0.002
E	0.270 ±0.004	70.000 ± 0.001	0.070 ±0.007	6.521 ±0.009	0.120 ±0.004	0.090 ±0.061	0.060 ±0.005
BPo	0.964 ±0.005	538.849 ± 0.001	0.802 ±0.006	45.062 ±5.166	0.368 ±0.022	0.383 ±0.054	0.336 ±0.002
B	0.161 ±0.001	60.000 ± 0.001	0.064 ± 0.013	1.504 ±0.002	0.110 ±0.002	0.085 ±0.040	0.061 ±0.001
FAO/WHO limit(mg/kg)	100	500	0.1	40	0.2	0.3	0.3

Table H: other heavy metal concentration in in vegetables at home garden and (Al-Jiftlik region after three month)								
	Metals Concentration (mg/kg)							
Vegetables type	**Al**	**Fe**	**Tl**	**51**	**Cr**	**Ni**	**Zn**	**Cd**
SaPo	1.237 ±0.001	16.768 ±0.002	N/A	0.036 ±0.002	N/A	0.023 ±0.005	0.866 ±0.001	N/A
Sa	0.918 ±0.003	3.458 ±0.002	N/A	0.002 ±0.009	N/A	0.002 ±0.030	0.742 ±0.001	N/A
MiPo	1.046 ±0.000	53.944 ±0.001	N/A	0.051 ±0.004	N/A	0.653 ±0.001	3.863 ±0.001	N/A
Mi	0.765 ±0.003	N/A	N/A	N/A	N/A		0.603 ±0.001	N/A
MPo	0.943 ±0.002	1.822 ±0.009	N/A	0.002 ±0.021	N/A	0.035 ±0.006	0.713 ±0.001	N/A
EPo	0.422 ±0.002	N/A	N/A	N/A	N/A	N/A	0 N/A	N/A
BPo	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
FAO/WHO limit(mg/kg	2	450	-		-	1.5	60	-

Table I : Major Heavy metal concentration in Water Irrigation							
	Metals Concentration (mg/kg) in water						
Water sample	**Ba**	**Mn**	**Co**	**Cu**	**As**	**Se**	**Pb**
WP	0.100 ±0.001	0.205 ±0.000	0.014 ±0.001	0.026 ±0.005	0.003 ±0.004	0.003 ±0.098	0.001 ±0.011
WW	0.094 ±0.001	0.015 ±0.005	0.001 ±0.014	0.004 ±0.001	0.002 ±0.013	0.002 ±0.069	0.005 ±0.004
Square root of WP	0.317	0.453	0.118	0.163	0.055	0.055	0.032
Square root of WW	0.307	0.122	0.032	0.062	0.042	0.047	0.069
Square root of WHO limit	1.000	0.447	0.224	0.447	0.316	0.141	2.236
WHO limit(mg/kg)	1	0.200	0.050	0.200	0.100	0.020	5.000

Table J : Descriptive statistics of CF, BF, EF, MF, CuF (S W UDC at 0 cm and 0-30cm)									
	Ba	**TI**	**Pb**	**Mn**	**Co**	**Cu**	**As**	**Se**	**Pb**
Mean	144.365	16.312	15.586	706.229	17.376	17.605	5.179	7.146	18.288
Standard Deviation	64.701	5.081	2.582	269.179	7.706	10.358	3.295	3.438	7.385
Sample Variance	4186.178	25.816	6.666	72457.581	59.375	107.286	10.854	11.817	54.535
Range	202.051	13.332	8.447	825.643	24.932	27.759	11.012	10.090	23.928
Minimum	62.641	11.600	12.356	273.810	2.383	7.110	1.573	2.781	10.216
Maximum	264.692	24.932	20.803	1099.454	27.315	34.870	12.585	12.871	34.144
Sum	1443.652	163.119	155.862	7062.295	173.757	176.054	51.786	71.465	182.877
Count	10.000	10.000	10.000	10.000	10.000	10.000	10.000	10.000	10.000

Table K: Descriptive statistics of CF, BF, EF, MF, CuF (S with compost at 0 cm and 0-30cm)									
	Ba	**TI**	**Pb**	**Mn**	**Co**	**Cu**	**As**	**Se**	**Pb**
Mean	15.244	1.785	2.248	100.106	3.530	0.100	0.013	0.130	3.687
Standard Deviation	7.953	0.687	0.882	30.772	3.149	0.053	0.007	0.126	1.143
Sample Variance	63.247	0.472	0.777	946.905	9.917	0.003	0.000	0.016	1.306
Range	26.355	2.152	2.159	109.044	10.694	0.162	0.020	0.375	3.350
Minimum	7.673	0.168	1.378	36.348	0.100	0.021	0.006	0.031	2.010
Maximum	34.028	2.320	3.537	145.392	10.794	0.182	0.026	0.406	5.360
Sum	152.436	17.851	22.480	1001.059	35.300	1.004	0.128	1.298	36.874
Count	10.000	10.000	10.000	10.000	10.000	10.000	10.000	10.000	10.000

Table L: Descriptive statistics of C, B, E, M, Cu									
	Ba	**TI**	**Pb**	**Mn**	**Co**	**Cu**	**As**	**Se**	**Pb**
Mean	0.201	0.157	0.197	37.925	0.063	4.626	0.103	0.047	0.074
Standard Deviation	0.099	0.061	0.086	32.264	0.023	2.497	0.041	0.025	0.023
Sample Variance	0.010	0.004	0.007	1040.940	0.001	6.236	0.002	0.001	0.001
Range	0.249	0.169	0.194	85.117	0.055	5.826	0.113	0.062	0.056
Minimum	0.073	0.081	0.100	3.154	0.027	1.540	0.049	0.014	0.035
Maximum	0.321	0.250	0.294	88.271	0.083	7.366	0.162	0.076	0.091
Sum	1.006	0.785	0.987	189.624	0.317	23.132	0.514	0.235	0.370
Count	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000

Table M :Descriptive statistics of CPo, BPo, EPo, MPo, CuPo									
	Ba	**TI**	**Pb**	**Mn**	**Co**	**Cu**	**As**	**Se**	**Pb**
Mean	1.953	2.153	2.058	606.173	0.660	50.755	2.607	0.414	0.686
Standard Deviation	0.887	0.727	0.417	187.872	0.360	16.226	1.510	0.083	0.246
Sample Variance	0.787	0.529	0.174	35296.073	0.130	263.291	2.281	0.007	0.060
Range	2.171	1.771	1.047	379.104	0.915	40.794	3.643	0.203	0.547
Sum	9.766	10.767	10.292	3030.866	3.298	253.777	13.034	2.071	3.432
Count	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000

Table N: Descriptive statistics MiPo and SaPo (S W UDC)								
	Ba	**Pb**	**Mn**	**Co**	**Cu**	**As**	**Se**	**Pb**
Mean	124.284	20.266	492.287	16.489	8.514	0.534	4.865	16.322
Standard Deviation	12.667	0.246	59.116	0.660	1.332	0.120	2.290	0.768
Sample Variance	160.444	0.061	3494.723	0.436	1.774	0.014	5.246	0.589
Range	17.913	0.349	83.603	0.934	1.884	0.170	3.239	1.086
Minimum	115.327	20.091	450.486	16.022	7.572	0.449	3.246	15.779
Maximum	133.240	20.440	534.089	16.956	9.455	0.620	6.485	16.865
Sum	248.567	40.531	984.574	32.978	17.027	1.069	9.731	32.644
Count	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000

Table O: Descriptive statistics Mi and Sa and M and B and E								
	Ba	**Pb**	**Mn**	**Co**	**Cu**	**As**	**Se**	**Pb**
Mean	0.151	0.038	68.833	0.003	12.801	0.003	0.009	0.039
Standard Deviation	0.187	0.037	18.641	0.005	7.544	0.003	0.007	0.038
Sample Variance	0.035	0.001	347.472	0.000	56.914	0.000	0.000	0.001
Range	0.411	0.089	47.556	0.011	18.788	0.006	0.019	0.089
Minimum	0.016	0.005	42.444	0.001	5.092	0.001	0.001	0.005
Maximum	0.427	0.094	90.000	0.012	23.880	0.007	0.020	0.094
Sum	0.757	0.191	344.163	0.017	64.003	0.014	0.045	0.194
Count	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000

Table P : Descriptive statistics MiPo and SaPo and MPo and BPo and EPo								
	Ba	**Pb**	**Mn**	**Co**	**Cu**	**As**	**Se**	**Pb**
Mean	1.688	1.255	657.282	1.321	53.828	0.681	0.788	0.911
Standard Deviation	0.740	0.612	110.203	0.669	14.948	0.305	0.379	0.704
Sample Variance	0.548	0.375	12144.766	0.447	223.451	0.093	0.143	0.496
Range	1.590	1.310	236.143	1.540	37.328	0.640	0.841	1.427
Minimum	1.084	0.675	538.849	0.670	42.248	0.368	0.383	0.336
Maximum	2.673	1.984	774.992	2.209	79.576	1.008	1.224	1.763
Sum	8.441	6.275	3286.410	6.603	269.139	3.404	3.938	4.554
Count	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000