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Effects of Petroleum Contamination on the Weight and Glucose Level of African Cat Fish (*Clariasgariepinus)*

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ABSTRACT

The study aimed to investigate the impact of petroleum contamination on the weight and glucose levels of African catfish (Clarias gariepinus). The experiment involved introducing African catfish into large plastic containers filled with water, into which varying concentrations of crude oil (0.000%, 0.003%, 0.006%, and 0.01%) were added as contaminants. Weekly measurements of the fishes' weights were taken and recorded throughout the duration of one month. At the end of the month, the fishes were euthanized, and blood glucose levels were promptly assessed using a glucometer. The results indicated that higher levels of petroleum contamination in freshwater were associated with slower weight gain in African catfish (Clarias gariepinus). Additionally, it was observed that as the level of petroleum contamination increased, the glucose concentration in African catfish also increased, suggesting that petroleum may induce a hyperglycemic condition in these fish. The study concluded that since glucose plays a crucial role as a fuel for various tissues in fish, including the brain, gills, erythrocytes, and gonads, efforts to address environmental pollution that could affect glucose metabolism in freshwater fishes should be prioritized.

INTRODUCTION

Crude oil and its derivatives stand as the primary energy source in contemporary society, constituting approximately 41% of the global energy demand, which was recently estimated at 8,677 million tons (IEA, 2012). Classified based on their predominant hydrocarbon composition, crude oil varieties range from light to heavy, encompassing aromatic compounds with one benzene ring, polynuclear aromatic compounds with multiple benzene rings, and aliphatic-rich compounds with long or short chains (Marchand et al., 2002). Additionally, petroleum may contain sulfur, nitrogen, oxygen, as well as trace metals like nickel and vanadium (Marchand et al., 2002). Environmental catastrophes worldwide often stem from petroleum exploration and associated activities such as transportation (Wang and Fingas, 2003), with the severity of an oil spill's consequences contingent upon the oil type and quantity involved (Marchand et al., 2002), alongside the organisms affected and their exposure routes to petroleum (Silva et al., 2009; Smit et al., 2009). Literature suggests that oil spills typically lead to widespread ramifications like biodiversity loss and disruptions to ecosystem services (Antonio et al., 2011).

In aquatic environments, petroleum undergoes various physical and chemical transformations generating a water-soluble fraction (WSF) rich in polycyclic aromatic hydrocarbons (PAHs), BTEX compounds (benzene, toluene, ethylbenzene, and xylenes), phenols, nitrogen and sulfur-containing heterocyclic compounds, and heavy metals (Pérez-Cadahía et al., 2004). The WSF poses risks to aquatic organisms by compromising their physiological functions and perpetuating chemical dissemination throughout the food chain (Pérez-Cadahía et al., 2004). Consequently, under petroleum contamination, ecological interactions across trophic levels can escalate the impacts from individual organisms to community and ecosystem structures and functions (Peterson et al., 2003).

Despite the increasing number of ecotoxicological studies on aquatic organisms (Weber et al., 2013), the assessment of petroleum toxicity on apex consumers remains an underexplored area. Fish species, being integral to all trophic levels in aquatic food webs, play vital roles in nutrient cycling and energy transfer within marine and freshwater ecosystems (Vanni, 2002). The limited mobility of sedentary fish species inhabiting hydrologically isolated environments heightens their susceptibility to environmental contamination. Therefore, understanding the impacts of WSF on consumers is pivotal for predicting contamination effects on aquatic food webs (Van der Oost et al., 2003).

Given the significant challenge of oil pollution in Nigeria, particularly in the Niger Delta region, there is a pressing need for pertinent research to explore the repercussions of petroleum pollution on freshwater fish. This study aims to assess the influence of crude oil contamination on the growth of African sharp-toothed catfish while evaluating its effects on plasma glucose concentration.

METHODOLOGY

Sample collection

African sharp-tooth catfish (*Clarias gariepinus*) were acquired as a unified group from a local market in Oghara, Delta State, Nigeria. Any fishes displaying injuries or signs of weakness were excluded from the study.

Determination of weight, and glucose level

The catfish were placed into large plastic containers, and varying concentrations of crude oil (0.00%, 0.003%, 0.006%, and 0.010%) were added as contaminants to the water-filled containers. Weekly weight measurements of the fishes were taken and documented. After one month, the fishes were euthanized, and their blood glucose levels were promptly assessed using a glucometer.

Result and discussion

Table 1.1 Effect of Petroleum Contamintion on the initial weight and percentage increase in the weight of African cat fishes after intoxication for a period of one month

Concentration of contaminant(%v/ml)	**Initial weight (g)**	**% increase in weight =** $\frac{\textbf{(final-initial)} \times \textbf{100}}{\textbf{Final}}$
0.000%	15.5	31.2%
0.003%	18.0	22.7%
0.006%	16.5	28.5%
0.01%	17.1	-

Result is expressed in mean of +SD of three determinations

a= value significantly lower than those of control at $p< 0.05$

b= value significantly higher than those of control at $p<0.05$

n= number of fishes used per essay

Table 2.0 Effect of Petroleum Contamination on Glucose concentration of African cat fishes for intoxication after a period of one month

Concentration of contaminant	**Glucose concentration mg/dl**
0.000%	110.3±6.35
0.003%	155.7 ± 28.1^{b}
0.006%	176.3 ± 10.4^{b}
0.01%	___

Result is expressed in mean of +SD of three determinations

a= value significantly lower than those of control at $p< 0.05$

n= number of fishes used per essay

b= value significantly higher than those of control at $p<0.05$

DISCUSSION OF RESULTS

From the data presented in Table 1.1, it is evident that the control group exhibited the highest percentage increase in weight (31.2%) compared to the groups exposed to 0.003% (22.7%) and 0.006% (28.3%) crude oil contamination. Following two weeks of exposure, African catfish subjected to 0.01% crude oil contamination experienced mortality. This observation suggests that higher levels of petroleum contamination in freshwater are associated with reduced weight gain in African catfish.

Additionally, the data in Table 2.0 reveals that the group exposed to 0.000% crude oil had the lowest glucose concentration compared to the groups exposed to 0.003% and 0.006% (with glucose concentrations of 110.3 mg/dl, 155.7 mg/dl, and 76.3 mg/dl, respectively). As the level of petroleum contamination increased, the glucose concentration in African catfish also rose, indicating a potential induction of hyperglycemia by petroleum.

While fish generally exhibit tolerance to hyperglycemia without displaying typical diabetic symptoms, recent studies have shown that hyperglycemia in certain fish species can lead to retinopathy and increased glycosylated hemoglobin, similar to diabetic patients. These findings align with previous research by Antonio et al. (2011), which highlights the extensive consequences of oil spills, including loss of biodiversity, reduced weight gain, and hyperglycemia in African catfish.

CONCLUSION

Glucose serves as a vital energy source for various tissues in fish, encompassing critical organs such as the brain, gills, erythrocytes, and gonads. A pertinent concern arises regarding the potential impact of environmental pollution on glucose metabolism in freshwater fish. The findings suggest that contamination from crude oil could potentially trigger hyperglycemia in fish and hinder their growth, as observed in African catfish. Such repercussions could extend to the broader ecosystem, potentially leading to the extinction of certain African fish species. Resolving this issue is imperative to safeguard the ecological balance of freshwater habitats.

REFERENCE

Antonio, F.J., Mendes, R.S. and Thomaz, S.M. (2011). Identifying and modeling patterns of tetrapod vertebrate mortality rates in the Gulf of Mexico oil spill. *Aquatic Toxicology*. **105**(1)2: 177-179.

Akaishi, F.M., Assis, H.C., Jakobi, S.C.G., Eiras-Stofella, D.R., St-Jean, S.D., Courtenay, S.C., Lima, E.F., Wagener, A.L.R., Scofield, A.L. and Oliveira R.C.A. (2004). Morphological and neurotoxicological findings in tropical freshwater fish (*Astyanax*sp.) after waterborne and acute exposure to water soluble fraction (WSF) of crude oil. *Archives of Environmental Contamination and Toxicology*. **46**(2):244-253.

Braun, R. L. and Burnham, L. K. (1993). Chemical reaction model for oil and gas generation from type I and type II kerogen. Lawrence Livermore National Laboratory. Retrieved April 10, 2014.

Gleeson, M.,Connaughton, V.and Arneson, L. (2007). Induction of hyperglycaemia in zebrafish (Daniorerio) leads to morphological changes in the retina. ActaDiabetol**44**:157–163.

Marchand, J., Codling, I., Drake, P., Elliott, M., Pihl, L. and Rebelo, J. (2002). Environmental quality of estuaries. In: M. Elliott and K.L. Hemingway. *Fishes in estuaries*. Oxford: Blackwell Science, pp. 322-409.

Pérez-Cadahía, B., Laffon, B., Pásaro, E. and Méndez, J.(2004). Evaluation of PAH bioaccumulation and DNA damage in mussels (*Mytilusgalloprovincialis*) exposed to spilled Prestige crude oil. *Comparative Biochemistry and Physiology Part C Toxicology &Pharmacology*.**138**(4): 453-460.

Silva, C.A., Oliveira, R., C.A., Katsumiti, A., Araújo, M.L.P., Zandoná, E.M., Costa-Silva, G.P., Maschio, J., Roche, H. and Silva de assis, H.C., 2009. Evaluation of waterborne exposure to oil spill 5 years after an accident in Southern Brazil. *Ecotoxicology and Environmental Safety*. **72**(2): 400-409.

Smit, M.G.D., Bechmann, R.K., Hendriks, A.J., Skadsheim, A., Larsen, B.K., Baussant, T., Bamber, S. and Sanni, S., 2009. Relating biomarkers to whole-organism effects using species sensitivity distributions: a pilot study for marine species exposed to oil. *Environmental Toxicology and Chemistry*. **28**(5): 1104-1109.

Van Der Oost, R., Beyer, J. and Vermeulen, N.P.E.(2003). Fish bioaccumulation and biomarkers in environmental risk assessment: a review. *Environmental Toxicology and Pharmacology*, **13**(2):57-149.

Vanni, M.J. (2002). Nutrient cycling by animals in freshwater ecosystems. *Annual Review of Ecology Evolution and Systematics*. **33**(1): 341-370.

Wang, Z. and Fingas, M.F. 2003. Development of oil hydrocarbon fingerprinting and identification techniques. *Marine Pollution Bulletin*, **47**(9-12): 423-452.