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MASTER THESIS

DETECTION OF HEAVY METALS CONCENTRATION IN SERUM OF INDUSTRY PLANT EMPLOYEES IN KOYA CITY IRAQ

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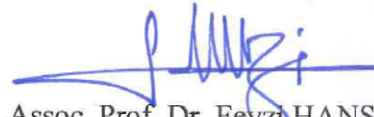
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ABBREVIATIONS AND SYMBOLS

Abbreviations	**Classification**
FFA	: Free Fatty cids
MG	: Monoacylglycerols
DG	: Diacylglycerols
TG	: Triacylglycerols
TC	: Total Cholesterol
LDL	: Low Density Lipoprotiens
HDL	: High Density Lipoprotiens
VLDL	: Very Low Density Lipoprotiens
CE	: Cholestryl Ester
PL	: Phospholpids
ATSDR	: Agency for Toxic Substances and Disease Registry
FAQ	: Food and Agriculture Organization
WHO	: World Health Organization
CNS	: Central Nervous System
UNEP	: United Nations Enviroment Program
DOM	: Dissolved Organic Matter
ICP-OES	: Inductively Coupled Plasma-Optical Emiission Spectroscopy
ICP-AES	: Inductively Coupled Plasma-Atomic Emiission Spectroscopy
ICP-MS	: Inductively Coupled Plasma-Mass Emiission Spectroscopy
SD	: Standard deviation
NS	: Non significant

Symbols	**Description**
Al	: Aluminum
Ba	: Barium
Cd	: Cadmium
Fe	: Iron
Pb	: Lead
Mn	: Manganese
Hg	: Mercury
Ag	: Silver
V	: Vanadium
Zn	: Zinc
$=$	: Equals is the Same as
$\neq$	: Is not equal to is defferenr from
$>$	: Is greater than is more than exceeds is above
$\geq$	: Is greater than or equal to is at least is not less than
$<$	: Is less than is fewer than is below
$\leq$	: Is less than or equal to is at most does not exceed is not greater than is no more than

ABSTRACT

DETECTION OF HEAVY METALS CONCENTRATION IN SERUM OF INDUSTRY PLANT EMPLOYEES IN KOYA CITY IRAQ

M.Sc. Thesis

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Heavy metals are among the most important sorts of the contaminant in the health and environment. Beside the natural activities, almost all human activities also have a potential contribution to producing heavy metals as side effects. Migration of these contaminants into noncontaminated areas as dust or leachates through the soil and spreading of heavy metals containing sewage sludge are a few examples of events contributing towards contamination of the ecosystems.

This study has attempted to establish an analysis method through validation against heavy metals in the serum [Aluminum (Al), Silver (Ag), Barium (Ba), Cadmium (Cd), Iron (Fe), Mercury (Hg), Manganese (Mn), Lead (Pb), Vanadium (V) and Zinc (Zn)] and Lipid profile [Cholesterol, TG, HDL, LDL and VLDL] in serum of (39) worker work in industrial plant employees in Koya city, Iraq (effected), and compare with the level of heavy metals and lipid profile in (39) healthy normal persons (control) using (ICP-OES) and find out the relevance of heavy metal and lipid profile after analyzing the distribution of heavy metal concentration and correlations between a control and effect groups and lipid profile.

The data of the current study was expressed as mean, standard error of the mean (Mean $\pm$ S.E.M) and the SPSS (statistical package for social science) (Version 20) statistical software was used to analyze the data. Probably level of P value ($P<0.05$) level of significance was considered to be statistically significant.

The results of this thesis showed significant differences of (Al, Ba, Fe, Pb, Zn, Hg, Mn, and V) levels in blood of both studied control and effected groups and P- value was less than (0.05), while no results detected for (Ag and Cd) and lipid profile (Cholesterol, TG, HDL, LDL, VLDL) levels in blood of both studied control and effected groups observed and P- value was greater than (0.05).

Keyword: Lipid profile, heavy metals, human health, industrial plant, Koya and ICP-OES.

ÖZET

YÜKSEK LİSANS TEZİ

IRAK'TAKİ KOYA ŞEHRİNDE BULUNAN SANAYİ ÇALIŞANLARININ SERUM ÖRNEKLERİNDEKİ AĞIR METAL KONSANTRASYONLARININ TESPİTİ

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Ağır metaller hem çevreyi hemde canlıların sağlığını olumsuz yönde etkileyen türler arasında ilk sıralarada yer alırlar. Doğal kaynakların yanı sıra , insan faaliyetlerinin sonucu olarakta çevredki ağır metal konsantrasyonu artış göstermektedir. Ağır metaller toz, toprak ve su yolu ile temiz bölgelere taşınıp bu bölgelerinde ağır metaller bakımından kirlenmesine yol açabilirler. Bunun yanı sıra atık su çamurlarının kontrolsuz bir şekilde doğa salınması sonucu ekosistemdeki ağır metal konsantrasyonun artışına sebep olarak ekosistemin kirlenmesine yol açabilir.

Bu çalışma; Irak'taki Koya şehrinde bulunan sanayi kuruluşlarındaki çalışanlarınının (39) serum örneklerinden [Alüminyum (Al), Gümüş (Ag), Baryum (Ba), Kadmiyum (Cd), Demir (Fe), Cıva (Hg), Manganez (Mn), Kurşun (Pb), Vanadyum (V) ve Çinko (Zn)] ve serumdaki lipit profillerindeki [Kolesterol, TG, HDL, LDL ve VLDL] ağır metallere karşı doğrulama yoluyla bir analiz yöntemi oluşturmaya ve (ICP–OES) kullanarak (39) sağlıklı Normal kişilerdeki (kontrol grubu) ağır metal seviyeleri ve lipit profilleri ile karşılaştırmaya ve ağır metal konsantrasyonlarının dağılımını ve bir kontrol grubu ile lipit profili arasındaki korelasyonları analiz ettikten sonra ağır metal ile lipit profili arasındaki ilişkiyi bulmaya çalışmıştır.

Mevcut çalışmanın verileri; ortalama, ortalamanın standart hatası (Ortalama ± O.S.H.) olarak ifade edilmiştir ve verileri analiz etmek için SPSS (sosyal bilimler için istatistik paketi) (Versiyon 20) istatistik yazılımı kullanılmıştır. Olası P değeri seviyesi ($P < 0.05$) anlamlılık düzeyinin istatistiki açıdan anlamlı olduğu kabul edilmiştir.

Bu tezlerin sonuçları; üzerinde çalışılmış olan hem kontrol grubunun hem de etkilenmiş grupların kanında belirgin (Al, Ba, Fe, Pb, Zn, Hg, Mn ve V) seviyeleri farklılıkları göstermiştir ve P- değeri (0.05)'ten küçüktür, üzerinde çalışılmış olan hem kontrol grubunun hem de etkilenmiş grupların kanında Ag ve Cd tespit edilmemiş olup, lipit profili (Kolesterol, TG, HDL, LDL, VLDL) seviyeleri farklılıkları gözlemlenmemiştir ve P- değeri (0.05)'ten büyüktür.

Anahtar kelimeler: Lipit profili, ağır metaller, insan sağlığı, endüstriyel santral, Koya ve ICP-OES.

1. INTRODUCTION

The air in the work environment usually contains a number of workers (chemicals, central process facility operators cpf, loading operators …etc.) which inhaled and/or absorbed by workers body leads to health risk to the workers'. To later years, confirmation need gathered that cooperations between air pollutants furthermore living tissues might result in aggravation of the pro-oxidant also anti-oxidant offset of the particular figure.

The main purpose of this work was to investigate blood levels of selected lipid profile, as well as concentration often trace elements (Aluminum, Barium, Cadmium, Iron, Lead, Manganese, Mercury, Silver, Vanadium, and Zinc) in workers exposed to oil refining environment, and to find out whether any association between the levels of toxic and essential trace elements does really exist.

1.1 Lipid profile

Lipids are hydrophobic biological substances in nature and in many cases soluble in organic solvents (Smith et al., 1997). These chemical properties cover a broad range of molecules, such as fatty acids, phospholipids, sterols, sphingolipids, terpenes, and others (Christie, 1973). Lipid classes are oils, fats, waxes, and complex lipids which involved in various biological processes like phospholipids, sterols, glycolipids, sphingolipids and lipoproteins (Vilhelmsen et al., 2005; Jannin et al., 2008).

Lipids are first absorbed from the small intestine; then emulsified by bile salts which are synthesized in the liver from cholesterol, stored in the gallbladder and secreted following the ingestion of fat. Dietary fats as an emulsion are accessible to pancreatic lipase. The products of pancreatic lipase, i.e. free fatty acids (FFA) and a mixture of monoacylglycerols (MG) and diacylglycerols (DG) from dietary triacylglycerols (TG) diffuse into the intestinal epithelial cells where resynthesis of TG occurs. Lipid profile includes total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C) usually called bad cholesterol, high-density lipoprotein cholesterol (HDL-C) usually called good cholesterol, and triglycerides (TG).

An extended profile may also include very low-density lipoprotein cholesterol (VLDL-C) and Non-HDL-C (Adeyemi et al., 2015; Nordestgaard et al., 2016).

1.2 Selected lipid profiles

1.2.1 Cholesterol (CH)

Cholesterol is a wax-like substance made by the liver and occurs either free or as fatty esters in all animal cells. It is the principal sterol of higher animals and is especially abundant in nerve tissues and in some gallstones (Bolton-Smith et al., 1991). Cholesterol has both hydrophilic properties, due to its hydroxyl end, and hydrophobic properties, due to its hydrocarbon side-chain. It is commonly found in the lipid bilayer of cell membranes (Loose-Mitchell et al., 1991).

Normal healthy adults synthesize cholesterol at approximately 1 gram/day and consume about 0.3 gram/day. A relatively constant level of cholesterol in the body (150–200 mg.dL^{-1}) is maintained primarily by controlling the level of de novo synthesis and that makes up about 85% of blood cholesterol, while only about 15% comes from dietary sources (Ravnskov et al., 2006).

Cholesterol synthesis level regulated in part by the dietary intake of it. Exogenous cholesterol down-regulates cholesterol synthesis in the liver to maintain cholesterol balance (Omoigui, 2007). Cholesterol also contributes to the working and development of the central nervous system (it has major functions in signal transduction and sperm development) (Dart et al., 2004).

1.2.2 Triglyceride TG

Glycerol (glycerine) is a trihydric alcohol, containing three alcoholic or hydroxyl (OH) groups to which the three fatty acids link one after the other to form triglyceride or triacylglycerol (TAG). The density of triglycerides lower than water. At room temperatures, triglycerides may be solid or liquid. When solid, they are called "fats" or "kinds of butter" and when liquid they are called "oils" (Bender and Bender, 1995).

Triglycerides constitute about 98% of total dietary lipids; the remaining 2% consisting of phospholipids, cholesterol and its esters (Fahy et al., 2005). Nearly all the commercially important fats and oils of animal and plant origin consist almost exclusively of triacylglycerols (Laakso and Voutilainen, 1996).

1.2.3 High density lipoprotein (HDL)

HDL particles run in breadth between 70-100⁰A furthermore clinched alongside sub-atomic impostor in the middle of 200 what's more 400×10^3 daltons. More modest also bigger span subclasses need additionally been distinguished. Plasma HDL levels would generally communicate by their cholesterol substance. This may be sad since that commitment from claiming cholesterol of the downright impostor of the lipoprotein maybe just something like 15%. This outflow masks the certainty that clinched alongside Grown-ups the fixation for circle HDL maybe regarding 250 will 500 mg/dL, equal to that for LDL (Eisenberg, 1984).

The total body content of high-density lipoprotein possibly exceeds that of LDL, because more HDL distributes to extravascular spaces than LDL. In younger humans, when LDL levels are relatively low, the major plasma lipoprotein is HDL, and in many animal species, HDL is the major plasma lipoprotein. When the number of circulating HDL particles is considered, there is no doubt that HDL is indeed the predominant plasma lipoprotein class: there are 10 to 20-fold more HDL particles in the human body fluids than the number of all other lipoprotein particles (Stein and Stein, 1973; Eisenberg, 1984).

1.2.4 Low density lipoprotein (LDL) and very low density lipoprotein (VLDL)

Lipids are insoluble in, plasma: thus their transport is mediated by lipoproteins which differ in composition, particle size, and density. These are chylomicrons, very low-density lipoproteins, low-density lipoproteins and high-density lipoproteins. All of them have a hydrophobic core containing TG and cholesteryl ester (CE) and a polar periphery with phospholipids (PL), cholesterol (C) and apolipoproteins (Mathews et al., 2000).

1.3 Metal toxicity

From 106 distinguished elements, over eighty of them need aid called metals. The metallic components could make isolated under two distinctive groups: the gathering that is fundamental for survival, for example, such that iron and calcium, and the differences that are unimportant alternately toxic, for example, lead furthermore cadmium. Dissimilar to a few natural substances, these poisonous metals need aid not metabolically degradable what's more their aggregation on existing tissues camwood reason passing alternately a genuine wellbeing danger. Furthermore, these metals were broken down on wastewaters, also released under surface waters, will be amassed as they head out up that natural way of life. Eventually, greatly harmful levels from claiming poison might move keeping of the prompt earth of the state funded. Metals that leak underground waters will debase for drinking water wells furthermore hurt those customers of that water (Wang et al., 2009).

Pollution from manufactured sources easily creates conditions of high percentage metal presence that leads to toxic effects on human lives and animals. Human's exploitation of the world's mineral resources tends to unearth, dislodge, and disperse chemicals and particularly metallic elements, which have recently been brought into the environment in unprecedented quantities and concentrations and at extreme rates (Wang et al., 2009).

1.4 Heavy metals

They are metallic elements: their atomic weights and densities are greater than 5 g/cm^3. Some heavy metals at low concentrations serve as micronutrients as iron (Fe), copper (Cu), and zinc (Zn). These metals are only toxic when in excess (Uriu-Adams and Keen, 2005; Valko et al., 2005). Other heavy metals and metalloids such as lead (Pb), mercury (Hg), cadmium (Cd), inorganic arsenic (As), nickel (Ni), and aluminum (Al) are toxic even at very low concentrations (Vallee and Ulmer, 1972; Hyman, 2004; Valko et al., 2005; Ravindranath et al., 2018; Schwartz et al., 2010).

Depending on health effects, metals can be divided into:

i. The individual's metals which would key with life courses case in point copper Cu), zinc (Zn), chromium (Cr), manganate (Mn), iron (Fe) furthermore cobalt (Co).

ii. Metals that are likely not key to existing systems, e.g. Aluminum (Al).

iii. Metals those are dangerous to some term process, e.g. Tin (Sn) and arsenic (As).

iv. Highly toxic metals to living system, e.g. mercury (Hg), cadmium (Cd), lead (Pb) and chromium (VI).

The heavy metals have the ability to bio-accumulate in the food chain and causing various diseases (Simeonov et al., 2010; Obiri et al., 2010; Waalkes, 2000).

Fig. 1.1 Periodic table of the elements. Metals, metalloids, the rare earth elements (lanthanide series, actinide series) and the lead-group elements and heavy metals indicated.

1.5 Heavy metals in crude oil, residual oil and sediment

The greater part about heavy metals would found in distinctive fuel oil. A percentage of claiming heavy metals might impact looking into individuals' wellbeing much toward all together low level. A few heavy metals at large amount utilized similarly as an ointment for motor parts. After using, heavy metals or other chemicals camwood make exhibited to utilized oil, which will be disposed of under earth. Left over oil is that finished item from claiming oil refining. This sort of oil might spill under the ground furthermore water waste frameworks. On these items were arranged under surroundings, for example, such that Agricola zone or watery area, the heavy metals might make exchanged under living framework similarly as the plant; fish; winged animal alternately other animals; they might enter individuals' existing alternately diet framework. Therefore, it will be exceptionally imperative on pondering that how those rough alternately left-over oil influences our earth (Bryan and Langston, 1992).

Studies on oil contamination have been done by (Carl's et al., 1995; Al-Senafi et al., 1997; Henry et al., 1997) for determination of barium (Ba), chromium (Cr), copper (Cu), lead (Pb), zinc (Zn); and on some non-metallic ions, as Cl^-, SO_4^{2-}, NH_4^+, NO_3^- by Pucci et. al., 2000).

1.6 Inductively coupled plasma optical emission spectrometry (ICP-OES)

Inductively coupled plasma-optical emission spectrometry also referred as inductively coupled plasma atomic emission spectrometry ICP-AES. In recent years ICP-OES and inductively coupled plasma mass spectrometry (ICP-MS) extremely used for the analysis of different samples because they have some advantages over other techniques, as its high sensitivity, excellent selectivity, wide dynamic range and used for simultaneous multi-elemental analyses with very low limits of detection. Inductively coupled plasma optical emission spectrometry usually used for multi-element estimation of the trace, minor, and major elements while ICP-MS is used for multi-elemental analysis at ultra-trace concentrations (Fletcher et al., 2010; Beauchemin, 2010; Ghosh et al., 2013). Another advantage of using of ICP-OES is that the effects of matrix usually are smaller than that in ICP-Mass spectrometry because ICP-OES involves measurement of emitted light while, which is a completely passive process. But in ICP-MS, ions must be extracted physically from the plasma (Deconinck et al., 2006).

Nowadays, ICP-OES is a recognized technique for the multi-elemental estimation in a wide samples range (environmental samples, biological samples and geological samples) (Bettinelli et al., 2000; Zhu et al., 2007; Chaves et al., 2011; dos Santos Depot et al., 2012; Sneddon et al., 2017; Dupre et al., 2018). The principle of the method is excitation of atoms and ions into high energy level using high temperature. The excited atoms and ions are not stable due to the natural tendency of atoms or ions to return to its ground state. When they return to the ground state, typically they release energy. The released energy called emission radiation. The intensity of emitted radiation depends on the temperature, a number of atoms or ions in excited levels and the type of atom or ion. Each element has a number of emission lines and can be used for the quantitative analysis. The most frequently used lines depend on the sensitivity of the line and the presence or absence interferences (El-Ghawi et al., 1999).

1.7 Ultraviolet – Visible Spectrophotometry

The simplest and straighter way to determine a compound is by UV – Vis. spectrophotometry, based on the measurement of its native absorbance (if of course, the compound has optical properties) at a predefined wavelength. Spectrophotometry, as one of the instrumental analytical methods, has not lost its attraction and is certainly the detection technique most widely employed in practical applications (Kolev and McKelvie, 2008).

UV – Visible spectrophotometry relies on the wavelength-dependent absorption of electromagnetic radiation by the processed sample. The wavelength range is typically between 180 and 780 nm and can be limited by the solvent (Skoog et al., 2017). As a rule, absorption is associated with electronic transitions and there is a relationship between the proportion of radiation absorbed and the concentration of the absorbing species (Zagatto, 2012).

A large number of reported applications of this technique is a logical result of its high flexibility for adaptation to a wide variety of analytical problems (Martinez-Calatayud, 1996).

2. REVIEW OF LITERATURES

2.1 Selected Heavy Metals

2.1.1 Silver (Ag)

Silver (Ag) is a soft element and its naturally occurring element. Silver found in the piles of earth crust as mineral ores in sulfide (S^{2-}) and chloride (Cl^-). Naturally occurring Ag is associated with other metals such as gold (Au), copper (Cu), lead (Pb), and zinc (Zn) (The Silver Institute, 2017). Even though Ag is considered a rare metal (Howe et al., 2002), 60% of Ag in the aquatic environment comes from natural sources at concentration ranges $0.001 - 0.01$ µg/L.

Due to its unrivaled characteristics, as high electric conductivity and its high thermal conductivity, it's used in many applications such as conductive adhesives, electronic and photovoltaic devices (TheSilverInstitute, 2017). Furthermore, it has an important role in health and medicinal applications. In personal care products silver used as an antimicrobial (Jones, 2009). It may be present in the aquatic system, as a result of industrial wastes and mining waste. Also, silver may enter the environment from the treatment of wastewater (Purcell and Peters, 1998).

Silver can exist in different oxidation states in environments (I, II and III). However, free Ag ion is the most reactive and high toxic. Studies by researchers have shown that its toxicity depends on bio-availability and bio-accumulation of free Ag in aqua organisms (Luoma et al., 1995).

2.1.2 Lead (Pb)

The density of lead was 11.3 g/cm^3 with an atomic number of 82. Lead obtained from its sulfide mineral galena, carbonate cerussite, and sulfate anglesite. The ores are usually found in combination with other recoverable metals such as copper, zinc, and cadmium. Pb exists in oxidation states (0, +1, +2 and +4). Oxidation state Pb (II) was environmental importance, the form in which most lead is bio-accumulated by aquatic organisms (Akan et al., 2009). Pb was placed position 2 on the Agency for Toxic Substances and Disease Registry's (ATSDR) top 20 lists of the most dangerous heavy metals, and lead accounts for most of the children's heavy metal poisoning cases. It has been used frequently in pipe making, drains and soldering materials. Also, it used in battery manufacture, plumbing, ammunition, additives of fuel, paint pigments and pesticides (ATSDR, 2007).

Lead is dispersed throughout the environment primarily as the result of anthropogenic activities. Environmental pollution sources of Pb include the mining and smelting of ore, manufacture of lead-containing products, coal and oil combustion, and waste incineration. Most anthropogenic sources leaded are gasoline, lead-based paints, lead solder in food cans, lead-arsenate pesticides, and shot and sinkers, have been eliminated or strictly regulated due to lead's persistence and toxicity. These former uses of lead leave their legacy as high concentrations of Pb in the environment because it doesn't degrade. Total global production of Pb from mining has decreased from 3.600.000 tonnes in 1975 into 3.100.000 tonnes in 2004; that means global refined Pb production has increased from 4.7 to 7.10 million tones (UNEP, 2008).

The Table below shows different countries Pb production (including developing countries). Previously used lead production via recycling is higher for developed countries (it is from 60 to 70.0% of their Pb production) higher than developing countries (less than 30%) (Simeonov et al., 2010).

Table 1. Developing countries Pb production compared to other developed countries Pb Production in 2009.

Country	Global lead production (%)
China	40
USA	12
Peru	9.0
Mexico	4.0
India	1.5
Ireland	1.0
Kazakhstan	1.0
Morocco	1.0
Poland	1.0
Brazil	0.64

A major use of lead in the production of antiknock compounds particularly tetraethyl lead, Pb $(C_2H_5)_4$ for addition to petrol. Vehicles exhausts are a major source of the environmental pollution by lead.

The main content of exhaust gases is lead halides and oxides, and about 10.0% of alkyl lead compounds also being present during incomplete combustion results (Dojlido and Best, 1993).

About 60.0% of world lead production used for the batteries manufacturing (especially car batteries), the remainder used in the production of pigments, solder, glass paints, cable sheathing, a gasoline additive and many others. The power storage battery industry has a relatively low effect on the surrounding environment because nearly 80.0 percent of all batteries are recycled. In most new homes, Cu pipes have replaced Pb pipes and Pb-free solder is used. However, Pb-free means that soldiers and flux may contain less than 0.2% Pb, while pipes, pipe fittings, and well pumps may contain less than 8.0% Pb. (Sarkar, 2002).

Some lead poisoning effects include a deficiency in cognitive function, abdominal pain, and discomfort, formation of weak bones as lead replaces calcium and causes anemia due to the reduction of enzymes concerned with the synthesis of red blood cells (Järup, 2003). Also, it leads to decreased fertility, causes cancer and other minor effects such as vomiting, nausea, and headache (Järup, 2003; WHO, 2008). Exposure to high levels of Pb damage brain and kidneys. Also, it causes miscarriage in pregnant women, damage the organs responsible for sperm production in men, and ultimately it may cause death (ATSDR, 2007).

2.1.3 Zinc (Zn)

Zinc makes up about 75 parts per million of the Earth's crust and its density 7.14 gm/cm^3. Normally, zinc found in association with base metals such as Cu and Pb in ores and it prefers to bond with sulfur and occurs as ores such as sphalerite (ZnS), zincite (ZnO), and calamite ($ZnCO_3$). Zn forms alloys such as bronze and brass and has been used in the construction of buildings, roofing, and cladding (Emsley, 2011). Other uses of Zn include making circuit boards, photocopiers, dry cell batteries and its compounds are used in chemical and pharmaceutical industries such as paints, pharmaceuticals, and nutritional supplements (Reilly, 2008).

The toxicity of Zn is as a result of excessive absorption which suppresses iron and copper absorption while free Zn^{2+} ion in solutions has high toxicity to plants, invertebrates, and even fishes (FAO, 2011; WHO, 2011).

2.1.4 Aluminum (Al)

Aluminum is the third most abundant element in the earth's crust (7.4%). It never exists free in nature and it is usually bound to oxygen (alumina) or to other elements like fluorine (cryolite (Na_3AlF_6)). Aluminum is one of the main constituents of naturally available minerals such as micas, feldspars, and zeolites. The majority of aluminum compounds have an oxidation state of +3 for the aluminum atom due to the high stability of Al^{3+} oxidation state. The Hall–He´roult process, which involves electrolysis of Al_2O_3 dissolved in cryolite, is the widely employed process in the production of aluminum metal (Cotton et al., 1999; Lacassagne et al., 2002; Schmitz, 2006).

The first human case of aluminum intoxication was reported in 1921 with neurological manifestations including loss of memory, impaired coordination, jerking movements and tremors. Since this report, Al has been shown to be an important central nervous system (CNS) toxin and has been implicated in the development of several neurodegenerative disorders, including dialysis dementia, Alzheimer's disease, amyotrophic lateral sclerosis of Guam, and Parkinsonism-dementia. A number of cellular mechanisms by which aluminum is thought to exert its toxicity have been described including the blood-brain barrier permeability increasing, interference with phosphorylation-dephosphorylation reactions, altered iron metabolism with subsequent free radical production and disruption of second messenger systems (Agarwal et al., 1996).

2.1.5 Barium (Ba)

Barium is a silvery-white metal that happens done nature over a number of separate types. Barium mixes would solids for the way and they don't blaze great. Barium sulfate ($BaSO_4$) also barium carbonate ($BaCO_3$) are two manifestations of Ba frequently establishes clinched alongside way as underground metal stores furthermore don't blend totally for water. Sometimes it found naturally in food and drinking water. Ba and its compounds are used for several important purposes. Barium sulfate ore mined, and it used in many industries. To make drilling muds in the gas and oil industries mostly barium used. $BaSO_4$ is also used to make rubber, paints, bricks, glass, tiles, and other barium compounds.

Some barium compounds like barium carbonate ($BaCO_3$), barium chloride ($BaCl_2$), and barium hydroxide $Ba(OH)_2$ used in making of ceramics, rat, and insect poisons, additives for fuels and oils, and to make many other useful products. People with the greatest known risk of barium exposure with additional health effects are industry workers that make or use Ba compounds. Most exposed humans breathe air that contains $BaSO_4$ or $BaCO_3$.

The well-being impacts from claiming Ba introduction what's more its exacerbates would contingent upon how great those particular Ba compound disintegrates for stomach or on water. For example, $BaSO_4$ doesn't undoubtedly break down on water and makes a couple of unfriendly well-being impacts. For those purposes about making x-rays of the intestines or stomach, at times doctors provide for $BaSO_4$ orally alternately toward putting it in the rectum from claiming patients straightforwardly. The utilization from claiming this barium intensifies in this kind for therapeutic test need not solid impact on the people. Barium mixes, for example, barium nitrate, barium carbonate, barium chloride, barium hydroxide, barium sulfide, furthermore barium acetic acid derivation broken down over water, also camwood result in unfriendly wellbeing impacts. Drinking or consuming exactly a lot from claiming water broken down barium exacerbates might foundation passing or loss of motion to a couple people. Exactly people who drink or consume to a degree little sums of barium or its exacerbates to a short occasion when might possibly need challenges for breathing, expanding blood pressure, minor blood changes, transforms done heart rhythm, stomach irritation, muscle weakness, progressions for nerve reflexes, swelling of the brain, furthermore harm of the heart, kidney, spleen, what's more liver. The particular case study demonstrated individuals who drank water holding to the extent that 10 ppm of barium to 4 weeks didn't bring expanded pulse or abnormal heart rhythms (Rober, 1992; Moffett et al., 2007).

2.1.6 Cadmium (Cd)

Cadmium will be a silvery-white, lustrous, anyway tarnishable metal; it may be delicate furthermore flexible and need a moderately secondary vapor weight. Cadmium is about continuously divalent; synthetically it nearly resembles zinc furthermore happens for very nearly constantly on zinc ores toward isomorphous reinstatement (Cotton Furthermore Wilkinson, 1988).

Natural sources of cadmium results from volcanic activities; while, anthropogenic sources of it results from the mobilization of its impurities in phosphate fertilizers, fossil fuels and other (Simeonov et al., 2010).

Secondary focuses about cadmium buzzing around are connected with intensely industrialized cities, notably the individuals Hosting refinery, also smelting exercises (Hiatt Furthermore Huff, 1975), the place levels might be a few hundred times the individuals discovered over non-contaminated zones (Friberg, et al., 1974).

Elemental cadmium is released during processes with high temperature such as organic fossil fuel combustion (Dillner et al., 2005; Kuloglu and Tuncel, 2005). WHO has recommended 5.0 ng/m^3 as an air quality guideline to prevent further increase in its level in soils (Lazaridis and Colbeck, 2010; Marchwinska-Wyrwal et al., 2010). Several studies indicate that about 4.0–7.0% of a single dose ingested Cd is absorbed from the intestine. The absorption of its nitrate or chloride in animal studies ranged between 0.5% and 3.0% (Bernard and Lauwerys, 1984). Other studies suggest that accumulation of Cd in the human body is a function of human age (Schroeder and Balassa, 1961). Concentrations of Cd in the renal cortex are normally about 5–20 times those in the liver (Fleischer et al., 1974).

Due to its high toxicity, it studied only recently, it has joined Pb and Hg in the most toxic "Big Three" category of heavy metals with the higher potential hazard to peoples and the environment. It is also among the most toxic to living organisms and more likely to leach from industrial wastes (Gleason, 1969).

2.1.7 Mercury (Hg)

It is a high density, silvery-white metal; its melting point is -38.9°C. It is present in the Earth's crust with about 0.08 mg/kg; cinnabar HgS is the most common Hg-ore. Mercury and its compounds are used in dental preparations, fluorescent and ultraviolet lamps, thermometers and pharmaceuticals, and as fungicides in paints, industrial process waters, and seed dressings. Significant amounts of mercury consume in the pulp and paper industry (Wang et al., 2009). Hg is one of the environmentally most hazardous metals (Cai and Braids, 2002; Hoffman et al., 2002).

United Nations Environment Program (UNEP) estimated atmospheric emission of Hg from anthropogenic sources in 2005 by 1930.0 tonnes as shown in Table 2 (Unep, 2008).

Table 2. Global Anthropogenic Air Emissions of Hg in 2005.

Region	Emissions (Tonnes)	Percentage (%)
Asia	1281	66.5
North America	153	7.9
Europe	150	7.8
South America	133	6.9
Africa	95.0	5.0
Russia	74.0	3.9
Australia	39.0	2.0
Total	**1930**	**100**

It can be found as elemental Hg (0), inorganic compounds such as mercury (I) and mercury (II), and organic compounds [mostly as mercury (II)] compounds]. Hg in (II) oxidation state can be ligated to a large number of counter ions, such as sulfide, chloride, and hydroxide. Inorganic mercury ligated to methyl groups, and to organic dissolved matter (DOM). The commonest regularly happening type for Hg will be the mineral cinnabar that discovered characteristically on mineral stores along that Pacific coast (Kim et al., 2004; Nacht et al., 2004).

Hg will be additionally extremely normal in coal (Finkelman Also Tewalt, 1998) what's more clinched alongside hydrocarbon wellsprings (Pirrone et al., 1996), regularly certain on sulfur to these materials. These wellsprings discharge natural Hg and different manifestations for it of the environment with smoldering (Huggins et al., 1999). Other important industrial sources of global Hg emission to the atmosphere, were primary non-ferrous metals production (10.0%), production of cement (9.0%), Au production with large-scale (5.0%) and waste of consumer products (landfill, but also incineration; 5.0%), contaminated sites (4.0%), pig iron production (2.30%), industry of chlor-alkali (1.40%), refining of oil (1.40%), production of Hg (0.60%), and dental amalgam emitted through cremation (0.20%) (Unep and Amap, 2013; Sundseth et al., 2017).

It emitted from anthropogenic sources to the environment mainly derives from high-temperature industrial processes, where it is introduced as a minor constituent in fuels, minerals, and wastes. Hg evaporates from raw materials during the high-temperature production of industrial gold and fuels combustion, entering the ambient air with exhaust gases. The concentration of Hg as an impurity in different raw materials, such as in fossil fuels and in various ores, physical and chemical properties of the mercury affecting its behavior during its production (Unep, 2010; Unep and Amap, 2013).

Relying upon its hotspot furthermore natural conditions, oxidation, reduction, methylation, what's more demethylation of Hg camwood occur, converting mercury under Different manifestations (Atwood, 2006). Other tainting wellsprings need aid degassing of mineral stores furthermore oceanic frameworks (Gustin et al., 2003; Wang et al., 2004). Climatic mercury (0) furthermore mercury (II) that might type with respect to water droplets on clouds could be stored ashore alternately water (Nacht et al., 2004), or might be consumed by plant abandons through transpiration (Kolka et al., 1999).

Photooxidation furthermore photoreduction could likewise cause interconversion in the middle of natural Hg furthermore mercury (II) (Lindqvist Furthermore Rodhe, 1985). Hg (II) might likewise enter the biological community by disintegration (where deforestation need occurred), starting with urban discharges furthermore Agricola sources, for example, pesticides, and from mining discharges (gold mining, to which Hg might have been utilized to amalgamation) (Wang et al., 2004). Hg starting with these wellsprings camwood a chance to be methylated further downstream. The mercury (I) particle might a chance to be bio transformed of the mercury (II) particle in vivo, In any

case. Ingested natural mercury is promptly consumed (Friberg Also Vostal, 1972), 95% or that's only the tip of the iceberg is consumed by people. Absorption relies on solubility, molecule size, and rate from claiming decay of the salts in living liquids.

2.1.8 Manganese (Mn)

It makes up nearly 1000 part per million (0.10%) of the Earth's crust, thus making it the twelfth most abundant element. Principally, it occurs as pyrolusite (MnO_2), psilomelane ($BaH_2O)_2$ Mn_5O_{10}, and lesser extent as rhodochrosite ($MnCO_3$). Manganese compounds are powerful oxidizing agents with various oxidation states (+4, and +7) and can directly combine with boron, carbon, sulfur, silicon and phosphorous (Emsley, 2011). Among the several oxidation states, the +2-manganese oxidation state is the most stable state and the one that used for essential functions in living organisms, while other states are toxic to the human body. Depending on manganese oxidation state, its ions have various colors and are used industrially as pigments (Zhang and Cheng, 2007).

Though it is an important trace mineral for all living organisms, in larger amounts, and apparently with far greater activity by inhalation, Mn can lead to a poisoning syndrome in mammals, with neurological damage (sometimes it's irreversible) (Srivastava et al., 2013). Mn-related complications also include psychiatric and motor disturbances termed manganism which has occurred in people employed in the production and processing of Mn alloys (Nussey, 2000). People exposed to high levels of environmental pollution by Mn suffer from cerebella dysfunctions, neurological damage as was once observed in inhabitants of Groote Eylandt off the North coast of Australia (Reilly, 2008).

2.1.9 Iron (Fe)

The atomic number of Iron is 26 and major valences are +2 and +3. Iron is found in many inorganic compounds with oxygen (as, magnetite), carbonyls, sulfur, carbonates, and chloride. Ferrous Fe (II) salts are soluble but at neutral pH readily oxidize and precipitate as insoluble Fe(OH)n (rust). The aggregate worldwide production in 2004 was approximately 1 billion metric tons of raw ore. The iron mining products are used in many industrial products, ranging from iron-based pigments to structural elements in buildings and pharmaceuticals (Nordberg et al., 2014).

In the environment, iron levels in soil and water vary exceedingly. Iron overload from their consumption has not reported. In the air, other than that encountered in foundries and other industrial environments, iron concentrations are generally negligible.

However, Sentz and Rakow reported air iron levels of 20–30 mg/m^3 in some steel manufacturing plants, levels that would very likely lead to at least pulmonary accumulation of iron (Sentz Jr and Rakow, 1969).

The typical daily American/western European dietary intake of (Fe) is approximately 15 mg/day, only about 10% of which actually absorbed. Foodstuffs iron content greatly varies from rich iron contents (red meat) to poor iron contents (milk). Exposure to excess iron— typically in patients who receive numerous transfusions for many years leads to numerous pathological score. By contrast, iron deficiency also causes serious health consequences (Nordberg et al., 2014).

Acute iron (Fe) overload resulting from intentional or unintentional overdose has also potentially life-threatening. Chronic Fe overload leads to bit by bit developing (and, in extremis, lethal) organs damage such as the heart and liver (Alipour et al., 2015).

2.1.10 Vanadium (V)

Vanadium occurs in two isotope forms, the most abundant one is $_{51}$V (about 99.75%). Elemental V is a soft, corrosion-resistant, steel-gray solid. It is group VB element in the periodic table; also it belongs to the 1st transition series. Vanadium form compounds usually in oxidation states +5, +4, or +3. Oxidation state +4 is the most stable form, in which it forms oxovanadium (IV) ion (vanadyl). Due to reducing conditions in tissues, V (III) and V (IV) predominate bound to small peptides, whereas V (V) predominates in plasma usually bound to transferrin (Crans et al., 1998; IPCS, 2001).

About 85.0% of (V) used in the production of special alloys and steels, some of which have a potential application for fuel cladding in nuclear power production. The aerospace market is a big user of it. V_2O_5 and metavanadates are important catalysts in organic and inorganic chemical industries (e.g., in plastics and sulphuric acid production) (Fisher, 1975). Vanadium pentoxide is also used in some pigments and inks in ceramic industry (IPCS, 2001).

Some coal types may have about 1.0% vanadium; however, for US coal the weighted average didn't exceed 30.0 mg/kg. The highest concentrations of vanadium in oils found in the Middle East and Venezuela (Davies, 1971). Venezuelan residual oils

were recently shown to be 200 mg/kg to 300 mg/kg, Middle Eastern oils 10 mg/kg to 20 mg/kg V, and North African oils 50 mg/kg to 90 mg/kg (Aureliano et al., 1998). Residual fuel oils manufactured from United States crude oils contained about 25–50 mg/kg V (Nordberg et al., 2014).

Vanadium absorption from the gastrointestinal tract is poor and not exceeding 2.0% in humans. Its soluble compounds after inhalation are absorbed to a considerable extent and concentrated in the lung (Mandiwana and Panichev, 2010). Absorbed vanadium widely distributed in the human body. In animals, vanadium highest values are found in kidney, bone, liver, and spleen. Bone maintains essentially unchanged levels for several weeks. Systemic effects of vanadium have been observed in the nervous system, liver, kidney cardiovascular system, and in blood-forming organs. Metabolic effects of vanadium include its interference with the biosynthesis of cholesterol, cystine, depression, and stimulation of phospholipid synthesis. At higher vanadium concentrations, it leads to inhibition of serotonin oxidation. Vanadate has been shown to inhibit Na^+-K^+-ATP, phosphatases and several other enzyme systems. Compounds of vanadium enhance insulin effect (Lagerkvist and Oskarsson, 2007; Nordberg et al., 2014).

Purpose and aims of the project:

1. Evaluation of heavy metals concentration in serum of industrial plant employees
2. Evaluation of lipid profiles in serum of industrial plant employees.
3. Estimation of the effect of heavy metals on industry plant employees.
4. Estimation the effect of heavy metals on lipid profiles in industrial plant employees

3. MATERIAL AND METHOD

3.1. Material

In this study, we used below matrial and instrumentals:

Cylinder, funnel, beaker filter paper watch glass,

Pipet, volumetric flask, conical flask, balance, bottle (250+500) ml

Hot plate, oven, centrifuge,

Hood, gloves, tissues, bio hand (alcohol to cleaning),

Para-film, bottle to save solution, falcon tube.

Chemical equipment

The chemical equipments were we used is:

Nitric Acid HNO_3, min.69, 5%, reagent grade, ACS, ISO, max.

Hydrogen peroxide solution: H_2O_2 (30%, J.T. Baker, z.a.)

Distell water

Deionized water

Vacuum clever for cleaning materials

Coupled plasma –optical emission spectroscopy ICP.

3.2. Method

The materials used for the study include the field and laboratory materials. The study will be conducted at the laboratories of the Genetic center at Koya University. The study designed to investigate the effects of industrial plant on employees and also to evaluate the heavy metals and lipid profiles in employees. The study will be performed on 40-60 samples from the industry plant employees. Also, around 40 samples will be collected as a control group. Blood samples were collected from employees and controls. Blood samples were drawn into vacutainer chemical tubes for performing the biochemical analysis by using biochemical analyzer.

The samples will then be dried and digested with concentrated HNO_3 and concentrated H_2O_2. A blank digestion should be prepared out in the same way for the control samples. After digestion, the samples will be allowed to cool down, filtered and then distilled water up to the mark of the volumetric flask. It's ready to determine the concentration of heavy metals by using inductively coupled plasma –optical emission spectroscopy

Evaluation of heavy metal concentration in serum of industry plant employees in Koya city, Iraq by Inductively coupled plasma –optical emission spectroscopy.

Procedure

1- One-gram serum of the dried sample, using sensitive balance Dropper.

2- Transfer the dried samples by using a sensitive dropper to the test tubes glass Pyrex 250 ml digestion.

3- Digest the sample by adding 10 ml of concentrated HNO_3 and mix well.

4- Then, the test tube was closed up and inserted into sunflower oil heating the digestion mixture on a hot plate at $100 \pm 10°C$ for 30 min, inside the fume chamber (Hood).

5- Cool down the mixtures to room temperature, then add 2 ml of concentrated H_2O_2.

6- Again heat the test tube to 200 $°C$ at the hot plate for 2 hours carefully, until it is completely digested.

7- After that, the test tube was taken out from the oil leave to cool down, then dissolve the mixture in distilled or deionized water until obtaining a clear solution. Filter the sample solution through a cellulose filter paper into 25ml digestion tubes.

8- The filtrate was diluted to 15 ml with distilled or deionized water and heated the solution to dissolve the precipitate

9- Transfer the samples and put in the Falcon tube in a normal freezer, and store until analyzing.

10- A blank digestion should be prepared out in the same way for the control samples.

11- Finally, analyzed the heavy metals in the sample solutions by Inductively coupled plasma/optical emission spectroscopy (ICP-OES). The final measurement volume of the sample solutions should be 5 ml.

Calbration curves of the metals determination by ICP showed in following tabels and figures.

Tabel 3.1 Calibration curve of Ag by ICP

No.	Conc.	Intensity
1.	0	650
2.	0.1	9206
3.	0.5	47476
4.	2	183480
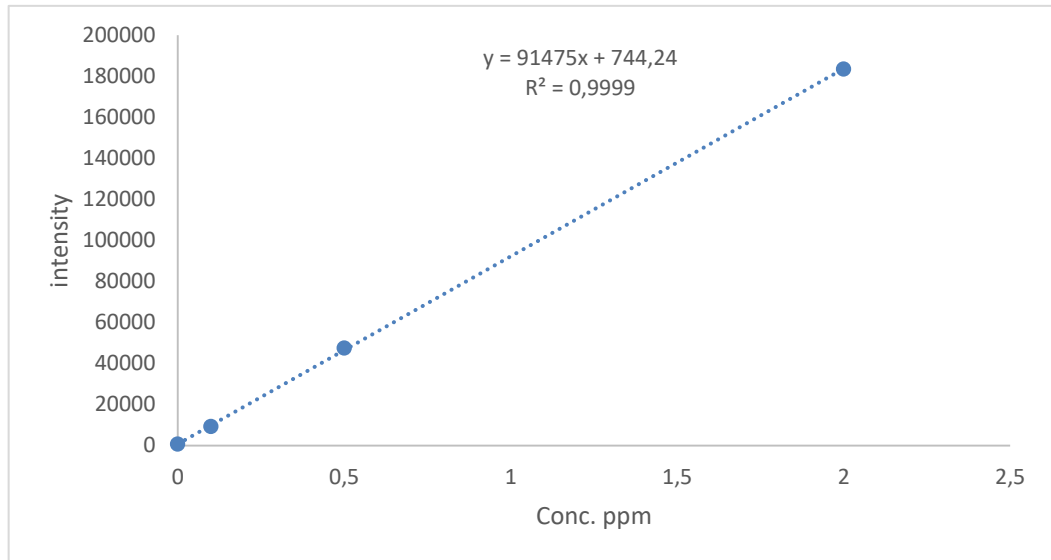
Figure 3.1 Calibration curve of Ag by ICP

Tabel 3.2 Calibration curve of Al by ICP

No.	Conc.	Intensity
1.	0	35
2.	0.1	262
3.	0.5	1225
4.	2	4901
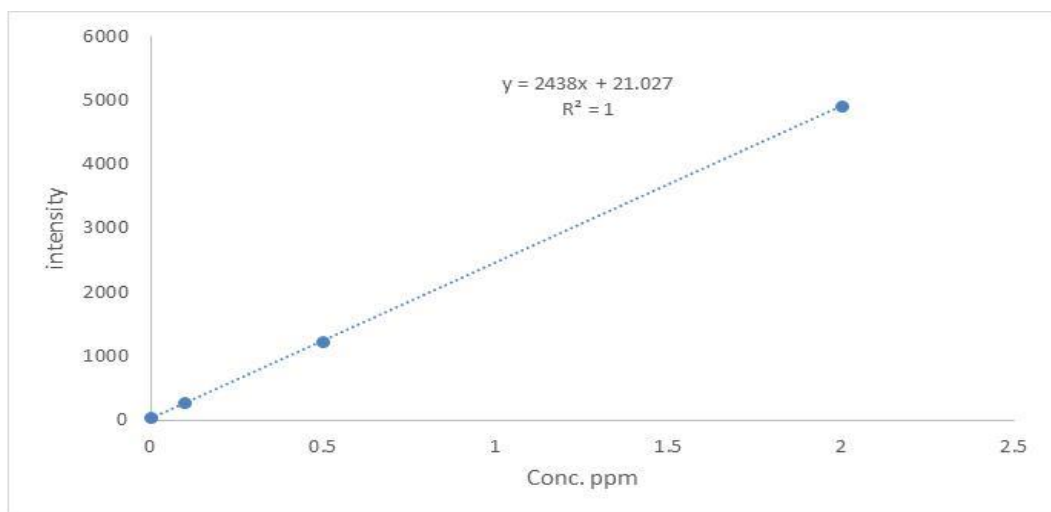
Figure 3.1 Calibration curve of Ag by ICP CP

Tabel 3.3 Calibration curve of Ba by ICP

No.	Conc.	Intensity
1.	0	4762
2.	0.1	98594
3.	0.5	501568
4.	2	1887070

$y = 939684x + 12204$

$R^2 = 0.9998$
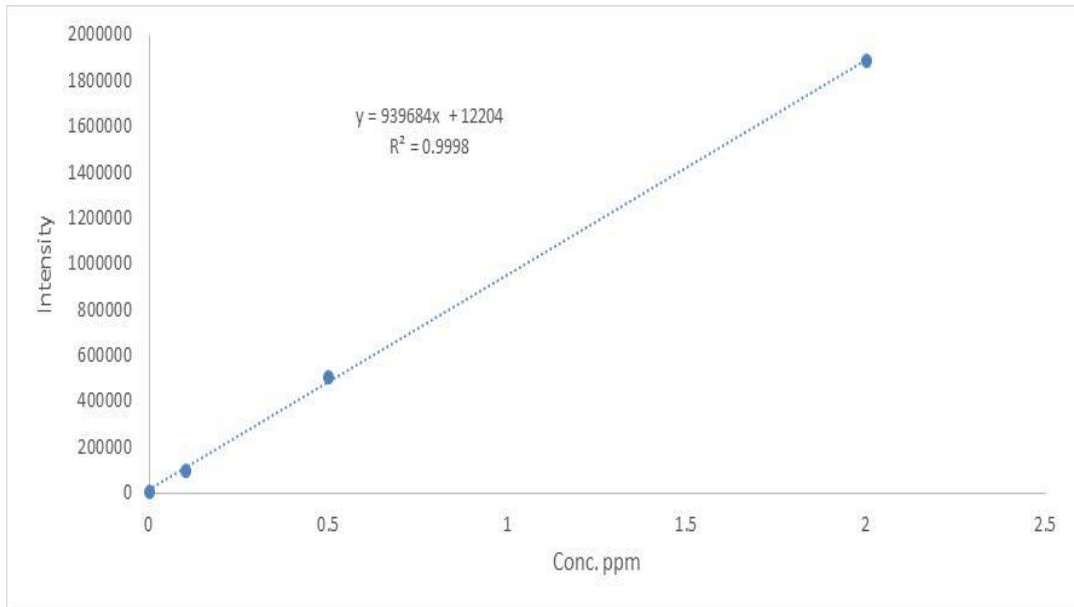
Figure 3.3 Calibration curve of Ba by ICP

Tabel 3.4 Calibration curve of Cd by ICP

No.	Conc.	Intensity
1.	0	64
2.	0.1	15115
3.	0.5	81522
4.	2	314744

$y = 157323x + 601.01$

$R^2 = 0.9999$
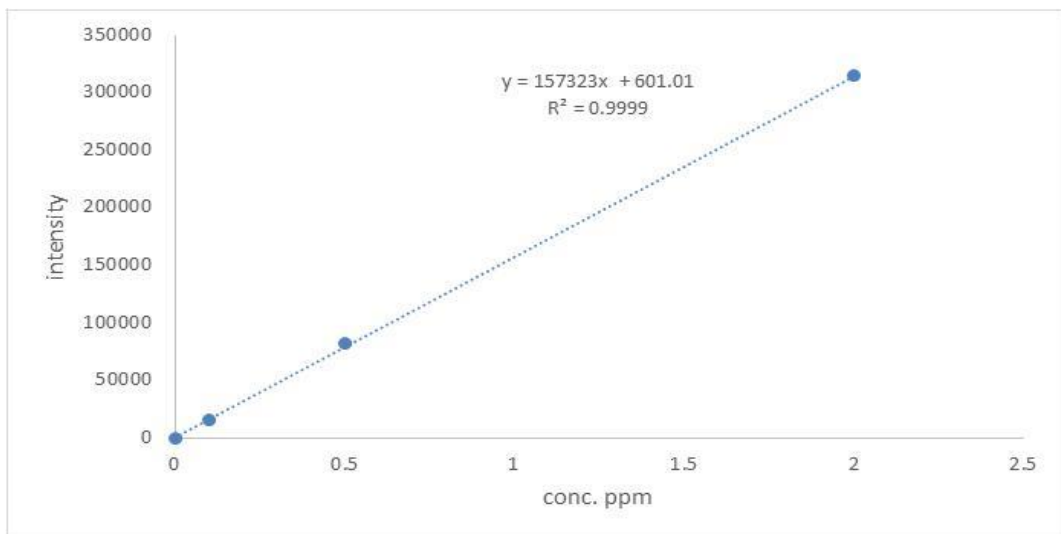
Figure 3.4 Calibration curve of Cd by ICP

No.	Conc.	Intensity
1.	0	-110
2.	0.1	6076
3.	0.5	38148
4.	2	145962
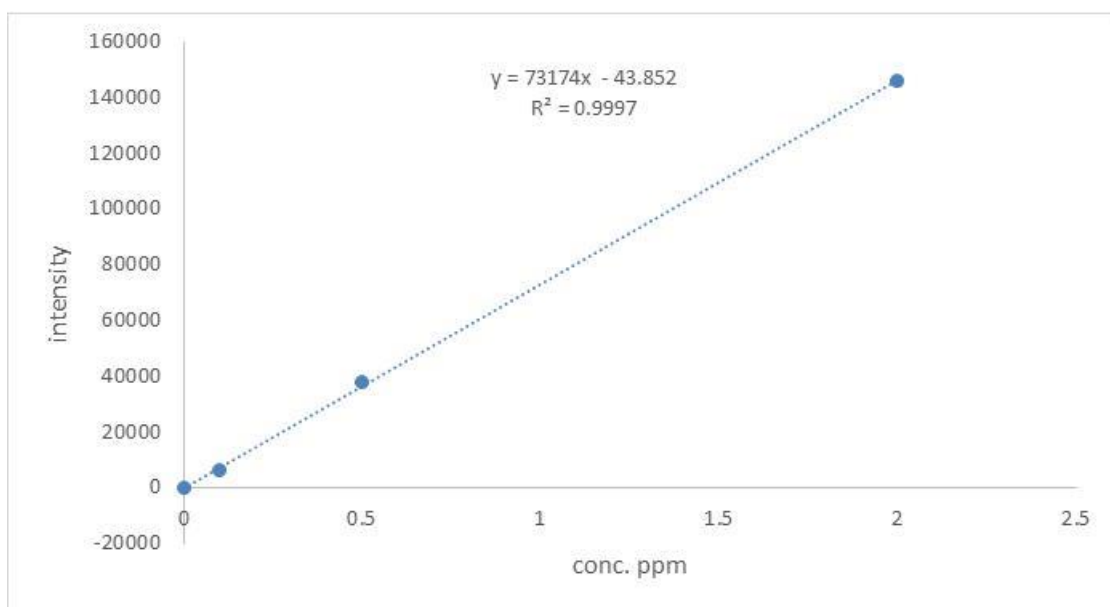
Figure 3.5 Calibration curve of Fe by ICP

Tabel 3.6 Calibration curve of Hg by ICP

No.	Conc.	Intensity
1.	0	193
2.	0.1	1160
3.	0.5	9135
4.	2	36133
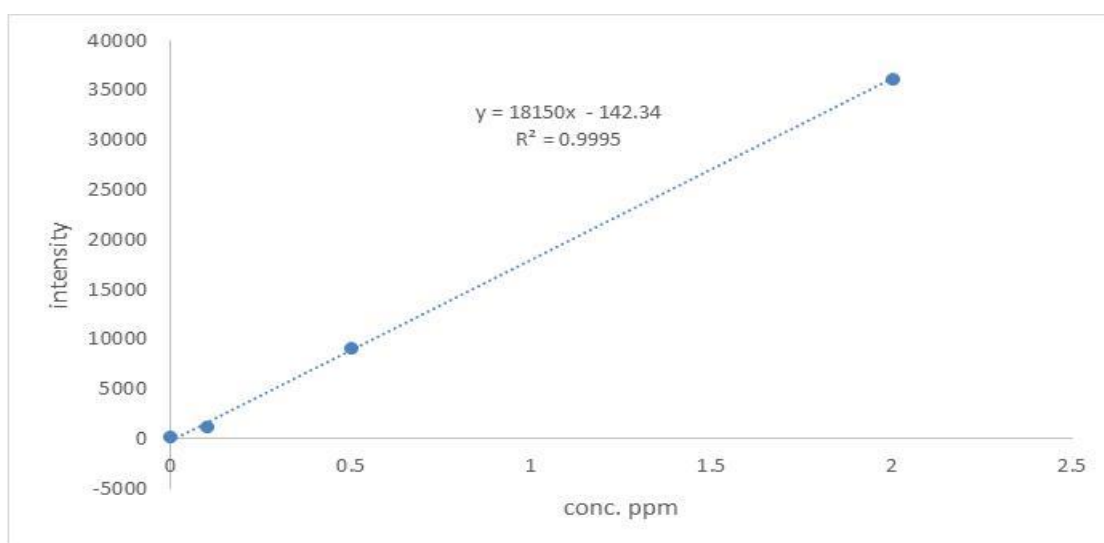
Figure 3.6 Calibration curve of Hg by ICP

Tabel 3.7 Calibration curve of Mn by ICP

No.	Conc.	Intensity
1.	0	200
2.	0.1	35556
3.	0.5	182600
4.	2	756252
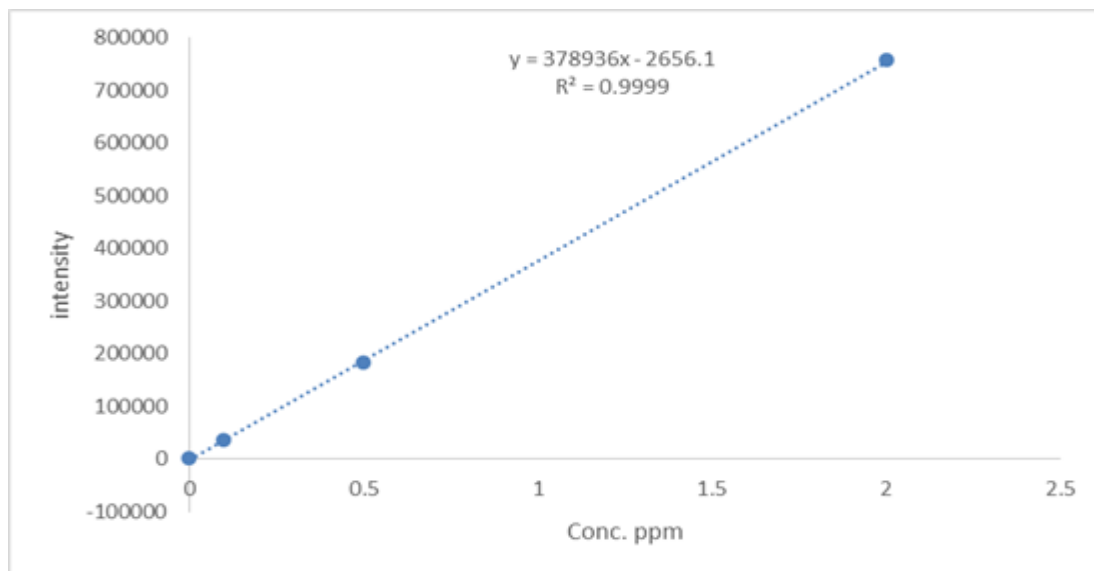
Figure 3.7 Calibration curve of Mn by ICP

Tabel 3.8 Calibration curve of Pb by ICP

No.	Conc.	Intensity
1.	0	-37
2.	0.1	744
3.	0.5	4121
4.	2	16174
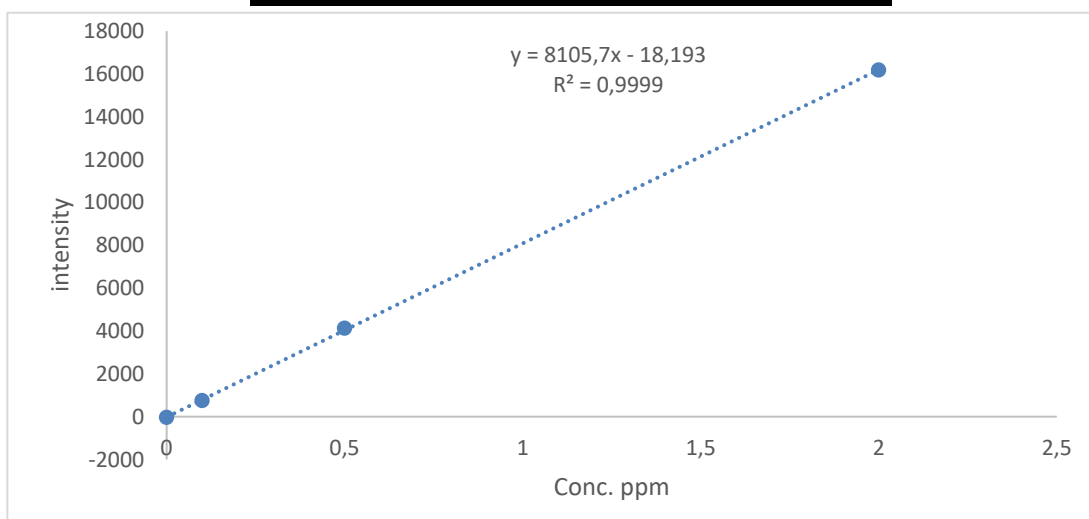
Figure 3.8 Calibration curve of Pb by ICP

Tabel 3.9 Calibration curve of V by ICP

No.	Conc.	Intensity
1.	0	-125
2.	0.1	4904
3.	0.5	27213
4.	2	109973

$y = 55162x - 363,88$
$R^2 = 1$
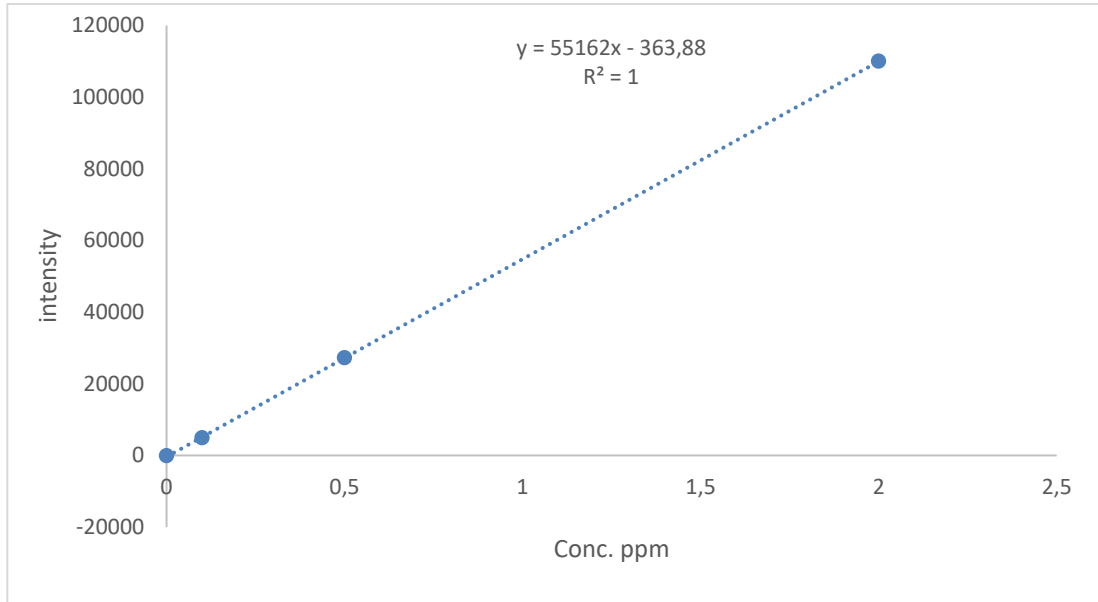
Figure 3.9 Calibration curve of V by ICP

Tabel 3.10 Calibration curve of Zn by ICP

No.	Conc.	Intensity
1.	0	671
2.	0.1	27176
3.	0.5	117071
4.	2	394164

$y = 194233x + 8519.3$
$R^2 = 0.9979$
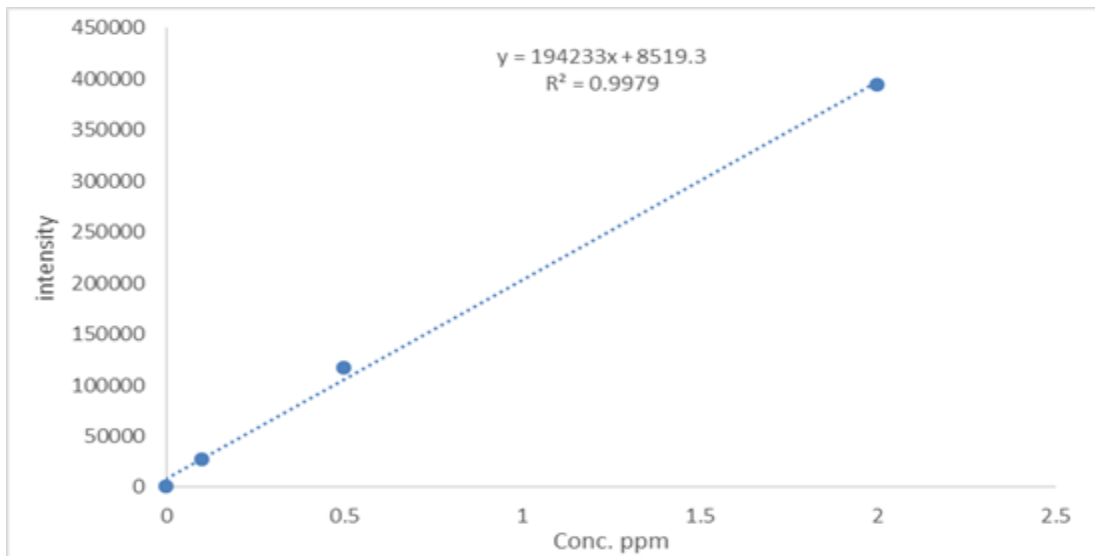
Figure 3.10 Calibration curve of Zn by ICP

4.1 RESULTS AND DISCUSSION

Macromolecules such as protein, carbohydrates, fats and nucleic acids regard as basic components of the human body. Elements like carbon, hydrogen, nitrogen, oxygen, and phosphorus chemically combine to form these molecules (Khursid et al., 1984). While there are other elements and complex compounds in the human body that affect a number of human functions and these elements supply into the body from food, water, and the environment. (Wahid et al., 2001).

Environmental pollution affected values of trace metal distribution. Body biological functions affected by the concentration of these metals for example deficiency or excess of Iron (Fe) and Manganese (Mn) in body than (WHO) recommendation limits caused chronic metabolic disturbances in spite of they are essential for human body. (Mertz, 1981).

Profound of biochemical and neurological conversions in the body occurs in presence of lead (Pb) and cadmium (Cd) that they are regarded as toxic and non-essential elements in ultra-trace level. Different metallurgical processes such as metal extraction, purification, mining, smelting and refining regarded as primary sources of metal pollution. Among, fossil fuels (coal and oil) with the production of industrial products considered as other sources of metallic particles. (Talib et al., 1990).

There are different pathways to enter metallic pollutants into the environment follow. In human first metals are absorbed through the skin, direct inhalation and gastrointestinal absorption (Talib et al., 1990) then enters into the blood stream either from the pulmonary or gastrointestinal tract and then transported around the body.

These elements accumulated in the body when body continuous exposure to these metals and their levels increase in tissues and fluids. Blood considered as the major source of these metals in the body and carry them to different parts of the body through blood circulation and cause serious health problems. (McAughey et al., 1987; Hassler et al., 1983).

In the past two decades, Koya city in northern Iraq has witnessed a remarkable development in the environment. The environment soil, water, and air have become increasingly polluted due to the use of large quantities of transportation, power generators. Despite these facts, there is no any environmental monitoring or data available regarding the level of toxic metals in the human blood. The present study was undertaken to determine and establish a level of heavy metals and lipid profile in human blood and correlation to the environment of work.

The study aimed to detect and evaluate the concentration of ten heavy metals [Aluminum (Al), Silver (Ag), Barium (Ba), Cadmium (Cd), Iron (Fe), Mercury (Hg), Manganese (Mn), Lead (Pb), Vanadium (V) and Zinc (Zn)] and lipid profile [Cholesterol, TG, HDL, LDL and VLDL] in serum of (39) worker work in industry plant employees in Koya city, Iraq (effected) , and compare with the level of heavy metals and lipid profile in(39) healthy volunteer persons (control).

4.1.1. The level of Aluminum (Al)

The statistical analysis of (Al) levels in both studied control and effected groups revealed significant differences between means of studied control and effected groups, which were (0.7261, 1.1961) and standard deviation (0.6340, 0.4174) respectively and (p<0.05) (Table and Figure 4.1.1).

The results showed significant differences between means of effected and control groups and the concentration of (Al) increased in effected group than control group.

Table 4.1.1. The level of (Al) in both studied control and effected groups

Test	Case	Size NO.	Mean ± Std. Deviation(mg L^{-1})	Std. Error Mean	P value
Al	Control	39	0.7261 ± 0.4174	0.0668	0.000
	Effected	39	1.1961 ± 0.6340	0.1015	

*The level of heavy metal was measured in part per million (ppm).

Figure 4.1.1 The level of (Al) in both studied control and effected groups

4.1.2. The level of Barium (Ba)

The statistical analysis of (Ba) levels in both studied control and effected groups revealed significant differences between means of studied effected and control groups , which were (0.544, 0.4472) and standard deviation (0.17117,0.1368) respectively and ($p < 0.05$) (Table and Figure 4.1.2).

The results showed significant differences between means of effected and control groups and level of (Ba) increased in effected group than control group.

Table 4.1.2. The level of (Ba) in both studied control and effected groups

Test	Case	Size NO.	Mean ± Std. Deviation(m L^{-1})	Std. Error Mean	P value
Ba	Control	39	0.4472 ± 0.1368	0.0219	0.007
	Effected	39	0.5440 ± 0.1712	0.0274	

*The level of heavy metal was measured in part per million (ppm).

Figure 4.1.2. The level of (Ba) in both studied control and effected groups

4.1.3. The level of Iron (Fe)

The statistical analysis of (Fe) levels in both studied control and effected groups revealed significant differences between means of studied control and effected groups, which were (0.2318 , 0.3338) and standard deviation (0.1049,0.1330) respectively and (p<0.05) (Table and Figure 4.1.3).

Table 4.1.3. The level of (Fe) in both studied control and effected groups

Test	Case	Size NO.	Mean ± Std. Deviation(mg L^{-1})	Std. Error Mean	P value
Fe	Control	39	0.2318 ± 0.1049	0.0168	0
	Effected	39	0.3338 ± 0.1330	0.0213	

*The level of heavy metal was measured in part per million (ppm).

Figure 4.1.3. The level of (Fe) in both studied control and effected groups

4.1.4. The level of Merqury (Hg)

The statistical analysis of (Hg) levels in both studied control and effected groups revealed significant differences between means of studied control and effected groups , which were (0.0349,0.0395) and standard deviation (0.0141,0.0012) respectively and ($p<0.05$) (Table and Figure 4.1.4).

Table 4.1.4. The level of (Hg) in both studied control and effected groups

Test	Case	Size NO.	Mean $\pm$ Std. Deviation(mg L^{-1})	Std. Error Mean	P value
Hg	Control	39	0.0349 ± 0.0141	0.0023	0.047
	Effected	39	0.0395 ± 0.0012	0.0003	

*The level of heavy metal was measured in part per million (ppm).
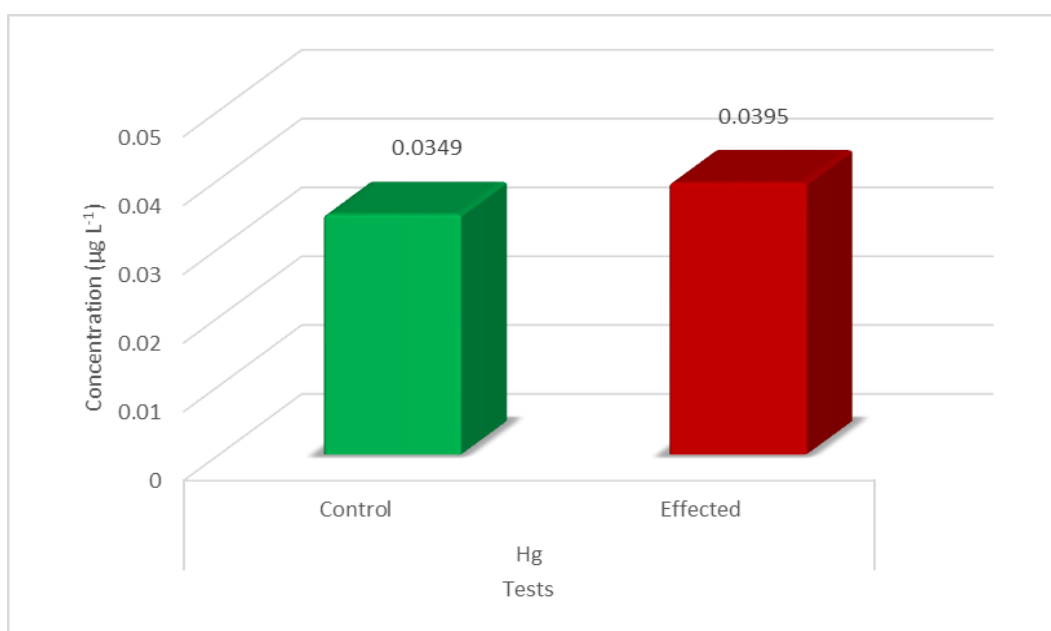
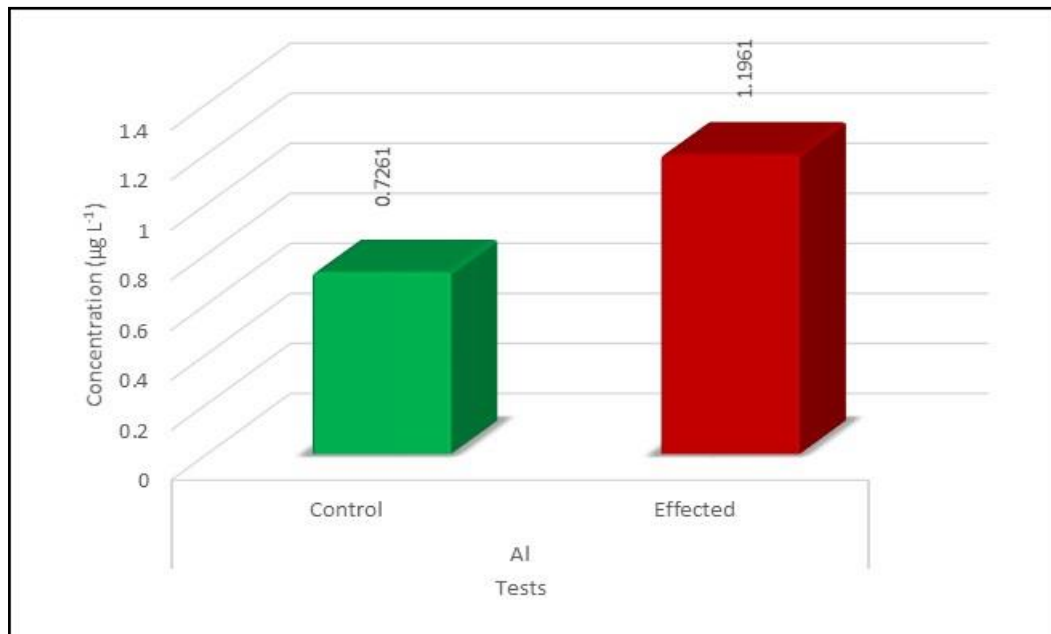**Figure 4.1.4.** The level of (Hg) in both studied control and effected groups

4.1.5. The level of Manganes (Mn)

The statistical analysis of (Mn) levels in both studied control and effected groups revealed significant differences between means of studied control and effected groups, which were (0.0239, 0.1654) and standard deviation (0.0442, 0.1034) respectively and ($p<0.05$) (Table and Figure 4.1.5).

Table 4.1.5. The level of (Mn) in both studied control and effected groups

Test	Case	Size NO.	Mean ± Std. Deviation(mg L^{-1})	Std. Error Mean	P value
Mn	Control	39	0.0239 ± 0.0442	0.0071	0.00
	Effected	39	0.1654 ± 0.1034	0.0166	

*The level of heavy metal was measured in part per million (ppm).
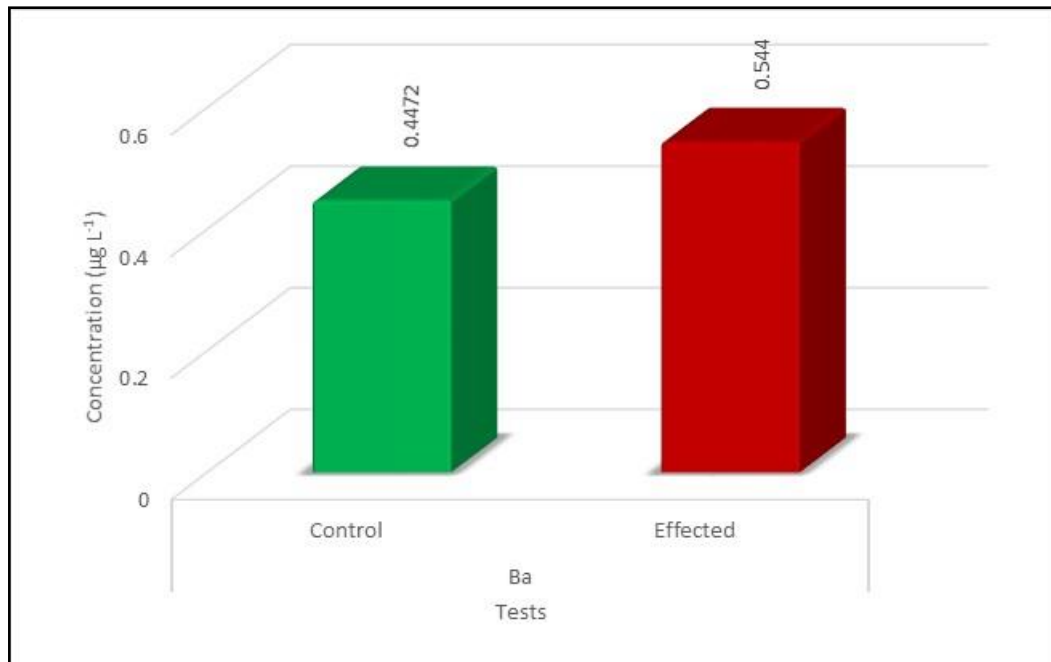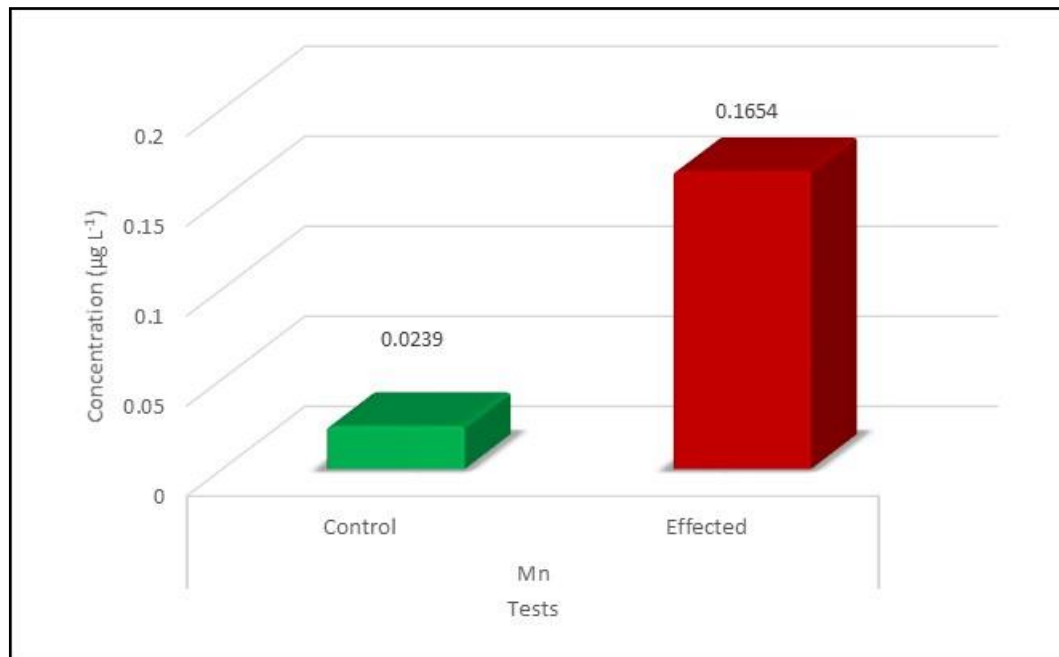

Figure 4.1.5. The level of (Mn) in both studied control and effected groups

4.1.6. The level of Lead (Pb)

The statistical analysis of (Pb) levels in both studied control and effected groups revealed significant differences between means of studied control and effected groups, which were (0.0113 , 0.0123) and standard deviation (0.0060, 0.0044) respectively and ($p<0.05$) (Table and Figure 4.1.6).

Table 4.1.6. The level of (Pb) in both studied control and effected groups

Test	Case	Size NO.	Mean ± Std. Deviation(mg L^{-1})	Std. Error Mean	P value
Pb	Control	39	0.0113 ± 0.0060	0.0001	0.0407
	Effected	39	0.0123 ± 0.0044	0.0007	

*The level of heavy metal was measured in part per million (ppm).
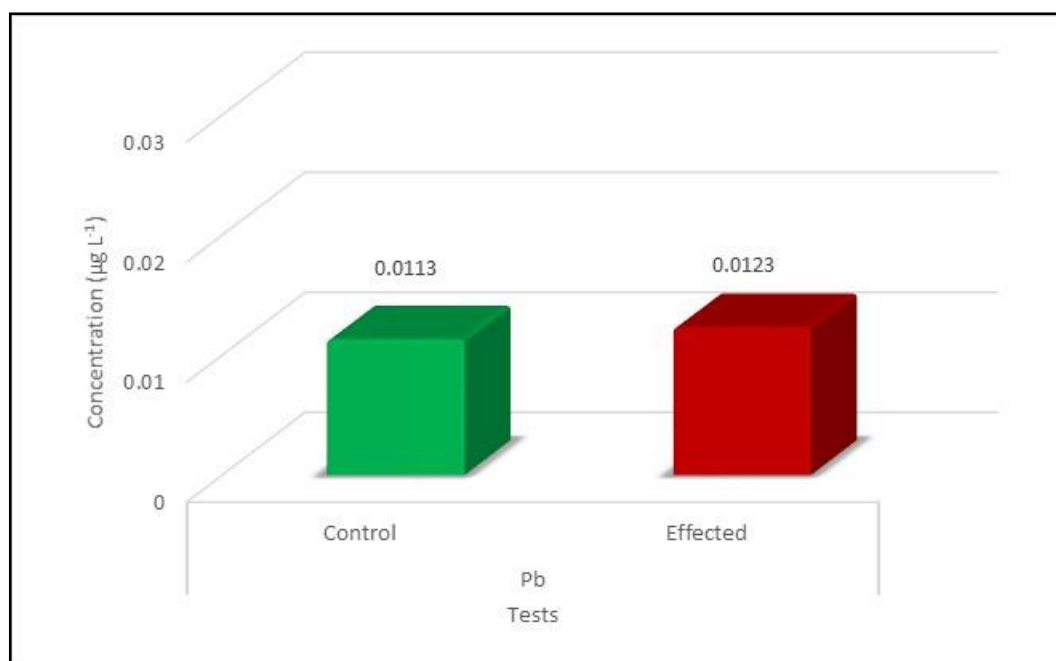
Figure 4.1.6. The level of (Pb) in both studied control and effected groups

4.1.7. The level of Vanadium (V)

The statistical analysis of (V) levels in both studied control and effected groups revealed significant differences between means of studied control and effected groups, which were (0.0014 ,0.0026) and standard deviation (0.0010, 0.0011) respectively and (p<0.05) (Table and Figure 4.1.7).

Table 4.1.7. The level of (V) in both studied control and effected groups

Test	Case	Size NO.	Mean ± Std. Deviation(mg L^{-1})	Std. Error Mean	P value
V	Control	39	0.0014 ± 0.0010	0.0002	0
	Effected	39	0.0026 ± 0.0011	0.0002	

*The level of heavy metal was measured in part per million (ppm).
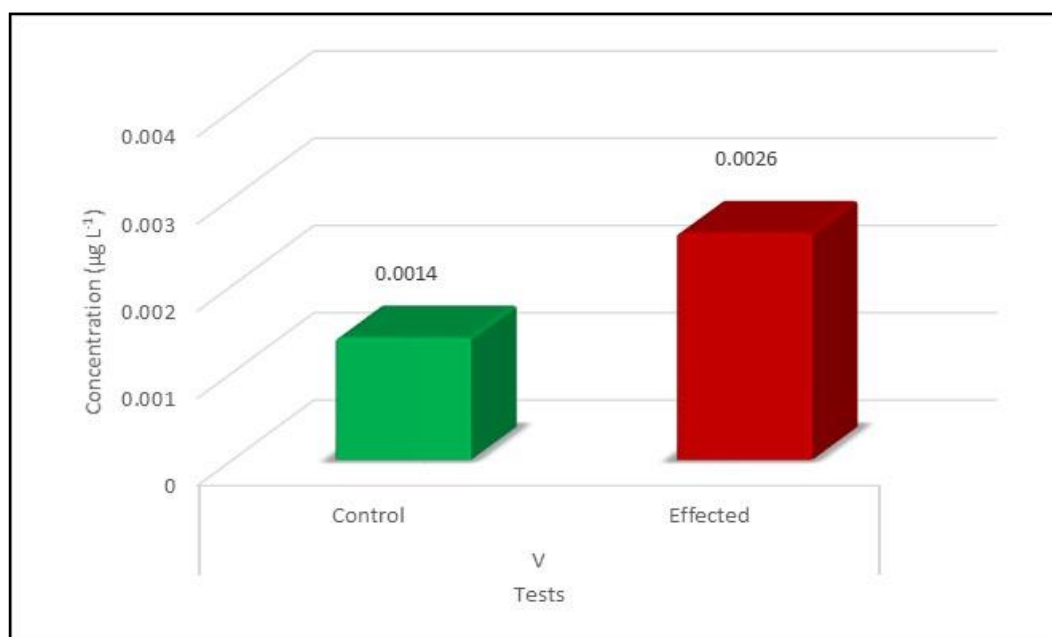
Figure 4.1.7. The level of (V) in both studied control and effected groups

4.1.8. The level of Zinc (Zn)

The statistical analysis of (Zn) levels in both studied control and effected groups revealed significant differences between means of studied control and effected groups, which were (0.1375, 0.1595) and standard deviation (0.1508,0.0532) respectively and (p<0.05) (Table and Figure 4.1.8).

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Table 4.1.8. The level of (Zn) in both studied control and effected groups

Test	Case	Size NO.	Mean ± Std. Deviation(mg L^{-1})	Std. Error Mean	P value
Zn	Control	39	0.1375 ± 0.1508	0.0241	0.393
	Effected	39	0.1595 ± 0.0532	0.0085	

*The level of heavy metal was measured in part per million (ppm).
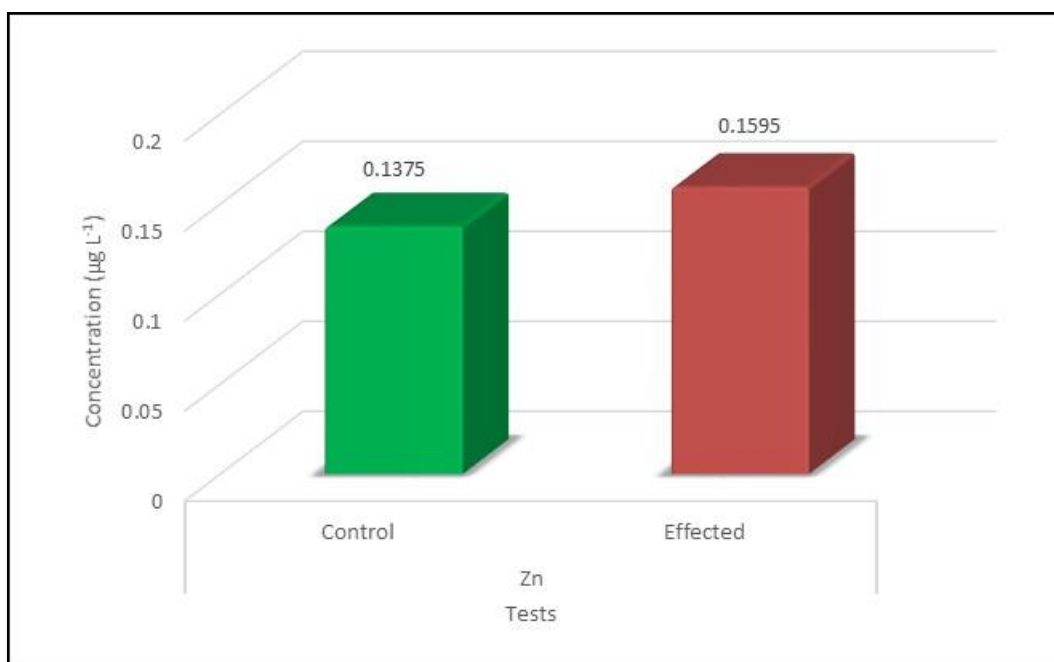
Figure 4.1.8. The level of (Zn) in both studied control and effected group

4.1.9. The levels of (Silver Ag and Cadmium Cd)

In this thesis after preparation samples and making calbritinon curves for both elaments (Silver Ag and Cadmium Cd), the results were not detected and the ICP show zero value for samples prepared for determining (Silver Ag and Cadmium Cd).

4.2.1. Lipid Profiles

The statistical analysis of lipid Profiles levels in both studied control and effected groups revealed no significant differences between means ofstudied control and effected groups. Blood cholesterol concentrations for both studied control and effected groups were (150.5128, 161.3077 mg/dL) and standard deviation (43.4547, 47.9134) respectively.

Blood TG concentrations for both studied control and effected groups were (182.4103, 218.4103 mg/dL) and standard deviation (119.5953, 151.1287) respectively.

Blood HDL concentrations for both studied control and effected groups were (45.3308, 218.4103 mg/dL) and standard deviation (12.4779, 13.1958) respectively.

Blood LDL concentrations for both studied control and effected groups were (78.0769, 98.3846 mg/dL) and standard deviation (41.5448, 51.2197) respectively.

Blood VLDL concentrations for both studied control and effected groups were (38, 44.0308 mg/dL) and standard deviation (23.8813, 29.9031) respectively.

P- Value for lipid profile concentrations in blood were greatear than (0.05) (p>0.05) (Table and Figure 4.2.1).

Table 4.2.1. The level of lipid Profile concentration in both studied control and effected groups

Test	Case	Size NO.	Mean ± Std. Deviation (mg/dL)	Std. Error Mean	P value
Cholesterol	Control	39	150.5128 ± 43.4547	6.9583	0.301
	Effected	39	161.3077 ± 47.9134	7.6723	
TG	Control	39	182.4103 ±119.5953	19.1506	0.247
	Effected	39	218.4103 ± 151.1287	24.1991	
HDL	Control	39	45.3308 ± 12.4779	1.9981	0.445
	Effected	39	43.0974 ± 13.1958	2.1130	
LDL	Control	39	78.0769 ± 41.5448	6.6525	0.58
	Effected	39	98.3846 ± 51.2197	8.2017	
VLDL	Control	39	38 ± 23.8813	3.8241	0.328
	Effected	39	44.0308 ± 29.9031	4.7885	

*The level of heavy metal was measured in part per million (ppm).
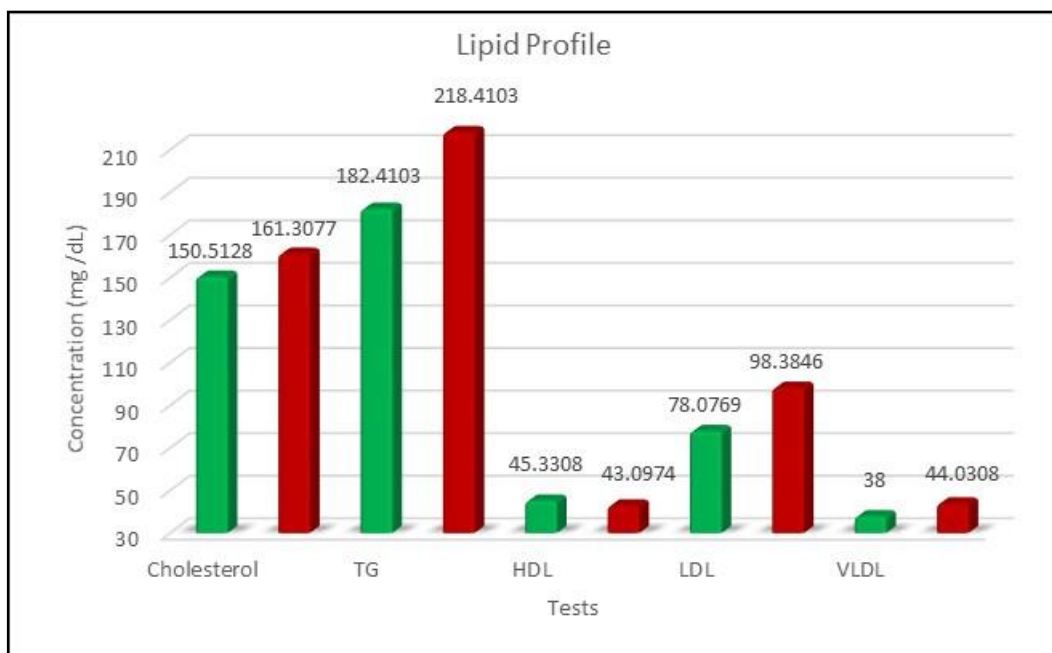
Figure 4.2.1. The level of (Lipid Profile) concentration in both studied control and effected groups

The results of lipid profile tests show that no siginificant results in effected groups because the value of lipid profile test related to the effects like food source, age, and stress in work and not related to the environment effects like time of expousing to selected elements or chemicals, while results of heavy metals except (Ag and Cd) show significant results in effected group because of expousing to environment containe high levels of this metals that came from burning crude oil residue and other material that used daily in place of working in open area that lead to increase level of this metals in environment of work and this lead to increase their levels inside blood of effected groups than the normal group.

5. CONCLUSION AND RECOMMENDATION

5.1. Conclusion

1- The statistical analysis of (Al, Pb, Zn, Ba, Fe, Hg, Mn, and V) levels in the blood of both studied control and effected groups showed significant differences between means of studied control and effected groups and P- value was less than (0.05).

2- The statistical analysis of lipid profile (Cholesterol, TG, HDL, LDL, VLDL) levels in the blood of both studied control and effected groups showed no significant differences between means of studied control and effected groups and P- value was greater than (0.05).

5.2. Recommendations

1- Study level of heavy metals in an environment of work land, water and air.

2- Study level of heavy metals in various work places.

3- Study level of heavy metals in daily diets of the workers.

4- Study level of heavy metals in the blood of workers and related to their gender, ages, and body masses.

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