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Impact of Detergents on Nutritive values of Freshwater catfish *Mystus Montanus*

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Abstract

The fishes are one of major and cheap source of protein for human being. The amount and quality of protein decides the nutritive value of fish. This value is gradually degrading by the contaminating agent present in the water bodies. The quality and quantity of nutritive substances in fish tissue is inversely proportional to amount of pollutants present in water bodies. The detergent is one of the key pollutants of fresh water bodies. The effect of detergents namely Surf Excel and Nirma powder on nutritive values of fresh water catfish, Mystus montanus was assessed. The 96-hours acute toxicity (LC_{50}) of Surf excel powder is found to be 22.0mg/L and it is 23.5 mg/L for Nirma powder. The test animals were exposed to 1/3rd and 2/3rd sublethal concentrations of LC50 values of Surf excel and Nirma as per recommendations for a period of 96hrs. After 24, 48, 72 and 96 hours of exposure the protein levels were estimated in Muscles and Liver. The amount of protein decreases with an increase in concentrations of both detergents and time of exposure.

Keyword: *Mystus*, detergent, nutritive values.

Introduction

The freshwater fishes are key and economy source of protein of poor people. The nutritive values of fishes are depends on amount and quality of proteins present in Muscles of fishes. The amount and quality of nutritive substances gradually degrading due to pollutants present in the water bodies. The quality and quantity of nutritive substances in fish tissue is directly depending upon quantity of pollutants present in water. The major freshwater bodies of World are getting polluted due to addition of different polluting effluents. These effluents includes domestic and industrial discharges including heavy metals, organic and inorganic chemicals, insecticides, pesticides, heat effluent, radioactive substances and domestic waste containing human faecal matter. As well as, a huge quantities of various brands of detergent powders, flakes as well as soaps used for washing of a variety of objects. These detergents increase alkalinity and produces foam on the water surface, stimulate excess growth of submerged and floating aquatic weeds, surface weeds reduce the exchanges of gases between air and water and penetration of sunlight to bottom of water body. This leads to shortage of dissolved oxygen to the aquatic animals. The detergent causes damages to the buccal lining and gill epithelium, which may results in poor utilization of food and interfere in oxygen uptake. These may affect the enzymatic actions and functions of various organs resulting into digestion of food and physiology of fish. The surfactants are one of the major contents of detergents, commercial surfactants LAS, AS, AES, AE, APE, CTAB etc are synthetic chemicals. These surfactants are used in large amounts in detergents, soap, fabric softeners, paint, shaving cream, leather and textile items, pesticides, defoliants, antiseptics, disinfectants, additives for food[1].

The freshwater fish *Mystus montanus* exhibited a variety of behavioural responses like opercular movement was 20-25 times faster than controlled, loss of nervous control, try to jump out of media. In dead fishes opercula region becomes blackish, haemorrhaging occurs of gill filaments amongst, along the belly, at the base of pectoral, anal and pelvic fins. Body was slimy due to mucus secretion from epithelium of gills. The fishes were surfacing frequently[2].

The effect of different concentrations of Nirma on the feeding, growth rates of fishes, rates of absorption and metabolism as well as change in total Protein content in tissues of freshwater teleost was investigated[3]. In freshwater prawns *Macrobrachium lamarrei* the amount of proteins, carbohydrates and lipid were decreased in the hepatopancreas and other organs of prawns after exposed to different concentrations of detergent[4]. When fish *Tilapia nilotica* exposed to sub lethal concentration of Detergent, decreased level of protein, globulin and serum enzyme activity was observed.[5]

The low level of protein content has been estimated in the Detergent treated fishes[6]**.** The significant decrease was studied in protein content in brain and gills decreases with an increase in concentration of detergent and time of exposure[7]. It has been observed that there is an increase in amount of protein in the muscle with increase in time in control group of fishes. Whereas, the experimental group of fishes were showed drastic decrease in the concentration of protein in muscle[8].

In the present investigation, two detergents namely Surf excel and Nirma powders were selected as toxic substance. The detergents cause destruction of riverine ecosystem by eutrophication and affect the physiology of aquatic fauna. Therefore natural aquatic fauna (fishes) has been disappeared at many places of Mula-Mutha River due to pollution. The effects of detergents like surf excel and Nirmal powder on nutritive value have been studied in muscles and liver of the fresh water fish *Mystus montanus* found in Mula River and rest of rivers of the Maharashtra.

Material and Methods

The freshwater fish *Mystus montanus* were collected from unpolluted area of river Mula one of the tributary of Bhīma River by fisherman. They were selected for the experiment based on size or lengthwise ranges from 12.3cm to 14.5cm and weight ranging from 18.72gm to 23.86gm and brought to laboratory for the acclimation. The fishes were acclimatized in glass tank in the laboratory for seven days as per APHA[9]. The acclimatized fishes were used for the present experiments. Static renewal bioassay tests were conducted in order to evaluate the acute toxicity of Surf excel and Nirma powder.

The LC_{50} values for 96 hours were estimated by the Litchfield and Wilcoxon graphical method[10]. Control group of fishes was maintained simultaneously. As per Litchfield and Wilcoxon graphical method, the LC_{50} values of Surf excel was 20.0 mg/litre and Nirma was 23.5 mg/litre for 96 hours. The test fishes were subjected to sub-lethal concentrations namely 1/3rd and 2/3rd of LC_{50} of Surf excel and Nirma as per suggestions for different exposure periods (24, 48, 72 and 96 hours) [11]. The equal number of fish was maintained in controls for similar duration of exposure[12]. In the scarified samples the biochemical parameter such as protein was analysed by adopting method of Biuret reagent.

Results and Discussion

Protein contents shows different decline levels with various sublethal concentration of Surf excel and Nirma Powder.

Muscles: Surf excel: With 1/3rd sublethal concentration i.e. 6.67mg/litre of surf excel, Protein content in muscles of *Mystus montanus* was decreased slightly at 24 and 72 hours of exposure, whereas it show significant decrease at 48 and 96 hours. Though with 2/3rd sublethal concentration i.e. 13.3mg/litre, there was a steady decrease upto 48 hours, but significant decrease was observed from 72 hours onwards.

Nirma powder: In Muscles protein content with Nirma powder displayed meager decrease during exposure upto 48 hours, then significant decrease after 48 hours with 7.833mg/litre was observed. While, with 15.67 mg/litre sublethal concentration significant decrease was noted at 24hrs, 72hrs and 96 hours of exposure, but at 48 hours insignificant decrease was observed.

Liver: **Surf excel**:- Protein content in liver with 6.67mg/litre sublethal concentration of surf excel slight decrease was noticed upto 48 hours then from 72hours onwards shows significant decrease. However, with 13.3mg/lit sublethal concentration of Surf excel insignificant decrease only at 24 hours, afterward significant decrease was observed.

Nirma Powder: In liver protein content with 7.833mg/litre sublethal conc. was slightly decreased during early periods of exposure i.e. upto 48 hours and from 72 hours shows significant decrease was identified. Whereas with 15.67 mg/lit sublethal concentration of Nirma protein content was significantly decreased from the early period of the experiment.

In present investigation in amounts of protein content in muscles and liver is decreased with an increase in concentration of Surf excel and Nirma powder and time of exposure. It indicates protein may be utilized for energy synthesis in tissue and inactivation of enzymes engaged in the protein production and breakdown or increase in proteolysis is affected. The inhibition of protein biosynthesis may be to encounter the extra demand of energy during stress conditions. During pollution stress fishes needs more energy to cope up with stress condition, the protein degradation and its products may be turn fed into T.C.A. cycle through aminotransferase system. The present results and findings are resembles with the results and findings of many investigators.

The contents such as protein, lipid and carbohydrate in the tissues like hepatopancreas, muscles and gills in the fresh water prawn *Macrobrachium lamarrei,* is decreased with exposure to various sublethal concentrations of detergent. Among the carbohydrates, a rapid decrease in the organic substances indicates its immediate mobilization towards the energy synthesis in prawn tissues. The enzyme that involves in protein synthesis and metabolism owing to effect of detergent may be inactivated[4].

The amount of protein, globulin and serum enzyme activity was decreased in inoculated *Tilapia nilotica* exposed to sub lethal concentration Detergent[5]. The protein concentration in the muscle was 8.5 ± 04mg/g during initial period of exposure in experimental and control group of fishes. Though, after seven days of experiment the amount of protein in the control group of fishes was increased upto 10.25 ± 0.4mg/g, whereas in the fishes treated with Detergent were more decreased value of protein 6.25 ± 10 mg/g in muscle[6].

The amount of protein content in brain and gills decreases with an increase in concentration and time of exposure. It may be due to damages of buccal lining and gill epithelium by detergents, which can results in change of the taste and poor utilization of food. Due to pollution stress the opercular and swimming movements (excitement) of animal increases, which require more glucose and oxygen for the production of increasing demands of energy. Because of poor consumption of food, the required amount of glucose is not available in blood. This deficit glucose can be obtained from reserve food such as

glycogen, fat and lastly proteins[7]. The toxicity of detergent SDS, SLS and Triton-X with fish *Oreochromis mossambicus* and *Cyprinus carpio*, showed a decrease in glycogen and protein content shows variations[8].

During the exposure of *Cirrhina mrigala* to sublethal concentration of detergent Linear Alkyl Sulfonate (LAS), in early periods of exposure Protein content was decreased and thereafter it increased after 30 days of exposure in the different tissues of fishes. It suggests that the interruption in protein content indicates that the protein present in the tissues undergoes proteolysis resulting in the production of free amino acids. Decrease in the protein level may specify a reduced rate in their synthesis. But, over a period of time fishes were adapted to the new conditions[13].

The amount of protein content decreased in the Detergent treated fishes. This is to the pollution stress force to the fishes to mobilize protein from muscle to blood, to reimburse to certain acidosis caused by the lactate accumulation[14]. The biochemical content like-carbohydrate, protein and fat content in the body of the fishes decreased with an increase in concentration of household detergents and time of exposure. This decline is due to increase in the metabolic rate and decrease in feeding. As well as an elevated tissue glycolysis, proteolysis and lipolysis, this is contributing to an increase in free glucose, amino acids, fatty acids and glycerol so as to supply the excess demands of energy during the stress conditions and due to tissue damage when there is minimum food intake[15].

The effects of sublethal concentration of fluoride on the activity of alkaline phosphatase (ALP), alanine aminotransferase (ALT), aspartate aminotransferase (AST) in gills of fresh water fish *Tilapia mossambica* was studied. Fluoride is act an inhibitor of various enzymes like lipases, phosphatases and esterases. The enzyme activities were significantly changed in upon exposure to sublethal concentrations of fluoride due to which protein-carbohydrate metabolism was disturbed. In the beginning, carbohydrate concentration was initially increase and later decreases with the time while a significant depletion of total protein and lipids in gills tissue were observed (p 0.001)[16].

Table-1
Effects of Surf Excel on Protein content (mg/gm) in Muscles of *Mystus montanus*

Concentraions in mg/litre	**Exposure Time**			
	24hrs	**48hrs**	**72hrs**	**96hrs**
Control	23.61067 ± 1.734989	23.8883 ± 2.097331	24.1663 ± 2.205045	24.4443 ± 1.734588
6.67mg/lit.	22.222 * ± 1.27297	20.5553 ** ± 2.097331	17.7773* ± 2.67886	15.5553** ± 1.734989
13.3mg/lit.	20.833* ± 1.667	18.333 * ± 2.204856	14.99967** ± 1.6665	11.944** ± 2.096867

Values expressed as ---mg/gram of tissue, ± = Standard deviation of three observation. * = Insignificant, ** = Significant at 5.5%, ***= Significant at 1 %, ANOVA table was used for calculation.

Table-2
Effects of Nirma on Protein content (mg/gm) in Muscles of *Mystus montanus*

Concentraions ---in mg/litre	Exposure Time			
	24hrs	48hrs	72hrs	96hrs
Control	24.444 ± 2.096867	24.722 ± 1.272974	24.99967 ± 1.6665	24.1663 ± 2.205045
7.833mg/lit.	22.77733 * ± 1.272865	21.38867 * ± 1.272865	18.88867 ** ± 2.06865	17.49967** ± 1.6665
15.67mg/lit.	21.38833** ± 2.097331	18.88867 * ± 1.734588	15.5553 ** ± 1.734989	13.611 ** ± 1.272974

Values expressed as ---mg/gram of tissue, ± = Standard deviation of three observation. * = Insignificant, ** = Significant at 5.5%, ***= Significant at 1 %, ANOVA table was used for calculation.

Table-3
Effects of Surf Excel on Protein content (mg/gm) in Liver of *Mystus montanus*

Concentrations ---in mg/litre	**Exposure Time**			
	24hrs	**48hrs**	**72hrs**	**96hrs**
Control	37.222 ± 2.096867	37.77767 ± 2.09733	37.49967 ±2.204478	38.0553 ± 2.09733
6.67mg/lit.	36.6663 * ± 2.205045	34.16633 * ± 2.204478	31.6663 ** ± 2.205045	28.333** ± 2.204856
13.3mg/lit.	35.0* ± 2.5	32.22167 ** ± 1.734588	24.72167 ** ± 1.734588	25.833** ± 2.204856

Values expressed as ---mg/gram of tissue, ± = Standard deviation of three observation. * = Insignificant, ** = Significant at 5.5%, ***= Significant at 1 %, ANOVA table was used for calculation.

Table-4
Effects of Nirma on Protein content (mg/gm) in Liver of *Mystus montanus*

Concentraions in mg/litre	Exposure Time			
	24hrs	**48hrs**	**72hrs**	**96hrs**
Control	38.333 ± 2.204856	38.05533 ± 2.09733	37.77767 ±2.545839	38.61067 ± 2.09733
7.833mg/lit.	35.55533* ± 2.09733	33.333* ± 2.204856	31.38833 **± 2.09733	29.16633** ± 2.204478
15.67mg/lit.	34.444** ± 2.096867	30.27767 ** ± 2.09733	24.72167**± 1.734588	26.38833** ± 2.09733

Values expressed as ---mg/gram of tissue, ± = Standard deviation of three observation. * = Insignificant, ** = Significant at 5.5%, ***= Significant at 1 %, ANOVA table was used for calculation.

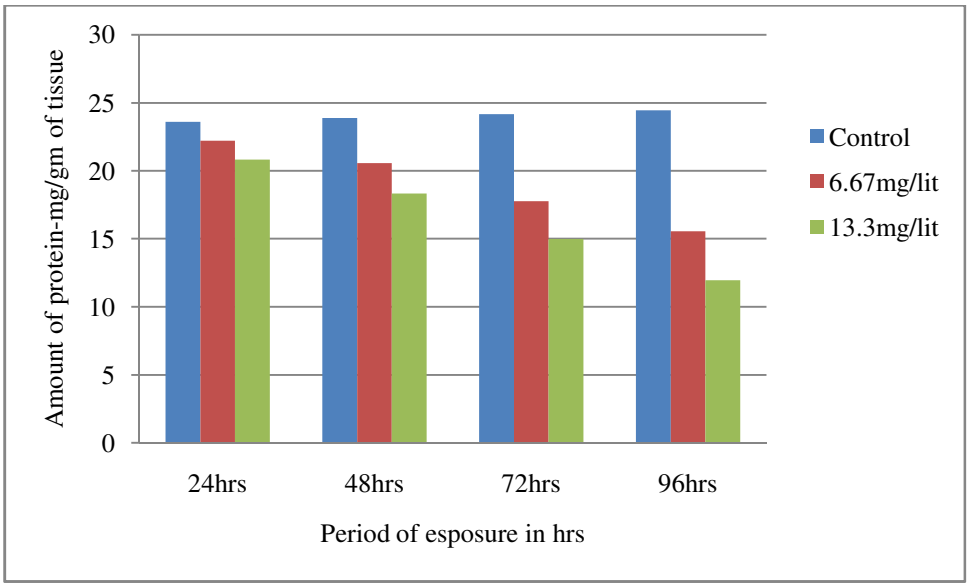

Figure-1
Effects of Surf Excel on Protein content in Muscles of Mystus montanus

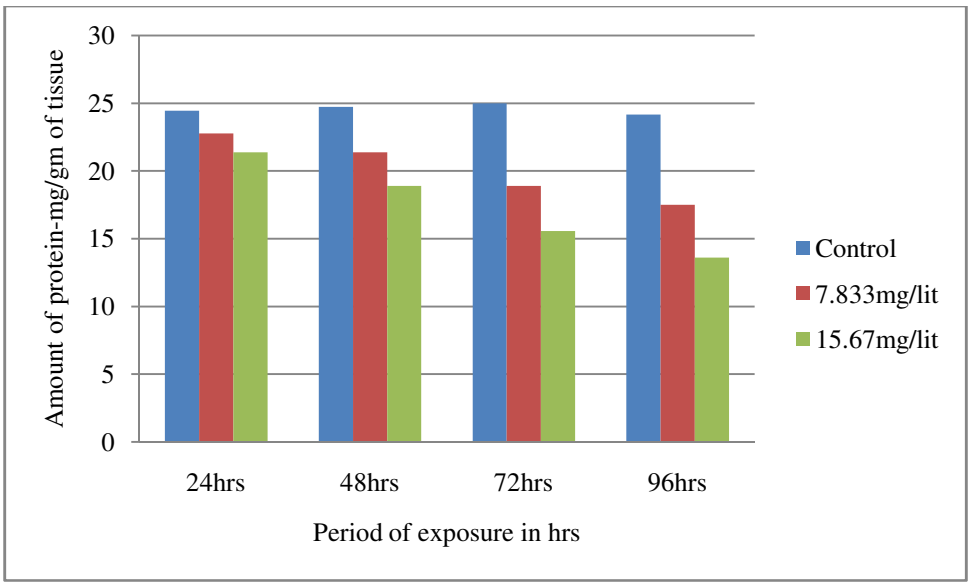

Figure-2
Effects of Nirma on Protein content in Muscles of Mystus montanus

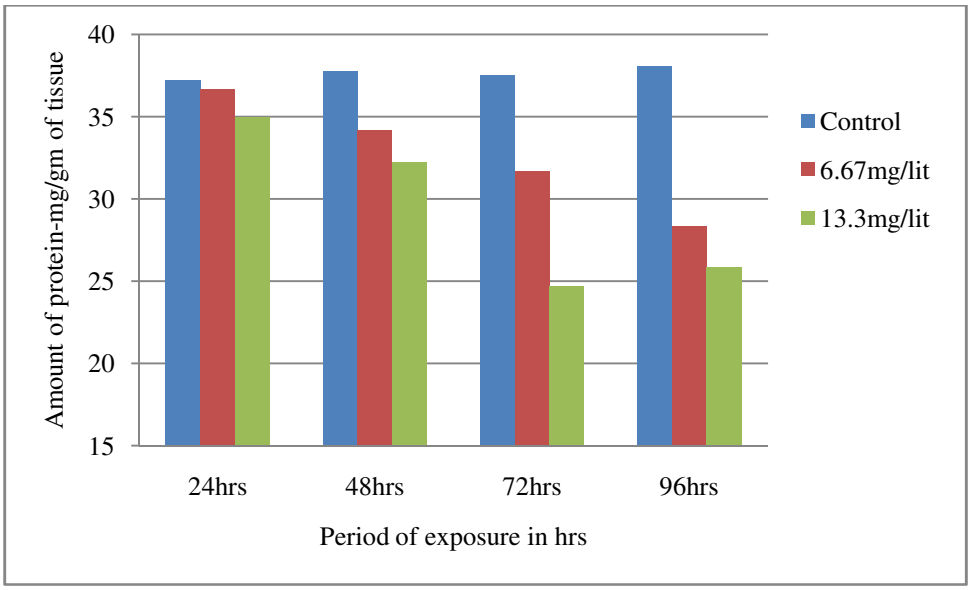

Figure-3
Effects of Surf Excel on Protein content in Liver of Mystus montanus

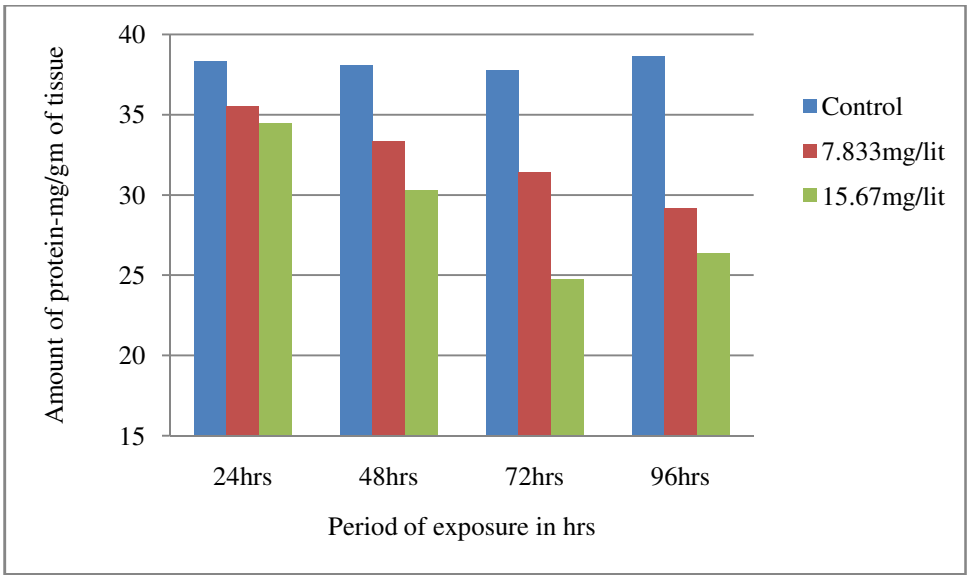

Figure-4
Effects of Nirma on Protein content in Liver of Mystus montanus

Conclusion

The detergents are toxic substances, causes damages to the epithelial lining of buccal cavity and gill, which might results in inadequate utilization of food and interfere in oxygen uptake. In presence of detergents the ability of fish to find prey and to taste the food is lost; it may interference with digestion or assimilation of food. These detergents may affect the enzymatic actions and functions of various organs resulting into digestion of food and physiology of fish. Detergents can be easily absorbed through gill or intestine and get accumulated in tissues and released into the blood stream. The potential toxicity of detergents changes composition of biochemical contents in the organs of animals. The toxicity acts as one type of stress, so the animals respond to it by emerging necessary potentials to counteract the stress. The first indication of stress is changes in biochemical contents in the body of an organism. At the time of stress an organism requires adequate amount of energy that can be supplied from reserve biochemical materials. Freshwater fishes are important and cheap source of protein of many poor people. The nutritive values of fishes are depends on amount and quality of proteins present in Muscles of fishes. In the present studies shown that amount of protein is decreased with increase in concentrations of detergents and time of exposure. It indicates that the amount and quality of (protein) nutritive

substances gradually degrading due to detergents and other pollutants present in the water bodies.

The use of detergents in homes and industries cannot be obsolete. However, better methods disposal of detergents after wash, need to be work out and need to develop a biodegradable detergents. If further more discharge of detergents in water bodies is controlled, then the aquatic fauna will be vanished very soon, including fishes.

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