Bacterial Study of Potable Water Storage Tanks of Houses in Some Anbar Districts

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Abstract: Samples were collected for the period from 18/5/2022 to 18/1/2023 included 20 samples of potable water from four areas in Anbar governorate, including the areas of Ramadi, Khalidiya, Fallujah and Garma, and the samples included five samples from each area taken from household tank water samples, and the results of the study showed that a large proportion of the water of household tanks was contaminated with some pathological bacteria such as Escherichia coli (8), Staphylococcus aureus (3) , Pseudomonas aeruginosa (1) , Bacillus sp. (6). Antibiotic sensitivity tests showed a disparity in resistance rates between bacterial isolations, as E. coli gave resistance rates ranging between (12.5-87.5) percent, while the rest of the isolated bacteria gave resistance rates ranging between (0-100) percent.

Keywords: water tanks, Escherichia coli, Pseudomonas aeruginosa, Potable water.

1. **Introduction**:

The study of water and the level of cleanliness and the extent of the population's interest in it is of great importance as it is the most important item on earth and potable water is the water that a person can drink directly and use in the preparation of foods (1), most people use network water, which may become polluted with a change in some of its properties before it reaches the consumer's water tap due to the materials it is exposed to or transmitted to it from the surrounding environment, such as tanks and pipes through which it travels (2). As pollution occurs as a result of mixing between drinking water and wastewater contaminated with microbes when the pipes of water distribution networks are old and defective, according to the World Health Organization, most of the diseases transmitted by water and food come from the use of contaminated water and food, where 88% of intestinal diseases **(such as diarrhoea**) are associated with contaminated water (3,4) and water quality problems in tanks are classified as microbiological, chemical and physical, and it is likely that the age of excessive storage of water in tanks may cause a deterioration in water quality and thus they are favourable conditions for the growth of microbes and the occurrence of chemical changes in water (5). Biological pollution (bacterial in particular) is one of the most important risks and health problems resulting from water pollution, as the group of coliform bacteria, which belongs to the family **Enterobacteriaceae**, is one of the most prominent types of bacteria that indicate water pollution with faecal bacteria, which are sourced from humans or animals, and that their frequent presence leads to a high incidence of diseases, the World Health Organization and the US Environmental Protection Agency have set health standards for drinking water and its quality around the world, the most important of which is a standard for examining the presence of coliform bacteria in water to determine Water pollution in addition to setting permissible limits for the numbers and types of bacteria in drinking water, some of which were determined that there is not even a single cell of coliform bacteria in the water (6,7), one study indicates that Escherichia coli bacteria have the ability to survive at a temperature of up to 25 ° C in dechlorinated water, as domestic water pipes and water tanks are usually covered and in a cold and warm area (8), while another study indicated that storing drinking water in water tanks or plastic containers may lead to post-treatment or filtering contamination due to the entry of coliform bacteria and potential opportunistic pathogens in water supply and networks (9). Several studies have indicated the relationship between water quality and safety of pathogenic bacteria, especially E. coli, total coliforms (faecal coliforms), pseudomonas aeruginosa and more, which include the risks of exposure to bacteria and their adverse effects on human health (10 and 11). Although domestic water tanks play an important role in providing water to consumers with the recurrence of the phenomenon of water cuts from the public network, they may be a source of pollution and a cause of many diseases if they are not taken care of, as they are vulnerable to many biological, organic and other factors that lead to their pollution, and thus affect the health of their users (12). The lack of awareness of the population of the importance of cleanliness, maintenance and periodic detection of domestic water tanks, regardless of the type of reasons behind it, whether it is ignorance, laziness, and lack of awareness, negatively affects the cleanliness of this water to become a threat to their lives.

The problem of the availability of potable water in Iraq has worsened due to the decrease in the amount of Tigris and Euphrates water arriving in Iraq as a result of the establishment of dams and reservoirs by Turkey and the low quality of water as a result of the lack of interest in filtering and sterilizing water and the age and decay of distribution networks, which led to a mixture between drinking water and sewage and thus drinking water became the first source of infection with various diseases. Therefore, the current study is designed to study some physical, chemical and bacteriological properties of domestic tank water by selecting a number of types of tanks used in homes for some areas in Anbar province.

Objective of the study: To evaluate the cleanliness of drinking water tanks in homes from a bacteriological point of view and some chemical specifications and at the same time to identify the most bacteria that cause biological contamination of water for the purpose of taking health measures in the future.

2. **Materials and methods**:

2.1. **Sampling**:

Houses that have drinking water collection tanks and at the same time that have filter devices were selected to sterilize water and for the purpose of collecting water samples, sterile glass bottles were used for the purpose of collecting models with a size of (1) liters, and the correct scientific methods were adopted in taking models, which are for water tanks, sterile water sample collection bottles were used and size (1) to see Water samples were taken from a depth of 15 cm from the depth of water in the tank, while the water samples in the filters were opened Metal tap for (2) minutes after sterilizing it with alcohol and then exposing it to fire and after taking the form in size (1) to close the bottle and transfer to the laboratory, noting that models were taken in the form of two groups for four selected areas (Ramadi, Khalidiya, Fallujah, Karma), one of which represents the water of the tanks and the second represents the water of the filters, at the rate of five samples for each area of water from the domestic tanks and five samples of filter water for each region.

2.2. Total Plate Count of Bacteria (TPC)

The total bacterial number was estimated by the Standard plates count (SPC) method through the use of membrane filtration method, as 100 millilitres of household tank water were filtered and filtered through a special filter paper for this purpose, then after completing the filtration process, the membrane was placed on the culture medium and blood cells were incubated at a temperature of 37 ° C for 24 hours, after which the colonies were counted (13), the number of faecal coliform bacteria Escherichia coli was calculated by the most probable number method mentioned in the American Public Health Union (13). This method is summarized as after the hypothetical examination is carried out a secondary implant of all the positive results in which it occurred to form (acid + gas) by transferring a full loop to test tubes containing (10) ml of the medium of mono-sterile McCongi broth, and incubating the implanted tubes in a water bath at a degree of (44) º for a period of (24) hours, and the pipes in which gas and acid are positive and in which gas is not formed are negative, and through special tables for the most likely counting, The most likely number of *Escherichia coli*/100ml of sample water is estimated.

2.3. Diagnosis of bacteria in water models:

For the purpose of identifying the types of pathological bacteria likely to be present in water samples in domestic water tanks that grew on the aforementioned culture media. A number of colonies that emerged after the steps as described in (2-2) were selected and cultivated on optional and differential media for the purpose of diagnosis, microscopic examination testing using Gram stain and biochemical tests were performed as mentioned before (Macfaddin, 2000).

2.4. Physical and chemical tests of tank water:

1- Temperature:

The maximum and minimum temperature was measured 24 hours before the water sample was taken using a mercury thermometer with a range of (- 10 to 100) degrees Celsius and gradually 1 degree Celsius and the water temperature was measured by immersing the party containing mercury from the thermometer directly in water for about two minutes until the reading stabilized and recorded after that.

2- Turbidity:

The water turbidity was measured by the Turbidity meter type HANNA-LP2000, where the device expresses the standard solutions in (N. T. U) naphthalene unit after zeroing the device.

3- Hydrogen potential (pH):

The pH of the samples was measured using a pH meter manufactured by HANNA type (Microprocessor HI 9321) after calibrating the device with a pH Buffer solution (9, 7, and 4).

4- Chlorine (Cl):

It is used to measure the residual free chlorine (Method Colorimetric DPD) because this method is suitable for measuring the residual chlorine in treated water at concentrations between (4-0.2) mg/litre, the examination is carried out using a tablet (LOVIBOND) with a reagent (DPD), which is a powder ready with special packages used for each test prepared by companies producing chemicals. The measurement process is carried out in the field by taking 10 ml of the water sample and then adding a bottle of (DPD) reagent as a result, a pink solution of varying colour varies according to the concentration of chlorine remaining in the sample. The cell is then placed in a LOVIBOND disc and the colour of the test sample is compared with the colour tones installed on the turntable (14).

3. Results and discussion:

The results of the survey which shown in Table No. (1) for four different sites from the city of Ramadi, by five samples for each site, showed that 95% of the household tanks examined were of galvanized iron, while the rest was plastic, and that the age of the tanks used to store water ranged between 5-13 years and was located on the roofs of houses and all the tanks from which the samples were taken were covered and examined, as the sizes of the tanks ranged from 1000-2000 cubic meters to accomplish various activities and that the number of people used The water in one house ranges from 4-13 individuals and the rate of cleaning is zero and they rarely clean it and the water stored in it was used for domestic uses and activities such as washing, cooking, cleaning and sometimes irrigation.

Table (1): Specifications of household tanks according to the sites from which samples were taken in the city of Ramadi

Sample	Locality	Tank Volume (L)	No. Of tank	Period of use (year)	User No,	No. Clean tank
1	Ramadi	2000	1	5	6	0
2	Ramadi	2000	1	5	8	0
3	Ramadi	1000	2	8	4	0
4	Ramadi	1000	2	10	6	0
5	Ramadi	1000	1	9	4	0
6	Khaldiyia	2000	1	8	10	0
7	Khaldiyia	2000	1	12	9	0
8	Khaldiyia	2000	1	10	13	0
9	Khaldiyia	1000	1	13	7	0
10	Khaldiyia	1000	1	12	6	0
11	Fallujah	2000	1	7	9	0
12	Fallujah	2000	1	9	11	0
13	Fallujah	2000	1	10	9	0
14	Fallujah	2000	1	8	13	0
15	Fallujah	1000	1	7	6	0
16	Qarma	2000	1	12	8	0
17	Qarma	2000	1	9	7	0
18	Qarma	2000	1	10	8	0
19	Qarma	1000	1	5	4	0
20	Qarma	1000	1	5	5	0

Table (2) shows some physical and chemical specifications of the water of domestic tanks, which have been analysed laboratory, in order to know their concentrations and evaluate them for their compliance with the specifications of the Iraqi Standardization and Quality Control Organization and global determinants. We analysed the results statistically with the SPSS system, as Table 2 shows the maximum and minimum temperatures for tank water 24 hours before taking the sample and some chemical standards for domestic tank water that is directly exposed to sunlight, where water temperatures ranged between 20-40 degrees Celsius for sites. The four and the temperature of the water is one of the important measurements because it is the critical factor related to the growth of microorganisms and through the examination of the degree of acidity of the water the rates range between 7.76-8.00 at the temperatures installed in the table for the four sites and since the values are greater than 0.05 they indicate that there are no statistically significant differences, and these values are consistent with the Iraqi specifications and the World Health Organization WHO, which is within the range of 6.5-8.5 (8). As the high values of the pH function contribute to the spread of microorganisms and a change in standard specifications, as these results coincide with studies dealing with drinking water produced in drinking water treatment plants (16, 15).

Turbidity is one of the important tests due to its direct impact on water quality in terms of the presence of bacteria, as values were recorded between 0.2020-0.3000 NTU at temperatures 20-40 ° C at the study sites, as the results came within the limits of the Iraqi standard specifications, which determined the values of turbidity in NTU (5) It was noted that there were no significant differences according to the variation table, (17) indicated during his study that the values of turbidity between 0.17-2.5 NTU and free chlorine between 0.01-0.08 mg / litre for water tanks in the city of Dubai, while turbidity exceeded 7% in the water reservoirs of the city of Sharjah, which is within the maximum limits of the World Health Organization (18).

From the observation of the rates of chloride values, we find that they ranged between 0.096-0.180 mg/litre at high temperatures within 40 °C, which contributed to the activity of microorganisms in the water if the rates fell below the minimum permissible limits for chlorine required to be available in drinking water, and it turns out that there is a difference in the rates of chlorine values in all study areas, and this may be due to several reasons, including: Lack of chlorine added in liquefied water projects, which is a factor for the spread of infectious epidemic diseases that are transmitted through water or that chlorine has been lost as a result of high temperatures and during storage (19)

The researcher (20) confirmed in his study to the low rates of chloride concentrations in water models for the maximum allowed by the Office of Standardization and Quality Control of (600) mg /litre in some neighbourhoods of the city of Baghdad.

Table (2) Analysis of the variation between water rates by locations and temperatures

parameter	location	sample	Mean	Std. Deviation	Temperature water tank (C°) (before 24 h(	
					Minimum	Maximum
PH	R	5	7.7800	.17889	26	39
	K	5	7.8000	.31623	25	40
	F	5	8.0400	.40988	20	40
	Q	5	7.7600	.29665	24	40
	Total	20	7.8450	.30860	24	40
Turbidity (NTU)	R	5	.2020	.01789	26	39
	K	5	.2400	.02915	25	40
	F	5	.2560	.03050	20	40
	Q	5	.3000	.03536	24	40
	Total	20	.2495	.04478	24	40
Chlorine (mg\L)	R	5	.0096	.00055	26	39
	K	5	.0180	.00837	25	40
	F	5	.0114	.00488	20	40
	Q	5	.0116	.00477	24	40
	Total	20	.0127	.00594	24	40

As for the effect of the study sites on the rates of pH, turbidity and chlorine values in tank water as in Table (3) and according to the Duncan multi-range test, as it indicates that the relationship is positive between the acidity function (pH) and the study sites, as for turbidity and chlorine, the relationship was negative.

Table (3) shows the effect of locations on the rates of variable values according to the Dunkin' test.

location	parameter	Mean	Std. Deviation
R	PH	.2800	.025
K	PH	.3000	.101
F	PH	.5400	.042
Q	PH	.2600	.122
R	Turbidity (NTU)	-.79800	.000
K	Turbidity (NTU)	-.76000	.000
F	Turbidity (NTU)	-.74400	.000
Q	Turbidity (NTU)	-.70000	.000
R	Chlorine (mg\L)	-.3404000	.000
K	Chlorine (mg\L)	-.3320000	.000
F	Chlorine (mg\L)	-.3386000	.000
Q	Chlorine (mg\L)	-.3384000	.000

The results of bacterial diagnostics:
The results showed that the number of positive samples for bacterial culture out of a total of (20) samples was 13 positive samples by (65%) and negative water samples due to the presence of bacteria in them numbered (7) by (35%) As for the number of total samples positive for the presence of *E. coli* bacteria, it was the most than the rest of the other bacterial isolates that were isolated in this study, as their numbers were (8) bacterial isolates by (40%), followed by *Bacillus sp*. bacteria, which numbered (6) isolates by (30%), followed by *Staphylococcus aureus*, which numbered (3). Bacterial isolates by (15%) and finally *Pseudomonas aeruginosa*, which was one bacterial isolation by (5%), and with regard to *Ps. aeruginosa*, the result of our study did not correspond to what was found (21) who found in the results of their study that the bacteria *Ps. aeruginosa* had appeared in all their samples (25 samples) of water stored as drinking water in the hospitals from which the samples were taken (21). Table 4 shows the presence and number of bacteria in each area for water samples belonging to our study.

Table 4 Occurrence Rate of Various Bacteria in Household Water Tanks

Locality	Type of bacteria	*Number of positive water sample*	Colony count rate (CFU\100ml)
Ramadi	*Escherichia coli*	2	130

	Pseudomonas aeruginosa	**1**	**70**
	Staph. aurous	**0**	**-**
	Bacillus. sp.	**1**	**220**
Khaldiyia	*Escherichia coli*	**2**	**200**
	Pseudomonas aeruginosa	**0**	**-**
	Staph. aurous	**1**	**110**
	Bacillus sp.	**2**	**380**
Fallujah	*Escherichia coli*	**2**	**285**
	Pseudomonas aeruginosa	**0**	**-**
	Staph aurous	**1**	**110**
	Bacillus sp.	**1**	**280**
Qarma	*Escherichia coli*	**2**	**310**
	Pseudomonas aeruginosa	**0**	**-**
	Staph. aurous	1	**110**
	Bacillus sp.	2	**260**
	Total sample	20	

The bacterial contamination of drinking water is one of the most serious problems that lead to the spread of infectious diseases through water from the observation of Table (4) the researchers will determine the validity of water whether it is fit or unfit for drinking on the basis of the presence of bacteria, where it indicated the presence of different types of bacteria, including a group of forms coli bacteria in all sites from which drinking water samples were taken, as the rates of preparation of *E. coli* bacteria ranged between (310-130) cfu / ml for the four sites. The location of the Ramadi was the lowest in value, while the values of the numbers of *Bacillus sp*. bacteria were very high in Khalidiya (380 cfu/ml) and the lowest number in Ramadi (220cfu/ml) and the presence of *Staph. aureus* bacteria were also observed in the reservoir water with values of (110cfu / ml) in the samples that examined, while *Pseudomonas aeruginosa* bacteria were the least in their presence in the water as they recorded a rate of (70cfu / ml) in the site of Ramadi. The results of the analysis Differentiation showed that the number of positive samples for bacterial culture were 13 and by 65%, while the negative samples were 7, thus constituting 35% and in Figure 1 shows us graphical diagram of species and their percent.

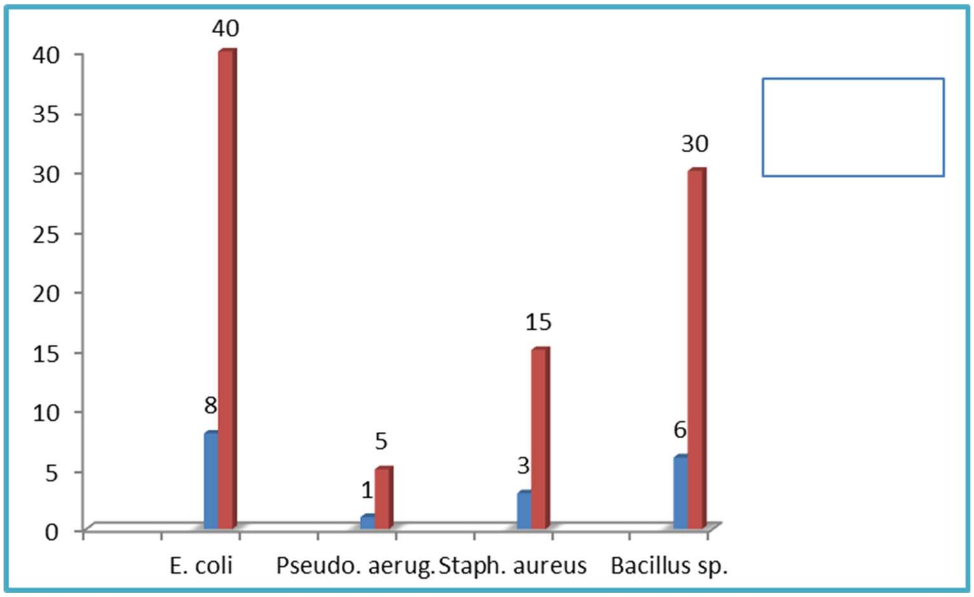

Figure (1) Graph of bacteria numbers and percentage

Escherichia coli recorded 40%, Bacillus sp. 30% and *Staph. aureus* recorded 15% while *Pseudomonas aeruginosa* was the lowest value of 5%.

The presence of *E.coli*, the most special indicator of faecal contamination from the group of coliform bacteria, as its source is faecal (22), as the presence of *E.coli* bacteria in the water of household reservoirs may be due to the availability of appropriate conditions for the growth and reproduction of bacteria in the case of the availability of nutrients, and a specific season is not determined by the increase in the number of coliform bacteria, but the numbers of increase and decrease are related to the medium in which they live and the abundance of nutrients suitable for their growth (23). The presence of coliform bacteria in drinking water indicates that the water is not treated properly, or that the operating system is of low quality or as a result of poor water quality (the supplied source of water) due to chemical and bacterial contamination with high temperature and heavy elements (24). The presence of high levels of organic matter and particles deposited at the bottom of the tanks contributed to the growth of bacteria more (25) in addition to the presence of weak concentrations of chlorine and the results obtained for bacteria in the water of the tanks may be due to resistance to the action of chlorine due to the occurrence of genetic mutations of bacteria enable them to resist the action of chlorine (26,27) and according to the standards set by the Environmental Protection Agency (EPA) 28). Most water samples are undrinkable under permissible standards for drinking water should not exceed one colony per 100ml of the form.

Table 5. Correlation between Total Plate Count and Total coliform count with turbidity and residual chlorine and PH parameters of the selected Household Water Tanks in Ramadi city

		Chlorine (mg\L)	Turbidity (NTU)*	PH	T.P.C cfu/100ml
Chlorine (mg\L)	Pearson Correlation	1	.276	.029	-.210
	Sig. (2-tailed)		.238	.903	.374
	N	20	20	20	20
Turbidity	Pearson	.276	1	.051	.210

(NTU)*	Correlation				
	Sig. (2-tailed)	.238		.830	.375
	N	20	20	20	20
PH	Pearson Correlation	.029	.051	1	.353
	Sig. (2-tailed)	.903	.830		.127
	N	20	20	20	20
MPN/ 100 ml	Pearson Correlation	-.210	.210	.353	1
	Sig. (2-tailed)	.374	.375	.127	
	N	20	20	20	20

Table 5 reviews the relationship between T.P.C and Total Coliform count with some chemical determinants of reservoir water such as turbidity, pH and residual free chlorine, where this table clearly indicates a significant positive relationship between turbidity and pH and between T.P.C Total coliform count, and the existence of a negative and inverse relationship between the remaining free chlorine and T.P.C and Total coliform count.

Sensitivity test results:

The results of the sensitivity test for bacteria isolated from the water of household tanks showed varying values in the sensitivity rates as shown in (Table 6), as *E. Coli* bacteria, which numbered (8) isolates gave the highest resistance to the antibiotic Ciprofloxacin, which amounted to (87.5%), while the percentage of resistance to other antibiotics varied until the lowest percentage was for the antibiotic (Imipenem), which had a resistance to these bacteria (12.5). The percentage of resistance to other antibiotics ranged (62.5%) for the antibiotic Amikacin and by (50% for the antibiotic Azithromycin) and by (37.5%) for each of the antibiotics *Trimethprim Sulphamethaxazole* and Tetracycline and (25%) for each of the antibiotics Amoxicillin, Cefixim and Ampicillin. The results of resistance to the antibiotic ciprofloxacin to *E. coli* bacteria showed a significant difference in proportions, as Adzitey *et al.* found that the resistance of *E. coli* bacteria isolated from household water was (17%) (Research 1 Adzitey), while Chidamba and Korsten found that the resistance of *E. coli* bacteria isolated from rainwater harvesting tanks was (4.6%) (29). the reason for this large difference in this antibiotic can be attributed to the possibility that these bacteria are pathogenic and therefore possess factors. Virulence helps them to resist ciprofloxacin antibiotics, and this is supported by the high percentage of resistance to *E.coli* bacteria isolated from pathological conditions such as urinary tract infection, in which one of the researchers found that the percentage of bacterial resistance to this antibody has reached 56.25%) (30).

(Table-6): Resistance percentage results of antibiotic susceptibility to bacterial isolates from house tank water.

Antibiotic	**Concentration of Antibiotic (µg)**	**Antibiotic code**	***E. coli* (Total N. = 8)**	***Ps. aeruginosa* (Total N. = 1)**	***Staph. aureus* (Total N. = 3)**	***Bacillus* sp. (Total N. = 6)**

Amoxicillin	10	AX	2 (25%)	1 (100%)	2 (66.7%)	3 (50%)
Amikacin	30	AK	5 (62,5%)	1 (100%)	2 (66.7%)	2 (33.3%)
Imipenem	10	IPM	1 (12.5%)	0 (0%)	1 (33.3%)	0 (0%)
Cefixim	30	CFM	2 (25%)	0 (0%)	3 (100%)	6 (100%)
Trimethprim Sulphamethaxazole	25	SXT	3 (37.5%)	1 (100%)	1(33.3%)	1 (16.7%)
Ciprofloxacin	5	CIP	7 (87.5%)	0 (0%)	3 (100%)	5 (83.3%)
Tetracylin	10	TE	3 (37.5%)	1 (100%)	0 (0%)	1 (16.7%)
Ampicillin	25	AM	2 (25%)	1 (100%)	0 (0%)	0 (0%)
Azithromycin	15	AZM	4 (50%)	1 (100%)	1 (33.3%)	2 (33.3%)
Chloramphenicol	30	C	2 (25%)	1 (100%)	1 (33.3%)	2 (33.3%)

For *Ps. aeruginosa*, which was only one isolate, it is found that they were resistant to seven types of antibiotics used in this study, recording the highest resistance of (70%), which is the highest percentage of all bacterial isolates isolated for this study as shown (Table 6) that *Ps. aeruginosa* bacteria were resistant to both antibiotics (Amoxicillin, Amikacin, Trimethoprim Sulphamethaxazole, Tetracycline, Ampicillin, Azithromycin, Chloramphenicol). This result is considered normal because these bacteria have the characteristic of multidrug resistance antibiotics (21). One researcher found that the isolates of the bacteria *Ps. Aeruginosa* resistant to all antibiotics used in his study (31).

As for *Staph aureus* bacteria, which was (3) isolates have shown the results of the resistance test for these bacteria that they are resistant by (100%) to each of the antibiotics (Cefixim, Ciprofloxacin) while their resistance to other antibiotics used in this study varied until their resistance was (0%) to each of the antibiotics (Tetracycline, Ampicillin) as shown in (Table 6) and somewhat this result coincided in terms of varying resistance to these bacteria when conducting an antibiotic resistance test and also the percentage of antibiotic resistance was among the antibiotics with high resistance against *Staph aureus* bacteria (32). The isolates of the bacterial genus *Bacillus sp*., which were (6) isolates have shown the results of the resistance examination that it is the resistance of these bacteria to it by (100%) to the antibiotic Cefixim, while the rates of resistance to antibiotics used in this study varied to reach resistance by (0%) for each of the antibiotics (Imipenem, Ampicillin) as shown (Table 6). One researcher explained that these bacteria are often discovered in drinking water even with treatment and disinfection procedures for treatment water, as it is possible that the species of this genus have the ability to produce enzymes that help them to have multiple antibiotic resistance patterns (33).

Conclusion:

It was found that *E coli* bacteria are the most bacterial species that cause bacterial contamination in potable water in tanks, which gives an indication of the presence of leakage of sewage networks that interfere with potable water pipe networks, as it was found that all water tanks in the study areas have not been cleaned and sterilized throughout the periods of their use as a water tank, despite their use as a water tank, despite their use for many years, The antibiotic resistance characteristic of a number of bacterial isolates appeared in this study, which gives an indication of the possibility of infecting drinking water users from household water tanks with some different diseases.

Recommendation:

1. The need to follow-up, clean and sterilize drinking water tanks in homes within specific periods of time.
2. The need for follow-up by health institutions water tanks and continuously.
3. Conducting continuous bacteriological and chemical tests to confirm the safety of water tanks used for drinking water.
4. If any symptoms of infection with a bacterial species appear within a particular area, it is necessary to healthy evaluation of drinking water tanks for homes located within that area.

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