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Possibility of Using Types of Filamentous Fungi in The Treatment of Domestic Wastewater and Evaluating Its Efficiency

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ABSTRACT

The current study was conducted to show the extent to which filamentous fungi can be used as a step in the biological treatment stage of Domestic wastewater and to evaluate its efficiency in removing and reducing pollutants in this water and improving its quality. Three types of filamentous fungi Penicillium, Aspergillus flavus, Aspergillus terrus were used for the purpose of using them in biological treatment , the study included conducting some physical and chemical tests for domestic wastewater before and after treatment, as the results of the study showed the ability of Penicillium mushrooms to reduce the electrical conductivity value of water after treatment to 950 micro siemens/cm, with a percentage of 8% and the value of nitrite to 0.91 mg/liter with percentage of 93%, and the value of phosphate to 0.014 mg/liter, with percentage of 98%. While the fungus Aspergillus terrus showed the ability to reduce the conductivity value to 990 µs/cm, with percentage of 5%, nitrite value to 0.039 mg/l with a percentage of 97%, and the value of phosphate to 0.005 mg/l, with percentage of 99%. The study also showed the ability of the fungus Aspergillus flavus to reduce the value of electrical conductivity to 1014 µS/cm with a Apercentage of 2%, while the mushroom showed the ability to reduce the value of nitrite.030 mg/liter with Apercentage of 98%, and the value of phosphate in treated water to 0.005 mg/liter with a percentageof 99%.

Keywords- filamentous fungi, wastewater, domestic wastewater.

I. INTRODUCTION

The problem of sewage water is one of the most influential problems in public health because it's the result of wastewater of homes and commercial establishments in the city within the sewage networks, these sources are presented to the aquatic environment in the form of fully or partially treated water, or sometimes untreated, and they constitute 28% of the sources of water pollution (1)

Untreated domestic wastewater contains abundant amounts of organic matter, which causes water pollution, and is produced mainly from sewage waste, plant leaves, and surface runoff loaded with animal waste, And that the bacteria and natural primitives present in the water work on the decomposition of organic matter, and during this process, the dissolved oxygen in the water is consumed, which affects the life of aquatic organisms that cannot live in water when the dissolved oxygen in water is less than 4 mg / liter This leads to the death of fish in huge numbers and affects food security, in addition to the fact that sewage water contains an abundance of pathogenic organisms that cause many diseases such as: typhoid and others (2) .

Domestic waste water has an effective impact on the aquatic environment as a result of the waste it contains, which causes a clear change in the natural characteristics of the aquatic environment, and accordingly it will affect plant and animal life, and then on human life, The pollution resulting from domestic sewage water causes a lot of concern, and accordingly it has become a focus of interest in all modern research fields (3). The release of untreated domestic sewage into rivers is one of the traditional phenomena known in many countries of the world, and accordingly it causes common problems in surface water and groundwater alike, and Iraq is one of the countries that release domestic sewage directly into the rivers. Before being treated for the lack of water stations Due to its importance in treating pollution using fungi, the term treatment of pollutants was used using mycoremediation fungi, which are a form of biotherapy (4).

The fungi are also suitable for the biological absorption of minerals and the biological treatment of pollutants from industrial waste water and polluted soil, because of their characteristics that enable them to grow in highly polluted environments that are very poor in nutrients. The fungi show remarkable tolerance to metallic pollutants and different pH values. One of the most important features of fungi as effective agents in biological treatment (5).

The growth of the thread of the fungus enables it to penetrate the base material widely to be in greater contact with the pollutants, Fungi grow on insoluble materials and analyze them by secreting extracellular enzymes that also enable them to withstand high concentrations of a wide range of pollutants, Filamentous fungi play an important role in the field of water treatment, as they are found naturally in water sediments and on water bodies (1). Microscopic filamentous organisms are present in the stages of wastewater treatment through several roles they play in those stages, as they play different roles in the processes

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of digestion and decomposition of organic matter through their presence in wastewater containing high concentrations of organic waste, as it works to dismantle these materials into Simpler components that facilitate the process of exploitation by other organisms. These organisms include bacteria, fungi, algae, protozoa, and others (2) Filamentous fungi can be used to treat a variety of wastewater, ranging from treating easily degradable wastewater to highly contaminated wastewater and with the help of fungi, the water can be purified and the fungi exploited in it.

Filamentous fungi are found naturally in sediments, soils, and water, and they play a vital role in the decomposition of hydrocarbons. Fungi found in environments contaminated with aromatic hydrocarbons have a major role in the process of converting them into metabolites less toxic than the original compounds. Thus, they play an important role in purifying the environment from these pollutants and others. The decomposition and adsorption of organochlorine compounds and remained Organic compounds by live and dead fungal cells and activated sludge. Studies have proven the importance of fungi in decomposing organic matter (6).

The research aims to study the possibility of some types of filamentous fungi to remove pollutants present in domestic waste water. The research also aims to identify the efficiency of these types in treating pollutants by estimating the percentages of removal.

II. MATERIALS AND METHODS

The first step: the method of purification of fungi:

Isolates of filamentous fungi were purified by taking samples from ancient fungal cultures for each from (Penicillium, Aspergillus terreus, Aspergillus flavus) by scraping using loop and transferred to Petri dishes containing PDA medium and anti-Tetracycline to prevent bacterial growth in the medium and then incubated in the incubator at a temperature of 21°C for 7 days. Then a specific size of the fungus was weighed 50mg.

The second step: the processing process

Waste water was placed in three 500ml glass bottles and sterilized to kill all the organisms in it, then 10 mg of fungi were added to each one separately.
(Penicillium, Aspergillus terreus, Aspergillus flavus)
Then the bottles were incubated at a temperature of 21 degrees Celsius for 15 days, then tests were conducted on them before and after the fungi were placed. These tests include:

Physical Examinations

Electrical conductivity

The transmissibility of water was recorded using an apparatus (EC CONSORT C830 multi-parameter analyzer made in Belgium)

-Measurement of Total Dissolved Salts (TDS)
Total dissolved salts were measured using a device according to the method (7)

-Measurement of total suspended solids (TSS)
The total suspended solids were measured according to the method (7).

Chemical Examinations

-pH measurement
The pH was measured using a pH-meter for water after calibrating the device with buffer solutions with a pH (4,7,9).

-**Total hardness**
Lind's method (8) was used to measure the total hardness

-**Calcium Harness Ca**
Calcium hardness was determined according to what was mentioned in (7).

-**Magnesium Hardness M**
Magnesium hardness was recorded by an arithmetic method, according to what was mentioned in (7).

- Chloride Cl- ion measurement
The chloride ion was measured according to the method described in APHA (10).

Measurement of Reactive Silica SiO2
followed the method mentioned in (11).

- Reactive Nitrite NO2-
Nitrite was measured using the Shin method applied by Bendshneider and Robinson and published by Strickland and Parsons (12) to measure nitrite.

Measurement of Reactive Phosphate PO4-
Effective phosphite was measured using the Murphy and Riley method published by Strickland and Parsons (12).

III. RESULTS AND DISCUSSION

The results of the current study show in Tables (1,2,3) the use of the fungi Penicillium, Aspergillus flavus, Aspergillus terrus in biological treatment for a period of ten days, where the Penicillium fungus showed a decrease in the value of electrical conductivity in the domestic waste water after treatment, as its value reached 950 µs/cm with a percentage of A decrease of 8%, while Aspergillus terrus showed a conductivity value of 990 µSm/cm. with a percentage of by 5%. While the fungus Aspergillus flavus showed a decrease in the conductivity value of 1014 µs/cm, with a percentage of by 2%. This decrease in the value of electrical conductivity may be attributed to the ability of the fungus to consume the ions and the nutritional salts found in the waste water as nutrients to it (13).

The results also showed a significant decrease in the pH value after treatment with the Penicillium fungus, which amounted to 6.12 with a percentage of 25% decrease, while the pH in the waste water using the fungus Aspergillus terrus decreased to 7.44 with a percentage of 9%, while the Aspergillus flavus recorded a decrease in the value of the The pH in the waste water after treatment was 6, with a percentage of 26%, and the reason for the decrease was attributed to the increase in the concentration of carbon dioxide in the waste water,

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which resulted from an increase in the decomposition of organic matter and thus a decrease in pH (14).

The results also showed the ability of the Penicillium fungus to reduce the value of the total hardness of waste water during the treatment period, as its value decreased to 78 mg / liter, a decrease of 43%, and the fungus Aspergillus terrus to 70 mg / liter, or 42%, While the fungus Aspergillus flavus recorded a decrease in the pH value of 70 mg / liter, or. 42%. The decrease in the value of the total hardness is attributed to the increase in the number of fungi during the treatment period, and consequently the increase in the precipitation of calcium carbonate, which results in a decrease in the value of the total hardness (15).

As for calcium and magnesium hardness, the Penicillium fungus contributed to a decrease in calcium and magnesium in waste water to 64 and 14 mg/liter, at percentage that reached 24% and 62%, respectively. And Aspergillus terrus 84 and 36 mg/L, or 40% and 44%, while Aspergillus flavus showed a decrease in the values of calcium and magnesium, 52, 16 mg/L, or 38%, 56%, respectively, as they are essential nutrients for fungi. Its overgrowth causes an increase in calcium and magnesium consumption and thus a decrease in calcium and magnesium hardness (16).

The results also showed the ability of the Penicillium fungus to decrease the value of total dissolved solids (TDS) after treatment to 0.4 mg/l with percentage of 91%, while Aspergillus terrus and Aspergillus flavus showed a decrease in the value of total dissolved solids to 0.6 mg/l with percentage of 73% This decrease in the value of total soluble solids is attributed to the fungi feeding on soluble organic matter.

The results also showed the ability of Penicillium and Aspergillus terrus to reduce the values of total suspended solids to 0.2 mg/liter by 93%, while Aspergillus flavus showed a decrease in the value of TSS to 0.6 mg/liter, or 79%, and this decrease in the value of (TSS) leads to fungi feeding on a lot of suspended organic matter or sedimentation due to its agglomeration and increasing its size. While the results showed the ability of the fungus Aspergillus flavus to reduce the value of chloride to 44 mg / liter, with percentage of 4%.

As for nutrients, the results showed the ability of fungi to reduce nutrients from waste water and use them in the process of nutrition and growth. It was also noted that the efficiency of Penicillium fungus in removing nutrients increases with the increase in acidity. The value of nitrite decreased after treatment to 0.091 mg/l, with percentage of 93%, while Aspergillus terrus showed a decrease in nitrite value of 0.039 mg/l, with percentage 97%, while Aspergillus flavus recorded a decrease in nitrite value of 0.030 mg/l with percentage of 98%.

The results also showed the ability of the Penicillium fungus to reduce the value of phosphate to 0.014 mg/l, with percentage of 98%, while the Aspergillus terrus and Aspergillus flavus showed a decrease in the phosphate value of 0.005 mg/l, with a percentage of 99%. The results also showed the ability of Penicillium to decrease the value of silica to 0.472 mg/L with percentage 33%, while Aspergillus terrus showed a decrease of 0.552 mg/L, with percentage of 23%, While the value of the decrease in silica using Aspergillus flavus was 0.454 mg / liter, with percentage 36%. The results of the study showed the effectiveness of the studied fungi in removing and reducing pollutants present in waste water and improving its quality by a high rate.

Table 1: Efficiency of Penicillium in treating domestic waste water.

percentage	**Measured factors**	**before treatment**	**After treatment with a fungus Penicillium**	**percentage**
1	electrical conductivity	1037	950	8%
2	pH	8.15	6.12	25%
3	total hardship	120	78	43%
4	Calcium hardness	84	64	24%
5	Magnesium insufficiency	36	14	62%
6	TDS	2.2	0.4	91%
7	TSS	2.8	0.2	93%
8	chloride	46	46	0%
9	nitrite	1.396	0.091	93%
10	phosphate	0.712	0.014	%98
11	silica	0.716	0.472	33%

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Table 2: Efficiency of Aspergillus terrus in treating Domestic waste water.

percentage	**Measured factors**	**before treatment**	**After treatment with Aspergillus terrus**	**percentage**
1	electrical conductivity	1037	990	5%
2	pH	8.15	7.43	9%
3	total hardship	120	70	42%
4	Calcium hardness	84	50	40
5	Magnesium insufficiency	36	20	44%
6	TDS	2.2	0.6	73%
7	TSS	2.8	0.2	93%
8	chloride	46	46	0%
9	nitrite	1.396	0.039	97%
10	phosphate	0.712	0.005	99%
11	silica	0.716	0.552	23%

Table 3: Efficiency of Aspergillus flavus in treating Domestic waste water

percentage	**Measured factors**	**before treatment**	**After treatment Aspergillus flavus**	**percentage**
1	electrical conductivity	1037	1014	2%
2	pH	8.15	6	26%
3	total hardship	120	70	42%
4	Calcium hardness	84	52	38%
5	Magnesium insufficiency	36	16	56%
6	TDS	2.2	0.6	73
7	TSS	2.8	0.6	79%
8	chloride	46	44	%4
9	nitrite	1.396	0.030	98%
10	phosphate	0.712	0.005	99%
11	silica	0.716	0.454	%36

REFERENCES

[1] APEGBC (Association of Professional Engineers and Geoscientists British Columbia). (2013). Professional Practice Guidelines Onsite Sewerage Systems. British Columbia. Version 1.2.

[2] Schuler, A., Jassly, Y.D.:(2007) Filament content threshold for activated sludge bulking: artefact or reality ? Water Res. 41, 4349-4356 .

[3] Amaike, Saori; Nancy P. Keller (2011). "Aspergillus flavus". Annual Review of Phytopathology. 49: 107–133 .

[4] Hedayati, M.T.; A.C. Pasqualotto; P.A. Warn; P. Bowyer; D.W. Denning (2007). "Aspergillus flavus: human pathogen, allergen, and mycotoxin producter". Microbiology. 153 (6): 1677–1692.

[5] Arabatzis M, Velegraki A (2013). "Sexual reproduction in the opportunistic human pathogen Aspergillus terreus". Mycologia. 105 (1): 71–9-

[6] Lopez, J.L; Perez J.L.; Sevilla J.M.; Fernandez FG.; Grima E.; Chisti Y (2003). "Production of lovastatin by Aspergillus terreus: effects of the C:N ratio and the principal nutrients on growth and metabolite production" . Enzyme and Microbial Technology. 33 (2–3): 270–277.

[7] APHA(American Public Health Association) (1999) . Standard Methods for the Examination of Water and wastewater, 20th Edition A.P.H.A.1015 Fifteen Street,N.W.,Washington DC.USA.

[8] Lind, O.T.(1979). Hand Book of Common methods in Limnology .C.V.Mos. by Co.,St.Louis:199p.

[9] APHA(American Public Health Association) (1995) . Standard Methods for the Examination of Water and wastewater, 20th Edition A.P.H.A.1015 Fifteen Street,N.W.,Washington DC.USA.

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Volume-9, Issue-3 (May 2022)

[10] M(American Society for Testing and Materials).(1984).Annual Book of ASTM Standards. Water and Environmental Technology. Section 11. Volume 11.01 water (1). 750p.
[11] Strickland, J. D. H. & Parsons, T. R. second edition (1972). A practical hand book of seawater analysis-Ottawa, Fisheries Research Board of Canada .310p.
[12] American Public Health Association (A.P.H.A.) (2003). Standard Methods for the Examination of water and wastewater, (20th ed).A.P.H.A.1015 fifteenth Street , NW. Washington. DC, USA.
[13] Al-Emara, Faris Jassim Muhammad; Al-Saad, Hamed Talib and Khalaf, Talib Abbas (2008) some
[14] Chemical and physical properties and nutritional salts in the waters of the coast of Mocha / Yemen and their comparison with the Arabian Gulf. Basra Research Journal 34 (1): 16-27
[15] Alhattab, M. (2014). Production of Oil from Freshwater and Marin water microalgae for biodiesel production. Master of Applied Science. Dalhousie University , Halifax, Nova Scotia. Canada.
[16] Al-Azzawi, Atheer Sayeb Naji (2006) Study of some environmental factors polluting the water of Shatt Al-Hilla River in Babil Governorate / Iraq. Al-Qadisiyah Journal, 13(3): 1-9.

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