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Adverse Effects of Different Detergents on Fish : A Review

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Review Article

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ABSTRACT

Detergents are often used by mankind in daily life for different purposes *viz,* laundry, washing utensils, cars, carpet cleaning etc. However, it is often reported that detergents contain a number of chemicals which are considered harmful for living organisms if get continuous exposure to it. Among all, detergents are considered as hazardous for the aquatic life especially fishes when these chemicals are released to the riverine system through household sewers, laundry waste etc. The aim of this review work is to highlight the adverse effects caused by the detergent water to fishes leading to the disruption of their physiology. Fishes also contribute to mankind economically, so disruption to them may also affect the economic background of mankind too. Secondary data from Google Scholar, PubMed, Shodh Ganga etc. were used to compile information regarding this present review work. From this present study it can be concluded that chemicals like Sodium dodecyl sulphate (SDS), phosphates, LABS, PEG's that are present in different detergents have adverse effects on fish lives. Different authors have published about the different harmful effects caused by detergents. Here, in this review work I am trying to show the different effects caused to fishes by different detergents.

TIDE is the detergent that we use in our homes in a regular basis but, the EPA considers this chemical solvent to be carcinogenic if ingested as it has the highest levels of harmful chemicals. Another toxin used is the phthalates used for the fragrances in detergents, which can negatively affect reproductive systems, endocrine systems, and infant development. However, further experimental works might help researchers to find certain eco-friendly cleaning agents as substitutes of synthetic detergents to be used in daily lives.

INTRODUCTION

Environment is the physical components of the earth, wherein man is an important factor affecting the environment. Water is such a commodity which is a vital elixir for all living beings. Besides minimum effects of natural factors, man-made factors affect them greatly. Potentially harmful substances like pesticides, heavy metals and hydrocarbons, detergents are often released into the aquatic environment from different factories, chemical industries as well as from house-hold sewages. When these large quantities of pollutants are released in the water bodies, there may have an immediate impact such as large-scale sudden mortalities of aquatic organisms, fish killing resulting from contamination of water with those agricultural pesticides etc. Detergents from sewers of household are directly drained into the river system which is ultimately affecting the lives of fishes and also man themselves indirectly. Those man-made synthetic chemicals in detergents are thought to have certain constituents that may disrupt the endocrine physiology of different organisms. Endocrine disruptors, sometimes also referred to as EDC's are hormonally active agents or endocrine disrupting chemicals,that can interfere with endocrine (or hormonal) systems of man when exposed. These disruptions can cause cancerous tumors, birth defects, and other developmental disorders. These include Poly Chlorinated Biphenyls (PCBs), Polybrominated Biphenyls (PBBs), dixons, Bisphenol-A (BPA) from plastics, Dichloro Diphenyl Trichloroethane (DDT) from pesticides, vinclozolin from fungizides, and Diethylstilbestrol (DES) from pharmaceutical agents etc. Soap and detergents acting as surfactants may provoke skin damage such as scaling, dryness, tightness, roughness, erythema, and swelling.

Surfactant detergents are implicated in decreasing the breeding ability of aquatic organisms; cationic surfactants are irritating to mucosa leading to gastrointestinal upset. Surfactants also disrupt lipid membranes that protect cells and this causes irritation to skin, eyes, and respiratory systems. After the surfactants enter into the human body, they damage the enzyme activity and thus disrupt the body's normal physiological function. Surfactants have some toxicity and may accumulate in the human body, so it is difficult to degrade. There have been the reports that SDBS (sodium dodecyl benzene sulfonate) is absorbed through the skin, they damage to the liver and cause narrowing and other chronic symptoms, as well as teratogenic and carcinogenic.

Fish is among the healthiest foods on the planet. It's loaded with important nutrients, such as proteins and vitamin D. Fish is also a great source of omega-3 fatty acids, which are incredibly important for our body and brain. But due to the adverse effects caused by man to aquatic life is posing a great problem and hence the life and health of man are also sacrificed in a greater extent. The primary requisites of fish habitats and fish health are water temperature, water ph, dissolved oxygen, different nutrients and gases etc., but factors like detergents, pesticides, chemicals, heavy metal toxicity are some examples as mentioned above leads to the destruction of fish habitat and water pollution. This review work emphasises on compiling secondary data on how detergents exhibit toxicity on fishes at the level of anatomy and physiology after getting exposed to the same.

LITERATURE REVIEW

Detergent

Detergent is an example of synthetic chemicals, massively and widely used in households, industries and agriculture over last few decades, which has severely contaminated the aquatic environment, causing problems to life therein. A large share of the detergent used, is biodegraded by natural processes but some of it remains undegraded or non-biodegradable, so they enter into water bodies and persists there as toxic compounds and gets concentrated in different tissues of the exposed animals. Detergents which are discharged in the water may change pH, total alkalinity, free CO_2, DO and also affect the rate of photosynthesis and lead to eutrophication (Najam et al., 2010).Thus,it has toxic effects on aquatic animals like fishes and causes mortality of animals.

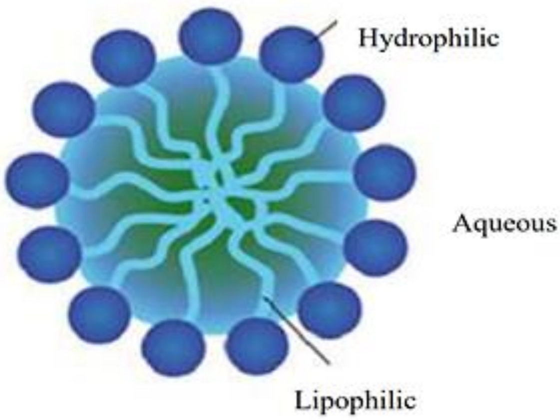
Detergents also add yet another problem for aquatic life by lowering the surface tension of the water. Organic chemicals such as pesticides and phenols are then much more easily absorbed by the fish. Phosphates in detergents can lead to freshwater algal blooms that release toxins and deplete oxygen in waterways. When the algae decompose, they use up the oxygen available for aquatic life (Cohen and Keiser, 2017).

Detergent is a substance that is oil-soluble and capable of holding insoluble foreign matter in suspension, used in lubricating oils, dry-cleaning preparations etc. Synthetic detergents are extensively used in various industries, laundries, textile industries and in households for washing operations. They are generally prepared in powder, cake and liquid forms for use. They are also used in washing powder and shampoos and in agriculture as phosphate fertilizers to shorten manufacturing cycle. In sprays of herbicides, insecticides and fungicides- they are used in wetting, dispersing and suspending of powdered pesticides and emulsification of pesticide solution to promote wetting, spreading and penetration of the toxicants. The detergents are also used in building and construction, in food and beverages industry, in bakery and cream industry, in crystallization of sugar, in leather or metal industry, in paints and protective coating, in pigment preparation, in waxes and polishes, in petroleum products and in textile industries. Surfactants are one of the major components of laundry and cleaning products. They breaks up stains and suspend the dirt in the water to prevent the redeposition of the dirt onto the surface. Surfactants disperse dirt that normally does not dissolve in water.

Chemistry of detergent

The main ingredient of detergent is a surface-active substance called a Surfactant. It is a molecule having one hydrophilic (water loving) group and one hydrophobic (water repellent) group. The ratio of the molecular weight of hydrophobic portion to hydrophilic portion gives the compound it's surface acting property when dissolved in water (Figure 1).

Figure 1. The structure of the surfactant.



Surfactants are classified on the basis of their hydrophilic group in four categories *viz*, anionic, cationic, non-ionic and amphoteric as mentioned below-

Anionic detergents

• The anionic surfactants are dissolved in water with generating the negatively charged surface active group, whose aqueous solution is neutral or alkaline.

• Anionic surfactants can be widely used as detergents, foaming agents, emulsifiers, antistatic agents, dispersants and stabilizers in the family and chemical aspects of life.

• Anionic surfactants are alkyl sulfates, alkyl ethoxylate sulfates, and soaps in the ingredient list.

• Bile acids, such as Deoxycholic acid (DOC), are anionic detergents produced by the liver that help in digestion and absorption of fats and oils.

Four anionic surfactants are used

- alkylbenzene sulfonates (The alkylbenzene portion of these anions is lipophilic and the sulfonate is hydrophilic).
- alkyl sulfates
- alkyl ether sulfates
- soaps

Cationic detergents

- Cationic surfactants are dissolved in water with generating the surface activity positive ions.
- They are widely used for sterilization, rust, corrosion, breaking, corrosion and mineral flotation.
- The cationic detergents are weak in detergent power but have good lubricating, fabric softening, wetting, foaming, emulsifying, antistatic and have germicidal properties.

Non-ionic and zwitter ionic detergents

- Non-ionic surfactants did not ionize any form of ions in an aqueous solution.
- They are widely used in the textile, paper, food, plastic, glass, fiber, medicines, pesticides, dyes and other industries.
- They are characterized by their uncharged, hydrophilic headgroups in them. Non-ionic detergents are based on polyoxyethylene or a glycoside. Common examples of the former include Tween, Triton, and the Brij series. These materials are also known as ethoxylates or PEGylates and their metabolites, nonylphenol.
- Zwitterionic detergents possess a net zero charge arising from the presence of equal numbers of +1 and −1 charged chemical groups. Example- CHAPS

Amphoteric detergents

- Amphoteric surfactants which take with both positive and negative ions can be divided into imidazoline, betaine, lecithin, and amino acid-type type according to the anion type.
- The toxicity of amphoteric surfactants is very low. It is also gentle to the skin, and has good biodegradability property.
- Amphoteric surfactants have wide application in the personal protective equipment such as shampoo, shower gel, cosmetics, etc. and also can be used in industrial softeners and antistatic agents.
- They contain both an acidic and a basic hydrophilic moiety in their structure.
- Their ionic functions may be like any of the anionic or cationic groups. Many amphoterics also contain either oxygen or hydroxyl that strengthen their hydrophilic tendency.

MECHANISM OF ACTION AND DETERGENTS

Soaps and detergents consist of a large hydrocarbon tail with a negatively charged head. The main thing is that -the hydrocarbon tail is hydrophobic (water-hating or water-repelling) and negatively charged head is hydrophilic (water-loving).In aqueous solution, water molecules which are polar in nature, surround the ions and not the hydrocarbon part of the molecule. Whenever, a soap or detergent is dissolved in water, the molecules associate together as clusters called micelles. The tail sticks inwards and the heads outwards. During cleansing, the hydrocarbon tail attaches itself to oily dirt. When water is agitated or shaken vigorously, the oily dirt tends to lift off from the dirty surface and dissociate into fragments. This thus gives opportunity to other tails to stick to the oil. The solution now contains small globules of oil surround by detergent molecules. The negatively charged heads present in water prevent the small globules from coming together and form some aggregates. Thus, the oily dirt is removed like this.

Detergents caused a large number of pollution in rivers and water bodies. The long carbon chain present in detergents used earlier contained lot of branchings. These branched chain detergent molecules were often degraded very slowly by the microorganisms present in sewage discharge septic tanks and the water bodies. Thus, the detergents persisted in water for long time and made water unfit for aquatic life in them. Nowadays, the detergents are made of molecules in which branching is kept at minimum. Thus, these are degraded more easily than branched chain detergents.

Toxicological effects of detergents on aquatic animals, especially on fish

The damage degree of surfactants to aquatic plants relates to its concentration. Whenever the content of surfactants is high in the water, it will affect the growth of algae and other microorganisms in water thus, resulting in decreased primary productivity of water bodies, thereby undermining the food chain of aquatic organisms in water bodies. A certain number of toxicity of surfactants will pass into the animal through animal feeding and skin penetration. When the surfactant concentration in water is too high, then surfactants can enter the gills, blood, kidney, pancreas, gallbladder and liver, and produce aquatic toxicity effect.

Fish easily absorb surfactants by the body surface and gills, and with the blood circulation they distribute to body tissues and organs. Contaminated fish enter the body through the food chain and produce inhibition to various enzymes in the human body, thus reducing the body's immunity. The toxicity levels of surfactants on bacteria and algae can be expressed in ECO_{50}, which means the suppression degree of surfactants on the movement of aquatic bacteria and algae within 24 hours.; Table 1 is ECO50 for several surfactants.

Table 1. Examples of surfactants and their ECO50 [1].

	Name	ECO_{50}/mg·L^{-1}	
		Water flea	Alga
Anionic surfactants	Linear AlkylbenzeneSulfonates (LAS)	4~250	
	Linear ether sulfate	5~70	60
	Octylphenolpolyoxyethylene m sodium	5~70	10~100
	Soaps		10~50
	Phosphate	3~20	3~20
Non-ionic surfactants	Lauryl alcohol ethoxylates(7EO)	10	50
	Polyoxyethylenestearyl ether(10EO)	48	
	Polyoxyethylenestearyl ether(20EO)		
	Nonylphenolethoxylates(9EO~11EO)	42	50
Cationic surfactants	Cetyltrimethyl ammonium chloride	82	

Many research findings have been reviewed during this study regarding the ill effects and behaviour caused by the different chemicals present in the detergents and some of which are given below: [2] in the year 1987 studied the effects of a component of detergent i.e., linear alkyl benzene sulphonate (LABS, an anionic detergent, belonging to ionic group of surfactants) in *Cirrhina mrigala* and they found that the epithelial cells of the gill lamellae showed a distorted appearance indicating severe damage that led to dysfunctions in respiration and osmoregulation. Linear alkylbenzenes (sometimes also known as LABs) are a family of organic compounds with the formula $C_6H_5C_nH_{2n+1}$. They are mainly produced as intermediate in the production of surfactants, for use in detergent. Linear alkylbenzene is sulfonated to produce linear alkylbenzene sulfonate (LAS), which is a biodegradable surfactant. Pathomorphological changes in the skin was noticed under the scanning electron microscope in fish fingerlings (*Cirrhina mrigala*), when exposed to 0.005 ppm concentration to linear alkyl benzene sulfonate. The epithelial cells present in the epidermis of the skin were found to secrete more mucus with Linear Alkyl benzene Sulfonate (LAS) than the controls. The presence or deposition of mucus on the surface of skin indicated likely molecular interaction between constituents of mucus and LAS. A comparative study on the toxicity of some detergents viz., Linear Alkylbenzene Sulfonate (LAS), Branched Alkylbenzene Sulfonate (BAS), Sodium Sulfonate (SS) and Alfa-Olefin

Sulfonate (AOS) on an estuarine fish ie., *Ambasis commersonii* was done by Sakunthala et al. [3],where they observed a significant correlation between observed and calculated mortalities for all the detergents. Some behavioural responses of fishes to all detergents were also observed. In their study, four anionic detergents, three of which (LAS, BAS & SS) are commonly used in the manufacture of soaps and other clearing compounds, in India, and a commonly available washing soap in the market called ''Mega'' which have alfa-olefin sulfonate (AOS) was choosen. It was observed during the experiment that- with all detergents that the fishes started swimming vigorously and tried to escape the water by jumping out for short while. In the tanks which have higher concentrations, uncontrolled movements (especially more with LAS) with small jerks were observed and also loss of equlibrium and convulsion, and became inverted and died. Contrarily, in the control, no such behaviour was noticed during their study. So, it depicts that detergents do have some effects on fishes which have ultimately lead to death. Another experiment was conducted by Raju et al. [4] that a commercial detergent "Ariel" at 5ppm was found to induce some degenerative changes in the respiratory lamellae in *Oreochromis mossambiccus* on 2 days exposure and this chronic exposure led to drastic changes like separation of epithelium layer and atrophy.

Chude et al. [5], studied laboratory comparison of effect of hair dressing salon effluent on fingerlings of *Oreochromis niloticus* and *Clarias gariepinus*. Hair dressing salon effluent was found to adversely affect the fingerlings of both *O. niloticus* and *C. gariepinus* as it contains a large number of chemicals in it which are used as detergents in hair salons. Effects included hyperactivity and acute toxicity. With both fish species the toxicant killed off 50% of test fish population within 60 hours. Varsha et al. [6] studied on effects of LABS on the Liver Tissues of *Puntius ticto* fish and explored out the toxicity of LABS in the liver of *Puntius ticto* fish by the histopathological study.As we know, liver is considered as the main organ which is damaged by the action of various toxicants when exposed. This is because,the liver is not only the main site of metabolism but it also plays a vital role in detoxification of various toxicants. Hence, the liver is choosen as it can be significantly damaged due to exposure of such toxicant as observed in this study also, showing various histopathological changes caused by the LABS. It is the most widely used surfactants in the world. This detergent has reported to cause hepatotoxicity in fish. Therefore, the present study explores out the toxicity of LABS in "Henko" detergent in this study in the liver of *Puntius ticto* fish as observed by the histopathological study. The liver tissues revealed issues like cytoplasmic vacuolar degeneration, nuclear pyknosis, necrosis and blood cells infiltration as the common lesions in the hepatocytes. The paper ''Effect of Different Concentrations of Detergent on Dissolved Oxygen(DO) Consumption'' in *Anabas testudineus* was studied and experimented by Mathew et al. [7] .*Anabas testudineus*, a common fresh water fish in Kerala, was used by them to determine the effect of detergent pollution on the fish's breathing. Three different concentrations of popular brands of detergent were prepared and the amounts of dissolved oxygen consumed by fishes exposed to the detergent were determined using Winkler's method. Their study demonstrated that Dissolved Oxygen (DO) consumption in *Anabas testudineus* increases in the presence of detergent. This is thus due to the stress caused by the detergent on the normal physiological activities of the fish.Hence, draining of domestic sewage containing detergents into water bodies adversely affect its aquatic fauna and ultimately humans indirectly. Another researcher, Chandashive [8] in the year 2014 observed the effects of different concentrations of detergents like Surf, Nirma at specific concentrations over *Mystus montannus* fish for several days and reported a variety of behavioural responses like-disturbed opercular movement, swimming behaviour etc. Similar characters were also observed by Mathew et al., 2013 when,they exposed *Anabus testudineus* to water containing detergent. They found that in air breathing fish *Anabus testudineus*, dissolved oxygen consumption increased when it was exposed to the water containing detergent. With increase in the concentration of the detergent, increased breathing and signs of distress were exhibited by the fish. Vasanthi et al. [9], did experiment on toxicity effect of the detergent "Tide" on the haematological parameters of the freshwater fish *Cirrhinus mrigala*. The presence of detergent in water accelerates corrosive action, empedes the filtering, sedimentation and coagulation processes,and increases the saturation of water with oxygen and also deteriorates the taste properties of water. The parameters like RBC, Hb, MCV, PCV, albumin and globulin were decreased and WBC have been increased in the fish. Saparuddin et al. [10] did laundry-industry toxicity of detergents and they measured the concentration of hemoglobin in tilapia (*Oreochromis niloticus*).They tested the fishes with detergent and the concentration of hemoglobin fluctuation is observed. The detergent from the laundry industry that continues to flow directly into the river will affect the oxygen supply of the aquatic biota and due to the disruption of the respiratory system. It can be concluded that, residues from the washing industry can affect the oxygen supply in fish, which is characterized by a reduced concentration of hemoglobin in tilapia from the normal concentration of hemoglobin. Saparuddin et al. [11] studied Hematological Response of Tilapia (*Oreochromis niloticus*) in Laundry Wastewater. Their study aimed to determine the condition of the hematological parameters of tilapia (*Oreochromis niloticus*) when exposed to wastewater from the laundry industry. Wastewater comes out of the laundry with additional energy (heat), lint, soil, dyes, finishing agents, and other chemicals from detergents. Some chemicals remain in the water after treatment, which may also contaminate the water system. This study indicates that wastewater treatment from the laundry industry reduces the water quality by lowering the DO value. Data were obtained from DO, pH, and temperature measurements during the study.

DISCUSSION

Pandey, 2000[12] after observing different disruptive effects of different concentrations of detergent on biochemical, haematological as well as reproductive indices on *Heteropneustus fossilis,* stated that disturbances in the level of chloride ion by the detergent is probably due to pathological changes in tissues like gills, intestine and kidney which are involved in the exchange of ions between the organism and the surrounding water containing cationic and anionic detergents. Chandashive N.E,2014 while observing disruptive behavioural responses on *Mystus montanus,* after exposure of different concentrations of Surf and Nirma concluded that, as gills are osmoregulatory organs in fishes and are primary site of uptake for water borne pollutants therefore they are the first sites where the effect of pollutants will be observed, because of the swelling of gill epithelium it leads to decreased efficiency for gases exchange and oxygen consumption. The researcher also stated that toxic elements of detergents also cause excessive secretion of mucus over gill filament and irritation of gill epithelium which may alter and interfere in respiration as well as reduced gill diffusing capacity, resulting in decrease or increase in oxygen consumption. Oxygen consumption decreases with an increase in concentration and time of exposure and may be due to –

1) Penetration of the pollutants at sub-cellular levels, and

2) Damage of gill tissues.

In *Mystus montanus* also, oxygen consumption has increased with low sublethal concentration (1/3rd) of both detergents with increase in time is due irritation of gill epithelium, movement of gills was observed faster. Whereas, with 2/3rd sublethal concentration of both detergents, significant decrease in oxygen consumption with an increase in time was noticed from 48 hours of exposure due damage if gill tissue after two days exposure.

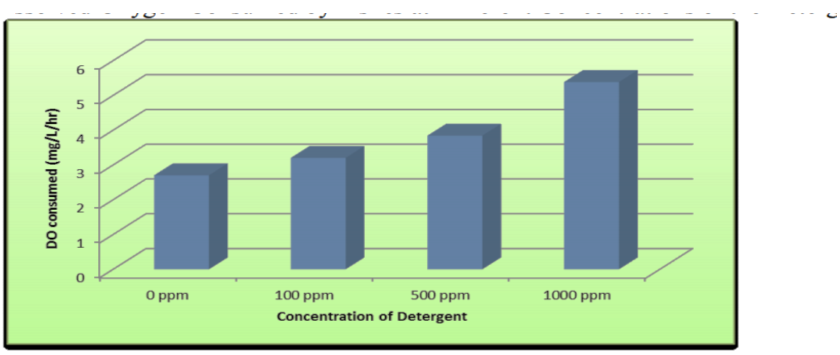
The another researcher named Vasanthi et al. which after observing the effects of the detergent ''Tide'' on the haematological parameters of the freshwater fish *Cirrhinus mrigala* concluded that decreased percentages of parameters like RBC, Hb, MCV, PCV, albumin and globulin and increased WBC percentage might be due to due to exposure to Tide detergent. The main route for entry of any chemical is through the gills. From the gills, it is thus trans ported to various parts of the body via the blood stream. The decrease in these parameters has also been reported by Benarjee et al. [13] in the fish *Channa punctatus* to the rayon industrial effluents. Haemolysis have been one of the causes for reduction in Hb, RBC and PCV values. The fall in haematological parameters is due to decreased rate of production or to an increased loss of destruction of RBC according to Larson, 1975. The another reason for RBC suppression could also be damage to the haemopoeitic tissue and PCV, i.e. mean packed cell volume appears to be positively correlated with RBC counts, hence, a decrease in PCV is observed.The decrease in albumin indicates fall in osmotic pressure leading to enhanced fluid retention tissue spaces causing edema in animals. Hence, RBC showed maximum decrease of 17.45 % in blood after 72 hrs exposure and minimum of 5.66 % after 24 hrs exposure in 36 mg Tide. In fish, the reduction in leukocyte number may be due to the stress associated leucopenia (Pickford et al., Johanson and Larsson), as a result of an increase in corticosteroids. The decrease in RBC and Hb concentration indicates the acute anaemia. The anaemia could be due to the destruction of RBC. Saparuddin et al. studied Hematological response of Tilapia (*Oreochromis niloticus*) in Laundry Wastewater. Death can occur due to physiological deviations of blood components according to them. Changes in blood components and blood chemistry, both qualitatively and quantitatively, can affect the fish's condition. Therefore, hematological conditions can be used as indicators to detect and determine a fish's health status also. This study indicates that the wastewater treatment from the laundry industry reduces the water quality by lowering the DO value. When it drops below levels necessary for sustaining aquatic life, it becomes significant water quality impairment, often referred to as low dissolved oxygen or DO. The paper "Comparative toxicity of some detergents on an estuarine fish, *Ambasis commersonii*'' was experimented By Sakunthala and co-workers. Here different detergent were taken and were compared on the fish.The comparative toxicity was evaluated using four detergents, viz., Linear Alkylbenzene Sulfonate (LAS), Branched Alkylbenzene Sulfonate (BAS), Sodium Sulfonate (SS) and Alfa-Olefin Sulfonate (AOS) on an estuarine fish i.e., *Ambassis commersonii*, abundant in Kali estuarine system. Standard toxicity bioassay method was followed as per APHA (1980). AOS concentration in 'Mega' soap was determined by the standard MBAS method as described in APHA (1980). The results indicate that LAS was the most toxic detergent to fish relative to the other types and the order of toxicity is LAS>AOS>SS>BAS. The LAS was more toxic than BAS by 1.2 times, AOS by 2.8 -2.9 times and BAS by almost 4.8 -5.3 times at all LC levels. Soap in the market ''Mega'' have Alfa-Olefin Sulfonate (AOS). It was observed during the experiment with all detergents that- the fishes started swimming vigorously and tried to escape the water by jumping out for a short while. In the tanks with the higher concentrations, uncontrolled movements (especially more with LAS) and deaths occurred. Contrarily, in the control, no such behavior was noticed. Hence, they concluded that in the unpolluted natural waters the total detergent load (measured as MBAS activity) is around 0.5 mg/l (which is the WHO standard for drinking water) and in highly polluted waters (Dave et al., 1986), at the point of sewage disposal and drainage, it is around 2.0 - 3.0 mg/l. The situation becomes still more serious if heavy metals are present in above normal concentrations, since, the mixture of heavy metal and detergents causes' greater damage the biota than either of them individually. Hence, any type of detergent pollution in coastal waters has to be viewed seriously, since the organisms are low in the food chain and other sensitive ones will be wiped out even at low concentrations. John studied effect of detergent industry effluent on the fresh water fish *Labeo Rohita*. The physiological and biochemical changes in *Labeo rohita* after exposure to the sub lethal concentrations of the detergent industry effluent have been investigated for the period of 30 days [14] .The results obtained in the study showed that, the industrial effluents from dairy caused marked depletion in the biochemical composition of muscles and blood parameters of fish *Labeo rohita* after the exposure period. The biochemical changes, protein, lipid and carbohydrates were recorded.In the study, tissue and plasma total protein were generally influenced by this wastewater which may be attributed to the relative changes in the mobilization of protein, and changes in the plasma protein concentrations may be a result of increased production of metallothionein which is a sequestering agent (Cousins, 1982).On the other hand, the elevation of plasma-glucose that runs parallel to a decrease in muscle protein content may be on indication of a gluconeogenetic response. This additional source of glucose supports the fish with the required energy highly demanded to cope with the presence of a potentially harmful substances such as the effluents. The condition of fish exhibited a significant depression after exposure to that wastewater, which might be a result of elevation of the fish metabolic rate and thus cessation of feeding. Buckley et al. 1982 showed also a decrease in the conditions of fish after exposure to effluents. The present study reveals that detergent effluent may induce biochemical alterations in the different organs of fish. These biochemical investigations can be used to study the mode of action of toxicants and the causes for death by poisoning of aquatic organisms. Thus, biochemical alterations in fish can be considered as biomarkers to access the health status of the fishes as well as aquatic bodies polluted by toxicants. In the research work thesis named-'' Effects of Linear Alkyl Benzene Sulfonate on the Liver Tissues of *Puntius ticto* Fish'' by Jain et al., they studied detergent effects on the liver of fish. Linear Alkyl Benzene Sulfonate" or LABS is selected [15] .This study was undertaken to assess the toxic effect of LABS on the liver cells of *Puntius ticto* fish. It is a native fish of the upper Mekong, Salwen, Irrawaddy, Meklong and upper Charo Phraya basins in the countries of Nepal, India, Pakistan, Myanmar, Bangladesh, Thailand and Sri Lanka. The present study helped to understand the effect of the sublethal concentration of LABS, which is not causing the death but damaging the liver tissues of *P. ticto* fish. In the experiment, healthy fresh water teleost fishes, *P. ticto* were collected from the Betwa river (also known as Vetravati or Shuktimati river which originates from Kumra village in Raisen district and flows through Vidisha district of Madhya Pradesh, and finally joins as a tributary of the Yamuna river at Hamirpur, Uttar Pradesh).These fishes were acclimatized under the standard laboratory conditions for 7 days before the experiment. They were also fed with a mixture of oil cake and wheat bran (50:50). The tube-well water was used for entire experimental work. The fishes measuring 3.5 to 5.0 cm in length were basically used for the experiment. After one month exposure of the sub-lethal concentration of LABS detergent, the histopathological lesions were thus studied. The electron microscopic study showed the degenerative changes in almost all the hepatocytes in them. The nuclei of most of the hepatocytes were seen with normal structure having the distribution of heterochromatin. But however some hepatocytes still had shrunken pyknotic nuclei with clumped heterochromatin. Rao and Mishra (1998) have also reported the vesicular degeneration of cytoplasm in the hepatocytes of *Labeo rohita* fish. Misra et al. and have suggested the possible reason for glycogen depletion (leading to hepatic degeneration), i.e., either more glycogen utilized to meet the energy demand warranted by toxic stress or by impairment in glycogen synthesis. The fish liver has been well studied to serve as a model for analysis of interaction between environmental changes and hepatic morphology. In conclusion,liver is considered as main organ, as it is almost damaged by the action of various toxicants in regular lives, and LABS (Henko detergent) is used in this study and the liver is significantly damaged due to exposure of such toxicants as observed in this study, showing various histopathological changes caused by the LABS. Chude et al., studied on fingerlings of *Oreochromis niloticus* and *Clarias gariepinus* on effect of hair dressing salon effluent on the fishes. Effect of the hair dressing salon effluents on both the test fish species was monitored through frequency or beat rate of both opercular plate and pectoral fins. Fish mortality was recorded for 24hours, 48hours, 72hours and 96hours. Observations of - loss of equilibrium, vigorous movement of gulping of air and other behavioral indices, death inclusive, were noted for fish in each tub. Death was confirmed when fish did not at all react to gentle prodding with a glass rod. Time of death of fish was also recorded in that experiment. Dead fishes were removed and its weight and length measurements were taken. During the experiment the fingerlings were not fed but at the same time the water quality was degrading as a result of biochemical processes and defecations by the specimens. As Dissolved Oxygen (DO) and alkalinity decreases, free carbon dioxide (CO_2) increases. Death may have occurred due to this as concluded by them. Furthermore with both fish species,the toxicant killed off 50% of test fish population within 60 hours except the lowest concentration of 20 ppm.

All values obtained were lower for *O. niloticus* signifying the ease with which the toxicant brought death outcome on the species. The 96hr LC_{50}, threshold (safe-level), lower and upper toxic limits determined again showed that *O. niloticus* had lower values. The inference therefore is that *O. niloticus* is more susceptible to death with hair dressing salon effluent than *C. gariepinus*.

C. garienpinus has been considered as a hardy species which is able to survive outside the water for some time, tolerate overcrowding and low dissolved oxygen content due to the possession of accessory breathing organs. Thus, it is recommended for intensive and polyculture aquacultural systems and brackish water fish-farms, in case there is the occurrence of pollution /or outbreak of disease. Hence, effluents of hair dressing salons discharged into drains and gutters ultimately end up in rivers and streams where they adversely affect aquatic biota. Being non-biodegradable and persistent, these surfactants are time-bombs which ultimately explode in times, places and in organisms far removed from the sources and circumstances which generated them. ''Effect of Different Concentrations of Detergent on Dissolved Oxygen Consumption'' in *Anabas testudineus* was studied and experimented by Emi Mathew et al,. Oxygen consumed by fishes exposed to the detergent was determined using

Winkler's method. This study demonstrated that Dissolved Oxygen consumption in *Anabas testudineus* increases in the presence of detergent. This is due to the stresses caused by the detergent on the normal physiological activities of the fish. *Anabas testudineus* is a common fish abundant in tanks, ponds, streams and lakes of India. *Anabas* has a habit of migrating from pond to pond. When in water, the fish frequently comes to the surface to breathe the air. The air swallowed by *Anabas* is taken into two chamber situated one on each side above the gills, forming outgrowths from the ordinary brachial chambers, richly supplied with fine blood vessels and covered with thin epithelium. Presence of accessory respiratory organs helps *Anabas* to survive in waters low in oxygen levels. In this experiment, Dissolved Oxygen or DO in the water sample was estimated before adding the detergent or introducing the fishes and the values averaged at 9.71 mg/L. This reading was taken as control. DO concentration near 10 mg/L indicated that the water sample collected for the experiment contained sufficient amount of dissolved oxygen for the survival of fishes. Sample water treated with 100 ppm of detergent for almost 1 hour showed a mean decrease in DO of 0.19 mg/L from the control. With increased concentration of detergent at 500 ppm for 1 hour, DO is further decreased by 0.51 mg/L from the control. This trend continued also with the sample water treated with a detergent concentration of 1000 ppm for 1 hour, where a mean decrease in DO of 0.83 mg/L from the control was noted. This decrease in DO content of sample water treated with detergents was due to the presence of phosphates present in detergents which readily react with dissolved oxygen. When experimental fishes were introduced into water containing 100 ppm of detergent, they started showing some discomfort within 10 minutes and began to move around rapidly. With increased concentrations of the detergent at 500 ppm and 1000 ppm, the time lag for rapid movements reduced to around 5 minutes and 2 minutes respectively. However, in all the experiments, the fishes appeared inactive later and rested at the bottom of the vessel but, they continued to breathe rapidly and the mucous on the body surface started to come off. Estimation of DO consumed by the fishes showed an increasing trend with the incensement in concentration of the detergent. Fishes used in control experiment (with no detergent added) showed a DO consumption of 2.7 mg/L/hr in that experiment and fishes kept at 100 ppm of detergent concentration showed a mean DO consumption of 3.2mg/L/hr. Table below indicates an increased consumption of DO by the fishes under increased concentrations of the detergent. (Figure 2)

Figure 2. Showing dissolved oxygen consumed by fishes at different concentrations of the detergent [7].



From this experiment, it is observed that the detergent had a severe impact on the experimental fish. *Anabas* has large respiratory capacity than other fresh water fishes due to the presence of accessory respiratory organs. Even with this capacity also, the fish's DO consumption increased when it was exposed to the water containing detergent. With increase in concentration of the detergent, increased breathing and signs of distress were exhibited by the fish. Even though *Anabas testudineus* is very sturdy in tiding over stressful environment, presence of detergents proved detrimental to them. Thus, other less sturdy aquatic fauna would have easily succumb to increased concentrations of the detergents (Table 2).

Table 2. Different types of surfactants present in different detergent powder in India.

Surf	Ariel	Tide	Rin
1. Anionic and nonionic surfactant for cleaning agents 2. Processing aids like sodium sulfate.	1.Non-ionic surfactant like Alcohol Ethoxylate (AE) 2.Anionic surfactant like Alkyl (or Alcohol) Ethoxy Sulphate (AES) and Alkyl Sulphate (AS), Linear Alkylbenzene Sulfonate (LAS) 3. Amphoteric surfactant like Amine Oxide 4. Polyethylene Glycols (PEG), Polyethylene Oxide (PEO) or Polyoxyethylene (POE)	1. Alcohol ethoxylates 2. Alcohol ethoxy sulfate 3. C10-16 4.alkyldimethylamine oxide 5.C12-16 Pareth 6.C14-15 Pareth 7.C10-16 Pareth 8.MEAdodecylbenzene sulfonate 9.MEA-LAS 10. MEA-laureth sulfate 11. Sodium laureth sulfate 12. Sodium lauryl sulfate (SLS)	1.Cleaning Agents (Anionic And Nonionic Surfactants, Enzymes)

CONCLUSION

In this present review work, it is seen that although phosphates from detergents contribute to the growth of algae, these can affect the oxygen levels in bodies of water and harm plant and animals living in the body of water. Excess phosphates create water that becomes cloudy and low in oxygen which are very depriving and sometimes suffocating for other aquatic life present in it. Chemical pollution damages the environment and poses both short-term and long-term health dangers to human beings as well as other organisms in the environment. Chemical pollution occurs, when chemicals resulting from human activities enter the environment, contaminating air, water or soil. Detergents as we know have high levels of chemicals that contain nitrates and phosphates are a source of chemicals that cause water pollution. Sodium Lauryl Sulfate (SLS) is a common example which is used as chemical or surfactant in laundry detergent which helps remove dirt and other debris from clothing. It also adds foaming action to the detergents, soaps, etc. It may cause the skin, eye, and lung irritations. These chemicals seep into the groundwater and mix with runoff moving to lakes and rivers and ultimately are harmful to the fish and indirectly to humans as we have already discussed in this paper. A detergent also contains oxygen-reducing substances that may cause severe damage to the fishes and marine animals. This may also lead to eutrophication that has negative impacts on environment, especially on aquatic animals because water rich in nutrients stimulates growth of the aquatic plant life, resulting in depletion of oxygen. It is seen that the toxicity of cationic surfactants is the biggest. However, individuals can help preventing chemical pollution by making simple changes in their habits and activities. Some ways we can prevent chemical pollution include buying only the chemicals one need, buying the least harmful or least hazardous products, and mixing and applying pesticides at the proper concentration and using alternative fuels. Today, many detergents, low in phosphates are available for purchase and we should use them only. Biosurfactants have shown some positive effects than the synthetic ones. They are biodegradable and non-toxic. Biosurfactants are amphiphilic compounds produced in living surfaces, mostly on microbial cell surfaces or excreted extracellular hydrophobic and hydrophilic moieties that has the ability to accumulate between the fluid phases, thus reducing surface and interfacial tension at the surface and interface respectively. Among the detergents, TIDE has shown maximum number of damages to fishes among other detergents according to recent surveys. So, it is the utmost time we should think about the environment along with the living organisms seriously and thus also indirectly about our future.

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