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# PHARMACO-CHEMICAL ANALYSIS OF INDUSTRIAL WASTEWATERS

**Atul R. Chopade, N. S. Naikwade, A. Y. Nalawade, V. B. Shinde and K. B. Burade***
Appasaheb Birnale College of Pharmacy, South Shivaji Nagar, Sangli-Miraj Road, Sangli-416 416, Maharashtra, India
*Govt. College of Pharmacy, Vidyanagar, Karad-415 124, Maharashtra, India

## ABSTRACT

The industrial wastewater contains various biological, organic and inorganic pollutants, and less information is known about their direct effects on human beings. The industrial wastewaters randomly collected from different industries, located at Ogalewadi and Malkapur areas of Karad, were used as test samples. Isolated rectus abdominus muscle preparation was used to study the pharmacological effects of the industrial wastewaters as simulation for the human effects. The composition of the industrial wastewaters was analyzed for its various parameters using standard analytical methods. The results demonstrated the effects of industrial wastewaters on the rectus muscle of frog, which indicates the toxic nature of the wastes. The study helps to elucidate the effects of industrial wastewaters on the vital human functions and will provide information for the management of pollution control.

## INTRODUCTION

The industries, which are burgeoning at a fast rate, produce about 55,000 million $m^3$ of wastewater per day, out of which 68.5 million $m^3$ is discharged into rivers and streams (http://www.wrmin.nic.in). In case of industrial units, effluents in most of the cases are discharged into pits, open ground or open unlined drains near the factories, thus allowing them to move to low lying depressions resulting in the ground water pollution. Although the industrial sector accounts for only 3% of the annual water withdrawals in India, its contribution to the water pollution, particularly in urban areas, is considerable. Water pollution is a serious problem as almost 70% of India's surface water resources are polluted by biological, organic and inorganic pollutants, which have also contaminated a growing number of its groundwater reserves (http://www.devalt.org/water/waterinindia/issues.htm). Pollution of surface and groundwater resources occurs through point and diffuse sources. Examples of point sources are effluents from industries and sewage treatment plants. As the presence of metal ions in the natural waters, wastewaters and other environmental bodies show different types of severe adverse effects on human beings (Table 1), by considering this view analytical and pharmacological parameters were taken into account to evaluate the biological effects of the industrial wastewaters. The isolated rectus abdominus preparation method was used in the present study as it is used for assaying various drugs, biological substrates, plant extracts and newly developed chemical agents (Crossland 1980). There is no such report of wastewater study using animal model. Therefore, it was through worthwhile to consider the evaluation of the biological and pharmacological activity of the industrial wastewaters as a simulation for the human effects.

## MATERIALS AND METHODS

The industrial wastewater, randomly collected from the different industries located at Ogalewadi (samples A, B, C, D, F & G), Malkapur (sample E & J), and Agashivnagar (sample H & I) areas, were used as test samples. Samples were mainly collected from the small-scale metal industries, workshops manufacturing spare parts, raw materials, electrical items and accessories. The industrial wastewaters, randomly discharged into open grounds, pits and open unlined drains near the industry premises, were used for the pharmacochemical analysis in the present study. The isolated rectus abdominus muscle preparation of frog was used as the animal model for the evaluation of the pharmacological effect of the industrial wastewater in the present study. The modified methodology by Gandhi & Goyal (1991) and Pillai (1999), previously quoted by Crossland (1981) and Quastel (1961) was used for the evaluation of pharmacological effects of industrial wastewaters. The quantitative doses of industrial wastewater samples were administered and the responses were recorded on a kymograph, which was later fixed with the help of colophony and then responses were interpreted. The test samples were also analyzed for their chemical composition and presence of heavy metals by standard analytical methods (APHA 1976).

## RESULTS AND DISCUSSION

Pharmacological studies showed that the samples A, B, C, D and E of the industrial wastewaters have significant skeletal muscle contraction activity, on the isolated rectus abdominus muscle of frog, in the doses administered (Table 2, Fig. 1). The study, therefore, revealed that the industrial wastewaters have biohazardous pharmacological effects or bioeffects (Fig. 2). The chemical analysis of industrial wastewaters showed increase in concentration of inorganic contents, heavy metals, COD, TDS, hardness and conductivity, while decrease, in pH of the samples A, B, C, D and E which showed significant bioeffects of toxic nature. Samples F, G, H, J and I did not show any bioeffects on the rectus abdominus muscle of the frog (Table 3). The toxic actions of metal ions occur at cellular or the subcellular level and the toxicity of metal ions is due to one of the three mechanisms.

1. Blocking of essential biological active sites of the biomolecules.
2. Displacement of the essential metal ions in biomolecules.
3. Modification of the structure of the biomolecules (Sigel 1973, Hockstra et al. 1974).

Every metal ion is potentially toxic if the range of the safe and adequate exposure needed to maintain optimum tissue concentration is exceeded. The most dangerous heavy metals are Hg, Pb, Cd and metalloids of As, Be, Sb.

The results indicate the dose dependent effects of heavy metal ions on the rectus muscle of frog and may help in understanding the complex toxicological properties of the heavy metals in different species and tissues, and will provide information for management of pollution. However, as it stands, the present work is a routine and preliminary study, and is going to form a part of more comprehensive in-depth study. The systems of reusing wastewater by giving increased effort to develop and

Table 1: Toxic effects of metal ions on human health.

| Metal ions | Source | Toxic effects |
|---|---|---|
| Lead | Industrial waste, mining, coal, water pipes, auto exhaust, roadside dust | Anemia, kidney damage, nervous disorder and brain damage |
| Cadmium | Industrial discharge, mining, metal plating, water pipes, tobacco smoke | High blood pressure, kidney and liver damage, destruction of testicular tissue and red blood cells, cancer metabolic disorders, anemia |
| Nickel | Fuel oil, coal, steel alloys, catalyst | Lung cancer, graying of hair |
| Zinc | Industrial wastes, metal plating, plumbing, industrial smoke | Lung damage, anemia, retarded growth, cough, headache |
| Fluorides | Industrial wastes, scrubbing of the flue gases, glass etching, metal plating | Dental and skeletal fluorosis |

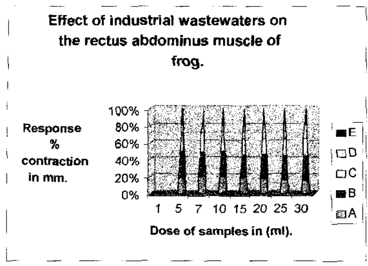


Fig. 1: Effect of industrial wastewaters on the rectus abdominus muscle of frog.

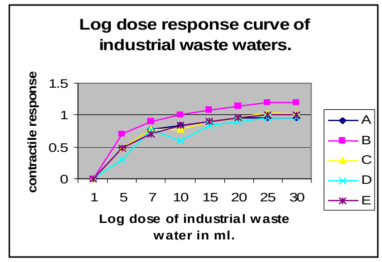


Fig. 2: Log dose response curve of industrial wastewaters.

Table 2: Wastewater analysis of samples showing the toxic effects.

| Parameters | Industrial waste water samples | | | | |
|---|---|---|---|---|---|
| | A | B | C | D | E |
| Conductivity | 803 | 923 | 906 | 855 | 899 |
| pH | 5.6 | 5.1 | 5.4 | 5.5 | 5.2 |
| COD | 170 | 205 | 181 | 153 | 141 |
| TDS | 721 | 828 | 785 | 655 | 647 |
| Hardness | 401 | 403 | 396 | 350 | 381 |
| Total Alkalinity | 320 | 295 | 310 | 355 | 365 |
| Chlorides | 580 | 750 | 612 | 521 | 620 |
| Magnesium | 73 | 89 | 81 | 79 | 66 |
| Sodium | 120 | 255 | 183 | 173 | 189 |
| Lead | 115 | 1.26 | 1.03 | 1.10 | 1.18 |
| Cadmium | 2.23 | 2.81 | 2.52 | 2.61 | 2.75 |
| Nickel | 2.52 | 3.07 | 2.75 | 2.41 | 2.41 |
| Zinc | 18.50 | 22.32 | 19.03 | 17.60 | 21.10 |
| Fluorides | 2.47 | 2.64 | 2.37 | 2.63 | 2.23 |

Values in mg/L except conductivity (μmho/cm) and pH.

Table 3: Wastewater analysis of samples which did not show the toxic effects.

| Parameters | Industrial waste water samples | | | | |
|---|---|---|---|---|---|
| | F | G | H | I | J |
| Conductivity | 700 | 615 | 795 | 766 | 680 |
| pH | 7.1 | 8.9 | 6.8 | 6.9 | 7.9 |
| COD | 59 | 48 | 80 | 88 | 51 |
| TDS | 419 | 359 | 463 | 440 | 390 |
| Hardness | 330 | 300 | 390 | 350 | 315 |
| Total Alkalinity | 450 | 401 | 450 | 500 | 550 |
| Chlorides | 415 | 410 | 510 | 390 | 485 |
| Magnesium | 45 | 49 | 53 | 41 | 64 |
| Sodium | 52 | 71 | 51 | 63 | 59 |
| Lead | 0.4 | 0.1 | 0.6 | 05 | 0.3 |
| Cadmium | 0.7 | 0.3 | 1 | 0.8 | 0.5 |
| Nickel | 0.1 | - | 0.6 | 0.4 | 0.3 |
| Zinc | 8 | 4 | 12 | 9 | 5 |
| Fluorides | 0.1 | 0.05 | 0.4 | 0.2 | 0.3 |

Values in mg/L except conductivity (μmho/cm) and pH.

implement new technologies for the removal of toxins from wastewaters are being given emphasis. Also numerous effective methods and technologies have been developed in the past for wastewater treatment (Besselievere 1968), which are capable of reducing the cost and complexities of wastewater treatment, without sacrificing the requirements of the pollution control. Thus, strict vigilance is the need of the hour, for proper treatment of industrial wastewaters as these exert negative effects on human health, aesthetics and ecosystems.

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