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# Effect of dairy industry effluent on living organisms

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**Abstract**
Environmental pollution is one of the most hazardous problems prevailing in the current world. For the safe and secure future of this world a proper pollution management system have to be implemented to control the rising level of pollution in the environment. Recycling of the effluents is considered as a better choice to reduce the pollutants in the environment rather than treating the effluent which demands a higher cost for the process. In this paper it is Shorty discussed about the effect of milk industry effluents on living organisms, so it will give a clear idea whether the milk industry effluent can be recycled and used as a supplement for growth of the organisms. In this current study the growth rate of *Nostoc* sp (Algae) and plant *Abelmoschus esculentus*was studied to determine the effect of milk industry effluent. It has been found that the milk industry effluent contains the essential nutrients required for the growth of the organisms and enhances their rate of growth.

**Keywords:** Diary effluent, Fertilizer, Waste water and recycling.

## 1. Introduction
Urbanization and rapid industrialization has resulted in release of large amount of effluent in the water stream, this affects the natural ecosystem and causes pollution. To avoid this type of water pollution we can recycle the waste effluents from the industry to create a very useful product out of it. Dairy industry is one of the most important food industries and India ranks the first place among the most important milk producing nations [1]. Dairy industry produces 1 to 3 times of effluent for a volume of milk processed, it produces an average 3.739 and 11.217 million $m^3$ of waste per year. It is one among the top 10 industries which produces a greater amount of effluent and leads to environmental pollution [2]. It is estimated that millions of dollars are required for the disposal and treatment of the effluents. The process of treating and disposing effluent is becoming a major socioeconomic problem; hence an alternate approach is needed to dispose the effluent in an economical and efficient way [4].
The main focus of the project is to estimate the effect of treated and untreated milk industry effluent on plants and Algal sp (Microorganisms). The growth rate of the living organism was taken as the major parameter to study the effect of effluents. It is estimated that the use of effluents at a desired quantity on a regular basis increased the rate of growth, flowering period and fruiting period of plants. It also showed a positive effect on the growth of algal species. The response of the living organisms to the untreated effluents was high and showed a high growth rate. Hence if we use the effluents in the most appropriate way it can be used as fertilizer for plants and the cost of recycling the effluents also decreases.

## 2. Materials and Methods
### 2.1 Area of study
The effluent was collected from one of the reputed milk industry in Tamil Nadu. The effluent was collected under hygienic conditions; the sample was collected in the month of summer in a humid environment. The average temperature recorded varies from 28º Celsius to 37° Celsius. The environmental factors and the climatic conditions determine the biome of the area.

### 2.2Requirements
Glassware, pipettes, pots, and other essential equipments was cleaned with tap water and rinsed with demonized water and sterilized before use. The BG-11 medium was prepared according to requirements and sterilized in autoclave.

The chemicals and reagent used for analysis were of analytical reagent grade. The procedure for calculating the different parameters were conducted in the laboratory.

**2.3 Source of effluent**

The various ways by which the effluents are generated in the milk industry is through homogenization of milk, production of milk products, and pasteurization of milk and cleaning of the production plant. Generally cleaning is done by automatic system which pumps the cleaning solution through all the production equipments. The cleaning takes places in three steps as primary cleaning is done by caustic soda , followed by water rinse and finally by a disinfectant and water rinse. These chemical used for cleaning become an integrated with the effluent. [4].The amount of effluent generated varies based on the amount of product produced; its nature depends on the environmental factors such as temperature, amount of cleaning solution used. Hence for every batch the nature of effluent changes and will not have a consistent value. [5].

**2.4 Characteristic of waste water**

**2.4.1 Physico-Chemical Study:** The samples collected were analyzed for temperature, pH, Total Solids(TS), Total Dissolved Solids(TDS), Total Suspended Solids (TSS), and Bio-chemical Oxygen Demand (BOD) values. These are the basic parameters which determine the nature of the effluent. [6]

**2.4.1.1 Temperature:** The temperature of waste water ranged from 28 °C – 33 °C.

**2.4.1.2 Colour**: Wastewater generated from the industry is in light brown colour when it is less than 6 h old, while a light-to-medium grey colour is characteristic of wastewater which has gone a few degree of decomposition or it has been in the collection tank for few hours. Finally the colour is changed to dark grey or black, when the wastewater is typically septic, which undergone extensive bacterial decomposition. Formation of various sulphides particularly ferrous sulphide results in the blackening of wastewater [3]. The effluent which are treated by clarifiers are found to be in white colour and the untreated effluent was in dark black colour & highly turbid in nature.

**2.4.1.3 Total Dissolved Solids (TDS)**

Total dissolved solid values were varying from 200.5-600.4 ppm in waste water. Increase in concentration of TDS was due to greater input of dissolved solids in water.

**2.4.1.4 Biological oxygen demand**

B.O.D. is defined as the amount of oxygen required by microorganism to break down all the organic compounds present in the effluent at an optimized condition. It is a very slow and time consuming process, in this method the simple end products such as carbon dioxide and water is produced. [7]. In the present study BOD was found to be 8036mg/l.

**2.4.1.5 Protein:** Protein content was determined by Lowry's method which ranged from 8.31-30.45 mg/L in waste water generated from the milk processing industry.

**2.4.1.6 Carbohydrate:** Carbohydrate values were determined to be 0.9234 -10.0134 mg/L in waste water of milk industry; it was estimated by anthrone method.

**3. Experimental Setup**

**3.1 Effect of effluents on algal species**

The growth rate of Nostoc sp (Algae) was used to demonstrate the effect of effluent on the microorganism. The algae were introduced into an environment containing treated and untreated effluents at varying amounts to the study the growth of the organisms. This experiment is carried out as follows, All the apparatus were cleaned and sterilized by autoclave before use. BG-11 medium was prepared with its necessary constituents and sterilized before use for growing algae culture. The Nostoc culture was collected from Aban lab, Thandalam and was cultured before the project started. The algae sample was allowed to grow till it reached optical density value of 0.70. Different test samples were used for studying the experiment. 175 ml of medium was taken in each test sample, 10ml of algae culture was taken and milk industry effluent was applied on regular basis to the algal culture at different amounts of quantity ranging from 0.5 – 1.5 ml/sample. The optical density value was taken on regular basis to check the growth of the microorganisms and the value was compared with control to study the growth rate of the organism. The details about different samples are,

| Parameters | Medium (ml) | Amount of culture(ml) | Effluent sample(ml) |
|---|---|---|---|
| Control | 175 | 10 | nil |
| Sample 1 (U.T) | 175 | 10 | 0.5 |
| Sample 2 (U.T) | 175 | 10 | 1.0 |
| Sample 3 (U.T) | 175 | 10 | 1.5 |
| Sample 1 (T) | 175 | 10 | 0.5 |
| Sample 2 (T) | 175 | 10 | 1.0 |
| Sample 3 (T) | 175 | 10 | 1.5 |

(U.T- Untreated effluent, T-Treated effluent)

**3.2 Effect of effluents on plants**

Lady's finger (Abelmoschus esculentus) seeds growthrate and its flowering period were considered as the major parameter to estimate the effect of the effluent on the plants. This experiment is carried out as follows,

The seeds of the lady's finger were obtained from the "Tamil Nadu Agricultural University". Seven containers of equal capacity was chosen to carry out the project, the containers were filled with 150 gram of fertile soil. 8 seeds were inoculated in each of the containers. 20 ml of water was poured on a regular basis and the volume of water poured in all the containers were gradually raised as the plant growth started to increase according to the need. The samples were exposed to different quantity of treated and untreated effluent correspondingly. The height of the plant was measured regularly from second week after the plants were inoculated in the soil. The height of plants from different samples was compared with the height of the control plants to study the growth rate of plants. The flowering and fruiting period of the plants were also estimated in the study.

| Parameters | Number of seeds | Amount of water (ml) | Effluent sample (ml) |
|---|---|---|---|
| Control | 8 | 20 | nil |
| Sample 1 (U.T) | 8 | 20 | 5 |
| Sample 2 (U.T) | 8 | 20 | 10 |
| Sample 3 (U.T) | 8 | 20 | 15 |
| Sample 1 (T) | 8 | 20 | 5 |
| Sample 2 (T) | 8 | 20 | 10 |
| Sample 3 (T) | 8 | 20 | 15 |

(U.T- Untreated effluent, T-Treated effluent), the amount of water poured on plants was increased according to plant growth and requirements.

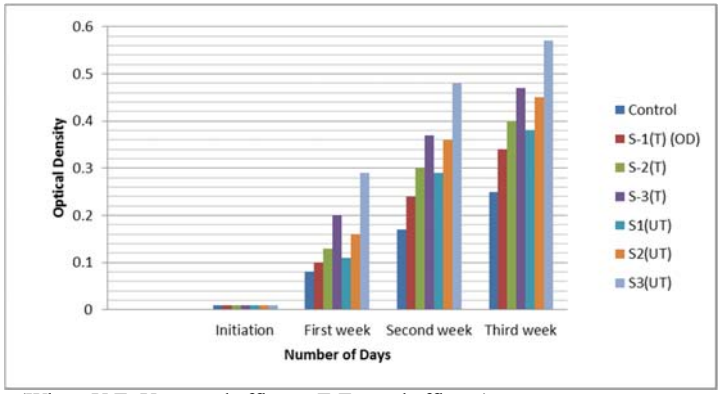
## 4. Result & Discussion

### 4.1 Effect of effluents on algal species

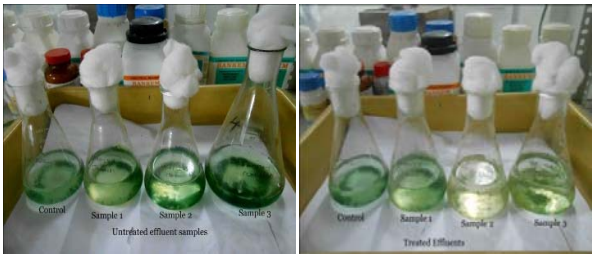
Optical density value of the culture was taken on daily basis to estimate the growth of the organism. The OD value was taken at 640nm. The values are given as,

| S.NO | Day | Control(OD) | S-1(T) (OD) | S-2(T)(OD) | S-3(T)(OD) | S1(UT)(OD) | S2(UT)(OD) | S3(UT)(OD) |
|---|---|---|---|---|---|---|---|---|
| 1 | Initiation | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| 2 | First week | 0.08 | 0.10 | 0.13 | 0.20 | 0.11 | 0.16 | 0.29 |
| 3 | Second week | 0.17 | 0.24 | 0.30 | 0.37 | 0.29 | 0.36 | 0.48 |
| 4 | Third week | 0.25 | 0.34 | 0.40 | 0.47 | 0.38 | 0.45 | 0.57 |

(Where U.T- Untreated effluent, T-Treated effluent)




(Where U.T- Untreated effluent, T-Treated effluent)




Samples after a span of 3 weeks

| Type of Effluent | Sample - 1 | Sample -2 | Sample-3 | Control |
|---|---|---|---|---|
| Untreated samples | 1.34g (wet weight) | 2.33g (wet weight) | 3.04 g(wet weight) | 1.03g (wet weight) |
| Treated Samples | 1.23g(wet weight) | 1.97g(wet weight) | 2.56g(wet weight) | 1.03g (wet weight) |

Wet weight of samples after a span of 3 weeks.

We can clearly observe from the above results that algae which were exposed to the effluent showed a higher growth rate. The sample which was added with 1.5ml of untreated effluent on regular basis showed rapid growth rate compared to the other sample. This shows us that the untreated effluent plays a vital role in the growth of the microorganism.

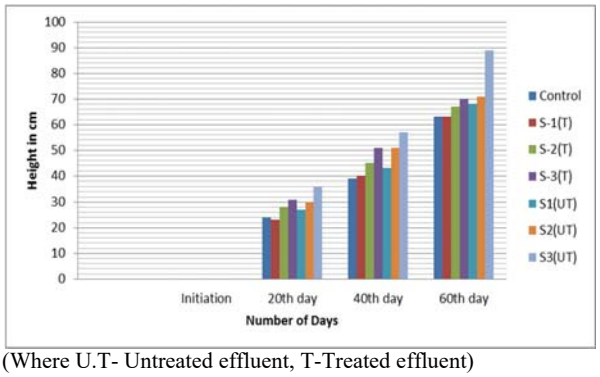
**Effect of effluents on plants:**

The height of the plant was measured on a regular basis and the value obtained was compared with the height of the plants in the control to estimate the rate at which the plants growth took place in the samples which was exposed to the effluents. The height of the tallest plant in the sample was recorded as,

| S.NO | Day | Control | S-1(T)(cm) | S-2(T)(cm) | S-3(T)(cm) | S1(UT)(cm) | S2(UT)(cm) | S3(UT)(cm) |
|---|---|---|---|---|---|---|---|---|
| 1 | Initiation | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | 20th day | 24 | 23 | 28 | 31 | 27 | 30 | 36 |
| 3 | 40th day | 39 | 40 | 45 | 51 | 43 | 51 | 57 |
| 4 | 60th day | 63 | 63 | 67 | 70 | 68 | 71 | 89 |

(Where U.T- Untreated effluent, T-Treated effluent)


Plant subjected to untreated effluents after 50 days




(Where U.T- Untreated effluent, T-Treated effluent)

We can clearly estimate from the above results that the plants which was exposed to the effluents showed a higher growth rate. The sample which was added with 15ml of untreated effluents on regular basis showed a rapid growth rate compared to the other sample. The flowering period and the fruiting period of the plants exposed to the effluent was shortened. The flowering period of the plant which was exposed to untreated effluent of 15ml, showed reduction in 7-14 days for flowering and fruit formation. This shows us that the untreated effluent plays a vital role in the growth of the plants.

## 5. Conclusion

In this research work the role of dairy effluents on enhancing the growth of the plants and microorganisms was studied. The rich nutrition content of the milk industry effluent provided all the essential factors which are required for the growth of the organisms. Ifwe use the milk industry effluent as a fertilizer for plant growth it definitely will aid in the growth of the plants and improves the yield of crops. Hence by this method we can avoid the cost of treating the milk industry effluent and can use the effluent as fertilizer in a more economical way.

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