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Ecofriendly Aerobic Bio-treatment of Cheese Manufacturing Wastewater using *Saccharomyces cerevisiae* ATCC 9763

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Treatment of industrial wastewater has become a priority for countries and governments to protect the environment from pollution. This study aimed to treat cheese manufacturing wastewater (CMW) using yeast as a safe method which provides the use of clean water for public consumption as well as in irrigation of agriculture. The Cheese Manufacturing Wastewater (CMW) samples of the present study were collected from dairy products manufacturing factory located in Southern of Jeddah, Saudi Arabia. The physico-chemical parameters were measured including, pH, color, electrical conductivity (EC), turbidity and temperature, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), total dissolved solids (TDS), total suspended solids (TSS), total nitrogen (TN), total phosphorus (TP), fats, oil and grease (FOG) and sulfates. The biological treatment assay was carried out using *Saccharomyces cerevisiae* ATCC 9763. The biological treatment of CMW revealed that, *p*H values moved towards the neutrality (6.5), turbidity removal efficiency was 92%, the overall removal percent of TSS was 97%, the removal percent of TDS was 77%, maximum removal percent of FOG was observed 93%, the most reduction in BOD was 86%,reduction in COD values was 83%, TN overall removal percent was about 85%, maximum removal percent of phosphate was 92%, and the overall removal percentage of sulfate was 57%. The biodegradation index (BI) was 0.79 and gradually decreased until reaching values of 0.24. The biological treatment process was optimized, and the most optimum pH was 6.5 when 0.3% of inoculum was used during the process.

Keywords: -treatment, Cheese Manufacturing Wastewater, *Saccharomyces cerevisiae* ATCC9763

INTRODUCTION

Treatment of industrial wastewater has become a priority for countries and governments to protect the environment from the pollution that occurs as a result of water drainage. It may contain toxins, germs, and non-decomposing materials with a harmful effect on health as well as the environment. It also may lead to pollution of surface and groundwater sources. The government of the Custodian of the Two Holy Mosques has sought within the framework of the Kingdom's 2030 Vision to protect natural resources, considering them a religious, ethical and political duty and introduced all efforts to reduce pollution of all kinds. It also urged organizations and institutions to optimize investment of water wealth through rationalization of regular consumption, reducing unfair consumption and using treated and renewable water in an appropriate manner which will save the natural resources for the next generations. In the last three decades, wastewater treatment technologies resulting from industrial activities have developed significantly. Thus, this study aims to treat industrial wastewater biologically using yeast as a safe method due to its ease in design and its low cost of treatment, which provides the use of clean water for public consumption as well as in irrigation of agriculture.

Water is considered the main raw material extensively used in the manufacturing of many foods as well as beverage industries. However, an extremely small amount is properly consumed, while the larger one is unfortunately discharged as wastewater (Abioye et al. 2014). In fact, such a manufacturing sector has harmful impacts on the environment and the global economy as well. This negative attitude may come from the ongoing demand for drinking water that showed an extreme scarcity in the few last decades (Shrivastava et al. 2022). Similarly, as much as the growth of several food industries, it enhanced the release and accumulation of many harmful and toxic substances into the environment which subsequently may exhibit some health issues (Ewida, 2020). Food processing Wastewater could be classified as nontoxic effluents since it contains no or little harmful as well as non-biodegradable substances (Hegde et al. 2018). The most important pollutants that may be found in food processing wastewater is the organic materials which could be treated by fermentation; however, in some circumstances it may contain few concentrations of cleaning substances that could be toxic (Tahir et al. 2010). According to the production processes and/or the resulting product, the quality as well as quantity of food processing wastewater (FPW) widely differs. Most of these wastewater streams are found to be rich in biological oxygen demand (BOD), total suspended solids (TSS), and oily compounds (Nayyar et al. 2021).

Depending on the raw materials used in these industries, their wastewater may be rich in carbohydrates, fats and proteins. Microorganisms have been used widely either under aerobic or anaerobic conditions for the removal and treatment of food processing wastewaters where they exhibit an unexpected ability to breakdown various organic compounds containing wastewater (Porwal et al. 2015). *Saccharomyces cerevisiae* is one of the most common microorganisms found in ethanol production and food industry (Belda et al. 2014). The recycling of wastewater has attracted more attention for it economic and ecological aspects. So, the need to reuse and optimize wastewater has become an essential request despite of there are different countries minimize the reuse of wastewater due to legal curtailment, human health and safety reasons (Frigon, 2020). There are several physico-chemical methods that have been conducted for wastewater treatment, including aeration, sedimentation, filtration, chlorination, coagulation and ozonation (Ewida, 2020). Depending on the raw material processed, the wastewater may be rich in carbohydrates, lipids or proteins (Eskicioglu et al. 2006). Application of microorganisms in the bio-recycling of FPW was extensively used either under aerobic or anaerobic conditions (Ewida, 2020). *Enterobacter*, *Bacillus cereus*, *Streptococcus faecalis*, *Bacillus subtilis*, *Escherichia coli*, and *Saccharomyces* are frequent microorganisms that found in FPW effluents and also been found, as indigenous microorganisms, in bio-treatment (Janczukowicz et al. 2008; Madigan et al. 2000).Thus, this study aims to treat cheese manufacturing wastewater biologically using yeast as a safe method due to its ease in design and its low cost of treatment, which provide the use of clean water for public consumption as well as in irrigation of agriculture.

MATERIALS AND METHODS

Samples collection

The Cheese Manufacturing Wastewater (CMW) samples of the present study were collected from dairy products manufacturing factory located in Southern of Jeddah, Saudi Arabia (latitude N 39°09'15"E"17'17°21). The samples were kept in the refrigerator until used.

Physico-chemical parameters measurements

All CMW samples were analyzed using the Standard Methods for Examination of Water and Wastewater (APHA, 2010) the physical parameters included: pH, color, electrical conductivity (EC), turbidity and temperature. On the other hand, the chemical parameters included: Chemical Oxygen Demand (COD), Biochemical Oxygen Demand (BOD), total suspended solids (TSS), total dissolved solids (TDS), total phosphorus (TP), total nitrogen (TN), fats, oil and grease (FOG) and sulfates.

Microorganism and growth optimization

Saccharomyces cerevisiae ATCC 9763 strain was kindly dedicated from College of Science and Arts at Khulis, University of Jeddah, Saudi Arabia. It is a fresh active yeast, which is stored at 4°C.The strain was preserved on potato dextrose agar medium (PDA) containing (g/L): 200, potatoes infusion; and 20, dextrose; 15, agar (HiMedia Laboratories Pvt. Ltd, India) and *p*H was adjusted at 5.5 ±0.2. All the constituents were dissolved (39 g) in distilled water up to 1L. For preparation of the potato dextrose broth (PDB)containing (g/L): 200, potatoes infusion; and 20, dextrose (HiMedia Laboratories Pvt. Ltd, India) and *p*H was adjusted at 5.5 ±0.2.All the constituents were dissolved (24 g) in distilled water up to 1L.the yeast strain was reactivated overnight on PDB medium and incubated at 28°C prior the ongoing of the biotreatment assay experiment until heavy growth was obtained (≈ 24-96 h). The yeast growing cultures were washed 3 times using sterile distilled water, centrifuged at 10000 rpm for 10 minutes until wet pellets are formed (Porwal et al., 2015). One ml of the wet pellets ($3.2x10^6$cfu/ml) was used as an inoculum for further studies.

Biological treatment assay

For studying the biodegradation efficiency of *Saccharomyces cerevisiae* ATCC 9763, the yeast strain was reactivated overnight on PDB medium and incubated at 28°C prior the ongoing of the experiment until heavy growth was obtained (≈ 24-96 h). One ml (0.2%) of the sterilized yeast wet pellets (*v/v*) was loaded in a sterilized 1000 ml conical flask containing 500 mL of sterilized CM wastewater. In addition, 500 raw CM wastewater was placed in another flask without seeding of the yeast strain and acts as control. All the experimental flasks with cultures were incubated in a rotary shaker for 30 days at an ambient temperature (28°C). Samples were drawn every 5 days, and the supernatant and residue were separated by centrifugation at 4000 rpm for 10 minutes. Experiments were performed in triplicates and average values were used in the results. Characterization of the wastewater was performed before and after treatment (All the tests were performed in triplicate). The removal efficiency (RE) (Zabermawi et al. 2022)

Was calculated as follows:

Removal Efficiency (RE %) = C0 -RC / C0 x 100

where C0 = Initial Concentration before Treatment (Zero Time); RC = Residual Concentration after Treatment at each Exposure Time. While the biodegradability index (BI) (Cruz-Salomón et al.2020), was calculated as follows:

Biodegradability Index (BI %) = BOD_5 / COD x 100

Effect of *p*H on BOD and COD reduction

The biotreatment assay was monitored for pH range 3 to 9. Regulation of *p*H was conducted using 0.1 M of NaOH or 0.5M of HCl. One milliliter (1 ml) of inoculum was inoculated in 500mlErlenmeyer flasks of the CM wastewater samples containing. All the flasks were maintained at different pH values ranging from 3 to 9 for 30 days at ambient temperature. At the end of the incubation period the whole cultures were centrifuged at 4000 rpm for 10 minutes and the supernatant was analyzed for the removal efficiency. Experiments were performed in triplicates and average values were used in the results.

Effect of different inocula sizes on BOD and COD reduction

The effect of different inocula sizes at 0.1 - 1 % (v/v) on bio-treatment of CM wastewater was investigated. Experiments were performed in triplicates and average values were used in the results.

RESULTS

CM wastewater Physico-chemical characteristics

As shown in Table 1, the results of physico-chemical characters of CMW samples were recorded. The color of samples was dirty white to creamy having an offensive odor. The pH values ranged from 5.5 which may be attributed to the presence of detergents (caustic and washing soda extensively used in the dairy industry for washing purposes etc.) in varying concentrations. The temperature of the sample ranged between 28-30ºC.The permissive ranges of the CM wastewater that could be discharged into public sewer or into inland surface water were recorded as mentioned by Das and Paul (2022). All the recorded parameters were not suitable to be discharged neither into public sewer nor into inland surface water.

Characterization of treated CM effluent

Table 2 shows the data obtained from physicochemical analyses of treated CMW, after the action of *Saccharomyces cerevisiae* ATCC 9763 strain as well as the removal efficiency percentage. Results showed that the color of CMW has been changed. After complete treatment, it turned from creamy white to almost clear.

*p*H

The obtained results from Table 2 and Fig. 1 showed that values of *p*H moved to be almost neutral (6.5) in the treated CM effluent. It was thought that the activity of the yeast strain has a direct effect on the changes of *p*H values.

Electric conductivity (EC)

Understanding electric conductivity is essential for assessing water quality, as it serves as an indicator of dissolved ions and pollutants present in a given water sample. Monitoring and controlling electric conductivity can help detect potential contamination and ensure safe drinking water for communities. It was obvious, after cultivation of *Saccharomyces cerevisiae* ATCC 9763(Table 2 and Fig. 1), great reduction in EC values was observed. The yeast strain showed RE percent (88%) in EC.

Turbidity

After bioremediation process (Table 2 and Fig. 1), it could be observed that RE of turbidity was 92%. Turbidity may be decreased due to the consumption of organic substances and suspended impurities by *Saccharomyces cerevisiae* ATCC 9763 through growth and survival.

Total suspended solids

Results in Table 2 and Fig. 1indicated the ability of *Saccharomyces cerevisiae* ATCC 9763 for removing of TSS, where the removal percentage of TSS was 97%.

Total dissolved solids

There is no doubt that the main cause of high levels of TDS in dairy effluent is the presence of organic as well as inorganic substances, including chlorides, carbonate, bicarbonate, nitrate, phosphate, sulfate, sodium, magnesium and calcium, etc. The present experiment (Table 2 and Fig. 1) showed that TDS overall removal was 77%.

Fat, oil and grease

This experiment indicates that whether the treatment process is highly efficient in removing fats, oils, and grease from the wastewater or not. The obtained results confirmed that the maximum RE of FOG was achieved at 93% (Table 2 and Fig. 1).

Biological oxygen demand

Results in Table 2 and Fig. **1**revealed aeration play a crucial role in enhancing the performance of wastewater treatment systems and efficiently reducing BOD levels. In the present study all the flasks were incubated under shaking which provided a good aeration condition for the cultivated yeast strain. The reduction in BOD was observed after the treatment process and the overall removal percent 86% was resulted.

Table 1: The Physico-chemical characteristics of untreated CM wastewater

Parameter	Average ± SD	Unit	Discharge effluent standards	
			Into public sewer	Into inland surface water
Physical				
Color	Dirty white to creamy	NA*	NA	NA
Odor	offensive	NA	NA	NA
*p*H	5.5 ± 0.75	NA	5-5.9	5-5.9
Temperature	28-30 ± 1.2	°C	NA	NA
Turbidity	1120 ± 27.4	NTU	NA	NA
Electrical Conductivity (EC)	597± 0.43	µS/cm	NA	NA
Chemical				
Total Suspended Solids (TSS)	937 ± 4.8	mg/L	600	100
Total Dissolved Solids (TDS)	2822 ± 3.7	mg/L	2100	2100
Fat, Oil and Grease (FOG)	136± 7.81	mg/L	20	10
BOD_5	1432± 15.22	mg/L	350	30
COD	1824± 27.16	mg/L	NA	250
Total Nitrogen (TN)	538 ± 1.6	mg/L	NA	100
Phosphate	456 ± 2.22	mg/L	524.94	NA
Sulphate	79± 4.13	mg/L	1000	1000

*NA= Not available

Table 2: Physicochemical parameters of treated CM effluent After 30 days of treatment with *Saccharomyces cerevisiae* ATCC9763

Parameter	Unit	Average ± SD		Removal Efficiency (%)
		Before treatment	After Treatment	
Color	NA*	Dirty white to creamy	Almost clear	NA
Odor	NA	offensive	Odorless	NA
pH	NA	5.5 ± 0.75	6.5± 0.05	NA
Temperature	°C	28-30 ± 1.2	28-30± 0.98	NA
Turbidity	NTU	1120 ± 27.4	89± 1.21	92
EC	µS/cm	597± 0.43	67± 3.54	88
TSS	mg/L	937 ± 4.8	12± 1.34	97
TDS	mg/L	2822 ± 3.7	320± 4.33	77
FOG	mg/L	136± 7.81	9± 0.22	93
BOD_5	mg/L	1432± 15.22	212± 5.13	86
COD	mg/L	1824± 27.16	311± 6.45	83
TN	mg/L	538 ± 1.6	79± 2.75	85
Phosphate	mg/L	456 ± 2.22	35± 1.98	92
Sulphate	mg/L	79± 4.13	34± 1.66	57

*NA= Not available

Chemical oxygen demand

The data shown in **Table 2** and represented graphically in **Fig. 1;** the maximum removal of COD was similar to results of BOD where overall removal percent of 83% was observed.

Total Nitrogen

Obtained results in **Table 2** and **Fig. 1** revealed that TN overall removal percent was about 85% after treatment of CM wastewater.

Phosphate

Results from **Table 2** and **Fig. 1** indicated that phosphate constituted about 92% after treatment of CM wastewater.

Sulfates

The negative effects of high concentrations of sulfates in CM wastewater may cause offensive odor and, in some circumstances, may lead to corrosion of sewer systems and formation of hard scales in heat exchangers and boilers. The present results shown in **Table 2** and **Fig. 1** represented the maximum removal percent of sulphate to

57%.

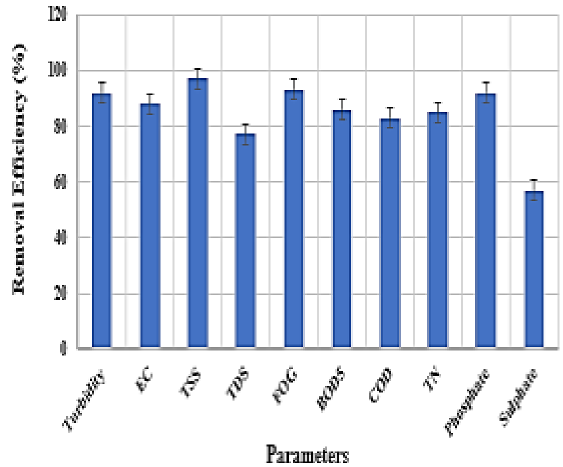

Figure1: Removal Efficiency (%) of CM wastewater after treatment with

Reduction efficiency (%) of BOD and COD using *Saccharomyces cerevisiae* ATCC9763

Percent reduction efficiency of BOD and COD for all the isolates is presented in **Fig. 2**. Results revealed the maximum reduction in BOD and COD values was 27 and 94 mg/l for BOD and COD respectively on day 21 and remained constant till day 30.

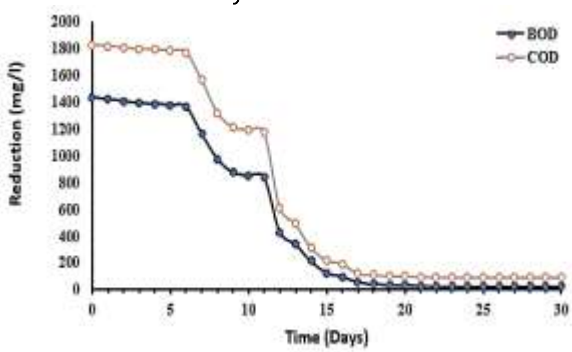

Figure 2: Reduction in BOD and COD for different incubation times (days) using *Saccharomyces cerevisiae* ATCC 9763

Biodegradation index

Our results showed that the higher concentrations of BOD_5 as well as COD in the beginning of the experiment represented a higher toxicity of the CM wastewater (BI value was 0.79> 0.3) which gradually decreased until reaching values of 0.24. At this final BI value, the CM treated water was said to be less toxic during the different treatment days (**Fig. 3**).

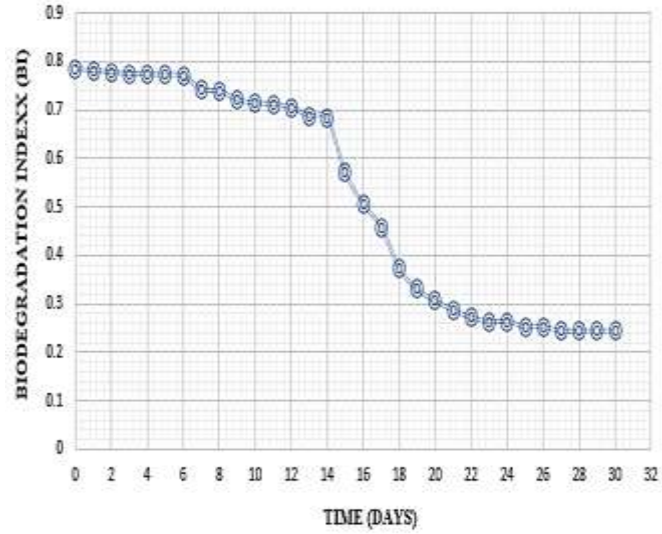

Figure 3: The biodegradation index (BI) calculated from the variations in BOD_5 and COD during different treatment days.

Biological treatment optimization

Effect of pH on the reduction (%) of BOD and COD

The tested strain of ***Saccharomyces cerevisiae* ATCC9763** grew in different pH ranges of 3.5 - 9.5showed an optimum pH of 6.5 where the reduction (%) was 93 and 84% for BOD (101 mg/l) and COD (298 mg/l) respectively (**Fig. 4**). Based on such results the yeast strain preferred the aciduric condition but slightly tended to be neutral.

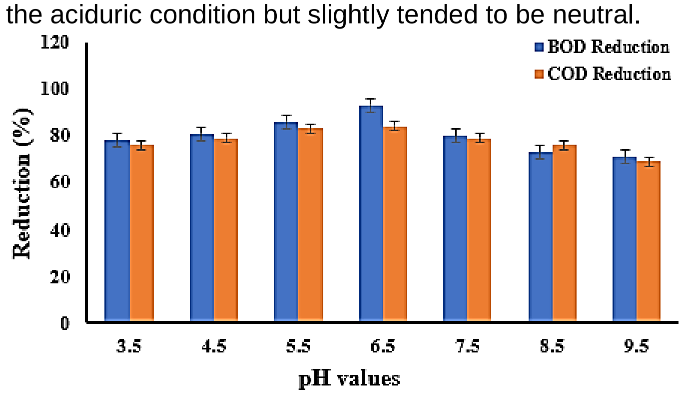

Figure 4: Effect of pH on the reduction percentage (%) of BOD and COD.

Effect of different inocula sizes on the reduction (%) of BOD and COD

As shown in **Fig. 5**, the maximumBOD_5 and COD reduction (%) was exhibited by 0.3 % (v/v) inoculum size i.e., 93 and 84 % for BOD_5 and COD respectively (**Fig. 5**). Using more than that optimum inoculum level showed a decrease in reduction percentage level that may be contributed to the competition between the yeast cells.

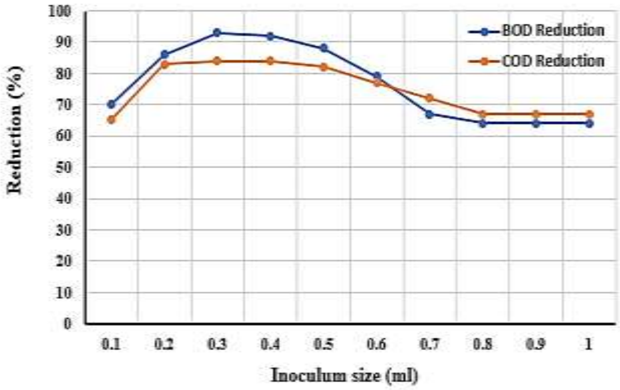

Figure 5: Effect of different inocula sizes on the reduction (%) of BOD and COD

DISCUSSION

Among the present study, *Saccharomyces cerevisiae* ATCC9763 strains showed its ability to degrade pollutants found in CM wastewater since they exhibited high bioremediation capability. *S. cerevisiae* ATCC9763 in the present study was used for the treatment of cheese manufacturing wastewater. Similarly, Kaur (2013) stated that applying yeasts mainly *Candida, Saccharomyces, Kluyveromyces* sp. for bioremediation purposes can offer a sustainable and eco-friendly solution to wastewater management. So, the primary aim of this study was to investigate the effectiveness of *S. cerevisiae* ATCC 9763 in bioremediation and treatment of CM effluents, specifically focusing on its ability to reduce harmful contaminants and improve overall water quality.

Regarding to the resulted data of the physicochemical characters for raw CM effluent, it was obvious that the resulted data were in accordance with findings of Passeggi et al. (2009) who stated that the wide pH range (from 4.7 to 12.2) highlights the importance of carefully monitoring and adjusting the pH levels in dairy wastewater treatment processes. Maintaining optimal pH levels can help to increase the efficiency of treatment processes and minimize any negative environmental impacts associated with the discharge of untreated or poorly treated dairy wastewater.

Untreated CM wastewater during the present study showed slight acidity (5.5 ± 0.75). The acidity characteristic of such CMW could be attributed to the presence of milk lactose which is considered as a source of acidity since it could be broken down into lactic acid in the raw CM wastewater (Kolev Slavov,2017).

Raw untreated dairy manufacturing wastewater could cause many environmental issues especially on soils, water sources as well as microflora (Bako et al. 2008). Furthermore, TSS is one of the crucial factors in wastewater treatment determination since it is used to study the effectiveness of wastewater treatment processes. Results of CM wastewater showed that there were high values of TSS (937 ± 4.8). Accordingly, Porwal et al. (2015), recorded high values of TSS (626.6±8.79). The presence of high concentrations of TSS in dairy effluents originates from gelatinous milk and flavorings (Al-Wasify et al. 2017).

BOD is considered as the main indicator of water quality. BOD is one of the most widely used indicators of water quality. The present CMW showed high amounts of BOD (1432± 15.22 mg/L). Kolhe et al. (2009) stated that dairy wastewater has higher concentrations of BOD where it contains considerable amounts of nutrients, lactose, fats, casein, inorganic salts and sanitizing agents.

Results of the values of physicochemical parameters of CM effluent showed that the color of CM wastewater has been altered, where it was dirty white to creamy while after completed the bioremediation process, it changed to almost clear. The main cause of such improvement of CMW color could be attributed to the biological breaking down caused by microorganisms (Al-Wasify et al. 2017).

The physicochemical parameters of treated CM effluent after treatment showed that pH values moved towards neutrality using *S. cerevisiae* ATCC 9763. Porwal et al. (2015), studied the use of microbial cells isolated from activated sludge in the bioremediation of dairy wastewater where they observed the same changes in pH values. These changes in pH readings could be explained as the capabilities of microbial cells to accumulate some organic acids at the end of the treatment process (Kowsalya et al. 2010).

Subsequently, a great reduction in electric conductivity (EC) values was observed. EC is one of the most important parameters that could be used in the quantitative determination of ionic constituents as well as detection of impurities found in water. *S. cerevisiae* ATCC 9763 showed EC removal percent of 88%, this reduction could be attributed to the ionic consumption caused by the activity of the microbial strain for its growth and other metabolic duties as explained by Porwal et al. (2015).

Another crucial parameter was turbidity which is used to evaluate the quality of water especially for disinfection processes. After treatment of CM wastewater by *S. cerevisiae* ATCC 9763, it could be clearly observed that turbidity removal efficiency was 92%. Decrease in turbidity may be caused by the consuming of organic matters and suspended materials by the microorganisms during their growth as well as survival. Similarly, Cosa & Okoh (2014) recorded a reduction in turbidity (83.3) by using a consortium of marine individual species.

The presence of organic as well as inorganic matters in dairy wastewater are the most considerable cause of high concentrations of TDS in such water. These concentrations reduce the possibility of using water in drinking, irrigation and industrial applications. The present result revealed that the maximum removal percent of TDS was 77%for *S. cerevisiae* ATCC 9763. Similarly, Shruthi et al. (2012), treated rubber processing wastewater with a reduction rate of 68.8% in TDS using *Pseudomonas* sp.

Results for total suspended solids indicated that the ability of *S. cerevisiae* ATCC 9763 to remove high concentrations of TSS, since the overall removal percent of TSS was found to be97%. The removal efficiency could be related to the consumption of organic constituents of the wastewater by microbial cells. Gaikwad et al. (2014) recorded reduction in TSS with maximum removal rate of79.76% using microbial consortia for treatment of industrial wastewater.

The results also showed that, using of shaking flasks offered more aeration to the yeast culture which was the crucial item in the reduction of BOD where most of microbial communities are in demand for oxygen to complete the metabolism of organic matters needed for their growth and other activities. The removal efficiency of BOD in the present study was 86%. Suman & Santra (2010) observed a maximum reduction (69.6%) in BOD using bacterial isolates.

Subsequently, the resulted overall removal percentage of COD (83%) was observed at the end of the treatment process. The resulted observations were in agreement with the results reported by Sreemoyee & Priti (2013). Reduction in COD could be due to the presence of high concentrations of nutrients as well as dissolved organic materials that could be easily consumed by the microbial cells.

Estimation of FOG through the process of wastewater treatment is of great importance as they resemble the efficiency of the process settlement. According to the present results, the maximum removal percent of FOG (93%) was observed after the CM wastewater treatment using *S. cerevisiae* ATCC 9763. Similarly, Kaur (2013) observed results near to the present result when used *Kluyveromyces marxianus*, while the maximum COD reduction was 80 %.

The presence of high concentrations of sulfates in wastewater may lead to bad odor (due to the formation of hydrogen sulfides) as well as corrosion of sewage pipes and systems when anaerobic conditions become available. In the present study, the maximum removal percent of sulfate was 57% using*. cerevisiae* ATCC 9763. Saranraj & Stella (2012) and Porwal et al. (2015), found that similar results of sulphate reduction were achieved when sugar mill wastewater was treated by using several bacterial species.

To study the effect of different incubation times on the maximum reduction of both BOD as well as COD, 27 and 94 mg/l were observed for BOD and COD respectively at day 21 and remain constant till day 30. On a similar study, Abioye et al. (2014) found that, *Saccharomyces cerevisiae* showed the most significant reduction in BOD (280mg/L) and COD (700mg/L) from textile effluent after 20 days of incubation period.

The present result showed that the higher concentrations of BOD_5 as well as COD in the beginning of the experiment represented a higher toxicity of the CM wastewater (BI value was 0.79 > 0.3) which gradually decreased until reaching values of 0.24. At this final BI value, the CM treated water was said to be less toxic during the different treatment days. Perez & Torres (2008) studied the physical-chemical profile of Cheese Whey Wastewater (CWW) and they found that there was a great potential to treat CWW an aerobically, since it presents a high BI (0.98) > 0.3, which turned to 0.35 ± 0.05 After the treatment process.

For optimization of the bioremediation process by *Saccharomyces cerevisiae* ATCC9763, different pH ranges of 3.5 - 9.5 were tested and since, the yeast strain showed an optimum pH of 6.5 where the reduction (%) was 93 and 84% for BOD (101 mg/l) and COD (298 mg/l) respectively. Similarly, Kaur (2013) found that pH at different ranges of 5.0, 6.0, 7.0 was effective for maximum reduction of BOD and COD in a process of dairy effluent bioremediation of using *Kluyveromyces marxianus.*

The present results showed that the optimum inoculums size was 0.3% (v/v) for maximum reduction of BOD_5 and COD. Using more than that optimum inoculums level showed a decrease in reduction percentage level that may be contributed to the competition between the yeast cells (Kaur, 2013).

In the present study, the maximum reduction of BOD, COD, and oil content were achieved by using *Saccharomyces cerevisiae* ATCC9763 for the treatment only without the need of chemical processes to be used, confirming the superiority of the proposed treatment efficiency, especially at the very high Oil Content and COD concentrations in the raw dairy manufacturing effluents.

CONCLUSION

From the present study, it could be concluded that:

Bioremediation of cheese manufacturing wastewater is a promising treatment process.

Industrial wastewater that contains Oily constituents showed clearly high concentrations of many tested contaminants, mainly organic as well as inorganic matters, giving it the consideration to be the harder industrial effluents to be treated which making many issues that facing the researchers who are interested to work in this field which reflects many negative effects on the surrounding environment.

The present strain *(S. cerevisiae* ATCC9763) showed a highly effective pattern in bioremediation of CM wastewater.

CONFLICT OF INTEREST

The authors declared that the present study was performed in absence of any conflict of interest.

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AUTHOR CONTRIBUTIONS

All authors contributed to the design and implementation of the research, to the analysis of the results and to the writing of the manuscript.

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