PERFORMANCE OPTIMIZATION OF MICROBIAL REMEDIATION OF DAIRY INDUSTRY WASTEWATER USING *MORINGA OLEIFERA* SEEDS AND *PSIDIUM GUAJAVA* LEAVES

Short Title:

Treatment of Dairy Wastewater Using Modified Bacterial Consortium Modified with *Moringa oleifera* Seeds and *Psidium guajava* Leaves

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ABSTRACT

- **Problem statement:** The study aimed to investigate the impact of natural and environmentally friendly materials, such as ***Moringa oleifera*** seeds powder and/or ***Psidium guajava*** leaves extract amendment on microbial efficiency and bioremediation performance of dairy industrial wastewater.
- **Methods:** Water samples were collected from a dairy factory in **New Borg Al-Arab city, Alexandria** Governorate, **Egypt** during the study. ***Moringa oleifera*** seeds powder and ***Psidium guajava*** leaves extract were prepared and their effects on bacterial remediation (using **R1 & R3** mixed culture) were investigated individually at **1, 2, 3** and **0.5, 1, 1.5** g/l, respectively. Then their optimum doses of **3.0** and **1.5** g/L, respectively were investigated at room temperature in combination with the bacterial remediation to evaluate their effects in enhancing microbial treatment and compared with their control samples under the same conditions. Residual concentrations (**RCs**) or density (CFU/mL) of quality parameters {**pH, BOD, COD, TSS, TDS, O&G** and total viable count of bacteria (**TVCB**)} were determined at each exposure time in the raw and treated wastewater and their removal efficiencies (**REs**%) were calculated. The efficiency and feasibility of the proposed treatments towards the tested industrial wastewater were discussed and compared.
- **Results:** Raw dairy wastewater contains very high levels of **COD** (**12550** mg/l), **BOD** (**5211** mg/l), **OG** (**317** mg/l) and high levels of **TSS** (**912** mg/l) and **TDS** (**1621** mg/l) as well as low **DO** level (**0.68** mg/l). Using ***Moringa oleifera*** seeds (**MO**) and ***P. guajava*** leaves extract (**PG**) with bacterial mixed culture **(R1+R3)** in combination (**MO/PG** -modified bacterial mixture) achieved the highest removal efficiency of **BOD (93.84%), COD (91.31%), OG (54.57%), TSS** (**94.85%**) and **TDS** (**87.79%**) as well as **DO** increase **(616.18%)**. As expected also, the control (unseeded wastewater) showed the lowest activity towards the dairy effluent's contaminants confirming the superiority of combined seeds and leaves extract with bacteria.
- **Conclusion:** Removal efficiencies achieved by the proposed microbial consortium modified with natural plants achieved much better results than unmodified bacteria. Results also confirmed the important role played by the bioactive compounds extracted from the agro wastes in improving the biological treatment efficiency and producing high quality effluents, complying with the environmental regulations for the safe drainage into open environment or potential reuse.
- **Recommendations:** The proposed biological treatment modified with ***Moringa oleifera*** powder and ***Psidium guajava*** leaves extract in combination is highly recommended for decontamination of dairy wastewater and

similar streams due to its high capacity for removing large amounts of organic matter, the major contaminants in dairy wastewater.

Key Words: Agro Waste, Dairy Industrial Wastewater, Microbial Remediation, *Moringa oleifera*, *Psidium guajava*, Upgrading Effluent Quality

VII. CONCLUSIONS & RECOMMENDATIONS

CONCLUSIONS

1. Among the tested bacteria, **R1** and **R3** mixed culture proved to be the most promising for either minimization or decontamination of pollution load (mostly organic) from dairy wastewater.
2. **R1**, **R2** and **R3** were molecularly identified as ***Bacillus cereus* ATCC 14579, *Bacillus aureus strain 24K*** and ***Bacillus cereus* ATCC 14579** with accession numbers of **NR-074540.1, NR-118439.1** and **NR-074540.1** and similarity of **99.64, 99.36** and **98.96%** to the closest neighbours.
3. **R1** and **R3** mixed culture proved to be the most promising for either minimization or decontamination of pollution load (mostly organic) from dairy wastewater.
4. Bacterial mixed culture **(R1** and **R3)** modified with **MO** seeds powder at **3.0** g/l achieved the highest removal efficiency of **BOD** (**85.20), COD (84.88**%), **OG** (**35.40%)**, **TSS** (**71.44 %**) and **TDS** (**84.30 %)**, as well as **DO** increase of **330.51%**.
5. Bacterial mixed culture **(R1** and **R3)** modified with **PG** leaves extract at **1.5** g/l achieved the highest removal efficiency of **BOD** (**87.87%), COD (80.09%), OG (42.93%)**, **TSS** (**84.81%**) and **TDS** (**67.65%)** as well as **DO** increase **(533.90%)**.
6. The **MO (3.0** g/l**)/PG** (**1.5** g/l) - modified bacterial mixture achieved much higher removal efficiencies compared to using **MO** or **PG** on an individual basis with microbial remediation. They reached **RE** of **BOD** (**93.84%), COD (91.31%), OG (54.57%), TSS** (**94.85%**) and **TDS** (**87.79%)** as well as **DO** increase **(616.18%)**.