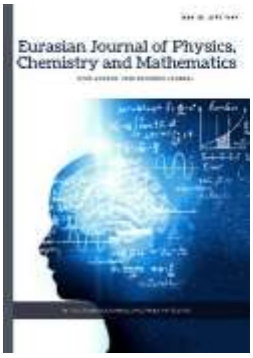

Determination of some metals and polyatomic ions in bottled water

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ABSTRACT

Regularly evaluating bottled water in the market is very necessary. There are different types of locally made or imported water in the market. To preserve the health of citizens, it was necessary to conduct chemical, physical and biological analyzes to determine its suitability for human consumption. Some may think that the process of evaluating the levels of minerals, salts and compounds in drinking water is not necessary, and the trend towards medical and scientific issues will be better. The source of infection with many diseases is caused by water pollution and the implementation of experiments related to scientific topics need clean water free of pollution.

Therefore, the levels of some minerals in bottled water samples such as iron, zinc, aluminum, copper and magnesium were evaluated using a spectrophotometer, as well as the evaluation of sulfate ions, silicates, nitrates and nitrites, as well as ammonia and ammonium. Through the results, there were deviations and the presence of high concentrations of some minerals and ions when compared with the standard specifications. Approved for bottled drinking water.

Keywords: Bottled water, ions, salts, spectrophotometer, minerals.

1-Introduction:

Water is a chemical compound produced by the reaction of oxygen gas with hydrogen gas with the molecular formula H2O. The Earth is unique in that it is the only planet of the solar system that contains liquid water in such large quantities that we know it, as water covers about 71% of the surface of the planet. By throwing waste into the water without treatment, in addition to population increase, urban expansion, and economic and industrial growth [1] . All of these factors have contributed to increasing pressures on our natural aquatic environment, and the matter becomes more dangerous when large quantities of different wastewater are dumped in locations close to clean water sources, which leads to its contamination with pesticides and various mineral pollutants. Pollution in water is defined as an increase in concentrations of physical, chemical or biological properties that make water harmful to humans or aquatic organisms [2]. The main sources of pollution in streams, rivers and groundwater arise from human activities that are caused by bad living habits and lack of human culture as well as unhealthy practices from factories and various industries.

The universe contains 92 natural elements whose concentrations and how they exist vary depending on where they are located, whether in the soil, in the atmosphere, in the bodies of living organisms, or in the water content of oceans, rivers and groundwater [3]. Heavy metals mean those metals whose atomic numbers are higher than iron and have a relatively high density. Heavy metals refer to any metallic chemical element that has a relatively high density. Examples are heavy metals, (Hg) , (Cd), (As), (Cr), (Tl, (Pb).Heavy metals are natural elements from the earth's crust that cannot be decomposed or broken down to a small degree and they enter our bodies through drinking water, food and air. Also, trace elements, and some heavy metals (such as copper, selenium, zinc) are necessary to maintain the metabolism of the human body). However, at high concentrations it can lead to poisoning (lead pipes for example). Heavy metals are dangerous because they tend to bio accumulate. Accumulation means an increase in the concentration of a chemical in a biological organism over time, compared to the concentration of a chemical in the environment. Scientists divide heavy metals according to their toxicity into three groups [4]. These minerals accumulate in soil, water and at present they are found in food chains.

It has become necessary to monitor water regularly due to the presence of potential pollution to the environment and its impact on food chains. Fish was considered an indicator of contamination with these minerals in aquatic environments as they are the final compounds in the food chain. Heavy metals are associated with amino acids and proteins and can also bind to enzymes, and accumulate in organs such as the liver, the spleen and gonads, therefore, it is necessary to examine the distribution of these metals in the body of the organism to understand their physiology and toxicity and their effects, as these metals are toxic and carcinogenic in low and high Concentrations [5]. Symptoms related to the presence of heavy metals concentrations range from mild to severe, they tend to develop slowly. by the time. Some of the common symptoms associated with exposure to heavy metals include [6]:

1- Diarrhea, nausea and/or vomiting
2-stomach ache
3-Shortness of breath general weakness

The World Health Organization has indicated that the United States is one of the countries in the world whose groundwater contains high levels of arsenic. Other common heavy metals that may be in your home water include amounts of copper, cadmium, chromium, nickel, and lead. Some symptoms are related to heavy metals, for example, exposure to mercury in drinking water leads to poisoning, problems with speech and hearing, changes in vision, or nerve damage in the hands or face [7].

Water is the backbone of life and the main element for the survival, continuity and renewal of life on the surface of the earth. Since ancient times, man and living organisms as a whole have searched for water to meet their main needs of drinking, hygiene, etc., and man is still striving to provide his daily need of water, especially countries that suffer from scarcity of water sources. And the trend of countries to rationalize the consumption of domestic water by governments and to purify polluted water using various techniques in an effort to provide the largest possible amount of water they have. On the other hand, the problem of drinking water pollution was one of the sensitive and important problems that cannot be overlooked. Contaminated drinking water is not water that carries any of the various dirt, but it includes the entry of anything into pure water with high percentages of elements or the presence of microorganisms or its remains and traces. It is good to have some dissolved mineral salts in drinking water, such as the calcium ion, the magnesium ion, the chlorine ion, or the fluorine ion, which are found in groundwater, wells and springs in abundance, as a result of rain dissolving these elements from their rocks as they seep into the ground into Underground wells, but if these elements dissolve in large proportions in the water, it becomes unfit for drinking within the international standards for potable water. As for polyatomic ions, their presence in drinking water and bottled water is very dangerous to people's lives. Phosphate, for example in drinking water, causes the water to be very toxic and harmful to human health and even animals [8] , and the increase in the proportion of polyatomic ions in drinking water affects the immune system. In general, an increase in the proportion of these ions causes poisoning or causes damage to the kidneys, digestive system and respiratory system human has

It is worth noting that there are international standards for potable water in which the highest percentages of dissolved ions in it are determined. If they exceed them, it becomes unfit for drinking and in need of purification. Because of the pollution of various water sources, more than 90 billion liters of bottled water have been turned towards bottled water. It is produced annually for a global market valued at about $22 billion, and global consumption is increasing at a rate of 7 percent annually. Bottled water is the fastest growing segment in the global beverage market [9].

But despite what is said about its health benefits, it is very expensive compared to domestic drinking water, which is of no less quality in many cases. Bottled water reviews have shown that many bottled drinking water is just 'tap water' packed in bottles! Many people prefer Drinking bottled water for many reasons, including the taste of chemicals added to tap water, especially chlorine used for purification. In France, 39 percent of the population abstain from drinking tap water because of its taste, compared to 7 percent in the United States. Consumers also seek safety, whether in developing or industrialized countries. Three main types of bottled water can be identified: natural mineral water, spring water, and refined water. Natural mineral water meets strict standards. It is microbiologically healthy groundwater, protected from the dangers of pollution, drawn from a spring through a natural outlet or perforated, containing a constant level of minerals and trace elements, and it is raw and cannot be treated or added any external elements to it.As for bottled spring water, it is also groundwater that is protected from the dangers of pollution, and it may not be subjected to any treatment except for what is permitted, such as aeration, and it is not necessary for it to have a fixed mineral composition. As for the refined or purified water, it is taken from rivers, lakes or springs, and treated by methods such as distillation, reverse osmosis and deionization, and it can be chemically treated to remove some harmful elements [10]. The status of bottled water is not clear in our country, most of which lacks water standards, sanitary conditions for containers, and a mandatory system for testing and monitoring the quality and safety of bottled water. Citizens buy bottled water of all shapes. The cries of consumers complaining of poisoning here and disease there are not interrupted. Therefore, it is very necessary and necessary to periodically and suddenly evaluate the bottled water in the markets because it affects people’s lives and is often the main cause of their infection with many dangerous and carcinogenic diseases.

2-Practical Part

The samples were collected for the common brands in the local markets in the Baghdad governorates of the total sample are 9 sample and collected in the form of three months. The first month October, the second December, and the last in February 2021. Nine samples for each month were named as follows (samples 1, 2, 3, 4, 5, 6, 7, 8, 9) and the nine samples were sent to the Karwanchi Company Laboratories to perform the tests. The Instrument a spectrophotometer for measuring the concentrations of heavy metals and polyatomic ions.

3-Results and Discussion

3.1. polyatomic ions

3.1.1. Phosphate (PO_4^{-3}):

All laboratory results for local bottled drinking water samples (1,2,3,4,5,6,7,8,9) and for the months (October, December, February).

Phosphorous in its elemental form is very toxic, and phosphate is formed from this element. It is a substance that helps the growth of algae, and phosphate can reach the water through agricultural lands that contain fertilizers and waste, and the quantities of phosphate in the water cause major environmental problems, so phosphate-based detergents are prohibited. Phosphate stimulates the growth of suspended and aquatic plants that provide food for fish and this increased growth may cause an increase in the number of fish and a deterioration of the overall water quality. But if it is found in excess quantities, algae and aquatic plants will grow excessively and cause a blockage in the water channels, which causes the consumption of large quantities of oxygen. High levels of phosphates accelerate the appearance of signs of aging in humans. And that these high levels of it in the body may increase the prevalence and severity of disease complications associated with age, such as chronic kidney disease and calcification or hardening of the tissues of the heart and blood vessels. It can also induce severe atrophy of the skin and muscles [11].

3.1.2. Silicate (SiO_2):

Through laboratory tests, the results of silicate came unevenly for the three months (October, December, February) shown in **(Table: 1)**, and that silica, the second most abundant element on earth after oxygen, can be found in almost every water supply in the world. Often known as a hard, glassy mineral, this element can be found in many forms including sand, quartz, and granite. Minerals can be found in natural groundwater supplies in the forms of colloidal silica or reactive silica [12].
Silica (silicon dioxide) is a natural compound found in sand and quartz. Silica is used to make glass, fiber optic cable, and concrete. Silica is commonly found in all types of soil. As the water moves through soil and rock, the water picks up the silica and can eventually end up in the water supply.
About 20-75% of silica is absorbed in the digestive system and used to build bones and tendons. Silica is rapidly excreted from the body, especially in the urine. Silica may improve the appearance and strength of skin and hair. Some studies suggest that silica may help build bone and reduce the risk of osteoporosis [13].
No adverse health effects have been reported in laboratory animals fed large amounts of silica (equivalent to an adult intake of approximately 3.5 g of silica) daily over periods ranging from several weeks to two years. The route of exposure is important in understanding the potential health effects. Exposure to silica in drinking water has not been reported to cause human health effects. Studies in humans have shown that inhaling certain forms of silica dust (for example, when working in a factory) can cause lung damage.

Table 1: Laboratory results of Silicate testing of bottled drinking water

Sample	First month	Second month	Third month
1	11	12	11
2	23	22	21
3	33	32	30
4	23	24	25
5	10	9	11
6	22	21	24
7	12	13	15
8	34	35	33
9	56	57	53

3.1.3. Ammonia (NH_3, NH_4):

Through the laboratory tests conducted on the nine samples, it was found that sample 2 in February had a result of (0.6 mg/L) and sample 3 had a result of (0.7 mg/L) in October, and the month of December was (0.7 mg/L) and the month of February (0.8 mg/L) and they were outside the permissible limits, but the sample

(1, 4, 5, 6, 7, 8, 9) was within the permissible limit (0.5 mg/L) as shown in (Figure**, 1&2) and (Table 2)**

The term ammonia includes the non-ionized (NH_3) and ionized (NH_4) species. Ammonia in the environment arises from metabolic, agricultural, and industrial processes and disinfection with chloramines. Ammonia in water is an indicator of potential bacterial contamination, sewage, and animal waste [14].

Ammonia is a major component of mammalian metabolism. Exposure from environmental sources is minimal compared to the endogenous synthesis of ammonia. Ammonia in drinking water is not directly relevant to health, and therefore no health-based indicative value is proposed. However, ammonia can impair disinfection efficiency, lead to the formation of nitrites in distribution systems, cause filters to fail to remove manganese, and cause taste and odor problems. An ammonia odor concentration threshold at alkaline pH of about 1.5 mg/L and a taste threshold of 35 mg/L have been suggested for the ammonium cation. Ammonia is not directly relevant to health at these levels, and it has nothing to do with health. Ammonia reacts with chlorine to reduce free chlorine and form chloramines. Ammonia has a toxic effect on healthy humans only if the intake becomes above the ability to remove toxins. If ammonia is administered in the form of its ammonium salts, the effects of the anion must also be taken into account. With ammonium chloride, the acidic effects of the chloride ion appear to be of greater importance than those of the ammonium ion [15]. At a dose greater than 100 mg/kg of body weight per day (33.7 mg of ammonium ion per kg of body weight per day), ammonium chloride affects metabolism by shifting the acid-base balance, disturbing glucose tolerance, and decreasing tissue sensitivity to insulin [15].

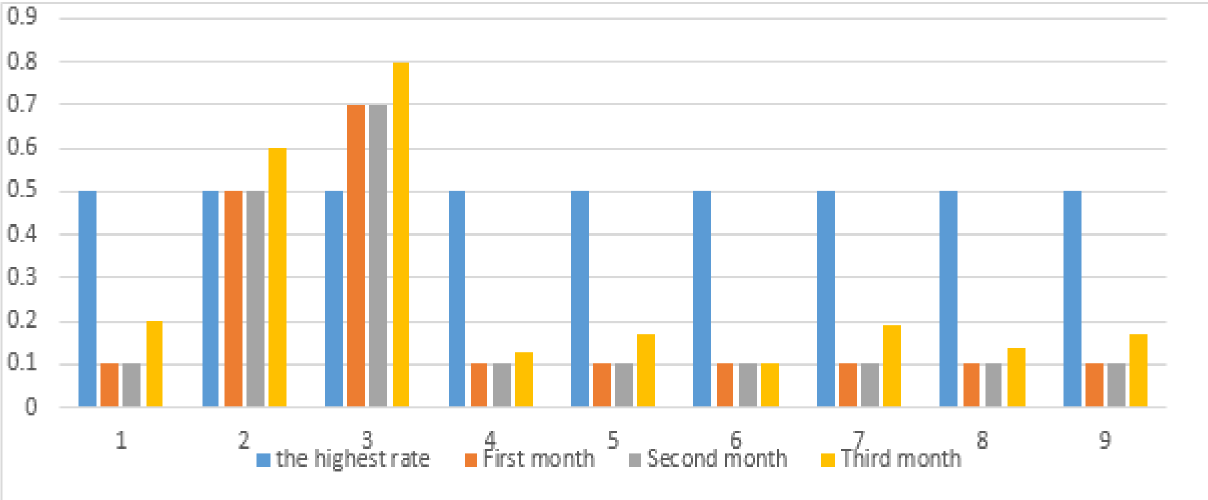


Figure.1: Laboratory results of Ammonia (NH_3) testing of bottled drinking water.

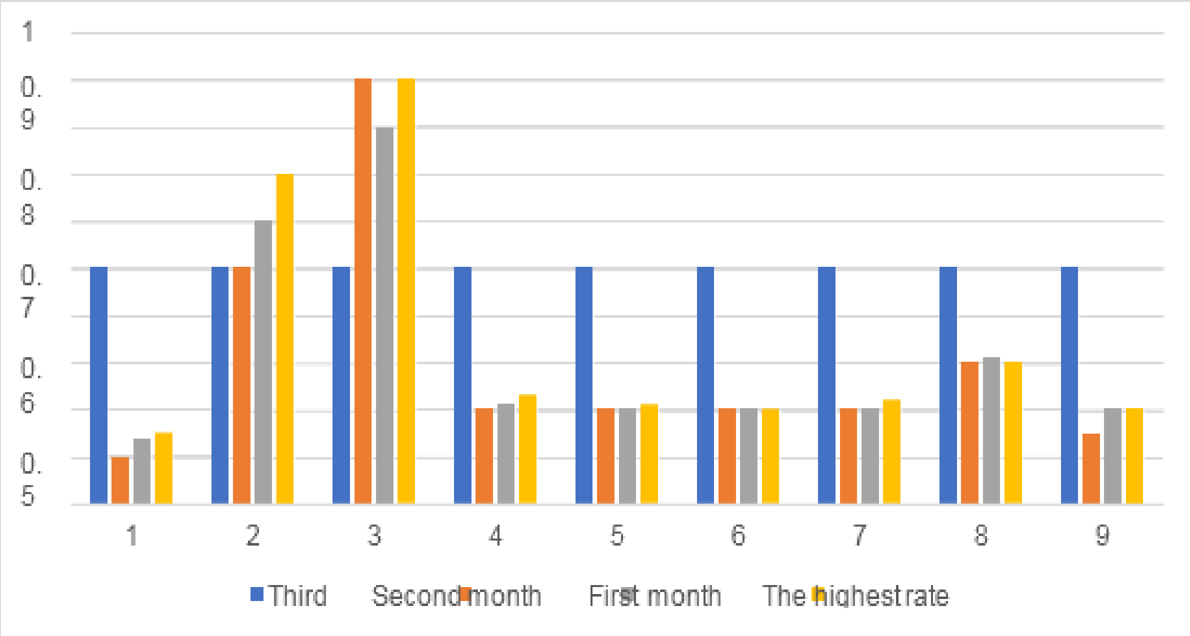


Figure 2: Laboratory results of Ammonium (NH4) testing of bottled drinking water.

Table 2 :Laboratory results of (NH_3) and (NH_4) testing of bottled drinking water

Sample	Normal rang		First month	Second month	Third month
1	NH_3	0.5 mg/L	0.01	0.01	0.2
	NH_4	0.5 mg/L	0.01	0.01	0.15
2	NH_3	0.5 mg/L	0.5	0.5	0.6
	NH_4	0.5 mg/L	0.5	0.5	0.7
3	NH_3	0.5 mg/L	0.7	0.7	0.8
	NH_4	0.5 mg/L	0.9	0.8	0.9
4	NH_3	0.5 mg/L	0.1	0.01	0.13
	NH_4	0.5 mg/L	0.2	0.2	0.23
5	NH_3	0.5 mg/L	0.01	0.01	0.17
	NH_4	0.5 mg/L	0.02	0.02	0.21
6	NH_3	0.5 mg/L	0.1	0.01	0.1
	NH_4	0.5 mg/L	0.2	0.2	0.2
7	NH_3	0.5 mg/L	0.1	0.01	0.19
	NH_4	0.5 mg/L	0.2	0.2	0.22
8	NH_3	0.5 mg/L	0.1	0.01	0.14
	NH_4	0.5 mg/L	0.2	0.2	0.3
9	NH_3	0.5 mg/L	0.1	0.01	0.14
	NH_4	0.5 mg/L	0.2	0.2	0.3

3.1.4. Nitrate (NO_3) and Nitrite (NO_2):

The laboratory results of local bottled drinking water samples (1,2,3,4,5,6,7,8,9) and for the three months (October, December, February) indicated that the concentrations of NO_3 nitrate and NO_2 nitrite were within the acceptable limits (0.5 mg/L) as shown in (Table:3).

Nitrates (NO_3^-) are found naturally in the environment and are an important nutrient for plants. It is found in varying concentrations in all plants and is part of the nitrogen cycle. Nitrite (NO_2^-) is not usually present in large concentrations except in a reducing environment, because nitrate is the most stable oxidation state. It can be formed by microbial reduction of nitrate and in vivo by reduction from ingested nitrate. Nitrite can also be chemically formed in distribution pipes by Nitrosomonas bacteria during the stagnation of nitrate-containing and oxygen-poor drinking water in galvanized steel pipes, or if chlorination is used to provide a residual disinfectant. An excess of free ammonia entering the distribution system can lead to nitrification and a possible increase in nitrates and nitrites in drinking water. Nitrates can reach both surface and groundwater as a result of agricultural activity (including excessive use of inorganic nitrogen fertilizers and manure), sewage disposal, and oxidation of nitrogenous waste products in humans and other animal waste, including septic tanks. . Nitrates can also sometimes reach groundwater as a result of natural vegetation. Surface water nitrate concentrations can change rapidly due to fertilizer runoff, uptake by phytoplankton, and denitrification by bacteria, but groundwater concentrations generally show relatively slow changes. Nitrates and nitrites may also be produced as a result of nitrification in the water source or distribution systems. In general, the most important source of human exposure to nitrates and nitrites is through vegetables (nitrates and nitrites) and through meat in the diet (nitrite is used as a preservative in many processed types of meat). However, in some circumstances, drinking water can contribute significantly to the intake of nitrates and sometimes nitrites. In the case of bottle-fed infants, drinking water can be the main external source of exposure to nitrates and nitrites [16].

Table 3: Laboratory results of Nitrate (NO_3) and nitrite (NO_2) testing of bottled drinking water

Sample	Normal rang		First month	Second month	Third month
1	NO_2	0.5 mg/L	0.0	0.0	0.0
	NO_3	50 mg/L	0.9	1.0	0.9
2	NO_2	0.5 mg/L	0.0	0.0	0.0
	NO_3	50 mg/L	0.7	0.8	0.9
3	NO_2	0.5 mg/L	0.02	0.02	0.02
	NO_3	50 mg/L	1.0	1.1	1.0
4	NO_2	0.5 mg/L	0.01	0.01	0.01
	NO_3	50 mg/L	2.33	2.4	2.3
5	NO_2	0.5 mg/L	0.0	0.0	0.0
	NO_3	50 mg/L	0.02	0.03	0.02
6	NO_2	0.5 mg/L	0.03	0.03	0.03
	NO_3	50 mg/L	1.78	1.8	1.9
7	NO_2	0.5 mg/L	0.08	0.08	0.08

	NO_3	50 mg/L	1.86	1.9	2.0
8	NO_2	0.5 mg/L	0.07	0.07	0.07
	NO_3	50 mg/L	2.75	2.8	2.8
9	NO_2	0.5 mg/L	0.03	0.03	0.03
	NO_3	50 mg/L	3.0	3.0	2.8

3.2 Metals

3.2.1. Iron (Fe):

The laboratory results of iron in the local bottled water samples for the three months (October, December, and February) showed that the iron percentage was normal and within the acceptable limits (0.2 mg/L) As shown in (Table. 4).

Iron is one of the most abundant minerals in the Earth's crust and is found in natural waters at levels ranging from (0.5 to 50 mg/L). Iron may also be present in drinking water as a result of the use of iron coagulants or corrosion of steel and cast iron pipes during water distribution. Iron is an essential component of human nutrition, particularly in the case of iron (II) oxidation. Estimates of the minimum daily requirement for iron depend on age, gender, physiological status, and iron bioavailability and range from about (10 to 50 mg/day). As a precaution against excessive iron storage in the body, in 1983 the Joint Expert Committee (JECFA) established a PMTDI of (0.8 mg/kg) body weight [17], which applies to iron from all sources except iron oxides used as coloring agents and iron supplements taken during pregnancy, breast-feeding or for specific clinical requirements.

Table 4: Laboratory results of Iron testing of bottled drinking water

Sample	Normal rang	First month	Second month	Third month
1	0.2 mg/L	0.0	0.0	0.0
2	0.2 mg/L	0.1	0.12	0.14
3	0.2 mg/L	0.2	0.15	0.13
4	0.2 mg/L	0.0	0.0	0.0
5	0.2 mg/L	0.0	0.0	0.0
6	0.2 mg/L	0.2	0.19	0.15
7	0.2 mg/L	0.0	0.0	0.0
8	0.2 mg/L	0.0	0.0	0.0
9	0.2 mg/L	0.1	0.11	0.09

3.2.2 Zinc

Through the laboratory results of the nine samples of local bottled drinking water (sample 1, 2, 3, 4, 5, 6, 7, 8, 9) for the months (October, December, February), it was found that all samples are free of zinc.

Zinc is an essential element found in nearly all foods and drinking water in the United States in the form of salts or organic compounds [18]. Diet is usually the main source of zinc. Although zinc levels in surface and ground water typically do not exceed (0.01 and 0.05 mg/L), respectively, concentrations in tap water can be much higher as a result of zinc dissolving from pipes. Recent studies in humans, derive an official indicative value Not required at this time. However, drinking water containing zinc at levels above 3 mg/L may not be acceptable to consumers [19].

3.2.3 Aluminum (Al):

The laboratory results of all local bottled drinking water samples (1,2,3,4,5,6,7,8,9) came within the acceptable limits for Aluminum (0.2 mg/L) during the three months (October, December, February).

Aluminum is the most abundant metallic element and makes up about 8% of the Earth's crust. Aluminum salts are widely used in water treatment as coagulants to reduce organic matter, color, turbidity, and levels of microorganisms. This use may result in increased aluminum concentrations in the final water. When residual concentrations are high, undesirable color and turbidity result [20]. The aluminum concentrations at which such problems may occur depend largely on several water quality parameters and operational factors in the water treatment plant. Intake of aluminum from foods, especially those containing aluminum compounds used as food additives, is the main route of exposure to aluminum for the general public. The contribution of drinking water to total oral aluminum exposure is usually less than 5% of total intake. There is little evidence that orally ingested aluminum is highly toxic to humans, although the element is widely distributed in foods, drinking water, and other antacid preparations. It has been hypothesized that aluminum exposure is a risk factor for the development or acceleration of the onset of Alzheimer's disease or thyroiditis in humans [21].

3.2.4. Copper (Cu):

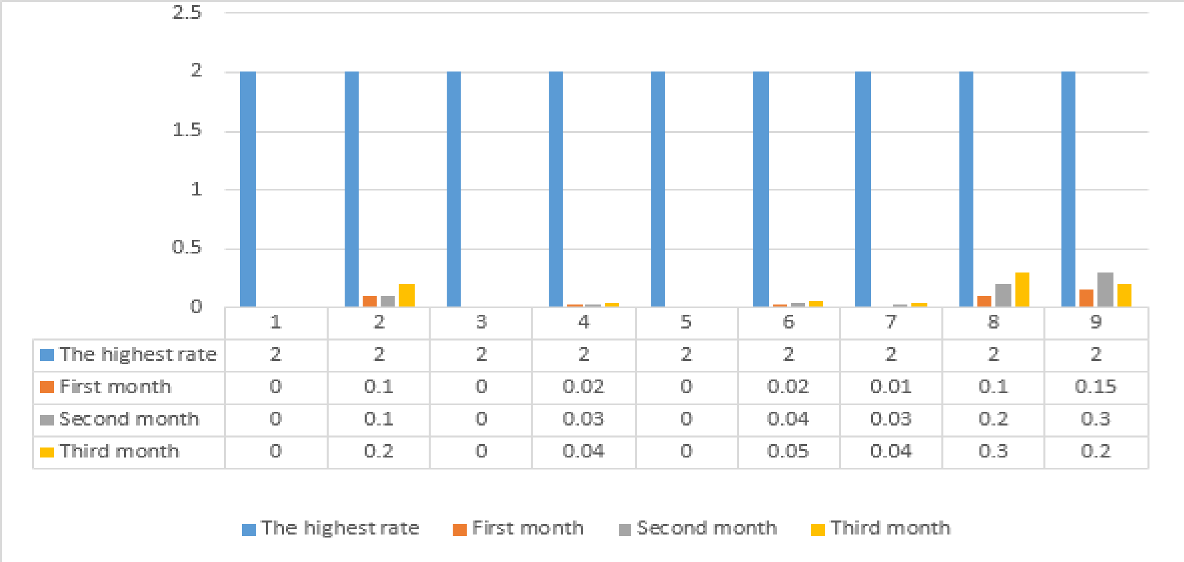
The laboratory results conducted during the three months (October, December, and February) indicated on the local bottled water models, the copper concentration in the nine models was within the normal range (2 mg/L) As shown in (Figure:3).

Copper is also an essential nutrient and a pollutant for drinking water. It is used to make tubes, valves, and fittings and is found in alloys and coatings. Copper sulfate Pentahydrate is sometimes added to surface waters to control algae. Concentrations in drinking water vary widely, with the primary source most often being corrosion of indoor copper plumbing. Levels in running or full rinse. Water tends to be low, while stagnant or partially washed water samples are also more volatile and can be much higher (often above 1 mg/L) [22].

Copper concentrations in treated water often increase during distribution, especially in systems with an acidic pH or highly carbonated water with an alkaline pH. Food and water are the primary sources of copper exposure in developed countries. Consumption of stagnant or partially washed water from a dispensing system that includes copper tubing or fittings can significantly increase the total daily exposure to copper, especially for infants fed formula reconstituted with tap water. The upper limit of the acceptable range of oral intake in adults is uncertain but likely in the range of several (more than 2 or 3 mg/day), but not many, milligrams per day in adults. This assessment was based only on studies of the gastrointestinal effects of drinking water contaminated with copper [23].

Data on toxicity in experimental animals did not help establish the upper limit of the acceptable range of oral intake due to uncertainty about an appropriate model for humans, but they do help establish a mode of action for a response.

Data on the gastrointestinal effects of copper should be used with caution, as the effects observed are influenced by the concentration of ingested copper to a greater extent than the total mass or dose ingested in 24 hours. Studies have established a threshold for the effects of copper in drinking water on the GI tract, but there remains some uncertainty regarding the long-term effects of copper on susceptible populations, such as gene carriers of Wilson's disease and other metabolic disorders of copper homeostasis [24].



	1	2	3	4	5	6	7	8	9
The highest rate	2	2	2	2	2	2	2	2	2
First month	0	0.1	0	0.02	0	0.02	0.01	0.1	0.15
Second month	0	0.1	0	0.03	0	0.04	0.03	0.2	0.3
Third month	0	0.2	0	0.04	0	0.05	0.04	0.3	0.2

Figure3; Laboratory results of copper testing of bottled drinking water all result in mg/L

3.2.5 Manganese

The laboratory results of the local bottled water samples came within the normal range of manganese in drinking water (0.5 mg/L) for the three months (October, December, and February) As shown in (Figure: 4). Since manganese is found naturally in many food sources, the greatest exposure to manganese is usually from food. Several epidemiological studies have indicated that molten manganese is associated with adverse effects on learning in children. These findings have not been confirmed and the association has not been established as causal. Experimental animal data. At levels greater than (0.1 mg/L), the presence of manganese in the water supply may cause an undesirable taste in beverages, stains, sanitary ware, and laundry. The presence of manganese in drinking water, as well as iron, may cause sediment to build up in the distribution system. Concentrations less than (0.1 mg/L) are usually acceptable to consumers. Even at a concentration (0.2 mg/L), manganese often forms coatings on the tubes, which may fall off as black deposits. The healthy value of (0.4 mg/L) manganese is higher than this acceptance threshold of (0.1 mg/L). However, under some conditions, manganese can be in concentrations higher than (0.1 mg/L) and may remain in solution for longer compared to its usual solubility in most drinking water [25].

	1	2	3	4	5	6	7	8	9
the highest rate	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
First month	0.04	0.05	0.07	0.08	0.01	0.03	0.01	0.02	0.04
Second month	0.04	0.05	0.07	0.08	0.01	0.03	0.01	0.02	0.04
Third month	0.06	0.07	0.09	0.1	0.02	0.07	0.04	0.04	0.06

Figure 4: Laboratory results of Manganese testing of bottled drinking water all result in mg/L

4-Conclusion

Raising awareness in desalination plants by using everything that reduces water pollution.Conduct biological, chemical, and physical tests periodically and continuously for water samples.We recommend using modern techniques to remove or reduce heavy water elements, follow all new technologies, and see research and studies in this field.

The necessary tests before the purification and filling process, the important of which is the percentage of total organic carbon in raw water as the main cause of the formation of carcinogens during the sterilization process.The quality of the material made in the bottles affects the quality and validity of the water so we recommend going the use of strong glass or plastic bottles.the introduction of new determinants and tests to examine water models and not limit ourselves to routine examinations.

recommend increased control over water filling plants and urge relevant centers to apply strict laws to achieve the goal of producing safe, pollutant-free healthy water.

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