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Zinc Fortified Diet Enhances Food Consumption and Levels of Serum Hepatic Markers in Male Wistar Albino Rats Fed with Crude Oil Adulterated Diet

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ABSTRACT: Crude oil mediates different form of systemic toxicity among living organisms. Hence, the objective of this paper was to investigate the effect of zinc fortification on food consumption and levels of serum hepatic markers in male Wistar Albino rats feed with crude oil adulterated diet using standard methods. The results showed that fortification did not significantly enhanced feed intake but positively enhanced weight gain and liver function markers. The outcome of this study elucidated the potency of the biological activities of zinc in ameliorating crude oil toxicity.

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The presence of black gold (crude oil) to the inhabitants of its exploration environment could be opined as a double edgedsword that is deceitful in its economic values at the expense of the burdens of its health complications and mortality (Bello, 2021). In spite of being a high energy driven liquid, its chemical composition favors the onset of various chemical pathologies based on induction of cellular hypoxia and oxidative stress (heavy metal bioaccumulation and free radicals mediated) (Soloperto *et al*., 2022, Ajarem *et al*., 2022). The onsets of oxidative stress at the cellular level propagate chaos in metabolic activities of the cell (Sharifi-Rad *et al*., 2020). Metabolic chaos of the cell propel aberration in the physiological and metabolic process of cellular transport (influx and efflux), up and down regulation, biomolecule synthesis, genetic information transferetc (Heng *et al*., 2022; García-de-Teresa *et al*., 2020). The abruption of these activities impair the cellular function of cell organelles (Fu *et al*., 2021) and also depletes the levels of the endogenous antioxidant defense system of the cell, a system in which the cell employs to checkmate the excesses of endogenous generated reactive oxygen and nitrogen species (Pisoschi *et al*., 2021). It not also in doubt that the chemical nature of crude oil also links its deleterious cellular activities to cut across a various organ system in the body (Kuppusamy *et al*., 2019; Varjani *et al*., 2018; Bhat*et al*., 2019). These systemic failure come against the backdrop that attenuation for the depletion of the endogenous antioxidants fails to compensate for deficits in the ratio of the oxidant to pro-oxidant of the cell (Martemucci*et al*., 2022). As a result the cell will require supplementation of antioxidants from exogenous source to boost the level of the endogenous antioxidant defense (Dais *et al*., 2020). The trace mineral zinc is an important metal that serve as coenzyme for various key~~s~~ enzymes of various endogenous antioxidant enzymes (Bratovcic,

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2022). Zinc modulate the detoxification of super oxide anion via the enzyme superoxide dismutase to water with the aid of catalase and glutathione peroxidase (Maywald and Rink, 2022). This trace mineral also play a crucial role in heamoglobin synthesis, folate absorption, genetic information transmission and protein translation, immune function, reproduction and general growth (Altobell *et al*., 2020; Kumar *et al*., 2021). These various cellular function of zinc depict that this trace mineral plays crucial role in managing metabolic syndrome, a condition that is affirmed with crude oil toxicity. As these biological activities of zinc are geared to restoring parity to the cell membrane structure and function (Wu *et al*., 2022). Therefore, the objective of this paper was to investigate the effect of zinc fortification on food consumption and levels of serum hepatic markers in male Wistar albino rats.

MATERIALS AND METHODS

The Crude oil used in this study is the Bonny light, was collected from the Warri refining and Petrochemical Company. Reagents used were of quality analytical grade.

Experimental Animals: Forty-eight (48) healthy male Wistar albino rats weighing between 190 and 200g was obtained from the Animal House, Faculty of Basic Medical Science, Delta State University, Abraka. They will be acclimatized for two (2) weeks. The rats were maintained on growers mash (Top feed, Premier feed mills Co. Ltd, Ibadan, Oyo State) and water *ad libitum.*

Experimental Design and Treatment of Animals: A total of forty-eight (48) male Wistar albino rats were used in this study. They were randomly divided into six (6) groups containing eight (8) rats in each group. All these animals were acclimatized for fourteen (14) days before experimental exposure of ninety (90) days. The animals were housed in plastic (polypropylene) cages using paddy husk bedding. The rats were provided with grower‘s mash and water *ad-libitum*. The experimental animal models were grouped as follows: Group A: Rats maintained on normal diet; Group B: Rats maintained on normal diet and received 0.5µgZn/g diet
Group C: Rats maintained on normal diet and received 1.0µgZn/g diet
Group D: Rats maintained on crude oil adulterated diet only (4.0ml/100g)
Group E: Rats maintained on crude oil adulterated diet and received 0.5µgZn/g diet
Group F: Rats maintained on crude oil adulterated diet and received 1.0µgZn/g diet
Crude oil contamination proportions will be prepared as prescribed by Achuba, (2019)
Based on preliminary study, Zinc diet dose was established that as high 2.0µgZn/g intake could be tolerable for over a chronic period of exposure by the experimental animals without drastic effects.

Collection of Samples and determination of biochemical parameters: At the end of exposure period of three months (ninety days), the rats were cervical decapitated and sacrificed. Blood was collected in sample containers through cardiac perforation. They were allowed to clot, subjected to centrifugation (at 4000rpm) for 10 minutes and the respective sera collected into sample containers and stored at −4˚C and used within forty eight hours. In the same vein, the respective liver was collected and respective homogenates prepared and used for the determination of biochemical indices. Liver function enzymes (Alanine transaminase, Aspartate transaminase and Alkaline Phosphatase) activities as well as protein and albumin levels were determined following the protocol of Reitman and Frankel (1957), Deutsche Gesellschaft fur klinischeChemie DGKC (1972), Tietz (1995) and Doumas*et al.* (1971).

RESULTS AND DISCUSSION

Crude oil is an established toxicant to the environment and all that dwell therein. The present study is another attempt to contribute to existing knowledge on the possible means to counter the toxicological impact of crude petroleum to biological systems. The observed drop in food intake, weight, and weight gain due to the consumption of petroleum adulterated diets (COAD) similar to the petroleum induced loss of appetite and body weight by rats and chicken species as reported by Ogara *et al*. (2016) and Onukwu *et al*. (2013).

Table 1: Feed intake, feed efficiency, body weight and body weight gain of rats exposed to crude oil adulterated diet (COAD).

GROUPS	Feed intake/g/week/Rat	Feed conversion efficiency	Body Weight(g)	Body weight gain(g)
A	293±12.0^{a}	1.41	207 ±7.61^{a}	16.4±3.05^{a}
B	253± 19.6^{bc}	1.23	201±2.50^{ab}	15.1±3.70^{ab}
C	274±19.4^{b}	1.35	202±2.10^{ab}	19.7±2.15^{a}
D	228±14.39^{c}	1.15	198±3.60^{b}	11.7±3.20^{b}
E	242±15.7^{c}	1.18	205±2.20^{ab}	14.8±1.8^{ab}
F	241±14.3^{c}	1.19	203±3.10^{ab}	15.4±2.2^{ab}

Values are expressed as Mean± SD values followed by different alphabet superscript in the same column indicates a significant difference
Key: A=Control; B= Feed + 0.5µgZn/g diet; C=Feed + 1.0µgZn/g diet; D=COAD; E=COAD + 1.0µgZn/g diet; F= COAD +1.0µgZn/g diet

Loss of appetite and weight is said to be the first sign and symptom of toxicity induced by prolonged exposure to any substance that is toxic to animals. Also, the improvement in appetite occasioned by increased food intake and body weight gain after supplementation with both concentrations of Zn is no surprise as this element has been previously noted for its ability to improve appetite and food consumption (Sharkur *et al*., 2009; Suzuki*et al*., 2011; Kusumatuti *et al*., 2018). There is no doubt therefore that the loss of appetite and loss of body weight is traceable to the consumption of COAD as there were observed drop in food conversion efficiency in rats that consumed COAD while Zn supplementation improved their food conversion efficiency implying that under a petroleum induced stress in animals, that even when food is well consumed, that the needed nutrient for the development and maintenance of the body systems are often unavailable. This argument coheres with the submission of Asagba (2019) who said that rat exposure to a prolonged cadmium induced stress via drinking water and food did not only reduce food intake, weight and weight gain, it contributed significantly to the loss of essential mineral elements and body building markers in rats compared to those not exposed. Findings revealed that there were observed rise in serum liver function markers (AST, ALT and ALP) which has been previously reported as the first line of diagnostic indicator of liver health status and may indicate a possible breakdown in liver architecture and structure (Kweki *et al*., 2019; Asagba *et al*., 2010; Achuba and Ogwumu, 2014).

Table 2: Serum hepatic function parameters of rats exposed to crude oil adulterated diet (COAD).

Parameters	Groups					
	A	B	C	D	E	F
AST (U/L)	48.44±2.41[a]	46.42±3.30 [a]	47.78±2.44 [a]	40.24±3.35 [b]	47.81±2.26 [a]	46.64±2.74 [a]
ALT (U/L)	40.53±3.33[a]	41.62±2.24 [a]	43.32±3.35 [a]	32.4321.75 [b]	36.66±2.66[b]	37.88±2.64[b]
ALP (U/L)	134.62±3.44[a]	136.35±4.61[a]	133.72±4.46[a]	124.86±4.53[b]	127.76±3.24[b]	127.84±3.26[b]
Total Protein (gdL^{-1})	22.14±2.11[a]	23.04±1.88[a]	24.11±1.74[a]	16.72±2.22 [b]	18.74±2.49[b]	19.63±2.44[b]
Albumin (gdL^{-1})	12.66±1.18[a]	15.06±2.32[c]	16.22± 2.84[c]	9.85±2.26 [b]	12.17±2.46[a]	12.25±2.14[a]

Values are expressed as Mean± SD values followed by different alphabet superscript in the same column indicates a significant difference
Key: A=Control; B= Feed + 0.5µgZn/g diet; C=Feed + 1.0µgZn/g diet; D=COAD; E=COAD + 1.0µgZn/g diet; F= COAD +1.0µgZn/g diet

The observed rise in liver function enzymes is in agreement with studies of Okpoghono *et al*. (2018); Achuba*et al*. (2018) who also reported that following a food route crude oil poisoning in Wistar rats that there were observed upsurge in serum liver function parameters as well as drop in serum total protein of Wistar rats. The liver role in metabolism of biomolecules cannot be deter as it serve as the major organ for energy metabolism and xenobiotic detoxification (Ohwokevwo and Ogunka-Nnoka, 2019).

The liver integrity are solely dependent on the levels its marker enzymes and organic molecule indicator (Ekayoda *et al*., 2022). The attenuation of these liver indicators in this study caused by the administration of zinc fortified diet decipher zinc biological function in enhancing the level of endogenous antioxidant defense system of the hepatic cell is not as in doubt(Wu *et al*., 2022; Maywald and Rink, 2022; Bratovcic, 2022).

Conclusion: The exposure to crude oil in this study depict that crude oil mediate toxicity, caused elevation of serum hepatic indicators and reduction food intake and body weight against the backdrop it was also observed that these biochemical alteration and response to food intake were restored by the biological activities of the trace mineral zinc.

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