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EVALUATION OF HEMATOLOGICAL PARAMETERS IN ALBINO RATS EXPOSED DERMALLY TO TANNERY EFFLUENT FROM CHALLAWA INDUSTRIAL ESTATE KANO, NIGERIA.

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ABSTRACT
The effects on haematological parameters of albino rats were evaluated to assess possible toxicity of tannery effluent. The study was carried out for 28 days. Forty (40) matured albino rats of both sexes were divided into four groups of 10 rats each. Group 1 is the control group, which were exposed dermally with normal water. Groups 2, 3 and 4 were exposed dermally at different concentrations of 100%, 50% and 25% of the effluent respectively. The result of the physicochemical analysis of the effluent shows that the physicochemical parameters were above the standard limit. Rats exposed to different percentages of the effluent showed significant decrease in the level of haemoglobin and packed cells volume. Red blood cell, white blood cell, mean corpuscular volume, mean corpuscular haemoglobin, mean corpuscular haemoglobin concentration, platelet and lymphocytes do not significantly decrease or increase.

Keywords: Haematological, Tannery effluent, physicochemical, dermal.

INTRODUCTION

There are many industries in Challawa industrial area Kano State Nigeria that are discharging their liquid and solid wastes into the immediate environment (consisting of land and water bodies), the problem of waste materials in the form of solid or liquid cannot be overemphasized as these effluents are more toxic to environment than the sewage. (Shen, 1999 and Mustafa *et al.*, 2010). Pollution has become a serious threat and has brought drastic changes and ill-effects to the growing population as well as the Earth (Praveena *et al.*, 2013). Extensive industrialization has measurably influences the quality of water of lakes, ponds and rivers all over the world (Praveena *et al.*, 2013). Industrial waste especially tannery effluent is posing serious problems in Kano, Nigeria where the environmental hazards awareness is low. Waste treatments and disposal of effluents is not according to standards in most of the tanneries in Challawa industrial estate. Effluents from tanneries are discharged into Challawa River, rendering the river water polluted and the atmosphere absolutely smelly and the air unsafe. The water has been reported to be harmful to the aquatic organisms especially fish (Pushaka *et al.*, 2015). The types and concentrations of the chemicals used in the pre-treatment, tanning, and finishing stages of leather production are varied. Chromium is one of the most widely used chemicals throughout this process. However, other raw materials used in this process can include limestone soda ash, sulphuric acid, and sodium chlorate. Thus, the effluent from tanneries can be a dangerous source of pollutants, and often contains dissolved and suspended organic and inorganic solids, potentially toxic metal salts, chrome, and electrolytes such as sodium chloride and sulphide. [Jenkins *et al*, 2004). However, as mentioned above, the toxicity and chemical composition of these effluents are subject to variation due to the diversity in the processes employed and the range of chemicals used within each stage of processing. In general, these effluents can cause environmental problems related to their high chemical oxygen demand and elevated chromium concentrations. (Song, *et al*, 2000), Effluents can also contaminate soils with magnesium, manganese, copper, cadmium, nickel, and lead. Cadmium, lead and manganese have the ability to induce and synergize significant imbalance in plasma electrolytes in mice in a short period of time and therefore can be used as biomarker of heavy metal pollution as well as deterioration (Osuala *et al.*, 2013).

The canals that transport the effluents away from these industrial facilities often run through villages, and on fields near residential areas into the bank of river Challawa and thus, People are exposed to the contaminants produced by tanning industries through various ways. The most common occupational hazard is inhalation of chromium at the work site, the populations also around the tanneries are often exposed to pollutants dermally through collection of sand in the canal for building, as well as using the contaminated rivers and streams for several purposes, such as irrigation, swimming (mostly children), bathing, and washing dishes and clothing. Thus, during these processes, people are exposed to direct contact with effluent released from the tanneries in the area which is believed to be harmful because it contains many substances that are toxic to human example chromium which may eventually lead to absorption of these toxic substances dermally causing problems of real health.

Furthermore, the direct discharge of these wastes can contaminate the ground and surface water with dangerously high concentrations of chromium, as well as cadmium, arsenic, and lead. (Saadia R. Tariq *et al.,* 2005), (Bhuiyan, *et al.* 2010). The contamination of rivers also allows these pollutants to accumulate in common fish and shellfish species, which are used as local food sources.

Studies have shown that the chromium-contaminated soil poses a significant health hazard, as the direct inhalation and ingestion of soil allows chromium to accumulate in both humans and livestock (Möller *et al.,* 2005). In addition, the chromium-laced solid wastes from tanneries are often converted into manure in areas around Challawa industrial dumping sites which can negatively affect agricultural products as chromium can accumulate in standard food crops. (Möller *et al*., 2005 and Hossain *et al*., 2007).

The use of small mammals such as rats for such experimental purposes may be attributed to their body physiology and nutrient requirements which closely resembles that of humans. The state of health of humans including systemic toxicity is however usually based on developmental indicators which are most often restricted to the blood and a number of visceral organs including the liver, heart, kidneys, pancreas, gonads etc. Determination of haematological parameters may be means of clinically accessing the nutritional values and or toxicity of substances (Princewill-Ogbonna, *et al.,* 2015).

The aim of this work was to evaluate the haematological effect of Albino rat exposed dermally with the tanneries' effluent from Challawa industrial area, Kano state Nigeria.

MATERIALS AND METHODS

Collection of Effluents: Effluent was collected directly from the canals that transport effluent away from the tanning industrial facilities to the river Challawa. The effluents were prepared into 100%, 50% and 25% different concentrations by adding distilled water.

Experimental animals and design: Albino Rats (Body weight: approximately 150g) were obtained from Department of Biochemistry, Bayero University Kano. They were separated, maintained and housed in rubber cages at Nigerian Institute of Leather and Science Technology, Kano Extension centre's Laboratory. The rats were allowed access to the feed and water according to their need while ensuring at the same time that the highest level of hygiene was maintained through-out the 28 days treatment period. All the animals were kept at room temperature as described by standard protocol for laboratory animal use and care. The Rats were used for the experiment for about 28 days. The study was carried out according to OECD 407 dermal toxicity guideline (OECD 2010).

Forty Rats were randomly divided into 4 groups of 10 rats each. The group 1 served as control group and was exposed dermally to water. Groups 2, 3 and 4 were the test groups and 10% of their body size around their neck were shaved and used as the treatment points. Group 2, 3, and 4 received 100%, 50% and 25% of the effluent respectively. After 28 days of administration of effluent on the shaved parts, all the experimental rats were sacrificed and then the blood samples were taken for the analysis.

Determination of Haematological Indices: The determination of the haematological indices; RBC (Red Blood Cells), WBC (White Blood Cells), Haemoglobin concentration, packed cell volume (PCV) or haematocrit value, MCV (Mean Corpuscular Volume), MCHC (Mean Corpuscular Haemoglobin Concentration), Platelet and Lympocytes was done within two hours of sample collection using SYSMEX (KX 21) Automated Hematologic Analyser in the haematology unit of the Ahmadu Bello University Zaria.

Statistical analysis: This was carried out using Minitab Statistical Package. One way analysis of variance was adopted for comparison, The data were expressed as mean ± standard error. Values $P<0.05$ were considered significant.

RESULTS AND DISCUSSION

There were no significance differences in the body mass of the animals among the experimental groups, suggesting that the treatments did not alter the feeding behaviour of the animals. Likewise, existing studies regarding tannery-effluent intake in mammalian models by (Siqueira *et al.,* 2011; Moysés *et al*., 2014, Lemos *et al.,* 2015) had not estimated the change of physical parameters of the animals. Weight change is one of most-used parameters in toxicological evaluations to indicate the early appearance of the toxicity of a particular substance in an animal organism (Pires Júnior *et al*., 2012).

Table 1: Body weight of Albino rats before and after the treatment

		WEEK 0	WEEK 1	WEEK 2	WEEK 3	WEEK 4
Group	1	152±6.2	151±6.2	152±6.2	152±6.2	153±6.2
Group	2		154±6.2	155±6.2	155±6.2	156±6.2	155±6.2
Group	3		152±6.2	152±6.2	153±6.2	153±6.2	154±6.2
Group	4		150±6.2	152±6.2	153±6.2	153±6.2	154±6.2

Data were analysed using one way ANOVA values expressed as ± standard error of mean, SEM

Table 2: Physiochemical constituents of tannery effluent obtained from Challawa industrial area Kano.

Constituents	Values (Unit)	BIS upper limit/Federal Ministry of Environment Nigeria
pH	8.5	6.5-8.5
Temperature	28.6 (^{0}C)	40
Appearance	Turbid	Clear
Electrical conductivity	1403 (µs/cm)	1000
Total dissolved solids	836 (mg/L)	500
Alkalinity	225 (mg/L)	250
Chloride	831 (mg/L)	350
Dissolved oxygen	2.1 (mg/L)	Minimum of 6
Sodium	159 (mg/L)	120
Potassium	78 (mg/L)	50
Sulphate	676 (mg/L)	500
Nitrate	1.3 (mg/L)	50
Calcium	46 (mg/L)	180
Phosphate	93 (mg/L)	3.5
Magnesium	4.1 (mg/L)	40
BOD	92 (ppm)	30 (ppm)
COD	478 (ppm)	23 (ppm)
Chromium	1.1 (ppm)	0.05 (ppm)

Physicochemical analysis of the effluent indicates that parameters are above standard limits, while the heavy metals contents are also above upper limits.

Table 3: effect of dermal exposure of tannery effluent on haematological indices for 28 days

	WBC	RBC	HGB	HCT	MCV	MCH	MCHC	PLT	LYP	PCV
GROUP 1	20.20	6.5	11.53	34.37	52.17	17.73	35.13	308.37	54.07	23.67
	0.06	0.06	0.07	0.26	0.58	0.23	0.15	0.41	0.15	0.33
GROUP 2	20.17	5.63	9.90^b	34.33	52.30	17.60	35.27	307.33	54.07	19.00^b
	0.07	0.26	0.40	0.12	0.55	0.12	0.09	0.22	0.09	0.58
GROUP 3	20.13	6.01	10.33^a	34.43	52.40	17.47	35.17	307.90	54.50	20.00^a
	0.09	0.09	0.09	0.07	0.17	0.32	0.23	1.40	0.12	0.58
GROUP 4	20.13	6.37	10.50	34.67	52. 73	17.53	35.13	308.00	54.20	19.67^b
	0.03	0.03	0.35	0.09	0.23	0.12	0.03	0.30	0.46	0.33

Data were analysed using one way ANOVA values expressed as ± standard error of mean, SEM, a represent $P<0.05$, b represent $P<0.001$ and n represent 10

The haematological parameters Hb, PCV, RBC, WBC, MCH, MCV, MCHC, LYM and PLT provide information on the general state of the blood in any subject (Adegoke *et al.,* 2012). The result obtained in this study shows that there were no statistically significant changes in WBC, RBC, MCH and MCHC, PLT, and LYM values in rats exposed from the effluents when compared with control. However, significant decrease in Hb and PCV values were observed. Sharma *et al*. (2007) reported decrease in RBC, Hb% and PCV of rat treated with textile dye. Eaton and Klassen (1996) reported the toxic substance present in effluents interacts with RBCs and may cause metabolic disorders decreasing their Hb carrying capacity.

The PCV value indicates oxygen carrying capacity of blood and the degree of stress on animal health (Larson *et al*., 1985), and (Kean and Vuanghao, 2012). Reduction in PCV values of male Wister rats exposed to dye effluent and the low PCV also indicated anaemia Sharma *et al*. (2007). The present output was also supported by Sharma and Goel (2005), similar observation was also reported by Devi and Singh (1988) who worked with Yellow and Organce-II that were reported the decrease in the haemoglobin content, which might be due to decrease of haemoglobin synthesis as a result of effluent poisoning. Thus; the rate of haemoglobin synthesis decreases during all stages of maturation of erythrocytes when the supply of iron was not sufficient. Normally the globin portion of haemoglobin is broken down into amino acids which return to the protein port while; porphyrin is metabolized and accredited as bile pigment. The iron released from breaking of haemoglobin is carried by transferring either to bone marrow for production of new red blood cells or to the liver for storage in the form of ferritin.

The synthesis of haemoglobin requires iron, which is generally supplied from the stored ferritin. Therefore, it seems that the metals in the effluents may have replaced the iron for the synthesis for haemoglobin which resulted in the fall of haemoglobin content. It could be concluded from this study that although effluents had no significant effect on most of the haematological parameters in rats but the dermal exposure of effluents caused decrease in hemoglobin (Hb) and Packed cell volume (PCV) in dermally exposed treated albino rats, indicating that long exposure of effluent is capable of eliciting haemolytic toxicity of the blood cells in Albino rats (Adegoke *et al*., 2012) and suggests that the dermal exposure at high doses could suppress the haemopoetic system which may lead to anaemia (Jenkins *et al.,* 1980; Ukpai and Nwabuko 2014) and (Veena *et al.,* 2013)

CONCLUSION

Tannery effluent produces various health problems. In this research, dermal exposure for 28 days indicated decrease in haemoglobin and PCV levels of the blood in the rats.

Therefore, to prevent the public health and environmental impact of tannery waste in general and chromium in particular the environmental regulation like effluent discharge limit has to be stringent and organization should be powerful to the extent to take measure by applying polluter principle or precautionary principle to avoid the effect of toxicity and bioaccumulation. Also, awareness campaign has to be carry out to those villagers around the canal that transport the effluents to the Challawa river, so that they shall avoid coming in contact with the effluents by either collecting the sand from the canal or using the effluents for irrigation purposes.

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