Sudan University of Science and Technology

College of Science

Department of chemical laboratories

Quantification of Lead and Cobalt in Nile river fish

-Reham Ahmed Sayreen

-FatimaAlzhra Mohamed Osman Mohamed Ali

-Hala Abd Elslam Bushra

Supervisor by:

Maali Saad Elawad

August 2016

قال تعالى : (أحل لكم صيد البحر متاعا لكم)

صدق الله العظيم

الانعام

Dedication

I dedicated to my great mother for her unlimited love, to my father for his constructive advice throughout my live

To stood beside me and helped me all my senses were, my sister and my brother ,and all my teachers and friend

Acknowledgement

With respect and gratitude, we thank our supervisor Maali Saad Elawad**,** who had patiently and continuously provided valuable assistance, guidance and experience from the beginning to the end of this study.

Special thanks extended to the college of Veterinary, Sudan university of science and technology, also special thanks to Dr. Fawzi and Dr. Asaad and to the laboratory staff of the faculty of science, University of Khartoum.

Our deepest thanks are expanded to our families and friends who help us in the completion this work.

Abstract

This study was aimed to investigate the presence of Lead and Cobalt in fish. Three samples were collected, two of them from natural sources (aquatic life) Almorada and Jabal awlia where the third one was fromfishplantingscheme ofSudan university of science and technology college of veterinary.Lead and cobalt wereanalyzed by atomic absorption spectrometer (AAS).

The results show different levels of contamination. The concentration of lead in Almorada, Jabal Awlia and planted fish samples was (2.32 ppm, 3.11 ppm, 0.67ppm)respectively. The concentration of cobalt in Almorada,Jabal Awlia and planted fish sample was (0.261ppm, 0.98ppm, 1.14ppm) respectively. According to WHO guide lines all samples were contaminated to some extent with Lead and Cobalt since the permissible limits is 0.5 ppm and 0.015ppm for Lead and Cobalt respectively.

ملخص البحث

هدف هذا البحث هو دراسة مدى تلوث الأسماك بعنصري الكوبالت والرصاص. تم جمع ثلاث عينات، اثنتان من مصدر طبيعي (نهر النيل) من منطقتي جبل اولياء والنيل الابيض أما العينة الثالثة فقد جلبت من مشروع استزراع الاسماك من كلية الطب البيطري - جامعة السودان للعلوم والتكنولوجيا.

تمت عملية التحليل بتقنية الامتصاص الذري AAS وقد اوضحت النتائج ان جميع العينات ملوثة لمدى ما بهذين العنصرين؛ حيث كان تركيز عنصر الرصاص (2.32 ppm, 3.11 ppm, 0.67ppm) بعينة السمك المستزرع ، جبل اولياء والموردة على التوالي. اما بالنسبة لعنصر الكوبالت فقد كان تركيزه (1.14ppm0.261ppm, 0.98ppm,) بعينة السمك المستزرع ، جبل اولياء والموردة على التوالي. بناء على مواصفات منظمة الصحة العالمية التي نصت على ان الحد المسموح به لكل من الرصاص والكوبالت هو 0.5ppm و0.015ppm على التوالي فان جميع العينات ملوثة لدرجة ما بكل من عنصرى الرصاص والكوبالت.

List of contents

List of table

1.1 Introduction:

The pollution of the aquatic environment with heavy metals has become a worldwide problem during recent years, because they are indestructible and most of them have toxic effects on organisms. Among environment pollutants, metals are of particular concern, due to their potential toxic effect and ability to bio accumulate in aquatic ecosystems.There is increasing concern about the quality of foods in several parts of the world. The determination of toxic elements in food has prompted studies on toxicologicaleffects of them in foods.Heavy metals are considered the most important form of pollution of the aquatic environment because of their toxicity and accumulation by marineorganisms.Heavy metals may enter aquatic system from different natural and anthropogenic (human activities) sources. Heavy metals are commonly found in natural water and some are essential to living organisms, yet they may become highly toxic when present in high concentrations. These metals also enter ecosystem through anthropogenic source and distribute water in the water body, suspended solids and sediments during the course of their mobility. Like in other organisms, heavy metals are not destroyed in humans. Instead they tend to accumulate in the body and can be stored in soft and hard tissues such as liver, muscles and bone and threaten the health of humans.Therefore, the heavy metals are among most of the pollutants, which received attention in various countries and considered the most dangerous category of pollutants in the water. An early example of an environmental problem due to heavy metal occurredin 1952, in the vicinity of Japanese fishing harbor of Minimate. This disease (minimata) was a result of consuming fish and shrimps contaminated with mercury from the waste water discharged by factories. Another example is the disease in fugwa, Japan in 1955 it was the result of consuming rice, fish and bivalves that were.Contaminated from waste water discharge by nearby mining. Mostly variation in elemental concentration in fish tissue has been attributed to variation in size. [1]

Many studies have focused attention on the dependence between the contents of metals and size of these fishes. [1]

1.2Water Pollution:

Water is the main source of life and regarded as the most essential naturalresources. Water covers most of our; however, approximately 98% ofthis water is seawater and is unusable for drinking because of the highconcentration of salt. About 2% of the planet's water is fresh, but 1.6% is locked up in polar ice caps and glaciers. Another 0.36 %is foundunderground in aquifers and wells. Therefore, only about 0.036% of theplanet's total water supply is accessible in lakes and rivers.

WHO/UNICEF survey states that in 45 developing countries,women and children bear the primary responsibility for watercollection in the vast majority (76%) of households. This is time notspent working at an income-generating job, caring for family members,or attending school.

Furthermore, existing freshwater resources are gradually becomingpolluted and unavailable due to human or industrial activities. Theincreasing contamination of freshwater systems with thousandsof industrial and natural chemical compounds is one of the keyenvironmental problems facing humanity worldwide. The everincreasingworld populations and rapidly advancing industrializationis causing more demand than ever for the dwindling supply of water,which makes it precious in more and more countries. In some parts ofthe world, water is a crucial commodity. Recently, a paper published inNature indicated that 80% of the world's population is exposed to highlevels of threat to water security.

A growing number of contaminants are entering water suppliesfrom industrialization and human activity like heavy metals, dyes;pharmaceuticals; pesticides, fluoride, phenols, insecticides, pesticidesand detergents fig 1 illustrates these sources. In the case of pharmaceuticals, personal care products,hormones, pesticides, and other chemical compounds that are releasedinto the water supply. Unprecedented health hazards are comingto light that did not previously exist resulting in an increased needfor additional legislature. Many water pollutants remain to beaddressed, due to rapid industrialization new chemical compounds arecontinuously being developed and brought to the market and sooneror later they will emerge into the aquatic systems. Additionally, waterborne pathogenic microorganisms are ubiquitous throughout theworld. These pathogenic microorganisms enter waterways throughuntreated sewage, storm drains, septic

tanks, runoff from farms, andfrom various industries, especially the tanning and meat packagingindustries. Emerging pollutants detected in water may have adverse effectson human health and aquatic ecosystems. Clean water that is free oftoxic chemicals and pathogens is essential to human health. On top ofthese concerns, contamination of water is a big concern after a naturaldisaster. Natural disasters(e.g., tsunamis, earthquakes, hurricanes,floods, and volcanoes)can influence water quality on a grand scale.

In the coming decades, water scarcity may lead to social andpolitical instability, water wars and diseases, unless new ways to supplyclean water are found. Increased public awareness has led governmentsand organizations worldwide to issue strict water pollution regulations.

Nowadays there is a continuously increasing worldwide concern forthe development of wastewater treatment technologies.[2]

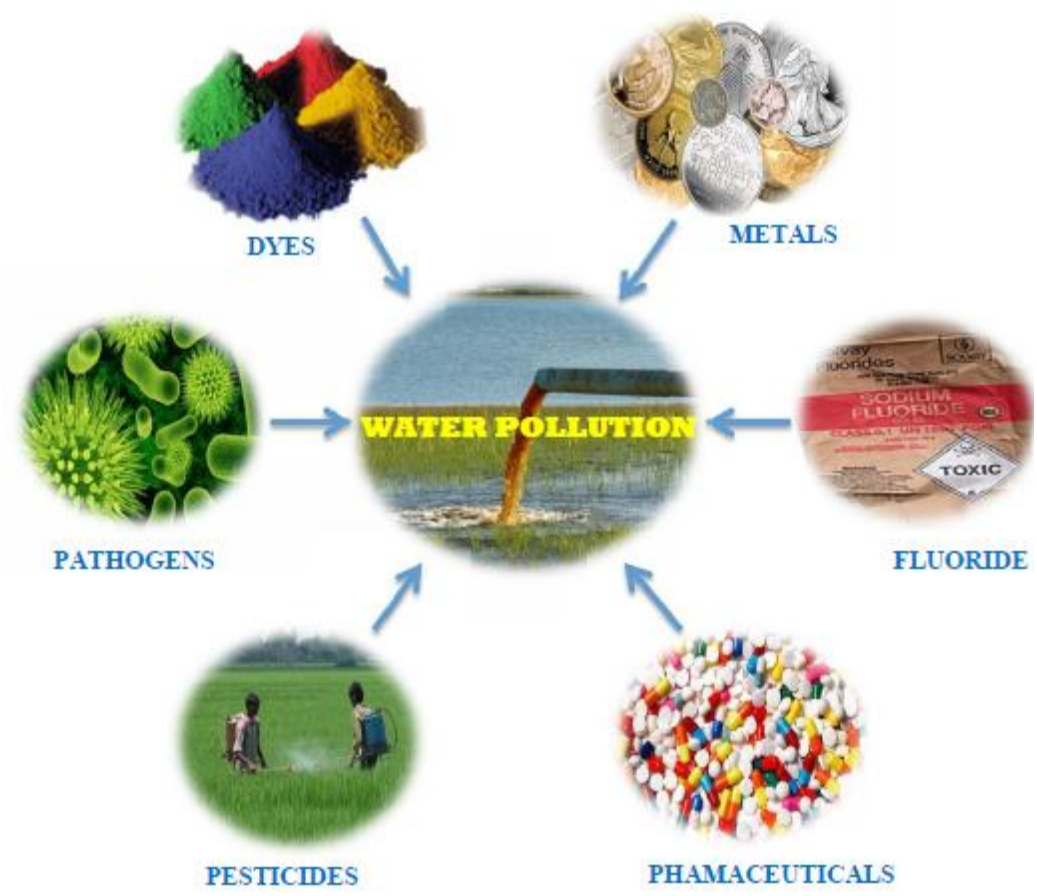

Fig. 1: Contaminants entering water supplies

1.3Progress in Water Treatment Technologies:

In view of the aforesaid problems, recent attention has been focusedon the development of more effective, lower-cost, robust methodsfor wastewater treatment, without further stressing the environmentor endangering human health by the treatment itself. Extensivestudies have been undertaken to find economically feasible alternativesfor water and wastewater treatment. A number of methods such ascoagulation, membrane process, adsorption, dialysis, foam flotation,osmosis, photo catalytic degradation and biological methods have beenused for the removal of toxic pollutants from water and wastewater.

However, their applications have been restricted by many factors, suchas processing efficiency, energy requirement, engineering expertise,economic benefit and infrastructure, all of which precludes their usein much of the world.

Due to the complex nature of the chemical mixtures present inwastewater, conventional wastewater treatment is not always sufficientto remove the entire contaminant load. Disinfection steps such asozonation and chlorination have been introduced to control human.[2]

1.4Pollution of fish in Sudan:

Minerals present in food can be essential, nonessential or toxic to human consumption. Minerals such as iron, copper, zinc and manganese are essential and play important roles in biological systems. Meanwhile, mercury, lead, cobalt and cadmium are toxic, even in trace amounts. However, essential minerals can also produce toxic effects at high concentration. Marine foods are very rich sources of various mineral components. Content of mineral in raw flesh of marine fish and invertebrates is in the range of 0.6-1.5% of wet weight. However, variation in mineral composition of marine foods can occur due to seasonal biological differences (species, size, dark\white muscles, age, sex and sexual maturity) ,area of catch, processing method, food source and environmental condition (water chemistry, salinity, temperature and contaminant). [3]

The elemental anomaly in the groundwater regime once created through natural processes or by unintended or unethical human intervention, often goes unabated. The toxicity of an element depends on dose, the chemical form, route of exposure, bio-availability,and distribution in the body, and storage and excretion parameters. In recent years, considerable interest has been focused on assessing the human health risk posed by metals, metalloids, and trace elements in the environment. It has long been recognized that large areas of the globe contain human populations characterized by having trace element deficiency, or excess including chronic poisoning. [3]

Heavy metals are among the most persistent of pollutants in the aquatic ecosystem because of their resistance to decompositionin natural conditions. High concentrations of these metals can be released into the aquatic environment as a result of leaching from bedrocks, atmospheric deposition, water drainage, runoff from riverbank, and discharge of urban and industrial wastewaters. [3]

Consumption of fish provides an important nutrient to a large number of people worldwide and thus makes a very significant contribution to nutrition. Fish is a highly proteinous food, consumed by a large percentage of the populace because of its availability and palatability. [3]

Considering the nutritional benefits associated with fish consumption and the attendant risk associated with eating fish, it has therefore become important that the proximate and mineral composition of fish be assessed in order to ensure they meet the requirements of food regularities and commercial specifications and also establish the safety level of fish. [3]

1.5Importance of fish:

The real importance of fish in human is not only in it is protein, but also to the two kinds of omega-3 fatty acids: eicosa pentenoic acid (EPA) and docosahexenoic acid (DHA). Omega_3 fatty acids are so important for growth where they reduce cholesterol levels and the heart disease, stroke and preterm delivery. Fish also contain vitamins and minerals that play essential role in human health. Since diet is the main way of exposure to heavy metals, and fish is a part of human diet, it is

not surprising that polluted fish could be a dangerous source of toxic metals.In the last two decades there has been a growing interest in assessing the levels of heavy metals in food such as fish, and interest amid at the safety of the food supply. [1]

1.6Hazards of heavy metals contamination:

Heavy metals have variously been used:

(1) metals with atomic number 23 on wards except Rb, Cs, Ba and Fr
(2) metals with density greater than 5 , and
(3) metals which are toxic to man and other life forms when found in the environment.

The eight most common pollutant heavy metals listed by the environment protection agency (EPA) are Pb and Co. Biosphere is the natural environment of living object. It envelops the earth and contains surficial parts of the lithosphere, the lower part of the atmosphere and the hydrosphere. A relative homeostatic environment is essential for the survival of organisms in eco system. This necessitates the study of the chemical composition of air, water and soil in order to monitor any abnormal changes due to industrial progression and consequent advancement society. Heavy metals are diluted and affected by various surface water components (carbonate, sulphate, organic compounds humic, amino acids) that formed complexes. These salts and complexes are predicted to be not harmful to aquatic organisms. Part of them sink and are accumulated in bottom sediments. However,when water pH has declined(during acidic rains or other acidic episodes) heavy metals can be mobilized and released in to the eater column and become toxic to aquatic biota. In addition, low concentrations of heavy metals can cause a chronic stress which may not kill individual fish, but lead to a lower body weight and smaller size and thus reduce their ability to compare for food and habitat. Aquatic organisms, such as fish, accumulate pollutants directly from contaminated water and indirectly via the food chain contamination of fish with these metals. The effect of pesticides either organo phosphorous or chlorinated pesticides have been extensively studied in fish. [1]

	Cu	Zn	Pb	Cd	Fe	Mn
FAO (1983)	30	30	0.5	0.05	-	-
FAO/ WHO limit	30	40	0.5	0.5	-	-
WHO 1989	30	100	2	1	100	1
European community	-	-	0.2	0.05	-	-
England	20	50	2	0.2	-	-

Table 1: Maximum permissible limit (mpl) of heavy metals in fish muscles (microgram\gram wet wt.) according to international standards.

Concentration, mg\kg	Heavy metal
0.015	Co

Table 2: Level of Cobalt in fish as reported by WHO

1.7Chemistry of heavy metals pollution:

Some of heavy metals are essential in very low concentration for the survival of all forms of life. Trace heavy metals are important in daily diets, because of their essential nutritious value and possible harmfuleffects, heavy metals such as Iron, Copper, Zinc, Cobalt, Manganese and Nickel are essential metals since they play an important role in biological system, where mercury, lead and cadmium are non-essential metals which can be toxic even in trace amount.

Mining activities and other geochemical processes often result in the generation of acid mine drainage (AMD), a phenomenon commonly associated with mining activities. It is generated when pyrite (FeS) and other supplied minerals in the aquifer andpresence of oxidizing bacteria, such as Thio-bacillus Ferro oxide, and oxidized to produce metal ions, sulphate and acidity.

$2FeS_2 + 2H_2O + 7O_2 = 2FeSO_4 + 2H_2SO_4$

$2FeSO_4 + 2H_2SO = Fe_2(SO_4)_3 + SO_2 + 2H_2O$

$Fe_2(SO_4)_3 + 2FeAsS + 9/2O_2 + H_2O = H_3AsO_4 + FeSO_4 + S$

Literature survey shows that heavy metals (M) at mining sites are leached and carried by acidic water downstream. They can be acted up on by bacterial and methyllasted to yield organic forms, such as mono methyl mercury and dimethyl cadmium. “This conversion is effected by simplified equation.

$$M + \text{organic matter} + H_2O \text{ bacteria} = CH_3M \text{ and } (CH_3)_2M$$

In the nonbiological conversion, the following reaction have been identified for Mercury.

$Hg^{+2} + H_2S(\text{Eutopic condition}) = Hg \ (\text{aeration}) = HgSO_4 = CH_3Hg^+$

Less Soluble more soluble

Methyl Mercury

These organic form have been reported to be very toxic and adversely effects water qualities by seepage to pollute underground water sources. Low pH values do not need to be established for metals to be released from mine wastes at adverse concentration because, near neutral pH (6-7) have been established for some metals, such as Zn, Cd and As.

Animals that graze on such contaminated plants and drink from polluted waters, as well as marine lives that breed in heavy metalsin their tissues, and milk, if lactating. Humans are in turn exposed to heavy metals by consuming contaminated plants and animals, and this has been known to result in various biochemical

disorders. In summary all living organisms with in a given ecosystem are variously contaminated along cycles of food chain. [4]

1.6.1Lead:

Lead is a naturally occurring metal found deep in the ground. It occurs in small amounts in ore, along with other elements such as silver, zinc or copper. Even though it is found in small amounts, there is an abundant supply of lead throughout the earth. Because it is widespread, and easy to extract and work with, lead was used for hundreds of years in a wide variety of products found in and around homes, including paint and gasoline.[5]

Lead is a soft, silvery gray metals melting at 327.5 °c. It is highly resistant to corrosion, but is soluble in nitric acid and hot sulfuric acid. The usual valence state in inorganic lead compounds is +2. Solubility in water varies; lead sulfide and lead oxides being poorly soluble and the nitrate, chlorate and chloride salts are reasonably soluble in cold water.Lead also forms salts with such organic acids lactic, and acetic acids and stable organic compounds such as tetra ethyl lead and tetra methyl lead.[1]Lead and its compounds may enter the environment at any point during mining, smelting, processing, use, recycling or disposal. Major uses are in batteries, pigments, petrol (gasoline) additives, solder and steel products. Lead and lead compounds are used in solder applied to water distribution pipes and to seams of can used to store foods, in some traditional remedies, in bottle closures for alcoholic beverages and in ceramic glazes and crystal table ware. In countries where leaded petrol is still used, the major air emission is from mobile and stationary sources of petrol combustion. Area in the vicinity of lead mines and smelters are subjected to high levels of air emissions. Air borne lead can be deposited on soil and water. Atmospheric lead is also a major source of lead in house hold dust.[1]In the general non-smoking adult population, the major exposure path way is from food and water. Air borne lead may contribute significantly to exposure, depending upon such factors as use of tobacco, occupation proximity to motorways, lead smelters etc. and leisure activities (e.g. arts and crafts, firearm target practice). Food, air water and dust/soil are the major

potential exposure pathways for infants and children. For infants up to 4 or 5 months of age air, milk, and water are the significant sources of lead exposure.[1]

1.6.1.1Effects of lead in children:

Exposure to lead can have a wide range of effects on child's development and behavior. Blood lead levels less than 10 micrograms per deciliter (mg\dl) are associated with increased behavioral effect, delayed puberty, and decreases in hearing, cognitive performance, and postnatal growth or height. Some of these health effectsare found even at low blood lead levels less than 5mg\dl, including lower IQ scores, decreased academic achievement, and increases in both behavioral problems and attention_ related behaviors. There is a wide range of lead_ associated behavioral effects in the area of attention. Attention deficit hyperactivity disorder (ADHD) is one example on the more severe end of the spectrum.[5]

Blood lead level	Health effects
Blood lead levels below 5microgram\deciliter	Children: Decreased academic achievement, IQ, and specific cognitive measures, increased incidence of problem and attention_ related behaviors Adults: Decreased kidney function, maternal blood lead associated with reduced fetal growth
Blood lead levels blow 10microgram\ deciliter	Children: Delayed puberty, reduced postnatal growth, decreased IQ and hearing Adults: Increased blood pressure, risk of hypertension, and incidence of essential tremor

Table (3): The health effect of blood lead level

1.6.1.2Health effect:

Health effects of lead are caused by lead entering the water through corrosion of pipes. This occurs when the water is slightly acidic, and that is why public water treatment systems are now required to carry out pH adjustment in water for drinking purposes. Lead is not essential to up take from food, air or water. Illnesses from high lead concentrations are disruption of the biosynthesis of hemoglobin anemia. Other health risks linked to lead are arise in blood pressure, kidney damage, miscarriage, declined fertility of men through sperm damage, diminished learning abilities in children, and behavioral disruption in children like aggression impulsive behavior.[1]

Lead exposure has been linked to a number of health effects in adults. As a general rule, the more lead you have in your body, the more likely it is you all have health problem. High blood lead levels greater than 15microgram per deciliter are associated with cardiovascular effects, nerve disorders, decreased kidney function, and fertility problem, including delayed conception and adverse effects onsperm and semen, such as lower sperm counts and motility.[5]

Blood lead levels below 10microgram/dl are associated with decreased kidney function and increases in blood pressure, hypertension, and incidence of essential tremor, a degenerative disorder of the central nervous system whose most recognizable feature is a tremor of the arms or hands during voluntary movement, such as eating and writing. There is also evidence showing that adults who have low levels of exposure to lead less than 5microgram/dl may have decreased kidney function.[5]

Pregnant woman need to be particularly careful around lead. Maternal blood lead levels less than 5microgram\deciliter are associated with reduced fetal growth. Because the effects of lead are different for everyone, more research needs to be done to fully understand the health effects. A 2004study, supported by MIEHS, also showed that life time lead exposure may increase the risk of developing cataracts, a clouding the eye lens resulting in partial loss of vision, which can be common in older people.Most adults with elevated blood lead levels are exposed to lead at work. Those in occupations related to mining, ironwork or welding, construction, renovation and remodeling activities, smelters, firing ranges, the

manufacture and disposal of car batteries, automobile radiator repair, metal shop work, and the manufacture of battery or stained glass are particularly at risk for lead exposure.[5]

1.6.1.3The harmful of lead:

No amount of lead is safe. Eliminating all lead exposure in our environment is our best course of action. [3]New findings from NIEHS_ supported grantees, as well as the national toxicology program (NTP), providesupport for many adverse health effects in both children and adults at blood lead levels below 10 microgram\dl, and for some below 5 microgram\dl. These finding add to the body of evidence that led the centers for disease control and prevention (CDC) in 2012 to update its reference value to identify children who have been exposed to lead and who require case management.The new level is based on the population of children aged 1-5 years, in the U. S, who are in the top 2.5 percent of children when tested for lead in their blood,currently, this means that public health actions be initiated for children with blood lead levels above 5 microgram\dl. Prior to this child were identified as having a blood lead level of concern if the test result was 10 microgram\dl or more. As part of a shift in focus to primary prevention of lead exposure.The CDC has dropped the level of concern terminology, since no safe blood lead level in children has been identified. The new, lower value gives parents, doctors, and public health officials an opportunity to prevent and reduce lead exposure very early on. [5]

1.6.2Cobalt:

Cobalt is a hard ferromagnetic, silver_ white hard, lustrous, brittle element. It is a member of group VIII of the periodic table. Like iron, it can be magnetized. It is similar to iron and nickel in its physical properties. The element is active chemically, forming many compounds. Cobalt is stable in air and unaffected by water, but slowly attacked by dilute acids. [6]

1.6.2.1 Applications:

Cobalt is used in many alloys (super alloys for parts in gas turbine aircraftengine, corrosion resistant alloys, high_ speed steels, cemented carbides), in magnets and magnetic recording media, as catalysts for the petroleum and chemical industries, as drying agents for paints and inks. Cobalt blue is an important part of artist's palette and is used by craft workers in porcelain, pottery, stained glass, tiles and enamel jewelry. The radioactive isotopes, cobalt-60, is used in medical treatment and also irradiate food, in order to preserve the food and protect the consumer.[6]

1.6.2.2Cobalt in the environment:

Most of the Earth cobalt is in its core. Cobalt is of relatively low abundance in the Earth crust and in natural waters, from which it is precipitated as the highly insoluble cobalt sulfide CoS.Although the average level of cobalt in soils is 8 ppm, there are soils with as little as 0.1 ppm and others with as much as 70 ppm. In the marine environment cobalt is needed by blue-green algae (cyanobacteria) and other nitrogen fixing organisms. Cobalt is not found as free metal and is generally found in the form of ores. Cobalt is usually not mined alone, and tends to be produced as a by-product of nickel and copper mining activities. The main ores of cobalt are cobaltite, erythrite, glaucodot, and skutterudite.The world's major producers of cobalt are the Democratic Republic of the Congo, mainland China, Zambia, Russia and Australia. It is also found in Finland, Azerbaijan, and Kazakhstan.World production is 17.000 tons per year.[6]

1.6.2.3Health effects of Cobalt:

As cobalt is widely dispersed in the environment humans may be exposed to it by breathing air, drinking water and eating food that contains cobalt. Skin contact with soil or water that contains cobalt may also enhance exposure.Cobalt is not often freely available in the environment, but when cobalt particles are not bound to soil or sediment particles the uptake by plants and animals is higher and accumulation in plants and animals may occur.Cobalt is beneficial for humans because it is a part of vitamin B12, which is essential for human health. Cobalt is used to treatanemiawith pregnant women, because it stimulates the production of red blood cells. The total daily intake of cobalt is variable and may be as much as 1 mg, but almost all will pass through the body unadsorbed, expect that in vitamin B_{12}. However, too high concentration of cobalt may damage human health, when we experience lung effects, such as asthma and pneumonia. This mainly occurs with people that work with cobalt.When plants grow on contaminated soils they will accumulate very small particles of cobalt, especially in the parts of the plant we eat, such as fruits and seeds. Soils near mining and smelting facilities may contain very high amounts of cobalt, so that the uptake by humans through eating plants can cause health effects.Health effects that are a result of the uptake of high concentrations of cobalt are:

-Vomiting and nausea

-Vision problem

-Heart problem

-Thyroid damage

Health effects may also be caused by radiation of radioactive cobalt isotopes. This can cause sterility, hair loss, vomiting, bleeding, diarrhea, coma and even death. [6]

This radiation is sometimes used with cancer-patients to destroy tumors. These patients also suffer from hair loss, diarrhea and vomiting.Cobalt dust may cause an asthma-like disease with symptoms ranging from cough, shortness of breath and dyspnea to deceased pulmonary function, nodular fibrosis, permanent disability,

and death. Exposure to cobalt may cause weight loss, dermatitis, and respiratory hypersensitivity. LD 50 (oral, rat)-6171 mg\kg. (LD50=lethal dose 50= single dose of a substance that causes the death of 50% of an animal population from exposure to the substance by any route other than inhalation. LD50 is usually expressed as milligrams of animal weight (mg\kg or g/kg).Carcinogenicity-International Agency for Research on cancer (IARC) has listed cobalt and cobalt compounds within group 2B (agents which are possibly carcinogenic to humans). ACGIH has placed cobalt and inorganic compounds in category A3 (Experimental animal carcinogen-the agent is carcinogenic in experimental animals at a relatively high dose, by route(s), histologic type(s), or by mechanism(s) that are not considered relevant to worker exposure.)Cobalt has been classified to be carcinogenic to experimental animals by the Federal Republic of Germany.[6]

1.6.2.4 Environmental effects of Cobalt:

Cobalt is an element that occurs naturally in the environment in air, water, soil, rocks, plants and animals. It may also enter air and water and settle on land through wind-below dust and enter surface water through run-off when rainwater runs through soil and rock containing cobalt.Humans add cobalt by releasing small amounts into the atmosphere from coal combustion and mining, processing of cobalt – containing ores and the production and use of cobalt chemicals.The radioactive isotopes of cobalt are not present in the environment naturally, but they are released through nuclear power plant operations and nuclear accidents.Because they have relatively short half – lives they are not particularly dangerous Cobalt cannot be destroyed once it has entered the environment. It may react with other particles or water sediment.Cobalt will only mobilize under acidic conditions, but ultimately most cobalt will end up in soils and sediment.Soils that contain very low amounts of cobalt may grow plants that have a deficiency of cobalt.When animals graze on these grounds they suffer from lack of cobalt, which is essential for them.On the other hand, soils near mining and smelting facilities may contain very high amounts of cobalt, so that the up take by animals through eating plants can cause health effects. Cobalt will accumulate in plants and in the bodies of animals that eat these plants, but cobalt is not known to bio magnify up the food

chain.Because of this fruits vegetables, fish and other animals we eat will usually not contain very high amounts of cobalt. [6]

Lead and cobalt were determined in sample fish using wet digestion method and were analyzed using atomic absorption spectrophotometer; other performance techniques such as stripping pulse voltammetry (SPV), atomic fluorescence spectrometry (AFS) inductively coupled plasma atomic session spectrometry (ICP-AES). Although these techniques are useful in determining ultra-trace heavy metals without pre-concentration, however they are very expensive and costly.[6]

1.8Common tests for fish tissues:

- Heavy metals

-Sodium meta bi sulfate.

- Hydrocarbon test.

-Pesticides.

-Organo chlorine.

-Histamine test.

-Parasites test.

-Ratio fat oil.

-Ratio protein.

-Moisture test.

-Ratio salt.

-Ratio ash.

-Ratio insoluble ash.

-Determined ammonia gas.

-Hydrogen sulphide.

-Ratio rancidity.

-CO_2.

-pH.

-Acidity.

-Dry matter.

-Free fatty acid.

-Acid value or peroxide value.

-Total volatile nitrogen.

1.9 The objectiveof the research:

This research was aimed toinvestigate the presence of heavy metals (Lead and Cobalt)in three fish tissues samples collected from local Sudanese fish markets; Jebl awlia and Elmawrada; which located nearby White Nileriver and Nile river respectively, and the third one from planting scheme in veterinary college- Sudan university of science and technology. The analysis was hold with atomic absorption spectrometer (AAS).

Chapter two:

2.Experimental:

2.1Chemicals;

Nitric acid (conc)

Distilled water

Standard solution of Coblat.

Standard solution of Lead.

2.2 Equipment;

Volumetric flask (25ml), plastic knife, Aluminum foil, pipette, sensitive balance, beaker (50ml), oven, furnace, atomic absorption spectrophotometer.

2.3 sample collection:

The fish samples (of the same species) was purchased from Elmawrada market,Jebel awlia lake. The third sample was from planting scheme.

2.4sample pretreatment:

Each sample was properly cleaned by rinsing with distilled water to removed debris planktons and other external adherent. It was then drained under folds of filter, weighed, wrapped in aluminum foil and then frozen at -10 c^0 prior to analysis.

For analysis the fish samples were defrosted for two hours. The scales were removed and each separated into head, Trunk, gills and the intestine using plastic knife. The fish parts were dried at 80 c^0 for 2 h in Gallenkamp hot box oven and then blended by mortar and pestle.[7]

2.5 Procedures: (wet digestion method):

Approximately 2.0 g of each sample was weighted and ashed in the furnace at 550 C for 90 mints.The ash was dissolved in 5 ml of concentrated nitric acid and made up to 25 ml volume.[7]

2.6 sample analysis:

Atomic absorption spectrophotometer (AA-6800) Shimadzu, equipped with a deuterium lamp for back ground correction was used for trace elements and heavy metals. The hollow cathode for Pb, Co(photron) were employed as radiation source.

The principle of AAS based on absorption of electronic structure of ions and molecules which depend on beer lambert law;

“when monochromatic light passes through a transparent medium, the decrease in intensity with the thickness of the medium is proportional to the intensity of light “

$\text{Log } I\backslash I_0 = \varepsilon.b.c$

Where I : the intensity of the light before passing through the radiation,

I_0 : the intensity of the light after passing through the radiation,

ε: is the absorption coefficient,

b: is the path length of radiation,

C: concentration.

Chapter 3

3.Results and discussion:

3.1: Lead:

3.1.1 results:

Sample	concentration/ppm
Almorada	2.32
JabalAwlia	3.11
Planted Fish	0.67

Table (4): Concentration of Lead (ppm) in the studied samples

3.1.2 Discussion of Lead results:

The concentration of lead was found to be (2.32ppm, 3.11ppm, 0.67ppm) in Almorada, Jabal Awlia, and planted fish samplesrespectively.

The highest concentration was present in Jabal Awlia sample followed by Almorada andplanted fish samples. According to world Health Organization the permissible limit of lead in fish is 0.5ppm, so the concentration of lead in all samples exceed the permissible limit According to WHO, resultedfrom contamination by nutrients, waste water, radioactive waste, boating pollution, pollution by cars, pollution by agriculture and fuel in Almorada and Jabal Awlia fish samples;while in theplanted fish of veterinary college may attributed to the contamination by establishing material like cement and other consumed material which are not monitored by them. Hence the high concentration of lead making the fish in these area insecure for use and human consumption.

3.2 cobalt:

3.2.1 results:

Sample	concentration /ppm
Almorada	0.261
Jabal awlia	0.98
Planted fish	1.14

Table(5): Concentration of Cobalt (ppm) in the studied samples

3.2.2 Discussion of Cobalt results:

The concentration of Cobalt was found to be (0.261ppm, 0.98ppm, 1.14ppm) in Almorada, Jabal Awlia and planted fish samplesrespectively.

According to World Health Organization the permissible limit of Cobalt in the fish is 0.015ppm; the highest concentration was present in the planted fish sample followed by Jabal Awlia and Almorada, so the concentration of cobalt in all sample exceed the permissible limit according to WHO. This results can be attributed to contamination by fuel and other industrial activity nearby river stream in the case of Jabal awlia and Almorada.

Regarding the planting scheme this high degree of contamination according to the workers can be resulted from the nutrients additives and the material used in the establishing the pool of the fish lastly also can be attributed to the tap water which is used continuously without any sort of analysis or treatment.

3.3 Conclusion:

The investigatedthree fish tissue samples collected from local Sudanese fish markets; Jabal awlia and Almorada; which located nearby White Nileriver and Nile river respectively, and the third one from planting scheme in veterinary college-Sudan university of science and technology for the presence of heavy metals (Lead and Cobalt)using AAS was found to be highly polluted to different ranges.

We can conclude that the pollution of Cobalt is more significant than Lead to some extent, since the permissible concentration of Cobalt (0.015ppm) in WHO guide lines is less than Lead (0.5 ppm).

It is clear that the human activitiesneed to be regulated since it is highly reflected on the environment components and thus the creature (animal and plant kingdoms).

3.4 Recommendations and suggestions of future work:

1-Heavy metals must to be monitored regularlyby the concerned authorities.

2-The contaminated fish pose a health risk to the fish generation, to their predators and to the consumptions.

3-Contamination control laboratories should be found near Fish markets to investigate the expected fish contaminant.

4-Control and pretreat the effluents of factoriesbefore disposed in Nile river, and establish units for waste water recycling.

5-Control and pretreat the agricultural waste before disposed in Nile river.

6- The authorities should state laws that prevent washing cars, boats and disposing trash in Nile river.

7-Planted Fish aquarium should frequently change water and other consumed materials and test it in order to reduce contamination.

8-Instrumental techniques for the determination of trace and ultra-trace elements in water and organisms which need for pre concentration should be applied such as argon coupled plasma- mass spectrometry, atomic fluorescence spectrometry and stripping pulse voltammetry, should be developed.

4. References:

[1] Zeinab A.S. Analytical Study On The Effect Of Bioaccumulation Of Toxic Metals In The Meat Of Oreochromis Niloticus (Tilapia) Fish In Jabal Aulia Damlake On Their Body Size. 2015. Vol. Pp. 1-2.Vol. Pp.4-5.

[2] D.Hari Kishore Kumar Reddy And S.M .Lee 2012 Environmental And Analytical Toxicology Department Of Environmental Engineering , Kwandong University, Gang Neung , Republic Of Korea. 2015. Volume 1,2

[3] Salaw Mek, Sara Am, Samia Ha, Abdalla Eb, Manal Yi, Samia Ah And Hala Ea. Heavy Metals Contaminants In Water And Fish From Four Different Sources In Sudan. Journal Of Infectious Diseases And Therapy. 2016. 2232-0877.

[4] Alia Aam, Khadega Mh, Roaa As. Heavy Metals: Analysis And Limits In Some Herbal Medicines In Sudan. 2015. Pp.19-21.

[5] National Institutes Of Health U.S, Department Of Health And Human Services. National Institute Of Environmental Health Sciences. Po Box 12233. Research Triangle Park, Nc 27709. 2013.

[6] Lenntech Bv Rotterdamseweg 402m 2629 Hh Delft. Lenntech B.V. 2016.

[7] Olowu. R. A., Ayejuyo. O.O., Adewuyi. G.O., Adejoro. I.A., Denloye. A. A. B., Babatunde. A. O. And Ogundajo. A. L. Determination Of Heavy Metals In Fish Tissues, Water And Sediment From Epe And Badagry Lagoons, Lagos, Nigeria. E-Journal Of Chemistry 2010, 7(1), 215-221.