Wastewater treatment using *spirulina platensis* at TH truemilk dairy farm - Nghia Dan district - Nghe An province

Le Thi Hong[1]* and Le Minh Thanh[2]

ABSTRACT : The present study was aimed to assess wastewater treatment ability of *Spirulina platensis* from TH Truemilk dairy farm - Nghia Dan district - Nghe An province. This study was conducted for near one year and included monthly water analysis for various physic-chemical factors. *Spirulina platensis* are belonging to blue green algae viable for biological treatment. The results were showed to reduce nutrient concentrations from wastewater such as, nitrate, phosphorus and sulphate. In addition, the ability of these algae reduces B.O.D, C.O.D, T.D.S, calcium and magnesium hardness. There are recorded ability of this algae on removing nitrate 77.53 % , active phosphorus 75 % and sulphate 61.23 % while there are C.O.D 75.14 % T.S.S 73.68 %, B.O.D 69.38 %, calcium and cloride 59.17 %, 51.05 % during the eleventh day of treatment.

Keywords: Dairy, Wastewater, Treatment, Microalgae, Nutrients

Introduction

In Nghia Dan, dairy production is growing and has contributed significantly for the socio-economic development, raising incomes and reducing poverty. In particularly, TH Truemilk dairy farm is the biggest farm in Nghia Dan. We found that wastewater from TH Truemilk dairy farm is increasing every year because farming area extended more. Most leftovers rot decay organisms tend to accumulate nutrients (**Figure 1**).

Figure 1 Wastewater from TH Truemilk dairy farm in Nghia Dan district-Nghe An province

[1] Institute for Research and Developement of New Technology, 17 Pham Kinh Vi str., Vinh city, Nghe An province

[2] Searcher, Biology Deparment, Vinh University, 182 Le Duan str, Vinh city, Nghe An provinc

* Corresponding author: lehong6893dhv@gmail.com

In addition, the current water quality in most of the different water sources is contaminated worsening. The water management ensures the sustainable development of aquaculture, while minimizing adverse impacts of various activities on the environment is a matter of urgency and necessity of the science as well as the authorities in the Nghia Dan in particular and Vietnam in general.

The study was carried out in order to apply *Spirulina platensis* to treat wastewater from TH Truemilk dairy farm for improving water quality.

Materials and methods

Material

The algae *Spirulina platensis* obtained from manufactured in Quynh Luu district - Nghe An was used in this study. They were grown in Erlemeyer flask (1000 ml) containing 80% of dairy wastewater solution. The cultures incubated at (25°C) for 11 days and measured physical and chemical analysis. (Velasco, 2007)

Method
Sample collection

Waste water samples were collected from TH Truemilk dairy farm and all experiments were performed for the treatment of pollutants and is mediated by a combination plastic containers 5 liter capacity after washing wastewater and then transported directly to the laboratory.

Assessment development capacity of Spirulina platensis in wastewater media

We prepared a container 1000 ml contain 80 percent wastewater (800 ml wastewater) and 20 percent algae water with density is 20.000 cell/

ml. Then incubated in outside condition for eleventh day and determined density of algae after 1, 3, 5, 7, 9, 11 days.

Measured physical and chemical analysis

The present study carried out study about PH, calcium, magnesium, chloride, sulphate, chemical oxygen, biological oxygen demand were measured at the field according to standard method. (American public health association, 1985) Nitrate, active phosphorus, T.S.S were determined according (Parsons et al., 1984) Sodium and potassium were measured by (American public Health Association, 2003).

Calculate the Percentage of Treatment

The efficiency of pollutant removal was expressed as the percentage ratio of pollutant concentration to that of before and after treatment value.

$$\% \text{ Treatment} = \frac{\text{Before treatment value} - \text{After treatment value}}{\text{Before treatment value}} \times 100$$

Statistical Analysis

Data wes analyzed the experiences of the study for some physical and chemical tests for dairy waste water according (t- student). (Glantz, 2005)

Results and Discussion

Development ability of Spirulina platensis in wastewater media

We found that *Spirulina platensis* can grow and develop in wastewater media. The results show the density of *Spirulina platensis* increases everyday (Table 1). The biggest density of *Spirulina platensis* is 87,75±4,17 at ninth day.

Table 1   The development of Spirulina platensis (10^3 cell /ml)

Day	Density
1	18,11±11,70
2	17,66±0,60
3	29,44±1,39
4	32,33±1,53
5	37±4,48
6	41,55±2,87
7	45,56±6,47
8	79±2,96
9	87,75±4,17
10	47,11±45,21
11	37,11±45,12

Measured physical and chemical analysis before treatment

Table 2 expresses some physical and chemical tests for dairy waste water. The rates of pH are between 6.3-8.3. The total values of the rates of calcium hardness were 218 mg/liter. The values ranged concentrations of nitrate 89 mg / liter, chloride 1281 mg / liter , active phosphorus 9 mg/liter, Sulphate 748 mg/liter .The values of chemical oxygen demand COD and biological oxygen demand BOD of 1850 mg/liter, 1300 mg / liter. The value of T.S.S is 380 mg/liter.

Table 2 The physical and chemical tests for dairy waste water

Parameter	Before Treatment (mg/liter)
TSS	380
Calcium hardness	218
Active phosphorus PO_4^{3-}	9
Sulphate SO_4^{2-}	748
Nitrate NO_3^-	89
Chloride Cl^-	1281
C.O.D	1850
B.O.D	1300

Treatment of Waste Water by Spirulina platensis

Table 3 shows the values and the percentage some physical and chemical tests for dairy waste water treatment with *Spirulina platensis.* The results showed a continuous decline of plant nutrients (nitrate, active phosphorus, sulphate) from the first day until the eleventh day when the waste-water treatment was the percentage of removal in the first day of 22.47 %, 16.3 %, 11.76 % and increased the rate of removal to 77.53 %, 75 %, 61.23 %, respectively in the eleventh day.

The rate of removal of calcium hardness in the first day 9.17 % of the model taken to increase up to 59.17 % respectively in the eleventh day while removal rates reached of chloride in the first day 20.30 % to reach to the removal rate 51.05 % respectively in the eleventh day.

Finally, the percentage of removal chemical oxygen demanded COD, biological oxygen demand in the first day 31.35 %, 30.77 % and continued to reach 75.14 %, 69.38 % in the eleventh day. It showed good efficiency in the removal of pollutants from waste water during the treatment period.

Table 3   The values of some physical and chemical tests for dairy waste water treatment with *Spirulina platensis*

Parameter	Before Treatment (mg/liter)	Days						Treatment ability after eleventh day (%)
		1	3	5	7	9	11	
TSS	380	362	298	270	255	198	100	73.68
Calcium hardness	218	198	158	137	120	100	89	59.17
Active phosphorus PO_4^{3-}	9	8	7	5	4.7	2.9	2	75.00
Sulphate SO_4^{2-}	748	660	570	480	400	320	290	61.23
Nitrate NO_3^-	89	69	47	31	28	23	20	77.53
Chloride Cl^-	1281	1021	811	754	710	640	627	51.05
C.O.D	1850	1270	970	730	680	550	460	75.14
B.O.D	1300	900	780	650	600	490	398	69.38

Conclusion and suggestions

The results of the current study demonstrated the ability of algae to remove pollutants. The results of the present study was high pH values of (6.3-8.3) during the treatment period and interpreted the research that the values of the exponent of hydrogen (pH) of the medium increases if the ratio of the absorption of phosphorus into energy is derived from the

process of photosynthesis or respiration as influenced by the absorption of phosphorus by most important factors of pH, temperature and light intensity as observed the pH by precipitating phosphorus. (Graham et al., 2000)

An algae plays an important role in the biochemistry of the land for more than three billion years ago, through their participation in the recycling of ground elements (C, N, O, S, P) and requirements important and necessary for the growth of green algae (phosphorus, nitrogen, sulfur, calcium, magnesium). May be present naturally or are added salts. (Reynold et al., 1984) The nitrogen is also important components for the growth of phytoplankton and other neighborhoods as entering in the manufacture of amino acids and proteins through the analysis of algal cells, the natural rate of atoms is (1.6) atom of carbon and (16) atom of nitrogen and (1) atom phosphorus.

In general, algae varies in their use of nitrogen Photos some prefer ammonia and urea and the other part of them as they prefer nitrates under certain circumstances prefer organic nitrogen (Delly et al., 2001).

For example, enter the nitrogen in the formation of amino acids and nucleotides of the algal cells (amino acid - Nucleotides). The phosphorus contributes to the generation of energy (ATP-ADP-Phospholipids) and calcium importance applied in the work Djint and calcium carbonate (Alginate - Calcium Carbonate) while the role of magnesium is essential in building chlorophyll (Chlorophyll) (Mandalam et al., 1998).

And it enters the sulfur in the formation of two amino acids, Cysteine & Methioinine which it plays a key role in the formation of covalent disulfide Alasrh (Covalent Disulfide bond formation) and

to accelerate the installation of the tripartite protein (tertiarly protein structure). As well as its importance in the work of fat (thylakoid lipida) can be considered from the requirements of energy (ATP - dependent) of algae and biomass of algae are not affected only the presence of nutrients but also affected by other factors such as light, temperature, pH and density communities. (Oh-Hama et al., 1988).

Research found that *Spirulina platensis* has the ability to remove nutrients from dairy waste water as phosphorus (about 75 %), nitrate (about 77.53 %), cloride (about 51.05 %).

In particularly, we found that *Spirulina platensis* can reduce the requirement of vital for oxygen (BOD) and the requirement of chemical oxygen (COD) 69.38 % and 75.14 %, respectively.

It was found that after treatment, the concentration of all the contaminants fulfilled the environmental requirement. This showed that we can apply *Spirulina platensis* into dairy wastewater treatment effectively.

References

American public health association (APHA). 1985. Standard method for examination of Water and Waste Water. 16th Edition, New York.

American public health association (APHA). 2003. Standard methaod for the examination of water and wastewater. 20th Edition. Washington. DC, USA.

Delly, F.A.H., T. Ibrahim, F. Chgat, and H. Abbas. 2001. The use of inorganic fertilizers in the production of the Mass alga Chlorella vulgaris. Journal of the Faculty of Education for Girls. pp. 512-507.

Glantz, S.A. 2005. Primer of biostatics. 5th Edition. Mac Graw, USA.

Graham, L.E., and L.W. Wilcox. 2000. Algae. Prentice-Hall, Inc. upper Suddle River, Wisconsin University.

Mandalam, R.K., and B. Palsson. 1998. Elemental balancing of biomass and medium composition enhances growth capacity in high density Chlorella vulgaris cultures. Department of chemical engineering, Michigan University, Michigan.

Oh-Hama, T., and S. Miyachi. 1988. Algal culture systems. Microalgae biotechnology, Gambridge University Press, Cambridge.

Parsons, T.R., Y. Mait, and C.M. Laulli. 1984. A manual of chemical and biological methods for seawater analysis pergamone press Oxford.

Reynold, C.S. 1984. The ecology of fresh water phytoplankton. Cambridge Univ, press Cambridge. pp. 384.

Velasco, A. 2007. Evaluation of marine algae as a source of biogas in two stage anaerobic reactor system. J. biombioe. 32(4): 338–344.