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Research paper

Solid trash molasses bio-degradation in Aranthangi sugar industry, Tamilnadu with utilization of Aspergillus niger

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A B S T R A C T

For investigating the Aspergillus niger performance in treating trash molasses emission from the sugar industry, Tamilnadu, South India. A.niger was chosen to treat the molasses emission according to the screen procedure. The emission has experimented to whole the physicochemical factors before the microbe insemination. After incubation, the physicochemical factors outcomes demonstrated a considerable reduction of factors like BOD 75 percent, and COD 65 percent in the emission treated by A.niger. According to the results, it is obvious that A.niger can be utilized for the molasses treatment. The mechanism understanding in this investigation might broadly utilized in bioremediation.

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Introduction

In the world, about 125-130 million tons sugar are made annually. Almost 2/3 of this amount is made from sugarcane and 1/3 of this amount is from sugar beet. Sugar process cane or beet emissions molasses that is generally 4 percent with weight on the amount of cane or beet provided or 40 percent on the sugar made. One of the main elements of growth media utilized in the industrial procedure is Molasses. According to its special physical and chemical features molasses has been utilized as the main ingredient in combination feeds, livestock feeds, and silage additives and is extremely utilized in different industrial operations. Distilleries that are based on Molasses are one of the most contaminating industries producing a large amounts of high-strength wastewater (Y. Satyawali and M. Balakrishnan, 2007).

Melanoidins are the main contaminant that is released to a water source system. They control the sunlight penetration and influence the photosynthetic movement of aquatic plants. The highly organic load of the emission generates eutrophication. This would thus produce an anaerobic situation that kills most of the aerobic aquatic fauna (Bernardo et al., 1997; Raghukumar et al., 2004).

Controlling contamination is one of the main social problems today. By economical restrictions on contamination controlling procedures, useful techniques have evolved into a need. Untreated or partly treated wastewaters and industrial emission discharge to natural ecosystems state a severe issue to the ecosystem and the living conditions. Of the considerable kinds of organics available, the hardest for removing is color. Since melanoidins are resistant to biodegradation, the

omission of colored wastewater in molasses-based distillery effluent treatment systems is primarily according to physical or chemical approaches like absorption, coagulation, rain, and oxidations. These techniques are useful, but they are not suitable because of the deficiency as needing highly reagent dose, highly expenses, dangerous byproducts organization, and severe energy utilization. These techniques cause considerable sludge. Thus, biological treatments by microbes are under attention.

however, industrial wastewater de-coloration has been acquired with degradation utilizing bacterial (Chaturvedi et at., 1986; Dupouy et al., 1988; Subramaniam et al., 2002 and Suhuttaya Jiranuntipon, 2009) and fungal (Subramaniam and Carpentor, 1994; Madhupratap, 1999; Sarangi et al., 2001, Suhuttaya Jiranuntipon, 2009) isolates, growing needs to useful and economic techniques for color disposal has cause investigation to a biosorption – based approach which uses the adsorption capability of biological matter for the contamination disposal (Desa, 2000). The bio-sorption methods have been utilized effectively in the emission treatment procedures, especially for the heavy metals (Carpentor and Price, 1976; Borstad et al., 1992) and dyes (Chauhan et al., 2002; Sarangi et al., 2001).

Bio-remediation is a contamination-controlling technology, which utilizes biological systems for catalyzing the degradation of or transfer of different toxic chemicals into less toxic conditions. The whole procedure for bio-remediation is enhancing natural bio-degradation by native organisms, via the microorganisms (Ashoka et al., 2002). The capability of microorganisms for transformation has been investigated for unfolding their degradative capabilities in contamination remediation.

Distillery wastewater production and features that are based on Molasses

Generation of alcohol from molasses causes large amounts of high-strength wastewater which is of severe environmental problem. The aqueous emission stream from distilleries is as sugarcane molasses wastewater is about 12 to 15 times the magnitude of the constructed alcohol. The wastewater from the distillery is distinguished by especially high chemical oxygen demand (COD) (80,000–100,000 mg/L) and biochemical oxygen demand (BOD) (40,000–50,000 mg/L). Nevertheless, the value and the features of the sugarcane molasses wastewater are high variables and related to the natural matters utilized in the ethanol generation procedure (Pant and Adholeya, 2007; Satyawali and Balakrishanan, 2008). Washing water utilized for cleaning the fermenters, cooling water, and boiler water additionally contributes for its variation (Pant and Adholeya, 2007).

Methodology

In this study, the specimens have been gathered from the Sugar industry at Aranthangi taluk, Pudukottai district, Tamilnadu, South India. Specimens have been gathered in a large sterilized bottle and conveyed to the lab. Physico-chemical elements have been accomplished on the exact day while the specimen has been obtained in the lab and the research for the physicochemical factors has been performed as per APHA (1999) systems.

Fungi Isolation

A hundred ml of the molasses specimen has been derived in a 250 ml conic flask including 90 ml of sterile distilled water. The flask has been shaken on an electrical shaker for getting a homogenous suspension and transferred respectively 10 ml of the molasses suspension for 90 ml of sterile distilled water producing various dilutions viz., 10^{-1}, 10^{-2}, and 10^{-3}. One ml of 10^{-3}dilution has been plated in Petri dishes including Potato Dextrose Agar medium (PDA). The pH of the medium has been adapted to 5.6.

Streptomycin sulfate has been added to the media for preventing bacterial development. According to Fig. 1, the plates have been set at 25 + 20C for 5 days and fungi occurring on the medium have been placed over a clean slide, smeared by lacto phenol cotton blue, and monitored under the microscope photomicrographs have been created.

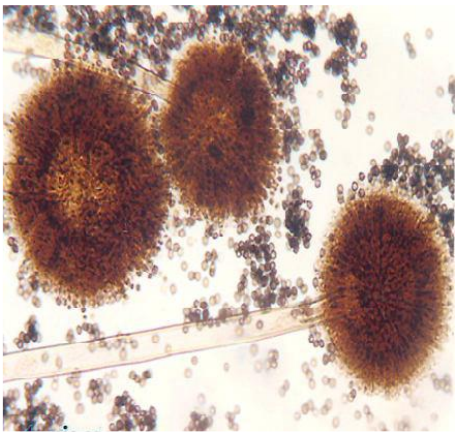

Fig. 1. A.niger Photomicrograph

Empirical Designing

The molasses has been purified by cotton before utilization and the primary physicochemical examination of molasses has been created following the standard (APHA, 1999). The following treatments have been used. Molasses before inoculation has been derived as management for physiochemical investigation. Aspergillus niger has been inseminated to molasses included in a conic flask.

The investigation has been performed in replications, in controlled situations for twenty days.

After twenty days, the cultures have been filtered by standard filter paper. The filtered molasses have been utilized for physicochemical and de-colorization investigation.

Discussion and Results

Physico-chemical investigation of molasses has been performed before insemination by A.niger and furthermore, after insemination and twenty days of incubation have been performed and outcomes are presented in Table.1. The mycoflora of unique ecologic places include some standard characteristics and it would be so rewarding for exploring the fungal variety in habitats such as thermophilic environments. One of the significant ecologic places to be examined is industrial emission that is so negligible comprehended.

Table. 1. Physicochemical features of raw and A.niger inseminate molasses effluent comparison

Factors	Controlling	Inoculated Effluent by A.niger
PH	6.8	6.7
Free CO2	31	6
Total Alkalinity	108	18
DO	1.34	1.75
Nitrate	90	46
Nitrate	48	21
Ammonia	42	22
Total Phosphate	90	44
Inorganic	55	26
Organic	35	18
Calcium	64	22
Magnesium	37	14
Chloride	30	24
BOD	240	60
COD	310	120

Therefore, this investigation has been performed for knowing the fungal species by a particular concern to A.niger in industrial molasses of the sugar industry.

De-colorization activity

According to Fig. 2, De-colorization activity has been discovered to be influential in the molasses inseminate by A.niger (42 percent). The color existence in material effluent imparts constant coloring to the receive streams and interferes by the photosynthesis of the phytoplankton (Cunningham and Saigo, 2001). Disposal of melanoidins from molasses garbage of 84.16 percent utilizing Aspergillus niger in the existence of glucose has been presented (Gomaa et al., 2003).

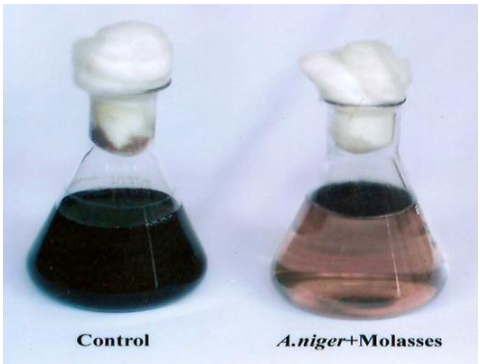

Fig. 2. Molasses de-colorization with treat by A.niger

Color removal by Aspergillus niger from wastewater in molasses alcoholic fermentation has been investigated by Peña Miranda et al (1996) furthermore investigated the nutrient concentrations effects, primary PH, and carbon resource on this color removal. It operated in an intermittent procedure in shaken cultures and in a situation procedure in a bubble reactor. In the set procedure, among whole experimentations, the maximum color removal has been gained after three or four days in the culture. Set procedures demonstrated a maximum color removal of 69 percent while $MgSO_4, KH_2PO_4, NH_4NO_3$, and a carbon resource have been added in the wastewater. The constant procedure by the identical nutrient concentrations demonstrated less color disposal and the de-colorization activity has been carried out for only four days. Raising consideration has been led to using microbial action for the de-colorization of molasses wastewater. Some results have demonstrates that several fungi particularly contain such a potential (Kumar et al., 1998). One of the most investigated fungi having the ability for degrading and de-colorizing distillery effluent is Aspergillus like as Aspergillus fumigatus G-2-6, Aspergillus niger, Aspergillus niveus, Aspergillus fumigatus $U_{B_2}60$ obtained 69 to 75 percent de-colorization along with 70 to 90 percent COD removal (Ohmomo et al., 1987; Miranda et al., 1996; Jimnez et al., 2003; Shayegan et al., 2004; Angayarkanni et al., 2003; Mohammad et al., 2006).

Destiny of Molasses Physico-chemical factors after incubation:

After insemination and incubation the physic-chemical factors demonstrated considerable deviations as controlling. Various fungous cultures have been studied newly for bioremediation procedure (Aust, 1990; Bumpus and Aust 1993; Akamatsu et al., 1990). Because of the aggressive growth, greater biomass generation and comprehensive hyphal attain in the environment, fungous have been caught to accomplish more acceptable in comparison with bacteria. The higher surface – to – cell proportion of filamentous fungous causes them more acceptable degraders under specific places (Ashoka et al., 2002). Molasses PH has been decreased to 1.47 percent acidic than controlling, when the free carbon dioxide has been decreased to 80.64 percent as controlling. Entire alkalinity has been decreased 83.33 percent by treating by the A.niger. Furthermore, dissolved oxygen has been little improved about 23.42 percent. There is a 48.88 percent nitrate decrease has been detected when the nitrite has been decreased to 56.25 percent. The ammonia has been decreased about 47.61 percent of decrease as controlling specimen.

Whole phosphate demonstrated considerable decrease about 51.1 percent. The inorganic phosphate decadence about 52.72 percent by A.niger has been seen to be more with distinction to organic phosphate of 48.57 percent. The whole phosphorus and in-organic and organic phosphate levels have been decreased in treated molasses. Many attempt has been accomplished in the past 3 decade for establishing procedures of treating that would cause the omission of more of the nitrogen present in wastewater. According to this investigation, a prosperous nitrate disposal, nitrite and ammonia have been seen almost 50 percent. The similar investigation has been accomplished by different scientists (Banu et al., 2001) noted the performance of disposal of phosphates has been more in the immobilized situation is comparison with free cells of bacteria. It supports the current study.

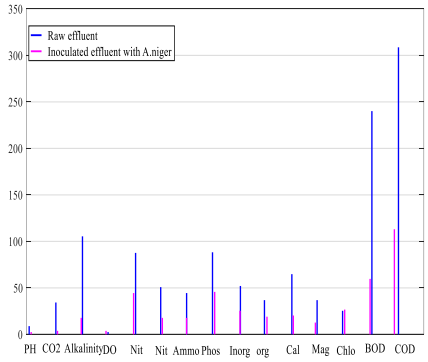

Fig. 3. Physico-chemical factors of molasses effluent by Aspergillus niger degradation

Furthermore, the minerals Ca and Mg demonstrated the decrease in the concentration about 65.62 percent and 62.16 percent orderly after treating by A.niger. Biological Oxygen Demand has been decreased to 60 mg/L from 240 mg/L about 75 percent and Chemical Oxygen Demand has been decreased to 120 mg/L from 320 mg/L about 61.29 percent. An investigation of the aerobic degradation of beet molasses alcoholic fermentation wastewater diluted to 50 percent (chemical oxygen demand, COD: 82 g/l) has been performed utilizing the following fungous: Penicillium sp., Penicillium decumbens, Penicillium lignorum and Aspergillus niger by Antonia M et al, (2003).

The main aim of wastewater treatingg is removing the suspended and soluble organic components calculated as chemical oxygen demand (COD) or biochemical oxygen demand (BOD). Biological treating procedures are utilized for degrading the organics in the wastewater before it is released. The most typical biological procedure for wastewater treating, the microbes is suspended by the wastewater.

the fungous bio-degradative activity is a complicated . Comprehending the technique of the biogradation role of this fungous is so essential if one must examine the unique enzyme system in it for the colored and complicated, poisonous effluents remediation. The enzymes stability in association to the physicochemical nature of the effluents is a critical characteristic in considering both technological and economical possibility of utilizing this organic commercially in bioremediation schemes.

Conclusion

For studying, the molasses treat with utilization of A.niger molasses effluent specimen has been gathered from sugar industry, Tamilnadu, South India. According to this study, the BOD and COD levels have been decreased about 75 percent and 65 percent orderly (Fig 3) and the color disposal has been presented highest in Aspergillus niger treated molasses by comparing with controlling.

According to the outcomes, Aspergillus niger can be utilized for the molasses treat. These techniques comprehension is a technology drawback and the extension of this fungous broudly in bioremediation. Nevertheless, continuous search would ultimately closet the current gap in knowledge regarding the utilization of this organism. The current study is written in the hope that it will stimulate interest and studies to the biotreatment development of colored and poisonous effluents in developed countries utilizing the Aspergillus niger model system.

sMicroorganism's mechanism in environmental pollution controlling is being investigated. Nevertheless, it is claimed that organism in

bioremediation eat-up or gobble the pollutants mainly organic compounds or incorporate heavy metals themselves, therefore degrade special pollutants or harmful combinations and transforming them to non-poisonous usable by productions.

Conflict of interest

The authors declare that they have no conflict of interest.

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