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Short Communication

Effect of palm oil and beef liver on diesel-induced haematotoxicity in wistar albino rats

Fidelis I. Achuba and Murphy D. Ogwumu.

Department of Biochemistry, Delta State University, PMB 1, Abraka, Delta State, Nigeria

*Corresponding author: Fidelis Achuba; achubabch@yahoo.com, +234(0) 8035663720

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ABSTRACT: The purpose of this study was to investigate the effects of palm oil and beef liver on some haematological parameters of rats fed with diesel-contaminated diets. Thirty wistar albino rats were equally divided into six groups with group1 as the control. Rats in groups 2, 3, 4, 5 and 6 were fed with diesel-contaminated diets only, diesel-contaminated diets plus palm oil and diesel-contaminated diets plus beef liver, respectively. The result of the experiment showed a significant decrease (P<0.05) in haemoglobin (Hb), Red blood cell (RBC), packed cell volume (PCV), mean cell volume (MCV), and mean cell haemoglobin (MCH) in rats fed with diesel-contaminated diet compared with the controls, the palm oil and the beef liver groups. However, there was a significant increase in white blood cell (WBC) count and lymphocytes in rats fed diesel-contaminated diet and the beef liver group relative to the control and the palm oil groups. This study suggests that palm oil and beef liver may confer some protective roles against haematotoxicity caused by diesel.

KEYWORDS: Contaminated-diet, diesel, haematotoxicity.

INTRODUCTION

Nigeria is the sixth largest exporter of crude oil in the world; as a result, its air, land and water are heavily polluted with crude oil and its refined products (Ita and Udofia, 2011). Pollution by petroleum is a widespread and common problem that can arise either accidentally or operationally whenever oil is produced, transported, stored, processed, or used at sea or land (Patrick-Iwuanyanwu et al., 2011). Most of the land and water in oil producing areas of Nigeria are essential to the people of the region for farming and fishing (Egborge, 1994). The devastating environmental consequences of oil spills, especially in the Niger Delta region of Nigeria, manifest as an irreversible chain effect on the biota (Sunmonu and Oloyede, 2007). The exposure of animals, including humans, to crude oil and its refined products is widespread and frequent, due to incessant oil spills and proliferation of sales outlets (Ita and Udofia, 2011).

One of the most common pollutants is diesel fuel, ~~is~~ a mixture of hydrocarbons, containing approximately 30% n-paraffin, 45% cycloalkanes and 25% aromatics (Frankenberger and Johnson, 1982). The health effects of diesel are well documented (OEHHA, 2007; ATSDR, 1999; Chilcott and Chapd, 2007), and the prevalence of diesel powered engines makes it almost impossible to avoid exposure to diesel or its by-products in both rural and urban settings (OEHHA, 2007). According to Patrick-Iwuanyanwu et al. (2011), petroleum has the potential to elicit multiple types of toxic effects due to its complicated composition

In experimental animals, petroleum products have been demonstrated to have adverse effects including the generation of free radicals (Achuba and Osakwe, 2003), increase in serum levels of urea and creatinine (Uboh et al., 2009) and significant degenerative changes in the structural integrity of hepatic and renal cells (Patrick-Iwuanyanwu et al., 2011). Acute toxicity study of diesel fuel in rats (*Rattus rattus*) by Dede and Kagbo (2001) indicated a dose-dependent hepatocellular necrosis and adverse alteration in structure and function of renal tubules.

Red palm oil has vitamin, antioxidant and antitoxin properties. Palm oil is a rich source of beta carotene (provitamin A), tocotrienols and tocopherols (Vit. E) (Oguntibeju et al 2009; Fife, 2010). Palm oil is the richest source of tocotrienols, which have 60 times the antioxident efficiency of ordinary vitamin E (Fife, 2010). Red palm oil is used amongst the people of south-south Nigeria as an antidote for poison; children who accidentally drink kerosene, or eat soap are made to drink large quantity of red palm oil either to regurgitate the poison or neutralize its effects (Agbogun, 2012). Beef liver is a rich source of iron, Vitamin A, Folate and vitamins B6 and B12 (USDA, 2015). It is also a rich source of haem iron (NIH, 2007) which is the iron that forms the part of the haemoglobin of the red blood cells (Hinzmann, 2003). Earlier study has indicated the use of vitamins E and C in ameliorating crude oil induced oxidative stress (Achuba, 2005). The aim of this study was to investigate a possible protective role of palm oil and beef liver against diesel-induced hepato-and nephrotoxicity.

MATERIALS AND METHODS

Chemicals

The diesel used in this study was obtained from Nigeria National Petroleum Corporation (NNPC) Agbor, Delta State, Nigeria. Other reagents are of quality analytical grade.

Experimental animals

Thirty (30) mature male albino wistar rats were obtained from the animal house of Department of Anatomy, Delta State University, Abraka. The experimental rats were housed in clean wooden cages and left to acclimatize for ten (10) days on growers mash. After the acclimatization period, the rats were weighed and their weights ranged between 110 to 150g.

Experimental design and treatment of animals

The thirty (30) adult male wistar albino rats were randomly assigned to six (6) groups with five in each group. Rats in the control group (group 1) were fed with grower's mash only. Rats in group 2 were fed with grower's mash contaminated with diesel (4ml per 100g of feed). Group 3 were fed with grower's mash- contaminated with diesel (4ml per 100g of feed) plus 4ml of red palm oil. Group 4 were fed with grower's mash contaminated with diesel (4ml per 100g of feed) plus 8ml of red palm oil. Rats in groups 5 and 6 were fed with grower's mash contaminated with diesel (4ml per 100g of feed) plus 3.5g and 7.0g of ground beef liver respectively. The rats in each group were allowed free access to clean drinking water while the experiment lasted. The feeds for the test groups (groups 2-5) were prepared fresh daily and stale feed remnants were regularly discarded.

Collection of blood samples

At the end of the exposure period, the rats were anaesthetized with chloroform soaked in swap of cotton wool in a desiccator. They were then sacrificed and 5ml sterile syringes with needle were used for collection of blood from the vena cava into properly labeled plain sample bottles.

Determination of haematological parameters

The haematological parameters such as Haemoglobin (Hb), Packed cell volume (PCV), White Blood cell (WBC), Lymphocytes, means cell volume (MCV) and means cell haemoglobin (MCH) were determined with the aid of an automated haematology analyzer (Mindray Hematology analyzer, BC-2300).

Statistical Analysis

All the results were expressed as means ±SD and all data were analyzed using Analysis of variance (ANOVA). Significant difference between the control and treatment means were determined at 5% ($P < 0.05$) confidence level using Duncan's Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

There was a significant decrease ($P< 0.05$) in the value of haemoglobin (Hb), Packed cell volume (PCV), red blood cell (RBC), mean cell volume (MCV) and mean cell haemoglobin (MCH) of rats fed diesel contaminated diet compared to the control .However, adding palm oil or beef liver reverse the decrease in these heamatological parameters to control value (Table 1).

The present investigation indicated that exposure of rats to diesel-contaminated diet resulted in haematotoxicity as evidenced by a significant decrease in Hb, RBC, PCV, MCV, MCH and lymphocytes; and a significant increase in WBC (Table1). This correlates with previous studies on haematotoxic effects of crude oil and its refined products (Uboh et al; 2005, 2007, 2010, 2012; Ita and Udofia, 2011; Patrick-Iwuanyanwu et al; 2010; Adegoke et al; 2012) The observed decrease in Hb, RBC, and PCV may be due to increase in the rate of destruction of red blood cell as the metabolism of the petroleum hydrocarbon has been reported to generate free radicals (Achuba and Osakwe, 2003; Nwaogu and Onyeze,2014). Free radicals are known to attack and alter red cell membrane during oxidative stress, thus making the red blood cells (RBC) more susceptible to haemolysis.

Table 1. Effect of palm oil and beef liver on some haemoatological parameters of Wistar albino rats fed diesel-contaminated diet, diet pre treated with palm oil and diet pre treated with beef liver.

GROUPS	HGB (g/l)	PCV (%)	RBCx10^{12}/l	WBCx10^{9}/l	LYMPHx10^{9}/l	MCV_{fl}	MCH_{pg}
Control	$14.70^{a}\pm1.20$	$57.60^{a}\pm1.14$	$8.34^{a}\pm0.71$	$8.44^{a}0.83$	$16.02^{a}\pm1.28$	20.50a±1.80	$18.10^{a}\pm1.51$
Diesel diet	$10.82^{b}\pm0.94$	$33.60^{b}\pm3.20$	$6.02^{b}\pm1.09$	$12.74^{b}\pm1.12$	$18.28^{c}\pm0.86$	$16.58^{b}\pm0.25$	$15.08^{b}\pm0.72$
Diesel diet + 4 ml palm oil	$13.55^{a}\pm0.51$	$54.00^{b}\pm3.5$	$7.29^{b}\pm0.47$	$9.1^{c}6\pm0.97$	$15.86^{c}\pm0.28$	$18.65^{c}\pm0.48$	$10.82^{b}\pm0.94$
Diesel diet + 8 ml palm oil	$13.70^{a}\pm0.51$	$53.60^{b}\pm1.58$	$7.53^{a}\pm0.64$	$9.02^{c}\pm0.83$	$14.26^{b}\pm0.87$	$18.65^{c}\pm0.48$	$18.65^{a}\pm0.47$
Diesel diet +3.5 g beef liver	$14.32^{a}\pm0.72$	$52.80^{b}\pm3.40$	$7.36^{b}\pm0.95$	$11.56^{c}\pm1.47$	$17.92^{c}\pm0.42$	$19.42^{c}\pm0.70$	$24.34^{c}\pm4.79$
Diesel diet + 7 g beef liver	$14.50^{a}\pm0.55$	$54.80^{b}\pm1.92$	$7.95^{a}\pm0.48$	$11.48^{c}\pm1.24$	$17.73^{c}\pm0.81$	$20.40^{a}\pm2.00$	$24.69^{c}\pm4.45$

Values are means ±SD for 5 rats. Means with different superscript letters (a,b,c) in the same column are significantly different fror other at the 0.05 ($P<0.05$) level.

The lower values of MCV and MCH in this study may possibly be due to destruction of red blood cell and decease in haemoglobin (Hb) synthesis as well as Hb content. MCV and MCH are indicators of variations in erythrocyte shape and size, in addition to haemoglobin content (Ita and Udofia, 2011). Adding palm oil and beef liver resulted in significant difference in some of these haematological parameters of rats compared to those fed with diesel contaminated diet only. While the values of Hb, RBC, PCV and MCV of rats fed with beef liver pretreated diets did not significantly decrease compared to the controls, they were significantly higher ($P < 0.05$) when compared to those in diesel contaminated diet group. However, rats in beef liver protocols did not show significant difference in the values of white blood cell and lymphocytes as compared to controls while those in palm oil protocols exhibited a significant reduction in these two parameters relative to the rats in diesel contaminated diet group (Table 1).

It is also interesting to note that MCH values in rats fed with beef liver diets were significantly higher as compared to rats exposed to palm oil pretreated diets and the controls. The insignificant difference in WBC and lymphocytes of rats ~~in~~ exposed to palm oil diet and the controls suggests a protective role of palm oil against diesel-induced haematotoxicity as immune response to foreign chemicals and stress results in increased leucocytosis (Adegoke et al; 2012). On the other hand, beef liver may not have any protective effect as increased levels of WBC and lymphocytes may indicate sustained chemical stress and infection (Marieb, 1995, Cheesbrough , 2006). However, the insignificant differrence in values of Hb, PCV, RBC and MCV in rats fed with beef liver compared to the control, and the significantly higher value of MCH in these groups suggest that beef liver may have played a positive role in replenishing destroyed erythrocytes as beef liver is a rich source of haem which is needed for haemoglobin synthesis (Hinzmann, 2003).

Conclusion

It can be concluded that palm oil could play a protective role against diesel induced haematoxicity probably because of its richness in vitamin E while beef liver may play a replenishing role on diesel-induced haemolysis due to its richness in haem iron.

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