Role of Molly fish on detoxification of waste water collected from Ori-plast limited, Balasore, Odisha.

[2]Abhilipsa Das, [2]Yashashwi Nayak, [1*]Atia Arzoo
1.Department of Environmental Science and 2.Department of Zoology
School of Applied Sciences, Centurion University of Technology and Management, Odisha, India

Abstract

Molly fish can survive in diversified habitat like fresh water, brackish water and saline water of different temperature, hardness and acidity. So in this present study Molly fish was taken as experimental fish. In this present study waste water from Oriplast limited, Balasore, Odisha were collected. The water samples were subjected to treated with Molly fish. Different physico-chemical parameters such as pH, electrical conductivity, total soluble solid, total dissolved solid and total solid and different elemental concentration of both untreated water and treated water were analyzed. From this experiment, it was observed that the level of pH, Fe, Eu and Er was found to be decreased and electrical conductivity, total suspended solid, total dissolved solid, total solid, Si, P, Cl, Ca, Co, concentration were found to be increased with the application of Molly Fish. But all the parameters were found within the permissible limit. Elemental analysis of control Molly fish and treated Molly fish were analysed and it was found that the concentration of Si, S, K_2O, Ti, Mn, Fe, Cu, Rb, Zr and Er were increased and P, Cl, Ca, Co, Zn, Br, Sr, Ce, were decreased. It was also observed that no harmful impact were fall on Molly fish by this waste water, so it can be suggested that Molly fish can be cultured in Oriplast waste water. As Molly fish neutralizes the waste water, so it can be used for the detoxification of water.

Key words: Molly fish, waste water, physico-chemical parameters

Introduction

Ori-Plast Limited is eastern India's largest PVC and PE Pipes and Fitting manufacturer with state- of-the-art ISO 9001 certified manufacturing plants in Balasore (Odisha).The four advanced plants are powered by world class technology and complement by extensive facilities for R&D and new product development. In fact, Ori-plast is credited with lunching of several innovative PVC and PE product in India. The oldest plant , located at Balasore in Odisha, is spread on a sprawling six acre campus with over 1,00,000 sq. ft of covered shed area housing 15 extrusion plants, 9 injection moulding machines and allied state- of - art machinery.

Environmental pollution with toxic metals has increased dramatically since the onset of the industrial revolution (Voegelan *et. al*., 2003).Pollution of heavy metals in aquatic environment is a growing problem worldwide and currently it has reached an alarming rate. Heavy metals occur in the soil in soluble form and in combined state. However, only soluble, exchangeable and chelated metal species in soils are mobile and hence more available in water. As heavy metals cannot be degraded, they are continuously being deposited and incorporated in water, thus causing heavy metal pollution in water bodies. The presence of heavy metals in the water may have a profound effect on the microalgae which constitute the main food source for bivalve molluscs in all their growth stages, zooplankton (rotifers, copepods, and brine shrimps) and for larval stages of some crustacean and fish species. Metals like aluminium, arsenic, cadmium, cobalt, chromium, copper, lead, manganese, mercury, nickel, selenium and zinc have been considered as the major environmental pollutants (Ross, 1994) and their toxicity on plants has already been established (Cseh, 2002 and Fodor, 2002). Some heavy metals like Fe, Cu and Zn are essential for plants and animals (Wintz et. al., 2002). Other metals like Mn, Mo and Co are essential micro-nutrients (Reeves and Baker, 2000), whose uptake in excess to the plant requirements result in toxic effects (Monni et.al, 2000; Blaylock and Huang, 2000). In this present study waste water of Oriplast limited area was collected and different physico- chemical parameters of water bodies were analyzed. In this study Molly fish has taken as experimental fish for remediation of pollutants.

Materials and methodologies

Water samples were collected from Ori-Plast Limited, Balasore, Odisha and different physico-chemical parameters like pH, electrical conductivity, total dissolved solids, total suspended solid, total solid and elemental content were analyzed (APHA, 2005).

Results and Discussion

In this present study different physico-chemical parameters like pH, electrical conductivity, total dissolved solids, total suspended solid, total solid and elemental content of both untreated water and water sample treated with Molly fish were analyzed and shown in table-1 and 2.

pH: The pH values in initial waste water samples were mostly found 8.4 which were considered to be slightly basic. The pH the sample is well within the limit prescribed by WHO (2004) for various uses of water. The pH value of waste water sample after treatment was found to be 7.95 which was slightly basic. From this treatment it was observed that the water sample was neutralised after treatment.

Electrical conductivity: The measurement of electrical conductivity is directly related to the concentration of ionized substance in water and may also be related to problems of excessive hardness or other mineral contaminants. The conductivity values in initial waste water sample was found to be 513 µmho/cm whereas after treatment it was increased to 593 µmho/cm.

Total dissolved solid: In natural water dissolved solids consists mainly of inorganic salts such as carbonates, bicarbonates, chlorides, sulphates and nitrates of calcium, magnesium, sodium, potassium, iron etc. and a small amount of organic matter and dissolved gases. In the present study the value of total dissolved solids in initial waste water was found to be 30g/l. After treatment with Molly fish, the TDS value in treated waste water was found to be 50 g/l**.** The TDS value increased in waste water after treatment of Molly fish.

Total suspended solids (TSS): Total suspended solids (TSS) is the dry weight of suspended particles, that are not dissolved, in a sample of water that can be trapped by a filter. It is a component of the total solids of a water sample with the total dissolved solids being its counterpart.TSS measurements are used in various industries and can be associated with the amount of water pollution in a body of water. For industrial situations, measuring TSS is important because can cause blockage and pipe damage. In the present study the value of total suspended solids in initial waste water of Ori-plast limited was 150 mg/l. The value of total suspended solids after treatment was increased to 200 mg/l.

Total solids (TS): Total solids is a measurement that includes the combination of total dissolved solids and total suspended solids. It is a measurement that is often used in the water treatment industry. Having some degree of total solids in a water sample is not necessarily detrimental to water quality or the organisms that depend on it. Excellent water quality often includes a good balance somewhere between too low a level of total solids and too high a level of total solids. The right kind of solids also need to be present in the water to ensure good water quality. In the present study the values of total solids in initial waste water of Ori-plast limited was 180 mg/l and after treatment by application of Molly fish, it was increased to 250mg/l.

Elemental Analysis Of Waste Water

Silicon (Si): Silicon is an element with symbol Si and atomic no 14.Silicon is very versatile element in earth surface ,as sandy soil and many rocks or silicate are very common. They are commonly regarded as non-toxic to humans and the environment. In this present study Silicon in waste water was found to be 114.92 ppm. After application of Molly fish to that water, Si concentration was found to be increased to 449.97 ppm.

Phosphorus (P): Phosphorus is a chemical element with symbol P and atomic no 15. The main function of phosphorus is in the formation of bone and teeth and also plays an important role in how the body uses carbohydrates and fats. It is also needed for body to make protein for the growth, maintenance, and repair of cell and tissues. If phosphorus levels are too high in water cause increase in fish population and improve the overall water quality. However, if an excess of phosphate enters the waterway, algae and aquatic plants will grow wildly, choke up the waterway and use of large amount of oxygen. Digestive problems could occur from extremely high levels of phosphates. In our present study P found in initial waste water sample was 550.27 ppm. After application of Molly fish the level of phosphorus was found to be increased to 578.95 ppm.

Chlorine (Cl): Chlorine has long been used to disinfect our drinking water because it controls the growth of such unwelcome bacteria as Ecoli and Giardia. In this study chlorine in initial waste water was 267.8 ppm. After water treatment by the application of Molly fish, it was found to be increased to 418.15 ppm.

Calcium (Ca): Calcium is a chemical element with symbol Ca and atomic number 20. Water described as 'hard' contains high amounts of dissolved calcium and magnesium. Hard water is not a health risk but is a nuisance because of mineral build up on plumbing fixtures and poor soap and or detergent performance. Recommendations have been made for the maximum and minimum levels of calcium (40-80 ppm) in drinking water. In this study the calcium level in Ori-plast limited waste water was 237.8 ppm. After treatment with molly fish the calcium level in treated waste water was increased to 242.67 ppm.

Iron (Fe): The desirable limit for iron in water is 0.3 mg/l (WHO, 2004). Iron has been considered to be an essential trace element for human and animal health but in excess it can change the taste, colour and odour of water and it stains the clothes. In this present study the initial waste water sample in Ori-plast limited, iron content was 19.5 ppm but after treatment it was found to be decreased to 18.95 ppm.

Cobalt (Co): Cobalt is beneficial for humans because it is part of vitamin B_{12} which is essential to maintain human health and also helps to treat illness such as anaemia and certain infectious diseases. Too much taken harmful health effects can occur. In present study the calcium level in Ori-plast limited, waste water was 40.5 ppm. After treatment with Molly fish, cobalt level was found to be increased to 54.4 ppm.

Tin (Sn): Inorganic tin compounds causes skin and eye irritation, respiratory irritation, gastrointestinal effects and neurological problems in human but the main effect will depend on the particular organic compound. In this present study the concentration of tin in Ori-plast Limited, waste water was found to be 35.05 ppm. There was no changes in concentration of tin after treatment with Molly fish.

Europium (Eu): Europium metal is a good neutron absorber and used to active red phosphorus in the manufacture of color television picture tubes. In this present study Europium was found in initial waste water was 7.45 ppm. After treatment by the application of Molly Fish europium level was decreased to 3.42 ppm.

Erbium (Er): Erbium has no biological role even if it has been noted that it stimulates metabolism. Erbium isotopes are good neutron absorbers and are used in nuclear reactor control rods and also used in amplifiers and lasers. Erbium poses no environmental threat to plants and animals. In this present study the level of erbium untreated waste water was found to be 239.02 ppm. After application of Molly fish in waste water sample the erbium level was found to be decreased to 221.47 ppm.

Elemental Analysis Of Molly Fish

Fish samples were collected from study site was subjected to grow in water collected from Oriplast site and in tap water. A comparative study on elemental content was analysed (Table-3 and 4).

Silicon Dioxide (SiO_2): Silicon dioxide also known as silica is a natural compound made of two of the earth's most abundant materials silicon (Si) and Oxygen(O_2) . Silicon dioxide is also added to many foods and supplements. It is an essential beauty mineral that helps heal brittle bones, teeth, hair and nails. Exposure to silica- nanoparticles at sub lethal concentration alters the oxygen consumption and therefore impaired oxidative metabolism in fish. Before treatment in normal tape water control Molly fish contained Silicon dioxide 1.395 %. After 15 days of cultured in Ori plast limited, waste water, it was found to be increased to 2.081% in Molly fish.

Phosphorus Pentoxide (P_2O_5): Phosphorus pentoxide reacts in water in the air or body to form phosphoric acid which is an irritant and corrosive. Phosphates don't directly harm to fish, even they are in high level, the algae blooms that result from elevated phosphates can ultimately cause problem for the aquarium inhabitants, however Green water can deplete the oxygen which in turn can harm the fish. In this present study P_2O_5 found in control Molly fish was 22.123%. After 15 days of cultured in Ori plast limited, waste water, it was found to be decreased to 20.542 % in Molly fish.

Sulfur Trioxide (SO_3): Sulfur trioxide (SO_3) is generally colourless liquid. When SO_3 is exposed to air, it rapidly takes up water and gives off white fumes. It can react with water to form sulphuric acid. It is used in manufacture of fertilizers, explosives, other acids and glue, in purification of petroleum. In this present study SO_3 found in control Molly fish was 8.285 %. After 15 days of cultured in Ori plast limited, waste water, it was found to be increased to 9.684 % in Molly fish.

Chlorine (Cl): Fish gills are very chlorine sensitive. A fish in chlorinated water will die slowly. Chlorine in even amount in tap water, gives marine invertebrates and fish chemical burns. Most municipal water companies sterilize their water with chlorine, while relatively harmless to humans but deadly to fish. In this present study Cl found in control Molly fish was 4.477 %. After 15 days of cultured in Ori plast limited, waste water, it was found to be decreased to 4.244 % in Molly fish.

Potassium Oxide (K_2O): Potassium Oxide (K_2O) is an ionic compound of potassium and oxygen. Major uses are production of potassium carbonate, potassium phosphates, liquid fertilizers and potassium soaps and detergents. Together with nitrogen and phosphorus, potassium is one of the essential macrominerals for plant survival. In this present study Potassium Oxide found in control Molly fish was 6.570 % . After 15 days of cultured in Ori plast limited, waste water, it was found to be increased to 7.684 % in Molly fish.

Calcium Oxide (CaO): Calcium Oxide (quicklime) white solid (CaO) made by heating calcium carbonate ($CaCO_3$) at high temperatures. It is used industrially to treat acidic soil and to make bleaching power, caustic soda, mortar and cement. Calcium oxide reacts with water to form calcium hydroxide which solublize in water producing an alkaline solution known as limewater. In this present study Ca found in control fish was 55.317 %. After 15 days of cultured in Ori plast limited, waste water, it was found to be decreased to 53.823 % in Molly fish.

Titanium Dioxide (TiO_2): Titanium is an environmental friendly metal that is easy to recycle. Titanium dioxide nano-particles enhance mortality of fish exposed bacterial pathogens. Nano-TiO2 is immunotoxic to fish and reduces the bactericidal function of fish neutrophils. In present study Titanium dioxide found in control fish was 670.45 ppm. After 15 days of cultured in Ori plast limited, waste water, it was found to be increased to 877.575 ppm in Molly fish.

Manganese Oxide (MnO): Manganese never occurs as a pure element in nature. It always combines with oxygen or other element. Manganese can be consumed from our diet and in our drinking water. Manganese effects occurs mainly in the respiratory tract and in brains. In our present study, MnO found in control Molly fish was 625.6 ppm. After 15 days of cultured in Ori plast limited, waste water, it was found to be increased to 772.57 ppm in Molly fish.

Ferric Oxide (Fe_2O_3) : In this present study Iron oxide found in control Molly fish was 0.453%. After 15 days of cultured in Ori plast limited, waste water, it was found to be increased to 0.812 % in Molly fish.

Cobalt Oxide : Cobalt oxide is an inorganic compound, used extensively in the ceramics industry to create blue coloured glazes and enamels and in the chemical industry for producing cobalt salts. Cobalt is needed in the diet and is found in trace amounts in many foods, excessive exposure may cause pulmonary distress symptoms and dermatitis. In this present study Cobalt oxide found in control Molly Fish was 812.5ppm. After 15 days of cultured in Ori plast limited, waste water, it was found to be increased to 3441.5 ppm in Molly fish.

Copper Oxide (CuO): Cupper is an essential nutrient for our body. Together with iron, it enables the body to form red blood cells and maintain healthy bones, blood vessels, nerves and immune functions. Sufficient copper in the diet may help prevent cardiovascular disease and osteoporosis. In this present study, CuO found in control Molly fish was 118.32 ppm. After 15 days of cultured in Ori plast limited, waste water, it was found to be increased to 191.55 ppm in Molly fish.

Zinc Oxide (ZnO): Zinc oxide is an inorganic compound with the formula ZnO. Industrial sources or toxic waste sites may cause the Zinc amount in drinking water to reach levels that can cause health problems. In this present study, ZnO found in control Molly fish was 0.305 %. After 15 days of cultured in Ori plast limited, waste water, it was found to be decreased to 0.266 % in Molly fish.

Bromine (Br): Bromine is a naturally occurring element that can be found in many inorganic substances. Bromine is corrosive to human tissue in a liquid state and its vapours irritate eyes and throat and very toxic with inhalation. Organic bromines are used as sprays to kill insects and other unwanted pests. In this present study, concentration of Br found in control Molly fish

was 350.62 ppm. After 15 days of cultured in Ori plast limited, waste water, it was found to be decreased to 139.47 ppm in Molly fish. of cultured in Ori plast limited, waste water, it was found to be increased to 2.081% in Molly fish.

Rubidium Oxide (Rb_2O): Rubidium Oxide is a highly insoluble thermally stable compound. Rubidium metals reacts very rapidly with water to form rubidium hydroxide which causes chemical burns of eyes and skins. In this present study Rubidium oxide found in control Molly fish was 129.57 ppm. After 15 days of cultured in Ori plast limited, waste water, it was found to be increased to 140.6 ppm in Molly fish.

Strontium Oxide (SrO): Strontium is an element with symbol Sr and it reacts with oxygen to form Strontium Oxide. Any other form of stable Sr causes cancer in humans or animals. The harmful effects of radioactive Sr are caused by high energy effects of radiation. In this present study SrO found in control Molly fish was 790.25 ppm. After 15 days of cultured in Ori plast limited, waste water, it was found to be decreased to 772.52 ppm in Molly fish.

Zirconium Oxide (ZrO_2): Zirconium is extremely resistant to heat and corrosion. While Zr is not toxic, it can cause contact irritation to the skin and eyes. Zr is unlikely to present a hazard to the environment and aquatic plants have a rapid uptake of soluble Zirconium. In this present study Zirconium oxide found in control Molly fish was 147.325 ppm. After 15 days of cultured in Ori plast limited, waste water, it was found to be increased to 219.27 ppm in Molly fish.

Cerium Oxide (CeO_2): Cerium is a malleable, soft, ductile, iron grey metal slightly harder than lead. Cerium oxide is a part of the catalyst of catalytic converters used to clean up exhaust vehicles and also catalyses the reduction of nitrogen oxides to nitrogen gas. In this present study Cerium oxide found in control Molly fish was 374.55 ppm. After 15 days of cultured in Ori plast limited waste water, it was found to be decreased to 196.625 ppm in Molly fish.

Erbium Oxide (Er_2O_3) : Erbium is sometimes used for colouring in glasses and erbium oxide can be used as a burnable neutron poison for nuclear fuel. In this present Study, Erbium oxide found in control Molly fish was 897.8 ppm. After 15 days of cultured in Ori plast limited waste water, it was found to be increased to 1160.5 ppm in Molly fish.

From this experiment it was observed that level of pH, Fe, Eu and Er were found to be decreased whereas EC, TSS, TDS, TS, Si, P, Cl, Ca, Co, concentrations were found to be increased with the application of Molly Fish. But all the parameters were found within the permissible limit. Elemental analysis of control Molly fish and treated Molly fish were done where Si, S, K_2O, Ti, Mn, Fe, Cu, Rb, Zr and Er concentration were found to be increased whereas P, Cl, Ca, Co, Zn, Br, Sr, Ce, concentrations were found to be decreased. It can be suggested that Molly fish can be cultured in Oriplast waste water. As Molly fish neutralizes the waste water, so it can be used for the detoxification of water. Similar results were also found from different literature such as From some experiment it was found that, the slow discharge of nitrogen supplied by food waste composts are perfectly suited for urban landscapes where moderate, consistent rate of plant growth is highly desirable (Oladapo et.al., 2015). Some metals like iron, copper and zinc are essential for plants and animals. The availability of some metals such as copper, zinc, iron, manganese, molybdenum, nickel and copper varies and such metals are essential micronutrients (Arzoo et.al., 2017). Compost prepared from organic wastes; when applied on land; increase soil organic matter and provide plant nutrients in a slowly available form (Hartz, 1996; Smith, 1992; Shank, 1989). Similarly, the waste mater generated from Oriplast limited, Balesore can be used as micro or macronutrient for hydrophytic plants or animals.

Conclusion

As there is no harmful impacts were fall on Molly fish after cultured in waste water collected from Oriplast limited, Babasore, Odisha. So it can be suggested that Molly fish can be cultured in Oriplast waste water. As Molly fish neutralizes the waste water and uptake some elements as their nutrients, so it can also be used for the detoxification of water. This process of detoxification of water by utilizing Molly fish is an environment friendly and cost effective method.

Acknowledgement

We are thankful to Centurion University of Technology and Management for providing lab facility during the investigation.

Reference

APHA (2005). Standard Methods for Examination of Water and Wastewater. 21st ed. American Public Health Association, Washington, USA.

Arzoo, A. and Satapathy, K. B. (2017). A review on sources of heavy metal pollution and its impacts on environment. International journal of current advanced research. 6(12): pp.2319-6505.

Blaylock, M. J. and Huang, J. W. (2000). Phytoextraction of metals. In: *Raskin I, Ensley BD (eds)* Phytoremidation of toxic metals-using plants to clean up the environment. *Wiley, New York*, pp 53-70.

Cseh, E. (2002). Metal permeability, transport and efflux in plants. In*: M.N.V. Prasad and K. Strzalka (Eds.).* Physiology and Biochemistry of Metal Toxicity and Tolerance in Plants, pp.1-36.

Fodor, F. (2002). Physiological responses of vascular plants to heavy metals. In: *M.N.V. Prasad and K. Strzalka (Eds.).* Physiology and Biochemistry of Metal Toxicity and Tolerance in Plants; *Kluwer* Academic Publishers, Dordrecht, Netherlands, pp. 149-177.

Hartz, T.K., Costa, F.J. and Schrader, W.L. (1996). Suitability of compost green waste for horticultural uses. Hortiscience. 31(6): pp.961-964.

Monni, S. Salemma, M. and Millar, N. (2000). The tolerance of Empetrum nigrum to copper and nickel. Environ Pollut. 109, pp. 221-229.

Oladapo, T.O., Samuel A.O. and Taiwo, L.B. (2015). Conversion of food wastes to organic fertilizer: A strategy for promoting food security and institutional waste management in Nigeria. International Research journal of Engineering Science, Technology and Innovation. 4(1), pp.25-31.

Reeves, R.D. and Baker, A.J.M. (2000). Metal-accumulating plants. In: Raskin I, Ensley BD (eds) Phytoremediation of toxic metals: using plants to clean up the environment. Wiley, New York, pp 193-229.

Ross, S.M. (1994). Toxic metals in soil-plant systems. Wiley, Chichester, England. pp 469.

Shanks, J.B. and Gouin, F.R. (1989). Compost value to ornamental plants. The Bio-cycle guide to composting Municipal waste. The J.G press Emmanus, P.A. pp 120-121.

Smith, S.R., Hall, J.E. and Hadley, P. (1992). Composting sewage sludge wastes in relation to their Suitability for use as fertilizer materials for vegetable crop production. Acta Horticulture. 302, pp.202-215.

Voegelan, A. Barmetter, K. and Kratzscmar, R. (2003). Heavy metals release from contaminated soils, comparism of column leaching and batch extraction results. Journal of environmental quality 32: 865 - 875.

Wintz, H. Fox, T. and Vulpe, C. (2002). Responses of plants to iron, zinc and copper deficiencies. Biochem Soc Trans. 30, pp.766-768.

World Health Organization for Drinking Water (2004).Guidelines for drinking water quality. Recomendation World Health Organization, France, 7(4): pp181

Table-1: Different physical paremeters of water sample collected from Oriplast.

Parameters	Unit	Ori-plast Limited, Waste water	
		Before treatment	After treatment
PH	——	8.4 ± 0.038	7.95 ± 0.064
Electrical Conductivity	mS/cm	513 ± 0.062	593 ± 0.087
TSS	mg/l	150 ± 0.645	200 ± 4.269
TDS	mg/l	30 ± 0.478	50 ± 3.966
TS	mg/l	180 ± 0.645	250 ± 0.628

Values of five replicates ± SEM

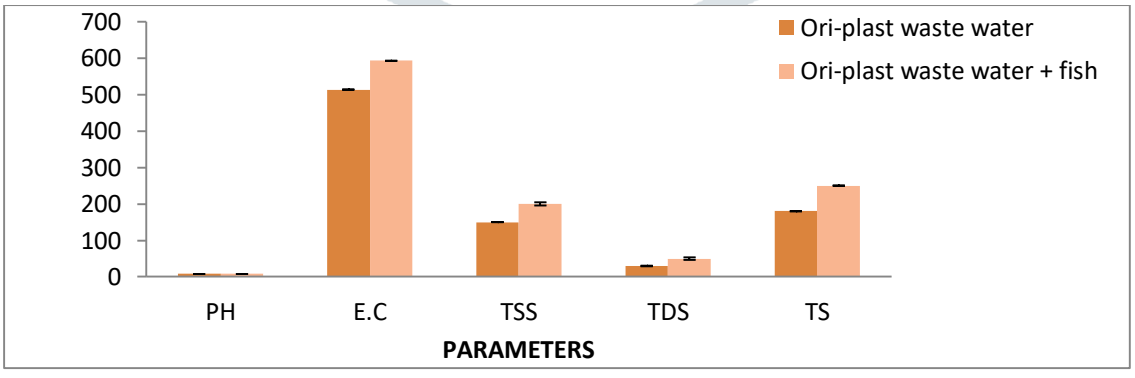

Fig.1: Different physical parameters of water sample.

Table-2: Elemental content present in Ori-plast waste water sample

Elements	Elemental Concentration of Ori-plast waste water in ppm	
	Before application of Molly fish	After application of Molly Fish
Si	414.92 ± 0.292	449.97 ± 0.368
P	550.27 ± 0.335	578.95 ± 0.208
Cl	267.8 ± 0.612	418.15 ± 0.170
Ca	237.8 ± 0.273	242.67 ± 0.110
Fe	19.5 ± 0.104	18.95 ± 0.064
Co	40.5 ± 0.297	54.4 ± 0.290
Sn	35.05 ± 0.064	35.05 ± 0.064
Eu	7.45 ± 0.104	3.42 ± 0.085
Er	239.02 ± 0.256	221.47 ± 0.201

Values of five replicates ± SEM

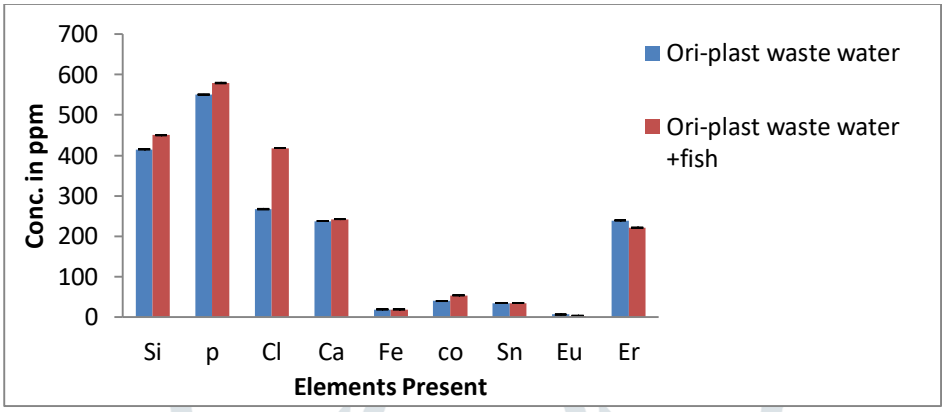

Fig.2: Elemental content present in water sample

Table.3: Major Elements/Compounds concentration present in fish

Elements	Elemental concentration in fish in %	
	Control fish	Treated Fish
Si	1.395 ± 0.001	2.081 ± 0.002
P	22.132 ± 0.032	20.542 ± 0.013
S	8.285 ± 0.001	9.684 ± 0.014
Cl	4.477 ± 0.002	4.244 ± 0.013
K_2O	6.57 ± 0.002	7.684 ± 0.012
Ca	55.317 ± 0.026	53.823 ± 0.008
Fe	0.453 ± 0.001	0.812 ± 0.011
Zn	0.305 ± 0.004	0. 266 ± 0.008

Values of 3 replicates ± SEM

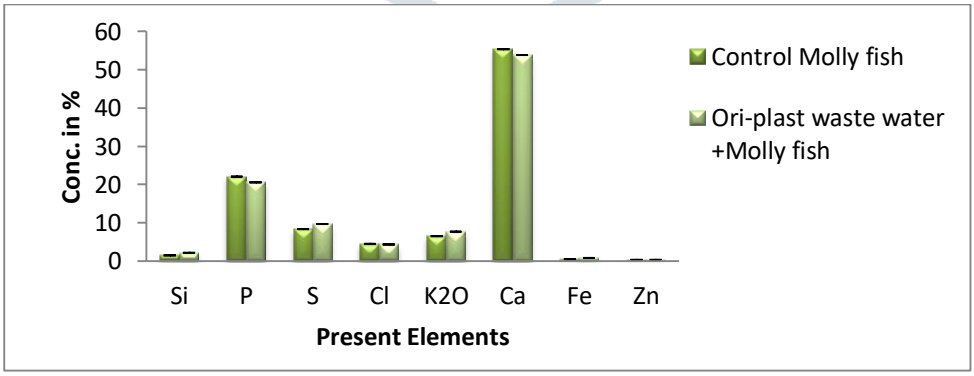

Fig.3: Major Elements/Compounds concentration present in fish

Table-4: Minor Elements/Compounds concentration present in fish

Elements	Elemental concentration in fish in ppm	
	Control fish	Treated Fish
Br	350.615 ± 0.110	139.475 ± 0.149
Rb	129.57 ± 0.137	140.6 ± 0.129
Sr	790.25 ± 0.064	772.52 ± 0.136
Zr	147.3 ± 0.137	219.27 ± 0.083
Ce	374.5 ± 0.170	196.62 ± 0.136
Er	897.8 ± 0.108	1160.5 ± 0.644
Ti	670.45 ± 0.132	877.575 ± 1.118
Mn	625.6 ± 0.129	772.57 ± 0.112
Co	812.5 ± 0.149	3441.5 ± 1.328
Cu	118.325 ± 0.118	191.55 ± 0.176

Values of 3 replicates ± SEM

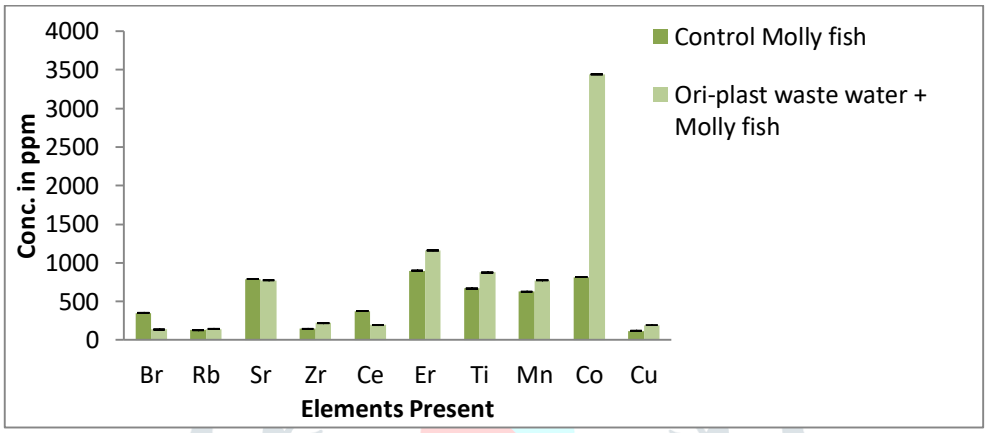

Fig.4: Minor Elements present in Molly fish