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Biochemical Assessment of the Effects of Soap and Detergent Industrial Effluents on Some Enzymes in the Stomach of Albino Rats.

A.Y. Faremi and O.B. Oloyede
Department of Biochemistry, University of Ilorin, Ilorin, Nigeria

Abstract: The effects of soap and detergent industrial effluents on some enzymes in the stomach of Albino rats (*Rattus norvegicus*) were investigated. Four concentrations (5, 25, 50 and 100% v/v) of the effluent were used as the main sources of water for four groups of rats over thirty days while feeding the rats ad libitum with a commercial rat chow such that the method of feeding did not constitute a variable. Tap water was used as the control water. The physicochemical characteristics of the effluents and tap water were determined and compared with WHO standard. The average life weight gain was measured at every fifth days. At the end of the experiment, the rats were sacrificed and activities of alanine amino transferase (ALT), aspartate amino transferase (AST), lactate dehydrogenase (LDH) and alkaline phosphatase (ALP) were monitored in the stomach of the rats as a means of assessing the biochemical implication of the consumption of the chemical effluents. Soap and detergent industrial effluents presented high level of Biochemical Oxygen Demand (BOD), chemical oxygen demand (COD), Total Dissolved Solids (TDS) and some heavy metals like Pb, Cd and Mn. There were significant ($p<0.05$) difference and effluent concentration dependent increase in the activity of ALT, AST, LDH while ALP activity showed an effluent concentration dependent decrease in the stomach of the rats. The results showed that the consumption of the water contaminated with soap and detergent industrial effluents may be involved in the stomach dysfunction.

Key words: Soap and detergent effluents, enzyme, albino rats, physicochemical characteristics, BOD, COD, TDS

INTRODUCTION

Industrialization is considered the cornerstone of development strategies due to its significant contribution to the economic growth and human welfare. It has become a yardstick for placing countries in the League of Nations and an index of its political stature (FEPA, 1991). Industrialization, like other human activities that impact on the environment, often results in pollution and degradation. It carries inevitable costs and problems in terms of pollution of the air, water resources and general degradation of the natural environment (Suflita *et al*., 1983; Thomas *et al*., 1992). Industries turn out wastes which are peculiar in terms of type, volume and frequency depending on the type of industry and population that use the product (Odumosu, 1992). Industrial waste is the most common source of water pollution in the present day (Ogedengbe and Akinbile, 2004) and it increases yearly due to the fact that industries are increasing because most countries are getting industrialized. The

Corresponding Author: A.Y. Faremi, Department of Biochemistry, University of Ilorin, Ilorin, Nigeria

extent of discharge of domestic and industrial waste is such that rivers receiving untreated effluent cannot give dilution necessary for their survival as good quality water sources. The transfer of unfavourable releases from industries is detrimental to human and animal health and safety (Sangodoyin, 1991). Most organics derived from industries are decomposed in water by bacteria, protozoan and various larger organisms (Johansen and Carlson, 1976). Such decomposition converts energy-rich substances to energy-poor ones by chemical reactions that utilize oxygen. The oxygen soon becomes exhausted and thus becomes unavailable for other forms of life such as fish which man prefers to eat. Finally, stinks of putrefaction set in (Lee and Jones-Lee, 1996). Analysis of industrial effluents by various researchers has shown that it contains many organic and inorganic substances which are dangerous to health (Cherry, 1990; Oloyede *et al*., 2003; Oloyede and Sunmonu, 2008). However, the biochemical consequence of the consumption of these pollutants on the stomach has not been extensively studied. The first region of the gut where any significant digestion of food takes place is the stomach and it primarily performs storage function. The secretion from the stomach, sometimes called gastric juice, plays essential roles in digestion. This function of the stomach and the appreciable time ingested materials spend in the region before absorption and excretion provoke the interest for this study. The choice of the soap and detergent industrial effluent was informed by the fact that it often drains into adjoining rivers thus making water from these rivers unfit for domestic and recreational purposes (Oloyede *et al*., 2003). In the present study we evaluated the biochemical effects of the consumption of global soap and detergent industrial effluents on the stomach of rats with a view to assessing the roles of the chemical effluent in the health of the stomach.

MATERIALS AND METHODS

Experimented Animals and Experimental Design

A total of 25 albino rats (Rattus norvegicus) were obtained from the animal holding of the Department of Biochemistry University of Ilorin, Nigeria in March 2005. The rats were fed ad libitum with commercial rat chow obtained from Yoruba road, Ilorin, Nigeria. The 25 rats used for this study were kept in wooden cage under conducive atmosphere. The animals were grouped into five sets of five rats in each set. Groups 2, 3, 4 and 5 were placed on various concentrations of the soap and detergent effluent: 5, 25, 50 and 100% v/v, respectively while group 1, used as the control group, was placed on tap water. These various concentrations of the soap and detergent industrial effluent were used as main sources of water for the rats over thirty days while feeding the rats with the commercial rat chow. The growth of the rats was monitored by weighing the rats at every fifth day. At the end of the thirtieth day, the rats were sacrificed and portions of the stomach were isolated for enzyme assays.

Chemical Effluents

The chemical effluents (waste water) used for this study were collected directly at the exit from soap and detergent industries in Nigeria. The effluent as collected was rated 100% v/v.

Determination of the Physicochemical Properties of the Effluents and Tap Water

The physicochemical properties of both the chemical effluents and the tap water were determined in accordance with the standard method (APHA, 1985) using atomic absorption spectrophotometer.

Reagents

All the reagents were of analytical grade and were used as supplied.

Anaesthetization of Animals and Isolation of Tissues

The rats were anaesthetized by placing them one after the other in jar containing cotton wool soaked with chloroform before being sacrificed. The rats were then dissected and part of the stomach was removed into a beaker containing ice-cold 0.25 M Sucrose solution.

Protein Determination

The protein content in the stomach homogenate were determined using the biuret method of Gornall *et al.* (1949).

Enzyme Assay

Alanine amino transferase (ALT) and Aspartate amino transferase (AST) were assayed using the method of Reitman and Frankel (1957). Lactate dehydrogenase (LDH) was assayed using the method of Wroblewski and La Due (1975). Alkaline phosphatase (ALP) activity was determined using method of Bessey *et al.* (1946) as modified by Wright *et al.* (1974).

Statistical Analysis

Data are presented as mean of five Replicates±standard Error of Mean (SEM). Analysis of variance was carried out. Level of statistical significance was taken at $p<0.05$ (Adamu and Johnson, 1997).

RESULTS AND DISCUSSION

Table 1 shows the physicochemical properties of the effluents, tap water and the WHO standard, the soap and detergent industrial effluents is acidic as presented by the pH. This may be due to the leftover from the chemical compounds used in the manufacturing of soap and detergent such as sulphonic acids, stearic acids, carboxymethylcellulose, sodium tripolyphosphate and other organic acids. The BOD value is low relative to the COD. This may be due to the low pH value of the chemical effluent. Some of the bacteria required to metabolize the chemical compounds in the effluents may not be able to survive such reduced pH. The BOD and COD values call for concern when compared with the WHO standard. The value suggest a decrease in the total dissolved oxygen in the chemical effluent and the water

Table 1: Physicochemical properties of chemical effluent, tap water and the WHO standard

			*WHO	
Parameters	Chemical effluent	Tap water	RMC	MPC
pH	5.0	7.2	7.8	ND
BOD	1.24	-	ND	ND
COD	1.98	-	ND	ND
TS	240.00	320.10	500	1500
TDS	139.00	141.30	ND	ND
Sulphate	17.63	40.01	200	400
Nitrate	5.14	0.8	ND	50-100
Pb	<0.05	<0.05	ND	1.0
Cd	<0.002	<0.002	ND	ND
Mn	0.351	0.05	0.1	0.5
Mg	983	51	50	150
Fe	0.464	0.001	0.3	1.3

Results are in ppm of solution, RMC: Recommended maximum concentration, MPC: Maximum permissible concentration, ND: Not to be detected. *USEPA (1973)

contaminated with the effluent. If effluent with high BOD levels is discharged into a stream or river, it will accelerate bacterial growth in the river and consume the oxygen levels in the river. The oxygen may diminish to levels that are lethal for most fish and many aquatic insects (Barnes *et al*., 1998). Lee and Jones-Lee (1996) submitted that the presence of BOD and COD probably accounts for the odorous nature of the effluent and that BOD and COD are responsible for the taste and odour of water. The TDS values for both the effluents and tap water are high. It is however lower to the value obtained by Niroula (2003) for Himalaya soap and chemical effluent. The TDS value for the effluent compares favourably with the value obtained by Oloyede and Sunmonu (2008) for Global soap and detergent chemical effluents. It is however lower to the value obtained for Himalaya soap and chemical effluent. The TDS value obtained for tap water in this study is lower than the value obtained by Oloyede and Sunmonu (2008). Metal ions such as Pb and Cd were observed in both the chemical effluents and tap water. Mn and Mg are exceptionally higher in the chemical effluent. This calls for concern as the tap water the public consume may spell disaster. Cadmium is widely used in industry and is often found in solution in industrial waste discharges. Cadmium replaces zinc in the body and long term consumption of cadmium may lead to bodily disorders. Cadmium is toxic to both humans and fish and seems to be a cumulative toxicant. Small salmon fry have been killed from concentrations of 0.03 mg L^{-1} (Barnes *et al*., 1998).

There was a consistently significant ($p<0.05$) increase in the activity of alanine amino transferase (ALT) relative to the control as the concentration of the effluent increased (Fig. 1). The increase in aspartate amino transferase activity (Fig. 2) in this study also

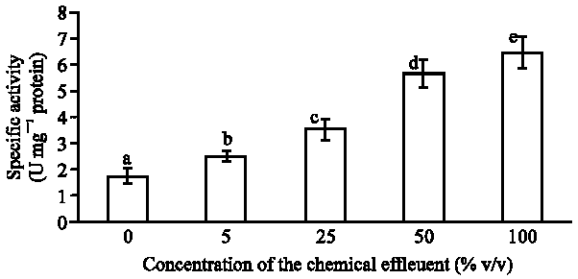

Fig. 1: Alanine amino transferase specific activities in the stomach of rats placed on the chemical effluent as source of water. Values are mean of five replicate±SEM. Bars with different letters are significantly ($p<0.05$) different

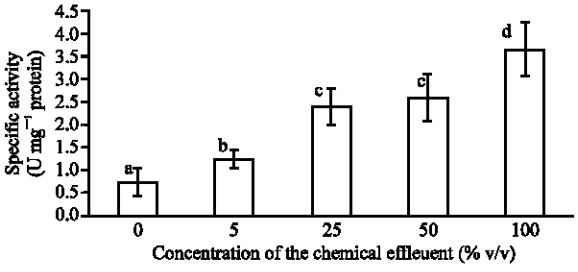

Fig. 2: Aspartate amino transferase specific activities in the stomach of rats placed on the chemical effluent as source of water. Values are mean of five replicate±SEM. Bars with different letters are significantly ($p<0.05$) different

supported the idea that activities of amino transferase were affected in the stomach of the rats. It is well known that the amino transferase play paramount roles in amino acid metabolism and in providing necessary intermediates for protein synthesis. The effluent concentration dependent increase in LDH activity (Fig. 3) indicated production of precursors of protein synthesis as a result of the assault from the soap and detergent industrial effluent. This lend credence to the possibility of increasing protein synthesis which may be involved in carcinogenesis. It has also been reported that these enzymes assist in differential diagnosis of cardiac diseases (Schmidt and Schmidt, 1963). The ALP activity in the stomach of the rats (Fig. 4) revealed a significant ($p<0.05$) decrease as the concentration of the effluent increases relative to the control water. The reduction in ALP activity could also be due to inhibition as it is the case with the consumption of polluted Asa water (Oloyede *et al*., 2003; Oloyede and Sunmonu, 2008) or metabisulphite (Akanji *et al*, 1993). Stomach is not an organ but the role of ALP in membrane cannot be overemphasized. The decrease suggest damage to the membrane. The absorption of water occurs in the stomach. Damage to the wall of the stomach may affect the absorption and digestion of food. There was no significant difference ($p<0.05$) in the growth rate of the rats (Fig. 5). This may be due to absence of high molecular weight compounds or that if present were being efficiently metabolized by the rats. The results of the enzymes indicate that the stomach may be damaged by the soap and detergent industrial effluents. Most industries claim to treat their effluents before discharge into the environment. It should be stressed therefore that biochemical analyses of most effluents show deception and do not depict safety.

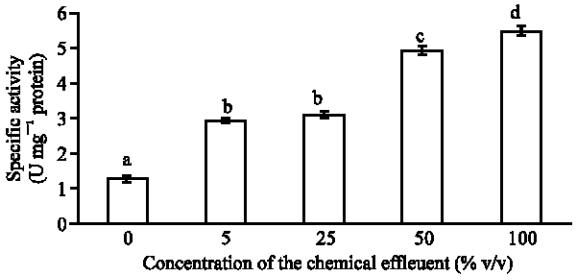

Fig. 3: Lactate dehydrogenase specific activities in the stomach of rats placed on the chemical effluent as source of water. Values are mean of five replicate±SEM. Bars with different letters are significantly ($p<0.05$) different

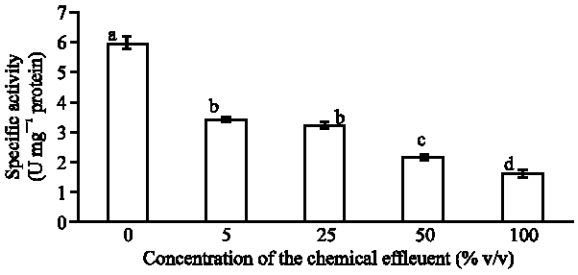

Fig. 4: Alkalinephosphosphatse specific activities in the stomach of rats placed on the chemical effluent as source of water. Values are mean of five replicate±SEM. Bars with different letters are significantly ($p<0.05$) different

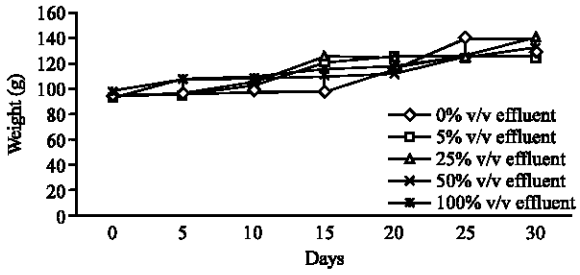

Fig. 5: Growth response curve of rats placed on various concentrations of the chemical effluents. Results are mean of five determination±SEM

CONCLUSIONS

The results of this study showed that the soap and detergent industrial effluent is toxic. It was also apparent that the consumption of the water contaminated with the effluent caused variations in the activities of enzymes in the stomach of the albino rats. Consumption of the effluent contaminated water by human may have similar effects on the enzymes which may affect the functions of the stomach.

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