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A study of dairy effluent by using phycoremediation treatment

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Abstract: As a result of its efficacy and extensive application, there are a range of biological therapeutic approaches available today. The vast majority of dairy waste is biodegradable, has an unpleasant odour, and contains a substantial quantity of oil. The contamination of water by untreated dairy waste led to the spread of several diseases among humans and animals. Because of this, it is probable that the majority of currently functioning dairies utilise activated sludge-based treatment facilities. The nutritional content of dairy effluent cannot be eliminated using this method of treatment. Dairy effluent has sufficient nutrients for biological growth, and biological treatment approaches are believed to be more successful and economical. The processing of milk and other dairy products generates foul-smelling effluent due to the presence of a substantial amount of organic materials. This wastewater also contains a notable quantity of COD and BOD. The growth in human population has resulted in a rise in the amount of water contamination. Concerns over the diverse types and amounts of garbage that are created and deposited into natural water sources have led to the implementation of new regional water quality regulations.

Keywords: Phycoremediation, Treatment Facilities, Dairy Effluent, Diseases

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INTRODUCTION

Water is one of nature's most priceless and valuable resources. It is sometimes referred to as the world's blood due to the fact that without it, life on Earth and human civilization would be unable to advance. One of the most devastating ecological disasters in human history has arisen as a direct result of pollution and the poisoned environment it has created. With more people living in more places, there is more water contamination. New regional guidelines addressing water quality have been enacted due to worries about the various types of waste and the quantities of trash that are created and deposited into natural water sources.

Wastewater from the processing of milk and other dairy products often has a strong odour because it includes a high concentration of organic materials. Both chemical oxygen demand (COD) and biological oxygen demand (BOD) are present in high concentrations in this effluent. The gas emissions, worsening of taste and odour, improvement of turbidity and colour, and encouragement of eutrophication are all caused by the presence of trace organics, solids suspended in water, and soluble organics. However, nitrogen may also be found in organic nitrogen sources like urea and nucleic acids in dairy effluent, even though milk protein is the predominant source of nitrogen in this type of waste. Polyactive phosphorus and orthoactive phosphorus (po3-4) make up the vast bulk of inorganic phosphorus (po3 -4). (p2o4). Dairy effluent also contains significant quantities of elements including sodium, chloride, potassium, calcium, magnesium, copper, cobalt, and nickel. [1]

Discharging dairy effluent may be harmful to the environment and groundwater, and it also poses a threat to human health and hygiene. Dairy effluent is mostly organic because it consists of biodegradable materials. These effluents are suitable for microalgal growth due to the high concentration of nutrients. Microalgae culture in wastewater treatment provides a cutting-edge answer to tertiary wastewater treatment in addition to the production of potentially valuable biomass that can be used for a variety of purposes, including but not limited to biogas and biofuels production, composting, animal feed, aquaculture, and the production of chemicals. [2]

Phycoremediation

It is possible to classify phytoremediation as one of the least expensive methods of pollution removal. Heavy metal bioremediation has various restrictions, such the metals being taken up by the algae and sinking to the bottom. In shallow water systems, this might be dangerous since the metal will still impact the species that consume the algae (s). For this reason, it can only be used in systems with very deep water. The water contamination is a threat not just to aquatic life, but also to humans. If the polluted water seeps into the ground, people may be exposed to it in the future. Most water filtration methods are insufficient when it comes to getting rid of metals in polluted water.

More research into the underlying mechanisms is necessary before affordable growth medium or byproducts from other industries may be used in development. Which algae are most effective in removing heavy metals may be determined by five factors: [3]

- Rate of growth with algae
- Concentration of metal in the algae
- Concentration of heavy metals in the medium
- Metal removal from medium in required percentage
- Metal recovery in relation to cost.

DAIRY WASTEWATER CHARACTERISTICS

The wastewater generated throughout the many stages of the dairy processing, handling, and packaging sector is very variable in both quality and quantity. Dairy effluent has high concentrations of organic compounds such proteins, carbohydrates, and lipids. Not only do they have fluctuating pH levels, but they also include a large number of suspended particles, biochemical oxygen demand, chemical oxygen demand, nutrients, fat, oil, and grease. In response to expanding demand for dairy products, manufacturers have increased their water usage, which has led to an increase in waste water production. Wastewater must be categorised so that the most appropriate treatment may be selected. Dairy effluent characteristics have been the topic of several literary works.

Water sustainability in India will be heavily influenced by the growing demands of the dairy industry. India's dairy industry generates double the amount of effluent per unit of processed milk produced compared to other countries. [4]

i. Conventional Treatment Technologies

The dairy sector in India is a major contributor to the country's wastewater problem, among many others. Sludge is also produced in large quantities because to the biological treatment they use. There are more organic substances, odours, BOD, COD, nitrogen, and phosphorus in industrial wastewater. Here, we take a look at what's written about the history of conventional methods for cleaning effluent from the dairy industries.

the process of producing biogas from the anaerobic digestion of dairy industry effluent. Dairy effluent would benefit most from biological treatment, however other physical, chemical, and biological approaches were also considered. Anaerobic treatment efficiency was shown to be sensitive to environmental conditions within the reactor, such as temperature, pH, organic loading rate, sludge retention time, hydraulic retention time, upflow velocity, and size distribution. Anaerobic treatment has potential for efficient biogas production. [5]

ii. Advanced Treatment Technologies

To protect the receiving water from dairy effluent and to promote the reuse of treated wastewater, the conventional treatment procedures, such as primary and secondary treatment, are rarely employed. Environmental legislation and regulation has tightened to help accomplish our goals of reduced pollution.

The best course of action, then, is to go for state-of-the-art treatments. Here we take a look at some of the most cutting-edge therapeutics now available.

The Moving Bed Biofilm Reactor is an example of an innovative wastewater treatment system. As an effort to reduce nutrient runoff from land-based sources into the North Sea, engineers in Norway developed plastic-carrier moving bed reactors in the 1980s. Soon after, a patent was filed for the biofilm-based mobile bed, and the technology was made commercially available. [6]

Pollution effects of Dairy wastes

Since dairy wastes are rich in all the ingredients bacteria need to develop, and since the temperatures found in much of India are conducive to bacterial growth, this promotes the degradation of pollutants in anaerobic circumstances, which is then followed by a foul odour. Besides the potential for strontium-90, a beta-emitting radioisotope that damages bone, to be present in dairy wastes, there is also a possibility that TB, an illness of cows, might be transmitted to humans through milk. Strong unpleasant odours are produced when dairy effluents are disposed of untreated because they breakdown quickly and deplete the dissolved oxygen of receiving streams. Since disorganised dairy units are not serious about handling the effluents from their units, which in one way or another cause contamination of water and soil, all legislative authorities need to address the effect of effluent created from a dairy/malt based food business. [7]

NATURAL STRAIN SELECTION

Microalgae that reproduce at a slow rate are challenging to keep alive in continuous systems because they are easily contaminated by microalgae that reproduce at a faster rate but are smaller. When using slow-growing microalgae, it is best to work with closed photo bioreactors since they provide superior species control and allow for more precise cultivation of the algae. In microalgal-bacterial systems, the removal rate of hazardous pollutants is often limited by the activity and sensitivity of the microalgae. For this reason, it is essential to choose microalgae that develop quickly and are highly resistant to the harmful pollutants. Chlorella species are another type of microalgae that are regarded as having high levels of resistance. [8]

Utilization of strains with unique properties

It has been shown that the efficiency of nutrient removal may be improved by using microalgae strains with certain features. The capacity to tolerate extreme heat or cold, a chemical makeup that favours high-value goods, rapid sedimentation behaviour, or enhanced nutrient removal are all examples of such distinctive features. Phormidium bohneri was an attractive candidate for high-temperature (about 30 C) wastewater treatment since it demonstrated rapid sedimentation behaviour. Spirulina is one of the most often used microalgae in wastewater treatment (Arthospira). Some of the varieties can even thrive in both autotrophic and heterotrophic settings. More and more microalgae have been used in recent decades to treat eutrophic or contaminated water by chelating metals and removing nutrients. [9]

MICROALGAE-BASED WASTEWATER TREATMENT PROCESS

Oxygen provision is a time-consuming, labor-intensive procedure that is both costly and labor-intensive. The solution is the cultivation of microalgae in wastewater treatment ponds and tanks, which helps to counteract these issues. The microalgae's photosynthetic activity results in the release of O2, guaranteeing a steady supply of oxygen for the biodegradation process. [10]

Microalgae-Based Treatment System - Design and Construction

When designing a microalgae-based wastewater treatment system, it's important to give equal consideration to both wastewater treatment and microalgae production. Cell retention period, nutrient input rate, water depth, and mixing intensity are common considerations for microalgae growth. Considerations for biological oxygen demand (BOD) reduction, total dissolved solids (TDS) reduction, pH, nitrogen removal rate, and phosphorus removal rate are commonplace in wastewater treatment. That's why it's important to design the system such that microalgae growth and wastewater treatment can both take place. [11]

Waste Stabilization Pond Systems

i. Microalgae role in WSPs

The wastewater in Waste Stabilization Ponds (WSPs) is treated "green" by the development of mutualistic microalgae and heterotrophic bacteria. In the process of photosynthesis, microalgae produce oxygen from water. The bacteria use this oxygen as fuel to bio-oxidize the organic matter in the wastewater in an aerobic fashion. Microalgae convert carbon dioxide produced by bio-oxidation into cellular carbon through photosynthesis.

ii. Microalgae role in HRAP

In the HRAP, microalgae reactors are joined with expanded oxidation ponds. HRAP's shallow, paddle wheel-mixed open raceway pond sand provides superior wastewater treatment compared to conventional oxidation ponds. High rates of microalgal photosynthesis, which generates abundant oxygen, are largely responsible for the quick aerobic treatment of wastewater and the uptake of its nutrients into microalgal biomass.

iii. Microalgae harvesting from HRAP

It has been estimated that microalgae in an open sewage pond may produce up to 300 mg of dry weight of biomass per litre of water. Since the removal of nutrients and BOD from wastewater is impossible without harvesting microalgae, this process is crucial for wastewater treatment. This, however, is not easy to accomplish, and the extra work required raises the total cost of cultivation. The harvesting effect can be achieved using filtration and centrifugation, but these methods can be time-consuming and costly. Some studies suggest that alternatives to chemical flocculation using immobilised systems, such as biological filtration or the polysaccharide chitosan, would be preferable. [12]

Sustainability of microalgae based wastewater treatment

Three different wastewater treatment methods were evaluated by Scandinavian researchers, and two different frameworks were compared for their leanness toward a sustainable system. The terms "energy analysis" and "socio-ecological principles" are used to describe the guiding concepts of these frameworks. The position of a given resource in the energy hierarchy is meant to reflect its relative importance to the whole system. Energy analysis ranks all biosphere resources in this way.

Comparing costs, renewable vs. nonrenewable energy sources used, environmental load, and energy production, they conclude that the microalgae-based therapy violates the socio-ecological principles to a lesser level than the other treatment methods. The price was prohibitive compared to available substitute treatments. They note that the process may become more economically viable if the microalgae biomass could be put to other uses. They advocate for keeping in mind the value of byproducts like methane and beneficial biochemicals. The benefits of microalgae biomass as a source of biofuel and animal feed are apparently lost on them. [13]

Pollution effects of distillery industries

The distillery sector is one of the most polluting since it releases 12-15 times as much alcohol into the environment through its effluent as it really generates. This is the primary sector that generates liquid wastewater. Most of the world's 2,95 distilleries are located in India, where they generate an annual total of 3.20 billion litres of alcohol and 45 billion litres of effluent. It is one of the strongest and most difficult organic industrial effluents due to its extremely high BOD and COD values.

Industrial effluent from a wide variety of distilleries is a major cause of environmental degradation. The effluent discharge is the primary source of severe organic and inorganic contamination in both aquatic and terrestrial ecosystems. The physicochemical characteristics, vegetation, and fauna of aquatic bodies are also altered by the effluents. It is important to understand the connection between toxicity and soil contamination in order to develop reliable environmental restoration indicators for bioremediation. [14]

METHODOLOGY

Due to its low COD:BOD ratio, biological treatment has the most promise for dairy wastewater. The wastewater is rich in nutrients that bacteria may use. It has been standard practise in the chemical processing industries to treat wastewater using bacteria and other microorganisms that may assimilate toxic substances (CPI). As a result of the success and broad use of biological therapy, there is a wide range of treatment options available. Most dairy waste is biodegradable, but it has an unpleasant odour and contains a lot of oil. The contamination of water sources by untreated dairy manure contributed to the spread of several diseases among both people and animals. Because of this, activated sludge treatment facilities are the norm for operational dairies today. This kind of treatment is ineffective at removing the nutrients included in dairy effluent. Due to the high nutritional content, biological treatment methods are used for dairy effluent.

RESULT

Microflora in the Dairy effluent

Dairy effluent was collected from the plant's grounds, and its microbial load was studied. In addition to the microalgae, bacteria is also present. The following microalgae were found in the waste water: Sewage contains a wide variety of bacteria, including Chroococcus turgidus, Spirulina platensis, Oscillatoria animalis, Stigonema turfaceum, Scytonema multiramosum, Closterium ehrenbergii, Chlorella vulgaris, Scenedesmus bijuguadus, Pithophora polymorpha, Navicula ambigua, and coliforms and Streptocci sp.

Table 1: dairy wastewater Treatment involves the use of cyanobacteria.

Order	Species	Family	Nature of form

Chroococcales	*Chroococcus turgidus* (Kutz) Nag.	Chroococcaceae	Coccoid forms
Chamaesiphonales	*Chroococcidiopsis indica* Desikachary.	Cyanidiaceae	Coccoid forms
Nostocales	*Spirulina platensis* (Nordst.) Gomont.	Oscillatoriaceae	Non-heterocystous
	Oscillatoria animalis Ag.ex Gomont.		Non-heterocystous
	Phormidium ambiguum Gomont.		Non-heterocystous
	Cylindrospermum licheniforme Kutz ex Born. et Flah.	Nostocaceae	Heterocystous
	Nostoc muscorum Ag. ex Born. et Flah.		Heterocystous
	Anabaena variabilis Kutzing ex Born.et Flah.		Heterocystous
	Aulosira laxa Kirchner ex Born.et Flah.		Heterocystous
	Scytonema multiramosum Gardner.	Scytonemataceae	Heterocystous
	Tolypothrix distorta Kutzing ex Born. et Flah.		Heterocystous
	Calothrix membranacea Schmidle.	Microchaetaceae	Heterocystous

Stigonematales	*Hapalosiphon welwitschii* W.et G.S. West.	Stigonemataceae	Heterocystous
	Fischerella ambigue Nag.Gom.		Heterocystous
	Stigonema turfaceum (Berk.) Cooke ex Born. et Flah.		Heterocystous

Selection of Cyanobacteria for phycoremediation of Dairy effluent

Microalgal "green-cell" factories solve many problems at once, which is impossible with chemical methods. Given that microalgae are naturally occurring living organisms, phycoremediation is also a naturally occurring phenomena. Phycoremediation makes use of naturally occurring microalgae that are actively degrading pollutants in the environment. Instead of using many treatments or stages to address issues like balancing pH, getting rid of sludge, lowering TDS, removing BOD and COD, etc., phycoremediation can do all of this at once. We are in constant touch with them, yet we have never had any negative impacts. By cleaning up polluted areas with plants, called phycoremediation, the ecosystem is returned to near-original state. Therefore, cyanobacteria was chosen for the treatment of dairy wastewater in the current investigation.

The clearance rate of dangerous contaminants in an algal-bacterial system is often constrained by the activity and sensitivity of cyanobacteria. In the current investigation, the dairy effluent was infected with both isolated freshwater cyanobacteria species and a consortium of algae.

Table 2: Physico-chemical parameters of Dairy effluent with Tolypothrix distorta and Aulosira laxa in untreated and treated

Parameters	**Before reatment (Control)**	***Tolypothrix distorta***		***Aulosira laxa***	
		After treatment	**Removal Efficiency (%)**	**After treatment**	**Removal Efficiency (%)**
Appearance	Milky and Grayish black	Green	-	Green	-
Odour	Offensive smell	Algal smell	-	Algal smell	-

Turbidity	154.91 ± 3.58	16.83 ± 1.728	-89.13	15.53 ± 0.28	-89.97
TSS	159.95 ± 1.29	100.66 ± 5.78	-37.06	112.5 ± 1.87	-29.66
TDS	1027.16 ± 6.43	116.66 ± 14.02	-88.64	430 ± 3.09	-58.13
Total solids	1305.50 ± 3.44	237.33 ± 255.57	-81.82	929.33 ± 3.82	-28.81
EC	1579.16 ± 3.86	933 ± 2.36	-40.91	1047.5 ± 1.87	-33.66
pH	5.15 ± 0.08	8.81 ± 0.05	+71.06	8.65 ± 0.08	+67.96
Alkalinity	551.66 ± 13.01	106.16 ± 2.1	-80.75	166.83 ± 4.99	-69.75
Total hardness	790 ± 9.35	250.33 ± 33.11	-68.31	180 ± 2.82	-77.21
Calcium	140.33 ± 2.58	52.16 ± 33.11	-62.83	42.33 ± 2.58	-69.83
Magnesium	80.16 ± 2.85	23 ± 2.09	-71.30	20.66 ± 6.34	-74.22
Sodium	130.83 ± 3.06	150 ± 4.89	-14.65	103 ± 4.73	-21.27
Potassium	29.5 ± 2.16	30.83 ± 2.48	+04.50	18.66 ± 2.16	-36.74
Iron	9.91 ± 0.31	0.32 ± 0.02	-96.77	0.28 ± 0.04	-97.17
Free ammonia	23.51 ± 0.75	1.38 ± 0.05	-94.13	1.19 ± 1.08	-94.93
Nitrite	0.14 ± 0.01	0.25 ± 0.03	+78.57	0.22 ± 0.02	-57.14
Nitrate	8.66 ± 1.75	10.83 ± 2.48	+25.05	7.24 ± 0.73	-16.39
Chloride	231.33 ± 2.16	93.33 ± 3.55	-59.65	84.66 ± 3.50	-63.40
Fluoride	0.12 ± 0.01	0.01 ± 0.008	-91.66	0.00 ± 0.00	-100.00
Sulphate	71.83 ± 2.48	38.66 ± 3.55	-46.17	36.5 ± 4.37	-49.18
Phosphate	12.16 ± 0.71	0.78 ± 0.02	-93.58	0.91 ± 0.01	-92.51

Silica	6.61 ± 0.10	10.65 ± 15.84	-61.11	5.38 ± 0.04	-18.60
COD	370.33 ± 4.58	100.83 ± 2.92	-72.77	115.33 ± 8.04	-68.85
BOD	120.5 ± 1.87	33.83 ± 3.43	-71.88	36.66 ± 5.16	-69.57
Oil and Grease	0.17 ± 0.40	0.001 ± 0.0002	-99.41	0.002 ± 0.003	-98.82

Chemical Examination is expressed in mg/l. Electrical conductivity as µS/cm, Turbidity as NTU.

Values expressed as mean ± SD

Table 3: Physico-chemical parameters of Dairy effluent with Aulosira laxa and Tolypothrix distorta in untreated and treated

Parameters	Before treatment (control)	*Tolypothrix distorta*		*Aulosira laxa*	
		After treatment	**Removal efficiency (%)**	**After treatment**	**Removal efficiency (%)**
Appearance	Milky and grayish black	Green	-	Green	-
Odour	Offensive smell	Algal smell	-	Algal smell	-
Turbidity	154.91 ± 3.58	44.45 ± 0.36	-71.30	15.48 ± 0.33	-90.00
TSS	159.95 ± 1.29	80.66 ± 4.54	-49.57	75.5 ± 1.87	-52.79
TDS	1027.16 ± 6.43	549.33 ± 3.32	-46.51	913 ± 4.85	-11.11
Total solids	1305.50 ± 3.44	746.16 ± 5.30	-42.84	965.33 ± 15.73	-26.05
EC	1579.16 ± 3.86	900.66 ± 13.89	-42.96	1384.5 ± 38.04	-12.32
pH	5.15 ± 0.08	7.72 ± 0.37	+49.90	8.63 ± 0.33	+67.57
Alkalinity	551.66 ± 13.01	260.83 ± 12.68	-52.71	360.16 ± 3.25	-34.71
Total hardness	790 ± 9.35	185.83 ± 3.43	-76.47	370.16 ± 6.04	-53.14
Calcium	140.33 ± 2.58	29.5 ± 3.16	-78.97	76.33 ± 2.16	-45.60

Magnesium	80.16 ± 2.85	14.33 ± 3.50	-82.12	43.83 ± 2.85	-45.32
Sodium	130.83 ± 3.06	115 ± 6.60	-12.09	99.83 ± 2.71	-23.69
Potassium	29.5 ± 2.16	8.55 ± 2.07	-71.01	20 ± 2.60	-32.20
Iron	9.91 ± 0.31	0.925 ± 0.02	-90.66	0.63 ± 0.01	-93.64
Free ammonia	23.51 ± 0.75	13.40 ± 0.81	-43.00	14.46 ± 0.22	-38.49
Nitrite	0.14 ± 0.01	4 ± 1.41	+96.50	0.04 ± 0.02	-71.42
Nitrate	8.66 ± 1.75	8.48 ± 0.33	-02.07	12.5 ± 1.87	+44.34
Chloride	231.33 ± 2.16	182.16 ± 4.66	-21.25	159.16 ± 4.26	-31.19
Fluoride	0.12 ± 0.01	0.07 ± 0.05	-41.66	0.05 ± 0.002	-58.33
Sulphate	71.83 ± 2.48	14.16 ± 1.47	-80.28	51.5 ± 3.08	-28.30
Phosphate	12.16 ± 0.71	9.37 ± 0.20	-22.94	5.46 ± 0.01	-55.09
Silica	6.61 ± 0.10	4.85 ± 0.30	-26.62	4.81 ± 0.02	-27.23
COD	370.33 ± 4.58	220.16 ± 3.31	-40.55	194.66 ± 2.94	-47.43
BOD	120.5 ± 1.87	61.16 ± 3.31	-49.24	50.33 ± 5.42	-58.23
Oil & Grease	0.17 ± 0.40	0.008 ± 0.06	-95.29	0.006 ± 0.002	-96.47

Chemical Examination is expressed in mg/l. Electrical conductivity as µS/cm, Turbidity as NTU.

Values expressed as mean ± SD

Table 4: Physico-chemical parameters of Dairy effluent with Scytonema multiramosum and Spirulina platensis in untreated and treated

Parameters	Before treatment (control)	*Scytonema multiramosum*		*Spirulina platensis*	
		After treatment	Removal efficiency (%)	After treatment	Removal efficie (%)

Appearance	Milky and Grayish Black	Green	-	Green	-
Odour	Offensive smell	Algal smell	-	Algal smell	-
Turbidity	154.91 ± 3.58	41.17 ± 3.68	-73.42	23.5 ± 1.74	-84.82
TSS	159.95 ± 1.29	57.66 ± 5.88	-63.95	54.16 ± 1.47	-66.13
TDS	1027.16 ± 6.43	848.5 ± 9.79	-17.39	864.83 ± 4.40	-15.80
Total solids	1305.50 ± 3.44	939.16 ± 8.30	-28.06	1020.66 ± 4.13	-21.81
EC	1579.16 ± 3.86	1374 ± 39.94	-12.99	1348.83 ± 5.11	-14.58
pH	5.15 ± 0.08	7.66 ± 0.09	+48.73	8.2 ± 0.17	-59.22
Alkalinity	551.66 ± 13.01	251.16 ± 12.33	-54.47	351.33 ± 17.28	-36.31
Total hardness	790 ± 9.35	426.66 ± 3.98	-45.99	220.00 ± 4.00	-72.15
Calcium	140.33 ± 2.58	74.83 ± 2.31	-46.67	54.66 ± 2.94	-61.04
Magnesium	80.16 ± 2.85	38.66 ± 5.04	-51.77	20.00 ± 2.60	-75.04
Sodium	130.83 ± 3.06	106.83 ± 4.26	-18.34	148.5 ± 1.87	+13.50
Potassium	29.5 ± 2.16	22.16 ± 2.13	-24.88	18 ± 2.19	-38.98
Iron	9.91 ± 0.31	6.25 ± 0.04	-36.93	0.93 ± 0.05	-90.61
Free ammonia	23.51 ± 0.75	10.65 ± 0.07	-54.70	6.73 ± 0.06	-71.37
Nitrite	0.14 ± 0.01	0.10 ± 0.02	-28.57	0.05 ± 0.01	-64.28
Nitrate	8.66 ± 1.75	3.93 ± 0.70	-54.61	6.66 ± 2.16	-23.09
Chloride	231.33 ± 2.16	176.33 ± 5.71	-23.77	147.5 ± 4.63	-36.23
Fluoride	0.12 ± 0.01	0.04 ± 0.01	-66.66	0.07 ± 0.00	-41.66
Sulphate	71.83 ± 2.48	40 ± 2.82	-44.31	40.33 ± 7.00	-43.85

Phosphate	12.16 ± 0.71	7.83 ± 0.03	-35.60	4.2 ± 0.02	-65.46
Silica	6.61 ± 0.10	3.38 ± 0.13	-48.86	7.68 ± 0.05	+16.18
COD	370.33 ± 4.58	140 ± 3.03	-62.19	77.83 ± 5.60	-51.89
BOD	120.5 ± 1.87	40 ± 3.74	-66.80	24.83 ± 3.25	-79.39
Oil & Grease	0.17 ± 0.40	0.0004 ± 0.001	-97.64	0.007 ± 0.00	-95.88

Chemical Examination is expressed in mg/l. Electrical conductivity as µS/cm, Turbidity as NTU

Values expressed as mean ± SD

CONCLUSION

An attempt has been made to investigate whether the algal groups have the potential to rapidly, efficiently, and effectively decolorize the dairy effluent and whether it may be employed as an alternative to more expensive materials. This is in light of the global realisation for the removal of environmental pollutants using less expensive biological means. In light of this realisation, an attempt has been made to explore whether the algal groups have the potential. The process of phytoremediation has a twofold purpose. Not only do the algae clean the effluent, but the algal biomass that is obtained at the conclusion of the experiment may be utilised for aquaculture, agriculture, gardening, and enriching the soil. The effluent treatment procedures are used thoughtfully so as to maximise their efficacy and minimise their impact on the surrounding ecosystem. This would assist achieve zero discharge as well as regulate pollution and reduce the amount of freshwater needed for cooling, washing, and cleaning. Additionally, it would reduce the amount of freshwater used.

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